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مجلة علمية نصف سنوية محكمة

تصدرها كلية الزراعة جامعة ام درمان الإسلامية



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موجهات النشر

أهداف المجلة:

- تعميق البحث العلمي وإثرائه.
 - نشر الإنتاج العلمي والمعرفة الأصيلة للباحثين في مجال العلوم الزراعية.
 - التواصل الفعال مع المجتمعات المحلية وخدمة قضاياها.
- مجلة العلوم الزراعية مجلة دورية علمية نصف سنوية محكمة تعمل على نشر بحوث نوعية أصيلة بالإضافة للرسائل الإخبارية ومواضيع المراجعة والمذكرات العلمية في المجالات الزراعية المختلفة. تنشر المجلة البحوث العلمية التي تتوافر فيها شروط البحث العلمي من داخل الجامعة وخارجها. تقدم البحوث باللغتين العربية أو الإنجليزية. يشترط في البحث ألا يكون قد نشر في أي مكان آخر، وتعرض البحوث المقدمة للنشر على محكمين مختصين لبيان صلاحيتها للنشر.

الشكل العام للمادة:

يجب طباعة المادة على وجه واحد من ورق A4 مع ترك هوامش 3 سم على كل الجوانب بخط مقاس 14. البحوث المكتوبة باللغة العربية يستخدم فيها الخط Simplified Arabic أما البحوث الإنجليزية يستخدم فيها الخط Time new roman. يقدم الأصل مطبوعاً من 3 نسخ كما يتم تسليم المادة في قرص مدمج بعد إجراء التعديلات والموافقة النهائية بالنشر. تنسق الأوراق العلمية كالتالي:

صفحة العنوان: يقدم عنوان البحث في ورقة منفصلة. يحتوي العنوان على المعلومات التالية:
العنوان: يجب أن يكون ذو صيغة دلالية ومختصراً كما يجب تجنب الإختصارات والمعادلات ما أمكن.

إسم الكاتب وعنوانه: يجب كتابة الإسم الأول والأخير للباحث (الباحثين) كاملاً مع إختصار الإسم الثاني للباحث (الباحثين). يجب كتابة عنوان الباحث الإلكتروني تحت الأسماء.
الملخص: يجب أن يوضح الملخص الغرض من الدراسة والنتائج الأساسية والإستنتاجات وأن لا يتجاوز عدد كلماته 300 كلمة.

المقدمة: توضح المقدمة الهدف من الدراسة مع إيراد خلفية كافية مع تجنب الإكثار من التفاصيل في الدراسات المرجعية.

طرق ومواد البحث: يكون من الضروري إيراد معلومات كافية خاصة المتعلقة بتنظيم البحث والتحليل والطرق الإحصائية المستخدمة.

النتائج والمناقشة: أن تكون واضحة ومختصرة كما يجب تجنب إيراد معلومات تم عرضها في الجداول. يجب أن توضح المناقشة بجلاء أهمية النتائج المتحصل عليها والإستنتاجات الناتجة عنها.

المراجع: يجب أن يكتب أي مرجع برز في متن الدراسة في قائمة المراجع. يتم الإقتباس فقط من الدراسات المنشورة أو تحت النشر والكتب.

المراجع داخل المتن:

كاتب واحد: يكتب إسم الكاتب (اسم العائلة) دون الحروف الأولى بالإضافة لسنة النشر (بين قوسين).

كاتبين: إسم العائلة للكاتبين دون الحروف الأولى بالإضافة لسنة النشر (بين قوسين).
أكثر من كاتبين: إسم العائلة للكاتب الأول يتبع بـ (وآخرون) بالإضافة لسنة النشر (بين قوسين).
قائمة المراجع: يكتب إسم العائلة أو الشهرة للمؤلف يتبع بالحرفين الأولين للإسم الأول والثاني ثم سنة النشر ثم عنوان البحث بين علامتي تنصيص، إسم المجلة بخط مائل، رقم العدد، رقم المجلد (إذا وجد) ثم أرقام الأوراق المقتبس منها.

الصور والأشكال التوضيحية والجدول: يوضع رقم الصورة واسم المؤلف وعنوان مختصر للصورة على جهتها الخلفية. يجب أن يكون الجدول واضحاً ومستقلاً بذاته بحيث يفهمه القارئ دون الرجوع إلى المتن، ويطبوع كل جدول على ورقة منفصلة مع مراعاة وضع رقمه وعنوانه في أعلى الصفحة مع استخدام نظام الوحدات المترية. يكون نوع الخط في الجداول للبحوث العربية (Simplified Arabic)، بحجم (10)، وللبحوث الإنجليزية (Times New Roman)، بحجم (8). في المعاملات الإحصائية يجب توضيح طريقة الاختبار ومستويات الأهمية والمعنوية في مفاتيح الجداول والأشكال.

ملحوظات:

إذا فشل البحث في الإيفاء بالمتطلبات الأساسية الموضحة أعلاه يتم إرجاعه للمؤلف دون مراجعة أو تحكيم.

البحوث المرسله للمجلة لا تعاد إلى أصحابها نشرت أم لم تنشر.
تحتفظ هيئة التحرير في عدم نشر أي بحث دون إبداء الأسباب، وتعتبر قراراتها نهائية.
ترسل البحوث والمقالات وجميع المراسلات المتعلقة بالمجلة على العنوان التالي:

مدير تحرير مجلة العلوم الزراعية - كلية الزراعة - جامعة أم درمان الإسلامية
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ما ورد في هذا العدد يعبر عن آراء الباحثين أنفسهم ولا يعكس بالضرورة آراء هيئة التحرير أو سياسة جامعة أم درمان الإسلامية

الإشتراك السنوي: الأفراد (20 دولار أمريكي أو 100 جنيه سوداني)

المؤسسات: (50 دولار أمريكي أو 250 جنيه سوداني)

حقوق التأليف والطبع والنشر محفوظة

لكلية الزراعة جامعة أم درمان الإسلامية

الحمد لله رب العالمين والصلاة والسلام على اشرف المرسلين
سيدنا محمد وعلى اله وصحبه اجمعين .

يسعدني أن أرحب بكم في مجلة العلوم الزراعية وأتمنى لكم
جولةً مفيدةً في محتوياتها، وقد أخذت المجلة على عاتقها المساهمة
بفعالية في الدراسات المتعلقة بالمجال الزراعي وبدأت بتقديم
الدراسات المتنوعة لسد هذه الفجوة باللغتين العربية والإنجليزية،
ويجئ العدد الرابع حاملاً هذه الرسالة في عدد من الأوراق وقد
تناول تبعاً العديد من الموضوعات المتعلقة اقتصادياً بأثر السياسة
الخارجية للصمغ العربي على أداء الصادرات للسودان إلى جانب
المقومات الاقتصادية والبيئية للسياحة في السودان، وكذلك تأثير
التسميد العضوي والكيماوي على النجيل، كما اشتمل هذا العدد على
الصعيد الآخر على موضوعات متنوعة وشاملة لمجالات الزراعة
المختلفة في الهندسة الزراعية، الاغذية، أمراض النبات، الارشاد
الزراعي، المحاصيل الحقلية، البساتين والاقتصاد الزراعي.

وهكذا تتوالى البحوث والدراسات وبها ترتفع معدلات اهتمام
العلماء والباحثين في العلوم الزراعية وخاصة ما يرتبط بالسودان،
ونحن في المجلة نحاول أن نتحرى الدقة ونجود أعمالنا كلما تبارى
العلماء والمهتمين بالعمل الزراعي بتجويد أعمالهم، ومن ثم يرتفع
المستوى العلمي للمجلة بإرتفاع درجة المناقسة في تجويد العلوم
الزراعية خدمة لوطننا ودفعاً لعجلة التنمية في بلادنا.
ولكم موفور الثناء والتجلة والإكبار

د. مأمون أحمد محمد النور
مدير التحرير

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المقومات الاقتصادية والبيئية للسياحة في السودان

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المستخلص

اجريت هذه الدراسة لتقييم الاثر الاقتصادي والبيئي السياحي في السودان (الحياة البرية) على الاقتصاد السوداني وشملت الدراسة حظيرة الدندر وسنقنيب كنموذج تم جمع المعلومات من الكتب والمراجع والتقارير. أظهرت نتائج الدراسة ان السودان غني بالموارد الطبيعية والحيوانية البرية إلا ان الإستفادة منها غير كافية لتحقيق عائدات إقتصادية مقدره في مجال السياحة التي تكاد تشكل دعامة اساسية للإقتصاد القومي . اثبتت الدراسة ان هناك عدم اهتمام كبير في جانب حماية الحياة البرية والموارد الطبيعية مما تسبب في إهدار الحياة البرية والموارد الطبيعية وتؤثر سلباً على الإقتصاد القومي والبيئية.

Abstract

This study was conducted to evaluate the economic and Tourism effect of wildlife in the national income. The information collected was from Dinder National Park and Sengenb as examples, in addition to textbook, references and previous reports. The results obtained confirmed the richness of Sudan with natural resources and variety of wildlife, but no visible economic revenue from these resources .The study confirmed that these valuable resources and neglected and not fully benefited.

المقدمة:

و1980 كان اسرع من نمو التجارة العالمية بشكل عام (3) وهناك امكانية كبيرة للزيارة خاصة في اوروبا والولايات المتحدة اللتين تضطلعان ب 70% و20% على التوالي من السياحة الدولية، اما وافية دول العالم فتشارك بنسبة 10% ومما لاشك فيه أن تطور الخدمات السياحية في كثير من دول العالم سيؤدي الى تطور اوسع في السياحة الدولية ككل (3) يوضح الجدول (1) التدفق السياحي في الفترة ما بين 1965-1994 على النطاق العالمي:-

يعتبر التدفق السياحي في جميع ارجاء العالم وبين الدول نشاطاً اقتصادياً هاماً يتزايد حجمه يوماً بعد يوم ففي العام 1986م مثلاً بلغ التدفق السياحي العالمي حوالي 336 مليون نسمة ، كما بلغ اجمالي الانفاق على السياحة فيها 115 مليار دولار . وتشكل حصة السياحة في الدول المتقدمة حوالي ثلث الخدمات التجارية، وتعتبر من اسرع الصناعات نمواً في العالم وتؤكد الارقام المتوفرة ان النمو السياحي على النطاق العالمي في الفترة ما بين 1974

تضاعف اعداد السياحة بين 1994-1965	تطور اعداد السياحة بالمليون						السنة الاقليم
	1994	1990	1987	1985	1975	1965	
10 مرات	19	14	10	10	4	2	افريقيا
4,6 مرة	107	84	66	59	47	2,3	امريكيتان
4 مرات	329	271	234	228	151	86	اوروبا
3 مرات	10	6	8	7	3	3	الشرق الاوسط
38مرة	77	50	37	30	8	2	سرق اسيا والمحيط الهادي

المصدر :- الريموي (1998)

يتميز السودان بتنوع المناخ وتعدد الاقاليم البيئية التي تنعكس ايجابياً في تنوع حيوي فريد متمثل في الانواع النباتية والحياة البرية وتعتبر الحياة البرية من الثروات الطبيعية المجده

سياحية يمكن الاستفادة منها اقتصادياً اذا احسن استغلالها وذلك من خلال التعرف على كيفية تطوير البيئة السياحية في السودان وتشجيع السائح الاجنبي في السودان لكي تصبح الفائدة اقتصادية . حيث ان الممارسات الخاطئة في مجال استقلال المعوقات الاساسية للبيئة السياحية والتي تقلل من المساهمة اقتصادياً لذا يجب ان تدخل الجوانب العلمية والتقنية

حيث تشكل ارثاً قومياً لا يستهان به على المستوي الاقتصادي والسياحي بالاضافة لقيمها الاخرى واهميتها كمكون هام للارث الطبيعي المحلي والعالمي (1)

ومن هذا المنطلق يجب علينا التعرف على مدى الاستفادة الممثلة لمعوقات البيئة السياحية في السودان نسبة لوجود معوقات سياحية غنية التي تعمل على تهيئة بيئة

هنالك العديد من الانماط السياحية في السودان والتي يمكن ان تستثمر فيها المقومات الطبيعية ومنها السياحة التراثية ، كالاثار والمتاحف والجمال (جبل مرة) مجرى النيل ، حظائر الحيوانات (حظيرة الدندر وغيرها) وايضاً هنالك مقومات اجتماعية نابعة من بيئة المناطق يمكن استغلالها سياحياً كالفنون الشعبية والازياء التقليدية التراثية وغيرها من الصناعات اليدوية والمهرجانات السياحية والتسويقية وغيرها لاشك ان الاستغلال السياحي الامثل لهذه المقومات الطبيعية والبيئية المتوفرة بمختلف مناطق السودان سيكون له الاثر الواضح على اقتصاد هذه المناطق وبالتالي على الاقتصاد القومي (7)

كانت المحميات الطبيعية قديماً تعتبر مواقعاً للمناظر الطبيعية الخلابة والحياة البرية تحفظ من اجل متعة الاثرياء والمترفين (6) تغيرت هذه النظرة فأصبحت المحميات الطبيعية مواقعاً تضم الاحتياجات الاساسية لكل المجتمعات . وفي مطلع القرن الحادي والعشرين فإن القيم والخدمات التي توفرها المحميات الطبيعية للإنسان عديدة ومتنوعة ، كما ان التقدم في العلوم الطبيعية والذي يتيح التعرف على تركيبية وخصائص الانواع الحية يتيح الامكانية للتعرف على غنى الموارد الحية المتمثلة في المحميات الطبيعية وتنوع بيئاتها وخصائصها وفي مواجهه التغير المناخي فإن المحميات الطبيعية تمثل الوقاية من خطر الفيضانات والجفاف وما يسمى بالكوارث الطبيعية كما انها توفر المياه النقية للمدن والقرى والارياف ، وتصيح المحميات الطبيعية المحور الاساسي للاقتصاد الريفي فتوفر الدخل وامكانيات العمالة ويتيح المجال

لتطوير وتشجيع السائح الاجنبي ، حتى نلحق بالكثير من الدول التي سبقتنا في هذا المجال ومدى الاستفادة من تجارب تلك الدول . منهج البحث وادواته:- المنهج الوصفي التاريخي يعتمد على المصادر الاولية التي تتمثل في الكتب والمراجع والتقارير.

كيفية تطوير السياحة:-

وقد قاد الاهتمام الدولي بحماية الموارد الطبيعية والحياة البرية الي تسارع الدول في سن التشريعات والقوانين والانضمام للإتفاقيات والبروتوكولات الدولية المنظمة لإطار الحماية والمحافظة عليها . والسودان يعتبر من اوائل الدول التي سنت القوانين والتشريعات لحماية الحياة البرية وإنشاء المحميات الطبيعية الي عهد قريب كانت الحيوانات البرية تغطي معظم اجزاء السودان ولكن تعرضت الحياة البرية والمحميات الطبيعية في الاونة الاخيرة الي التدهور الذي بدد مواردها وعرضها للتلاشي والانغراض نتيجة عوامل طبيعية واخرى بفعل الانسان (1)

اجمع الكثيرون تطور وازدهار الحركة السياحية الي صلاحية البيئة والموارد الطبيعية التي يجب ان تراعي مسألة الحفاظ عليها عند وضع استراتيجيات وخططنا السياحية المستقبلية بإعتبار ان نجاح التنمية السياحية يتجانس مع عناصر البيئة المختلفة ، وتضم البيئة العديد من المغريات السياحية منها ما كان طبيعياً الصحارى والسهول والجمال ومنابع المياه المعدنية والنباتات الطبيعية ، كما يدخل المناخ عنصر اساسياً في المغريات الطبيعية اذ ان درجة الحرارة والشمس الساطعة واتجاه الرياح والامطار تعتبر من عوامل الجذب السياحي (7)

الانواع المهددة قد تعرضت للتناقص الشديد سواء بموتها او لتجزئة وتغير طبيعة الموائل البيئية الخاصة بها او نتيجة لتعرضها للحصد الجائر ، لاشك في ان الانواع وتحت مثل تلك الظروف سوف تتجه للانقراض سريعاً بينما تبقى الانواع التي تعيش خارج نطاق الحماية تواجه المخاطر ، وان افضل استراتيجية لحماية الجماعات القليلة الباقية للانواع المهددة هي وضع خطة الحماية لأكبر عدد ممكن من افراده داخل اكبر مساحة ممكنة ولتنفيذ ذلك فإن خبراء التخطيط واستخدام الارض ومتخذي القرار وخبراء الحياة البرية الذين يبذلون غاية جهدهم لحماية الانواع من الانقراض بما لديهم من ميزانيات محددة يحتاجون الي وجود ارشادات تعينهم في هذا المجال(8)

الحيوان البري في السودان :- تلعب الحيوانات البرية دوراً هاماً في حفظ التوازن البيئي واهميتها الاقتصادية والحضارية والترفيهية والسياحية كما ان الحيوانات البرية هي تلك الفقاريات التي تعيش في بيئات طبيعية وهذه البيئات الطبيعية تتميز بتواجد انواع متميزة من الحيوانات البرية والطيور التي تتلائم معها وتستطيع البقاء والاستمرارية بها.

يوجد بالسودان تباين بيئي قطري وذلك لإشتماله على وجود البيئات الصحراوية شبه الصحراوية السافانا الفقيرة والغنية ، مناطق السود، الغابات الاستوائية والبيئات الجبلية الامر الذي ينتج عنه تبايناً فريداً في انواع الحيوانات المتوحشة والطيور البرية التي تقطن هذه البيئات والتي تشتمل على فصائل الثدييات والطيور والبرمائيات والمائيات النيلية ، البحرية والزواحف ، يوجد في السودان حوالي

لوضع استراتيجيات التنمية لفقراء الريف، كما ان المحميات الطبيعية تساعد بما قد توفره من منافع مباشرة وغير مباشرة في فض النزاعات حول الموارد الطبيعية (1)

أن حماية الموائل الطبيعية التي تحتوي على المجموعات الحيوية القومية تعد من اكثر الطرق فاعلية في صون التنوع الحيوي وقد يرى البعض انها هي الطريقة الوحيدة للمحافظة على الانواع لأنه لا يوجد لدينا المصادر او المعلومات الكافية لصون اغلبية انواع العالم المسجلة لدينا حالياً. ان من اكثر الخطوات اهمية في حماية المجتمعات الحيوية هي اقامة محميات طبيعية ذات وضعية قانونية تسمح بدرجات مختلفة من الاستغلال التجاري للموارد فيها، وكذلك باستخدام السكان المحليين لها بالصورة التقليدية واستخدامها في الترفيه عنهم، ويجب على مؤيدي صون الموائل البيئية توفير موارد التمويل والحصول على الدعم السياسي للتأكد من تحقيق المحميات لأهدافها عند اقامتها (8)

الجدير بالذكر ان انشاء العديد من المتنزهات الوطنية ومحميات الحياة البرية بهدف حماية الانواع الحيوانية الضخمة التي تحظى بمكانة اسرة في فكرة ووجدان الناس مثل الاسود والنمور والثور الامريكي ووحيد القرن والدببة تلك الحيوانات تعتبر رموزاً قومية مهمة وهي تلعب دوراً مهماً في مجال السياحة بالرغم من ان حماية الموائل البيئية التي تعيش فيها تلك الكائنات فإن ذلك قد لا يكون كافياً لوقف انهيار اعدادها وقنائها حتى لو اعطيناها الحماية القانونية حيث ان المحميات غالباً ما تنشأ بعد فوات الاوان اي بعد ان تكون غالبية جماعات

البرية وتصديرها الى حدائق الحيوانات ومزارع التربية الخاصة وللأغراض السياحية او الاستئناس بها في المنازل قد يصل عائدها الي عشرات الملايين من الدولارات سنوياً في بعض الدول، كما تساهم الحياة البرية في انعاش الحركة الاقتصادية في الدول بتجارة المنتجات وجلب السواح والباحثين والهواء وجلب العملات الصعبة عن طريق اقامة المعارض ووسائل الدعاية الاعلامية كطباعة الافلام السياحية والعلمية وخلافها اضافة الي الاستثمار في مجال المزارع للحيوانات البرية والذي نشأ حديثاً بالسودان في مطلع عام 1992م(6).

الفوائد الاقتصادية غير النقدية للحيوانات البرية:-

ان معظم الفوائد الاقتصادية الغير نقدية للحيوانات البرية تتمثل في الاتي:-
فوائد بيولوجية وبيئية متمثلة في الدور الذي تقوم به الحيوانات البرية في تلقيح النباتات او في القضاء على بعض الافات او في اكل بعضها البعض او في تخصيب التربة .
فوائد علمية وبحثية وتعليمية.
فوائد ترفيهية وترويحية
فوائد تراثية وثقافية متمثلة في الطقوس التعبدية والرسم والنحت والشعر والموسيقى.
فوائد روحية ونفسية بارتباط الحيوان بالمقدسات والالفة والمؤانسة .
فوائد غذائية حيث تعتمد معظم القبائل الرعوية والبدائية على الحيوانات البرية في غذائها وعلاجها
الهدايا السيادية تمكيناً للصدقة بين الدول .
تحويل النباتات الي لحوم ومنتجات اخرى بكفاءة عالية

266 نوعاً من الثدييات وهي تمثل مجموعة 12رتبة من جملة 13 رتبة تم حصرها بالقارة الافريقية كما يوجد حوالي 938 نوعاً من الطيور البرية و106 نوعاً من الاسماك و90 نوعاً من التعابين منتشرة في بيئات مختلفة (6) المقومات الاقتصادية السياحية:- تمثل الثدييات والطيور مكانة مرموقة كثروة لا يستهان بها باعتبارها احد موارد الاقتصاد القومي اضافة الي الاهمية السياحية والترفيهية والحضارية والدور الذي تلعبه في حفظ التوازن البيئي الطبيعي ، وتأكيداً لحمايتها واستمراريتها كان لا بد من وضع القوانين واللوائح التي تكفل لها البقاء للأجيال الحاضرة والمستقبلية (6) اذا تناولنا الفوائد المادية والاقتصادية نجد ان منتجات الحيوانات البرية متعددة ، حيث يمكن الحصول منها على اللحوم والجلود والفراء لصناعة الحقائب والملابس، كما يمكن الحصول على اجزاء مختلفة من الحيوانات للزينة والتحف او استعمالها في الفرش والاثاث في المنازل او استعمالها كحلى كما في العاج او في بعض انواع الاسنان كما تستخدم الشحوم و غدد واجزاء بعض الحيوانات البرية في صناعة الادوية والمواد الطبيعية كالخيوط الجراحية وزيت نخاع العظم للنعام والذي يستخدم في علاج الروماتيزم او كمصدر للفيتامينات كما في شحوم الدب والفتنفذ وغيرها كما تستعمل الشحوم في صناعة الصابون ومستحضرات التجميل ، اما العظام والقرون والاذلاف فإنها تدخل في صناعة الازرار والمصاييح ومقابض السكاكين والادوات المختلفة (6) كما ان الكثير من الدول تتحصل على ايرادات نقدية ضخمة من رسوم الصيد وبيع الحيوانات

الفوائد الاقتصادية النقدية للحيوانات البرية:-
تتلخص في الآتي:-

رسوم رخص الصيد التجارية

رسوم تربية الحيوان البري في الاسر

التجارة في اللحوم والاجزاء المجففة محلياً
وعالمياً

تصدير الحيوانات الحية .

تصدير الجلود .

تصدير اجزاء من الحيوانات المحنطة .

تصدير العاج الخام والمصنع والعظام لبعض
الانواع

ايرادات الغرامات الناتجة عن المخالفات (2)

تجارة الحيوانات البرية:-

دور الحيوانات البرية في التجارة الداخلية:-

تتمثل التجارة الداخلية للحيوانات البرية كما

اشار بعض الكتاب بما يعرف برياضة الصيد

السياحي والذي ينتج عنها رسوم خاصة

وضرائب من شركات السياحة وما تجنيه الدولة

من الاشتراك في المعارض الدولية ، الجدول

(2) يوضح انواع واعداد الحيوانات البرية

والطيور التي تم التصديق باصطيادها للاعوام

(2006-1995) ونسبة التغيير السنوي لها (5)

جدول رقم (٢) يوضح الرقم القياسي

لتطوير اعداد الحيوانات البرية حسب

تقديرات الباحثين

نوع الحيوان	١٩٧٢	١٩٨٩	١٩٩٤	٢٠٠١
الباشمات	١٠٠	٧٩,٧	٢٩	٢٨,١
ظبي المور	١٠٠	١١٦,٧	٤٣	١٩
تيتل بنايخ	١٠٠	١١٢,٢	-	-
الكتمبور	١٠٠	٨٥,٣	٣٢,٢	١٤,٩
ابو عرق	١٠٠	٤٨,٢	٢٥٨,١	١٦٣,٩
ابو تباح	١٠٠	٥١٥٧,١	١١٥,٩	٨٧٤,٧
الحلوف	١٠٠	٦٨,٨	-	١٥٩,١

اضافة الي موقع السودان الاستراتيجي وقربه

من موقع الاستهلاك في الخليج واوروبا(5)

وكنتيجة لهذه المقومات توضح البيانات

المتوفرة من الادارة العامة لحماية الحياة البرية

انه توجد 26 مزرعة لحيوانات برية في مناطق

بيئية مختلفة تشمل النيل الابيض ، الجزيرة ،

الخرطوم ، البحر الاحمر، جنوب دارفور،

لان المعوقات الخاصة بالاستثمار في المزارع

الخاصة والسياحة البيئية فهي في اللاساس

ومن الناحية الاقتصادية تتمثل في ارتفاع تكلفة

الاستثمار مقارنة بقطاعات اخرى كالدواجن

المصدر مجلة جامعة جوبا للادب
والعلوم(2008).

ولتعزيز دور التجارة الداخلية للحيوانات البرية

من خلال انتاج المزارع الاستثمارية الخاصة

حيث يعتبر السودان ذو مقومات بيئية واقتصادية

واجتماعية لانجاح أي مشاريع استثمارية في

مجال الحياة البرية ويمكن توضيح ذلك في تعدد

بيئة ومناخ السودان يعطي الفرصة لتربية العديد

من انواع الحيوانات البرية والطيور وتوفير

العمالة وقلة تكاليفها وتوفر غذاء الحيوان

البري وقلة تكاليف مقارنة بالدول الاخرى

ان الجدول (1) (5) ص69 يوضح صادرات السودان من الحيوانات البرية الحية للأعوام 1995 حتى 1999 واضح من الجدول ان هنالك 25 من الحيوانات التي تم تصديرها وتتصدر القائمة الغزلان الدور كاس، ، السلاحف البرية، الضب الخلوي والقطا والقمرى. القراءة التحليلية لهذا الجدول تؤكد ان هنالك طلب لبقية القائمة لم يتوفر لها العرض الكافي او ان هنالك اعداد مهمة خرجت عبر بوابة التهريب لم يتم تسجيلها لدى السلطات او انها لم تمر عبر مطار الخرطوم او ان الجهات المختلفة لا تسمح بتصدير اعداد اكبر من المسجلة (2)

تصدير اجزاء الحيوانات البرية:-

صادرات السودان من جلود الحيوانات البرية:-
الجدول رقم (2) يشير الى الكميات المصدرة من جلود الحيوانات البرية حيث عرف السودان تجارة الجلود منذ القدم الا اننا نذكر على سبيل المثال وليس للحصر تصدير الكميات والانواع المستوردة لبعض هذه الجلود وذلك من خلال الاعوام 1957 – 1960 جدول (5)

تصدير العاج :- تبين الاحصاءات والتقارير ان الدول المستوردة للعاج من السودان في الفترة من -1970 1982 هي الصين – اليابان – ومصر – الهند- بتسوانا - وفرنسا وانجلترا – والمانيا الغربية والاقطار الشرق اوسطية (6).
3- تصدير ناب الفيل :- هذا النوع من التجارة يعتبر من اقدم ضروب تجارة اجزاء الحيوانات البرية كما اسلفنا من قبل حيث يوضح الجدول اعداد واوزان من ناب الفيل التي رصدت لهذا النوع من التجارة عن الاعوام 1982-1951 (6)

4-مزارع تربية الحيوانات الوحشية:- تمثل مزارع التربية واجهة من اوجه استغلال

مثلاً وضعف البنية التحتية وعدم الكفاية في التمويل وخصوصاً من المصارف وعدم مرونة الجوانب التشريعية الخاصة بحماية ورعاية الحيوانات البرية اضافة الى ضعف البحوث والميزانيات المرصودة لها ومن ثم ضعف الجانب الارشادي للمربين ومستثمري السياحة البيئية (5)

دور التجارة الخارجية للحيوانات البرية :-
ان التطور السريع في وسائل الاتصالات وتكنولوجيا نقل المعلومات ادى الى تطور موازي في التبادل التجاري والاقتصادي على المستويين الاقليمي والعالمي حيث يتم التداول لتلك الثروة قيد الالتزام بالقوانين الدولية الخاصة بالحياة البرية لذا نجد ان معظم الصادرات من الدول تكون من حيوانات مسموح بها وفق الجداول التي تنظم الاتجار في تلك الحيوانات بعد اجراء المسوحات والدراسات عن كل فصيل (5)

وان عدم وجود مسوحات واحصائيات وافية عن الانتاج من الطبيعة يجعل من الصعب المقارنة بين الصادر الفعلي والانتاج ولكننا نسبة لنوع البيانات الطبيعية نجد ان معظم انحاء القطر يزخر بالحيوانات البرية والدليل على ذلك اننا متى ما وفرنا الامكانيات الخاصة بالصيد استطعنا الحصول على الكميات التي نرغب في الحصول عليها. (5)

التجارة والتصدير:-

تصدير الحيوانات البرية الحية:- ان الانواع المختلفة التي تم تصديرها من الحيوانات البرية والطيور وذلك للفترة من عام 1976 وحتى عام 1982 جدول (6) ص67 تبين الاعداد والانواع التي يتم تصديرها في ذلك الوقت مقارنة بالاعداد والانواع التي تصدر حالياً الا

استيراد هذه الفصائل وخصوصاً دول الخليج والسعودية يجب ان تركز اوزان الصادر على نتائج المسوحات الدورية وتحليل الاحصاءات الواقعية وان لا يكون الهم الاساسي هو العائد الاقتصادي وحده (6)

نماذج للمحميات السياحية في السودان :-

لقد كان السودان يذخر بحياة برية غنية من حيث التنوع الإحيائي وحجم مجتمعات الأنواع، إلا أن الصيد الجائر أدى لإنقراض بعض الأنواع في البر مثل أبو حراب وأيضا الإنقراض الموضوعي لكثير من الأنواع مثل الزراف وغزال الأريل والتيتل بمحمية الدندر القومية كما أن بعض الأنواع أصبحت قليلة العدد ونادرة الوجود في الموائل كانت تعرف في الماضي بغناها الأحيائي. ولقد أنشأ السودان العديد من المناطق المحمية للمحافظة على الحياة البرية. وتضم المناطق المحمية :-

المحميات القومية التي تضم محمية الدندر القومية ومحمية الردوم القومية ومحمية وادي هور القومية ومحمية سنقريب القومية كمحمية مرجانية في البحر الأحمر ومحمية خليج دنقاب البحرية (9)

حرم الطيور الذي يضم غابة السنط بالخرطوم وبحيرة الأبيض وبحيرة كيلك وبحيرة النوبة وخران الرصيرص وخشم القربة وجبل أولياء (9)

حرم الحيوانات البرية الذي يضم حرم أركويت سنكات وأركويت

معازل الحيوانات البرية التي تضم معزل الرهد وتلال البحر الأحمر والسبلوقة وطوكر (9)

حظيرة الدندر:- تقع محمية الدندر في الجزء الجنوبي الشرقي وسط السودان مع الحدود بين السودان واثيوبيا، تم اعلانها كحظيرة

الارض وقد ادخلت حديثاً في السودان (4) ولكن بالنسبة لمزارع تربية الحيوانات البرية في السودان بدأت اول المزارع العمل عام 1992 وذلك بالتصديق لتربية الغزال العادي ثم تابعت التصديق لعدد من المزارع لتربية غزال ام سير وغزال سنجة والنعام والسلاحف والتماسيح والطيور البرية حيث تم التصديق حتى الآن لعدد ستة وعشرين مزرعة في مختلف ولايات السودان بتصديق مبدئية ونهائية اضافية الى اكثر من خمسين تصديق مبدئي لإقامة مزارع اخرى وذلك رغبة في الاستثمار للمواطنين والمستثمرين العرب (6) معوقات الاستثمار في مجال الحيوانات البرية :-

الحيوانات البرية وبيئاتها تتأثر بكل اوجه استقلال الارض وقد شهد السودان تغيرات كثيرة في البيئة الاقتصادية والتركيبة السكانية مما اثر سلباً او ايجاباً في اعداد وانواع الحيوانات البرية وفي بيئاتها الطبيعية وقد وضح جلياً ان الحيوانات البرية كانت تتواجد بأعداد كبيرة في مناطق شاسعة من البلاد الا ان اعدادها قد انحسرت كثيراً ومازالت تخفتي في الكثير من المناطق بدرجة كبيرة ، ان اعداد وانواع الحيوانات والطيور المسموح بصيدها والتي تدخل في اطار الاتجار في الحيوانات البرية واجزائها لازالت مبنية على توفر اعداد الحيوانات عندما تم وضع القوانين واللوائح ولم تخضع لأي مراجعة اساسية تهتم بالمتغيرات التي واجهت تلك الحيوانات والتقليص الواضح في اعدادها وبيئاتها وتعتبر التجارة والتصدير في الحيوانات البرية الحية كالغزلان والنعام والسلاحف وخلافه من اهم مصادر الدخل القومي ومع تزايد الطلب على هذه الحيوانات في الكثير من الدول التي دأبت على

هذه الغابات تعرضت لقطع الشئ الذي جعلها مهددة بالانقراض.

الجدير بالذكر فإن التباين في البنيات الطبيعية ادى الي تباين في انواع الحيوانات البرية الموجودة في المحمية (التيتل - الجاموس- الحلوف - الغزلان) حيث حددت المسوحات التي اجريت عام (2001)

تواجد 115 نوع من الطيور المهاجرة والمقيمة و 90 نوعا من الطيور التي تنتشر علي محميات المياه مثل الحبار والبجبار والرهر وهي الأسماء المحلية للطيور التي تأتي في موسم الشتاء هاربة من صقيع السويد وأوربا . كما هناك دجاج الوادي بلونه الأسود وأبو سعن والقرقوق والنعام وغيرها (10)

أما بالنسبة للأسماك تمت مسوحات عام 1984 م حيث سجل وجود 21 نوعا ، ولوحظ أنها متماثلة لأسماك النيل الأزرق ، كما تم تسجيل 32 نوع مما ادى الي زيادة تشكيلية للحيوانات الموجودة في الدندر .

بالنسبة للحشرات بمحمية الدندر وجد 200 نوع من الحشرات مثل النمل - النحل والارضة.

إلا انه اجر الباحثون دراسات عام 2000م عن اعداد الحيوانا المتواجدة في حظيرة الدندر ووجد انها لا تتجاوز %30 من اعداد الحيوانات التي تم رصدها في بداية السبعينات (4)

حظيرة سنقنيب:-

كلمة سنقنيب تعني شجرة السمر بلسان البجة وتوجد شجرة السمر بكثرة على المرتفعات اللجافة غرب السهل الساحلي . ويعتقد ان زوار سنقنيب من السكان المحليين يصنعون مراكبهم من اخسابها.

اسست حظيرة سنقنيب البحرية في عام 1995م وتقع على بعد 30 كيلومتراً شمال شرق

قومية 1935م تحيط بها ثلاثة ولايات سنار - القضارف - النيل الأزرق . حيث تبلغ مساحتها حوالي 3500كم2 وهي لاتتمثل وحدة بيئية متكاملة لذلك تقدر في عام 1988 زيادة في مساحتها الي 10288كم2 والتربة طينية ومتشققة وذلك يعود الي ان %60 عبارة عن طين حيث ان الامطار بين شهري يونيو ونوفمبر اما مصار المياه الاخرى نهر الدندر والرهد وروافدها (خور قلقو ومساويك) ولكنها انهار موسمية (4)

ويعتبرها خبراء الحفاظ علي البيئة إحدي أجمل المحميات بالسودان وهي المناطق التي انشأت من أجل حماية الحيوانات كاملة ولايسمح فيها بأي أنشطة إنسانية سوي للأغراض السياحية والترفيهية والتعليمية (10)

ومع ذلك تستغل محمية الدندر طيلة هذه الفترات كواجهة سياحية مميزة او كمصدر إقتصادي مهم إلا في السنوات الأخيرة. حيث بدأت تنشأ نهضة سياحية مثل تأسيس بعض شركات خاصة بتوفير السيارات للترحيل والإقامة في الحظيرة مع توفير الأمن والسلامة (10)

وتعتبر الفترة من يناير حتي أبريل من أفضل الفترات لزيارة المحمية ذات الموقع الفريد ، حيث تغطيها السهول ذات الحشائش والنباتات والأدغال والبحيرات ويمكن للسياح الوصول إليها براً بالسيارات حيث تستغرق الرحلة من الخرطوم حتي محطة القويس 8 ساعات ومن ثم مواصلة الرحلة إلي للمحمية لاتزيد عن 4 ساعات (10) تتميز محمية الدندر هذه بتنوع في البنيات الطبيعية وتنوع في درجة الحرارة والرطوبة حيث نجد الغابات النهريية (الطلح - الهجليج- الجميز- الدوم - السنط- التبدي) اي نباتات السافنا قليلة الامطار الا ان

الرياح الشمالية التي تبلغ أقصى سرعتها في يناير وديسمبر.

تختلف مستويات الملوحة باختلاف عمق المياه وعموماً تبلغ مستويات كميات الاملاح المذابة %41-36 درجة شفاية المياه عالية نسبياً تتراوح شفاية مياه شعب سنقنيب 16 متر .

يعزي ارتفاع مستوى الملوحة في البحر الاحمر الي عاملين:-

الكميات القليلة من المياه العذبة الواردة الي البحر

ارتفاع درجات الحرارة الجوية التي يزيد من معدل تبخر المياه.

تعتبر الشعاب المرجانية المقوم الاول والاساسي لصناعة السياحة على امتداد ساحل البحر الاحمر حيث تمثل اكبر مصدر للعملة الصعبة للاقتصاد القومي .

وعلى الرغم من عدم سهولة التقدير المادي المباشر لمثل هذه الموارد الطبيعية بسبب اهميتها وادوارها المتشعبة الا انه وجد ان كل متر مربع من الشعاب المرجانية وما يرتبط بها من اسماك ورخويات وصخور مرجانية في منطقة جنوب سيناء يعود على الاقتصاد القومي بما يعادل 120 دولار من ممارسة القوص فقط (4)

وتعتبر التجارة من اسماك الشعاب المرجانية واحداً من صور استثمارات الانسان للموارد الطبيعية لبيئة الشعاب المرجانية حيث يتم التعامل مع مايقارب 250 نوع من مختلف الاسماك وتعتبر اسماك الفراشة والملاك والجراح والزناد ومعكوفة الفكين من اشهر الانواع التي يتم الاتجار فيها وتتراوح اسعار السمكة الواحدة من تلك الانواع في الاسواق العالمية ما بين واحد دولار امريكي ومايزيد عن

بورتسودان وهي محمية ومنتزه قومي متعدد الاغراض . المحمية مسجلة في سجل الامم المتحدة ضمن محميات التنوع الحيوي.(4)

عيوبها:-

لا توجد بها كوادر مؤهلة ومدربة في مجال ادارة المحميات البحرية .

لا تتوفر المعدات الضرورية من قوارب ومعدات غطس ومعدات معملية وغير ذلك

حظيت حظيرة سنقنيب بعدد قليل من سياح البحر وممارسي رياضة الغطس كما انه

توجد بها الشعب المرجانية كما انها معروفة لمجموعة منتقاة من علماء البحر والمستكشفين.

تعتبر مدينة سنقنيب هي المحمية الوحيدة التي تكتمل فيها دائرة الشعب المرجانية في البحر الاحمر.

النباتات التي توجد بالمنطقة:-

توجد ثلاثة انواع من نباتات المنجروف :-

Avicenuia marine

Rhizophora mucro nata

-Brug uriera gymnorliza

الحيوانات التي توجد بالمنطقة :-

توجد 124 نوعاً من الحيوانات المرجانية متوزعة على 24 فصيلة وتوجد بها الشوكيات والاسماك.

*توجد بها ثلاثة انواع من سمك القرش

*يوجد كذلك الحوت والدولفين والسلاحف

* توجد العوالق الدقيقة التي تكونها الطحالب الحمراء التي اضفت على مياهه اللون الاحمر طبيعة المنطقة:-

تتراوح درجات حرارة الجو في منطقة سنقنيب بين 10-47.5 مئوية كما تتباين الرطوبة

النسبية بين %42 و %76 ونادراً مايزيد معدل الامطار وهي تهطل شتاءً تسود في المنطقة

مائة وعشرين دولار امريكي. الإدارة العامة لحماية الحياة البرية – وزارة
والجدير بالذكر ان اسماك الشعاب المرجانية الداخلية - الخرطوم - 2012
من اهم العوامل التي تجذب الغواصين حيث محمية الدندر الإتحادية – كلية علوم وتكنولوجيا
تشكل 30% تقريباً من اجمالي القيمة الاجمالية الإنتاج الحيواني 2013
لأي منطقة غوص. اي ان القيمة المادية
لأسماك الشعاب المرجانية التي تعيش في المتر
الواحد المربع قد تصل نحو 40 دولار امريكي
سنوياً(4)

المراجع:-

المحميات الطبيعية في السودان د.سلوى
منصور – ومعتصم بشير – هيئة بحوث الثروة
الحيوانية – مركز بحوث الحياة البرية .
المؤتمر البيطري العربي الثامن- الخرطوم –
السودان د. احمد الامين محمد – قاعة الصداقة
28-24 مارس 1998 م .
حسين الريماوي- مدخل الي السياحة والتنزه
جامعة الاسراء الاهلية – عمان – الاردن
1998م دار النظم للنشر
علي سعد محمد – الحياة البرية في السودان-
الخرطوم
مجلة جامعة جوبا للآداب والعلوم – العدد
السابع مايو 2008م
ندوة الحياة البرية – مركز بحوث الحياة البرية
– الهيئة العربية للاستثمار والانماء الزراعي
والمنظمة العربية للتنمية الزراعية – الخرطوم
يوليو 2001م
ندوة استخدام المناطق المحمية للسياحة البيئية-
1443/1-14/10 24-28/3/2002 م مدينة
الرياض.
بتشارد بريماك – اساسيات الصون الحيوي –
المملكة العربية السعودية – دار الريح للنشر
2003م.

أثر سياسة تحرير التجارة الخارجية للصبغ العربي على أداء الصادر في السودان خلال الفترة ١٩٧٠-٢٠١٥م

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المستخلص

هدفت هذه الدراسة إلى تقييم أثر سياسات التجارة الخارجية للصبغ العربي تحديداً سياسة الإحتكار وسياسة التحرير الجزئي وسياسة التحرير الكلي على صادر الصمغ العربي في السودان. إتمدت الدراسة على البيانات الثانوية التي تم الحصول عليها من المؤسسات الرسمية للفترة 1970-2015م. تم استخدام التحليل الاحصائي الوصفي وتحليل التباين اللامعلمي Kruskal Wallis وتحليل Mann Whitney لمقارنة أداء صادر الصمغ العربي في السودان لفترات سياسة الإحتكار وسياسة التحرير الجزئي وسياسة التحرير الكلي. أظهرت نتائج الدراسة وجود تقلبات في صادر الصمغ العربي في السودان خلال فترة الدراسة. أيضاً توصلت الدراسة إلى وجود تأثير إيجابي ذو دلالة إحصائية (عند مستوى معنوية 5%) لسياسة التحرير الكلي على حجم صادرات الصمغ العربي مقارنةً بسياستي الإحتكار والتحرير الجزئي. كما توصلت الدراسة إلى أن النقصان في صادر الصمغ العربي بعد تبني سياسة التحرير الجزئي مقارنةً بفترة الإحتكار ليست ذات دلالة إحصائية وهذا يعني أن تبني سياسة التحرير الجزئي لصادر الصمغ العربي بدلاً عن سياسة الإحتكار لم يثبت أنها أدت إلى تناقص صادر الصمغ العربي في السودان. بالإضافة إلى ذلك فقد أوضحت النتائج أن الزيادة في صادرات الصمغ العربي بعد التحرير الكلي لتجارته الخارجية مقارنةً بفترتي الإحتكار والتحرير الجزئي كانت ذات أثر كبير الحجم. أوصت الدراسة ببناء مخزون استراتيجي للصبغ العربي في السودان لتقليل حجم التذبذب في إمداد السوق العالمي به. كما أوصت بتشجيع المحافظة على تطبيق سياسة تحرير التجارة الخارجية بجانب تطبيق سياسات إقتصادية أخرى محفزة لزيادة الصادر. أيضاً أوصت الدراسة بإجراء دراسات مفصلة عن أثر سياسة التحرير للتجارة الخارجية للصبغ العربي على تركيبة صادر الصمغ العربي من حيث مساهمة صمغ الهشاب وصبغ الطلح في إجمالي الصادر.

الكلمات المفتاحية: التجارة الخارجية، الصمغ العربي

The Impact of Foreign Trade Policies on Export Performance in Sudan for the Period 1970-2015

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Abstract

This study aimed at evaluating the effect of the gum Arabic foreign trade policies specifically that of monopoly, partial liberalization and full liberalization on the export of gum Arabic in Sudan. The study depended on secondary data obtained from official government institutions for the period 1970-2015. Descriptive statistical analyses were done in addition to Kruskal-Wallis and Mann-Whitney non-parametric tests for analysis of variance in order to analyze the export performance of gum Arabic in Sudan for the periods of monopoly, partial liberalization and full liberalization. Results showed fluctuations in gum Arabic export in Sudan during the study period with an overall increasing trend. The study also found a significant positive impact (at 5% level of significance) for the full liberalization policy on gum Arabic export quantities compared to the monopoly and partial liberalization policies. In addition, the study found that the decrease in exports for the period of partial liberalization policy compared to that of the monopoly period was of no statistical significance which implies that the adoption of partial liberalization in gum Arabic trade instead of the monopoly policy did not prove to lead to an increasing in the exports of gum Arabic in Sudan. Furthermore, results showed that the increase in gum Arabic exports after full liberalization of its export trade policies compared to that of both the monopoly and partial liberalization periods was of a large size. The study recommended establishing strategic reserves for gum Arabic to minimize fluctuations in its supplies to the world market. Furthermore, the study recommended encouraging the implementation of external trade liberalization policies in addition to the adoption of other economic policies that would help in increasing gum Arabic exports. The study also recommended carrying out detailed studies on the impact of the foreign trade liberalization policy on the gum Arabic export structure in terms of the contribution of Hashab and Talha in the total exports.

Keywords: Foreign trade, Gum Arab

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مقدمة

112 مليون دولار عام 2015م (2015) CoB.

كما أن الدخول الإضافية التي يحققها الصمغ العربي ذات أهمية قصوى في تحسين سبل حياة حوالي ستة ملايين نسمة في السودان يعيشون في مناطق الزراعة المطرية التقليدية حيث تتراوح نسبة الفقر بينهم ما بين 65 إلى 90% (2007) WB.

بالإضافة للقيمة البيئية العالية لشجرة الهشاب من حيث وقف زحف الرمال وزيادة خصوبة التربة باعتبارها محصول بقولي (Pearce et al, 2000; Barbier, 1990). وبالتالي فإنه يعمل على إزالة الفقر وتنمية الريف والاستقرار ومحاربة الهجرة العكسية

لم تسن ضوابط أو سياسات معينة لتجارة المحصول منذ بداية تجارة الصمغ العربي بالبلاد، مما عاد بالضرر على المنتجين والمصدرين نسبةً للمضاربات المتعددة التي كانت تحدث آنذاك ومن ثم مر تسويق المحصول بعدة مراحل تتلخص في الآتي ، Karama (2000م):

(أ) إنشاء المزادات: في عام 1922م وكان الهدف الرئيسي من إنشاء هذه الأسواق (المزادات) حماية المنتج من خلال نظام التسعير عن طريق المزاد المفتوح، إلا أنها لم تكن ناجحة بسبب المضاربات الكبيرة .

(ب) نظام تركيز الأسعار: عام 1962م تم إنشاء لجنة إستشارية مكونة من وزارة التجارة والتموين والغابات وبنك السودان وكبار

المصدرين مهمتها تحديد سعر أدنى للشراء في أسواق المزادات الرئيسية وسعر أدنى للتصدير.

(ج) نظام الإمتياز وإنشاء شركة الصمغ العربي (1969م)

الصمغ العربي عبارة عن مستحلب من جذوع أغصان شجرة الهشاب (Acacia Sen-egal) وشجرة الطلح (Acacia Seyal). للصمغ مادة مركبة من الكربوهيدرات (-pol-ysaccharide) به مواد غذائية وأخرى دوائية ويعود استخدامه إلى حوالي 5000 سنة WB (2007م).

ويعتبر حزام الصمغ من الغابات الأكثر أهمية في السودان، إذ يقع الحزام داخل المنطقة القاحلة / شبه القاحلة التي تتميز بعدم انتظام هطول الأمطار وضعفها ، Mohammed، 2000 Eلفadh (2006). ويعتبر الصمغ العربي واحد من أهم المنتجات الغابية غير الخشبية، كما يعتبر واحد من أكثر الأصماغ شيوعاً (2004 ، TIC).

ويستخدم الصمغ العربي لخواصه كمثبت ومكثف ورايط وكمادة لاصقة. وتمثل المشروبات الغازية (soft drinks) والحلويات 70% من الطلب على الصمغ العربي. ويستخدم الصمغ العربي عادة كمادة مضافة تمثل جزءاً ضئيلاً من تكلفة السلعة ويعتبره مستخدموه ذا مزايا تصنيعية خاصة يصعب إيجاد بديلاً له وهذا يجعل من الطلب على الصمغ طلب غير مرن سعرياً وبذا يكون العرض هو العامل الأساسي في تحديد السعر. كما يتسم الطلب على الصمغ العربي بالازدياد (2007) WB.

وتعتبر سلعة الصمغ العربي من الصادرات الزراعية ذات المساهمة الكبيرة في الإقتصاد السوداني وهي تأتي دائماً في مقدمة سلع الصادر. وقد بلغت قيمة الصادر منه حوالي

الخارجية للصمغ حيث تم السماح للشركات المحلية بتصدير الصمغ المصنع الذي يشمل البدرة الرذاذية والبدرة الميكانيكية والحببيات. وبعد ذلك تم إصدار قرار فك الإحتكار وإلغائه مرتين ليكون فك الإحتكار في مايو 2009م.

2. المشكلة

تميز التسويق الخارجي للصمغ العربي ومنذ العام 1969م بإحتكار شركة الصمغ العربي له، ومع بداية التسعينيات من القرن الماضي تبنت حكومة السودان سياسة التحرير الإقتصادي. وفي عام 1992م تم التحرير الأول للتجارة الخارجية للصمغ حيث تم السماح للشركات المحلية بتصدير الصمغ المصنع الذي يشمل البدرة الرذاذية، البدرة الميكانيكية والحببيات (فك إحتكار جزئي أو تحرير جزئي).

وبعد ذلك ومنذ العام 1992م تم إصدار قرار فك الإحتكار وإلغائه مرتين ليكون فك إحتكار الشركة لصادر الصمغ الخام نهائياً في مايو 2009م (فك الإحتكار الكلي/ تحرير كلي). إذاً فسياسة تحرير التجارة الخارجية للصمغ العربي لا بد وأن يكون لها أثر على أداء صادر الصمغ العربي الخام. وهذا ما سوف تحاول الورقة دراسته وذلك من خلال الإجابة على الأسئلة الآتية:-

ما هو أثر التحول من سياسة الإحتكار إلى سياسات التحرير الجزئي والكلي للتسويق الخارجي للصمغ على أداء صادر الصمغ العربي؟

في حالة وجود تأثير لهذه السياسات على حجم صادر الصمغ العربي هل يعتبر هذا التغيير ذا قيمة إعتبارية؟

3. الأهداف

هدفت الدراسة بصورة أساسية إلى دراسة أثر

أدت المضاربات المتكررة في أسواق المحصول داخلياً وخارجياً إلى إفلاس العديد من المصدرين، مما حدا بالجهات المختصة التحرك العاجل لحماية المحصول من تبعات هذه المضاربات. وذلك بإنشاء كيان رقابي ينظم وينشط ويدعم التجارة العالمية للمحصول، فكان التوجه لإنشاء شركة الصمغ العربي للإرتقاء به داخلياً وخارجياً. في عام 1969م منح وزير التموين والتجارة الداخلية شركة الصمغ العربي وهي شركة عامة تأسست بموجب قانون الشركات لعام 1925م حقاً حصرياً لتصدير خام الصمغ العربي. كان الهدف الوحيد من ذلك تنظيم الصادرات وضمان الإنتاج وحماية المنتجين عن طريق سياسة سعر التركيز وحماية البيئة عبر المحافظة على الشجرة. تتدخل حكومة السودان في إدارة شركة الصمغ العربي بقوة (2000، Karama م):.

تفرض شركة الصمغ العربي سعر التركيز المعلن في المزادات المختلفة، حيث يتم شراء الصمغ عن طريق مشتريين مستقلين يقومون بنظافة وفرز وبيع صمغهم للشركة أو للمصنعين. إذا لم يتم شراء الصمغ من المنتجين أو لم يصل السعر في السوق إلى سعر التركيز في المزادات فإن الشركة تلتزم بشرائه بسعر التركيز

تحرير تجارة الصمغ العربي

ومع بداية التسعينيات من القرن الماضي تبنت حكومة السودان برامج الإصلاح الإقتصادي فتم تحرير تجارة المحاصيل الزراعية. أما بالنسبة للصمغ فقد كان هنالك تحرير للتجارة الداخلية أما التجارة الخارجية فكانت الشركة تحتكرها.

وفي عام 1992م تم التحرير الأول للتجارة

ويعتبر موضوع سياسة التحرير وأثرها على صادرات الصبغ العربي في السودان من المواضيع التي تعاني من شح في الأدبيات التي تناولتها ومن هنا تأتي أهمية هذه الورقة.

6. المنهجية

إعتمدت الورقة على البيانات الثانوية والتي تم جمعها من تقارير بنك السودان وشركة الصبغ العربي والهيئة العامة للجمارك. حيث غطت البيانات الفترة ما بين 1970-2015م.

إستخدمت الدراسة:

التحليل الإحصائي الوصفي لدراسة البيانات .
تقدير معادلات الإتجاه العام الخطية:-

$$Y_t = b_0 + b_1T$$

حيث T = الزمن = صادر الصبغ العربي
b0 = الثابت = b1 = الميل

قسمت الدراسة فترة البيانات 1970-2015م إتماداً على سياسات التجارة الخارجية المختلفة للصبغ العربي وذلك على النحو التالي:

1970-1991م فترة الإحتكار الكامل لشركة الصبغ العربي.

1993 – 2008م فترة سياسة التحرير الجزئي للتجارة الخارجية للصبغ العربي.

2010 – 2015م فترة سياسة التحرير الكلي للتجارة الخارجية للصبغ العربي.

وقد تم استبعاد السنين التي بها تداخل من التحليل وهي 1992م و2009م

إختبار Kruskal-Wallis لتقييم التغير في صادر الصبغ العربي بعد سياسة فك الإحتكار الجزئي والكلي لشركة الصبغ العربي.

تحديد الفترات التي حدث تغير ذا دلالة إحصائية في حجم صادرها وذلك بإستخدام إختبار Whitney Mann.

قياس حجم الأثر Effect Size: يعطي حجم

سياسات التجارة الخارجية للصبغ العربي على صادر الصبغ العربي خلال الفترة 1970-2015م وذلك من خلال التركيز على ثلاث فترات هي فترة الإحتكار الكلي وفترة التحرير الجزئي وفترة التحرير الكلي، وتحديداً هدفت الدراسة إلى:

تحليل الأداء العام لصادر الصبغ العربي في السودان خلال الفترة 1970-2015م.

تقييم التغير الذي حدث في صادر الصبغ العربي خلال المراحل الثلاث لسياسات التجارة الخارجية للصبغ وهي الإحتكار الكلي والتحرير الجزئي والتحرير الكلي.

تقييم أهمية التغير في حجم صادر الصبغ العربي بعد سياسة الإحتكار والتحرير الجزئي والتحرير الكلي.

4. الفرضيات

وجود تذبذب وإتجاه عام متزايد في صادر الصبغ العربي في السودان.

أدى التحرير الجزئي إلي زيادة ظاهرية ذات دلالة إحصائية وكبيرة الحجم في صادر الصبغ العربي في السودان مقارنة بفترة الإحتكار.

أدى التحرير الكلي إلي زيادة ظاهرية ذات دلالة إحصائية وكبيرة الحجم في صادر الصبغ العربي في السودان مقارنة بفترتي الإحتكار والتحرير الجزئي.

5. أهمية الدراسة

تناقش الدراسة صادر محصول الصبغ العربي وهو أحد أهم المحاصيل التي يمتلك فيها السودان ميزة نسبية تكاد تكون مطلقة فهو المُنْتَج الأول له على مستوى العالم. والصبغ العربي واحد من أهم صادرات السودان والتي يعول عليها كثيراً في توفير العملة الأجنبية والتي يعاني السودان من قلة مصادرها.

1970-2015م

يشير الرسم البياني رقم (1) إلى التذبذب في صادر الصمغ العربي في السودان خلال فترة الدراسة، ومن الجدول رقم (1) و(2) يتضح أنه لا توجد علاقة بين الزمن وأداء صادر الصمغ العربي وبالتالي يمكن الإعتماد على معامل الإختلاف (CV) كمقياس للتذبذب، وقد بلغ معامل الإختلاف حوالي 45% وهذا يعني وجود تذبذب في سلسلة إجمالي صادر الصمغ العربي في السودان خلال فترة الدراسة.

ومن الرسم البياني رقم (1) يُلاحظ بأن خط الإتجاه العام في وضع أقرب إلي الوضع الأفقي وهذا يعني ظاهرياً أنه لا يوجد إتجاه في سلسلة إجمالي صادر الصمغ العربي في السودان خلال فترة الدراسة وهذا ما تؤكدته معادلة الإتجاه العام من الجدول رقم (1) حيث أن العلاقة بين الزمن وإجمالي صادر الصمغ العربي ليست ذات دلالة إحصائية.

الأثر الدلالة العملية للفروق الإحصائية أو العلاقات بين المتغيرات، وما إذا كانت تلك الدلالة العملية كبيرة بحيث تبرر الأخذ بنتائجها، وبذلك يتميز عن الدلالة الإحصائية التي تهتم باحتمالية رفض الفرضية الصفرية من الناحية الإحصائية النظرية فقط.

في حالة استعمال الطرق اللامعلمية فإن حجم الأثر لمقارنات المتوسطات يتم وفقاً للمعادلة التالية:-

$$t = Z$$

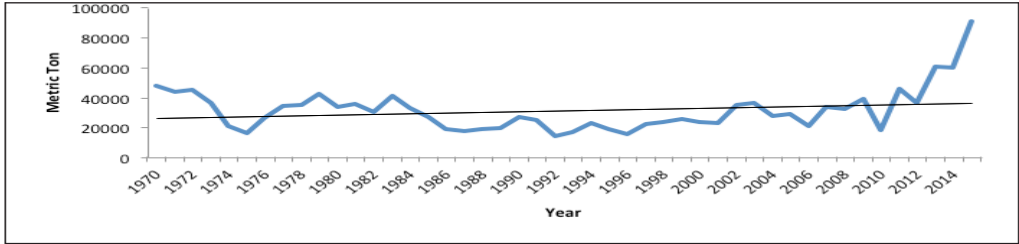
حيث:

r معامل حجم الأثر N مجموع الملاحظات للعينتين.

سستخدمت الدراسة برنامج Social Sci-ences SPSS Statistical Package for لإجراء التحليل.

7. النتائج والمناقشة

1.7 صادر الصمغ العربي خلال الفترة



الرسم البياني رقم (1): صادر الصمغ العربي في 2015م.

جدول رقم (1): مؤشرات معادلة الإتجاه العام لإجمالي صادر الصمغ العربي في السودان للفترة 1970-2015م

المصدر: بالطن المتري للفترة 1970-2015م. المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصمغ العربي، 1970-

البند	β	F	Sig	T	sig	R	Durbin Watson
إجمالي الصادر	215	1.868	179.	1.367	179.	04.	520.

المصدر: بواسطة الباحث من بيانات تقارير 2015م.

ويلاحظ من الجدول رقم (2) أن متوسط صادر

بنك السودان وشركة الصمغ العربي، 1970-

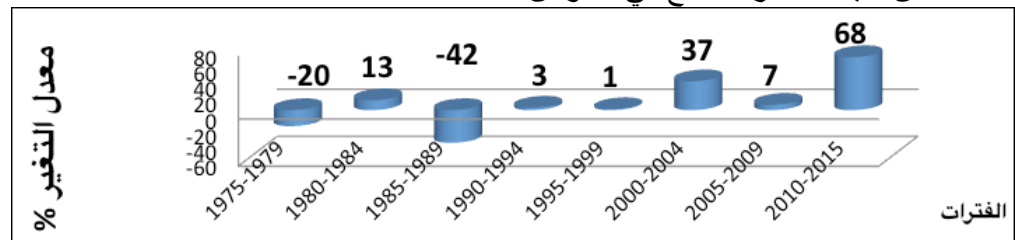
حيث تجاوز المتوسط الـ 30 ألف طن متري. الجدول رقم (3): متوسط فترات خمس سنوات لصادق الصبغ العربي في السودان خلال الفترة 1970-2015م

الفترة	القيمة (طن متري)	ملاحظات
1970-1974	38,771	
1975-1979	30,853	
1980-1984	34,732	
1985-1989	20,249	أقل متوسط
1990-1994	20,888	
1995-1999	21,152	
2000-2004	28,958	
2005-2009	38,30	
2010-2015	51,847	أعلى متوسط

المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصبغ العربي، 1970-2015م

ومن الرسم البياني رقم (2) والذي يوضح معدل التغيير في متوسط صادق الصبغ العربي للفتريات المذكورة يُلاحظ التذبذب الكبير في صادق الصبغ العربي، وقد شهدت الفترة 1999-1995م أقل معدل نمو في الصادق بلغ 1% بالمقارنة مع الفترة السابقة لها بينما شهدت الفترة 2015-2010م أعلى معدل نمو بلغ حوالي 68%.

الرسم البياني رقم (2): معدل التغيير (%) في متوسط فترات خمس سنوات لصادق الصبغ العربي في السودان خلال الفترة 1970-2015م



الصبغ العربي في السودان بلغ حوالي 31 ألف طن متري خلال فترة الدراسة وأن أعلى مستوى لصادق الصبغ العربي كان حوالي 91 ألف طن متري وذلك في عام 2015م وأدناه حوالي 14 ألف طن متري في عام 1992م. الجدول رقم (2): مؤشرات عامة لصادق الصبغ العربي في السودان للفترة 1970-2015م

المؤشر	القيمة	ملاحظات
المتوسط	(طن متري) 326,31	1970-2015م
القيمة الأعلى	(طن متري) 90,920	2015م
القيمة الأدنى	(طن متري) 14,068	1992م
الإنحراف المعياري	14286	----
معامل الإختلاف	45%	----

المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصبغ العربي، 1970-2015م.

ولمعرفة تفاصيل أداء صادق الصبغ العربي تم تقسيم الفترة 1970-2015م إلى فترات أصغر مدى كل فترة خمسة سنوات، ومن الجدول رقم (3) والذي يوضح متوسط هذه الفترات يُلاحظ أن أعلى متوسط لهذه الفترات كان حوالي 52 ألف طن متري (2015-2010م) وهي فترة سياسة التحرير الكلي وأقله 14 ألف طن (1989-1985م) وهي فترة ما بعد جفاف عام 1984م. أيضاً يُلاحظ أن متوسط الثلاث فترات الأولى (جزء من فترة الإحتكار) ومتوسط الفترتين الأخيرتين (فترة التحرير الكلي) كانت الأفضل من حيث صادق الصبغ في السودان

المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصمغ العربي، -1970م 2015م من النتائج أعلاه:-

لم تتفق نتائج الدراسة مع فرضية وجود اتجاه متصاعد لصادر الصمغ العربي في السودان خلال فترة الدراسة حيث أثبتت النتائج عدم وجود إتجاه عام لبيانات إجمالي صادر الصمغ العربي خلال فترة الدراسة.

اتفقت نتائج الدراسة مع فرضية وجود تذبذب في إجمالي صادر الصمغ العربي في السودان. اتفقت نتائج الدراسة مع فرضية وجود زيادة ظاهرية لصادر الصمغ العربي بعد تبني سياسة التحرير الكلي.

2.7 أثر سياسات تحرير التجارة الخارجية للصمغ العربي على صادراته لتقييم أثر سياسات تحرير التجارة الخارجية للصمغ العربي على الصادر منه استخدمت الدراسة اختبار التباين للفترات الثلاث للسياسات المختلفة، ولإستخدام تحليل التباين الأحادي One Way ANOVA لا بد من إستيفاء ثلاثة شروط هي:

للتوزيع الطبيعي للبيانات Normal Dis-tribution: تم أولاً اختبار التوزيع الطبيعي للبيانات. ومن الملحق رقم (1) يتضح أن بيانات صادر الصمغ العربي للفترات السياسات الثلاث موزعة توزيعاً طبيعياً.

العينات مستقلة Independent Samples: إستوفت طريقة التحليل المستخدمة هذا الشرط لأن الفترات الثلاث التي طبق عليها تحليل التباين فترات منفصلة ليس بينها أي تداخل.

تجانس التباين Equal Variance: ومن الجدول رقم (4) يُلاحظ أن قيمة اختبار تجانس التباين باستخدام معامل ليفن بلغت (9.395) لصادر الصمغ العربي وهي قيمة ذات دلالة معنوية.000) (Sig = وعليه فإن تباين المجموعات لصادر الصمغ غير متجانس. وبما أن أحد افتراضات استخدام تحليل التباين الأحادي غير متحققة في هذه البيانات فقد تم إستخدام اختبار (كروسكال واليس) وهو أحد الأساليب الإحصائية اللامعلمية التي تستخدم عندما لا تتوفر أحد افتراضات تحليل التباين الأحادي.

الجدول رقم (4): تجانس التباين لصادر الصمغ لفترات سياسات التجارة الخارجية الثلاث للصمغ العربي (1970-2015م) بواسطة إحصائية ليفن

المؤشر	قيمة ليفن	المعنوية
صادر الصمغ	9.395	0.000

المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصمغ العربي، -1970م 2015م 1.2.7 أداء صادر الصمغ العربي للفترات الثلاثة

من الرسم البياني رقم (3) والذي يوضح أداء متوسط صادر الصمغ العربي للفترات الثلاث قيد الدراسة يُلاحظ أن متوسط الصادر لفترة التحرير الكلي كان الأعلى تلتها فترة الإحتكار الكلي بينما كانت فترة التحرير الجزئي الأقل من حيث متوسط الصادر.

الرسم البياني رقم (3): أداء متوسط صادر الصمغ العربي في السودان (طن متري) لفترات السياسات المختلفة للتجارة الخارجية

للصح العربي خلال الفترة 1970-2015م

الجزئي عن متوسط فترة الإحتكار.

1.2.2.7 تقييم التغيير في صادر الصح العربي

بين الفترات الثلاث

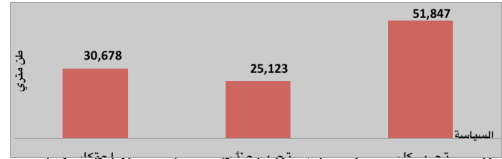
نظراً لعدم تجانس التباين، استخدمت الدراسة اختبار كروسكال واليس. ومن الجدول رقم (5) والذي يوضح نتيجة هذا الإختبار بلغت قيمة مربع كاي 8.988 (Sig. = 0.011) بمستوى دلالة معنوي إحصائياً عند 5% وبالتالي نرفض الفرضية المبدئية والتي تنص على أنه لا توجد فروق بين قيم الوسط الترتيبي لصادر الصح في السودان في ظل السياسات الثلاث للتجارة الخارجية للصح العربي. وهذا يعني وجود فروقات ذات دلالة إحصائية نتيجة لتطبيق هذه السياسات للتجارة الخارجية لصادر الصح العربي في السودان خلال الفترة 1970-2015م. الجدول رقم (5): إختبار كروسكال - واليس لصادر الصح العربي لفترات سياسات التجارة الخارجية الثلاث للصح خلال الفترة 1970-2015م.

المؤشر	القيمة	المعنوية
مربع كاي	8.988	0.011

المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصح العربي،-1970 2015م.

ونظراً لوجود فروق ذات دلالة إحصائية بين الوسط الترتيبي لصادر الصح العربي لفترات الثلاث سياسات هذه، تم إستخدام تحليل مان - وتني كتحليل لاحق وذلك لتحديد الفترة التي تختلف في قيمة وسطها إختلافاً ذا دلالة جوهرية عن بقية فترات السياسة الخارجية للصح العربي.

يتضح من الجدول رقم (6) أن تزايد صادر الصح بعد تبني سياسة التحرير الكلي بالمقارنة



المصدر: بواسطة الباحثة من بيانات تقارير بنك السودان وشركة الصح العربي،-1970 2015م.

ومن الرسم البياني رقم (4) والذي يوضح معدل التغيير في متوسط صادر الصح العربي للفترات الثلاث قيد الدراسة يُلاحظ بأن هنالك تزايد ظاهري في حجم صادرات الصح العربي تجاوز 100% عند التحول من سياسة التحرير الجزئي لسياسة التحرير الكلي، وأيضاً تزايد ظاهري في متوسط فترة التحرير الكلي بالمقارنة مع فترة الإحتكار بلغ حوالي 69%. بينما تناقص متوسط فترة التحرير الجزئي عن متوسط فترة الإحتكار بحوالي 18% فقط.

الرسم البياني رقم (4): معدل تغيير متوسط صادر الصح العربي في السودان (%) لفترات السياسات المختلفة للتجارة الخارجية للصح العربي خلال الفترة 1970-2015م.

إتفقت هذه النتيجة مع فرضية أن هنالك زيادة ظاهرية كبيرة جداً في متوسط صادر الصح العربي لفترة سياسة التحرير الكلي مقارنة بمتوسطه لفترتي سياسة الإحتكار وسياسة التحرير الجزئي. بينما لم تتفق هذه النتيجة مع فرضية أن هنالك زيادة ظاهرية كبيرة في متوسط صادر الصح العربي لفترة سياسة التحرير الجزئي مقارنة بمتوسطه لفترة سياسة الإحتكار، حيث أثبتت الدراسة أن هنالك تناقص ظاهري في متوسط فترة سياسة التحرير

سياسة الإحتكار لم يثبت أن لها أثر جوهري في إنخفاض صادر الصمغ العربي.
جدول رقم (٦): نتائج اختبار مان وتني لأجمالي صادر الصمغ العربي للفترات الثلاث خلال ١٩٧٠-٢٠١٥م.

مع سياستي الإحتكار والتحرير الجزئي كان ذا دلالة جوهريّة مما يعني أن سياسة التحرير الكلي كانت ذات تأثير إيجابي مقارنة بسياستي الإحتكار والتحرير الجزئي.
بينما تبني سياسة التحرير الجزئي بدلاً عن

ملاحظات	Sig	قيمة Z	قيمة U	الوسط الترتيبي	العدد	السياسة
غير معنوي	0.078	-1.774	116	22.23	22	الأولي
				١٥,٧٥	16	الثانية
معنوي	0.025	-2.240	26.000	12.68	22	الأولي
				21.17	6	الثالثة
معنوي	0.010	-2.507	14.000	٩,٣٨	16	الثانية
				١٧,١٧	6	الثالثة

حيث الأولي= فترة الإحتكار الثانية= فترة التحرير الجزئي الثالثة= فترة التحرير الكلي
المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصمغ العربي، 1970م-2015م.

سياسات التجارة الخارجية الثلاث على صادر الصمغ العربي خلال الفترة ١٩٧٠-٢٠١٥م.

حجم الأثر	R	السياسة
تغير متوسط الحجم	٤.0	الأولي الثالثة
تغير كبير	٥.0	الثانية الثالثة

حيث الأولي= فترة الإحتكار الثانية= فترة التحرير الجزئي الثالثة= فترة التحرير الكلي
المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصمغ العربي، 1970-2015م.

اتفقت هذه النتيجة مع فرضية أن التحول من سياسة الإحتكار وسياسة التحرير الجزئي إلي سياسة التحرير الكلي أدى إلي زيادة متوسطة الحجم وكبيرة الحجم في صادر الصمغ العربي على التوالي.

2.2.2.7 حجم الأثر Effect Size للتغيرات في صادر الصمغ العربي للفترات الثلاث
لقد أثبتت الدراسة أن التزايد في حجم صادر الصمغ العربي خلال فترة سياسة التحرير الكلي مقارنة بفترتي التحرير الجزئي والإحتكار كان ذا دلالة جوهريّة، ومن هنا كان لابد من قياس حجم هذا التغير وأهميته. ولمعرفة حجم أثر هذا التغير تم قياس معامل r والذي يستخدم لتقييم حجم الأثر، ومن الجدول رقم (7) ومن قيمة r يتضح أن قيمة حجم الأثر لصادر الصمغ بلغت حوالي 0.4 و0.5 لفترة سياسة التحرير الكلي مقارنة بفترتي الإحتكار والتحرير الجزئي على التوالي، ومن الملحق رقم (2) يتضح أن هذا الأثر يعتبر متوسط الحجم في حالة التحول من سياسة الإحتكار إلي التحرير الكلي بينما يعتبر كبير الحجم في حالة التحول من سياسة التحرير الجزئي إلي التحرير الكلي.

الجدول رقم (٧): نتائج اختبار حجم الأثر

خلاصة النتائج

وجود تذبذب في صادرات الصبغ العربي في السودان عبر الزمن.

لايوجد اتجاه عام لصادرات الصبغ العربي في السودان.

هنالك زيادة ظاهرية كبيرة جداً في متوسط صادرات الصبغ العربي خلال فترة سياسة التحرير الكلي.

هنالك أثر إيجابي ذو دلالة جوهريّة لتبني سياسة التحرير الكامل لتجارة الصبغ العربي الخارجية على صادرة مقارنة بسياسة الإحتكار وسياسة التحرير الجزئي.

لم يختلف أداء متوسط فترة التحرير الجزئي عن متوسط فترة الإحتكار.

الزيادة التي حدثت في صادرات الصبغ العربي بعد تحرير تجارته الخارجية مقارنةً بفترتي الإحتكار والتحرير الجزئي كانت كبير الحجم. أدى تحرير التجارة الخارجية للصبغ العربي إلى زيادة كبيرة في صادرة.

التوصيات

(أ) بناء مخزون استراتيجي للصبغ العربي في السودان لتقليل حجم التذبذب في إمداد السوق العالمي به.

(ب) تشجيع المحافظة على تطبيق سياسة تحرير التجارة الخارجية بجانب تطبيق سياسات إقتصادية أخرى محفزة لزيادة الصادرات

(ج) إجراء دراسات موسعة عن أداء صادرات الصبغ العربي والعوامل المؤثرة عليه على مستوى الإنتاج وعلى مستوى الإقتصاد الكلي وعلى مستوى الطلب والمنافسة العالمية.

(د) منع الإحتكارات الفردية والمضاربات الناتجة عن سياسة التحرير الكلي للتجارة

الخارجية للصبغ العربي من خلال تطبيق سياسات تنظيمية متكاملة.

(هـ) تطبيق سياسات إقتصادية محفزة تعمل على زيادة صادرات الصبغ العربي.

(و) إجراء دراسة مفصلة عن أثر سياسة التحرير للتجارة الخارجية للصبغ العربي على تركيبة صادرات الصبغ العربي من حيث مساهمة صبغ الهشاب وصبغ الطلح فيها.

(ز) إجراء دراسة مفصلة عن أثر زيادة صادرات الصبغ العربي على الإقتصاد السوداني. المراجع

Barbier, E. B. 2000. The Economic Linkages between Rural Poverty and Land Degradation: Some Evidence from Africa". Agriculture, Ecosystems and Environment, Vol. 82 Central Bank of Sudan. Annual Report for the Ending Year (2015). Khartoum, Sudan

Elfadh, M., Luukkanen, O. & Kaarakka, V. (2000). Environmental Conservation and Economic Development in the Sudan: A Case Study of Gum Arabic. Kehitystutkimus- Utvecklingsforskning: Yearbook of the Finnish Society for Development Studies 7: 117-137

Gum Arabic Company. Various Records. For the Ending Year (2008). Khartoum, Sudan

Karama, M. M. (2000). Gum Arabic Marketing Issues: Marketing Model,

TIC (2004). Pioneers of New Sources of Gum Arabic. Website: <http://www.ticgums.com/store/GumArabic.asp>
 WB (2007). Policy Note: Export Marketing of Gum Arabic from Sudan. Website http://siteresources.worldbank.org/INTAFRMDTF/Resources/Gum_Arabic_Policy_Note.pdf

الملاحق

ملحق رقم (1): التوزيع الطبيعي لصادر الصمغ العربي في السودان للفترة 1970م-2015م
 اختبار Kolmogorov-Smirnov and Shapiro-Wilk للتوزيع الطبيعي لبيانات صادر الصمغ العربي لفترات سياسة الإحتكار وسياسة التحرير الجزئي وسياسة التحرير الكلي في السودان للفترة 1970م-2015م

Buffer Stocking, Processing and Financing. International workshop on Promotion of Gum Arabic Export Processing & Marketing. Khartoum, Sudan, 2002

Macrae, J. and Merlin, G. (2002). The Prospects and Constraints of Development of Gum Arabic in Sub-Saharan Africa. A document based on the available literature and field trips to Chad, Mali and Niger. Version dated 28/10/02, Paris, October 2002

Mohamed, A. (2006). Gum Arabic Belt Potential in the Livelihood improvement of Central Sudan Dry lands. Website <http://intranet.iucn.org/web-files/ftp/public/ForumEvents/E1539/Final%20Document/FNCGumAraic-BackgroundPaperWCCSept08.doc>

Pearce, D., E. Barbier and Markandya, A. 1990. "Sustainable development: Economics and environment in the Third World", England: Edward Elgar

Tests of Normality

policy	Kolmogorov-Smirnov ^a			Shapiro-Wilk			
	Statistic	df	.Sig	Statistic	df	.Sig	
gum exports	1.00	116.	22	*200.	948.	22	282.
	2.00	157.	16	*200.	960.	16	668.
	3.00	199.	6	*200.	975.	6	927.

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance .

المصدر: بواسطة الباحث من بيانات تقارير بنك السودان وشركة الصمغ العربي 1970م-2015م.

ملحق رقم (2): حجم الأثر للاختبارات اللامعلمية r

	small size	medium size	large size
(abs(r	0.1	0.3	0.5

تأثير التسميد العضوي والكيميائي على النجيل *Eremochloa ophiuroidea* نوعي سانتبيد وباسبالم *Paspalum notataum*

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المستخلص

أجريت هذه التجربة بمزرعة كلية الزراعة جامعة ام درمان الإسلامية لدراسة أثر التسميد العضوي والكيميائي على نمو نبات النجيلية نوعي سانتبيد *Eremochloa ophiuroidea* وباسبالم *Paspalum notataum*، وقد تمت إضافة السماد العضوي (دواجن، أبقار) بمعدل 480 جرام/حوض (352) م، والسماد الكيميائي (اليوريا) بمعدل 200 جرام / حوض (352) م، وذلك باستخدام تصميم القطاعات العشوائية الكاملة متعددة العوامل في ثلاثة مكررات وتمت دراسية طول الساق وقطر الساق وطول الساق الجارية. أوضحت النتائج أن التسميد بالأسمدة العضوية (الدواجن، الأبقار) مقارنة بالسماد الكيميائي (اليوريا) لم يكن له أثر معنوي على مواصفات النمو عند مستوى معنوية 5%، أما الأصناف فقد كان لها تأثير معنوي على طول القياس في الأسبوعين الرابع والسادس، أما طول الساق الجارية فقد تأثر معنوياً بالأصناف في الأسبوع الرابع والسادس والثامن. كما أدت إضافة السماد العضوي إلى زيادة تحسين خواص التربة الفيزيائية، وتقليل ملوحة التربة وخفض الرقم الهيدروجيني (PH) لها مقارنة مع السماد الكيميائي (اليوريا).

الكلمات المفتاحية: التسميد العضوي، التسميد الكيميائي، نبات النجيلية

Abstract

This experiment was carried out in the farm of faculty of Agriculture – Omdurman Islamic University to study the effect of organic and chemical fertilization on the growth of two types of the sailing plant (*Eremochloa ophiuroidea*) and (*Paspalum notatum*). Organic manure (poultry- cows) has been added at a rate of 480 g/ basin (35)m², and chemical fertilizer (urea) at a rate of 200g /basin (35)m², using the design of multi- factor randomized complete sectors in three replications were studied stem length and stem diameter and length of the ongoing leg. The results showed that composting organic manure (poultry- cows) compared to chemical fertilizer (urea) had no significant effect on growth specification in the significant level of 5% , while the varieties have had a significant effect on the measurement along in two weeks (fourth and sixth), and the length of ongoing leg was mentally affected by the items in the fourth week, the sixth, and eighth, also resulted in adding organic manure to further improve in the physical properties of the soil, reduce soil salinity and lower soil (PH) by comparing with chemical fertilizer (urea).

Key words: organic fertilizer, chemical fertilizer, sailing plant

المقدمة:

في ملاعب الخماسيات بالنجيل الطبيعي، وذلك لما للنجيل من أثر في الترويج على الرياضيين ، وذلك نسبة لإرتفاع الأكسجين في النجيل الطبيعي وترطيب الملاعب وقلة الإنزلاق وتقليل إصابات اللاعبين والتي يتعرضون لها في النجائل الصناعية (American Lawn, 1997-2003).

البحوث والدراسات السابقة:

المسطلحات الخضراء عبارة عن مساحة مغطاة بطبقة من النجيل التي تكسبها اللون الأخضر الزاهي، كما عرفت نباتات النجيل النجيل على أنها نباتات عشبية صغيرة وقصيرة تنمو بجانب بعضها وبكثافة لتغطي كل الأرض التي تنمو عليها بسمك قد يصل الي حوالي 15 سم ومعظم هذه النباتات من العائلة للنجيلية (Han-son, 1981).

السانتينيدي *Eremochloa* (Munro) Hack ، *ophiuroida* والإسم العربي هو العشب الصيني (عديد الأرجل) ، أما الإسم الإنجليزي هو Centipedegrass ومن أهم الأصناف التابعة له هو الصنف الوحيد Oklawn وهو من نباتات المناطق الدافئة مدارية الأصل من جنوب الصين وشرقي آسيا، كما أنه متوسط الكثافة والإخضرار وخشن القوام وهو بطئ النمو ومعمر ويمكنه التأقلم مع التربة قليلة الخصوبة، والنوع الثاني الباسبالم *Paspalum notataum* من الأنواع الملائمة للجو الحار الموجود في السودان خصوصاً منطقة ولاية الخرطوم، وقد تم استجلابها من البرازيل للولايات المتحدة الأمريكية عام 1971م. ومن أهم مميزاتها أنها تحتاج لكميات قليلة من التسميد والرري (15-12 ملم) يومياً (الزغت،

في هذه الدراسة استخدم نوعين من النجائل وهما السانتينيدي *Eremochloa ophiuroidea* والباسبالم *Paspalum notataum* وعلى الرغم من أن العناية بالنجائل المكونة للمسطحات الخضراء ليس صعباً وغير مكلف إلا أن هذه الأنواع من النباتات حساسة ويجب إدراك ما يطرأ عليها من تغيرات، وهي من أكثر النباتات احتياجاً للعناصر الغذائية في مراحل نماتها وخاصة الأولية، وقد نبعت مشكلة البحث في أن الإستخدام الأمثل للنجيلية يجب أن يتبع بعدد من الخدمات خاصة بعد الزراعة ومن أهمها التسميد حيث تظهر بعض الأعراض المصاحبة لنقص العناصر الغذائية التي من وجود البقع الميتة على النجيلية وتحوله إلى لون باهت أو مصفر، أو وجود الحشائش المتطفلة، وقد اعتمد بعض أصحاب الحدائق وفتيها في تسميد النجيلية على الأسمدة الكيميائية مثل اليوريا واليوبرفوسفات إلا أن عدم توازن الجرعة من الأسمدة المضافة وعدم إضافتها بالطريقة الموصى بها زاد من أهمية الدراسة في كيفية استبدال الأسمدة الكيميائية بأسمدة عضوية.

لذا فإن هذه الدراسة هدفت إلى إمكانية استبدال الأسمدة الكيميائية والتي تسبب أضراراً بالغة لمرتادي الأماكن العامة وأضرار على البيئة والنبات معاً، أيضاً تتسبب بأضرار اقتصادية، وذلك لكلفتها العالية مقارنة بالأسمدة العضوية المخمرة، حيث تتميز بعدم وجود روائح نفاذة مما يتيح لنا استخدامها على النجيلية في أي وقت دون الإضرار بالبيئة، كما أن التكلفة منخفضة والمواد الخام متوفرة. من الأهداف المهمة لهذه الدراسة أيضاً إمكانية استبدال النجيل الصناعي

1990م).

في ملاعب بالجهة الجنوبية للكلية، وهما عبارة عن ملعبين مساحة كل واحد 600 متر مربع ، والمساحة الكلية قدرها 1200 متر مربع، كما تم تقسيم كل ملعب إلى 12 حوض حيث تبلغ مساحة الحوض الواحد (35 متر مربع) بأبعاد (7×5) متر، تم إضافة 4 معاملات هي كنترول(شاهد) وإضافة سماد اليوريا بنسبة 200جرام/حوض وإضافة سماد الدواجن بنسبة 480 جرام/حوض وإضافة سماد الأبقار بنسبة 480جرام /حوض باستخدام تصميم القطاعات العشوائية الكاملة متعددة العوامل وكررت كل معاملة ثلاث مرات وأخذت أربعة قراءات في أربعة تواريخ مختلفة حيث أجريت على الصنفين من نبات النجيلة السانتبيد والباسبالم.

تمت تسوية الملعبين يدوياً وآلياً مع الإستعانة بالمتري وميزان المياه لعمل التسوية ، وتم فصل كل حوض عن الآخر بمربعات بلاط مساحة الواحدة منها 20سم² ، كما تم عمل تقانن بالرمال للتأكد من عدم تسرب الماء بين الأحواض ، وتم تسوير الملاعب المكونة للأحواض بغرض الحماية.

تم استجلاب الشتول من مزرعة في جبل أولياء لإنتاج السانتبيد والباسبالم حيث كان عمرها شهرين من تاريخ الزراعة في أماكن إنتاجها، وتم زراعتها في التجربة بمعدل 15 كيس للمتر المربع وزرعت في حفر المسافة بين الحفرة والأخرى 20 سم ، وتمت العمليات الفنية من ري وتسميد بطريقة متساوية لكل الاحواض بانواعها.

تم قياس طول النجيلة من سطح الأرض وحتى آخر ورقة أعلى النبات وذلك كل 15 يوم من تاريخ الزراعة باستخدام متر القياس وذلك باخذ ثلاث عينات عشوائية ثم حساب المتوسط

عرف السماد بأنه هو أي مادة تمد النبات بواحد أو أكثر من العناصر المعدنية الضرورية لنموه والتي تعرف بالعناصر الغذائية النباتية (برهان وهجة، 2000م) ومن أهم العناصر الغذائية المكونة للأسمدة الكيميائية المضافة للمساحات الخضراء هو النتروجين، ويُعد الهواء الجوي المصدر الأصلي للنتروجيت حيث تعلق مساحة فدان واحد من الأرض طبقة من النتروجين تصل (35) ألف طن، لكن تقتصر الاستفادة من النتروجين على كائنات معينة، أما بقية الكائنات فتستخدم النتروجين في صورة مركبات عضوية أو معدنية ، وتتكون أغلب الأسمدة النتروجينية من الأمونيا الصناعية ورمزها NH3 (بليغ، 1988م).

أما الفسفور تختلف نسبة الأراضي في محتواها منه تبعاً لعدة عوامل من أهمها درجة الحرارة ومادة الأصل، وتتراوح نسبة الفسفور في الأرض بين (0.1-0.5%) ، وللفسفور عدة مصادر من أهمها المصادر المعدنية ومن الأسمدة الكيميائية الشائعة الاستخدام والتي تحتوي على الفسفور هو سوبر فوسفات أحادي(بليغ، 1988م).

بالنسبة لتأثير السماد النتروجيني والفوسفاتي على طول النبات يعتبر من المعايير المهمة للنمو، لذلك فقد تناوله عدد من الباحثين حيث أوضح كل من (Gasim, 2001, Rai, 1965, Mohamed et.al , Koul. 1997, Sai-gusa et.al) أن إضافة السماد النتروجيني والفوسفاتي أدت إلى زيادة في طول النبات.

طرق ومواد البحث (Material and Methods):
تم إجراء التجربة في كلية الزراعة بجامعة أم درمان الإسلامية بالمدينة الجامعية بالفتحاح

أدت إلى تفوق نجيلية سانتبيد *Eremochloa ophiuroidea* على الباسبالم في الطول وذلك كما ذكر (الزغت، 1990م) أن طبيعة نمو الباسبالم *Paspalum notatum* مقترشة ، أما السانتبيد *Eremochloa ophiuroidea* فتموها يكون طويلاً ، كما أن زيادة طول النجيلية يعزى إلى زيادة النشاط المرستيمي فيزداد طول سلاميات النبات وهذا يتوافق مع ما توصل إليه (Harma, 1972) وذلك بوجود علاقة إيجابية قوية بين العوامل الوراثية وعدد العقد ويقترح بأنها المكون الرئيسي لطول النبات (جدول 1). أثر التسميد العضوي والكيميائي على زيادة طول النبات (سم):

بالنسبة للسماد فقد بلغ أعلى متوسط للزيادة في طول النبات في الأسبوع الثامن لليوريا 16.83 سم أما أقل متوسط لطول النبات، فكان في الأسبوع الرابع للشاهد 10.21 سم مقارنة مع بقية المعاملات الأخرى. على الرغم من عدم وجود فروق معنوية بين أنواع الأسمدة المختلفة إلا أن سماد الدواجن في الأسبوعين الرابع والسادس سجل أعلى متوسط لإرتفاع النباتات (11.53 و 14.65 سم، على التوالي). وقد يعزى ذلك إلى تأثير العناصر النيتروجينية الموجودة في سماد الدواجن، حيث إنها تساعد على نمو النبات من خلال أثره على عدد الخلايا وسرعة انقسامها كما ذكر (Double, 1994) ولم تتأثر زيادة طول نباتات النجيلية معنوياً بأنواع السماد المختلفة (شاهد، دواجن، أبقار واليوريا) لكل فترات القراءة (الأسابيع 4، 6، 8). كذلك فإن التفاعل بين الأنواع والسماد لم يؤثر على ارتفاع النبات في الأسبوعين الرابع والسادس ، بينما أثر معنوياً ($P < 0.05$) على هذه الصفحة الأسبوع الثامن (جدول 2).

للحوض الواحد كذلك تم قياس قطر النجيلية بواسطة الخيط من البداية وحتى نهاية الحزمة النباتية للنجيلية ، ثم قياس طول الخيط بالمتر وأخذت ثلاث عينات عشوائية لحساب متوسط القطر الواحد في الحوض.

وتم أيضاً قياس الساق الجارية من بداية العقدة النجيلية وحتى النهاية بواسطة المتر ، وأخذت ثلاث عينات عشوائية لحساب متوسط الساق الجارية الواحدة للنجيلية في كل حوض.

تم تحليل البيانات إحصائياً إحصائياً باستخدام تحليل التباين Analysis variance بتصميم القطاعات العشوائية الكاملة متعددة العوامل لحساب الخطأ المعياري Standard error وبيان مستوى تأثير كل معاملة غير مستوى معنوية $P = 0.05$ level .

النتائج والمناقشة Results and Discussion:

أثر الأنواع والتسميد العضوي والكيميائي على زيادة طول النبات (سم):

أثر الأنواع على زيادة طول النباتات (سم): بلغ أعلى متوسط لطول النبات في الأسبوع الثامن للسانتبيد 16.36 سم مقارنة بالباسبالم 13.86 سم. أما أقل متوسط فكان للسانتبيد في الأسبوع الرابع 10.33 سم، وفي الأسبوع السادس سجل النوع باسبالم أعلى متوسط لزيادة طول النبات 15.53 سم مقارنة بالنوع سانتبيد 11.33 سم. لذلك أثر نوع النجيلية سانتبيد *Eremochloa ophiuroidea* تأثيراً معنوياً على النباتات في الأسبوع السادس وتأثيراً معنوياً في الأسبوع الثامن ($P < 0.05$) ، بينما لم تتأثر هذه الصفة بالأنواع في الأسبوع الرابع. وربما يعزى الأثر المعنوي لهذا النوع في زيادة طول النبات إلى عوامل وراثية

جدول (١): أثر الأنواع على زيادة طول النبات (سم):

طول النبات(سم)			الأنواع
الأسبوع الثامن	الأسبوع السادس	الأسبوع الرابع	
13.86	15.53	11.69	(V1) باسبالم
16.36	11.33	10.33	(V2) سانتبيد
3.80	2.55	1.40	LSD

جدول (٢): أثر التسميد العضوي والكيميائي على زيادة طول النبات (سم):

طول النبات(سم)			السماذ
الأسبوع الثامن	الأسبوع السادس	الأسبوع الرابع	
15.78	13.47	10.21	الشاهد
15.22	14.65	11.53	الدواجن
12.61	13.35	10.86	الأبقار
16.83	12.25	11.43	اليوريا
5.38	3.32	1.98	LSD

أثر التسميد العضوي والكيميائي على قطر النبات (سم):

أما بالنسبة للسماذ والتفاعل بين الأنواع والسماذ فعلى الرغم من عدم وجود فروق معنوية بين أنواع السماذ المختلفة على قطر النباتات إلا أن معاملة الشاهد في الأسبوعين الرابع والسادس سجلت أعلى متوسط لهذه الصفة 22.65 و 29.03 سم مقارنة بالمعاملت الأخرى، بينما سجلت معاملة الأبقار في الأسبوع الثامن أعلى متوسط لهذه الصفة (26.50 سم) (جدول 4). لم يتأثر قطر نباتات النجيلية معنوياً بهاتين المتغيرين بكل فترات القراءات في الأسابيع الرابع، السادس والثامن. وقد يعزى ذلك إلى عدم سرعة تحلل الأسمدة

تأخذ الأنواع *Paspalum* و *Eremochloa ophiuroidea* سجل أعلى متوسط لقطر النبات في الأسبوع الرابع والسادس 24.69 و 30.69 سم ، على التوالي، مقارنة بالنوع سانتبيد *Eremochloa ophiuroidea* 19.55 و 22.44 سم، على التوالي. بينما كان أقل متوسط لقطر النجيلية في السانتبيد *Eremochloa ophiuroidea* في الأسبوع الرابع 19.69 سم. وقد أثرت الانواع على قطر نباتات النجيلية في الأسبوعين الرابع والسادس تأثيراً معنوياً بينما لم تؤثر الأنواع على هذه الصفة في الأسبوع الثامن (جدول 3). وقد يعزى الأثر المعنوي للأنواع على قطر النبات إلى زيادة المجموع الخضري وافتراش النجيلية كما ذكر (الزغت، 1990م).

الخلايا ويؤدي إلى تحسين معنوي في جوهر النبات وشكله مما يزيد من المجموع الخضري ويزيد من قطر النبات كما أشار (عبد الجواد وآخرون، 1989م).

للعضوية في التربة وذلك حسب ما ذكره (Du-ble, 1994) بأن الأسمدة العضوية تأخذ فترة ما بين 4-6 أسابيع حتى تكون العناصر المكونة لها متاحة للإستهلاك من قبل النبات. كما أن عناصر النيتروجين تؤدي إلى زيادة انقسام

جدول (٣): أثر الأنواع على قطر

النبات (سم):

القطر (سم)			الأنواع
الأسبوع الثامن	الأسبوع السادس	الأسبوع الرابع	
23.71	30.69	24.690	(V1) باسبالم
23.53	22.44	19.52	(V2) سانتبيد
4.49	5.44	2.96	LSD

جدول (٤): أثر التسميد العضوي والكيميائي على قطر النبات (سم):

طول النبات (سم)			السماد
الأسبوع الثامن	الأسبوع السادس	الأسبوع الرابع	
23.50	29.02	22.65	الشاهد
21.92	25.97	21.31	الدواجن
26.50	24.92	21.31	الأبقار
22.55	26.35	22.55	اليوريا
6.35	7.69	4.19	LSD

أثر الأنواع على طول الساق الجارية (سم):

سجل نوع *Eremochloa ophiuroidea* أعلى متوسط لطول الساق الجارية (25.18 و 29.40 سم، على التوالي) مقارنة بالنوع *Paspalum notataum* (5.00 و 14.1 سم) على التوالي، كما في (جدول 5). تأثر طول الساق الجارية بالأنواع تأثيراً معنوياً في الأسابيع (الرابع، السادس)، بينما لم تؤثر الأنواع على هذه الصفة في الأسبوع الثامن، وقد يعزى ذلك إلى زيادة معدل انقسام الخلايا وبالتالي افتراضها، كما أشار (الزغت، 1990م).

سجل التفاعل سانتبيد *Eremochloa ophiuroidea* في الشاهد وكذلك سانتبيد في الدواجن أعلى متوسط لطول الساق الجارية (31.43 و

29.63 سم، على التوالي)، بينما سجل التفاعل عند مستوى معنوية 5% (جدول 7).
 باسبالم *Paspalum notataum* في الشاهد
 أقل متوسط 9.77 سم لهذه الصفة وقد كان الأثر
 جدول (5): أثر الأنواع على طول الساق

الجارية للنبات (سم):

طول الساق الجارية للنبات (سم)			الأنواع
الأسبوع الثامن	الأسبوع السادس	الأسبوع الرابع	
25.00	25.69	14.15	(V1) باسبالم
29.40	13.91	25.18	(V2) سانتبيد
4.26	3.23	3.03	LSD

جدول (6): أثر التسميد العضوي والكيميائي على طول الساق الجارية للنبات (سم):

طول النبات (سم)			السماذ
الأسبوع الثامن	الأسبوع السادس	الأسبوع الرابع	
30.75	19.22	20.60	الشاهد
23.53	19.94	20.87	الدواجن
27.27	18.88	19.27	الأبقار
27.25	21.16	17.90	اليوريا
6.03	4.57	4.29	LSD

جدول (7): أثر الأنواع ، السماذ والتفاعل بينهما على طول الساق الجارية للنبات:

متوسط الأصناف	الاسبوع الرابع				الأنواع
	اليوريا	الأبقار	الدواجن	الشاهد	
14.15	17.94	16.78	12.11	9.77	باسبالم
25.18	17.86	21.77	29.63	31.43	سانتبيد
-	17.90	19.27	20.87	20.60	متوسط السماذ

0.49	LSD	الأنواع
0.69	LSD	السماذ
0.98	LSD	التفاعل

المراجع:

lodes) (L.)(press) and Velvetleaf (Abutilon avicennae Grath) growing in adentcorn field for winter feeding for cottle Tohku. Journal .Crop Science. Japan 42, 43, -44
 Mohamed, M.I. Noor, M.A. Alio, A .N.(1987). The influence of the level of nitrogen fertilizer and spacing .on maize in Somalia. Field Crops
 Rai, K.D. (1965). Study of rain grown sorghum and maize in Central rain land of Sudan. II. Effect of fertilizer on crude protein content and nitrogen accumulation.I. .Agron. 10:139-144

أولاً: المراجع العربية
 الزغت، معين فهد، فهد بن عبد العزيز المانع وفيصل محمد سعداوي(1990م)، المسطحات الخضراء ، الطبعة الأولى - مطابع جامعة الملك سعود.
 برهان، حامد عثمان وهجو تاج الدين الشيخ موسى(2000م)، أساسيات إنتاج المحاصيل ، كتاب نماذج من السودان، كلية الزراعة جامعة الخرطوم ؟، مطبعة جامعة الخرطوم الطبعة الأولى ، ص117-125.
 بلبع، عبد المنعم(1988م)، خصوبة الأراضي والتسميد دار المطبوعات الجديدة.
 عبد الجواد ، عبدالحفيظ أحمد، نعمت عبد العزيز نور الدين وطاهر بهجت فايد(1998م)، مقدمة في علم المحاصيل أساسيات الإنتاج، الدار العربية للنشر والتوزيع، القاهرة.

ثانياً: المراجع الإنجليزية

Gasim, S. H. (2001). Effect of nitrogen , phosphorus and seedrate on growth, yield and quality of forage (.maize (zeamays L
 Hanson, A.A. and Juska, F.V.(1981) Turfgrass Science . Am .Soc. of AgronomyInc. Madison, Wisconsin, USA
 Koul, B.G. (1997) Effect of Sowing methods, nitrogen level and seed rate on yield and quality fod- .(der maize (Zee maysl
 Saiqusa- M, Kusagaya- Y: Watanabe and Shibuyak.(1999). Ecology of apple of Peru(Nicandra physa-

الهاتف النقال وأثره في التغيير الاجتماعي لمجتمع الإناث (دراسة حالة طالبات جامعة أم درمان الإسلامية - كلية الزراعة)

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المستخلص

للهااتف النقال مسميات كثيرة مثل المحمول أو الجوال أو الخليوي، ويعتبر من الهوااتف الإلكترونية الحديثة التي ظهرت في الأونة الأخيرة وهو شكل من أشكال أدوات الإتصال الذي يعتمد على الإتصال اللاسلكي عن طريق شبكة من أبراج البث الموزعة ضمن مساحة معينة. وهو من أدوات الإتصال المهمة التي ساعدت في عملية التقدم والتطور، وتساعد كثيراً من الأفراد وتوفر لهم الوقت والجهد وتقريب المسافات وتقلل لهم تكاليف الترحيل. لذا اصبح الهااتف النقال جزءاً مهماً في حياتنا اليومية، كما يعد من أخطر الأدوات التدميرية للمجتمع إذا ما أسئ استخدامه، لما يحتويه من تقنية حديثة، هدفت الدراسة إلى توضيح الأثر الاجتماعي والاقتصادي لإستعمال الهااتف النقال على شريحة الشباب من الإناث (طالبات كلية الزراعة جامعة ام درمان الإسلامية)، وكذلك التعرف على أثره على مجتمع الإناث وما أحدثه من تقدم وتطور، بإعتباره أحد وسائل الاتصال الحديثة، افترضت الدراسة أن بيانات العملاء الغير مكتملة في سجلات شركات الاتصال يؤدي إلى كثير من المشاكل الاجتماعية، وإن الاستخدام السئ للهوااتف ساعد في بث الأخبار والصور والفيديوهات الفاضحة وبث الشائعات وسط المجتمع. توصلت الدراسة إلى أن جميع المبحوثات يحملن هاتف نقال، وأكثر الماركات المستخدمة هي من الأجهزة الذكية ذات التقنية العالية، أوصت الدراسة بأن على شركات الاتصال حث الناس وتوعيتهم بضرورة تسجيل البيانات كاملة ، ضرورة وجود توعية للشباب بكيفية الإستخدام الأمثل للهاتف النقال ، وعدم نشر الصور والفيديوهات الفاضحة وهذا ما يؤدي الي هتك الاعراض ويولد الفتن بين الناس.

Mobile phone and its impact on the social change of the female community
(A case study of girl students of Omdurman Islamic University-faculty of agriculture)

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Abstract

Mobile telephones have lots of Arabic names like Eljawal, Elmehmool, Elkhalawi. The recently developed mobile phones are means of wireless communication that operate through sets of disseminators which are distributed according to measured distances on the target area. Mobiles helped a lot in all aspects of development, server time and effect in addition to shortening distances and reducing costs of transportation. Never the less mobile phone could be very destructive if miss-used. The study aims to describe the influence of mobile phones on youth female stratum using the population of female students at the faculty of agriculture of Omdurman Islamic University. The study assumes that customer's uncompleted record information leads to lots of social problems and complications. Also that the irresponsible and miss-uses of mobile telephones helped to disseminating bad news and rumors among members of society. It was found that all members of the sample have smart mobile telephones. The study recommends that members of society specially the youth be motivated and encouraged to record their personal information. Also those advisory sessions directed to the youths concerning appropriate and proper use of mobiles should be held and guiding pamphlets should be distributed

Key words: Mobile telephones, social change

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المقدمة:

أبناء الشرق الأوسط.

وسوف تكشف لنا هذه الدراسة أثر الهاتف النقال في التغيير الاجتماعي لمجتمع طالبات جامعة أم درمان الإسلامية - كلية الزراعة، وتأتي أهمية الدراسة في أنها قد تشكل نقطة انطلاق ولفت نظر المختصين في هذا المجال من إيلاء الهاتف النقال واستخداماته الاهتمام الكافي حيث أنه أصبح جزءاً هاماً في حياتنا اليومية ، فالبرغم من فوائده العديدة إلا أنه يعتبر من أخطر الأدوات التدميرية للأخلاق خاصة وسط شريحة الشباب والمراهقين خاصة إذا ما أسئ استخدامه، ويشكل أداة متطورة لعرض وبث المادة الإباحية والإشاعات الضارة لمختلف شرائح المجتمع.

أهداف الدراسة:

تهدف هذه الدراسة إلى الآتي:

معرفة الأثر الاجتماعي والاقتصادي لاستعمال الهاتف النقال على شريحة الشباب من الإناث. معرفة أثر الهاتف النقال في مجتمع الإناث وما أحدثه من تقدم وتطور بإعتباره أحد وسائل الإتصال الحديثة. التعرف على الهاتف النقال كوسيلة إتصال وتقنية جديدة.

دراسة وتحليل الأسباب المختلفة التي أدت إلى إنتشار الهاتف النقال والتعرف على إيجابياته وسلبياته.

دراسة أثر الهاتف النقال ومعرفة مدى أهميته في التغيير الاجتماعي لمجتمع الإناث.

دراسة أثر استعمال الهاتف النقال في توطيد العلاقات الاجتماعية وتقريب المسافات وتوفير الوقت والجهد والمال.

دراسة مدى التأثير الاجتماعي سلباً أو إيجاباً الذي يحدثه استخدام الهاتف النقال في مختلف

تلعب الهواتف دوراً مهماً في حياتنا نستخدمها طوال اليوم في الاتصال بالآخرين ومتابعة الأعمال وتبادل المعلومات لقد أصبحت الهواتف الجوال الآن جزءاً لا يتجزأ من ضرورات الحياة اليومية، كذلك هي من أدوات الاتصال المهمة التي ساعدت في عملية التقدم والتطور، كما تقوم بمساعدة كثير من الأفراد وتوفر لهم الوقت والجهد، إلا أن هناك العديد من المسؤوليات الكبيرة الملقاة على عاتق مستخدمي هذا النوع من الهواتف فضلاً عن الكثير من الاعتبارات الخاصة بالسلامة التي يجب طرحها على بساط البحث.

للهااتف النقال مسميات كثيرة مثل المحمول والجوال أو الخليوي ويعتبر من الهواتف الإلكترونية الحديثة التي ظهرت في الأونة الأخيرة وهو جهاز اتصال بين الناس يوطد العلاقات بينهم ويقرب المسافات بين الأصدقاء وأفراد العائلة الذين فرقت بينهم المسافات. فيكون جهاز الهاتف واستخداماته هو الوسيلة الوحيدة لهم للإطمئنان على بعضهم البعض لإكمال صلة الرحم والإيفاء بالواجبات الاجتماعية.

تأتي أهمية الهاتف النقال بشكل واضح في حياتنا التي نعيشها إذ أنها تشكل أهمية كبرى في تغيير المجتمعات وتطورها وخاصة المجتمع السوداني نسبة لإنتشارها وتوفرها بنسبة عالية لدى كثير من الأفراد.

كشفت تقرير الإتحاد الأوروبي للإتصالات عن توقعات بأن يبلغ عدد المشتركين في الخدمة واسعة النطاق للهاتف النقال إلى 7 مليارات مشترك على إمتداد العالم على خلفية الزيادة بوتيرة سريعة في الدول النامية بحسب وكالة

شرائح مجتمع الإناث.

مشكلة الدراسة:

لقد أدت التكنولوجيا المتعددة والحديثة في المعلومات وفي الاتصالات الى طفرة كبيرة في الحياة الاجتماعية والاقتصادية والثقافية للمجتمع وبالأخص مجتمعنا السوداني الذي أدت به الثورة والنقلة السريعة في المعلومات وفي الاتصالات مع عدم تهيئة المجتمع واستعداده للتعامل مع هذه المتغيرات السريعة والمتتالية، أدت إلى فتح الباب لحدوث مشكلات اجتماعية وانحرافات أخلاقية جديدة وخطيرة في مجال تقنية المعلومات وصفت بالجرائم وذلك بسبب أضرارها الكبيرة على الفرد والمجتمع، ونتيجة لما لها من دور كبير في التأثير على اتجاهات الناس وقيمهم وأخلاقهم وسلوكياتهم ومختلف أنماط عيشهم. وتتخلص مشكلة هذا البحث في السؤال المحوري التالي:

هل للهاتف النقال أثر في التغيير الاجتماعي لمجتمع الإناث؟
وتتفرع منه الأسئلة الآتية:

ما هو الهاتف النقال؟

ما هو الأثر الاجتماعي والاقتصادي لاستعمال الهاتف النقال على شريحة الشباب من الإناث؟
ما هو أثر وأهمية الهاتف النقال في التغيير الاجتماعي لمجتمع الإناث؟

ما هو أثر استعمال الهاتف النقال في توطيد العلاقات الاجتماعية وتقريب المسافات وتوفير الوقت والجهد والمال؟

فروض الدراسة:

يقوم البحث على عدد من الفروض التي تختص بالهاتف النقال:

بيانات العملاء غير المكتملة في سجلات شركات الإتصال يؤدي إلى كثير من المشاكل

الاجتماعية.

سهولة الحصول على الشريحة وانتشارها بدون ضوابط يؤدي إلى ارتكاب جرائم دون الوصول إلى مرتكبيها.

الإستخدام السيئ للهواتف ساعد في بث الأخبار والصور والفيديوهات الفاضحة ويث الشائعات وسط المجتمع.

أسعار الخدمات المقدمة عن طريق الهاتف النقال تشكل عبئاً اقتصادياً على أرباب الأسر.

حدود الدراسة:

الحدود المكانية: جامعة أم درمان الإسلامية ، طالبات كلية الزراعة ، الدفعات 25-21.

الحدود الزمانية: 2015م

منهج الدراسة:

تشتمل منهجية الدراسة على الطرق البحثية التالية: المنهج التاريخي، المنهج الوصفي الإحصائي. استخدم الاستبيان كمصدر أولي للبيانات، والمراجع العلمية والكتب والمجلات والأنترنت كمصادر ثانوية.

مفهوم الهاتف النقال والاتصالات:

للهاتف العديد من التعريفات منها:

الهاتف هو أحد أشكال الاتصال والتي تعتمد على الاتصال اللاسلكي عن طريق شبكة من أبراج البث الموزعة ضمن مساحات معينة(1).
الهاتف المحمول هو أداة اتصال لاسلكية تعمل خلال شبكة من أبراج البث موزعة لتغطي مساحة معينة ثم تترابط عبر خطوط ثابتة أو أقمار صناعية"(2).

ويعرف الاتصال بأنه: " العملية التي يتم من خلالها نقل رسائل معينة من مرسل إلى مستقبل(3). والاتصال " عبارة عن طريق إقناعي بحث الآخرين على تفسير

أقل تكلفة من إجراء المكالمات، كما أنها توفر المعرفة للشخص بأمر ما إذا لم يكن بوسعه الرد على المكالمة في وقت انشغاله .
بوسع الشخص استخدام الهاتف المحمول ككاميرا للتصوير

هناك بعض الهواتف التي تتصل بالشبكة البينية (الإنترنت) ويتم تصفح مواقع الشبكة عن طريقها، وقراءة البريد الإلكتروني بالمثل . كما توجد به اللعبة وآلة حاسبة ونتيجة تقويم ، وغيرها من الخواص الأخرى، فكلما ازدادت إمكانات الهاتف .. كلما ارتفع ثمنه بالمثل .(2)
إيجابيات الهاتف النقال الاجتماعية والاقتصادية لا شك أن الهاتف النقال كان نتيجة قفزة نوعية علمية تقنية وصار وسيلة ضرورية في عالم اليوم واصبح في متناول كل من يقدر على دفع تكاليفه من الملياردير في نيويورك أو سويسرا إلى البدو في الصحراء وهو يولد الشعور بالثقة لدى حامله على التواصل وهو يتسم أيضاً بالمرونة الشديدة في استعماله ، وإمكان نقل الرسالة المسجلة إلى حيث يوجد الإنسان مع توفر إمكانية الإستغناء عن الهاتف الثابت ، كما يؤمن الهاتف النقال سهولة التواصل الاجتماعي في كل الأوقات ، حيث أصبح مريحاً جداً للشركات المنتجة وكذلك الشركات صاحبة الإمتيازات في إحتكار تسويقه وتقديم الخدمات فقد حققت كل الشركات المنتجة أرباحاً خيالية في فترة زمنية قصيرة(1) . ولا ريب أن الجوال نعمة كبيرة يقضي بها الإنسان حاجاته بأقرب طريق وأقل كلفة ولكن هناك أمور تنافي شكر هذه النعمة وهناك ملحوظات يحسن التنبيه لها والتنبيه عليها حتى تتم الفائدة المرجوة من هذه النعمة(1).

الأفكار المرتبطة بالطريقة المقصودة لدى المتحدث"(4).

أهمية الاتصال الهاتفي؛

زادت أهمية الاتصالات في السنوات الأخيرة كوسيلة أساسية لنقل المعلومات وربط المنازل وأماكن العمل بالشبكة الإلكترونية المركزية ، وقد تطور الاتصال وظهرت خدمات الهاتف المحمول التي تتيح الاتصال الفوري بأي مكان في العالم كما شهدت السنوات الأخيرة تطور خدمات البريد الإلكتروني التي تتيح التبادل الفوري للمعلومات سواء في شكل نصوص أو رسوم وتعد المؤتمرات عن بعد من مظاهر الاتصالات الحديثة التي يزداد استخدامها لعقد الأعمال وإنجاز المشروعات وتوفير الخدمات . إن الهاتف ليس مجرد أداة للنداء أو إنهاء الأعمال عن بعد إنما هو نظام اتصال داخلي معقد فمن خلال الهاتف يمكن عمل قنوات اتصال لعقد المؤتمرات بين الافراد الذين يقيمون في أماكن متباعدة كما يقوم بربط المنازل والمكاتب بأجهزة الشبكة الإلكترونية المركزية لإدخال البيانات وتحليلها واسترجاعها وهناك كميات ضخمة من المعلومات تنقل عن طريق الاتصال الهاتفي سواء داخل الدولة أو خارجها كما أصبح الهاتف أداة ربط بين عدد كبير من وسائل التكنولوجيا الحديثة في أماكن الإقامة أو العمل(1).

فوائد الهاتف النقال؛

يستعمل الهاتف النقال في حياتنا اليومية بكثرة للتواصل مع الأقارب والأصدقاء وحتى في حياتنا العلمية ومن فوائد الهاتف النقال الآتي:
أنه يمكنك الاتصال من خلاله بهاتف آخر محمول أو بهاتف أرضي .
يمكن من استخدام خدمة إرسال الرسائل، وهي

سلبيات الهاتف النقال وسط الطلاب؛

يستخدم في فكاهاث تؤدي إلى مشاحناث خصوصا بين الطلاب التباهي يولد الغيرة بين الطلاب. يحتاج لميزانية مالية خاصة. تعزيز الفردية والإنعزال بعيداً عن الآخرين. نشر الإشاعات والابخار الشائنة. الغش في الإمتحانات. شيوع ظاهرة سرقة الهواتف. قد يشجع على الإنحراف والجروح لدى المراهقين.

المعاكسات آفة الآفات فيرغم من بساطتها في البداية إلا أنها تقود الشباب إلى عالم من المناهات لا طاقة لهم بها.

من السهولة الإبحار في الإنترنت عبر الهاتف النقال سواء في المنزل أو الخارج وفي أي لحظة.

ممارسة سلوكيات غير سليمة ومرفوضة بواسطة الهاتف النقال مثل : تصوير المعلمين ونشر صورهم ، تصوير طلاب آخرين ، ازعاج الأساتذة في المحاضرات وتبادل الرسائل والملفات الصوتية وغير اللاتقة تربوياً واجتماعياً(1).

الأثار الصحية لإستخدام الهاتف؛

ربط بعض الباحثين بين أخطار أبراج البث المنتشرة في الأحياء بالاضافة للموجات المنبعثة من الجوالاث المحمولة وبين بعض الأمراض خاصة السرطاناث ولكن القايمين على أمر هذه الأبحاث لم يجروا تجارب حقيقية على مستخدمي الهاتف النقال وذلك لصعوبة التحكم في العوامل المختلفة التي تؤثر في الصحة. إن الحاجة ماسة لإجراء البحوث الميدانية في محيط أبراج الهاتف لمعرفة تأثيراث الأمواج

الكهرومغناطيسية المرتبطة بها على صحة الإنسان والحيوان ومعرفة تأثيراها على البيئة بصفة عامة في العقدين المقبلين بعض البحوث أكدت على حدوث الإجهاض وإضطرابات ضربات القلب والنوم وخاصة لأولئك الذين يقطنون بجوار هذه الأبراج والمحطات ويمكن أن يكون كل هذا مؤشراً مبدئياً لحدوث مشكلات صحية أكبر نتيجة للتعرض المستمر للموجات الكهرومغناطيسية الصادرة عن هذه الأبراج ولا سيما مرض الوكيميا(سرطان الدم الابيض) وسرطان الغدد الليمفاوية(1).

ظلت مسألة الأثار الصحية للهاتف النقال محل أخذ ورد بين الباحثين انقسمت الأراء بين فريقين إحداهما يؤكد وقوع أضرار صحية على المدى الطويل ولكن دون أن يستطيع أن يقدم إثباتاث موثقة من جهات محايدة اعتمد على دراساث محايدة، والفريق الآخر يرى أن كل ما يقال عن تلك الأضرار لا دليل عليه خاصة وأن مستخدمي النقال يعدون بالملايين ولم تسجل حالات إكلينكية لأي إصابة من الهواتف النقال. وحيثاً تناقلت وكالات الأنباء إن إشعاعات أبراج النقال تمنع النحل من العودة إلى خلاياه، فقد أشار مجموعة من الباحثين في جامعة لاندا الألمانية إلى أن ذبذبات موجات اللاسلكي التي تبثها أو تلتقطها المحطات الفرعية للهواتف النقال في مناطق مختلفة في معظم المدن التي أدخلت خدمة النقال تقلل من فعالية شغالات النحل وتحول دون عودتها إلى خلاياها. ترد شركاث الهاتف النقال عن الاثهماث التي تثيرها الدراساث بالإعلان عن إنترامها التام بحدود الأمان المعتمدة دولياً كما أنها تشكك في صحة نتائج تلك الدراساث. ويضاف إلى هذا احتمالاث أن التعرض إلى

عرض وتحليل الدراسة الميدانية
الصفات الشخصية للمبحوثين:

جدول (١) العمر على حسب الفئات العمرية

الفئات العمرية	التكرارات	النسبة المئوية
17-19	43	39
20-22	47	42.8
23-25	19	17.3
أكثر من 25	01	0.9
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه وضح ان أكثر من 80% من المبحوثات في الفئة العمرية من 17 - 22.

جدول (٢) الحالة الاجتماعية

الخيارات	التكرارات	النسبة المئوية
عازب	103	93.6
متزوج	6	5.5
مطلق	1	0.9
أرمل	0	0
المجموع	110	100

المصدر: الدراسة الميدانية 2016

أكثر من 93% من المبحوثات في شريحة العزاب

الصفات العامة للهاتف:

جدول (٣) نوع الهاتف

الخيارات	التكرارات	النسبة المئوية
نوكيا	63	57.4
صيني	9	8.1
سامسونج	38	34.5
المجموع	110	100

خطر الإشعاعات الكهرومغناطيسية تسبب
العقم للنساء والرجال (2).

منهجية الدراسة:

تم اختيار العينة بطريقة العينة الطبقية العشوائية.

كيفية اختيار العينة:

أولاً: تم الحصول على قوائم بأرقام واسماء الطالبات وقد كانت أعداد الطالبات كالاتي:

الدفعة الأولى عدد الطالبات 256 طالبة

الدفعة الثانية عدد الطالبات 214 طالبة

الدفعة الثالثة عدد الطالبات 143 طالبة

الدفعة الرابعة عدد الطالبات 167 طالبة

الدفعة الخامسة عدد الطالبات 151 طالبة

مجموع الطالبات لكل الدفع 931 طالبة

تم أخذ عينة بنسبة (12%) من كل دفعة ومن ثم تم اختيار العينات من كل دفعة كالاتي:

الدفعة الاولى عدد الطالبات 256 ،

$$31 = 100 \div 256 \times 12$$

الدفعة الثانية عدد الطالبات 214 ، 214×12

$$25 = 100 \div$$

الدفعة الثالثة عدد الطالبات 143 ، 143×12

$$16 = 100$$

الدفعة الرابعة عدد الطالبات 167 ، 167×12

$$20 = 100 \div 167$$

الدفعة الخامسة عدد الطالبات 151 ، 151×12

$$18 = 100$$

مجموع العينة من الطالبات هي : 110 طالبة،

تمت اضافة ثلاثة طالبات كإحتياطي لكل دفعة

، بقسمة مجموع الطالبات على مجموع أفراد

العينة.

مجموع الطالبات في كل دفعة ÷ عدد الطالبات

كعينة = $931 \div 110 = 10$ ، لتصبح القفزة أو

المدى بين الرقم الأول والرقم الثاني هي 10.

جدول (٦) منذ أي مرحلة دراسية يحملين الهاتف النقال:

الخيارات	التكرارات	النسبة المئوية
الاساس	9	8.2
الثانوي	37	33.6
الجامعة	64	58.2
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه وضح أن أكثر من 41% من المبحوثين يحملن هواتف منذ المرحلة الثانوية.

بيانات الشريحة:

جدول (٧) عدد الشرائح

الخيارات	التكرارات	النسبة المئوية
شريحة واحدة	47	42.7
شريحتين	47	42.7
ثلاثة شرائح	16	14.6
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه وضح أن أكثر من 57.3% من المبحوثات يحملن أكثر من شريحة .

جدول (٨) هل قمت بتسجيل بياناتك كاملة

الخيارات	التكرارات	النسبة المئوية
نعم	106	96.6
لا	4	3.4
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 95% من المبحوثات قمن بتسجيل البيانات كاملة.

نوصي أن تقوم شركات الاتصال بتزويد الأشخاص الذين لم يكملوا تسجيل بياناتهم عبر

المصدر: الدراسة الميدانية 2016
من الجدول أعلاه نجد أن أكثر من 90% من المبحوثات يحملن هواتف نوكيا وسامسونج.

جدول (٤) هل الهاتف للإتصال فقط

الخيارات	التكرارات	النسبة المئوية
نعم	29	26.4
لا	81	73.6
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه يلاحظ أن أكثر من 73% من المبحوثات هواتفهن ليست للإتصال فقط نسبة لتطور أجهزة الإتصال ودخول تقنيات جديدة للتواصل الإجتماعي والبحث العلمي.

جدول (٥) طريقة الحصول على الهاتف

الخيارات	التكرارات	النسبة المئوية
عن طريق الشراء المباشر	18	16.3
من أفراد العائلة	88	80
من أقاربك	0	0
أخرى	4	3.7
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن نسبة 80% من المبحوثات حصلن على هواتفهن من أفراد العائلة.

6-1 جنيهاً. الأمر الذي يشكل عبئاً إضافياً على أرباب الأسر.

جدول (١١) سهولة الحصول على الرصيد وعلاقته بميزانية الفرد:

النسبة المئوية	التكرارات	الخيارات
29	31	أوافق بشدة
49	54	أوافق
9	10	محايد
10	11	لا أوافق
3	4	لا أوافق بشدة
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه يلاحظ أن أكثر من 76% من المبحوثات يرون أن سهولة الحصول على الرصيد وتوفيره للمستهلك يؤدي إلى تدهور ميزانية الفرد.

جدول (١٢) يصرف الفرد على الهاتف أكثر مما يصرف على نفسه

النسبة المئوية	التكرارات	الخيارات
20	22	أوافق بشدة
29.1	32	أوافق
17.3	19	محايد
28.2	31	لا أوافق
5.4	6	لا أوافق بشدة
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 49% من

برامج توعية لأهمية تسجيل البيانات وبيان خطورة عدم التسجيل وأن يتم تقييد الحصول على شريحة بإستيفاء البيانات المطلوبة وأن تقوم الشركات بإلغاء إشتراك أو عدم تفعيل كل الشرائح غير المستوفية لإكمال البيانات.

جدول (٩) بيانات العملاء غير المكتملة في سجلات الإتصال ومشكلاتها:

النسبة المئوية	التكرارات	الخيارات
51	56	أوافق بشدة
40	44	أوافق
6.3	7	محايد
0.9	1	لا أوافق
1.8	2	لا أوافق بشدة
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 90% من المبحوثات متفقون على أهمية إكمال بيانات العملاء وأن البيانات الغير مكتملة من الممكن أن تؤدي إلى الكثير من المشاكل الاجتماعية. الحصول على الرصيد:

جدول (١٠) مقدار إستهلاك الرصيد يومياً:

النسبة المئوية	التكرارات	الخيارات
67.3	74	1-3 جنيهاً
21.8	24	4-6 جنيهاً
10.9	12	7-10 جنيهاً
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 88% من المبحوثات يستهلكن يومياً رصيد يتراوح بين

النسبة المئوية	التكرارات	الخيارات
62.7	69	أوافق بشدة
25.4	28	أوافق
8.5	9	محايد
0.7	1	لا أوافق
2.7	1	لا أوافق بشدة
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول نجد أن أكثر من 86% من المبحوثات يرين أن الهاتف النقال يوفر الوقت والجهد خاصة في حالات الطوارئ.

استخدام الهاتف النقال وأثره :

جدول (١٦) هل أثر وجود الهاتف النقال عليك أكاديمياً

النسبة المئوية	التكرارات	الخيارات
28.2	31	نعم
71.8	79	لا
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول نجد أن أكثر من 70% من المبحوثات لا يرين تأثيراً للهاتف عليهن أكاديمياً

جدول (١٧) الاستخدام الغير مرشد للهواتف النقالة

النسبة المئوية	التكرارات	الخيارات
70	77	أوافق بشدة
22.7	25	أوافق
1.8	2	محايد
1.8	2	لا أوافق
3.7	4	لا أوافق بشدة
100	110	المجموع

المصدر: الدراسة الميدانية 2016

المبحوثات يرون أن الفرد يصرف على الهاتف أكثر مما يصرف على متطلباته الأخرى.

أهمية الهاتف النقال:

جدول (١٣) الهاتف النقال مهم لكل فئات المجتمع السوداني

النسبة المئوية	التكرارات	الخيارات
31.9	35	أوافق بشدة
26.3	29	أوافق
8.1	9	محايد
26.4	29	لا أوافق
7.3	8	لا أوافق بشدة
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 56% من المبحوثات يرين أن الهاتف مهم لكل فئات المجتمع السوداني.

جدول (١٤) أصبح الهاتف النقال جزءاً هاماً في حياتنا اليومية

النسبة المئوية	التكرارات	الخيارات
96.6	106	نعم
3.6	4	لا
100	110	المجموع

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه وضح أن أكثر من 95% من المبحوثات يرين أن الهاتف النقال أصبح جزءاً هاماً في حياتنا اليومية ومواكباً لكل المناشط الحياتية المختلفة، فقط أقل من 4% من المبحوثات لا يرين أهمية كبيرة للهاتف النقال في حياتنا.

جدول (١٥) الهاتف النقال يوفر الوقت والجهد خاصة في حالات الطوارئ

لا يوجد	26	23.6
وسط	47	42.7
علاقة جيدة	37	33.7
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 75% من المبحوثات يدخلن مواقع التواصل الاجتماعي الواتساب وتويتر والفييس بوك.

من الجدول أعلاه نجد أن أكثر من 92% من المبحوثات يرين أن الاستخدام الغير مرشد للهواتف النقالة يساعد في بث الأخبار والصور الفاضحة وبث الإشاعات وسط المجتمع نسبة لتطور تقنية هذه الأجهزة بما فيها البلوتوث ومواقع الإنترنت ساعد في تيسير التداول للإشاعات والصور الفاضحة والأخبار الغير صحيحة.

جدول (18) هل يمكنك الاستغناء عن

الهاتف النقال يوماً ما

الخيارات	التكرارات	النسبة المئوية
نعم	47	42.7
لا	63	57.3
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه وضح أن أكثر من 57% من المبحوثات لا يمكنهن الإستغناء عن الهاتف النقال لأنه أصبح يمثل حيزاً اجتماعياً ضرورياً في حياتهن.

جدول (19) المواقع التي تشاهدونها

الخيارات	التكرارات	النسبة المئوية
لا يوجد	38	34.4
الموسوعة الحرة	37	33.6
المواقع الثقافية	35	31.9
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن نسبة 65.5% من المبحوثات يشاهدن مواقع محددة الموسوعة الحرة والمواقع الثقافية الأخرى.

جدول (20) علاقتك بمواقع التواصل

الإجتماعي

الخيارات	التكرارات	النسبة المئوية
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جدول (21) هل تقضين وقتاً طويلاً في مواقع التواصل الاجتماعي

الخيارات	التكرارات	النسبة المئوية
لا	52	61.9
بعض الوقت	10	11.9
نعم	22	26.2
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه وضح أن أكثر من 61% من المبحوثات لا يقضين وقتاً طويلاً في مواقع التواصل الاجتماعي. وحددت الساعات التي يقضينها من 1-4 ساعة يومياً ، انظر الجدول رقم (22).

جدول (22) عدد الساعات التي تقضيها في مواقع التواصل الاجتماعي

الخيارات	التكرارات	النسبة المئوية
1-4 ساعات	58	69.1
5-9 ساعات	9	10.7
10-14 ساعات	6	7.2
15-19 ساعات	3	3.5
20-24 ساعات	8	9.5
المجموع	110	100

المصدر: الدراسة الميدانية 2016

جدول (٢٣) تأثير مواقع التواصل

الخيارات	التكرارات	النسبة المئوية
إيجابي	62	73.8
سليبي	22	26.2
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 73% من المبحوثات يرين أن علاقتهن بمواقع التواصل الاجتماعي أحدثت تأثيراً إيجابياً عليهن.

جدول (٢٥) أثر المواقع الإباحية عليكي

الخيارات	التكرارات	النسبة المئوية
إيجابي	6	25
سليبي	108	75
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول نجد أن أكثر من 75% من المبحوثات أثرت عليهن هذه المواقع سلبياً. التغيير الذي أحدثه الهاتف النقال:

جدول (٢٤) هل تدخلين مواقع إباحية

الخيارات	التكرارات	النسبة المئوية
نعم	24	21.8
لا	86	78.2
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 78% من المبحوثات لا يدخلن مواقع إباحية ، تعتبر المواقع الإباحية من الأدوات الفعالة لهدم القيم والأخلاق والدين وسط فئات الشباب خاصة في دول العالم الإسلامي .

صحيح أن هنالك عدد من المؤسسات التي تعمل على تنقية الشبكة العنكبوتية وتحجب عدد كبير من هذه المواقع إلا أن الإمكانيات العلمية والتقنية لهذه المؤسسات تقف في أحيان كثيرة عائقاً من إكمالها لدورها المنوط بها بالإضافة لذلك أن المواد الخادشة للحياء وللأخلاق صارت من خلال مواقع التواصل مفتوحة وعليه يمكنك الوصول إليها والتعامل معها دون التقيد باشتراك أو الدخول لمواقع محددة بالاسم، البعض يرى فوائد إيجابية لهذه المواقع.

جدول (٢٦) ما مدى التغيير الذي أحدثته الهاتف النقال بالنسبة لكي

الخيارات	التكرارات	النسبة المئوية
كثير	18	16.5
وسط	73	66.3
قليل	19	17.2
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد كل المبحوثات يرين أن الهاتف النقال أحدث تأثيراً على حياتهن تراوح مدى هذا التأثير ما بين كبير إلى وسط إلى قليل.

جدول (٢٧) ما هو التغيير الذي أحدثته في حياتك

الخيارات	التكرارات	النسبة المئوية
التواصل عبره مع الأهل والمعارف	80	72.7
إكتساب الثقافة العامة	30	27.3
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن كل المبحوثات يرين أن الهاتف النقال قد ساعد على تواصلهن عبره

التوصيات:

ضرورة نشر الوعي بأهمية إكمال بيانات المشتركين وحث الناس على ذلك عن طريق الإعلان في وسائل الإعلام المختلفة وأن تقوم شركات الإتصال بتقديم حوافز للذين قاموا بتسجيل بياناتهم كاملة لأن تسجيل البيانات يقلل من الجرائم وعملية الإبتزاز الإجرامي الأخرى كالإبتزاز المالي والأخلاقي الخ.....)

يجب أن يكون هنالك توعية بالإستخدام الأمثل للهاتف النقال حيث أن الإستخدام غير المرشد يساعد على نشر الصور والفيديوهات الفاضحة والإشاعات الكاذبة وهذا يؤدي إلى هتك أعراض الناس ويولد الفتن بين الناس فنجد الكثير بسبب هذه الصور والفيديوهات قد خرب بيته وتفككت أسر كثيرة بهذا النهج.

يصرف الفرد على الهاتف يومياً، هذا بدوره يؤدي إلى تدهور ميزانية الأسرة خصوصاً مع ارتفاع المعيشة وهذا يزيد من متطلبات الأسرة، خاصة وأن نسبة المتزوجات من المبحوثات كانت فقط في حدود 5% وان عبء تكلفة الرصيد يقع على كاهل الأسرة.

إمكانية تقديم خدمة بتكلفة أقل تكون خاصة بالطلاب مشابهة لخدمة تخفيض أجرة المواصلات لهم.

المواقع الإباحية هي دخلية علينا من المجتمعات الغربية وتهدف لدمار وهم المجتمع الإسلامي إنتشرت بصورة كبيرة وأصبحت تعرض بأسماء غير أسمائها والغرض الاساسي هو دمار الشباب من الجنسين وحثهم للوقوع في الجرائم الأخلاقية البشعة بقصد إنحرافهم.

الاهتمام بتوعية الشباب حتى لا تؤدي هذه التقنية إلى انحرافه اجتماعياً وأخلاقياً؟، كما

مع أهلهم وذويهم بالأضافة للمساعدة في إزدياد ثقافتهم العامة.

جدول (٢٨) هل تعتقد أن التغيير

الإجتماعي الناتج من الهاتف النقال سلبي أم إيجابي

الخيارات	التكرارات	النسبة المئوية
إيجابي	86	78.2
سلبي	24	21.8
المجموع	110	100

المصدر: الدراسة الميدانية 2016

من الجدول أعلاه نجد أن أكثر من 78% من المبحوثات يعتقدن أن التغيير الإجتماعي الناتج من الهاتف النقال إيجابي، وذلك لسهولة التواصل الإجتماعي والاستفادة من خدمات المواقع والمكتبات الإلكترونية وايضاً يوفر الوقت والجهد فبكل مميزاته يجب إستخدامه إستخدام أمثل.

النتائج:

توصلت الدراسة إلى النتائج التالي:

جميع المبحوثات من شريحة الشبابات الإنث يحملن هاتف نقال حديث.

أن أهم الماركات المستخدمة هي النوكيا والسامسونج الذكية ذات التقنية العالية.

هنالك وعي تام لتسجيل البيانات كاملة حيث أشار أغلب المبحوثات بنسبة بلغت (96%) أنهن قد أكملن تسجيل بياناتهن.

أغلبية المبحوثات (86%) يرين أهمية إمتلاك هاتف نقال وأنه قد وفر لهن جهداً ووقتاً خاصة في الحالات الطارئة ومتابعات أولياء الأمور.

أغلبية المبحوثات (62%) يرين أن الهاتف النقال قد أثر إيجابياً على حياتهن الإجتماعية والعلمية والثقافية.

يمكن أن تتم التوعية والتثقيف والتوجيه بالتضامن بين شركات الاتصال المختلفة والمؤسسات التعليمية على مستوى الجامعات والمدارس الثانوية.

المراجع:

- حسن عماد مكاوي "تكنولوجيا الإتصال الحديثة في عصر المعلومات" 1980م.
 لطيفة حسين الكندري. جريدة الأنباء ، 2006م
 ع 24 .
 محمد بسام ، مجلة التقدم العلمي ، 2008م
 ع 24 .
 محمد سعيد عبدالمجيد "التلفون المحمول وثقافة الإستهلاك في المجتمع المصري" 2006م.
 محمد عبدالقادر الفقي ، مجلة التقدم العلمي ،
 2008م ع 61 .
 محمد قاسم "مخاطر وفوائد الهاتف النقال"
 1997م ، ع 2.
 نعمان الحاج ، مجلة الفيصل العلمية ، 2007م
 ، ع 2 .
 الموقع الإنترنت - ويكيبيديا. ar
 m.wikipedia.org wiki هاتف محمول.
 الموقع الإنترنت - ويكيبيديا . ar
 m.wikipedia.org إتصال.
 الموقع الإنترنت - مفهوم الهاتف النقال -
 نارتو الشيخ.
 للموقع الالكتروني -jadidaljawal.blogs-
 ...pot.com/.../mobile phone

tivity obtained by adoption of improved technology (18 sacks/feddan) is achieved.

The adoption of improved technology scenario indicated that the crops to be grown in Merowe are broad beans, tomato and onion, while those to be grown in Dongola are wheat, broad beans and small areas of fennel crop. Land, labour and capital were the main factors constraining agricultural production in the Northern State.

REFERENCES

Abd Elaziz H.H. (1999) An Economic Analysis of Small Private Farms in the River Nile State, Ph.D. Thesis. Faculty of Agriculture, University of Khartoum, Sudan.

Beneke.R. and R. Winterboer (1973). Linear Programming Application to Agriculture. The Iowa State University Press. Ames.

Dent. J.B.S.R. Harison and K.B. Woodford (1986).Farm Planning With Linear Programming Concept and Practice.

Heady.E.o and W. Candler (1973). Linear Programming Methods.The Iowa University Press, Ames, Iowa, U.S.A.

Hazel, P.B.R. and R.D. Norton (1986).Mathematical Programming for Economic Analysis in Agriculture. Macmillan Publishing Company. New York, U.S.A.

Malik, A.M. (1994). Analysis of Traditional Farming Systems.A case Study from Jebel Marra Area, Darfur State, Sudan. Ph.D. Thesis. Faculty of Agriculture, University of Khartoum, Sudan.

Northern State Ministry of Agriculture, Animal Wealth and Irrigation (NSAAI), (1986).The Horizons of the Agricultural Investment in the Northern State. The State Coordination Office. Khartoum, Sudan.

Schiller, B.R. (1991). The Micro Economy Today. The American University, MCGaw-Hill, Inc. New York, U.S.A.

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duction practices by farmers is not just a question of transfer of technology. An essential prerequisite to this is securing resources and inputs to the farmers. The implementation of newly developed technologies is expected to affect crop organization due to their impact on yields as well as cost of production (AbdEaziz, 1999). The results of this scenario showed that the adoption of improved technology increased the net farm income in Merowe locality by 52% from SDG 7578.04 to SDG 11496.93. Broad beans occupied the largest area (5.55 feddans) beside the restricted area of tomato crop. Broad beans occupied the largest area by adoption of improved technology since it is a high value crop and the prices for the season 2002/03 was twice as that of wheat crop, and for this reason wheat crop did not enter the plan. In Dongola Locality the net farm income increased by 123% from SDG 3788.59 to SDG 8453.99. The wheat crop occupied the largest area (6.3 feddans), broad beans occupied its restricted area (4.6 feddans) and only 0.4 feddans was occupied by fennel crop. With adoption of improved technology, land, labour and capital are the constraining factors in Dongola Locality, while, the constraining factors in Merowe Locality are the land and

labour. The peak months of labour utilization are November, December and March in Merowe Locality and November, December, January and April in the model of Dongola Locality.

CONCLUSIONS

The basic solution of the LP model indicated that comparative and absolute advantages are not made use of, wheat crop should not be produced on commercial basis in Merowe and Dongola Localities. The crops to be grown in Merowe Locality are broad beans, tomato and onion, in addition to wheat crop at level just satisfying consumption requirements. The crops to be grown in Dongola Locality are broad beans, garlic and fennel. As a result the net farm income increased by 184% and 116% respectively. According to the results of the basic model wheat could be produced on commercial basis in Merowe locality when its present costs are reduced by 25%, when its price is increased by 20%, when its present productivity is increased by 25% (i.e 15.4 sacks/feddan) or when tomato price is decreased by 25%. While in Dongola Locality wheat could be produced on commercial basis when its present productivity is increased by 30% (i.e 11 sacks/feddan) together with 20% rise in its price, or when the produc-

The impact of increase in broad beans productivity by 25%: In Merowe Locality, the net farm income increased from SDG 7578.04 to SDG 8425.27 (11% increase). Broad beans occupied the largest area (4.65 feddans), beside the restricted areas of tomato and onion crops. In Dongola Locality the net farm income increased by 27% from SDG 3788.59 to SDG 4822.01. Broad beans occupied its restricted area (4.6 feddans), fennel and garlic crops occupied 3.32 and 3.37 feddans respectively.

The impact of increase in productivity of wheat and broad beans together by 25%: The results of this scenario increased the net farm income in Merowe Locality by 12% from SDG 7578.04 to SDG 8494.96. Wheat crop occupied the largest area (4.65 feddans) beside, the areas restricted to tomato and onion crops. In Dongola Locality the net farm income increased by 27% from SDG 3788.59 to SDG 4829.59. Broad beans occupied 2.86 feddans, while only 0.89 feddans were allocated to wheat crop. The impact of increase in productivity of wheat in Dongola Locality by 50%: The answer of this scenario increased the net farm income by 2% from SDG 3788.59 to SDG 3873.18. Broad beans occupied its restricted area (4.6 feddans), fennel occupied

3 feddans, garlic occupied 2.95 feddans and wheat also occupied only 0.74 feddans.

D: The effect of crops productivity and prices

The impact of increase in productivity of wheat in Dongola Locality by 25% and in its price together by 20%: In the results of this scenario the wheat crop occupied only 0.89 feddans which is satisfied only a part of the consumption requirements.

The impact of increase I productivity of wheat in Dongola by 30% and in its price together by 20%: The results of this scenario increased the net farm income by 3% from SDG 3788.59 to SDG 3899.18. It allocated the largest area (5.46 feddans) to the wheat crop, while broad beans crop occupied its restricted area (4.6 feddans) and only 0.95 and 0.28 feddans were allocated respectively to fennel and garlic crops.

E: The effect of application of technological packages

Technological packages can be defined as the transfer of technology and innovation generated by research scientists aims at improving farm productivity to maximize farmer's returns. It is broadly defined as a change in the total farm output resulting from given set of production inputs. The adoption of improved pro-

results of lowering wheat cost by 50% increased the net farm income from SDG 3788.59 to SDG 3827.65 (1% increase) and wheat crop entered the plan at a level just satisfying the consumption requirements (1.11 feddans).

B: The effect of crops prices

The impact of increase wheat price by 20%: The results was changed only the model of Merowe locality. The net farm income increased from SDG 7578.04 to SDG 7784.21 (2.7% increase). Wheat crop occupied the largest area (4.6 feddans), beside the restricted areas of tomato onion crops. Broad beans and fennel were excluded due to their low productivities.

The impact of decrease in tomato price in Merowe locality by 25%: This run was made for the aversion of marketing risk with respect to tomato crop. The supply of tomato product is elastic since it is a perishable vegetable and hence the expansion in its production expected to face low prices. The result of this scenario reduced the net farm income by 34% from SDG 7578.04 to SDG 5026.61. Wheat occupied the largest area (4.6 feddans, beside the restricted areas of tomato and onion crops. Broad beans and fennel crops were also excluded. The impact of decrease in tomato

price by 25% and increase in wheat price in Merowe Locality by 20%: The results of this scenario decreased the net farm income by 26% from SDG 7578.04 to SDG 5625.56. It allocated 4.6 feddans to wheat, beside the restricted areas of tomato and onion crops.

The impact of decrease in tomato price by 50% and increase in wheat price in Merowe Locality together by 20%: The results of this scenario decreased the net farm income by 54% from SDG 7578.04 to SDG 3466.91. The crop mix was the same as the previous scenario.

The effect of crops productivity

The impact of increase in wheat productivity by 25%:

In the model of Merowe Locality the net income increased from SDG 7578.04 to SDG 8071.78 (6.5% increase). Wheat crop occupied the largest area (4.65 feddans) beside the areas restricted for tomato and onion crops. In the model of Dongola the net farm the net farm increased from SDG 3788.59 to SDG 3796.17 (0.2% increase). Broad beans occupied its restricted area (4.6 feddans), Fennel and garlic occupied 2.93 and 2.86 feddans, respectively and only 0.89 feddans was confined to wheat crop which is satisfied a part of the consumption requirements.

Net farm income

From table 1, the net farm income in the optimum solution of the LP model of Merowe Locality was SDG 7578.04 which was higher than the actual achieved by 184%. In Dongola Locality, the net farm income was SDG 3788.59 which was higher than the actual value in the season 2002/03 by 116%.

Sensitivity analysis

In this analysis the basic linear programming modes were developed by changing their parameters to reflect a range of production option, prices, productivities and adoption of improved technologies.

A: The effect of the cost of production

The impact of lowering the present cost by 25%: This scenario was developed to examine the impact of lowering the present cost of all crops by 25%. The results increased net farm in Merowe locality by 18% from SDG 7578.04 to SDG 8934.34 and no change in the crop mix. In Dongola Locality the net farm income increased from SDG 3788.59 to SDG 5423.99 (43% increase). The crop mix was changed and the largest area (6.2 feddans) was allocated to garlic, broad beans crop occupied its restricted area (4.6 feddans), while

fennel crop occupied only 0.4 feddans.

The impact of lowering the present cost by 50%: The results of this scenario have no effect in the crop mix of Merowe Locality. However, the net income increased from SDG 7578.04 to SDG 10474.26 (30% increase). In Dongola Locality the net farm income increased by 78% from SDG 3788.59 to SDG 6756.24. The crop mix was slightly changed and allocated 6.7 feddans to garlic crop beside the restricted area of the broad beans crop (4.6 feddans).

The impact of lowering wheat cost by 25% and 50%: The results of lowering wheat cost by 25% increased the net farm income in the model of Merowe Locality by 3% from SDG 7578.04 to SDG 7824.04. Wheat occupied the largest area (4.65 feddans) beside the restricted area of tomato and onion crops. The results of lowering wheat cost by 50% increase the net farm income in the model of Merowe Locality from SDG 7578.04 to SDG 8303.13 (9.6% increase) and also wheat crop occupied the same largest area. Broad beans and fennel crops did not enter the plan due to their low productivities. In Dongola Locality the net farm income and the crop mix were not changed by lowering wheat cost by 25%. The

Table4. The surplus irrigation water in the basic solutions of the LP models

Month	Merowe	Dongola
Sept.	40.9	
Oct.	38.3	27.6
Nov.	32.98	15.07
Dec.	25.35	11.7
Jan.	27.30	15.02
Feb.	28.20	23
March	40.1	30.92
April	44.3	-
May	47.8	-
Total	235	123.5

Table5. Marginal value productivities of credit (SDG/unit) in the basic solutions of the LP models

Month	Merowe	Dongola
Sep.	0.00	-
Oct.	0.00	0.15
Nov.	0.00	0.15
Dec.	0.00	0.15
Jan.	0.00	0.15
Feb.	0.00	0.15
March	0.00	0.00
April	0.00	0.00
May	0.00	0.00
June		0.00 0.00

Table2. Number of man days required in the basic solutions in comparison to the observed

Merowe		Dongola		
Month	Model	Observed	Model	Observed
Sept.	24		10.3	- -
Oct.	59	37.8	61	45
Nov.	59.6	44.2	69	50.5
Dec.	64.4	444.8	96	69.8
Jan.	54	33.6	61.2	51.6
Feb.		60 37.3	33	24.7
March	81.6	58.8	62	45
April	36	13.4	76	55.6
May	7.6	3	-	-
June	19.4	7.5	-	-
Total	465.6	290.5	458.2	342.2

In the basic solutions in comparison to the observed				
Merowe		Dongola		
Month	Model	Ob- served	Model	Observed
Sept.	7.8	2.1	-	-
Oct.	10.4	2.8	6.7	0.7
Nov.	15.7	8.8	19.22	8.4
Dec.	23.33	18.3	22.6	20
Jan.	21.39	14.7	19.25	16
Feb.	20.49	13.8	11.3	12
March	8.59	3.8	3.33	4.1
April	4.4	1.4	-	-
May	0.9	0.4	-	-
Total	113	66.1	82.4	61.2

About 87% of the family labour was required for the optimum plan of Merowe locality. Family labour are all required during the months from September to April. In Dongola locality all family labour was required during all months of the season (October to April). The percentage of hired and nafir labour required for the optimum plan of Merowe locality was 39% of the total required labour, while the required percentage for Dongola plan was 49.6%. Table 2 shows the number of man days required for the optimum plan of the basic models. The table shows two peaks of labour utilization in the optimum solution of Merowe locality, the first one was during March. The table also shows two peaks of labour utilization in the optimum solution and the real situation of Dongola locality, the first peak was during November and December, while the other was during March and April.

Irrigation water use in the basic models in comparison to the actual:

From table 1, the total number of irrigations required for the optimum solution of the restricted model of Merowe locality was 113 compared to 66.2 watering actually utilized. In Dongola locality the number of 82.4 watering was required for the optimum solution compared to 61 wa-

tering actually utilized in the winter season 2002/03. Table 3 shows the monthly average number of watering required in the optimum solution, while the surplus irrigation water per month is shown in table 4.

Credit use in the basic models

The results showed no problem of credit in the model of Merowe locality, while it showed a credit problem during October, November, December, January and February in the model of Dongola locality. Table 5 shows the marginal value productivities of credit in the basic models.

Table1. Basic solution of the LP models in comparison to the observed

Merowe Item	Unit	Dongola			
		Model	Actual	Model	Actual
Cropping pattern					
Wheat	Fed.	0.69	1.3	0.00	3.75
Broad beans	Fed.	0.96	2.75	4.6	3.65
Fennel	Fed.	0.00	0.6	3.32	0.4
Onion	Fed.	0.9	0.35	-	-
Garlic	Fed.	-	-	3.38	0.33
Tomato	Fed.	2.6	0.7	-	-
Resource use					
-Total land	Fed.	8.15	5.7	11.3	8.13
-Family labour	MD	289	247.4	231	222.7
-%(utilized FL/Total FL*100)		86.5%	76.4%	100%	96%
-Hired and nafir labour	MD	176.6	43.1	227.2	120
-%(utilized HL/T Land NL/total utilized labour*100)		39%	15%	49.6%	35%
-Total labour	MD	465.6	290.5	458.2	342.2
-%(utilized TL/TL*100)		86%	54%		73.2%
Total number of watering		113	66	82.4	61
Returns					
-Net farm income (including value of wheat consumption)	SDG	809654	319086.4	437284.5	233704.7
-Net farm income (wheat consumption requirement is satisfied)	SDG	757804	266811.4	378859.5	175754.7
Ratio of actual income to model		35.2%		46.39%	

which is lower than the average for the past twelve years. The wheat crop entered the plan at a level just satisfying the consumption requirements. In the results of the LP model for Dongola locality, broad beans occupied its restricted area (4.6 feddans), followed by garlic and fennel crops. The wheat crop did not enter the plan due to its low productivity and low prices. The productivity of wheat for the season 2002/2003 was 8.5 sacks per feddan in Dongola locality which was lower than 10.5 sacks per feddan, the average for the past twelve years. The productivity of fennel crop in Dongola locality was better than that of Merowe locality. The average

obtained was 7.6 kantar per feddan compared to 7.8 kantar per feddan, the average for the past twelve years. The garlic crop yield obtained in the season 2002/2003 was 36.8 kantar per feddan which was higher than 33.8 kantar per feddan, the average for the past twelve years.

B: Resource use

Labour use in the basic model in comparison to the actual use
From table 1, the total labour required for the optimum plan was 465.6 man days compared to 290.5 man days actually utilized. In Dongola locality the total man days required were 461.2 compared to 342.5 man days actually utilizes.

$X_j > 0, j = 1$ to n

Where:

Z = objective function value

C_j = gross margin per feddan of the j th activity i.e input/output coefficient.

X_j = the level of the j th farm activity

A_{ij} = the quantity of the i th resource required to produce one unit of the j th activity i.e input/output coefficients.

b_i = vector of resource availability.

The intended LP- matrix comprises cultivation activities of winter crops, sales activities and hiring labour activities. The constraints on the matrix included land, irrigation water, labour, capital, and subsistence requirements. The LP matrix was employed to rest different scenarios (sensitivity analysis). This was done through changing the parameters of the basic run.

RESULTS AND DISCUSSION:

The discussion presents and discusses the results of the basic models and present, the different scenarios by changing their parameters. The information drawn from the LP solution includes the value of the objective function, the optimum enterprise combination, the level of resources used and their representative marginal productivities. The results of the basic models were validated by comparing the results to the real situation

in the state as shown by the results of the field survey conducted in the year 2003.

A: Cropping pattern

The free cropping models option does not reflect the existing situation in the two localities. Some crops are usually grown to limited areas because of the need for diversification and aversion of natural and market related risks. The maximum areas usually allocated to these crops are limits used in the LP models as constraints. In Merowe locality model the cropping restriction was made for tomato and onion crops, while in Dongola locality only the area of broad beans crop was restricted to its maximum area usually cultivated. The optimum solutions of the basic cropping models are shown in table 1.

From table 1, broad beans crop occupied the largest areas as the answer of the basic cropping LP model of Merowe locality, beside the areas restricted for tomato and onion crops. Fennel crop did not enter the plan due to its low productivity. The productivity of fennel crop for the season 1990/91-2001/02 ranged between 6 and 10 kantar per feddan, with an average of 7.8 kantar (Northern State Ministry of Agriculture, 2002). The average productivity obtained for the season 2002/2003 was 5.2 kantar,

avoidance of risk, or simply, survival an uncertain environment, and other leisure and socially related objectives (Malik, 1994).

For small – scale farmers in developing countries, more primary objectives often to provide their families with adequate food. Such farmers face rural markets that are often incomplete, exploitative or unreliable and trading cash crops for food is a rarely sound strategy for ensuring survival. Under these circumstances, it is not surprising that farmers first allocate resources to assure necessary food supplies, and only then are remaining resources used to generate cash income. Another important consideration for small-scale farmers is often a desire to enjoy more leisure. As incomes rise above subsistence level and the required drudgery to eke out a living is reduced (Hazel and Norton, 1986).

METHODOLOGY:

The study depended mainly on the primary data, which was collected by direct interviewing of sampled farmers using a structured questionnaire conducted in 2003 season. The linear programming technique was applied to the survey data collected. The technique can serve as an important management aid to individual farms or marketing firms. The method also

promises to be useful in aggregative analysis relating to regional production patterns, interregional competition and many policy problems (Heady and Candler, 1973). The simplex method is based on the economic principle of opportunity cost. It is defined as mathematical procedure that checks corner points of the production possibility boundary so as to locate the most profitable plan (Dent, Harrison and Woodford, 1986). It is defined as a mathematical procedure (algorithm) use addition, subtraction, multiplication and division in a particular sequential way to solve problems (Beneke and Winterboer, 1973). Early application of linear programming in farm planning, assumed profit maximizing behavior Hazel and Norton, 1986). Linear programming problem has three quantitative components, an objective, alternative methods or processes for attaining the objective and resources or other restrictions (Heady and Candler, 1973). The objective function of the representative farm model maximizes net farm income after satisfying family requirements of the main food crop which is wheat. The mathematical form of the model used is as follows:
 Max $z =$
 Subject to $\leq b_i$
 And

INTRODUCTION:

Factors of production are the inputs: land, labour and capital. The quantities of available resources are limited. We can't produce everything we want in the quantities we desire. Resources are scarce relative to our desire, because our resources are services. Opportunity costs exist in all situations where available resources are not abundant enough to satisfy all our desire. In all such situations, we must make hard decisions about how to allocate our scarce resources among competing uses. Our ability to alter the mix of output depends in part on the capability of factors of production to move from one industry to another. Two issues arise, first, can the resource be moved, second, how are efficient will the resources be in a new line of production (Schiller, 1991). The opportunity cost is defined as, the most desirable goods or services that are forgone in order to obtain something else. The opportunity cost of a product is measured by the most desirable goods and services that could have been produced with same resources. The shadow price of the activity defined as a measure of its true profitability after taking account of both cash returns and opportunity cost (Dent, Harrison and Woodford, 1986). The

terms shadow price, opportunity cost and marginal value product are often used synonymously when referring to resources. Shadow prices for production activities indicate how the value if the program would change (how much income would be penalized) if an additional unit of the activity was forced into the final plan. They will be referred to frequently as income penalties. Shadow price for the disposable activities, provide information concerning the productivity of added resources (relation of restraints) (Beneke and Winterboer, 1973).

The objectives of traditional farming have been a source of legacy in agricultural economics literature. Three schools of thought emerged: The first one is represented by the neoclassical theory, which advocate a profit maximization aim, the second school which is the extreme of the first one, argues that the fulfillment of the family grain requirement is the sole objective of peasant farmers, while the third school represents a middle ground between the other two theories. That is, peasant farmers have a combination of objectives which may be listed in the following: Securing an adequate and assumed food supply, ensuring a cash income to meet other material needs,

التركيبة المحصولية المثلى للنظام المحصولي في الولاية الشمالية - السودان

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أجريت هذه الدراسة (1) لتحديد التوليفة الموردية المثلى للنظام المحصولي في الولاية الشمالية. (2) لتحديد المعوقات التي تواجه الإنتاج الزراعي في الولاية. أوضحت نتائج الحل الأساسي لنموذج البرمجة الخطية أن الاستخدام الأمثل للأرض يختلف كثيرا عن الاستخدام الفعلي. المحاصيل التي ينبغي زراعتها في محلية مروى هي: الفول المصري، الطماطم، البصل ومحصول القمح بمستوى يكفي فقط الحاجات الاستهلاكية. بينما تلك التي ينبغي أن تزرع في محلية دنقلا هي: الفول المصري، الثوم والشمار. ونتيجة لذلك فإن صافي دخل المزرعة يزداد بنسبة %184 و %364 في المحليتين على التوالي. بالإمكان إنتاج محصول القمح بمستوى تجاري في محلية مروى متى ما انخفضت تكاليف إنتاجه الحالية بنسبة %25، إذا زاد سعره الحالي بنسبة %20 أو متى ما زادت إنتاجيته الحالية بنسبة %25. بينما في محلية دنقلا فيمكن زراعة محصول القمح بمستوى تجاري متى ما زادت إنتاجيته الحالية بنسبة %30 مع زيادة سعره الحالي بنسبة %20 في آن واحد، أو متى ما تحققت نتائج تطبيق الحزم التقنية في حقول البحوث الزراعية (18 جوال للفدان).

The optimum Cropping Pattern of the Northern State, Sudan

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Abstract

This study was carried out to (i) formulate an optimum resource allocation cropping system in the Northern State. (ii) identify the constraints facing the agricultural production in the state. The results of the basic solution of the linear programming model showed a land use that is very different from the current land use. The crops to be grown in Merowe locality are broad beans, tomato and onion, in addition to wheat at level just satisfies consumption requirements. While those to be grown in Dongola locality are broad beans, garlic and fennel. As a result the farm income increased by 184% and 116% in the two localities respectively. Wheat can be produced on commercial basis in Merowe locality when its present costs are reduced by 25%, its present price is increased by 20%, and when its present productivity is increased by 25%. While in Dongola locality it can be produced on commercial basis when its present productivity is increased by 30% together with 20% rise in its price, or when the productivity obtained in the experimental fields by adoption of improved technology (18 sacks /feddan) is achieved.

- sha, Alex. Univ.
- Hu, J., Seiler, G. and Kole, C., 2010. Genetics, genomics and breeding of sunflower. Routledge, USA, 342.
- Idris, S.E. (2006). Genetic Variability in Newly Developed Sunflower (*Helianthus annuus* L.) Population Using Half-Sib Families. Thesis for Ph.D. degree, Faculty of Agric. Sciences, University of Gezira, Wad Medani, Sudan.
- Karaaslan, D., Hatipoglu, A., Türk, Z. and Kaya, Y., (2010). Determination of potential sunflower cultivars (*Helianthus annuus* L.) cultivars for the irrigated conditions of Diyarbakir. *Helia* 33(52): 145-152.
- Khana, K.R. (1972). Factors affecting the production of filled seeds in sunflower. *Euphytica* 21: 284 – 287.
- Khidir, M.O. (2007). Oil Crops in Sudan (in Arabic), Khartoum University Press, Sudan.
- Killi, F. and Altunbay, S.G., (2005). Seed Yield, Oil Content and Yield Components of Confection and Oilseed Sunflower (*Helianthus annuus* L.) Cultivars Planted in Different Dates. *Journal of Agriculture and Biology* 7(1): 21-24
- Mohamed Ali, I.M. (1999). Genetic variability and correlation studies in a sunflower (*Helianthus annuus* L.) population for rain fed conditions. M.Sc. Thesis, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.
- Monotti, M. 2004. Growing non-food sunflower in dry land conditions. *Ital. J. Agron.*, 8: 3-8.
- Obeid, M.Y.M. (2001). Self-fertility, hollow seeded-ness and yield components in different sunflower cultivars. M.Sc. Thesis, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.
- Onwueme, I.C. and T.D Sinha, (1999). Field Crops Production in Tropical Africa. CTA publications, Wageningen, the Netherlands. pp 349-354.
- Patil, B.R., M. Rudraradhya, C.H.M. Vijayakumar, H. Basappa and K. Virupokshappa (1996). Genetic variability in sunflower. *Journal of Oil Seeds Research* 13: 157-161.
- Putnam, D.H., E.S. Opinger, D.R. Hicks, B.R. Durgan, D.M. Noetzel, R.A. Meronuck, J.D. Dll and E.E. Sehulte, (1990). Sunflower Alternative Field Crops Manual. University of Wisconsin, WI, USA.
- Putt, E., (1997). Early History of Sunflower: American Society of Agronomy, Madison, Wis. (USA). 1–19.
- Sadghi, M., Seyed Sharifi, R., Namvar, A., Khandan-e-Bejandi, T. and Molaei, P., (2008). Responses of Sunflower Yield and Grain Filling Period to Plant Density and Weed Interference. *Research Journal of Biological Sciences* 3(9): 1048-1053.
- Tarig, M., G. Idress and A. Tahir, (1992). Genetic variability and correlation studies in sunflower, *S.J. of Agric.* 8(6): 659-663.

*, ** Significant at 0.05 and 0.01 levels of probability, respectively. Ns. not significant

References:

Abdel Rahman, A.M., I.E. Mohamed and A.S. Gangi, (2004). Influence of some innovation attributes on the adoption of growing sunflower in Rahad Scheme. *Gezira J. of Agric. Sci.* 2(1): 117 – 124.

Carter, J.F. (1978). *Sunflower Science and Technology*. Longman, New York. pp. 89 – 125.

Demirer, T., Özer, I., Koçtürk, Ö.M. and Yesilyurt, Er. A., (2004). Effect of Different Leaf Fertilizers on Yield and Quality in Sunflower (*Helianthus annuus* L.). *Pakistan Journal of Biological Sciences* 7(3): 384-388.

Dong, G., Liu, G. and Li, K., (2007). Studying genetic diversity in the core germplasm of confectionary sunflower (*Helianthus annuus* L.) in China based on AFLP and morphological analysis. *Russian Journal of Genetics* 43 (6): 627-635.

Ekin Z, Tunçtürk M, Yılmaz I (2005). Evaluation of seed yields and yield properties of different sunflower (*Helianthus annuus* L.) hybrid varieties in Van, Turkey. *Pakistan J. Biol. Sci.*, 8: 683-686.

FAO, (2013). *Food and Agriculture Organization of the United Nations*. <http://www.factfish.com/statistic/sunflower%20seed%20yield>.

FAO- STAT-Food and Agricultural Organization of the United Nations (2012). *Statistics Division*.

FAS.USDA, (2008). *Oil seed situation and outlook*. (CF. Osman, E.B.A. and M.M.M. Awed. 2010. Response of sunflower (*Helianthus annuus* L.) to phosphorous and nitrogen fertilization under different spacing at new valley. *Ass. Univ. Bull. Environ. Res.*, 13(1): 11-19.

Fereres, E., C. Gimenez and J.M. Fernandez, (1986). Genetic variability in sunflower cultivars under drought. I. Yield relationships. *Aust. J. Agric. Res.* 37: 573 – 582.

Fernandez – Martinez, J., Velasco, L. and Perez – Vich, B., 2004. Progress in the genetic modification of sunflower oil quality. *Proc. of 16th International Sunflower Conference*, Fargo, ND USA, 1-14.

Fick, GN., (1989). Sunflower. In: *Oil Crops of the World: Rbbelen G, Downey RK, Ashri A (eds.)*. McGraw-Hill, New York, 301-318.

Gill, H.S., R.K. Sheoran, L. Kumar, and N. Chandra. (1997). Genetic variability and genetic advance for seed yield and component traits in sunflower (*Helianthus annuus* L.). *Ann. Of Biol. (Ludhiana)* 13(2): 279-281.

Groove, J.H and summer, M.E. (2005). Yield and leaf composition of sunflower in relation to N.P.K. and lime treatment in nutrient cycling. *Agro ecosystems*. 3 :(4): 367-378.

Henen, M.E., (2011). Response of some sunflower to water stress and bio fertilization. Ph.D. Thesis (unpublished), Fac. of Agric. Saba Ba-

*, ** Significant at 0.05 and 0.01 levels of probability, respectively. N.S. not significant

Table4. Orthogonal contrasts between six varieties of sunflower evaluated for yield and yield components at Agadi in season (2009/10).

.No	Comparison	Days to 50% flowering	Plant height ((cm	Days to maturity	Head diameter ((cm	Empty (%) seeds	100-seed weight (g	Grain yield ((kg/ha
1	Varieties vs Hybrids	ns 2.327	ns 1.859	**42.483	ns 0.392	*3.510	ns 0.831	ns 1.635
2	Hysun 33 vs Other hybrids	**68.192	ns 2.222	**152.693	ns 1.271	ns 1.276	ns 1.477	*3.386
3	Sv 60050 vs Sv 60046 and Sv 60036	ns 0.935	ns 0.748	*7.754	ns 1.765	ns 1.009	ns 0.185	**11.672
4	Sv 60050 vs Sv 60036	*5.992	ns 1.718	**14.631	ns 2.848	ns 2.046	*3.462	*4.180
5	Rcvh4 vs Rcvh17	**13.014	ns 1.193	**96.278	ns 0.377	ns 2.357	**8.862	**8.575

Means within the column followed by the same letter (s) are not significantly different at the probability level of 0.05, and 0.01

(*,**) = significant at the 0.05 and 0.01 probability level respectively. N.S= no significant at the probability level of 0.05.

Table3. Orthogonal contrasts between six varieties of sunflower evaluated for yield and yield components at Wad Medani in season (2009/10).

No	Comparison	Days to 50% flowering	Plant height ((cm	Days to maturity	Head diameter ((cm	Empty (%) seeds	100-seed weight (g	Grain yield (kg/ha
1	Varieties vs Hybrids	**52.920	*3.989	**16.662	ns 1.116	ns 2.635	ns 1.371	ns 0.943
2	Hysun 33 vs Other hybrids	**27.000	ns 2.975	**13.435	ns 0.199	ns 0.278	*6.635	ns 0.481
3	Sv 60050 vs Sv 60046 and Sv 60036	*4.860	ns 0.476	ns 2.918	*4.850	ns 0.791	ns 0.987	ns 0.223
4	Sv 60050 vs Sv 60036	**58.320	**11.690	**24.993	*6.422	ns 2.307	ns 2.961	ns 0.300
5	Rcvh4 vs Rcvh17	*4.500	ns 1.635	*4.591	**11.841	*2.307	*5.264	**9.686

Means within the same column followed by the same letter (s) are not significantly different at the probability level of 0.05, and 0.01.

(*, **) = significant at the 0.05 and 0.01 probability level respectively. N.S = no significant at the probability level of 0.05.

Table 2 Cont.

Entry	% Empty seeds			(100-seed weight (g			(Seed yield (kg/ha		
	Medani	Agadi	Combined	Medani	Agadi	Combined	Medani	Agadi	Combined
SV60050	18.95	14.17	16.56	b 5.75	ab 5.12	c 5.44	3136.00	ab 2102.75	2619.37
SV60046	16.55	8.47	12.51	b 5.87	b 4.62	c 5.25	3531.25	a 2454.25	2992.75
SV60036	17.62	20.65	19.13	ab 7.25	a 6.37	ab 6.81	4135.25	b 1729.00	2932.37
Rcvh4	9.67	15.42	12.55	ab 7.00	6.62a	6.81ab	3355.25	b 1887.00	2621.12
Rcvh17	12.32	20.27	16.30	a 8.00	a 6.50	a 7.25	3581.25	b 1821.50	2701.37
Hysun33	16.60	13.47	15.00	ab 7.00	ab 6.00	b 6.50	3311.75	a 456.75	2884.25
Mean	15.3	15.4	15.4	6.8	5.9	6.3	3508.46	1741.88	2791.87
±SE	1.60	1.60	1.60	1.23	0.24	0.23	113.60	64.60	92.40
(% C.V)	41.88	41.5	41.71	13.57	16.17	14.78	12.95	12.46	13.24
Sig. level	N.S	N.S	N.S	*	*	**	N.S	**	N.S

Table 2. Mean performance and rank of six sunflower varieties evaluated for yield and yield components at two environments Medani and Agadi and their combined analysis in season (2009/10).

Entry	Days 50% flowering			(Plant height (cm)			Days to maturity			(Head diameter (cm)		
	Medani	Agadi	Combined	Medani	Agadi	Combined	Medani	Agadi	Combined	Medani	Agadi	C o m - bined
SV60050	ab 60	b 60	b 60	abc 154	170.5	a 162.3	b 80	b 86	c 83	c 15	16.8	c 15.9
SV60046	ab 61	b 60	b 60	a 165	153.75	b 160	ab 83	b 85	b 84	a 20.8	16.0	b 18.4
SV60036	a 62	a 65	a 63	a 165	160	a 163	a 85	a 92	a 88	a 21.5	19.5	A 20.5
RcvH4	c 52	c 53	c 52	c 134	162.5	c 149	c 71	c 70	d 71	b 16.0	17.0	c 16.52
RcvH17	c 52	d 46	d 50	bc 139	157.5	c 148	c 71	c 72	d 72	b 16.6	16.0	c 16.27
Hysun33	b 58	ab 61	b 59	ab 156	171.25	a 163	b 80	b 85	c 83	b 14.9	16.3	c 15.55
Mean	58	58	58	152.4	162.6	157.5	78	82	80	17.5	16.9	17.2
+SE	0.42	0.68	0.57	3.18	2.83	3.00	0.87	0.53	0.72	0.66	0.58	0.62
(% C.V)	2.89	4.71	3.92	8.35	6.97	7.65	4.43	2.60	3.60	15.18	13.62	14.45
Sig. level	**	**	**	**	N.S	*	**	**	**	**	N.S	**

and 2792 kg/ha) at both environments and combined, respectively (Table 2). Generally, seed yield obtained in this study is higher when compared with seed yield reported by other researchers, e.g. Idris, (2006), who reported yield of 1051kg/ha, Obeid (2001) who reported yield of 1638 kg/ha and Mohamed Ali (1999) who reported yield of 1289 kg/ha. Fereres et al., (1986) reported seed yield ranging from 500 to 2500 kg/ha when the crop was subjected to water deficit, while under irrigation the yield exceeded 3000 kg/ha. The yield potential did not differ from the world average, i.e., 3000 kg/ha (FAO, 2012). The orthogonal contrast was not significantly different for seed yield (kg/ha) for all comparisons, except the comparison of Rcvh4 vs Rcvh17, which was significantly different at Wad Medani (Table 3). While all comparisons showed significant differences, except the comparison of open-pollinated varieties vs hybrids at Agadi (Table 4). This could be attributed to environmental differences between the two locations. Generally, the performance of open-pollinated varieties and hybrids was better in Wad Medani when compared to Agadi.

Conclusion and Recommendations:

The study revealed that, there were

highly significant differences for the most studied agronomic characters among varieties in each environment and combined, except for empty seeds percentage which showed no significant differences. The hybrids and open-pollinated varieties performed better at Wad Medani, than at Agadi, so based on the result of this study they can be a suitable and adapted genetic planting material at the Gezira State; hence more investigation is needed to choose the most suitable ones. Meanwhile, the hybrid Sv60036 can be used as growing material in Wad Medani as it produced the highest yield. Whereas, in Agadi the hybrid Sv60046 can be selected for commercial production as it produced the highest yield in that area.

Coefficient of variation (C.V %) for this trait recorded the highest value compared to other traits, this could be attributed to sampling as well as genotype x environment interaction (Obeid, 2001).

Under both environments and their combined, there were highly significant differences among tested varieties for 100 – seed weight, this indicates the large diversity among the tested varieties for 100-seed weight. Similar results were also reported by Gill, et al., (1997) and Obeid (2001). The 100 seed weight at Wad Medani ranged from 5.75 to 8.00 g, the open-pollinated variety Rcvh17 gave the highest (8.00g) 100-seed weight, while the hybrid Sv60050 showed the lowest (5.75 g) 100-seed weight. At Agadi, this parameter ranged from 4.62 to 6.62 g, the open-pollinated variety Rcvh4 exhibited the highest (6.62g) 100 – seed weight, while the hybrid Sv60046 showed the lowest (4.62 g). In combined over the two environments, 100 seed weight ranged from 5.25 to 7.25g, and the open-pollinated variety Rcvh17 gave the highest (7.25 g) weight, while the hybrid Sv60046 showed the lowest (5.25 g) 100-seed weight. The varieties and hybrids means were (7.0, 6.0 and 6.3 g) at both environments and combined, respectively (Table

2). Orthogonal contrast showed no significant differences for 100-seeds weight (g) for all comparisons, except the comparisons of Hysun 33 vs other hybrids and Rcvh4 vs Rcvh17, which were significantly different at Wad Medani (Table 3). The same situation was observed in Agadi, except comparisons Sv60050 vs Sv60046 and Rcvh4 vs Rcvh17, which were significantly different (Table 4).

Under Agadi environment, there were highly significant differences among tested varieties, while there were no significant differences at Wad Medani and when combined over two environments, for seed yield (Table 2). Seed yield at Wad Medani ranged from 3136.00 to 4135.25 kg/ha, the hybrid Sv60036 produced the highest (4135.25 kg/ha) seed yield, while hybrid Sv60050 produced the lowest (3136.00 kg/ha). Seed yield at Agadi ranged from 456.75 to 2454.25 kg/ha, the hybrid Sv60036 produced the highest (2454.25 kg/ha) seed yield, while Hysun 33 produced the lowest (456.75 kg/ha). In combined, seed yield of varieties and hybrids ranged from 2619.37 - 2992.75 kg/ha, the hybrid Sv60046 produced the highest (2992.75 kg/ha) seed yield, while Sv60050 produced the lowest (2619.37 kg/ha). The varieties and hybrids means were (3509, 1741.88

est head diameter (21.5 cm), while Hysun 33 recorded the smallest head diameter (14.9 cm). Head diameter at Agadi ranged from 16.0 to 19.5 cm, the hybrid Sv60036 showed the highest (19.5 cm), while hybrid Sv60046 exhibited the lowest (16.0 cm) head diameter. In combined over two environments, the range for head diameter was from 15.9 to 20.5 cm, the hybrid Sv60036 showed the largest (20.5 cm), while hybrid Sv60050 exhibited the smallest head diameter (15.9 cm). The varieties and hybrids means were (17.5, 16.9 and 17.2 cm) at both environments and combined, respectively; (Table 2). Head diameter is an important factor in determining seed yield of sunflower. However, the large-size disk is usually characterized by relatively high percentage of empty seeds (Khana, 1972). At Wad Medani, the orthogonal contrasts were significantly different for head diameter (cm) for all comparisons, except the comparisons of varieties vs hybrids and Hysun33 vs other hybrids (Table 3). While in Agadi all comparisons showed no significant differences, (Table 4). This could be attributed to environmental differences between Wad Medani and Agadi.

Under both environments and their combined, there were no significant differences among tested varieties

for percentage of empty seeds. Percentage of empty seeds/head at Wad Medani ranged from 9.67 to 18.95%, the hybrid Sv60050 showed the highest (18.95%) percentage of empty seeds/head, while Rcvh4 exhibited the lowest (9.67%) percentage of this character. Percentage of empty seeds at Agadi ranged between 8.47 and 20.65%, the hybrid Sv60036 showed the highest (20.65%) percentage of empty seeds/head, while Sv60046 showed the lowest value (8.47%). In combined over the two environments, the percentage of empty seeds range from 12.55 to 19.13%, the hybrid Sv60036 exhibited the highest percentage of empty seeds/head (19.13%), while hybrid Sv60046 exhibited the lowest (12.51 %) percentage of empty seeds/head. The open-pollinated varieties and hybrids means were (15, 16 and 15%) at both environments and combined, respectively; (Table 2). The orthogonal contrasts were not significantly different for empty seeds percentage for all comparisons, except comparison of the varieties RCVH4 vs RCVH17, which showed significant differences at Wad Medani (Table 3). The same situation was observed in Agadi, for all comparisons, except the comparison of varieties vs hybrids, which it was significantly different (Table 4).

est (153.8 cm). In combined, plant height ranged from (148.4 - 163.4 cm), both SV60036 and Hysun 33 were the tallest (163.0cm), while Rcvh17 was the shortest (148.4 cm). The open-pollinated varieties and hybrids means were 153.0, 163.0 and 158.0 cm at both environments and combined, respectively. The orthogonal contrast showed no significant differences for plant height for all the comparisons, except comparisons of open-pollinated varieties vs hybrids and the hybrid Sv60050 vs hybrid Sv60046 which were significantly different at Wad Medani (Table3). Meanwhile, all comparisons showed no significant differences at Agadi (Table 4). This could be attributed to environmental differences mainly climates between the two environments.

Under both environments and their combined, there were highly significant differences among tested varieties for days to maturity, this indicated that there is a wide genetic variability among the tested varieties for time to maturity. Days to maturity at Wad Medani ranged from (71 - 85 days), the earliest genotypes were Rcvh4 and Rcvh17, which took about (71 days), while the latest genotype was Sv60036 (85 days). Days to maturity at Agadi, ranged from (70 - 92 days),

the earliest variety was Rcvh4 which took 70 days, while the latest variety was sv60036 (92 days). In combined over two environments the number of days to maturity ranged from (71 - 88 days), the earliest variety was Rcvh4 and it took 71 days. On the other hand, the latest (88 days) was the hybrid Sv60036. The varieties and hybrids means were (68, 69 and 68 days) at both environments and combined respectively, (Table 2). The orthogonal contrasts between varieties and hybrids were significantly different for days to maturity for all comparisons, except the comparison between the hybrids Sv60050 and Sv60046 vs Sv60036, which showed no significant difference at Wad Medani (Table 3). The same situation was observed at Agadi, where all comparisons were significantly different (Table4). This indicated that there is a wide genetic diversity among the tested genotypes for time to maturity.

Under Wad Medani and when combined over two environments, there were highly significant differences among the tested varieties while they showed no significant differences at Agadi, for head diameter. This indicates that there is a wide genetic variability. Head diameter at Wad Medani ranged from 14.9 - 21.5 cm, the hybrid Sv60036 recorded the larg-

Results and Discussion

Result of analysis of variance indicated highly significant differences ($P < 0.01$) for all agronomic characters among genotypes in each environment and combined, except empty seeds percentage, which showed no significant differences (Table 2), and the orthogonal contrasts between varieties and hybrids were shown in table 3 and 4.

Under both environments and their combined, there were highly significant differences among tested varieties for days to 50% flowering, this indicates that there is diversity among the tested varieties for time to flowering, and similar results have been reported by Tarig et al. (1992) and Obeid (2001). Days to 50% flowering ranged from (52 - 62) days at Wad Medani, the earliest variety was Rcvh4 and Rcvh17 (52 days), while Sv60036 was the latest (62 days). Days to 50% flowering at Agadi, ranged from (46 - 65) days, with variety Rcvh17 being the earliest (46 days) while hybrid Sv60036 was the latest (65 days). In combined over two environments the number of days to 50% flowering ranged from 50 - 63 days, Rcvh17 was the earliest (50 days), while the hybrid Sv60036 was the latest (63 days) one. The varieties and hybrids means were (58,

58, and 58) at both environments and combined respectively, (Table 2). The orthogonal contrasts between varieties and hybrids showed significant differences for days to 50% flowering for all comparisons at Wad Medani (Table 3). The same situation was observed in Agadi for all comparisons, except the comparisons of open-pollinated varieties vs hybrids and comparisons of the hybrids Sv60050 and Sv60046 vs Sv60036 (Table 4). This indicates that diversity among the tested varieties for time to flowering is valuable and can be used in improving the crop.

Under Wad Medani environment and when combined over two environments, there were highly significant differences among the tested varieties for plant height it was not significantly different at Agadi. This indicates that there is a wide genetic variability for this parameter, similar results have been reported by Tarig et al., (1992), Patil et al., (1996) and Obeid (2001). Plant height at Wad Medani ranged from (134.0 - 165.0 cm), the hybrids Sv60046 and Sv60036 were the tallest (165.0cm), while the variety Rcvh4 was the shortest (134.0cm) one. Plant height at Agadi, ranged from (153.8 - 171.3 cm), the hybrid Hysun 33 was the tallest (171.3 cm), while hybrid sv60046 was the short-

Agadi. Each variety was grown in 6 rows, each was 5.0 m long, with spacing of 0.80 m between rows and 0.20 m between holes within rows. After three weeks from sowing, plants were thinned to two seedlings per hill. Weeds were controlled by hand when needed. Irrigation was supplemented at 14 days' interval when necessary in Wad Medani location only. The total rainfall at Wad Medani in season 2009/10 was 253.83 mm: 30 mm in June, 104.8 mm in July, 89.1 mm in August, 29.7 mm in September, 0.23 mm in October and 0.10 mm in November. The total rainfall at Agadi in season 2009/10 was 425.70 mm: 70.9 mm in June, 103.8 mm in July, 153.8 mm in August, and 97.2 mm in September and zero mm in October and November. Days to 50% flowering, plant height (cm), days to maturity, disk diameter (cm), percentage of empty seeds, 100-seed weight (g) and seed yield (kg/ha) are the main traits measured in this study. In all experiments, measurements were made in the central rows of each plot dis-

carding one row or more at each side and all data were then based on 4.00 m of rows length except for days to 50% flowering and days to maturity, which were estimated on the entire row. Harvesting and threshing was performed by hand.

Analysis of variance was used for each location separately and the results of the two locations were combined using the statistical package (MSTAT-C) to test – significant differences among varieties. Orthogonal comparisons were constructed among the seven characters as shown in (Table 1) based on the following combinations

1 - Hybrids vs open-pollinated varieties.

Sv600 50 vs Sv600 46 and Sv60036
Hysun 33 vs other hybrids

4 - Sv600 46 vs Sv600 36

5- Varieties vs each other.

Table 1. Coefficients of the orthogonal contrasts between different hybrids and open-pollinated varieties of sunflower.

	Sv60050	Sv60046	Sv60036	HY 33	RcvH4	RcvH17
Hybrids vs varieties	1	1	1	1	-2	-2
Check 33 vs hybrids	1	1	1	-3	0	0
Sv60050 vs Sv60046 and Sv60036	2	-1	-1	0	0	0
Sv60046 vs Sv60036	0	1	-1	0	0	0
Rcvh4 vs Rcvh17	0	0	0	0	1	-1

had Scheme and Sennar State (Abd El Rahman et al., 2004). It is now grown on large scale in Damazin area mainly by the private sector.

One of the main problems of sunflower is the lack of suitable genotypes and proper breeding techniques to improve the crop. In Sudan, seeds are introduced and they are very expensive. For this reason, most of the farmers cannot afford buying hybrid seeds, so they tend to use open-pollinated cultivars and F2 hybrids which are characterized by high percentage of empty seeds.

Therefore, the objective of this study was to evaluate the performance of some sunflower varieties for yield and yield components, under two different environmental conditions of Sudan.

Materials and Methods:

The experiment was conducted at two different environments (locations), during the season (2009). The first environment was the Faculty of Agricultural Sciences Experimental Farm at Nishesheiba, Wad Medani. Nishesheiba area lies at latitude $14^{\circ} 24'N$ and longitude $33^{\circ} 29'E$ (Central of Sudan). The climate is hot and arid in summer and rain fall is mainly during July, August and September. The soil is deep cracking clay, which belongs to the central clay plain of

Sudan. It is alkaline in reaction, with pH ranging from 7.8 to 8.5. Organic matter and total nitrogen are very low in this soil being 0.22% and 0.034%, respectively, and generally the nutrients status is good. The second environment was the Arab Authority for Agricultural Investment and Development (AAAID) Experimental Farm at Agadi, Damazin, Blue Nile State (Southern Sudan). Agadi area is located at 30 km west of Damazin, Blue Nile State, at latitude $11^{\circ} 59'N$ and longitude $33^{\circ} 26'E$. The climate is tropical, semi-arid with pronounced wet period during the summer. Total annual rainfall ranges from 700 to 800 mm during July to October. Temperature is generally high. The soil is part of the "central clay plain" of the Sudan. Organic matter and nitrogen are low and pH is 8.2. The varieties used consisted of four hybrids: SV 60050, SV 60046 and SV 60036, (introduced from France), and Hysun 33 as check and two open pollinated varieties; RCVH – 4 and RCVH17, which were developed locally at the Rain- Fed Crops Research Center University of Gezira Wad Medani, Sudan. The experiment was arranged in a randomized complete block design (RCBD) with four replicates. Sowing dates were August 25, 2009 in Wad Medani and July 13, 2009 in

Introduction:

Sunflower (*Helianthus annuus* L.) is a member of the Asteraceae family (Groove and summer, 2005). It is one of the few crop species that originated in North America (Janet et al, 2010 and Putnam et al., 1990). Sunflower is a highly cross-pollinated crop. It is one of the most important industrial crops in the world after soybean and rapeseed because of its edible vegetable oil, (Putt, 1997; Fernandez – Martinez et al., 2004; Hu et al., 2010 and FAS.USDA, 2008). *Helianthus annuus* L. is a diploid plant with $2n = 34$ chromosomes (Fick, 1989). Sunflower oil is widespread because of its high quality and is one of the five basic nutrients for human food (Demirer et al., 2004). The main objective in many researches is to evaluate the agronomic properties for commercial sunflower cultivars (Killi and Altunday, 2005; Sadghi et al., 2008; and Karaaslan et al., 2010). Based on morphological, physiological and biochemical data, many methods were used to estimate the genetic diversity of sunflower genotypes (Dong et al., 2007). Sunflower has a high potential for seed yield and oil accumulation in the seed. According to FAO (2013), it is successfully grown over a widely scattered geographical area and considered as a crop adapted to

a wide range of environmental conditions (Carter, 1978 and Ekin et al.2005). Seeds contain 24-49% oil and the cake contains 25-35% protein (Henen, 2011). The oil accounts for 80% of the value of the crop, and it is generally considered premium oil because of its light color and high level of unsaturated fatty acids. Sunflower meal is a good diet for livestock, poultry and cage birds. The protein percentage of sunflower meal ranges from 28% - 42%. Sunflower can also be used as fodder and silage crop, and the cake that remains after oil extraction can be used for animal feeding. Several industrial applications have been explored. It has been used in certain paints, varnishes and plastics because of its semidrying properties without color modification.

Sunflower was first introduced in Sudan in 1932 for testing yield potential under irrigation at Gezira Research Station (Khidir, 2007). Sunflower is produced under irrigation and rain-fed conditions in the Sudan. Although its trials were started as early as 1970th in the mechanized crop production schemes, its commercial production began in the 1987/1988 growing season in the rain-fed sector in Gedarif and Blue Nile States, and in 1992/1993 growing season for the irrigated sector especially in Ra-

تقييم أداء بعض أصناف زهرة الشمس للإنتاجية ومكوناتها في وسط وجنوب السودان

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المستخلص

محصول زهرة الشمس يعتبر من أهم المحاصيل الزيتية التي تزرع بالري الصناعي وبالأمطار في السودان. أجريت الدراسة لموسم (2009/2010) بموقعين مختلفين في السودان، الموقع الأول بالمزرعة التجريبية لكلية العلوم الزراعية بالنيشيشيه، ودني، السودان، والموقع الثاني المزرعة التجريبية للهيئة العربية للاستثمار والإنماء الزراعي (اقتصادي)، الدمازين، ولاية النيل الأزرق، السودان. هدفت الدراسة لتقييم أداء بعض أصناف وهجن زهرة الشمس للإنتاجية ومكوناتها. تمت زراعة أربع هجن (*Hysun 33*, *SV 60050*, *SV 60046*, *SV 60036*) استجلبت من فرنسا و (*RCVH - 4* and *RCVH17*). باستخدام تصميم القطاعات العشوائية الكاملة بأربعة مكررات. شملت الدراسة سبع صفات وهي: عدد الأيام لـ 50% إزهار، عدد الأيام للنضج، ارتفاع النبات (سم)، قطر القرص (سم)، نسبة البذور الفارغة، وزن المائة حبه (جرام)، والإنتاجية لوحدة المساحة (كيلو جرام/هكتار). أجري التحليل الإحصائي بتحليل التباين ومقارنة المتوسطات المستقلة. أظهرت نتائج التحليل الإحصائي أن هنالك فروق معنوية بين الأصناف والهجن لكل الصفات التي درست فيما عدا نسبة البذور الفارغة. كما أوضحت الدراسة أيضا أن أداء الأصناف والهجن كان ممتاز بموقع ودني ولهذا يمكن أن تكون هذه الأصناف والهجن مناسبة للزراعة في منطقة الجزيرة.

الكلمات المفتاحية: الإنتاجية زهرة الشمس - التقييم

Evaluation of the Performance of some sunflower (*Helianthus annuus* L.) varieties for yield and yield components under central and Southern Sudan conditions

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Abstract

Sunflower is one of the important oil crops which are produced under irrigated and rain fed areas in Sudan. The study was carried out to evaluate the performance of some sunflower varieties for yield and yield components at two different environments of Sudan, during the season (2009/10); one environment was the Faculty of Agricultural Sciences Experimental Farm at Nishesheiba, Wad Medani, and the second environment was the Arab Authority for Agricultural Investment and Development Experimental Farm at Agadi, near Damazin, in Blue Nile State. The tested varieties consisted of four hybrids: SV 60050, SV 60046, SV 60036, which introduced from France and Hysun 33 as check, and two open pollinated varieties RCVH – 4 and RCVH17, which were developed locally. The experiment was arranged in a randomized complete block design (RCBD) with four replicates. The measured traits were days to 50% flowering, plant height (cm), days to maturity, head diameter (cm), percentage of empty seeds, 100-seed weight (g) and seed yield (kg/ha). Data was subjected to analysis of variance and orthogonal comparisons. Analysis of variance indicated highly significant differences ($P < 0.01$) for all agronomic characters among varieties in each environment and combined, except for empty seeds percentage which showed no significant differences. On the average, number of days to 50% flowering ranged between (50 -63 days), plant height (148.4 - 163.4 cm), number of days to maturity (71 - 88 days), head diameter (15.9 - 20.5) percentage of empty seeds (12.51 - 19.13%), 100 seed weight (5.25 - 7.25g) and seed yield (2619.37 - 2992.75 kg/ha). The hybrids and open-pollinated varieties performed better at Wad Medani, than at Agadi, so they can be a suitable and adapted genetic planting material at the Gezira State; hence more investigation is needed to choose the most suitable ones. Meanwhile, the hybrid Sv60036 can be used as growing material in Wad Medani as it produced the highest yield, whereas, in Agadi the hybrid Sv60046 can be selected for commercial production as it produced the highest yield in that area.

Keywords: Performance, sunflower, varieties, yield

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- Tertiary Education Trust Fund Office (TETFund), Federal Republic of Nigeria, Abuja, Nigeria.
- Olowu, T.A., and Oyedokun, O.A. (2000). Farmers' Accessibility of Agricultural Marketing Information: The Case of Oyinladun Radio Programme. *Journal of Economics Rural Development* 14(1): 109–125
- Omotayo, A.M., Chikwendu, O.D and Adebayo, K (2001): Two decades of World Bank Assisted Extension Service in Nigeria: Lessons and Challenges for the Future. *Journal of Agricultural Education and Extension* 7(3): 131-145
- Onemolease, E. (2002). Extension Needs of Women Cassava Farmers in Igueben and EsanNortheast Local Government. Areas of Edo State, Nigeria. Council for Development of Social Science Research in Africa. *Africa Development* 27: 116–26
- Rees, D., Momanyi, M., Wekundah, J., Ndugu, F., Odonde, J., Oyure, A.O., Andima, D., Kamau, M., Ndubi, J. Musembi, F., Mwaura, L. and Jolndersma, R. (2000). Agricultural Knowledge and Information Systems in Kenya: Implications for Technology Development and Dissemination. ODI Agricultural Research and Extension Network. Network Paper No:107
- Rola, A.C., Quizon, J.B., and Jamis, S.B. (2001). Do Farmer Field School Graduates Retain and Share What they Learn? An Investigation in Loilo, Phillipines. The World Bank, Washington, DC. USA.
- Samuel, G. S. (2001). The Development of Integrated Management Information Systems for Agricultural Extension Institutions of Developing Countries: The Case of Oromia Agricultural Development Bureau of Ethiopia, Aachen: Shaker pp.18-33
- Starasts, A. M. (2004). Battling the Knowledge Factor: A Study of Farmers' Information Seeking Learning and Knowledge Process with an Online Environment in Queensland. Unpublished Ph.D Thesis. Alemaya University Studies. Vol. 28, 277 – 301
- Swanson, (2008). Global Review of Good Agricultural Extension and Advisory Service Practices. Rome: FAO, pp 82
- van Den Ban, A. (1998). Supporting Farmers' Decision-making Process by Agricultural Extension. *Journey of Extension Systems* 14:55-64

- MSc. Thesis Alemaya, University.
- Egbule, P.E, and Njoku, E.C. (2001). Mass Media Support for Adult Education Agriculture in Southern Nigeria. *Adult Education and Development*, 56: 16–24
- FAO (2002). Report of the Second Consultation on Agricultural Information Management. Rome, Italy. Available at <http://www.fao.org/docrep/Meeting/005/Y7963E/>
- Girard, B.(2001). (ed.) *A Passion for Radio: Radio Waves and Community Goals* <http://www.eferencglobal.com/doi/abs/10.1555/9783598441257.161>.
- Kuponiyi, FA (2000). Mass Media in Agricultural Development: The Use of Radio by Farmers of Akinyele Local Government Area of Oyo State, Nigeria. *Nigeria Agricultural. Development Studies* (1)1:26–32
- Machethe C.I., Mollel N.M., Ayisi K., Mashatola M,B,Anim F.D.K.,and Vanasche F.(2004). Smallholder Irrigation and Agricultural Development in Olifants River Basin of Limpopo Province: Management, Transfer, Productivity, Profitability and Food Security Issues. Water Research Commission Report, Pretoria, South Africa
- Maize Technology Adoption. Empirical Evidence from Southwestern Oromia Report.
- NSSO (National Sample Survey Organisation) (2005). Situation Assessment Survey of Farmers: Access to Modern Technology for Farming, 59th round (January–December 2003). Report No. 499(59/33/2). New Delhi: Ministry of Statistics and Programme Implementation.
- Ogunfiditimi, T.O and Ewuola, S.O (1995). *The Sythensis of Comparative Agricultural Extension Systems*. Emmi Press Limited Ibadan pp3-85
- Oloruntoba, A. (2013). ‘Unleashing the Power of Capacity Building as an Elixir for Agricultural and Rural Development’. The First Inaugural Lecture of the University for Development Studies (UDS) Tamale, Ghana Series No 1, 61pp
- Oloruntoba, A. and Adegbite, D.A (2006). Improving Agricultural Extension Services through University Outreach Extension Initiatives: A Case of Farmers in Model Villages in Ogun State, Nigeria’. *The Journal of Agricultural Education and Extension* 12(40): 273-283. Available at: <http://www.journalsonline.tandf.co.uk>
- Oloruntoba, A., Abdul salaam, R., Ahungwa, G., and Nasiru, A. (2015). ‘Survey of Agricultural Extension Outreach Communities in Jigawa State, Nigeria’. Report submitted to

- bra State, Nigeria. ASSET Series A.) 2(1): 97-104
- Anderson, J.R and Feder, G. (2007). 'Handbook of Agricultural Economics'. Agricultural Extension. 3:2343-2378
- Apantaku, S. O., Oloruntoba, A. and Fakoya, E. O. (2003): 'Farmers' Involvement in Agricultural Problems Identification and Prioritization in Ogun State, Nigeria.' South African Journal of Agricultural Extension. 4 (1): 45-59 <http://www.ajol.info/viewissue.php>
- Ayankogbe, O., Omotola, B.D., Inem, V.A., Ahmed, O.A., and Manafa, O.U. (2003). Knowledge, Attitude, Beliefs and Behavioural Practices for Creating Awareness about HIV/AIDS in Lagos State, Nigeria. Nigerian Journal of Behavioural Science 44(1): 7-10
- Berhanu, G., Hoekstra, D., and Azage, T. (2006). Commercialisation of Ethiopia Agriculture: Extension Service from Input Supplier to Knowledge Broker and Facilitator. IPMS (Improving Productivity and Market Success) of Ethiopia Farmers Project Working Paper 1. ILRI (International Livestock Research Institute), Kenya pp 36
- Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., Mbabu, A., David J., Spielman, D.J., Horna, D., and Benin, S. (2006): From "Best Practice" to "Best Fit": A Framework for Analysing Pluralistic Agricultural Advisory Services Worldwide. IFPRI, Washington. Available at: <http://www.ifpri.org/pubs/ib/rb04.asp>
- Davis. K. (2009). Agriculture and climate change: An agenda for negotiation in Copenhagen. The Important Role of Extension Systems. IFPRI Focus 16, Brief 11. Washington, D.C.: International Food Policy Research Institute.
- Deribe Kaske, (2007). Agricultural Information Networks of Farm Women and Role of Agricultural Extension: The Case of Dale Woreda, Southern Nations, Nationalities and Peoples' Region. MSc. Thesis. Rural Development and Agricultural Extension. Haramaya (Ethiopia): Haramaya University 141p
- Dulle, F. W. (2000). The Extension Triads Approach in Disseminating Agricultural Information to Extension Workers: Some Experiences from the Southern Highlands Dairy Development Project, Tanzania. Journal of Information Science. 26 (2):121-128
- Ebrahim, J. (2006). Adoption Dairy Innovations: its Income and Gender Implications in Adami Tulu District. Unpublished

household size, small fragmented lands, low education and very weak agricultural extension linkage. The effort of the University for establishing the Outreach Centre was to serve as remedial measures for the rural communities in terms of agricultural extension access on one hand, and on the other hand, bring good understanding with the host communities. Following the near-collapse of the supply-driven public agricultural extension system at different periods in Nigeria, the University Extension initiative appears to be the panacea in 'helping the farmers to help themselves'. However, the Outreach Centre has to cultivate effective partnerships and collaborations with other agencies to bring about the expected successes and provide opportunities for stakeholders to appreciate the university's contribution to extension services and rural development.

Consequently, to continue to be relevant, effective and efficient, the Outreach Extension Centre and extension personnel should be well acquainted with the problems of the farmers and rural dwellers. The success is by indentifying and simplifying the key problem areas and then dealing with it with full support from the University and other partners. In this circumstance, local experience of

successes and failures will enable the extension administrators to continue to identify the most critical problems which may have varying degrees of importance at different levels.

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References

- Abbas, M., A.D. Sheikh, S. Muhammad and M. Ashfaq, (2003). Role of Electronic Media in the Adoption of Agricultural Technologies by Farmers in the Central Punjab-Pakistan. *International Journal of Agriculture Biology*, 5:22-5.
- Adereti, F.O., O.E. Fapojuwu and A.S. Onasanya,(2006). Information Utilisation on Cocoa Production Techniques by Farmers in Oluyole Local Government Area of Oyo State, Nigeria. *European Journal of Social Science*, 3(1): 1-7
- Ajayi, M. T. (2003): "Analysis of Mass Media Use for Agricultural Information by Farmers in Nigeria", *Journal of Extension Systems* 19 (2): 45 –55
- Anyanwu, A. C., Agwu, A. E. and Umeweni, C. A. (2002). Sources of Agricultural Information used by Women Farmers in Orumba Anam-

more efficient delivery of agricultural extension as well as other rural development services to smallholder farmers are now widely appreciated. From agricultural extension point of view, it will be much easier for change agent to deal with nucleated settlements either in the provision of improved technologies or communication since the development effort envisaged is through social groups which are usually cohesive and easier to work with. From the simple principles of small group dynamics, farmers tend to learn more quickly in small group situations where there is more face-to-face contact and therefore less room for misunderstandings; and decisions can be reached more quickly than in larger group situations. When small group membership is homogeneous - i.e., when members share some common bond, like location proximity, a similar income activity, or they come from the same socio-economic background - then there is also less potential for inter-member conflict and consequently more solidarity.

Accessible Advice

Oloruntoba (2013) reported that Africa has lagged behind in harnessing the Information Communication Technology (ICT) potential for extension services and rural development. Hence, the use of ICT in agricultural

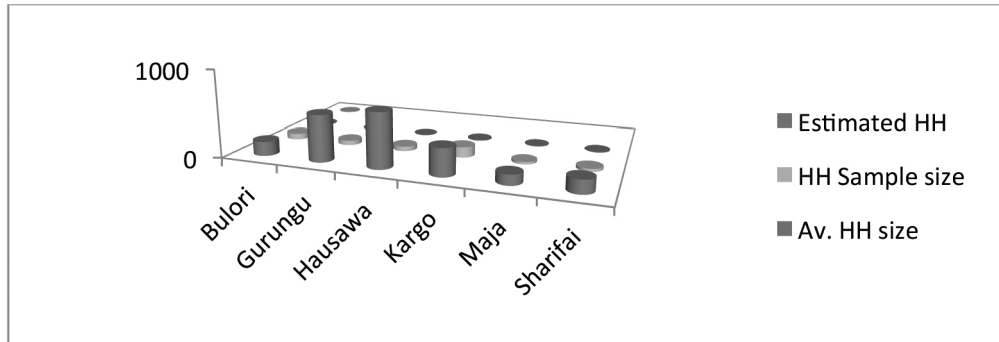
extension services has become necessary because of low ratio of extension officers to farmers. The Centre will develop methods of using ICT's such as multimedia, video to reinforce extension services and improve farming. Information will be provided to farmers and extension officers in local languages through a dedicated website. The quality of information will be presented in a readily accessible means to farmers and actors to improve agricultural production. Again, the use of cell phones to network with farmers, input suppliers and extension advisors will be encouraged to keep the farmers up-to-date on improved agro-technologies.

Advocacy and Sensitisation

Relevant contacts are being made with several Non-Governmental Organisations and farmer-led initiatives to continuous advocacy and sensitisation visits to the villages in company of the District Head of Dutse; encourage them on the need to cooperate with the institution which will pave way for them to enjoy immense benefits from this relationship

Conclusion

The situation analysis of the rural communities around the Federal University Dutse in the Northwest Nigeria depicted that of peasantry with very low annual income, large



characteristics of the communities is an essential requirement in planning and implementing useful and sustainable socio-economic empowerment programmes for improving the livelihoods of the communities.. It should be noted that the degree of participation in any intervention generally depends on the needs, opportunities, level of motivation of both individual and community, which is an essential condition for making agriculture and rural development intervention sustainable, while the lack of their involvement may lead to apathy and generate dissidence, neglect and abandonment of intervention.

To this end, a baseline surveys that provided useful in-situ information on the socio-economic and demographic characteristics of the households was concluded in 2015 in the model villages using appropriate methodologies that will generate adequate information and stimulate households' participation in the planning process. The outcome from the survey would hopefully lead to designing specific project interventions

that would ameliorate the condition of the communities.

Implementation Strategy

Small Group Approach

The Outreach Extension Centre would adopt the Small Farmer Groups (SFGs) approach to deliver agricultural extension services and rural development to smallholder farmers in the communities as an effective institutional device for lowering the delivery costs of these services, for reducing the expenses smallholder farmers incur in gaining access to those same services, and to markets, and for promoting small farmer self-development. Small farmer groups (SFGs), are also seen as a useful organisational mechanism for mobilising smallholder farmer collective self-help actions aimed at improving their own economic and social situations and that of the communities in model villages. Indeed, the benefits of using small group approaches for

and a weak link to extension system. Therefore, most smallholder farmers are usually affected by prices, subsidies and markets, but the input and output markets, which are not fully formed, remain localised to some extent. Smallholder farmers in the communities are highly vulnerable to inadequate agricultural extension access which is a major challenge to agricultural productivity. The term

smallholder farmer is synonymous with small-scale farmers, resource-poor farmers, peasant farmers, food-deficit farmers, household food security farmers, land-reform beneficiaries and emerging farmers (Machethe et al., 2004). The main criteria often used to classify farmers as smallholders by various analysts also include: land size, purpose of production (subsistence or commercial), and

Community	Estimated Population	Estimated HH	HH Sample size	Av. HH size	Overall HH Size
Bulori	2300	163	68	8.0	
Gurungu	1400	530	53	2.6	
Hausawa	3500	635	54	5.5	
Kargo	3500	317	120	11.0	7.6
Maja	1000	117	29	8.5	
Sharifai	1500	154	33	9.7	
Total	12, 200	1,916	357	-	

income level.

Fig 2: Average Household Size by Community

Source: Field Survey Oloruntoba et al. (2015)

Strategies for Agricultural Extension Access

The strategies for agricultural extension access in the communities are linked to the mission, objectives and activities. The realisation of any initiative is attributable to three complementary sets of factors including:

A high concentration of talents and team building;
Abundance of resources;

Supportive regulatory framework.

The dynamic interaction among these three factors is the distinguishing characteristic of high ranking successful initiatives. Consequently, the Centre will avail itself with the pool of intellectuals available within and outside the University such as local and international NGOs to partner in making extension delivery accessible to the communities. To this end, the pre-intervention and implementation strategies are as follows:

Pre-Intervention Strategy

The understanding of the peculiar

Table 1: Estimated Population and average Household size in Model Villages

Source: Field Survey Oloruntoba et al. (2015)

The educational level was generally low with low school enrolment rate with only one primary school. Generally, smallholder' is characterised by highly fragmented small farm size

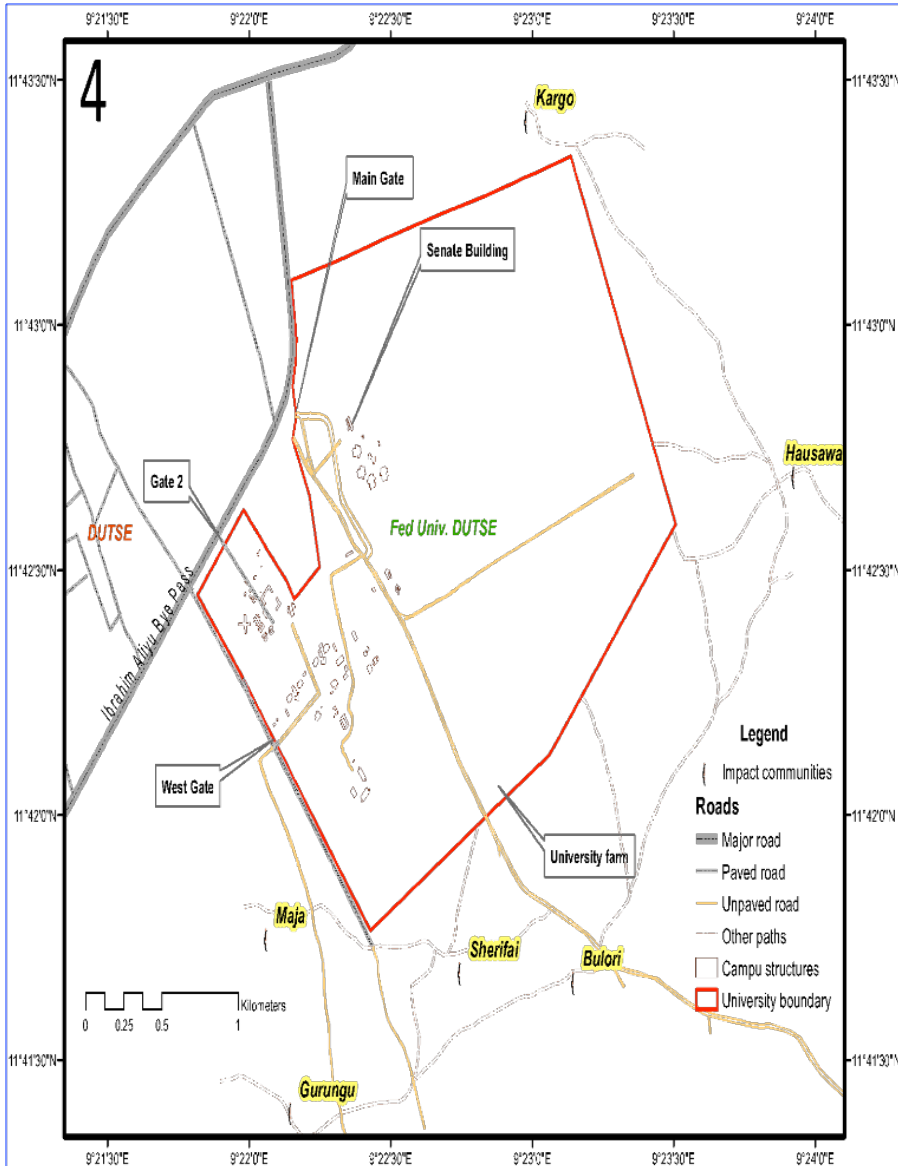


Fig. 2: Spatial Map of Outreach Communities at The Federal University Dutse Campus (Source: Field Survey Oloruntoba et al., (2015)

lages around the University campus.

Situation Analysis

There is little available information and data about the socio-economic and demographic imperatives of households in the model villages. But the baseline survey by Oloruntoba et al. (2015) revealed that the six model communities bordering the University are: Maja, Bulori, Gurungu, Hausawa, Kargo and Kawayi which were contiguous villages to each other and located on 2811 hectares of land (Fig. 2). Typically, a village is a common type of settlement which consists of many farmers' dwellings either with their farms or some distances away from the village. Hence, these rural village communities are made up mainly of nucleated with few dispersed settlement patterns, homesteads, barns, schools and mosques frequently visited by the inhabitants. Local mini-markets are usually found at the village square with main markets located in nearby major towns; the boundary of the community though might not be very distinct from another but has been spatially mapped. The inhabitants are mainly Hausas with few Fulanis and other ethno-linguistic groupings. The primary occupation is mainly subsistence farming with little or no

access to agricultural extension. The predominant cropping system is intensive cultivation of rain-fed mixed cropping. Arable crops commonly cultivated include millet, maize, sorghum and beans. The soil types ranged from aeolian sandy soil to iron rich laterite.

Table 1 presents the estimated population, average household size in model villages. Estimates based on Oloruntoba et al., (2015) suggested that the communities have about 12,200 people with 1916 households as presented in the Table 1 and Fig. 2. Findings also show that the six communities are male-headed with overall mean household size of 8 persons. Kargo has and the highest of 11 and Gurungu the lowest of 3 persons per household. The survey further revealed that the annual mean and median of household incomes in the communities were N185, 533.3 (US\$942) and N134, 083.3 (US\$681) respectively depicting poverty.

text of the Extension Outreach, focus would be on the extension information needs of the underserved or inadequately served target communities around the university.

Mission Statement

To create an enabling environment that would strengthen the structural base of local communities through action-research, extension, capacity building, quality learning and adoption of proven technologies.

Overall objective

To ensure that communities in ‘model villages’ are linked with potential partners to access agricultural extension information and skills for the improvement of their farms and homes.

The specific objectives are to:

build capacity and ensure technology transfer to farmers, local communities, change agents and students; link communities with potential partners and development agencies to become efficient and effective in availing themselves of their services; mobilise and develop communities toward self-reliance; make the university responsive to the needs and aspirations of the host communities.

The acquisition of large expanse of land for infrastructural development in educationally-disadvantaged agrarian communities was laudable and hoped to confer enormous benefits to the catchment areas. The negative consequence however was the displacement of the original owners of the land which was not only immediately disruptive but could be fraught with heavy long-term risks. Cultural heritages and important landmarks have disappeared, sensitive habitats destroyed and rare biological resources irretrievably lost as a result of implementation of the projects considered to be highly beneficial to mankind. With respect to negative social impacts of such projects; there are instances where displaced people have been reported to become more impoverished in their new settlements than they were before displacement. Cases also abound where people become more economically vulnerable and socially disintegrated. Although, the displaced communities appears to have settled down since 2012, their loss of farmland, water points, schools and clinic tend to increase the level of poverty of the affected persons; especially women and children folk. To the rescue, the land owners were adequately compensated and resettled as model vil-

outreach. For instance, Some attempts have been made with success with the Isoya Rural Development Project of the Obafemi Awolowo University Ile-Ife, Badeku Project by the University of Ibadan, Extension Village Model at the Federal University of Agriculture, Abeokuta, Maigari Project of the Ahmadu Bello University Zaria and lately in the last quarter of 2014, Federal University Dutse established the Agricultural Extension Outreach Centre.

The outreach by definition is any programme of activities initiated and designed to meet the information needs of an un-served or inadequately served target group (Young, 1983). Oloruntoba and Adegbite (2006) posited that, university outreach is an educational and an action-research-based information source enabling farmer to make decisions that improves quality of lives. It is therefore the art and science of understanding and responding to the needs and wants of groups of people. It is often built around a commitment to information flow across segments or niches.

The establishment of the Outreach Centre at the Federal University Dutse was consequent upon the need to extend practical knowledge acquired

from research to the host communities. This would promote partnership and development by bringing the 'town and gown' together through action-research and extension outreach. The benefit of transferring and disseminating improved technologies to the communities is expected to empower them to take control of their own affairs, foster inclusiveness, build capacity and increase the efficiency with which resources are used for the benefit of the target communities. It would also create a congenial atmosphere between the university and the host communities through various intervention projects to be embarked upon in due course. From the out-set, the Centre was designed as an innovative and emerging institution to cater for the extension information needs and wants of farmers, farmers' groups and communities around the University in Dutse. The outreach is an effort by the Centre to connect its ideas or practices to the efforts of other organisations, group or specific audiences. The outreach was built around a commitment to information flow across diverse target beneficiaries from those engaged in farming, to those displaced from their farmland, and would inform the type of extension information needs and advice to be given. In the con-

Public Extension System in Nigeria
The Nigerian Government has been adopted and implemented different types of extension approaches to boost agricultural production across the country. As the historical account of the country's agricultural extension approach portray, it has evolved over the years and was initiated in the nineteenth century by the early missionaries which focussed on the production of export crops. The method was known as the Commodity Extension Approach.

Various approaches have evolved since the independence in 1960. These include extension under the Ministry of Agriculture Approach which was tied to bureaucratic principles of the government ministry. The Farm Settlement/Farm Institute Leavers' Extension of 1959 to 1965 designed to reduce rural-urban drift but was purely top-down strategy. In 1972, the National Accelerated Food Production Programme was launched which employed participatory technology development but with minimal involvement of farmers in farm trials known as 'mini-kits'. In 1976, the Operation Feed the Nation was introduced as a strategy to mobilise the general public to participate in food production through supply of input without articulated extension

system. The River Basin Development Authority was established in 1977. Then the Green Revolution in 1979 premised on the Green Revolution success story in Asia but the approach did not have a focussed and was unsustainable.

The Pilot (Enclave) Agricultural Development Projects started in 1975 and later metamorphosed to the State-wide Agricultural Development Programme in 1989 which basically emphasised the Training and Visit (T&V) approach propounded by Benor and Baxter (as cited by Omotayo et al. 2001) and promoted in Nigeria and other countries by the World Bank. This approach operated a separate organisational structure with tripartite funding from the Federal Government, State Governments and the World Bank. There were many criticisms levied against this strategy (Ogunfiditimi and Ewuola, 1995).

The Unified Agricultural Extension System was introduced as an amendment of the ADP model. In this arrangement, one Village Extension Agent (VEA) is expected to teach farmers improved farm practices in all areas including crops, agro-forestry, animal production, fisheries and processing using the T & V system.

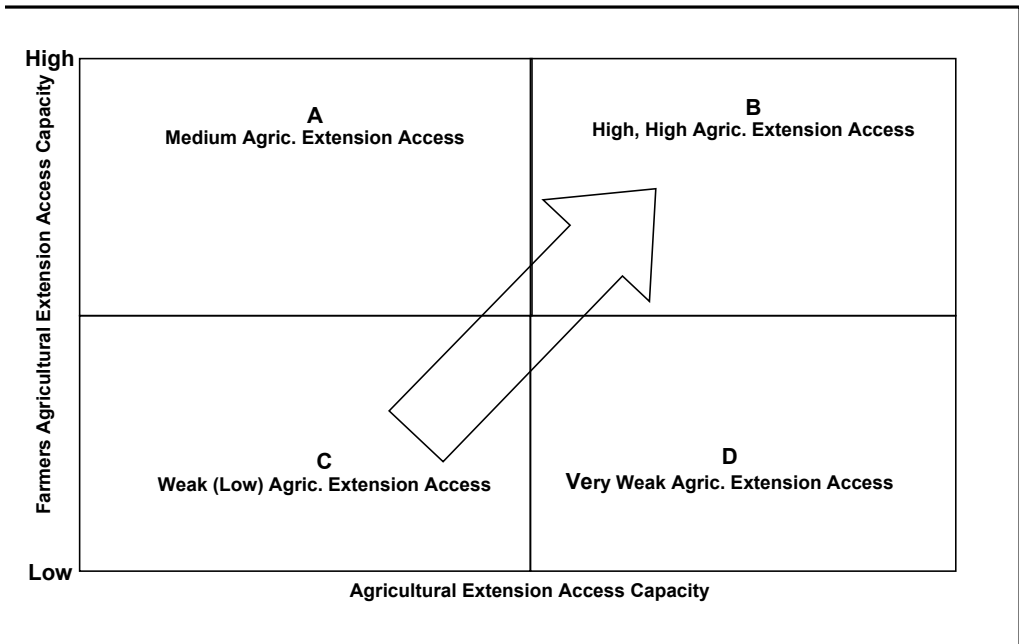


Fig.1: A typology of Agricultural Extension Access Transformation Path
Source: Authors (2016)

However, the approach has been variously criticised due partly to its non-sustainable nature. This government-funded extension programmes have been found not to be participatory, but top-down as farmers had no room to participate in extension policy. Information flow has been largely top-down to the end users. Hence, the link between extension and research putting farmer at the centre of technology generation has been overlooked. This was partly due to the dearth of agricultural extension workers responsible for dissemination of agricultural information to farmers and probably because information was

not well aligned to sustainable farming practices.

University Agricultural Extension in Nigeria

The Universities have come to the rescue because Agricultural extension in the country has been and still remains largely public sector-driven. Recently, universities have embarked on extending access to agricultural information to communities through Extension Outreach strategy. Basically Universities were established to provide leadership, advance learning through teaching and research. Serve as beacon to the society in terms of

Fig 1 presents an agricultural extension access transformation path. It illustrates the direction of the strengthening of agricultural extension access by smallholder farmers. Accessibility connotes the ability of farmer or group of farmers to obtain agricultural information needed for agricultural production in a relevant and timely manner. If farmers received appropriate agricultural extension services, this could lead to improved agricultural information and accessibility, farmers could then transformed as follows:

Box D = VWA; Box C = WA; Box B = MA; and Box A = HHA

If a farmer remains with Very Weak Agricultural Extension Access (Box D), meaning the lack of improved agricultural technology / accessibility. If a farmer is found at Medium Agricultural Extension Access Capacity (Box B), it will follow the strategy of enhancing the use of improved agricultural technology/accessibility to transform to High, High Agricultural Extension Capacity (Box A). The current status of the farmers in University Model villages reflects a Very Weak Agric Extension requiring the intervention of the University Outreach Centre to transform it to Medium or High Agric Extension

Access Capacity. Rola et al., (2001) reported that a critical challenge for extension lies with conveying the major advances in agricultural technologies and markets to farmers efficiently, in timely manner that ensures proper utilisation by the farmers

According to Berhanu et al., (2006), extension is a service of information, knowledge and skill development to enhance adoption of improved agricultural technologies and facilitation of linkages with other institutional support services (input supply, output marketing and credit). Birner et al., (2006) reported that agricultural advisory services in developing countries today have assumed a much more holistic and facilitator's role, and the field staff of an agricultural advisory service is not just a conduit of information, but an advisor, facilitator, and knowledge broker. The characteristics of a good information source are relevance, timeliness, accuracy, cost effectiveness, reliability, exhaustiveness and aggregation level (Statrasts, 2004).

spectively (NSSO, 2005).

In Fiji, radio and television accounted for more than 80 percent coverage of agricultural information and could be used to broadcast quality programmes to impact agricultural populace. Again, in central Punjab, India more than 56 percent farmers listened to radio and watched agricultural programme on television (Abbas et al., 2003). According to Onemolease (2002), sources of agricultural information through friends and relatives have profound effect on level of access to information needs by farmers. However, the relatively low patronage of media channels may be attributed to poor coverage, poor reading habits and weak purchasing power of farmers (Ayankogbe et al., 2003).

According to FAO (2002), rural women and girls usually have less access than men to information and new technologies. Without equal access to agricultural information, they are at a disadvantage in making informed choices about what to produce and when to sell their product. However, in spite of research and extension services efforts, Adereti et al., (2006) stated that there are improved packages on agricultural production that are not being adequately used by

farmers.

Agricultural Extension Access Transformation Path

Agricultural extension access refers to quality, quantity and timely agricultural information available to farmers through agricultural extension. Access to adequate agricultural extension services is very essential to increased agricultural productivity of farmers. Deribe (2007) and Ebrahim (2006) indicated that access to extension services has significant influence on adoption of agricultural technologies. Therefore, the frequency of extension contact has important role in the access to and utilisation of agricultural technologies. Samuel (2001) posited that agricultural information for decision-making must be acquired and used in order to make an informed decision. Agricultural extension is simply information communication in agriculture. Farmers have different information needs during each stage of agricultural production process ranging from weather forecasts, pest and diseases attacks, inputs (seeds and fertilizers), improved cultivation practices and prices. Broadly speaking, agricultural extension is the delivery of information inputs to farmers (Anderson and Feder, 2007).

markets and trade, organising farmers and producer groups, and working with farmers toward sustainability

Olowu and Oyedokun (2000) reported that several channels such as extension agents, individuals, farmer-to-farmer contact, print media (newspapers, magazines, newsletters, leaflets, pamphlets, and posters) and electronic media (radio, television, film, slides and film strips) have been widely used to disseminate information to farmers. Agricultural extension agents provided HIV/AIDS information for only 37.9% of the farmers. This is low in view of the redefined role of extension agents. In addition to the dissemination of proven farm technologies, extension agents are expected to disseminate HIV/AIDS awareness information to farmers (Egbule and Njoku, 2001).

According to Anyanwu et al. (2002) educational attainment predisposes one to using different sources of information, emphasis being more on professional rather than inter personal sources of information. In other words, the more educated an individual, the more exposed the person becomes to sources of information. Rees et al. (2000) reported that most Kenyan farmers considered their

most pressing information requirement which was not being adequately addressed as technical details of farming from the agricultural extension. Farmers need to be informed and educated about improved agricultural practices to enable them increase their productivity and income.

Kuponiyi (2000) opined that radio and television are important sources of agricultural information in Nigeria. Girard (2001) observes that radio undoubtedly remains the most important medium in Africa since low levels of literacy, distribution problems of newspapers and the cost of television leaves it the most accessible medium.

Ajayi (2003) reported that radio was the most popular among farmers in Southwest Nigeria. The popular use of radio by farmers is probably due to the fact that many farmers can afford to purchase a transistor radio as it is cheap, more accessible and easy to maintain than other mass media. Radio has a high capacity of creating awareness for new technologies and stimulating people to get involved. In India, it has been documented that radio and television accounted for 13 percent and 9.3 percent sources of information accessed by farmers re-

Problem Statement

Most farmers in rural Northwest Nigeria appeared to have low or little access to agricultural extension as a source on modern agro-technologies despite the presence of the State-wide Agricultural Development Programme whose primary responsibility was to disseminate improved innovation to farmers. The paucity of funds, inadequacy of extension agents require to make contacts with farmers which need to reach a large and complex farming community, inappropriate and poor quality information sharing among farmers are some of the reasons for non-performance. In other words, the content of the information provided by agricultural extension and the information farmers actually need appeared not to be aligned. cursory observation revealed that farmers in the Federal University Dutse Agricultural Extension Outreach Centre model villages in particular have no access to scientific and technological information that could help improve their capacity and ultimately agricultural productivity as reflected on the continuous reduction in agricultural production in the area. The paper examines the agricultural extension access of farmers and attempt to find answers to the following research questions:

Do smallholder farmers have access to agricultural extension as and when required?

What strategy has emerged to counter the emerging challenges/constraints militating against smallholder's farmers' access to agricultural extension?

Literature Review

Farmers require a diverse range of agricultural information to support their farm enterprises. Agricultural information is knowledge that farmers seek from extension services, fellow farmers, family and relatives and from media. van den Ban (1998) posited that farmers require information related to most appropriate technological options and management of technologies. Dulle (2000) reported that agricultural research results constitute an important knowledge base that should be made available to farmers for increased food production. Vuuren (2007) found that much of the knowledge generated by scientific research ended up on shelves and it is inaccessible to the farmers. Swanson (2008) noted that transfer of technology still has relevance since agric extension is now seen as playing a wider role by developing human and social capital, enhancing skills and knowledge for production and processing, facilitating access to

Introduction:

In rural Nigeria, the pervasive poverty is often blamed on lack of capacity building of farmers as a result of numerous ineffective strategies employed in handling it. If poverty is to be reduced, productivity of the agricultural sector must be enhanced. However, agricultural productivity will not increase if the capacity of farmers and other actors in the agricultural value chain remains low, preventing them from innovating. Innovations could include new agricultural knowledge or technologies related to primary production, processing and commercialisation—all of which could positively affect productivity, competitiveness and livelihoods of rural folks. Farmers represent the majority of people living and earning their living in rural areas.

Agricultural extension has been recognised as an indispensable factor in the practice of farming and it is the basis of extension service delivery. Farmers require a diverse range of agricultural information to support their farm enterprises. Davis (2009) reported that agricultural extension, or agricultural advisory services, comprises the entire set of organisations that support people engaged in agricultural production and facilitate their efforts to solve problems; link to

markets and other players in the agricultural value chain; and obtain information, skills, and technologies to improve their livelihoods. Swanson (2008) also reported that transfer of technology still has relevance since agricultural extension is now seen as playing a wider role by developing human and social capital, enhancing skills and knowledge for production and processing, facilitating access to markets and trade, organising farmers and producer groups, and working with farmers toward sustainable natural resource management practices. Within this expanded role, the breadth of information that agricultural extension can support through provision and facilitating access and sharing is much larger. In addition, as the agricultural sector has become more complex, farmers' access to sources of reliable and relevant information has become increasingly important. Apantaku, Olorunjoba and Fakoya (2003) examined smallholder farmers' involvement in agricultural technology generation and utilisation. Found that the level of farmer's involvement in the agricultural problem identification and prioritisation was low because majority of the technologies were not based on farmers identified problems and felt-needs.

Agricultural Extension Access in Model Villages Evidence from Rural Northwest Nigeria

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Abstract

The smallholder farmers who are mainly peasants constitute majority of the agricultural workforce in rural Nigeria with weak to very weak agricultural extension access. The paper explores the historical antecedent of the near-comatose public extension services.

The scenarios had created a serious gap in the agricultural knowledge dissemination and information sharing between actors and have not foster opportunities for collaboration and partnership. Bearing in mind that agricultural extension is institutionally weaker in the farmer-extension-farmer continuum; the University Outreach Extension strategy appears to be a panacea in creating an extensive bottom-up engagement in farming issues, agro-technology generation and transfer in the farming system and respond to the agricultural extension and rural development needs of farmers have been established in model villages in rural Northwest Nigeria.

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- Hindmarsh, M. and Love, S.C.J. (1991). Anasarca and myopathy in Ostrich chicks. *Aust. Vet. J.*, 68: 237-240.
- Satteneri, G. and Satterlee, D.G. (1994). Factors affecting hatchability of ostrich eggs. *Poult Sci.*, 73(1):
- Shanawany, M.M. (1994c). The importance of light for ostriches. *Ostrich Update*, 3: 52-54.
- Shanawany, M.M. (2006). Recent developments in ostrich farming. <http://www.seaworld.org/>
- Shanawany, M.M. and Dingle, J. (1999). Ostrich Production Systems. FAO animal production and health paper 144, Food and Agriculture Organization of the United Nations, Rome, Italy.
- Swart, D. (1988). Studies on the Hatchability Growth Energy Metabolism of ostrich chicks (*Struthiocamelus var. domesticus*). Ph.D. Thesis, University of Stellenbauch, South Africa.
- Smit, D. J. V. Z. (1963). Ostrich farming in the Little Karoo. Department of Agriculture, Technical Series Bulletin No. 358, Republic of South Africa.
- Steel, R.G.D. and Torrie, J.H. (1989). Principles of Statistics. McGraw-Hill Book Co., New York, USA.
- Van Schalkwyk, S.J. (1997). Thesis Project. Klein Karoo Agricultural Development Centre, Oudtshoorn, RSA.
- Van Schalkwyk, S.J.; Brand, Z.; Cloete, S.W.P. and Blood J.R. (1998). The Influence of different disinfection protocols on the hatching performance of ostrich eggs. Proc, 2nd international Ratites congress, Oudtshoorn, South Africa.
- Schalkwyk, S.J. van; Cloete, S.W.P.; Brown, C.R. and van Schalkwyk, S.J. (1999). The effect of temperature of ostrich on the hatching performance of ostrich chicks, and its implications for artificial incubation in forced drought wooden incubators. *S. Afr. J. Anim. Sci.*, 29 (2): 92-99.
- Van Schalkwyk, S.J.; Brown, C.R.; Jarvis, M., Dekock, J.A and Yesel, A. (1994). Ostrich Development. Poster for Prohatch Ostrich Incubation Systems, Somerset West, South Africa.
- Van Niekerk, B.D.H and Muller, U.T (1996). Maximizing growth of the ostrich for slaughter. Proc., European Ostrich Association: World Congress, European Ostrich Association, Expo Centre, Hengelo, the Netherlands.
- Wilson, H.R.; Eldred, A.R. and Wilcox, C. J. (1997). Storage time and ostrich egg hatchability. *J. Appl. Poult. Res.*, 6: 216-220

- Seasonal plasma levels of luteinizing and steroid hormones, in male and female domestic ostrich (*Struthiocamelus*). *Gen. Comp. Endocrinol.*, 93: 21 – 27.
- Gonzalez, A.; Satterlee, D.G.; Moharer, F. and Cadd, G.G. (1999). Factors affecting ostrich egg hatchability. *Poult. Sci.*, 78 (9): 1257-1262.
- FMTW (1996). Annual Report. Wildlife Conservation Administration, Federal Ministry of Tourism and Wildlife, Khartoum, Sudan.
- Hallam, M.G. (1992). The TOPAZ Introduction to Practical Ostrich Farming. Superior Print and Backaging, Harare, Zimbabwe.
- Lodhi, G. N.; Singh, D. and Ichhponani, J.S. (1976). Variation in nutrient content of feeding stuffs rich in protein and reassessment of chemical method for metabolizable energy estimation for poultry. *J. Agric. Sci.*, 86: 293.
- Jarvis, M.J. F; Harvis, C. and Keffen, R.H. (1985a). Breeding seasons and laying patterns of the Southern Africa ostrich *Struthiocamelus*. *Ibis*, 127:442-449.
- Jensen, J.M.; Johnson, J.H. and Weiner, S.T. (1992). Husbandry and Medical Management of Ostrich, Emus and Rheas. Wildlife and Exotic Animal Teleconsultants, College station, Texas, USA.
- Leuthold, W.(1977). Notes on the breeding biology of ostrich (*Struthiocamelus*) in Tsavo East National park, Kenya. *Ibis*., 119: 541-544.
- Jost, R. (1993). Ostriches and their commercial use. Investigation at an ostrich farm in Namibia. Institut fur Hygiene Infektionskrankheiten Giessen, Germany.
- Krawinkel, P. (1994). Investigations on different factors affecting natural and induced hatching in the African ostrich (*Struthiocamelus*) and on other data on ostrich. Institut fur Gflugelkrankheiten, Justus-Liebig Universtat, Giessen, Germany
- Kreibich, A. and Sommer, M. (1995). Ostrich Farm Management. Landwirtschaftsverlag Gmmtt, Munster- Hilltop, Germany.
- Aisha E.Faki, Elobied, E.A.; Hagir I.M. Osman and Amin, A.E. (2015). Ostrich (*Struthio camelus*) Egg Embryonic Death during Artificial Incubation. *International Journal of applied Sciences and biotechnology (IJASBT)*. Vol 3(4):566-578.
13. Su
- More, S.J. (1996a). The performance of farmed ostrich hens in eastern Australia. *Prev. Vet. Med.*, 29(1):107-120.
- More, S.J. (1996b). The performance of farmed ostrich eggs in eastern Australia, *Prev. Vet. Med.*, 29(2): 121-133.
- More, S.J. (1997). Monitoring the health and productivity of farmed ostrich flocks. *Aust. Vet. J.*, 75:583-587.
- Nikolaus, G. (1987). Distribution Atlas of Sudanese Birds, with notes on habitats and status. *Bonner Zoologische Monographier*.
- Philbey, A.W.; Button, C.; Gestier, A. W.; Munoro, B. E.; Glastonbry, J.R.W.;

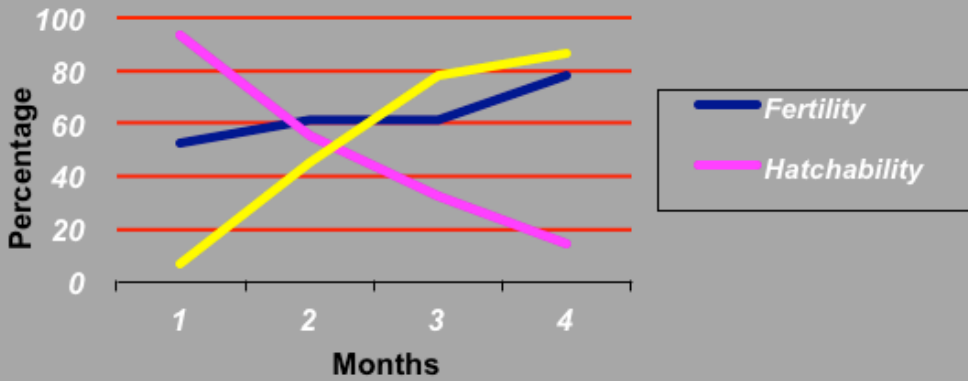
Item	Egg weight range					
	I	II	III	IV	V	VI
	<1150	1150-1300	1301-1450	1451-1600	1601-1750	1751-1900
Number of eggs / category	3	14	32	55	26	9
Aver. egg weight / category	1008.30	1245.36	1384.84	1519.82	1675.50	1848.89
No. of fertile eggs	2	5	14	40	18	6
Fertility %	66.66	35.71	43.75	72.73	69.23	66.66
Hatchability % of fertile eggs	33.33	64.29	56.25	27.27	30.77	00.00
Number of live chicks	2	4	7	20	5	0
Aver. chick weight (g)	775.00	800.00	914.29	1008.75	1058.00	00.00
Aver. chick weight% of the egg weight	69.51	64.57	66.44	66.36	62.13	00.00

* Done on the 139 fresh eggs of the second year lay.

REFERENCES

- Ar, A.; Gefen, E. and Huchzermeyer, F.W. (1998). Further improving hatchability in artificial incubation of ostrich eggs. Proc., 2nd International Ratite Congress, Oudtshoorn, South Africa.
- Blood, J. R.; Schalbywyk, S. J. van; Cloete, S.W.P. and Brand, Z.; van Schalkwyk, S. J. and Huchzermeyer, F.W. (1998). Embryonic deaths in relation to water loss of artificially incubated ostrich eggs. In: Ratites in a competitive world. F.W. Huchzermeyer (Ed.). Proceedings, 2nd International Ratites Congress, Oudtshoorn, South Africa.
- Brinsea (2003). Guidelines for incubation of ostrich eggs. <http://www.brinsea.com/>
- Brown, C. R.; Peinke, D. and Loveridge, A. (1996). Mortality in near-term ostrich embryos during artificial incubation. Brit. Poult. Sci., 37: 73-85.
- Cogburn, D. (2006). What is commercial ostrich? Rooster Cogburn Ranch, Picacho Peak, Arizona, USA, <http://www.roostercogburn.com/>
- Deeming, D. C. (1995a). Factors affecting hatchability during commercial incubation of ostrich (*Struthio camelus*) eggs. Brit. Poult. Sci., 36 (1): 51- 56.
- Deeming, D. C. (1996a). Production, fertility and hatchability of ostrich (*Struthio camelus*) eggs on a farm in the United Kingdom. J. Anim. Sci., 63: 329 – 336.
- Deeming, D.C. (1996d). Ostrich eggs – an incubation challenge. World. Poult., 12 (11) :49 – 53.
- Deeming, D. C. (1997a). Ratite Egg Incubation – Practical Guide. Oxford Printing Centre, Oxford, U K.
- Degen, A. A., Weil, S.; Rosentstrauch, A.; Kam, M. and Dawson, A. (1994).

Figure 2. Batch incubation percent performance for the second season.



Mean chick weight% of the egg weight 65.41 ± 0.123 of the second year of production.

Table 4. Breeding ostrich egg embryonic deaths values during the second year of production

Item	Breeding pen	
	A	
No. of incubated eggs		139
No. of early embryonic deaths		30
Early embryonic deaths % of total embryonic deaths		63.83
No. of late embryonic deaths		17
Late embryonic deaths % of total embryonic deaths		36.17
Mean egg weight (g) of late embryonic deaths	83.03	$1549.77 \pm$
Water loss% of late embryonic death eggs	1.90	$10.48 \pm$
No. of total embryonic deaths		47
Total embryonic deaths % of incubated fertile eggs		55.29

Table 5. Average incubation / hatching values based on egg weight (g) category

Item	Breeding pen
	A
No. of hens	7
Total egg production	161
Egg production performance	
Aver. egg production/ hen	23.00
No. of broken eggs	3
Mean egg weight (g)	1508.23 ±96.23
No. of incubated eggs	139
No. of un-fertile eggs	54
No. of fertile eggs	85
Fertility %	61.15

Table 3. Breeding ostrich hatchability values during the second year of production

Item	Breeding pen
	A
No. of incubated eggs	139
No. of hatched chicks	38
Hatchability % of incubated eggs	27.34
Hatchability % of fertile eggs	44.71
Mean weight of hatched eggs (g)	1468.55 ±150.21
Water loss% of hatched eggs	9.94± 0.50

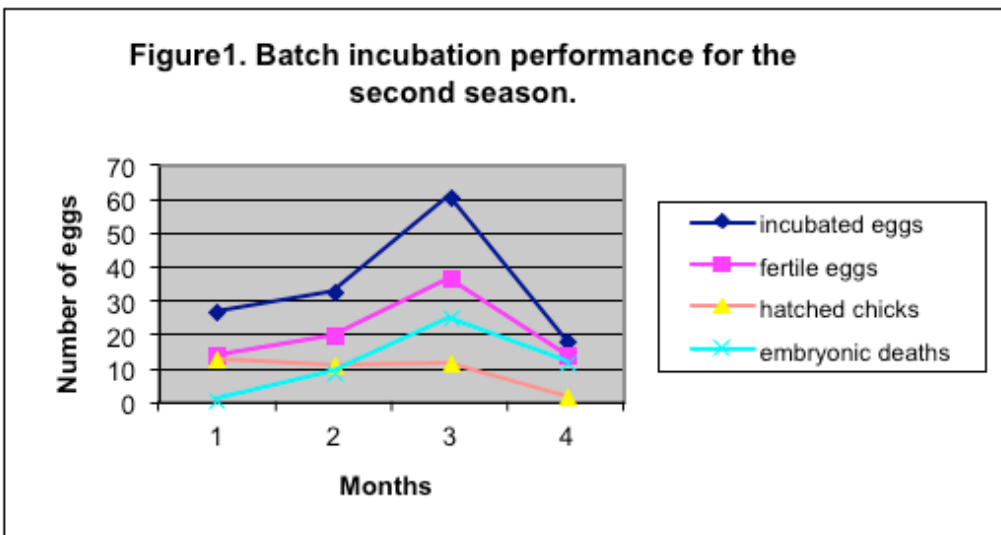


Table 3. Breeding ostrich hatchability values during the second year of production

Item	Breeding pen
	A
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No. of hatched chicks	38
Hatchability % of incubated eggs	27.34
Hatchability % of fertile eggs	44.71
Mean weight of hatched eggs (g)	1468.55 ± 150.21
Water loss% of hatched eggs	9.94 ± 0.50
Mean chick weight (g)	968.82 ± 50.05
Mean chick weight% of the egg weight	65 .41 ± 01.23

Table 4. Breeding ostrich egg embryonic deaths values during the second year of production

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	A
No. of incubated eggs	139
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Early embryonic deaths % of total embryonic deaths	63.83
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Late embryonic deaths % of total embryonic deaths	36.17
Mean egg weight (g) of late embryonic deaths	1549.77 ± 83.03
Water loss% of late embryonic death eggs	10.48 ± 1.90
No. of total embryonic deaths	47
Total embryonic deaths % of incubated fertile eggs	55.29

Table 2. Breeding ostrich egg production and fertility values during the second year of production

Table 1. Effect of time of lay on mean (\pm s.d.) breeding ostrich egg weight (g).

Production season	Laying season(mean \pm s. d.)		
	Early	Mid	Late
Second	1358.21 \pm 166.38 b	1506.14 \pm 77.26 ab	1619.64 \pm 73.03 a

Means in a row bearing the same letter subscript are similar ($p > 0.05$).

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hatching mechanism of the chick (when piping in the middle of the air cell) to decide on intervention. Hatching chick draws the yolk sac inside the body during the last 24 hours of incubation and normally, piping and crushing the egg between top side (air cell region) and mid region (equatorial region) with their beak and right leg toe seen near each other. Residual albumin can be found in some eggs after the complete development of the embryo without being incriminated for any ill effect. Our observation in hatching edematous chicks is that they always have the yolk sac unabsorbed in the abdominal cavity. From the above mention, there were no differences in the piping area and the procedure of piping in poultry or ostrich as seen by Deeming (1995a and 1996d) 2-3 days before ostrich hatching normally starts or equivalent in the chicken embryo at 17 days of development.

Practical implications

The red-necked ostriches originating from the wild can be reared in captivity successfully and can attain fair levels of

production.

The use of a chicken type incubator for ostrich eggs proved practically to be unsuccessful as it was not designed with suitable capacities. It is imperative to observe the homogeneity of eggs setting as differences in egg size implies differences in incubator settings for temperature and ventilation.

Conclusion

The red-necked ostrich can well be managed for a fair level of production, fertility and hatchability under feeding up to energy and protein requirements specified for the different physiological stages of the bird. Incubating ostrich eggs is much like the domestic fowl in aspects of temperature, ventilation, humidity and turning, but ostrich eggs are variable in sizes, a matter which necessitates setting similar egg size categories to enable the incubator manager to set and sustain the temperature and humidity. Hence the fixed incubator setting will not be perfectly suitable to all egg sizes, resulting in hatching chicks that may need assistance.

Table 1. Effect of time of lay on mean (\pm s.d.) breeding ostrich egg weight (g).

Production season	Laying season(mean \pm s. d.)		
	Early	Mid	Late
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Means in a row bearing the same letter subscript are similar ($p > 0.05$).

al., 1997). The ostrich eggs in this second season were incubated in a modified chicken egg incubator which is not fairly fitting for the incubation of ostrich eggs. Designed temperature, ventilation, humidity, turning and egg heat generation all are different. Krawinkel (1994) found that egg size and weight had a significant effect on hatching rate.

During the eighties Swart (1988) had observed more eggs were produced from large number of breeding stock, but numbers of live chicks produced were still low. He suggested that the low and variable (40-30%) hatchability was due to the high embryonic mortalities and Infertility. Jensen et al. (1992) summarized that the two main reasons for poor incubator hatching results are poor hatchability potential of the egg (genetic, nutritional and physical components) and incubator environment factors (temperature, humidity and the carbon dioxide/oxygen balance). The mortality of ostrich chick embryos is the major problems in the incubation of ostrich egg especially in the first trimester of incubation.

Early embryonic mortality was higher in the second season of incubation when eggs were subjected to the stress of transportation over about 90 kilometers to the hatcheries which were designed for chicken eggs. The egg turning, temperature and humidity cannot be controlled properly. Nevertheless, Jensen et al., (1992) reported that one third of

the total mortality occurs during the first trimester of incubation, the period of organs and systems development.

Late embryonic deaths occur within the last trimester of incubation as the chicks prepare to hatch (Jensen et al., 1992). The total percent embryonic deaths were high in the second season. The high rate of death in the second second season due to the improper incubation conditions was already explained. The chicken eggs incubator was also utilized as a hatcher. Late deaths were related to the high temperature (Van Sckalkwyk et al., 1999), incorrect setting and inadequate turning of eggs (Deeming, 1996a; 1997a and Brown et al., 1996).

The major contributing factor in the late dead embryo or dead-in shell was the low percentage of water loss from the ostrich egg during the incubation. Our results had always related low water loss to high embryonic deaths, similar to Blood et al. (1998) who showed that embryonic deaths due to the less evaporative water loss had occurred to 35 days of incubation.

Observation on chick hatching throughout the breeding season revealed that chicks in low weight eggs pip earlier than high weight ones but average of chick weight had increased with increasing eggs weight. This finding is similar to Gonzalez et al., (1999) who associated chick weight with egg size and stated that large eggs produce large chicks.

Candling was utilized to follow up the

gle, 1999). Similar to that seen by Van Schalkwyk et al. (1994), Van Schalkwyk et al., (1999) and Deeming (1995a), candling after the first week of incubation showed the small embryo as a black spot and as incubation advances to the third week, the fertile egg increased in the black shadow in the center of the egg yolk surrounded by the light yellow colored albumin. Living small embryos when candled (2-3 weeks) and exposed to light and/or heat of the candling lamp were observed to turn away to the other side of the egg in an indication of chick livability.

Diagnostically, candling can detect early dead embryo (up to 3 weeks) as a black non increasing shadow centralized in the egg yolk that doesn't respond to the candling light or heat. Corresponding examination revealed a small body embryo, a remarkably large black eye of the head with the body with or without covering feathers subject to the advancement of development. No comparable descriptions were cited in the relevant literature. Candling infertile eggs usually show clear yellow light color covering all over the egg up to the third week of incubation, but Deeming (1996d) reported candling infertile eggs sometimes can be missed for fertile by showing a cloudy shadow and when examining no embryo would be seen in real. He attributed this to the intensive water loss or heating of the egg resulting in shrinkage of the inner layer membranes and the albumin

then candles as a Jelly-like structure.

The low water loss in the second season may be attributed to the use of chicken egg incubators which was not efficient in ventilating ostrich eggs. The egg batches were in different stages of development; hence differ in their requirement of heat, moisture and ventilation subject to embryonic development. The different variation in egg water loss from the egg incubated were attributed to the egg mass, shell thickness (act as pore length), pore area or pore density and temperature and humidity within and outside the setter (Philbey et al., 1991; Satteneri and Satterlee, 1994; Deeming, 1995a; 1997a; Brown et al., 1996 and Faki et al., 2015). Batch incubation performance for the second season marked the third month (March) as peak production with peak fertility. This was tied to the longer daylight at this month of the year compared to the preceding and succeeding months. Furthermore in batch incubation percent performance for the second season, fertility increased with the season progress while hatchability and embryonic deaths are to the inverse of each other. Hence every failure hatchability counts as embryonic death rather than infertility.

The hatchability of incubated fertile eggs stands as key character in the evaluation of an ostrich farm success. Our second season hatchability was low. Stock was first coming on lay at low rate of egg production hence low hatchability (Deeming, 1996a and Wilson et

Ostriches are seasonal breeders like other ratites and other avian species exemplified by the Guinea fowl and the Water fowl. The captive red-necked ostriches laying season observed here started late December and concluded late May i.e. 5 months. The observations of Shanawany (1994c) were that the mating season lasts from six to eight months annually and the timing and duration of breeding season varies with the latitude and altitude. Our results differ with Leuthold (1977) who found in the southern hemisphere nearby the equator (Tsavo National Park, east Kenya), the breeding season commences March and ends around August/September. Hence the time it starts matches the peak of production in central Sudan (around the tropic of Cancer). The trend of egg production is characterized by low egg production at the beginning and at the end of the season, while peak production is in the middle of the season. Egg production/ hen/ week in the first season was 1.08, which was less than the average egg production/ hen/week (1.5) reported by Jost (1993). The production/hen increases in ascending order according to their advancing age. The trend of seasonal egg weight changes obtained show that egg weight increases successively during the season (early, mid and late) with heavier egg weights obtained late in the season. Average egg weight categories of the second season of production were 12.23% for less than 1300 (g) and 81.3% for

weight range 1300 to 1750 and 6.47% for weight range 1750-1900. The mean egg weight (1508.23 ± 96.23) was similar to the findings of Brinsea (2003), Ar et al., (1998), Van Schalkwyk et al. (1999) and Blood et al. (1998) in the African black. Female ostriches during the second season started laying late thereby produced less eggs. This was attributed to the lack of sexual maturity and past experience. Similar seasonal trend in egg weight changes was confirmed by Jarvis et al. (1985a) in the wild and Degen et al. (1994), More (1996a) and Deeming (1996d) in the domesticated birds. Female ostriches in the breeding season produce an egg every other day. Ostriches from various areas appear to have a characteristic average egg shape and size. This may be attributed to variations in body dimensions of the bird.

Fertilities recorded here were 61.15% in the second season, comparable fertility values (27.4- 91.2%) were reported by More (1996b and 1997) who observed fertility to have considerably varied between farms. In the second season the higher ratio of female to the male (1:1.4) allows much chances of mating within the group and hence increased fertility (61.15%). Mating stimulates the female to lay.

Candling is the quickest and easiest method for detection of the fertile/infertile eggs, surviving, early or late dead embryos (Deeming, 1995a, 1996d, Brinsea, 2003 and Shanawany and Din-

tion. Average egg production per hen was 23 with mean egg weight of 1508.23 ± 96.23 g and fertility of 61.15%.

Table 3 shows the breeding ostrich hatchability values during the second year of production. The hatchability % of incubated and fertile eggs was 27.34 and 44.71 respectively. Water loss % of hatched eggs was 9.94 ± 0.50 . Mean chick weight was 968.82 ± 50.05 g and mean chick weight % of the egg weight was 65.41 ± 01.23 .

Table 4 shows the breeding ostrich egg embryonic deaths values during the second year of production. The early embryonic deaths % of total embryonic deaths were 63.83 % and the late embryonic deaths % of total embryonic deaths were 36.17. Water loss was 10.48 ± 1.90 % of the late embryonic death eggs. Total embryonic deaths % of incubated fertile eggs was 55.29.

Table 5 shows the average incubation / hatching values based on egg weight categories (I-VI at 150 g increment each) during of the second year of production. Average egg weight / category parallels that of the maximum set as increasing from the first to the sixth group. Average chick weight increases up to the fifth group (1058.00 g). Hatchability and fertility are negatively related up to the fifth group also when hatchability declines.

Figure 1 shows the batch incubation performance during the second season. The number of eggs increases to a peak at the third month then declines towards the

fourth. Fertility and embryonic deaths follow the change in the number of eggs. Hatched chicks are inversely proportional to the number of eggs till the third month when it declines with the number of eggs.

Figure 2 shows batch incubation percent performance during the second season. Hatchability and embryonic deaths are inversely related. Fertility started medium ($\approx 50\%$) and reached high values ($\approx 80\%$) at the fourth month.

DISCUSSION

Farming some wild species like gazelles, crocodiles and ostriches has proved high economic reward due to the increasing demand of their products. In the Sudan, proper wild farming started to grow, especially ostrich farms with at least one breeder farm in operation selling ostrich chicks to the public. The red-necked is a vicious type ostrich to raise compared to the African Black originating from South Africa, which is easily managed and defined by Cogburn (2006) as the right commercial bird to stock. Worldwide studies on different ostrich production aspects were done on the African Blacks. Hence very few studies were done on the red-necked ostrich which is till now is the only species available in the wild and farmed in the Sudan. Needless say the findings in open literature on wild and captive red-necked ostrich egg production, incubation, chick rearing and management practices are meager.

on turning. Eggs were set in the incubator trays horizontally for the first 3 weeks, and then placed in the vertical position for the remaining period. In both positions, eggs were manually turned over 180° every 6 hours (Van Schalkwyk et al., 1998). Temperature is measured daily in the morning and mid day, by an incubator built-in thermometer and the humidity is controlled by using water pans resting on the incubator floor. Eggs were incubated at 36.10°C and relative humidity 25% till hatched. Eggs were first candled prior to incubation using a candling box of dimensions 30x22x24cm with a 200 watt lamp. Candled eggs rest on a 10cm diameter circular mid opening at the top of the box. The second candling was done at the end of the third week of incubation to determine fertility. Final candling was done at the end of the fifth week before Hatching. Incubated eggs were weekly weighed till the fifth week. Incubation time was recorded ending by the first chick pipping.

Hatching chick

The hatching chick was allowed time to dry up, then the navel area was gently swabbed two or three times in the first 24 hours of life with diluted iodine solution to suppress liable bacterial infection. Hatched chick weight (g) was recorded immediately after drying up. The number of surviving hatching chicks per batch was recorded. Three days post hatching, the remaining un-hatched

eggs were broken down and examined for determining either infertility, early or late embryonic deaths.

Statistical analysis

Data obtained in mean values were compared using the un-paired student's t-test (Steel and Torrie, 1989). Data in egg weight categories were figured as histograms. Data in incubation performance, chick growth and developmental values were shown as a trace. Percent values were utilized in expressing chick mortalities.

RESULTS

The breeding flock during the second season of production started lay December till May i.e. 150 days of production. The time of egg lay observed was nearly two hours before mid day and thereafter continues to sunset. Egg color of ostrich eggs laid was creamy white or yellowish with the texture of surface being pitted with pores. Egg lay during the night or early morning was rarely observed.

Table 1 shows the effect of time of lay (in season) on mean egg weight. Mean egg weight during late second season are heavier ($p < 0.05$) than early season. Egg weight increases across season at all times (early, mid or late) with heavier average egg weight (1619.64 ± 73.03 g) in late season.

Table 2 shows the breeding ostrich egg production and fertility values of seven hens during the second year of produc-

White Nile State. The parent breeding flock, at the beginning of the second year of production, comprised seven females and 5 males (male/female ratio is 1:1.4) of the same age (3 years old). They were first stocked in the farm from the wild (Dindir National Park, Dindir Province, Sinnar State). The birds were housed in one pen (A), of dimensions 40x30 m., surrounded by a mesh-wire fence (5x5 cm. openings) of two meters height with metal pipe supports at intervals of three meters. Sandy ground was laid under the shaded area (3x6m). Some trees scatter inside the pen. Two longitudinally half-cut oil barrels were used as feeders and drinkers.

Feeding

The breeding flock was maintained on a laying ration for two weeks before the beginning of lay for adaptation. The ration was formulated to meet breeding ostrich nutritional requirements (Kreibich and Sommer, 1995), crude protein 13.62%, crude fiber 16.99%, Ca 3.06%, P 00.46 and energy 9MJME/Kg calculated according to Lodhi et al. (1976). Feeding was offered ad lib. 8.00 a.m. daily with water always being available.

Egg collection and storage

Night egg lay collection takes place in the morning before feeding and collection continues during the day. Eggs were collected manually. Collection date was marked on the egg surface before stor-

age. The eggs were placed in the vertical position with the air-cell (wide end) to the top to stay the plastoderm. Eggs were stored for a maximum of 7 days at room temperature before being transferred to incubation and hatching. The storage room was 4x4x3m. with windows always closed. The room was equipped with an electric fan and three flat exposed water plates to increase the humidity and decrease room temperature. Eggs of the second season were transported to the incubators at the Department of Animal Production, College of Agriculture Studies, Sudan University of Science and Technology, Shambat, Khartoum North. Eggs were placed in boxes holed to half egg's height and embedded in foam, utilizing setting boxes in an air conditioned van. Upon arrival at the incubation room, eggs were given a serial incubation number before taking the egg incubation weight (egg setting weight) in g., using a dial balance of max. 2 kg.

Egg incubation

An incubator (Funk-68, Hammerum, Denmark) for poultry was used with some modifications in the tray lodges for the second season eggs. Four wooden trays of dimensions 95x35x18cm with expand wire base were accommodated. A total of 139 eggs were incubated in 14 batches. Eggs were set in six pairs for each tray with control galvanized cross wires in between to keep eggs in position

INTRODUCTION

Ostrich farming was started in South Africa late during the eighteenth Century, mainly for the feathers up to 1975 when production of skins and meat come on lead with feathers contracting only 7-10% of the gross income of the industry (Smit, 1963). Before 1986, commercial ostrich production was virtually unknown to the rest of the world (Hallam, 1992). Ostrich products (feather and egg) trade was old in history and dates back to the Egyptian, Abyssinian and Babylon civilizations when feathers were exported from Senegal, Morocco, Algeria, Sudan and Libya (Van Schalkwyk, 1997).

The global expansion of the ostrich industry has relied on the high prices of the ostrich products with a subsequent increased demand for breeding stock. The ostrich industry income supersedes other avian species, being derived from meat, skin and feather sales. Revenue from skins currently constitutes approximately 70-75% of the income from ostrich products in South Africa (Van Niekerk and Muller 1996). Ostrich is an advantageous bird to raise, it can live in a wide range of habitats, from the dry to the rainy zones. It is high infecundity and can produce annually more than ten times tons of meat compared to cattle (Shanawany, 2006). Nowadays the bulk of ostrich population in the Sudan drew back to Lat. 13oN, namely the Dindir National Park

which is remarkable for being the only location of high ostrich abundance in the semi-arid savanna. Also the Blue Nile (southwards), southern Kordofan and Darfur (south western) ecozones are suitable ostrich habitats (Nikolaus, 1987), but no census of ostrich population estimations were given.

In the Sudan, ostrich farming was only recent. Some ostrich collection farms were established for export purposes before the first intensive ostrich farm was granted a permit in 1992 (FMTW, 1996). The feeding, egg production, incubation management, hatching and rearing of the red-necked ostrich (*S.camelus*) were not appreciably studied in the Sudan. Thus there is need for basic scientific information on these aspects to arrive at a stand to improve these production traits in the future.

This study was conducted to add to the meager information on breeding captive red-necked ostrich (*S.camelus*) egg production and incubation /hatching parameters under Sudan farming conditions, testing for the efficiency use of chicken egg incubator.

MATERIALS AND METHODS

Stock and accommodation

The following experiment was conducted using a commercial red-necked ostrich (*S. camelus*) breeding flock maintained in EL-Rajaa Agricultural Scheme, ELGitaina Province, 70 Km. South to Khartoum by the White Nile,

أداء تفقيس بيض النعام ذو الرقبة الحمراء باستخدام فقاصة دجاج

العبيد عبد الرحيم العبيد، محمد تجاني صالح، عابشة الفكي محمد، أحمد الأمين محمد

المستخلص

اجريت هذه الدراسة في نعام الأسر (عمر 3 س، نوات) في موسم الانتاج الثاني لتقييم التحضين الصناعي للبيض باستخدام فقاصة بيض الدواجن مع بعض التعديل في صواني البيض. قطع نعام التربية التجاري احمر الرقبة (7 اناث و5 ذكور) احضر أصلاً من البرية (محمية الدندر، محافظة الدندر ولاية سنار). اسكن القطيع بحظيرة تربية بمزرعة تجارية ابعادها (40x30 متراً) مؤمنة بسياج شبكة سلكية ارتفاعها مترين بدعائم مواسير معدنية ومزودة بأكالتين وشرابيتين موضوعتان تحت مظلة ابعادها 3x6x3 متراً. مستوى التغذية كان بروتين خام %14 وطاقة ممثلة 09.23 ميغا جول لكل كجم. جمع البيض يدويا وخرن لمدة أقصاها 7 ايام تحت حرارة الغرفة قبل ترحيله الي الفقاسات. تم تحضين 139 بيضة في 14 مجموعة. البيض تم وضعه في صواني الفقاصة افقيا لمدة الثلاث اسابيع الأولى ثم وضع راسيا لباقي المدة. بكلا الوضعين كان البيض يقلب يدويا الي 180 درجة كل 6 ساعات. تم تحضين البيض في درجة حرارة 36.1 درجة مئوية والرطوبة النسبية 25% حتي الفقس. تم الكشف الضوئي للبيض قبل التحضين وفي نهاية المدة للتحضين والكتاكت الفاقسة يتم تحضينها. كان متوسط انتاج النعامة من البيض 23 بمتوسط وزن البيضة 1508.23 ± 96.23 جرام وخصوبة قدرها 61.15%. يزداد وزن البيض خلال الموسم في كل الاوقات (البداية، المنتصف و آخر الموسم) مع اعلي متوسط لوزن البيضة 1619.64 ± 73.03 جم في نهاية الموسم. كانت نسبة التفقيس المئوية للبيض المحضن ونسبة الخصوبة 27.34 و 44.71 علي التوالي. النسبة المئوية للماء المفقود من البيض الفاقس كانت 0.50 ± 9.94. كان متوسط وزن الكتكوت 968.82 ± 50.05 جرام ومتوسط نسبة وزن الكتكوت المئوية من وزن البيضة 01.23 ± 65.41. كانت النسبة المئوية للموت الجنيني الباكر من النسبة المئوية الكلية للموت الجنيني %63.83 والنسبة المئوية للموت الجنيني الأخير من النسبة المئوية الكلية للموت الجنيني 36.17. كان فقد الماء 1.90 ± 10.48% من بيض الموت الجنيني الأخير. كانت النسبة المئوية للموت الجنيني الكلي من البيض المخصب المحضن %55.29. يستفاد من الدراسة أن النعام البري ذو الرقبة الحمراء الذي يربي في الأسر يمكن أن يصل إلي مستويات مقدره من الانتاج مع خصوبة ونسبة فقس معقولتين إذا ما تم إعلافة حسب متطلبات انتاج البيض.

Captive red-necked ostrich (*Struthio camelus*) egg incubation performance using chicken incubator

By

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Abstract

This experiment was conducted in captive ostriches (3 years old) second season of lay to evaluate artificial incubation of eggs using poultry incubator with egg tray modifications .Commercial red-necked ostrich (*Struthio camelus*) breeding flock (seven females and 5 males) was originally stocked in from the wild (Dindir National Park , Dindir Province, Sinnar State) .Accommodation was in a commercial farm breeding pen of dimensions 40x30 m., secured by a mesh-wire fence of two meters height with metal pipe supports and provided with 2feeders and 2 waterers laid under a shaded area of 3x6 x3 m. Feeding plane was at 14% crude protein and 09.23 MJ ME/ Kg. Eggs were collected manually and stored for a maximum of 7 days at room temperature before being transported to the incubators. A total of 139 eggs were incubated in 14 batches. Eggs were set in the incubator trays horizontally for the first 3 weeks and then placed in the vertical position for the remaining period. In both positions, eggs were manually turned over 180o every 6 hours. Eggs were incubated at 36.10C and relative humidity 25% till hatched. Eggs were candled before and end term incubation and hatched chicks were brooded. Average egg production per hen was 23 with mean egg weight of 1508.23 ±96.23 g and fertility of 61.15%. Egg weight increases across season at all times (early, mid or late) with heavier average egg weight 1619.64 ± 73.03g. in late season. The hatchability % of incubated and fertile eggs was 27.34 and 44.71 respectively. Water loss% of hatched eggs was 9.94± 0.50. Mean chick weight was 968.82 ± 50.05 g and mean chick weight% of the egg weight was 65.41 ± 01.23.The early embryonic deaths % of total embryonic deaths were 63.83 % and the late embryonic deaths % of total embryonic deaths were 36.17. Water loss was 10.48± 1.90 % of the late embryonic death eggs. Total embryonic deaths % of incubated fertile eggs was 55.29%.It was concluded that the wild red-necked ostriches reared in captivity can attain fair levels of production with reasonable fertility and hatchability when fed up to requirements of lay.

- nonaSquamosa).In: Fruits of warm climates Ed: JF. North Miami, Florida, USA. p. 69–72.
- Nyam KL, Tan C, Che Man Y, Lai OM, Long K (2009) Physicochemical properties of Kalahari melon seed oil following extraction using solvent and aqueous enzymatic methods. *IntJ Food Sci Technol* 44:694–701
 - Pinto AC de Q, Cardeiro MCR, de Andrade SRM, Ferreira FR, de Filgueiras CHA, Alres RE, Kinpara DI (2005) *Annonaspecies*. International Centre for Underutilised Crops. University of Southampton, Southampton, UK
 - Rafeeq M, Mustafa A, Khan NZ (2002) Phytochemical standardization of sharifa oil (*Annonasquamosa* Linn). *Hamdard-Medicus* 45(2):88–89.
 - Raj, S.D., Vennila, J.J. and Panneerselvam, A.J., (2009). The hepatoprotective effect of alcoholic extract of *Annonasquamosa* leaves on experimentally induced liver injury in Swiss albino mice. *International Journal of Integrative Biology*, 5(3):182-186.
 - Rohman, A., Che Man, Y.B., Ismail, A. and Hashim, P., (2011). Monitoring the oxidative stability of virgin coconut oil during oven test using chemical indexes and FTIR spectroscopy. *International Food Research Journal*, 18: 303-310.
 - STATGRAPHICS_ 1985–1989. Statgraphics statistical graphics systems, Version 4.0, STSC Inc. & Statistical Graphics Cooperation, Rockville
 - Strayer, D, Belcher M, Dawson T, Delaney B, Fine J, Flickinger B, Friedman P, Heckel C, Hughes J, Kincs F, Linsen L, - McBrayer T, McCaskill D, McNeill G, Nugent M, Paladini E, Rosegrant P, Tiffany T, Wainwright B, Wilken J., (2006). *Food Fats and Oils*. 9th ed. Institute of Shortening and Edible Oils. 1750n New York Avenue, Nw, Suite Washington, 37 pages.

Subjection of gishta oil to precise refining or processing steps such as degumming and alkali refining neutralization, bleaching, deodorization, so as to investigate their effects on oil characteristics, composition and stability.

The un saponifiable fractions such as sterols, phospholipids need to be studied in the crude and refined oils, to detect their effects on oil stability.

Seed cake of the sample must be further investigated for amino acids, protein fractions, solubility, other functional properties, and the possibility of industrial utilization of the gishta seed protein

References

- Ansari MH, Afaque S, Ahmad M (1985) Isoricinoleic acid in *Annona squamosa* seed oil. *J Am Oil Chem Soc* 62(10):1514
- Anyasor, G.N., Ogunwenmo, K.O., Oyelana, O.A., Ajayi, D. and Dangana, J., (2009). Chemical Analyses of Groundnut (*Archishypogaea*) oil, *Pakistan Journal of Nutrition*, 8(3): 269-272.
- AOAC (1990) *Official Methods of Analysis*, 15th edn. Washington, DC, USA
- AOCS (1993) In: AOCS (ed) *Official methods & recommended practices of the American Oil Chemists Society*, 4th edn. Champaign, IL Official 25.
- Branco, P.C., Castilho, P.C., Rosa, M.F. and Ferreira, J., (2010) Characterization of *Annona cherimola* Mill. Seed Oil from Madeira Island: a Possible Biodiesel Feedstock. *Journal of the Amer. Oil Chem Soc*, 87 (40): 1350 – 1353.
- Ching M.C.S., Tong, S.Y. and Benzie, I.F.F., (2007). Antioxidant Protection of Edible Oils. *Plant Foods for Human Nutrition (Formerly Qualitas Plantarum)*, 62(1):39-42.
- Codex Standard for named vegetable oils CODEX-STAN210-1999
- Crapiste, G.H., Brevedan, M.I.V. and Carelli A.A., (1999). Oxidation of sunflower oil during storage. *J. Amer. Oil Chem. Soc.*, 76(12): 1437-1443.
- Intaranongpai J, Chavasiri W, Gritsanapan W (2006) Anti-head lice effect of *Annona squamosa* seeds. *South-east Asian J Trop Med Public Health* 37(3):532-535
- Mariod AA (2000) Seeds of *Sclerocarya birrea* oil and protein: quality and product development aspects, M.Sc. thesis, University of Gazira, Wadmedani, Sudan
- Mariod AA, Mattha`us B, Eichner K, Hussein IH (2009) Study of fatty acids, tocopherol, sterols, phenolic compounds and oxidative stability of three unconventional oils in comparison with four conventional ones. *Arab J Food and Nut* 23:50–55
- Morton JF (1987) Fruits of warm climates (Sugar Apple). Miami, FL, pp 69-72
- Morton, J.F. (1987). Sugar Apple (*An-*

tle increase with storage time from 1.2 to 6.1 meq O₂/kg oil in ASSE and from 1.6 to 6.0 in ASCE in the last 72 h. From these data results showed that the *Annona squamosa* seed oil showed high oxidative stability. These results could be explained by the fact that the intrinsic antioxidants compounds from crude oil may retard oxidative reactions. These observations are in agreement with other

results (Crapisteet al., 1999),(Ching et al., 2007) and (Brancoet al.,2010) who analyzed the *Annona squamosa* seed oil as an added value product, namely as a source of biodiesel. The oil was characterized in terms of lipid composition (HPLC-APCI-MS and ¹³C NMR), resistance to oxidation and acidity index.

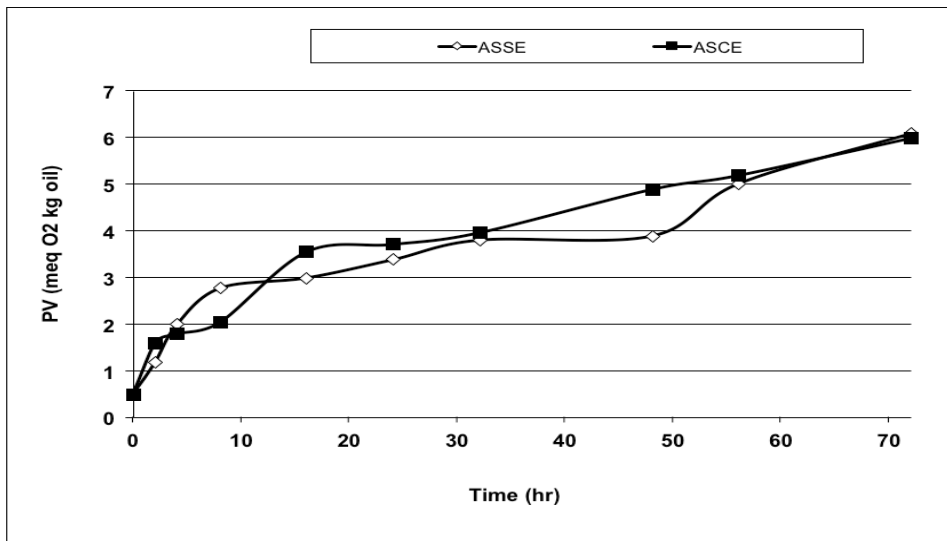


Fig. (1): Oxidative stability measured by peroxide value (PV) of *Annona squamosa* soxhelt and cold extracted oils subjected to 70°C.

ASSE: *Annona squamosa* soxhelt extraction.

ASCE: *Annona squamosa* cold extraction.

Conclusions

This study showed that *gishta* (*Annona squamosa*) seeds are rich in protein and oil. The oil extracts exhibited good physicochemical properties and could be useful for industrial applications.

Oxidative stability of *gishta* seed oil was determined. The results show high stability of *gishta* oil.

Recommendations

gishta (*Annona squamosa*) grown as a wild plants in Sudan, these multipurpose trees must be maintained and their oil seed deserve further attention and investigations.

Toxicological studies need to be done to determine if oil of *gishta* (*Annona squamosa*) is edible or not.

Table 2: Physicochemical properties of *Annona squamosa* *

Physicochemical parameters	ASCE	ASSE
(% Oil content (w/w	26.800 ± 1.1^a	27.500 ± 1.1^a
(Refractive index ($40 \pm 1^\circ\text{C}$	1.470 ± 0.005^a	1.470 ± 0.005^a
(Acid value (mg KOH/g	0.890 ± 1.1^a	1.540 ± 1.1^b
(Peroxide value (meq O ₂ /kg oil	1.000 ± 0.2^a	0.900 ± 1.1^a
(Saponification value (KOH/g	185.7 ± 0.21^a	184.5 ± 0.11^a
(Specific gravity ($30 \pm 1^\circ\text{C}$	0.816 ± 0.001^a	0.816 ± 0.001^a

* All determinations were carried out in triplicate and mean value \pm standard deviation (SD).abcdValues with different superscript letters within a row indicate significant difference at $p < 0.05$. ASCE=Annona squamosa cold extraction, ASSE=Annona squamosa Soxhlet extraction.

Oxidative Stability of Gishta Oils

The evaluation of oxidative stability is a key factor in developing the new oil for food applications. The oil stabilities during storage or upon heating are vital parameter for ensuring that oil has the good performance at elevated temperature (Rohman et al., 2011). Several methods have been used to evaluate the extent of oxidative deterioration, which are related to the measurement of the concentration of primary or secondary oxidation products. The most frequently used are peroxide value (PV). The PV is used for monitoring of peroxide for-

mation in the early stages of oxidation. Changes in the peroxide value (PV) as a measure of the primary oxidation in the two samples during storage at 70°C and measurement of the peroxide value at certain time are shown in Fig. (1). From this figure the initial PVs of Annonasquamosaxhlet extraction (ASSE), Annona squamosa cold press (ASCE), are 1.0 and 0.9.meq O₂/kg of oil, respectively. The initial peroxide values of crude oils were less than the standard peroxide value (10 meqO₂/kg) for vegetable oil deterioration (Anyasoret al., 2009). The low peroxide values indicated slow oxidation of these oils. These values were considered satisfactory according to the international regulations on edible oils. At the end point of oxidation, the two oil samples reached PVs of 6.1, 6meqO₂/kg respectively. ASSE and ASCE showed very slight increase in PV throughout the first 24 h and then there was a very lit-

the production of oil from such seeds could be of interest.

Table 1: The proximate analysis of kernels of *Annona squamosa**

(%)Proximate Analysis	<i>Annona squamosa</i>
Moisture	0.2 ^a 6.7±
Fat	0.4 ^a 26.8±
Protein	0.2 ^a 17.5±
Ash	0.1 ^a 2.2±
Fiber	16.8±0.2 ^a
CHO	0.3 ^a 30.0±

*All determinations were carried out in triplicate and mean value ± standard deviation (SD) is reported. ab Values with different superscript letters within column indicate significant difference at $p < 0.05$.

Oil Physicochemical Properties

Table (2) shows that the oil content of *A. squamosa* seed kernel using cold and Soxhlet extraction methods was significantly ($P > 0.05$) higher (26.8, 27.5%) respectively. The difference in oil content between cold extraction, and Soxhlet extraction method was not significant and can be attributed to the fact that during Soxhlet extraction, the high temperature employed in solvent evaporation may have caused sample heating which will allow oil droplets to come out of the sample easier. The oils obtained from *A. squamosa* kernels were odorless, of good color, and of good appearance. The physicochemical properties of the oils

are represented in Table (2). The oil was significantly different ($P \leq 0.05$) concerning their physico-chemical properties, the *Annona squamosa* oil saponification value which gives an indication of the nature of the fatty acids in the fat, was lower than that (186.4) reported by (Morton 19870). The refractive index, specific gravity, saponification and acid values of *A. squamosa* oil were different from those (1.475, 0.927, 183.0, and 10.0, respectively) reported by (Rafeeget al., 2002). From Table (2) it can be summarized that the method of extraction only significantly affects ($P \leq 0.05$) the acid value, and no significant changes were observed in the refractive index, peroxide value, saponification value and specific gravity of the *A. squamosa* seed oil. Compared with the (Codex standard 1999) for cotton seed, sunflower, sesame and groundnut oils the *A. squamosa* oils showed lower values for specific gravity, refractive index and saponification values..

to ensure removal of all solvent from the oil. The oils obtained by cold extraction from *A. squamosa* (ASCE) was then kept in dark bottles and stored at 4 °C for further analysis.

Soxhlet Extraction

The oil from the seeds of the sample was extracted exhaustively with petroleum ether (b.p. 60–80 °C) analytical grade in Soxhlet extractors according to the AOCS official method (AOCS1993). The oils obtained by Soxhlet extraction from *A. squamosa* (ASSE) was then kept in dark bottles and stored at 40 °C for further analysis.

Oil Physicochemical Analysis

Physical Parameters

Specific Gravity

The AOCS official method (AOCS1993) was followed for determination of the specific gravity of the oil at 60 °C.

Refractive Index

The AOCS official method (AOCS1993) was followed to determine the refractive index of the oils at 30 °C.

Chemical Parameters

The following chemical parameters: acid value, peroxide value, saponification value, and the amount of unsaponifiable matter were determined according to AOCS official methods (AOCS1993).

Oxidation

Samples (50g) weighed into 250-ml Erlenmeyer flasks were oxidized at 70 °C in the dark in a shaker water bath (Kot-

termann, Hanigsen, Germany). The oxidative stability was evaluated by analysis of the peroxide value (PV) of the oil samples periodically after 0, 2, 4, 8, 16, 24, 32, 48, 56, 72 hours. All analyses were done in duplicate.

Statistical Analysis

The analyses were performed with three replicates. The mean values and standard deviation (means \pm SD) were calculated and tested using the Student's *t* test ($P < 0.05$). Statistical analysis of variance (ANOVA) was performed on all values using the statistical program Statgrafics Statistical Graphics System version 4.0 (STATGRAPHICS_1985–1989).

Results and Discussion

Proximate Analysis of Seeds

Table (1) shows the proximate analysis of *A. squamosa* seed kernels, it is clear that the sample shows high levels of protein and oil content. The oil content of *A. squamosa* kernels in this study was higher than that reported by (Ansari et al., 1985) who reported 23% oil content, but it was in the range of 14–49% which was reported by Morton in 1987 (Morton 1987). The oil content of *A. squamosa* was lower than that of most Sudanese conventional oilseeds (cottonseed, sunflower and groundnut), (Mariodet al., 2009). These results indicated very clearly that the seeds from this tree form a potential source of oils and fats. Therefore, from an economic point of view,

al., 2002). Nyam et al., 2009 studies revealed that the different extraction methods of oil produce oils with different physicochemical properties. This paper deals with the seed proximate analysis, physicochemical properties and oxidative stability of seed oil obtained by two methods of extraction

Materials and Methods

Plant Material and Chemicals:

Fruits of *A. squamosa* were collected from the Khartoum central Market, Sudan. Specimens identified by taxonomist in medicinal and aromatic plant national center for research Institute (MAPRI) Khartoum, Sudan. The outer dried surrounding pith of the fruit was removed and the seeds were air-dried in an oven at 40 °C to reach constant moisture content (6.5%). The dried seeds were cracked manually, the shells carefully removed and the kernels thus obtained were crushed and ground in a grinding mill (Petra electric, Burgau, Germany) the ground kernels with particle size of 0.5 mm were used for oil extraction. The kernels obtained were stored at 40°C until further investigations. All solvents were of analytical grade.

Methods

Approximate Analysis of Seed

Moisture and Volatile

The moisture content of the sample was determined by the air oven method ac-

ording to the AOCS Official Method (AOCS, 1993).

Crude Protein

The crude protein analysis of the sample was carried out and nitrogen content was determined by the semimicro-Kjeldahl digestion, distillation and titration method, as described by the Official Methods of Analysis (AOAC 1990).

Crude Fiber

The crude fiber of the sample was determined according to the AOCS official method (AOCS 1993).

Ash

The sample was ashed in a muffle furnace at 550 °C for 3 hour or more and allowed to cool and weighed following the AOCS official method (AOCS 1993).

Oil Extraction

Two methods were used for oil extraction, Cold solvent extraction and Soxhlet extraction.

Cold Solvent Extraction

The powdered sample (250 g) was put in conical flasks (1 L), and petroleum ether (b.p. 60–80 °C) was added. The solvent/sample ratio was 2:1 (v/w); the mixture was put in an automatic shaker (IKA, KS 501, Staufen, Germany) for about 16 h at room temperature. The mixture was then filtered twice using glass wool. The clear filtrate was concentrated using a rotary evaporator to remove the solvent from the oil. The oil was allowed to stand in an open air at room temperature

Introduction

Fats and oils are recognized as essential nutrients in both human and animal diets (Strayer, et al., 2006). Sudan is a large producer of conventional oilseeds such as cotton seed, sesame, ground nut and sunflower. Recently, researchers have started to be greatly concerned about identifying new oil sources from a large number of vegetables, fruits, and wild plants commonly grown in the Sudan (Mariod 2000). One of these wild plants is the promising, unconventional and new sources of oil in the Sudan is the available species of the family Annonaceae. Family Annonaceae is a large family which has been in previous phytochemical work with significant biological activities. It is of interest to research on pharmaceutical products to serve human needs from the plants in this family (Intaranongpai, et al., 2006). *Annona squamosa* is one of the species which is available in a considerable amount in Sudan. It is locally known as Gishta. It is grown in western and southern Sudan and its fruit eaten as a dessert fruit (Pinto et al., 2005). It is a multipurpose tree with edible fruits and is a source of medicinal and industrial products and it possesses potent bioactive principles in all its parts (Raj et al., 2009). The oil content of *Annona squamosa* seed kernels varies from 14 to 49% of whitish or yellowish, non-drying oil (Morton and Miami, 1987).

Annona squamosa L., commonly known as custard apple is a native of the West Indies, it is widely grown throughout the tropics in India and popularly cultivated in the north eastern parts of Thailand, mainly for its edible fruit. Its seed is well known for killing head lice but there has been no report on the active component (Intaranongpai et al., 2006). The plant is deciduous and small; reaching a maximum of 6 metre in height with many lateral branches, it grows well in regions of medium humidity. Its seeds comprise 30% of its fruit's weight, which is edible (Pinto et al., 2005). *A. squamosa* seed oil was reported to be used in the soap and plasticizer industry as well as in alkyd manufacturing, the seeds are acrid and poisonous. The bark leaves and seeds contain the alkaloid anonaine (Morton 1978). It has been reported that *A. squamosa* seeds contain 23% oil of which 9.8% is a hydroxyl acid, the oil contains 38.6% saturated fatty acids and 61.4% unsaturated fatty acids (29.0% oleic and 32.0% linoleic:), with saponification value of 191.8, a refractive index of 1.4826 (Ansari et al., 1985), a specific gravity of 0.927, an iodine value of 88.0 and 1.5% of unsaponifiable matter (Rafeeq et al., 2002). Studies have revealed that the oil of *A. squamosa* is somewhat viscous in appearance, pale yellow in color and with a persistent smell. The oil is freely soluble in petroleum ether (Rafeeq et

دراسة التحليل التقريبي لبذور القشطه

سارة الخير مصطفى فضل وفاتن حسن عثمان

المستخلص:

تمت دراسة التحليل التقريبي لبذور القشطه *Annona squamosa* بتقدير محتواها من الرطوبة, الزيت, البروتين, الألياف, الرماد والمواد الكربوهيدراتيه. تم استخلاص الزيت من البذور بطريقتين الاولى بإستخدام جهاز السوكسيليت والثانيه بطريقة الإستخلاص البارد لمعرفة تأثير كل طريقة على خصائص الزيت ومن ثم قمنا بدراسة الخواص الفيزيوكيميائيه للزيت الناتج واجري اختبار الثباتيه لزيت بذرة القشطه المستخلص بالطريقتين حيث تم تخزينهما فى الظلام تحت درجة حراره 70^oم ولمدة 72 ساعه بقياس رقم البيروكسيد. وقد أظهرت النتائج ان نسبة الزيت تساوى 26.8%. البروتين 5.17%. الكربوهيدرات الكليه 30.0%. الرطوبة 6.7% والرماد 2.2% لبذور القشطه. وكانت نسبة الزيت بطريقة الإستخلاص البارد والاستخلاص بالسوكسيلت 26.8% و 27.5% على التوالي. وقد دلت النتائج انه لا توجد فروقات معنويه فى نتائج الاستخلاص بالطريقتين. اما نتائج الخواص الفيزيوكيميائيه للزيت المستخلص بالاستخلاص البارد والسوكسيلت كانت كالآتي: معامل الانكسار 1.470 و 1.470 ورقم الحموضه 0.89 و 1.5 ورقم التصبن 184.5 و 184.7 ملجرام هيدروكسيد بوتاسيوم/ جرام من الزيت ورقم البيروكسيد 0.9 و 1.0 ميلي مكافئ / كيلو جرام من الزيت على التوالي. وأظهرت النتائج أن الخواص الفيزيوكيميائيه لزيت القشطه موافقه للزيوت المعروفه كما أوضحت ايضا ان زيت القشطه يمكن استخدامه كزيت للقلى أو فى صناعة المستحضرات التجميليه.

Chemical composition and Oxidative stability of Sudanese *Annona squamosa* (Gishta) seeds and Seed Oil

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Abstract

The proximate composition of seeds and main physicochemical properties and Oxidative stability of oil extracted from *Annona squamosa* (AS) seeds were evaluated. The percentage composition of the seeds was as follow: ash (2.2%), crude oil (26.8%), protein (17.5%), total carbohydrate (30.0%) and moisture (6.7%). The oils were extracted using cold extraction (CE) and Soxhlet extraction (SE) methods, the oil content were (26.8, and 27.5) respectively. Generally the physico-chemical properties was not significantly ($P \leq 0.05$) affected by the extraction methods. Physicochemical properties of the oil were: refractive index, 1.470, 1.470; saponification value, 185.7, 184.5 mg of KOH/g of oil; acid value 0.89, 1.5 mg of KOH/g of oil; and peroxide value, 1.0, 0.9 meq of O₂/kg of oil for ASCE and ASSE respectively. The results showed that physicochemical properties of the oil were in good agreement to those of conventional oils. Oxidative Stability of the oils extracted with two methods were determined during storage at 70°C by measuring the peroxide value, the study revealed that *A. squamosa* seed oil was presented high oxidative stability. These analytical results indicated that the *A. squamosa* seed oil could be used as a frying oil and in the cosmetic industry.

Keywords: Annona squamosa, Oxidative stability, Extraction method, physicochemical properties.

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- Labor in the Nuba Mountains. In J. Res. Peace Gend. Dev. 4(3):48-54. Derek, H. C, Chen and Carl J. Dahlman (2005). "The Knowledge Economy, the KAM Methodology and World Bank Operations". The World Bank, Washington DC 204433.
- Mustafa, Sabary, (1997). Agricultural Extension: Methods and Teaching Means, Publisher: Omer Elmukhtar University, Libya
- Maunder, Addison, H. (1972). Agricultural Extension. A reference Manual. United Nations Food and Agriculture Organization, Rome (Italy).
- Oakley, Peter & Garforth, (1985). Guide to Extension Training, FAO, Rome.
- Obibuaku, L. O. and G. D. Hursh, (1994). "Farm Practice Adoption in the Eastern States of Nigeria". Journal of Agricultural Administration (1): 18-20.
- Rashid, A.T. and Elder, L (2009), Mobile Phones and Development: An analysis of IDRC- Supported Projects. The electronic journal of information system in developing countries. viewed 30/11/2016, www.ejisdc.org/ojs2/index
- Seyed Jamal F. Hosseini, (2011). Effective Extension Methods In Improving Sustainable Forest Management In Iran, ARPN Journal of Agricultural and Biological Science, Vol. 6, No. 12, December 2011
- Tenebe. V. A and Mundi N. E. (2008). Comparative Study of Direct Extension Teaching Methods (DET) and Open and Distance Learning (ODL) on Technology Adoption Rate by Cowpea Farmers in Bauchi State of Nigeria Proceeding of 2nd ACDE Conference held in Lagos.
- Tinsley, R. (2004). Developing Smallholder Agriculture: A Global Perspective Brussels: AgBe Publishing.
- United Nation, (2005). "Global E-government Readiness Report: From E-Government to E-Inclusion". UN-PAN/2005/14, United Nations, New York.
- Vanden Ban, A.W. & Hawkins, H.S, (1988). Introduction Agricultural Extension. John Wiley & Sons, New York.
- <http://theonlinemedia.blogspot.com/2012/06/functions-of-mass-media.html#more> Accessed: 3/11/2016

tributions because of the specific nature of their messages and the fact that they are available for easy reference (Tenebe, 2008). And according to table 6 results the education level did not significantly affect the respondent's reliability degree on demonstrations, farm visits, extension meetings, friends and training workshops ($F = 0.511, 0.811, 1.566, 1.085, 0.940$ respectively, $\alpha = 0.05$)

4. Conclusion:

Nowadays we are living in the era of information; which is characterized by knowledge explosion in all aspects of life including agricultural sectors which are growing rapidly in terms of information technologies. In these situations the extension workers should play greater and vital roles to let farmers be aware of the new technologies and information; that is through efficient application of suitable extension methods. However, and based on this study findings, the respondents are partially dependent on some extension methods; mainly individual and group methods

5. Recommendations:

The necessity to use mass media to support both group and individual methods. Training progressive farmers in the field of learning process and knowledge transferring, and they should work under the direct supervision of extension workers. Training extension workers in the ad-

vantages of using extension methods especially individual & group methods

References:

- A.A. Ladel, Dr. S. T, Ogunride, Dr. N, E. Mundi, (2008). *Agricultural Extension Education*, National Open University of Nigeria, ISBN: 978-058-510-9
- Allajabu A., (2009). *The Effect of Personal Characteristics on Participation of Rural Youth in Development Projects (Dilling Locality – South Kordufan State)*, Ph.D Thesis, Faculty of Agricultural Studies, Sudan University for Science and Technology.
- Aker, J.C. (2010). "Dial 'A' for Agriculture: Using Information and communication Technologies for Agricultural Extension in Developing Countries." Tuft University, Economics Department and Fletcher School, Medford MA02155.
- Atteh, D. (1989). *Indigenous Local Knowledge as a Key to Local-level Development: Possibilities, Constraints and Planning Issues in the Context of Africa*. Studies in Technology and Social Change, No.20. Ames, Iowa: Technology and Social Change Program, Iowa State University.
- Ballal E. Salih, E. and Abdel Magid D. (2014). *Ethno-botany of Natural Forests of Nuba Mountains, South Kordufan State, Sudan*. *Journal of Forest Products and Industries*, 2014, 3(1). 13-19
- Bello A. (2014). *Agriculture Communal*

3.6 The effect of educational level on reliability degree of extension methods:

Table (6) ANOVA for significance variances in extension methods' reliability degree according to education level variable (N = 50)

Extension methods	Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Field demonstration	Between Groups	2.864	4	0.716	.511	.728
	Within Groups	63.056	45	1.401		
	Total	65.920	49			
Field visits	Between Groups	4.387	4	1.097	.811	.525
	Within Groups	60.833	45	1.352		
	Total	65.220	49			
Office Visits	Between Groups	4.447	4	1.112	1.123	.005
	Within Groups	44.533	45	0.990		
	Total	48.980	49			
Extension Meeting	Between Groups	6.110	4	1.528	1.566	0.200
	Within Groups	43.890	45	0.975		
	Total	50.000	49			
Training Workshops	Between Groups	4.724	4	1.181	1.085	0.375
	Within Groups	48.956	45	1.088		
	Total	53.680	49			
Neighbors & Friends	Between Groups	3.892	4	0.973	0.940	0.450
	Within Groups	46.608	45	1.036		
	Total	50.500	49			

As shown in Table (6) a one-way analysis of variance (ANOVA) showed that the respondents' education levels significantly affect the reliability degree of office visits as extension methods to gain the required agricultural knowledge ($F = 1.123$, $\alpha = 0.05$). This means that respondents with high education level

are more eager to follow the extension workers to get the required knowledge. In teaching farmers with little or no education, extension workers should be selective in the methods they use; very little use can be made of pamphlets, bulletins, and circular letters. However, where the farmers are literate, extension written materials can make valuable con-

The Table (4) reveals that the significant correlation was not observed between respondent's age and reliability degree for all extension methods under study (field demonstrations, field visits, office visits, general meeting, training work-

shops and neighbors - friends).

3.5 The effect of farm's size on reliability degree of extension methods:

Table (5) Correlation matrix showing relationships between farms size and degrees of reliability on extension methods (N = 50)

Degree of reliability	Farms size
Field demonstration	0.149
Field visits	0.360
Office Visits	0.025*
Extension Meetings	0.214
Training Workshops	0.792
Neighbors & Friends	0.919

**Correlation is significance at the 0.01 level (2-tailed)

* Correlation is significance at the 0.05 level

Table (5) revealed that significant and positive relationship have been observed between the farms size and reliability degree for office visits ($r = 0.025$ significant at 0.05); this means that the big producers or farmers have more motivations to pursue the extension workers in their offices to get knowledge about

the technical package of sorghum crop, because they spent a lot money in agriculture. Also the table shows that the significant correlation was not observed between farms size and reliability degree on demonstration fields, field visits, extension meetings, training workshops and neighbors & friends.

3.3 The effect of gender on degree of reliability for extension methods:

Table (3) Independent T-Test results for significant differences in extension methods (N = 50)

Extension Methods	Male (N=30)		Female (N=20)		T	Significance
	Mean	SD	Mean	SD		
Neighbors & Friends	3.44	1.02073	3.62	1.02470	-0.593	0.381
Field visits	2.50	1.13485	2.00	1.15470	1.445	0.512
Extension Meetings	2.35	1.01152	1.88	0.95743	1.585	0.039*
Field demonstration	2.24	1.18216	1.63	1.02470	1.773	0.663
Training Workshops	2.23	1.01679	1.75	1.06458	1.551	0.793
Office Visits	2.18	1.02899	1.69	.87321	1.641	0.926

Table (3) shows that there are statistically significant differences between the male and female (in favor of male) in reliability degree of extension meetings as a source of agricultural knowledge, where the T value reached (1.585), this is statistically significant at level 0.05. This may be due to the social restrictions for women to attend these meetings. Whereas there are no significant differences between males and females

for their reliability degree on Neighbors – Friends, field visits, demonstrations, training workshops and office visits, at 0.05 level

3.4 The effect of respondent's age on reliability degree for extension methods:

Table (4) Correlation matrix showing relationships between respondent's age and degrees of reliability (N = 50)

Degree of reliability	Respondent's age
Field demonstration	0.985
Field visits	0.360
Office Visits	0.370
Extension Meeting	0.741
Training Workshops	0.975
Neighbors & Friends	0.358

**Correlation is significance at the 0.01 level (2-tailed)

* Correlation is significance at the 0.05 level

the respondents were always dependent; the office visits extension methods had obtained 6th highest mean 2.02 and SD 0.99, which considered as the lowest mean. The overall means of reliability degree is 2.15 out of 4 points and SD 1.08, this result indicates that the reliability degree of respondents in general is medium. According to the above illustrated results which reflect respondent's reliability degree for extension methods, we found that the great majority of these methods (4 out of 6) are group methods; and the remaining two (field & office visits) are individual methods. On other side there is no mass media used by the respondents; this might be due to the lack of local radio & TV stations in the study area. The attraction of mass media to extension services is the high speed and low cost with which information can be communicated to people over a wide area (Oakley & Garforth, 1985). The extension methods should be used in integrated ways to overlap the weak points. The extension work requires many methods and tools of teaching, and people are influenced to make changes in behavior in proportion to the degree of their contact with several different methods. A good extension worker must not only have in his command a variety of teaching methods, but must also know where to use them, when to use them and how to use them to achieve best results

(Obibuaku, 1994). Studies have shown that the more different extension teaching methods are used, the more people change their practice (Maunder, 1972). On another hand the wide spread of mobile phones among the respondents can be supportive tools to other different extension methods. Mobile phone has been growing rapidly even in the remote rural areas, the unprecedented speed of adoption of mobile phone technology has raised the general expectations about its potential contributions to spread of innovative farming technologies, as well as farmers' knowledge and awareness of other relevant knowledge and information (Rashid, 2009).

According to the table (2) above, about one third (34%) of the respondents were not at all dependent on field visits methods as a source of gaining agricultural knowledge and technologies of sorghum crop production; whereas 18% of respondents were rarely dependent on field visits, 28% were sometimes dependent and 20% were always dependent; with mean 2.4 and SD 1.19, which considered as the highest mean. For the extension meetings methods, about one third (32%) of respondents reported that they were not at all dependent, while more than a quarter of the respondents (26%) were rarely dependent and 32% were sometimes dependent, and only 10% were always dependent on extension meetings methods which were held by extension workers to the knowledge; with the 2nd highest mean 2.2 and SD 1.01. The table also indicates that more than half of the respondents (52%) were not at all dependent on field demonstration methods to gain the agricultural knowledge and technologies for sorghum crop production; while 4%, 32% & 10% were rarely, sometimes and always dependent respectively. So, the field demonstration methods achieved 3rd highest rank with mean 2.1 and SD 1.2. For neighbors and friends methods, 12% of respondents were not at all dependent on neighbors and friends methods to receive the required knowledge, while 2% & 10%

were rarely & sometimes dependent respectively. The majority of respondents (76%) were always dependent on their neighbors and friends as a source of gaining extension messages; neighbors and friends achieved 4th highest rank position with mean 2.11 and SD 1.07. The neighbors and friends are mainly the progressive farmers in the area who have better agricultural experiences. Farmers often listen and take advice from a friend, a relative or a neighbor who has traveled to some other regions to adopt new information or technology; this is called informal extension; it is the information that passed out mouth-to-mouth (Tinsley, 2004). Farmers learn from their own actions, from observing others' actions and from discussing relations between cause and effect (Vanden, 1985). For the training workshops methods, 42% of respondents reported that they were not at all dependent on training workshops to receive knowledge and information on sorghum crop production, while 16% & 34% were rarely & sometimes dependent respectively; and only 8% were always dependent; the training workshops methods obtained 5th highest position with mean 2.08 and SD 1.04. Finally 42% of respondents were not at all dependent on office visits to gain their agricultural knowledge, 20% were rarely dependent, 32% were sometimes dependent and only 6% of

Table (1) shows that the majority of the respondents (60%) were male, while the female are 40%. The women have greater contribution in the production of vegetable crops in the homestead garden which is called Jubraka. The Jubraka usually run exclusively as Bello (2014) said by women to grow vegetables such as okra, chilies, pepper, pea, and others for home consumption, and the Jubraka is located by the farmers' homes. According to the table above 70% of respondents were in the (21-40) age group i.e. the youth stage which considered as a peak of human activity. Data in the table also revealed that (6%) of the respondents were illiterate; while the majority (82%) had education up to both basic and secondary levels; (34%) of marital status is single; while more than half (56%) are married. Regarding the farms size, 8% of respondents have less than one acre; while the majority (62%) their farms size varies between (1 to 12 acres).

3.2 The degree of reliability on extension methods:

Table (2) The distribution of respondents according to their reliability on different extension methods (N=50):

Extension Methods	The degree of reliability								Mean*	SD
	Not at all		Rarely		Sometimes		always			
	#	%	#	%	#	%	#	%		
Field visits	17	34.0	9	18.0	14	28.0	10	20.0	2.4	1.19
Extension Meetings	16	32.0	13	26.0	16	32.0	5	10.0	2.2	1.01
Fields demonstration	26	52.0	2	4.0	16	32.0	5	10.0	2.1	1.2
Neighbors & Friends	6	12.0	1	2.0	5	10.0	38	76.0	2.11	1.04
Training Workshops	21	42.0	8	16.0	17	34.0	4	8.0	2.08	1.04
Office Visits	21	42.0	10	20.0	16	32.0	3	6.0	2.02	0.99
Grand Total									2.15	1.08

*Maximum degree 4 points (1= not at all, 2= rare, 3= sometimes, 4= always)

and depressions where fertile alluvial soils deposition occurs seasonally (Balla et al, 2014).

2.2 Sample selection and data collection:

The research populations in the study area are the Sorghum smallholders. Random sampling technique was used to select 50 respondents. Primary data were collected through face-to-face in-

terviews by using a pretested questionnaire and observation. The secondary data were obtained from relevant sources. The collected data were analyzed in form of percentages, means, independent T-test, correlation and analysis of variance (ANOVA).

3. Results and discussion:

3.1 The respondents' socio-economic

characteristics:

Table (1) the distribution of respondents according to their socio-economic characteristics (N=50):

Sex	F	%	Age	F	%
Male	30	60.0	less than 21 yrs.	5	10
Female	20	40.0	21-30 yrs.	21	42
			31-40 yrs.	14	28
			More than 40 yrs.	10	20
Marital status	F	%	Education level	F	%
Single	17	34	Illiterate	3	6
Married	28	56	Basic education	13	26
Widowed	3	6	Secondary school	30	60
Divorced	2	4	University graduate	3	6
Farms size	F	%	Post graduate	1	2
<1 acres	4	8			
1 – 4 acres	7	14			
5 – 8 acres	17	34			
9 – 12 acres	7	14			
13 acres and above	15	30			

acteristics (Mustafa, 1997). Although farmers already have a lot of knowledge about their environment and their farming systems, extension can bring them other knowledge and information which they do not have. The application of such knowledge often means that the farmers had acquired new skills. The transfer of knowledge and skills to farmers and their families is an important extension activity. The extension agent should prepare himself to find out which skills or areas of knowledge are lacking among the farmers in his area, and then arrange suitable learning experiences through which the farmers can acquire them (Atteh, 1989). Dalami locality is one of the promising agricultural and pastoral areas in South Kordofan state. The locality is very rich in natural resources. Nonetheless, the majority of local population are farmers who are practicing a traditional agriculture, which is characterized by low productivity due to low adoption of recommended technologies. The extension department there is working hard to implement a mix of extension methods to persuade farmers to adopt the appropriate technologies. This study was conducted to determine the degree of reliability of farmers on agricultural extension methods i.e to which extent the farmers are dependent on extension methods to gain the required agricultural knowledge.

1.1 Objectives:

The main objective of this study was to determine the degree of reliability of farmers on agricultural extension methods.

The following are the specific objectives of the study:

To know the respondents' socio-economic characteristics.

To determine the preferences of the respondents on extension methods.

To identify the relationship between some respondents' socio-economic characteristics (gender, age, farm size and educational level) and their dependability on various extension methods.

Hypothesis:

There is no significant relationship between respondent's sex, age, educational level and farm size and their degree of reliability on extension methods.

2. Study Methodology

2.1 The study area:

The study was conducted in 2016 in Qadabar village in Dalami Locality, South Kordofan State, Sudan. The state lies between latitudes 9° and 12° N; longitudes 27 ° and 32° E.; and covering an area of 13.44 million Hectares (allajabu, 2009). Dalami locality has an annual rainfall ranging from 450 mm to 800mm, with a raining season running between May and October. Vast areas of the state are covered with hills intersected by seasonal watercourses, valleys

tal and or physical action on the part of the learner, and (iii) to take the learner through one or more steps of the teaching-learning processes which are attention, interest, desire, conviction, action and satisfaction (Vanden, 1988). Hosseini, Soltani (2010 cited in Seyed Jamal F. 2011) said that the extension teaching methods are classified based on their use into individual contacts, group contacts and mass contacts. He added that these methods are also sorted out based on their forms into written, spoken and audio visual. Mass media is described at (<http://theonlinemedia> 2016) as a public communication process reaching large and heterogeneous audience. Media disseminates information mostly through radio, TV, as well as columns of newspapers or magazines. The individual methods consist of visits of extension workers to clientele homes and farms on the one hand and clientele's visits to the agent's office or home on the other hand; and at such contacts, face-to-face interaction ensues. It allows the most intensive form of communication between the two parties. It is usually not a very effective means of promoting the cause of vast number of small farmers (Albrecht et al (1989 as cited in A.A. Ladele et al 2008). Individual methods are likely to be the most essential part in extension work. Although direct contact with the farmers is important, individual meth-

ods require a lot of time and resources, and they only make contact with limited number of people (Oakley & Garforth, 1985). Vanden (1988) stated that mutual discussion is a costly process but very important in individual methods; for it allows the change agent to combine a farmer's information with his own to solve the farm problems. Group methods are characterized by reaching fewer people who have some degree of opportunity for interaction and feedback. Group extension is the most important method for advising and promoting the interest of a large number of small farmers. To be effective, group extension has to be supplemented by individual and mass extension; this is because learning is an individual process (Albrecht et al, 1989). However, forming a farmer group is a difficult procedure which requires a lot of time. In addition, extension agent has to consider many factors about farmer groups before starting the work. For example, the group should consist of farmers with similar interest and problems. Examples of group methods are group meetings, demonstrations, field days, and tours (Oakley & Garforth, 1985). Many researches revealed that the farmers' confidence and response to each extension methods are affected by some factors included the farmers' socio-economic and psychological characteristics; in addition to communicational char-

INTRODUCTION

Global attention focuses on agriculture due to the price hike in recent years, resulting somewhat from long-standing negligence on the diffusion of an appropriate technology that enhances production in the face of a rising population. Increasing production is a major challenge facing present agriculture. A smallholder farmer which dominates the setting of a developing world needs to improve farming through gaining adequate knowledge and information. Agricultural extension services provide access to the knowledge, information and technology that farmers need to improve the productivity and thus improving the quality of their lives and livelihood (UN, 2005). Knowledge as concluded by Derek (2005) plays a key role in rural and agricultural development, guiding policy making processes, forming development strategies, and facilitating better and faster decision making. Furthermore, he said that effective use and creation of knowledge is important and central to longstanding economic development. Knowledge is now seen as the fourth factor of production besides labor, capital and land. All forms of cultivation techniques and land use decision making processes are particularly depending on specific knowledge bases. Thereby knowledge is embedded in external economic and political frameworks as well

as individual preferences gained through various information channels, e.g. public media, individuals, organizations and education. The consideration of information flow and the transmission of knowledge is a neglected topic in the context of human-environmental system studies. This topic highlights the role of agricultural knowledge in the context of agricultural development. Knowledge has been widely recognized to be strategically important for organizational learning, innovation survival and success. Aker (2010) added that agricultural extension services which include transferring of knowledge to farmers, advising and educating farmers in decision making are enabling farmers to clarify their own goals and stimulating desirable agricultural development. The agricultural extension is a process of educational communication aimed to achieve desirable changes in the knowledge, skills and attitudes of the farmers. The qualified extensionists should always try to use various types of methods (Mustafa, 1997). Extension teaching methods defined as tools used to create situations in which meaningful communication can take place between the instructor and the learners. The functions of extension methods are: (i) to provide communication so that the learners may see, hear and do things to be learnt, (ii) to provide stimulation that causes the desired men-

درجة اعتمادية المزارعين على الطرق الإرشادية

حسن عبد النبي جابو عمر و الجيلي مكي دلدوم

المستخلص:

تهدف هذه الدراسة الى دراسة درجة اعتمادية المزارعين على الطرق الإرشادية المختلفة بمحلية دلامي، قرية كدبر ولاية جنوب كردفان - السودان. تم اخذ عينة عشوائية قوامها 50 مزارع، جمعت البيانات الأولية بواسطة استمارة الاستبيان والمقابلة، بينما جمعت البيانات الثانوية من المصادر ذات الصلة. استخدمت قياسات احصائية عدة تمثلت في التكرارات والنسب المئوية واختبار «ت» والارتباط بالإضافة لتحليل التباين الاحادي وذلك باستخدام البرنامج الاحصائي (SPSS). أظهرت نتائج الدراسة وجود فروقات معنوية احصائيا بين الذكور والاناث (لصالح الذكور) في درجة الاعتمادية على الاجتماعات الإرشادية كمصدر للمعلومات الزراعية، حيث بلغت قيمة «ت» (1.585) عند المستوي الاحتمالي (0.05). عدم وجود فروقات معنوية بين الذكور والاناث في درجة اعتماديتهم على بقية الطرق الإرشادية موضع الدراسة. أيضا اشارت نتائج الدراسة لعدم وجود علاقة ارتباطية معنوية بين اعمار المبحوثين ودرجة اعتماديتهم علي كل الطرق الإرشادية موضع الدراسة، بينما اشارت نتائج تحليل التباين الأحادي الي وجود فروقات معنوية بين المستوي التعليمي للمبحوثين ودرجة اعتماديتهم علي الزيارات المكتتبية كمصدر للحصول علي المعلومات الزراعية حيث بلغت قيمة F 1.123 عند المستوي الاحتمالي 0.05، اوصت الدراسة بضرورة تدعيم طرق الاتصال الفردي والجماعي بطرق الاتصال الجماهيري.

الكلمات مفتاحية: الارشاد الزراعي - الطرق والوسائل الإرشادية - المزارعين

The Degree of Reliability of Farmers on Agricultural Extension Methods

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Abstract

The present study was designed to identify the reliability degree of extension methods. It was conducted in Dalami locality (Qadabar village) in South Kordofan State; Sudan. A questionnaire was used to collect the primary data, while the secondary data were obtained from the relevant sources. The collected data were analyzed in form of frequency distribution, independent T-test, correlation and analysis of variance (ANOVA). The study findings indicated that there are statistically significant differences between the male and female (in favor of male) in reliability degree of extension meetings as a source of agricultural knowledge, where the T value reached (1.585), significant at 0.05. No significant differences between male and female for their reliability degree on other extension methods. The findings also revealed that there is no significant correlation between respondents' age and reliability degree for all extension methods. The one-way analysis of variance (ANOVA) showed that respondents' education levels are significantly affected by reliability degree of office visits as extension methods to gain a required agricultural knowledge ($F = 1.123$, $\alpha = 0.05$). The study suggested mass media to support both groups and individual extension methods.

Key words: Agricultural Extension - Extension Methods - Farmers - Reliability

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Thesis, University of Khartoum.

Elshikh, A.M.E.2004. Investigation on the causal agent of sooty canker disease of date palm trees in Northern-State. Thesis of M.Sc.(Agric)Sudan University of Science and Technology.

Giha, O. H. 1975. *Hendersonula toruloidea* associated with serious wilt disease of shade trees (*ficusbenhahensis*) in Sudan. *Plant Disease* .Reptr.59, 899-902.

Msikita, J. S. Yaninek, M. A Hounou, H. Baimey, and Fagbemissi.2005.

First report of *Nattrassia mangiferae* root and stem rot of cassava in West Af-

rica. *Plant Disease* .81 (11) 1332.

Mahadi A., M, I. 2003 . *Nattrassia mangiferae* die-back of date palm in Iran. *Plant Disease*.71: 1045.

Nori, W. S. 1996.Branch wilt and mortality of some shade trees in Khartoum State caused by *Nattrassia mangiferae*.M.Sc. (Agric).Thesis, University of Khartoum.

Pandey, R.S., Bhargava, S. N. Shukla, D. N. and Khati, D. V. 1981. A new leaf disease of mango. *Plant Disease*, 65: 441-442.

Wangikar , P .D . Raut , J . G. and Gappal Krishna, N. 1975. Drying of grape vines caused by *Hendersonula toruloide*

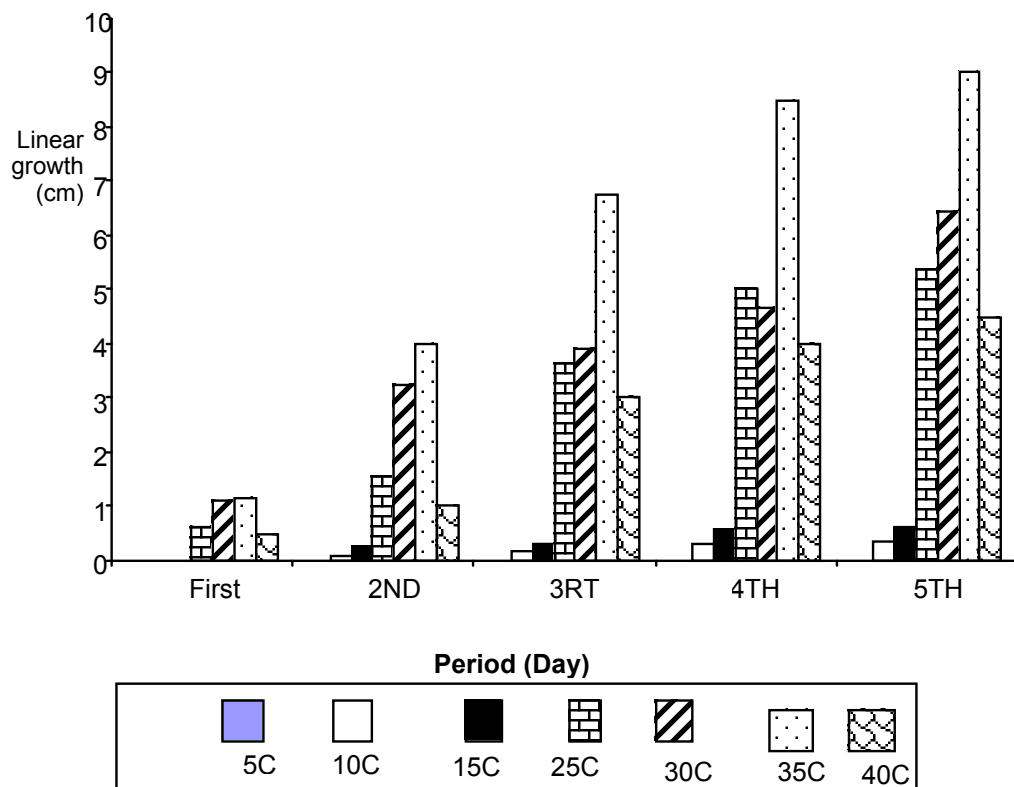


Fig1 :Effect of different Temperature on Linear growth of *Nattressia mangiferae*

REFERENCES

- Ahmed, N. A. and Yassin, A.M.1992. Technical Bulletin No.5.AgricRes.Crop .Sudan Wad medani.
- Baghdadi, A .M. Abulgasim , E. A. and Mokhtar, M.S. 2003. An epidemic wilt disease affect date palm trees in Northern Sudan. Paper presented in date palm workshop .SUST.Univ.of Khartoum.Dec.2003
- Elliot, M. and Edmonds. L.2003. Systemic study of *Nattressia mangiferae* The causal of Madrone canker .WIFD-WC 51, 2003. PP. 59-62.
- Elliot, M. and Edmonds. L, Mayer , S. 2002. Role of fungal diseases in decline of Pacific madrone. North W. Sci 76: 293-303.
- Elliot, M. 1999. The decline of pacific madrone (*Arbutus menziesii*Pursh) in urban and natural environment. Its causes and management.M.sc.Thesis, University of Washington Seattle.
- Ellis, M. B. 1976. More Dematiaceous Hyphomycetes, Commonwealth Mycological Institute Kew, Survey, England, 507 pp.
- Eltaher, S.E.2003. An investigation on biological control of *Nattressia mangiferae* using *Trichoderma* spp.M.sc.

Table 3. Effect of temperature on linear growth of *N. mangiferae* (in vitro) (colony diameter in cm)

TEMPERATURE	First	2nd	3rd	4 th	5th	Means
5°C	0	0	0	0	0	0e
10 °C	0	0.1	0.18	0.3	0.38	0.19e
15 °C	0	0.25	0.3	0.6	0.63	0.36e
25 °C	0.6	1.58	3.63	5	5.38	3.24c
30 °C	1.1	3.25	3.93	4.68	6.43	3.88b
35 °C	1.18	4	6.75	8.5	9	5.89a
40 °C	0.48	1	3	4	4.5	2.60d
Means	0.48	1.45	2.54	3.30	3.76	

%5 LSD = 0.391

C.V = 27.1

Data average of four replicates

Means in the same Column with the same letters are not significantly different at $P < 0.05$ of probability according to the Duncan's Multiple Range Test (DMRT).

Table 4. The effect of pH on linear growth of *N. mangiferae* (colony diameter in cm)

pH	First	2nd	3rd	4 th	5th	Means
pH 4	0.63	2.5	4.75	7.38	8	4.65b
pH 5	0.68	3.05	5.75	8	9	5.29a
pH 7	0.38	2.35	3.6	5.2	6	3.51c
pH 8	0.15	2.1	3	4.15	5	2.88d
Means	0.46	2.5	4.28	6.18	7	

%5 LSD = 0.245

C.V = 9.5

Data average of four replicates

Means in the same Column with the same letters are not significantly different at $P < 0.05$ of probability according to the Duncan's Multiple Range Test (DMRT).

Table 1. The effect of carbon source on linear growth *N. mangiferae* (colony diameter in cm)

Carbon source	First	2nd	3rd	4th	5 th	6th	7th	Means
Maltose	1.15	2	4.65	6.33	6.35	7.8	7.08	5.05c
Starch	0.76	3.08	5.83	6.8	6.9	6.93	7.7	5.41b
Sucrose	1.35	1.88	3.3	3.68	3.74	3.9	4.1	3.14d
Dextrose	1.23	4.25	6.75	7.35	7.45	7.9	8.55	6.19a
Means	1.1	2.8	5.13	6.01	6.11	6.63	6.86	

%5 LSD = 0.278

C.V = 14.5

Data average of four replicates

Means in the same column with the same letter are not significantly different at $P \leq 0.05$ of probability according to the Duncan's Multiple Range Test (DMRT)

Table 2. Effect of different media on linear growth) of *N. mangiferae* (in vitro) (colony diameter in cm)

PDA	1.25	2.5	5	7	8.95	4.94a
CZAP	0.28	1.1	2.93	4.2	5.1	2.72c
CORN	0.2	1.05	2.2	3.3	4.5	2.25d
MALT	0.5	1.8	3.38	5	6.2	3.38b
W.AGAR	0.13	1.03	2.18	2.98	3.48	1.96e
Mean	0.47	1.49	3.14	4.49	5.65	

%5 LSD = 0.278

C.V = 14.5

Data average of four replicates

Means in the same Column with the same letters are not significantly different at $P < 0.05$ of probability according to the Duncan's Multiple Range Test (DMRT)

The symptoms of chlorosis and necrosis were observed in artificially inoculated plant were typical to symptoms of naturally infected trees. This in agree with those reported by Nori (1996).

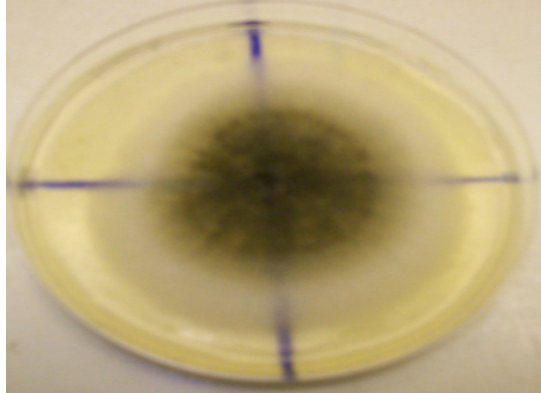


Plate 1. *Natrassia mangiferae* on PDA; 3 days old culture.

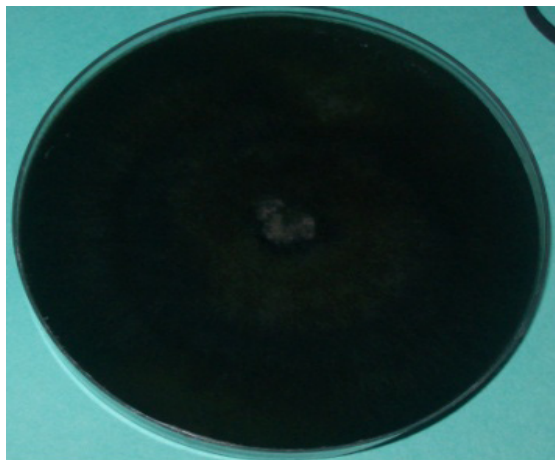


Plate 2. *Natrassia mangiferae* on PDA; 7 days old culture

the fungus tolerates is between 10-15° C, but at 5° C the fungus failed to grow. This result is with agreement with those reported by several authors Pandey et al., 1981; Nori, 1996; Eltaher 2003; Elshiekh 2004.

The fungus grows best on PDA (Potato Dextrose Agar) medium. On PDA the colony diameter was achieved 8.9cm after 5 days after inoculation while Malt Extract Agar, Czapek's Dox Agar, Corn Meal Agar, and tap water agar the fungus achieved a colony diameter of 6.2, 5.1, 4.5, and 2.98 cm respectively.

The maximum growth of the fungus achieved on PDA medium, the result is similar with those reported by several authors (Ahamed and Yassin, 1992; Nori, 1996; Eltaher, 2003).

Nutritional requirement can be studied on different carbon sources, the result showed that the Dextrose and Starch provided higher growth of the fungus than sucrose and maltose. The results are in agreement with Elshiekh (2004) who reported that *N.mangiferae* gave higher growth on starch.

pH that gave best growth was in the range of 4-5 pH, and decline at pH 7-8, this coincides with the result those reported by Msikito et al., (2005)

In artificial inoculation experiments the types of inoculations treatment has very clear effect on success of

inoculation by *N.mangiferae* inoculation on root injection caused successful infection and gave rapid result than inoculation on stem, but there was no difference between soil injection and control. This result is in agreement with Elshiekh (2004) who reported the disease symptoms of inoculated date palm seedlings with *N. mangiferae* appeared first on root injection and there no difference between soil injection and the uninfected control.

The development of the disease in seedlings was clear and started after 2 weeks in root injection and after 45 days in stem injection.

The symptoms of yellowing and drying of the leaves from upper part to downwards and death of one branch or leaves to another in the off-shoots of date palm, also present of sooty black layers on the basal parts of the leaves after 3 months observed in artificially inoculated plant were typical symptoms in naturally infected trees. This result in agree with those reported by (Nori, 1996; Elshiekh, 2004).

The artificial experiments also proved that *Ficus bengalensis*, guava, *Citrus* spp, Mahogany, were more susceptible to *N.mangiferae*, and then development of the disease in *Ficus* started from first week of inoculation whereas in citrus and guava symptoms of wilt appear after two weeks of inoculation.

The pathogenicity tests on Lemon seedlings and Guava the symptoms appeared after 10 days of inoculation, the leaves become drooped and rolled over, and then developed chlorosis (yellowing) of all seedlings necrotized and wilted completely after 4 weeks of inoculation with stem inoculations whereas in root inoculations the wilt occurred after 6 weeks.

Thus stem inoculation is more responsive in producing wilt symptoms.

In *Ficus* spp. and Mahogany the symptoms of chlorosis and necrosis began to develop two weeks after inoculations in seedlings by drying of the leaves margin, after several days affected seedlings wilted from upper to downwards,

After 6 weeks seedlings with stem inoculations wilted completely whereas within 7 weeks wilted and mortality occurred with root injections.

It may be conducted that the stem injections were more successful in developing symptoms followed by root injections.

DISCUSSION

Various grades of symptoms were reported in the present study, they may be summarized as chlorosis, necrosis and yellowing of the leaves, black sooty canker on the basal part of the leaves then partial or total wilt and mortality. These symptoms are typi-

cal of *N.mangiferae* as reported before (Giha 1975, Bagadadi et al 2003, and Elshiekh (2004).

Pycnidial formation was detected in this study and this result is in agreement with, Calavan and Wallace (1954) who found the pycnidiospores in three type's hyaline continuous, hyaline to sub hyaline, uniseptate and biseptate with the terminal cells hyaline to sub hyaline and the middle light to dark brown. The colony of *N.mangiferae* effused dark blackish brown to black, smooth 2-8 μ thick, spores were 3.5-6.0 μ wide and 9.8-14.7 μ long. This finding is in agreement with Ellis (1976).

Production of thick wooly mycelium with white colour in the growth colony at initial growth and then turn to black mycelium after 5 days. This in agreement with Giha (1975), Nori (1996), Elshiekh (2004).

Physiological study revealed that there were differences in time required to attain the maximum colony radius, colony radius of 9 cm was achieved at 35° C after 5 days and 6.43 cm at 30° C, 5.38 cm at 25° C, at 40° C achieved 4.5 cm while at 15° C, 10° C achieved 0.68 and 0.38 cm respectively, at 5° C the fungus failed to grow, so the optimum temperature required for the growth of *N.mangiferae* is around 35° C. The minimum temperatures which

PDA medium provided the maximum growth and sporulation with significant difference over the other media except Maltose. CZAP, Corn Meal Agar, and tap Water Agar supported the least growth respectively.

The fungus growth was influenced by carbon source (Table 3), showed that there was significant difference ($P \leq 0.05$) between the growths of the fungus in different carbon sources. Dextrose provided the maximum growth with significant difference followed by Maltose, Starch, and Sucrose respectively.

The fungus growth on different hydrogen ion (pH). The fungus grows at all pH levels however differential growth was displayed (Table 4) with significant difference. The fungus growth on different ($P \leq 0.05$) between the fungus growth. The pH 5 provided the maximum growth and sporulation with significant difference over the other tested pH level except pH 4, where the difference was not at pH 7 and pH 8 less growth was supported.

Three inoculation procedures, stem injection, root injection and soil injection of fungal inoculums were used. The infestation was done to seedlings and off-shoots of date palm. The result showed that the disease symptoms for all plants were firstly observed in those plants inoculated with stem in-

jection, prior to root and soil injection. On date palm seedlings the symptoms appeared 28 days after inoculation. The development of the disease symptoms started as yellowing of leaves from upper and downwards, followed by drying the leaf death.

First symptoms appeared on root injection, 40 days after treatment all seedlings were stunted in comparison to control, but there was no difference between soil injection and control, (Plate. 4,5).

The seedlings of date palm wilted completely after two month of inoculation, on date palm off-shoots symptoms started after 45 days of inoculation. First yellowing of the leaves and drying of the margins, after brown colour appeared on the leaf blades, and then the leaves wilted and dried except the leaves of the heart. Present of black sooty powder layers at the base of the drying leaves later. Symptoms of the disease were observed firstly on the root injection, stem injection and no difference between soil injection and control,

After 3 months of inoculation the off-shoots wilted and dried.

It may be conducted that the root injection in date palm trees is more successful in the developing symptoms followed by stem injection while soil injection alone was least successful.

clay loamy soil and placed in the glass house at Crop Protection Directorate.

In August 2009 three types of treatment were made which were stem, root, and soil injection. Five(5) mm long and 2mm deep. Inoculations were made using sterile syringes. The total numbers of inoculation were three replicates and there were three controls.

The same techniques used in the seedlings inoculation above were made using the off-shoots inoculations. The off-shoots were examined daily to records the symptoms development.

The study the susceptibility of different plant species belonging to different taxonomic group, which included lemon (*Citrus orientales*), Ficus (*Ficus benghalensis*), Guava (*Psidium guajavae*), and Mahogany (*Khaya grandifolia*).

Seedlings of six month old were used. The seedlings were obtained from Faculty of Agric. Science.(Nursery Shambat). Three replicates were used for each plant species.

A set of inoculation on stem and root injection was done in pathogenicity experiment were made in August 2009. Pure culture of *N. mangiferae* grown on sterile PDA was prepared as described in page 28 under isolation; spores of fungus were pressed into the scars as described under pathogenicity experiments. Total numbers of treatments was twelve treatments were ar-

ranged in complete randomized block design with three replicates.

The seedlings were examined daily by recording symptoms development.

RESULTS

Infected plant tissue was plated on Potato Dextrose Agar medium (PDA), the causal organism was isolated from diseased tissue, the vegetative mycelium of the isolate in pure culture on PDA at room temperature ($28 \pm 2^\circ\text{C}$) grew readily and formed a whitish mat in colour within 2-3 days, and then turn to blackish in colour (Plate 1,)

The colonies of *N. mangiferae* effused dark blackish brown to black, Hyphae mid to dark brown, smooth $2-8 \mu$ thick, conidia (arthroconidia) mid to dark brown, smooth, mostly aseptate but occasionally with one or more very dark transverse septa. The results in (Table 1) showed that mean colony diameter on "5" days from inoculation at different temperature was significantly different ($P \leq 0.05$) between the growth in different temperatures. At 35°C the maximum growth obtained was significantly different over the other tested temperatures except 25°C , 30°C . There was no significant difference at 40°C , 15°C as the fungal growth was inhibited, at 5°C the fungus fail to grow, as it shown in (Fig.1).

The fungus showed different growth on different media (Table 2). The

Four different pH values (4, 5, 7, and 8) were used to study the effect of hydrogen –ion concentration on the linear growth of *N.mangiferae*.

About 100ml of PDA medium were poured in four flasks. The required pH values of the medium in each flask calculated using buffer solution of citric acid and NaOH according to Hale (1965), the following pH levels were maintained 4, 5, 7, and 8. The medium was poured in Four Petri-dishes; two perpendicular diameters were marked on the back of each Petri-dish, 5mm disc cut from the edge 7-day old culture of *N.mangiferae* were placed in contact with medium of each Petri-dish. Four (4) replicates of each pH value, the plates were incubated at room temperature (25-30°C). The growth was estimated daily by measuring colony size along two diameters drawn previously.

3-Pathogenesty tests

Pure culture of *N.mangiferae* isolate actively growing in sterile PDA liquid medium, were prepared for inoculation by the mycelia and spores. The liquid culture was incubated for one month, at room temperature. A homogeneous suspension of the liquid culture was prepared by stirring for 5 hours using a magnetic stirrer.

One year old seedlings of date palm (variety Barakawi) of a comparable

vigour were planted in plastic bags. The seedlings were transferred 15 days later to plastic pots (35x20 cm) filled with loamy clay soil and placed in the premises of the Crop Protection Directorate at glass house .(Khartoum).

In August 2008 three types of scars treatment and scar, inoculation were made on the stem, root, and soil injections. Five mm long 2mm deep, inoculation was made using a needle sterilized by ethanol (70 %). The total numbers of inoculation were three replicates and controls’.

Firstly 5ml of distilled water was sterilized in tubes; full loop with *N.mangiferae* was dissolved in sterilized water. This loop contained arthrospores and mycelia of *N.mangiferae* were injected with sterile syringe into scars stems, roots, and soil for three treatments. Controls were covered with the moist polythene bags to obtained humidity and to prevent entry from surroundings. The seedling was examined daily to record symptoms development.

Off-shoot of date palm 3-5 old (var. Barakawi) were used for inoculation, the off-shoot was obtained from healthy trees from Marawi orchard. Following the development of the root system, the off-shoot were transferred to big plastic bags, filled with

changes of sterile distilled water and dried up on filter paper. Each sample was placed at the centre of Petri-dish (PDA medium) using a needle flamed to redness and then cooled. All cultures were inoculated at room temperature 25- 30 C°, the fungal growth was observed daily.

The fungus *N.mangiferae* was identified based on morphological and histological features as described by Ellis (1976). After 1-3 days of cultures inoculation the microorganisms were examined under light microscope.

2-Physiological and biological characteristic of fungus *N.mangiferae*

Inocula from actively growing culture of *N.mangiferae*, 5 mm disc of 7-days old culture of isolate was placed at the centre of sterile Petri-dish (9cm) containing 20 ml of sterile PDA; the inoculum was placed with mycelium in contact with agar in the Petri-dish. All cultures were incubated at 5, 10, 15, 25, 30, 35.40° C. Four replicates were used for each temperature. Two diameters were drawn at right angles on the reverse side of the Petri-dish; colony radius was measured daily for 7days. The rate of the fungal growth was estimated daily by measuring the colony size along the two diameters drawn at the reverse side of Petri-dish and the mean colony diameter was calculated for each temperature.

Different media were used to study their effects on growth of the fungus.

The media used were.

i) Potato Dextrose Agar (PDA), ii) Corn Meal Agar (CMA), iii) Gzapeks' Dox Agar, iv) Malt Extract Agar (MEA), V) Tap Water Agar (TWA).

A number of sterilized Petri-dishes, were poured with above media, two diameters were drawn on the reverse side of each Petri-dish for centering the inoculum, then 5mm disc was cut from the edge of 7days old culture, then the cultures were incubated at room temperature (25-30 C°), four replicates were used for each treatment, the radius of each colony along the two diameter was measured daily for 5days for each medium.

Effect of carbon source on the linear growth of the pathogen under the study was investigated. A liter of Gzapeks' Dox Agar medium was prepared then distributed into four Erlenmeyer flask of 250ml capacity, each of the four types of carbon source were added at 30g/l to them individually. These were starch, maltose, sucrose and dextrose. Each content of flask was poured into Petri-dishes, and then inoculated with 5mm disc of *N.mangiferae* culture. Four replicates of each carbon source were incubated at room temperature (25-30 °C), colony diameter measured daily for 7days for each treatment.

imum temperature for the fungus is (15° C), the optimum (30-35°), and maximum (38-40°C), the growth of *N.mangiferae* range above 5°C while for *Fusocium arbutithe* temperature ranges 10 , 25 , and 30-35 C° respectively (Elliott,1999, 2003,2003) .The most suitable medium for the growth of *N.mangiferae* is PDA(Pandey et al., 1981, Eltaher, 2003). Generally PDA supported the most extensive growth of *N. mangiferae*(Nori, 1996), (PDA) Potato Dextrose Agar was the most suitable medium followed by Corn Meal Agar , Tap Water Agar and Salt Agar media (Elshiekh, 2004).The type of carbon source significantly affect growth of *N. mangiferae* it is evident that using the same basal medium PDA result in significantly more growth (36 mm) compared to sucrose (25.75 mm) (Nori 1996).The growth of *N.mangiferae* on the three carbon source test the starch promoted better growth followed by corn meal and maltose (Elshiekh, 2004).

N.mangiferae cultured on potato dextrose Agar (PDA) acidified to pH 4.5 with 0.4% (v/v) lactic acid culture were incubated at 25° C under 12-h light provided by cool – white florescent lamps. After a week, mycelia, conidiospore, and *Conidia* of *N.mangiferae* were observed at x 30 to x 40 magnifications under compound microscope

(Msikito et al., 2005).

Stem inoculations were the most successful whereas root inoculations were least successful in *Ficus* inoculation with *N.mangiferae*(Nori, 1996).

On date palm seedling inoculation with inoculated with *N.mangiferae* the symptoms appeared after one month of inoculation. First symptoms of the disease sooty canker appeared on root inoculation and after 42 days on stem inoculation, but there was no difference between soil inoculation and the uninfected controls (Elshiekh, 2004).

The present study was undertaken with the objectives of :-

i) isolate and identify *N.mangiferae* that infect date palm trees was it to confirm, ii) undertake biological and physiological characteristics' of terminal growth requirements of the causal organism e.g. effects of temperature, media and other factor on the growth of pathogen ,ii) undertake pathogenicity test of the fungus causing the sooty canker disease ,iii) define the host range of pathogen.

MATERIAL AND METHODS

1-Isolation and identification of the fungus

Small pieces of 5mm size from diseased tissue, root, leaves, bud, and inside tissue were surface sterilized with 0.1% mercuric chloride for one minute, then washed thoroughly in three

INTRODUCTION

The fungus *Natrassia mangiferae* was distributed in all Sudan and become more serious in Northern Sudan causes wilt and sooty canker disease of date palm (Elshiekh 2004). The disease sooty canker was observed in date palm in Sudan during a survey undertaken by Ahmed and Yassian (1992). The fungus *N. mangiferae* was identified to be the causal organism of the sooty canker of date palm which was reported by Bagdadi and Abu elgasim (2003).

In western Sudan the fungus attack *Acacia* and cause big problems at Khour Taggat causing loss of about 50 % (Eltaher, 2004). The first report of date palm leaf die-back on Barhee, Kabkab, Mazafati and Zahedi cultivars in southern Kerman, Iran caused by *N. mangiferae* in 2001-2003 (Mahadi, 2003).

N. mangiferae colonies effuse dark blackish brown to black, The fungus is well illustrated and described by Ellis (1976) Calavan and Wallace (1954). The symptoms of sooty canker disease caused by *N. mangiferae* on date palm observed by Elshiekh (2004) include; General wilt of the trees and maceration of off-shoot in which the leaves become almost white. Cross-section in diseased off-shoot revealed black layer of sooty masses of arthrospores, black

colour and destruction of conductive system. The trunks of the infected trees become small and the roots turn to black colour. Leaf bases is easily detached and the fibers turn to cottony texture.

The vegetative growth of mycelium of *N. mangiferae* isolated from infected date palm on PDA in pure culture was white in colour, after 2 days the mycelium turned to olive green and after that become black (Nori 1996, Elsheikh, 2004).

The sooty canker disease of date palm caused losses of yield (30-60 %), as well as high loss of mature trees and off-shoot in the main growing areas in the Northern state (Elsheikh, 2004).

The fungus *N. mangiferae* was identified based on morphological and histological features as described by Ellis (1976). After 1-3 days of cultures inoculation the microorganisms were examined under light microscope.

The optimum temperature for germination of the fungus on PDA is 30-35°C while the minimum temperature is 15°C, maximum temperature is 40°C. At 6-12°C the fungus failed to grow (Nori, 1996). The optimum temperature for *N. mangiferae* isolated from date palm was 35°C followed by 25°C and 40°C while the growth was slow at 15°C and the fungus failed to grow at 5°C (Elshiekh, 2004). The mini-

مرض القرحة السخامية في نخيل التمر في الولاية الشمالية - السودان

منتصر آدم و أحمد بغدادي

المستخلص:

هذه الدراسة اهتمت بالخصائص الفسيولوجية والمرضية للفطر *Natrassia mangiferae* المسبب لمرض تقرح وجفاف القلف في سيقان وأوراق النخيل في الولاية الشمالية بدأت الدراسة بإجراء مسح للمرض في موسم 2009-2010م في محليات حلفا، دنقلا، الدبة ومروي. وقد شمل المسح الميداني حوالي 54 مزرعة نخيل. وقد تراوحت نسبة الإصابة بالفطر ما بين 21-31% في الولاية وكانت محلية حلفا أكثر المناطق. أعراض الإصابة بالفطر في النخيل تبدأ باصفرار في قمة الأوراق يعقبه جفاف وموت الأوراق، ذبول الأشجار وموت الإطراف حتى تموت الشجرة بكاملها، تتفرح الأجزاء المصابة وتظهر طبقة سوداء ناعمة من الجراثيم الفطرية المميزة لفطر النتراسيا. نتيجة العزل من العينات المصابة من النخيل أوضحت أن هذا الفطر *N. mangiferae* هو الفطر السائد في معظم العينات في كل المناطق، نمو الميسليوم الفطري في البيئة الغذائية (PDA) كان أبيض اللون ثم تحول الي اللون الاسود و الهيفا بنية سوداء ناعمة غير مقسمة وأحيانا تكون مقسمة اسطوانية او دائرية قطرها 11-5ميكرون. أجريت دراسة فسيولوجية للفطر شملت درجة الحرارة المناسبة لنمو الفطر وبيئة النمو المناسبة والأس الايدروجيني المناسب و كذلك مصدر الكربون حيث وجد أن درجة الحرارة المناسبة لنمو الفطر كانت 35° م وبيئة أجار البطاطس وسكر الدكستروز أفضل بيئة لنمو الفطر ودرجة 5 من الأس الايدروجيني أفضل وسط لنمو الفطر وأفضل مصدر كربوني سكر الدكستروز. تجارب القدرة المرضية للفطر *Natrassia mangiferae* علي النخيل والماتجو والجوافة والليمون والمهوقني واللبخ أظهرت أعراض مماثلة للإصابة الطبيعية بالفطر. والإصابة عن طريق الجذور أكثر فعالية من الساق. الفطر له مدي عائلي واسع من الاشجار والنباتات المختلفة تشمل الموالح، المانجو، الجوافة، المهوقني، اللبخ والهشاب، النخيل وغيره.

PHYSIOLOGICAL AND PATHOLOGICAL characteristic OF *Natrassia mangiferae* THE CAUSAL AGENT OF SOOTY STEM CANKER DISEASE IN NORTH SUDAN

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Abstract

The present work is concerned with the study of physiological and pathological characteristics of the fungus *Natrassia mangiferae* as a causal organism of sooty stem canker disease and leaf die back of date palm (*Phoenix dactylifera* L.) in the Northern state of the Sudan (2009-2010). Symptoms of *Natrassia mangiferae* in date palm first appear as chlorosis on the tip of the leaf followed by necrosis and dryness, trees wilt and die-back, black sooty canker layers of spores are revealed when the infected part was removed from infected areas. The vegetative mycelium grew readily and formed a whitish mat in colour within 2-3 days, and then turn to blackish in colour. The colonies of *N. mangiferae* effused dark blackish brown to black, Hyphae mid to dark brown, smooth 2-8 μ thick, conidia (arthroconidia) mid to dark brown, smooth, mostly aseptate but occasionally with one or more very dark transverse septa, cylindrical 4-17 x 3-8 μ , or spherical to sub spherical and 5-11 μ in diameter. Physiological studies of the fungus include temperature, suitable medium, and pH and carbon source. The maximum temperature for the fungal growth was 35° C. The PDA medium was found to be the best medium for the growth compared to other tested media. The best carbon source for the growth of the fungus was dextrose. The hydrogen ion concentration at level pH 5 gave the maximum growth of the fungus colony. Pathogenicity experiment proved that the symptoms of infection were produced in artificial inoculation similar to those caused by *N. mangiferae* in nature. Root inoculation was more successful as compared to stem soil inoculations. The host range of *N. mangiferae* is extremely wide and it includes plants belonging to different plant families e.g. Citrus spp., Guava, Ficus spp., Mahogany, Albizia, *Acacia nilotica*, *Ficus nitida*, *Ficus bengalensis*, *Eucalyptus camaldulensis*, *Khayasengalensis*, *Acacia senegal*, *Terminalia catappa*, *Albizia lebbek*, *Adonsonia digitata*, *Cassia nodosa*, and *Psidium* spp.

Key words: date palm (*Phoenix dactylifera* L.), sooty canker, *Natrassia mangiferae*.

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- Maize. *Agron. J.* 101, 488-498.
- GEERTS S, RAES D, GARCIA M, MIRANDA R, CUSICANQUI JA, TABOADA C, MENDOZA J, HUANCAR, MAMANI A, CONDORI O, MAMANI J, MORALES B, OSCO V and STEDUTO P (2009a) Simulating yield response of Quinoa to water availability with AquaCrop. *Agron. J.* 101 499–508.
- ZINYENGERE N, MHIZHA T, MASHONJOWA E, CHIPINDU B, GEERTS S and RAES D (2011) Using seasonal climate forecasts to improve maize production decision support in Zimbabwe. *Agric. For. Meteorol.* 151 (12) 1792–1799.
- Raes, D., Steduto, P., Hsiao, T.C., and Fereres, E. 2009. AquaCrop—The FAO crop model to simulate yield response to water: II. Main algorithms and software description. *Agron. J.* 101, 438-447.
- PHILIPS JG, DEAN D, UNGANAI L and CHIMELI A (2002) Implications of farm-level response to seasonal climate forecasts for aggregate grain production in Zimbabwe. *Agric. Syst.* 74 351–369.
- PHILLIPS JG, CANE MA and ROSENZWEIG C (1998) ENSO, seasonal rainfall patterns and simulated maize yield variability in Zimbabwe. *Agric. For. Meteorol.* 90 39–50.
- PINSTRUP-ANDERSEN P, PANDYA-LORCH R and ROSEGRANT MW (1999) World food prospects: Critical issues for the early twenty-first century. URL: <http://www.ucc.ie/famine/conference/papers/Pandya-Lorch.pdf> (Accessed 29 August 2008).
- ROCKSTRÖM J and BARRON J (2007) Water productivity in rain-fed systems: overview of challenges and analysis of opportunities in water scarcity prone savannahs. *Irrig. Sci.* 25 299–311.
- ROCKSTRÖM J, BARRON J and FOX P (2003) Water productivity in rain-fed agriculture: challenges and opportunities for smallholder farmers in drought-prone tropical agroecosystems. In: Kijne JW, Barker R and Molden D (eds.) *Water Productivity in Agriculture: Limits and Opportunities for Improvement*. International Water Management Institute (IWMI), Colombo.
- . Steduto, P., Hsiao, T.C., Raes, D. and Fereres, E. 2009. AquaCrop - The FAO crop model to simulate yield response to water: I. Concepts and underlying principles. *Agronomy Journal* 101: 426-437.
- JONES CA, KINIRY JR and DYKE PT (1987) *CERES-Maize: A Simulation Model of Maize Growth and Development*. Texas A and M University Press, Texas.

Assuming that most of the institutional impediments can be overcome it is quite feasible to increase production and yields. The technology and agricultural practices required are well known and already used on a large scale world-wide and on some of the more advanced farms in Sudan, such as Agaadi. The ultimate improvement would be zero tillage also known as no till or conservation tillage.

To introduce the new technology and agricultural practices will involve greater capital investments by farmers in terms of farm infrastructure, machinery and buildings and greater inputs would be required in terms of machinery, fertilizer, seeds, agrochemicals and - importantly - farmer's time. Support would be required for farmers: small farmers with a few feddans, medium enterprises of less than 1,000 feddans and larger farms up to 5,000 feddans.

Evaluate and quantify the errors involved in AquaCrop simulations.

Developing water production functions with AquaCrop and using them in Decision Support Systems

Using AquaCrop for water allocation decisions at basin or regional levels

Determining the seasonal water requirements and its components for various crops on a farm

Developing deficit and supplemental irrigation programmer at a field scale influence of field management on rain fed agriculture

References

FAO (FOOD AND AGRICULTURAL ORGANISATION OF THE UNITED NATIONS) (2009) theETo Calculator Version 3.1. Reference Manual. URL: <http://www.fao.org/nr/water/docs/ReferenceManualETo.pdf> (Accessed 20 July 2012).

ALLEN RG, PEREIRA LS, RAES D and SMITH M (1998) Crop evapotranspiration – Guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper No. 56. FAO, Rome. 300 pp.

Mhizha, T. 2010. Increase of yield stability by staggering the sowing dates of different varieties of rainfed maize in Zimbabwe. PhD Thesis, Katholieke Universiteit Leuven, Belgium, 166pp.

MPANDE RL and TWANDA M (1998) Case study: Southern Africa population dynamics and the emerging competition for water use in the Zambezi river basin. URL: <http://www.aaas.org/international/ehh/waterpop/southaf.htm> (Accessed 13 July 2011).

Heng, L.K., Hsiao, T.C., Evett, S., Howell, T., and Steduto, P., 2009. Validating the FAO AquaCrop Model for Irrigated and Water Deficient Field

Table 3 Traditional Rain fed

Traditional Rain-fed				
River Nile	58	43	27	586
Khartoum	42	27	9	293
Gezira	406	273	100	347
Sennar	193	128	60	439
White Nile	216	160	86	529
Blue Nile	66	50	32	670
Kassala	117	60	20	324
Red Sea	14	10	5	473
North Kordofan	477	340	90	254
South Kordofan	426	354	220	590
North Darfur	123	67	15	204
West Darfur	148	95	82	760
Central Darfur	33	21	5	92
East Darfur	30	18	4	31
South Darfur	512	327	176	544
Total Traditional Rain-fed	2,860	1,973	929	467
Total Rain-fed	7,630	5,041	2,252	447

Source: Ministry of Agriculture statistics.

Conclusions:

Study of Benchmarking yield gaps in rain fed agriculture and assessment of long-term productivity in rain fed agriculture in Sudan indicate that:

To decrease the gap between potential yield (grain and biomass) and actual obtained yield Aqua Crop model may be employed to help in identifying the

possible underlying causes of the yield gap.

Aqua Crop model can be used determining yield gap between potential yield Identify regions and crops whereby substantial improvements in production and productivity may be possible.

Recommendations

using a mobile PTO-driven thresher. In the 7 years from 2005/6 to 2012/13 sorghum was the most widely grown crop with a planted area of around 8 million hectares (Table 3.1). Of this area only 6% was irrigated and the remaining 94% was rain-fed. In the rain-fed area the semi-mechanized sector is most important with 63% of the area.

The distribution of growth of rain-fed sorghum is shown in Table 2. The semi-mechanized sector is mainly concentrated in the Eastern and Central Regions, in particular Gedaref State, where almost half the semi-mechanized sorghum is grown and where traditional rain-fed sorghum is completely absent.

State	Planted	Harvested	Production	Yield
Mechanized Rain-fed				
Sennar	835	484	195	371
White Nile	428	331	136	422
Blue Nile	325	245	151	645
Gedaref	2,191	1,381	559	382
Kassala	539	296	116	406
North Kordofan	17	12	5	413
South Kordofan	436	318	160	502
Total Mechanized Rain-fed	4,770	3,068	1,323	419

Table 2.3 Sorghum - Planted and Harvested Areas ('000 ha), Production ('000 MT) and Yield (kg/ha) – Average 7 years 2005/6 to 2012/14

Traditional rain-fed sorghum is grown over a larger area, including Darfur, where mechanized farming is absent. Average yields from the traditional sector (419 kg/ha) are lower than from the mechanized sector (467 kg/ha). These low yields reflect both the unreliable rainfall and the absence of inputs such as fertilizer and weeding. The proportions of the planted areas

actually harvested are 64% for the mechanized sector and 69% for the traditional sector.

those of neighboring and other countries (Egypt 5.2t/ha; Eritrea 0.3t/ha; Ethiopia 2.1t/ha; India 0.9 t/ha; USA 3.5t/ha). Egypt's production is all irrigated but nevertheless its yield is about two-and-a-half times that of Sudan's irrigated crop.

The area of harvested sorghum can fluctuate dramatically from year to year (Figure 3). This fluctuation may be partly explained by varying rates of attrition from planted area to harvested area, but other major causes include rainfall variation and market

expectations. Farmers tend to grow more sorghum following a year of high sorghum prices; a market glut then depresses prices and farmers decide to grow less the next year. In the semi-mechanized rain-fed sector there is a tendency for these fluctuations to run counter to those of sesame; after a year of low sorghum prices the area under sesame may increase; if this then brings down the price of sesame, farmers are encouraged to return to sorghum the following year.

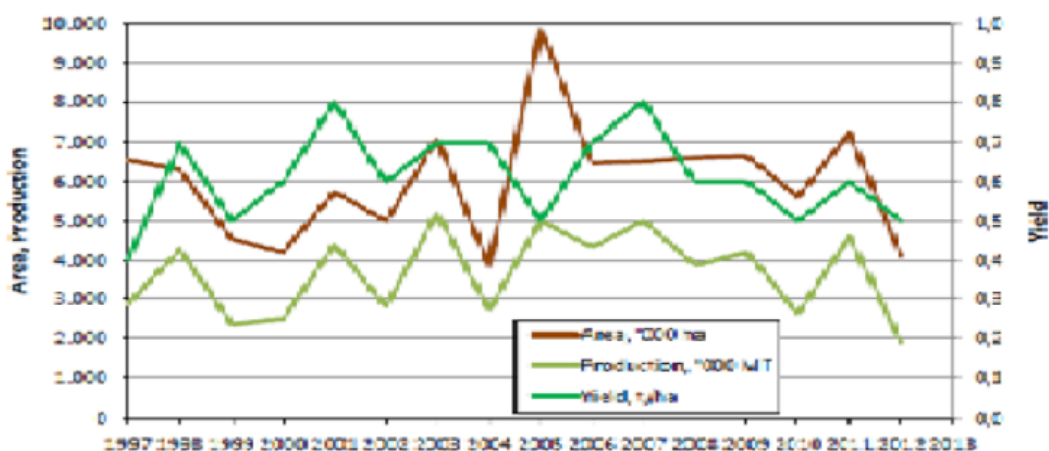


Figure 3: Sorghum Production Parameters (All Sectors) 1997 – 2012

The main pest problems in sorghum production in Sudan are birds (*Quelea quelea*), which weed (*Strigahermonthica*), sorghum bug (*Agonoscelispubescens*) and sorghum midge (*Contariniasorghicola*).

Most of Sudan's sorghum is harvested

manually although harvesting by combine is beginning to be practiced on some projects. The crop is threshed manually in the traditional rain-fed sector while on the irrigation schemes and in the semi-mechanized rain-fed sector threshing is usually carried out

Figure (2) Actual, Potential Grain yield and yield gap (Tone/ fed) for the studied five stations.

It is evident from the figure (2) that: in all stations that there is wide gap between potential yield and actual one. However, the actually attained yield is less in the stations with lowrain fall. This calls for introducing rain water harvesting techniques to avail water and thereby increase the crop yield. However, even in the station with high rain fall (e.g. Dalange and Gadaref) attained yield is far less than the potential. These indicate that water is not only the limiting factors and other crop cultural practices need to be improved. Results from different years were employed to give some clues as to the possible reasons for the yield gap in traditional and semi-mechanized rain fed Sorghum production systems (i.e. low soil fertility, pest, disease, and weed limitations, socio-economic constraints, or low-yielding crop varieties, etc.). A specific application of this approach for assessing Sorghum yield constraints in a region were investigated as detailed bellow. The objective is to help in identifying the possible underlying causes of the yield gap and identify regions and crops where substantial improvements in production and productivity may be possible.

In an average year, most of the country's sorghum is produced in the semi-mechanized rain-fed sector, followed by the traditional and irrigated sectors. Rain-fed yields (semi-mechanized and traditional sectors) are generally of the order of 0.5 t/ha, while those in the irrigated sector are usually about 2 t/ha. The irrigated sector accounts for a relatively small proportion of the area under sorghum - 7% in the period 2008/09 – 2012/13 but yields, at more than 2 t/ha, are usually four to five times greater than those achieved under rain-fed conditions. Consequently, from 7% of the total area under sorghum during that 5-year period, 26% of the country's sorghum was produced. Almost half of Sudan's irrigated sorghum production comes from the Gezira Scheme

The semi-mechanized rain-fed sector is Sudan's largest producer of sorghum, and about half of this comes from Gedaref state; other significant producers include Sennar, Kassala, Blue Nile, White Nile and South Kordofan states. Traditional sorghum production is important in most states apart from Northern. At about 0.5 t/ha, yields are low in both the semi-mechanized and traditional rain-fed sectors. It is interesting to compare Sudan's recent average national sorghum yield of 0.6 t/ha (irrigated and rain-fed) with

Western: North Darfur – El Fashir- (rain fall 100 to 200 mm)

North Kordofan: El Obayied: -(rain fall 200 to 300 mm)

Central Region (Gezira, Sennar, White Nile, and Blue Nile): -(rain fall 300 to 400 mm) The central region is considered the most important cereal producer in the country. The region’s contribution to total grain production is estimated at over 30 percent owing to the presence of the major irrigation scheme (Gezira), part of Rahad scheme, rain fed production and minor irrigation schemes in each state.

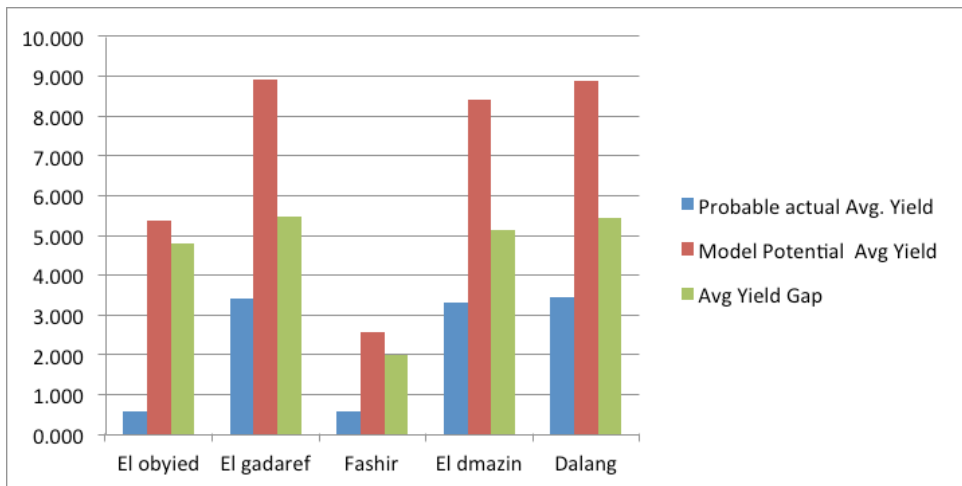
Eastern : Gadaref: -(rain fall 400 to 600 mm)

Southern : South Kordofan: -(rain fall 600 to 700 mm)

Characteristics of each station are detailed in Chapter three. Actual yield is that reported by Federal Ministry of Agriculture, Potential yield is determined by Aqua Crop model and

attainable yield is the long term average reported by Fao.org food security mission (FAO-SIFSIA-N,FAO-ERCU SUDAN, Ministry of Agriculture and Irrigation, Food Security Technical Secretariat (FSTS), Strategic Reserve Corporation -Quasi crop and food supply assessment mission– January 2012). The data is collected for 30 years for the comparison of the long-term productivity using the cumulative distribution functions to show the relative risk levels. Probability analysis was conducted to estimate the most reliable yield.

From the actual yield information and the simulated yield, the capacity of rainfed environments and the yield gap (simulated minus actual yield) was determined and given in figure (2) (shows the average values of Actual, Potential yield, and yield gap for each one of the studied stations for the last 30 years.



f. Soil salinity stress ; g. Effect of soil fertility stress ; h. Calendar of growing cycle

3. Management:

i. irrigation type : a. Soil fertility :ii. Field; b. Mulches; c. Field surface practices iii. Surface runoff soil bund occurrence

A Characteristics of soil horizon (no. of soil horizon, thickness, PWP, FC, SAT, Ksat) b. soil surface (runoff, evaporation) c. restrictive soil layerd. capillary rise

4. Soil Ground water (constant or varying depth and water quality)

B. Simulation data

1. Simulation period (linked to growing season) 2. Initial condition

Initial soil water content soil layer thickness soil salinity (Specified for specific layer)

All these input data were used in the model to predict the yield, water productivity, and biomass and harvest index of a given crop. However, the model should be calibrated and validated using the data acquired from field experiments for its further use.

AQUACROP Yield Prediction Model
Description of AQUACROP

AquaCrop (Raes et al., 2009) is a crop water productivity model developed by the Land and Water Division of the Food and Agricultural Organization (FAO). It simulates yield response to

water of herbaceous crops and is particularly suited to address conditions where water is a key limiting factor in crop production (FAO, 2009). The model does not take into consideration such factors like pests, diseases and weeds. AquaCrop requires the following input data: daily weather data (air temperature, reference evapotranspiration and rainfall), soil texture data (sand, clay, loam, in %) and crop parameters (initial, final and rate of change in %; canopy cover; initial, final and rate of deepening in root depth; biomass water productivity; harvest index; typical management conditions such as irrigation dates and amounts, sowing and harvest dates, mulching, etc). If daily climatic data is not available, 10- day and monthly data can be used as input. Details of the crop model that include: phenology, growth and water balance are contained in FAO (2009).

RESULTS AND DISCUSSIONS

Specific data requirements representing: climate (long-term data set), soil-profile characteristics, Sorghum crop and current practices related to water management, cultural practices, fertilization, level of crop protection and other agronomic practices relevant to actual yields were collected from five cities representing various regions of Sudan. The stations include:

transpiration (ET_o). We used observed data as well as downscaled global climate model data (GCM). Observed data was provided by the Sudan Meteorological Services Department (SMSD). For the study, the daily Satellite data (air temperature, precipitation, wind, and relative humidity) have also been downloaded from <http://global-weather.tamu.edu/#website> in CSV1 file format for a given location, (South Latitude (12), West Longitude (31), North Latitude (16), East Longitude (34)) and time period, (1/1/1979 to 12/31/2014). The numbers of downloaded weather stations were made for each one of the five cities. Appendix I shows the monthly data averaged over ten to fifteen years for all 5 Weather Stations.

Input Data

Model Parameters and Input Data

Weather Data: The weather data required by AquaCrop are the daily values of minimum and maximum air temperature, ET_o, rainfall and solar radiation (Raes et al., 2009, Steduto et al., 2009). The standard procedure is to calculate daily reference evapotranspiration (ET_o) following the FAO Penman–Monteith equation (Allen et al., 1998).

Soil Data: The required input soil pa-

rameters for AquaCrop are the saturated hydraulic conductivity (K_{sat}), volumetric water content at saturation (θ_{sat}), field capacity (θ_{FC}), and permanent wilting point (θ_{PWP}). These parameters were derived from field measurements.

Crop Yield Data: actual field reported yield data was collected from the data bank of Federal Ministry of Agriculture for Sorghum crop in each one of the 5 cities. AquaCrop requires identifying generic growth stages of time to emergence, maximum canopy cover, start of senescence, and maturity. For the purpose of AquaCrop simulation, time to emergence, maximum canopy cover, and start of senescence were based on field observations.

Input data requirement of AquaCrop Model

1. Climate:
 - i. Daily /10 days/monthly Rainfall; ii. Daily /10 days/monthly ET_o ; iii. Daily /10 days/monthly Temperature; iv. CO₂ concentration
2. Crop:
 - i. limited set (crop development and production parameter which include phenology and life cycle Length)
 - ii. Full or all crop parameters: a. Crop development at no water, fertility and Salinity stress ; b. Evapotranspiration ; c. Crop water productivity ; d. Water stresses ; e. Air temperature stresses ;

Table1: Characteristics of the stations used in the study

Station	Region	Location	Coordinates	Elevation	Humidity (%)	Min. Temp. (°C)	Max. . ((Co	An- nual Rain- fall (mm	Sunshine Duration (hours	Wind Speed (km/d
Dalang					44.1	20.8	35.3	680.6	8.3	225.3
Gedarif			14°02'N 35°23'E / 14.033°N 35.383°E / 14.033; 35.383	m 634	42.4	21.4	36.8	612.0	9.1	231.7
Edama- zine			11°46'N 34°21'E / 11.767°N 34.350°E / 11.767; 34.350	m 475	47.7	20.7	35.8	698.2	8.1	218.8
Elobied					34.6	20.0	34.7	329.0	9.2	312.2
Elfashir					31.2	17.2	34.7	193.3	9.3	180.2

According to Emberger method, Eld-mazine belong to the sub-humid class. El-Gedarif is classified as semi-arid and the remaining stations are classified as arid. The semi-arid zone can be represented by the climate data of El Obeid, Nyala, Abu Naama (Umm Benin) and Gedarif (Figure.1). The Dry Monsoon zone

can be represented by the climate data of Damazin and Kadugli (Figure.1). Rain-fed agriculture is generally confined to areas where the climate can be categorized as “semi-arid”, with mean annual rainfall of 300-600 mm in the north, and “dry monsoon” with mean rainfall of 600-850 mm in the south

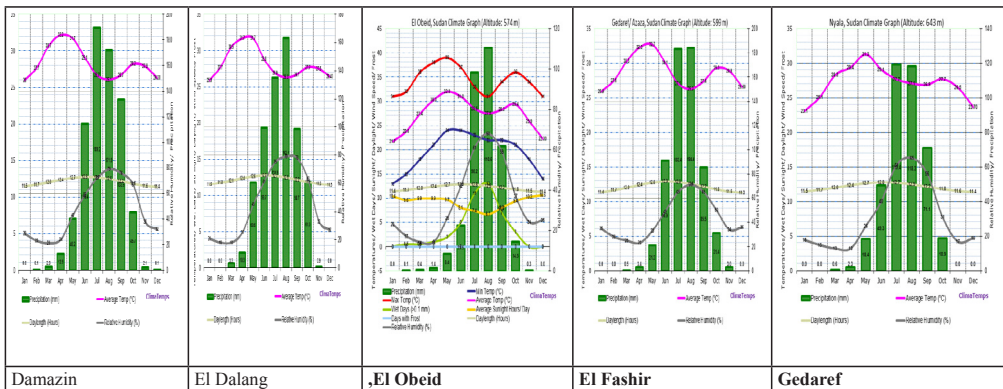


Figure1: Semi-arid Zone - Climate Data of Damazin and El Dalang El Obeid, Damazin, and GedarefTypes and sourc

es of data Climatic data The climatic variables used were rain-
fall, air temperature and reference evapo

scenarios generated from crop simulation models to explore the possible range of climate change impacts on crops. While some studies predict that sorghum will be worse affected by climate change and variability than other crops like wheat or rice mainly from increased atmospheric carbon dioxide other studies indicate positive or contrasting results about the future yield response of sorghum. It is thus crucial to understand the uncertainty surrounding sorghum yield variability, but limited information exist in the clay plains of Sudan regarding the response of existing improved sorghum cultivars towards new climatic futures, considering that sorghum is one of the crops promoted under current climate variability and projected climate change.

This study was directed to examine sorghum crop yield response and identify the adaptation options in the sorghum based cropping system using simulation modeling. This requires calibration and validation of results of the crop simulation model and simulation of the impacts of future climate change scenarios on sorghum productivity.

Specific Objectives:

Benchmarking yield gaps in rainfed agriculture and assessment of long-term productivity in rain fed agricul-

ture in Sudan.

To predict rainfed Sorghum crop grain yield at five regions representing different climate zones in Sudan in reference to prevailing climate conditions.

MATERIALS AND METHODS

The study area

The study was collected from five meteorological stations to represent 5 different agro ecological zones located in the north, middle and south of the country (Table.1). Daily Climate Data (Rain fall, humidity, wind speed, sun shine hours, and max and min temperature) and Sorghum crop yield was collected from the five climatic stations (Dalang, Edamazine ,Gedarif, Elobied, and Elfashir) For the period of 1979 to2014.

Introduction

The global population is projected to continue on a rising trend (FAO, 1998; Mpande and Tawanda, 1998), more so in sub-Saharan Africa in general and in Sudan in particular, where food deficit is already a significant challenge (Pinstrup-Andersen et al., 1999). Competing demands for freshwater from industry and municipalities, as well as environmental problems such as climate change, will limit future extension of surface Nile freshwater for irrigation to cultivate land areas. With limited room for expansion of both agricultural land and the irrigated portion of the arable land from Nile Water (Rockström and Baron, 2007), additional food production will have to come from intensification of production in rainfed farming systems. Rockström et al. (2003) showed that it is possible to at least double rainfed staple food production by producing more 'crop per drop' of rainwater. It is therefore necessary to explore ways of increasing water use efficiency in rain fed agricultural systems.

Climate variability has been identified as the major constraint to agricultural productivity in Sudan; and hence reducing the risk associated with climate variability has a high potential for increasing productivity in rain fed areas in the central clay plains of Sudan

(Phillips et al., 1998).

a crop water productivity model AQUACROP was developed by the Land and Water Division of FAO and released for use during 2009 (Steduto et al., 2009; Raes et al., 2009). AQUACROP is a water-driven crop model to simulate yield response to water of several herbaceous crops. It is designed to balance simplicity, accuracy and robustness, and is particularly suited to address conditions where water is a key limiting factor in crop production. The AQUACROP model has been parameterized and validated for simulating crops yield response to water Heng et al. 2009). Although AQUACROP is based on complex crop physiological processes, it uses a relatively small number of explicit and mostly intuitive parameters with simplicity and accuracy (Steduto et al., 2009; Raes et al., 2009). Some of the advantages of AQUACROP are: a) it is widely applicable with acceptable accuracy; b) it requires only commonly available input (i.e. climate, soil, and crop and field data); c) it allows easy verification of simulation results with simple field observations.

Despite the difficulty in predicting climate change impacts on crop production, mainly due to occurrence of extreme events, some studies clearly demonstrate the capacity of different

قياس فجوة انتاجية الذرة الرفيعة في الزراعة المطرية باستخدام نموذج (أكواكروب)

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المستخلص:

نظرا للنمو السريع في عدد سكان العالم، يزداد الضغط على الموارد المائية لانتاج الغذاء للسكان المتزايدين. تم استغلال حصة السودان من مياه النيل تقريبا؛ كما أن الإنتاج الزراعي في القطاع المطري يهدده تحدي تغير المناخ. ولا بد من زيادة إنتاج كل وحدة من المياه المستهلكة وذلك برفع كفاءة استخدام المياه لمواجهة هذا التحدي. ولذلك يركز هذا البحث على قياس إنتاجية المياه الحقيقية في مناطق الزراعة المطرية، والوصول الى فهم أفضل للتغيرات الزمانية والمكانية ونطاق التحسين المحتمل. وتمت مراجعة واستعراض السجلات والمصادر المتاحة التي توفر قياسات لإنتاجية المحاصيل الزراعية لتقييم الحدود المعقولة لمستويات إنتاجية المياه لمحصول الذرة الرفيعة في الوراثة المطرية وتوفير شرح أول للفروق التي تم العثور عليها باستخدام نموذج أكواكروب. يمكن اعتبار الدراسة خطوة حقيقية في إنشاء قاعدة بيانات لإنتاجية المياه لمحصول الذرة الرفيعة في الزراعة المطرية في البلاد. إن الذرة الرفيعة التي تعد أهم محاصيل الحبوب في السودان قد طالها التأثير من الجفاف الذي تسبب في كثير من الأحيان في نقص الأغذية. حوالي 90% من إجمالي المساحة المزروعة بالذرة الرفيعة تقع في نطاق الزراعة المطرية، و 60% منها في ظروف التربة المعرضة للجفاف. سوف تلعب المعلومات المكانية عن استخدام المياه وإنتاج المحاصيل وإنتاجية المياه دورا مهما لمتخذى القرار للتقييم حيث يمكن أن تتحسن إنتاجية المياه في المناطق المستهدفة. ومن ثم تم وضع منهجية في هذه الدراسة لقياس التباين المكاني لإنتاج المحاصيل، التبخر والنضح وإنتاجية المياه باستخدام نموذج أكواكروب في خمس محطات. اللغات المفتاحية: قياس الفجوة، الزراعة المطرية، محصول الذرة الرفيعة، القطاع المطري والمناخ

Benchmarking Sorghum Yield gap in Rained Agriculture using AQUA crop model

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Abstract

Due to the rapid growth in world population, the pressure on water resources to feed the growing population is increasing. The Nile water share of Sudan is almost exploited; and agricultural production by rained water is threatened by the pressure of climate change. It is inevitable that the production per unit water consumed, the water productivity, must be increased to meet this challenge. This research therefore focuses on the benchmarking of physical water productivity in rain fed areas and gaining a better understanding of the temporal and spatial variations and the scope for possible improvement. A review of the available records and sources that provide measurements of crop-water productivity was consulted to assess plausible ranges of water productivity levels for rain fed Sorghum crop and to provide a first explanation for the differences that are found using AQUACROP model. As such this study may be considered as crucial step was to establish a water productivity database for the rain fed Sorghum crop in the country. Sorghum (*Sorghum bicolor* (L.) Moench) which is the most important cereal crop in Sudan has been constrained by the detrimental effect of drought which has often caused food shortages. Almost 90% of the total sorghum cropped area is rain-fed, and 60% of that is in drought prone soil conditions. Spatial information on water use, crop production and water productivity will play a vital role for water managers to assess where scarce water resources are wasted and where in a given region the water productivity can be improved. Hence, a methodology has been developed in this study to quantify spatial variation of crop yield, evapotranspiration and water productivity using the AQUACROP model in five stations.

Key words: benchmarking, aquacrop model, sorghum yield, rain fed and climate

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622, 1999.

W. R. Livingston, Biomass ash characteristics and behavior in combustion, gasification and pyrolysis systems, Final draft report, Technology and Engineering, Doosan Babcock Energy, Report NO. 34/07/005, project/subproject 78541/SD001, 2007, pp. 50-69.

F. Yu, Y. Liu, X. Pan, X. Lin, C. Liu, P. Chen, R. Ruan, "Liquefaction of corn stover and preparation of polyester from liquefied polyol," *Applied Biochemistry Biotechnology*, Humana Press Inc. 2006, pp. 129-132.

Y. Lu, L. Tighzer, P. Dole, D. Erre, "Preparation and properties of starch thermoplastics modified with waterborne polyurethane from renewable resources," *Polymer*, vol. 46, pp. 9863-9870, 2005.

T. Wang, D. Li, L. Wang, J. Yin, X. Chen, Z. Mao, "Effects of CS/EC ratios on structure and properties of polyurethane foams prepared from untreated liquefied corn stover with PAPI," *Chemical Engineering Research and Design*, vol. 86, pp. 416-421, 2008 .

Z. Meng, B. Lu, "Dust events as a risk factor for daily hospitalization for respiratory and cardiovascular diseases in Minqin, China," *Atmospheric Environment*, vol. 41, pp. 7048-7058, 2007.

M. Metwally, R. Williams,. Development of non-petroleum based binders for use in flexible pavements, Institute for Transportation, Iowa State University, Final Report, 2010, pp. 1-180.

Y. Kurimoto, M. Takeda, A. Koizumi, S. Yamauchi, S. Doi, Y. Tamura, "Mechanical properties of polyurethane films prepared from liquefied wood polymeric MDI," *Bioresource Technology*, vol. 74, pp. 151-157, 2000.

Y. Yan, M. Hu, Z. Wang, "Kinetic study on the liquefaction of cornstalk in polyhydric alcohols," *Industrial Crops and Products*, vol. 32, pp. 349-352, 2010 .

G. W. Gee, J. W. Bauder, "Particle size analysis," In: A. Klute (ed.) *Methods of Soil Analysis*, part 1, 2nd ed. Agronomy Monogram 9. ASA and SSSA, Madison, W 1, 1986, pp. 383-411.

B. Craze, Soil survey standard test method for soil moisture content, *Laboratory Procedure*, 1990, pp. 2-5.

GTM, Test method for determination of pH value of water or soil: *Geotechnical Test Method*, State of New York, Department of Transportation, Geotechnical Engineering Bureau, 2007, pp. 4-5.

Y. Wang et al., J. Wu, Y. Wan, H. Lei, F. Yu, P. Chen, X. Lin, Y. Liu, R. Ruan, "Liquefaction of corn stover using industrial glycerol," *Agriculture and Biological Engineering*, vol. 2, pp. 32 -39, 2009.

- nal of Soil Science, vol. 33, pp. 141-163, 1982.
- W. S. Chepil, "Field structure of cultivated soils with special reference to erodibility by wind," Soil Science Society of American Proceedings, 17, USA, 1953, pp. 185-190.
- W. S. Chepil, "Soil conditions that influence wind erosion," USDA Technical Bulletin 1185, pp. 26-28, 1958.
- K. E. Saxton, D. Chandler, W. Schillinger, "Wind erosion and air quality research in the Northwest US Columbia Plateau: Organization and Progress," In D.E. Stott and R.H. Mohtar, and G.C. Steinhardt (eds), Sustaining the Global Farm, Selected Papers for the 10th International Soil Conservation Organization Meeting May 1999. USDA-ARS National Soil Erosion Research, 2001, pp. 766-770.
- F. R. Toreh, J. A. Hobbs, R. L. Donahue, "Soil and water conservation for productivity and environment protection," Printice-Hall, Englewood Cliffs, New Jersey, pp. 1-718, 1980.
- B. Diouf, E. L. Skidmore, J. B. Layton, L. J. Hagen, "Stabilizing fine sand by adding clay: Laboratory Wind Tunnel Study," Soil Technology, vol. 3, pp. 21-31, 1990.
- S. M. Forter, "Microbial aggregation of sand in an embryo dune system," Department of Biological Science, University of Dundee, Dundee, UK, 1979.
- E. L. Skidmore, F. H. Siddoway, "Crop residue requirements to control wind erosion," In: W.R. Oswald (ed.), Crop Residue Management Systems, American Society of Agronomy Specie 31, 1978, pp. 17-33.
- L. Abbott. Djajadi, C. Hinz, "Synergistic impact of clay and organic matter on structural and biological properties of sandy soil," Geoderma, vol. 183-184, pp. 19-24, 2012.
- J. Eldridge, R. Green, "Microbiotic soil crusts: A review of their roles in soil and ecological processes in the rangelands of Australia," Australian Journal of Soil Research, vol. 32, pp. 389-415, 1994.
- D. V. Armbrust, I. Lyles, Soil stabilizers to control wind erosion. In: W.C. Moldenhauer (ed.), American Soil Science Society Spec. 7, Madison, Wisconsin, 1975, pp. 77-82.
- A. sharma, T. R. Rao, "Kinetic of pyrolysis of rice husk," Bioresource Technology, vol. 67, no. 1, pp. 53-59, 1999.
- T. Nakano, "Mechanism of thermopasticity for chemically modified wood," Hlozforschung , vol. 48, pp. 318-324, 1994.
- C. H. Chio, A. P. Mathews, "Two-steps acid hydrolysis process kinetics in sacharification of low-grade biomass: Experimental studies on the the formation and degradation of sugars," Bioresource Technology, vol. 58, pp. 101-106, 1996.
- T. Yamada, H. Ono, "Rapid liquefaction of lignocellulosic waste by using ethylene carbonate," Bioresource Technology, vol. 70, pp. 61-67, 1999.
- Y. Kurimoto, S. Doi, Y. Tamura, "Specific effects on wood liquefaction in polyhydric alcohols," Holzforschung, vol. 53, pp. 617-

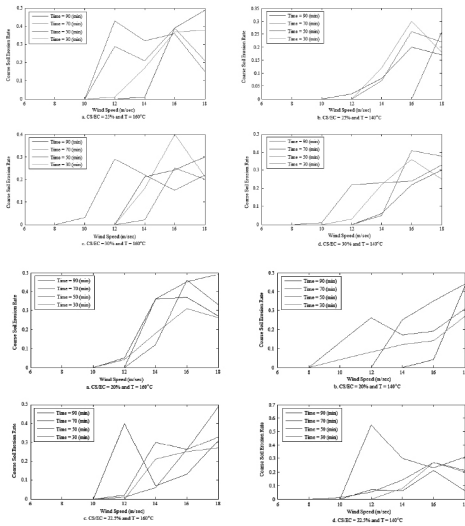


Fig. 4. Coarse sand particles erosion rates at different CS/EC mixtures.

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References

J. R. Williams, C. A. Jones, P. T. Dyke, “A modeling approach to determining the relationship between erosion and soil productivity,” *Transaction American Society Agricultural Engineering*, vol. 27, pp. 129-144, 1984.

G. S. Okin, B. Murray, W.H. Schlesinger, “Degradation of sandy arid shrub-land environments: observations, process modeling, and management implications,” *Journal of Arid Environment*, vol. 47 no. 2, pp. 123-144, 2001.

X. Yang, G. Chapman, R. Yeomans, “Assessing soil erosion risk after severe bushfires in New South Wales, Australia using RUSLE and MODIS,” 7th International Symposium on Digital Earth, Perth Australia, August 2011, pp. 23-25.

L. Gomes, J. L. Arrue, M. V. Lopez, G. Terk, D. Richard, R. Gracia, M. Sabre, A. Gaudichet, J. P. Frangi, “Wind erosion in a semi-arid agricultural area of Spain: the WELSONS project,” *Catena*, vol. 52, pp. 235-256, 2003 .

J. R. Williams, A. N. Sharpley, D. Taylor, “Assessing the impact of erosion on soil productivity using the EPIC model,” In: J. Boardman, I.D.L. Foster, and J.A. Dearing (Eds), *Soil Erosion on Agricultural Lands*, John Wiley, Chichester, 1990, pp. 461-464. UNEP, In: Thomas, D.S.G., Middleton, N.J., (Eds), “World Atlas of Desertification,” UNEP of United Nations Environment Program. Arnold, London, 1997, pp. 182.

H. Dregen, M. Kassas, B. Razanov, “A new assessment of the world status of desertification,” *Desertification Control Bulletin*, vol. 20, pp. 6-18, 1991 .

J. M. Tisdall, J. M. Oades, “Organic matter and water-stable aggregates in soils,” *Jour-*

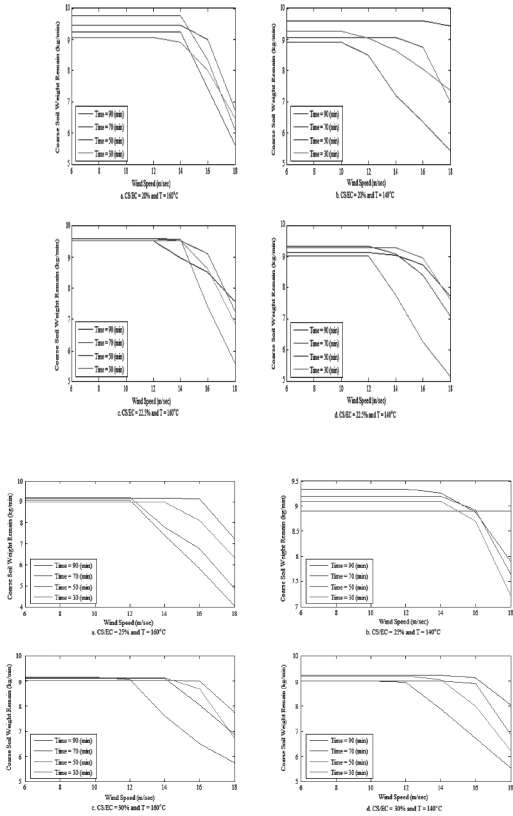


Fig. 5. Coarse sand particles weights remain at different CS/EC mixtures.

The rate of the wind erosion on the coarse sand soil relative to the wind speeds applied with the time interval of 5 minutes is shown in Fig. 5. It was revealed that for most of the samples wind speed of 6 m/s ~8 m/s applied on the crusts developed from the CSLS and coarse sand soil particles resulted in zero erosion rates, which indicate that within this wind speed the crusts strength was strong enough to resist the wind force. Thereafter, a gradual increase in the wind speed to 10 m/s ~12 m/s caused a gradual and continual deterioration of the CSLS and coarse sand

soil particles crusts of the most samples, exposing more soil particles to direct wind force which caused a gradual increase in rate of coarse sand soil erosion. Increasing the wind speed beyond 12 m/s (14 m/s, 16 m/s, and 18 m/s) all the CSLS and coarse sand soil particles crusts moved in high rates, resulting in a concurrent increase of their erosion rate. Generally, a gradual increase in erosion rate of the coarse sand soil with wind speed suggested the high adhesive force of CSLS and the coarse sand soil particles crusts at first versus a low wind force at the low speed, and then the opposite is true with increasing the wind speed. Also it is well mentioning that the CSLS and coarse sand soil crusts start to move by wind force at some point (s) within the sample, which in turn ease and accelerate crusts deterioration more than the other samples, despite the CSLS, and its liquefaction conditions.

The effects of the corn stover liquids on the sand soil particles stabilization

According to the classification scheme of USDA standards for soil particle size, and with referring to Table 1, that one of the soil sample falls in the coarse sand soil type and the other soil as fine soil which is a mixture of fine coarse sand, silt and clay.

The sticking abilities of the CSLS samples produced at 140 °C and 160 °C on the coarse sand soil particles subjected to different predetermined wind speeds are shown in Fig. 3. All the samples showed resistance to movement (without deformation in the CSLS coarse sand soil crusts) under the wind speed of 6~10 m/s. But in some samples a gradual increase in the wind speed up to 12 m/s resulted in partial deterioration of the soil crusts accompanied with a tiny detachment of the coarse sand particles. When the wind speed reached 14~16 m/s higher deterioration of the CSLS and coarse sand soil crust was observed in the most of the samples, as a consequence, more detachment of the coarse sand soil particles was found. However, more and more crusts deterioration occurred when the wind speed was increased beyond 16 m/s that resulted in extreme negative effects on the soil particles for the whole coarse sand soil samples. Most of the samples curves showed a tendency that the difference existed in the starting points continued with no change during the wind tunnel test until the upper

limits of the crusts strength. This indicate that below this upper limits the stickiness or the strength force of the CSLS acting on the surface of the coarse sand soil particles samples was enough to resist the effect of the wind speed. But after that upper limits CSLS coarse sand soil particles samples showed different and fluctuated trend attributing mainly to the difference in the application rate of the CSLS on the samples surface, which in turn revealed different crusts surface strength and thickness, and thus different wind speed resistance. In general, the findings indicated that the CSLS succeeded in sticking the coarse sand soil particles together by acting as cement material, simultaneously helped to develop a soil crust and thus increased the ability of the coarse sand soil to resist the wind force, this sticking ability may attributed to some rheological properties such as liquids viscosity and also high organic carbon as supported by [9]. Besides, all the CSLS and coarse sand soil particles crusts investigated showed nearly the same effects (without loss when the wind speed not exceeding an upper limit) within a wide range of wind speed and with no apparent differences between the CSLS samples under the described liquefaction temperature and time.

TABLE I: physiochemical properties of the soil samples

Soil type	Soil size (mm)	Moisture content (%)	Bulk density	Soil pH
Coarser particles	1.20 ~ 0.16	0.21	1.50	7.95
Finest particles	≤ 0.16	0.30	1.18	7.88

Results and Discussions

The liquefaction rates and viscosities of the corn stover liquids

Fig. 1 shows the results of liquefaction efficiency of CSLs (20%~30% CS/EC) prepared at 140 °C and 160 °C at different liquefaction times (30 min ~ 90 min). The liquefaction rates of all CSLS samples prepared at 140 °C and 160 °C were at minima at 30 minutes and they increased gradually as the liquefaction time prolonged, and reached their maxima at 90 minutes. Except for a CS/EC mixture of 22.5%, it is noteworthy that the liquefaction rate of the CSLS samples treated at 140 °C increased rapidly at the first 50 minutes and then the rate of increase slowed down with time. At 160 °C, the 20% and 22.5% CS/EC samples behaved similar as at 140 °C. While with CS/EC mixtures of 25% and 30% the steady increase in the liquefaction rate extended to 70 minutes and then the rate of increase started to slow down. Moreover, 20% CS/EC samples heated at 140 °C and 160 °C showed higher liquefaction rates compared to 22.5% CS/EC and as the percentage of the CS increased in the sample the liquefaction rate further decreased. Accordingly, 30% CS/EC had the lowest liquefaction rate. It can be seen from Fig. 1 that treating the CS/EC samples at 160 °C resulted in better liquefaction rate than that at 140 °C. However, low CS/EC mixture and high reaction temperature and time gives better CSLs yield, these results are similar to that

reported by [35]. The results of viscosity of the CSLS prepared at 140 °C and 160 °C at different liquefaction times (30 min ~ 90 min) are presented in Fig. 2. The viscosities of CSLS at 140 °C and 160 °C were in sequence. The viscosity of the sample was increased as the amount of CS in the liquid increased. Hence, the CSLS with 30% CS/EC showed the highest viscosity. The viscosity of the liquid samples (20~30% CS/EC) at 140 °C and 160 °C increased steadily with the progress in reaction time whereas at 90 minutes the highest viscosity was found. A positive correlation between CSLS viscosity and the solid content as well as the high liquefaction temperature and time was reported [26], and [29].

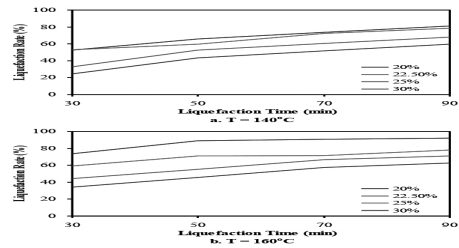


Fig. 1. Liquefaction rate for different CS/EC mixtures at 140°C and 160°C.

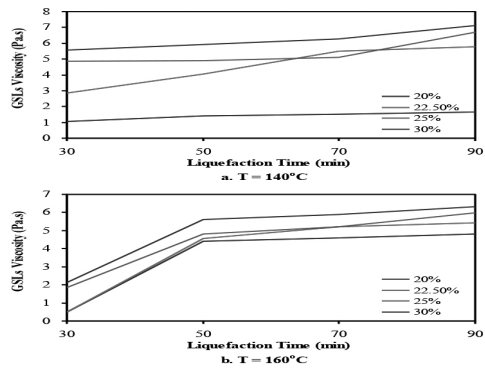


Fig. 2. Liquefaction viscosity for different CS/EC mixtures at 140°C and 160°C.

sity were calculated as suggested by [33], and the soil pH was obtained in accordance with [34] method using a pH meter (Model: Sartorius AG PB-20, Switzerland).

Lab wind tunnel experiments

The laboratory experiments for the lab wind tunnel were conducted in General Experimental Hall, College of Water Resources and Civil Engineering, China Agricultural University; and according to the lab conditions as in the following steps:

To determine the effect of the CSLs on the sand soil particles stabilization, the different CSLs that were prepared with different CS/EC mixtures (20%, 22.5%, 25%, and 30%) and the 2 different reaction temperature (140 °C and 160 °C), and the 4 different reaction time (30, 50, 70, and 90 min), were employed as CSLs samples. The CSLs samples were then heated in the water bath for 2 hours at 70 °C to decrease the viscosity of the stored CSLs and to ease its pumping out. Empty trays (50 cm×45 cm×15 cm) were weighed and then filled with the prepared sand soil with a careful leveling. The filled trays were re-weighed and labeled to be ready for the coming CSLs application. About (20 g) CSLs samples were sprayed individually on the surface of the leveled sand soil (about 1.5 m above the labeled trays) using a small hand pump by means of compressed air stream from electric air compressor (Model: AIRTATE 0.2/8 D-3 (II), Shanghai, China), at constant pumping

pressure (0.8 MPa). The weight of each tray was determined, recorded, and remarked, each was then known as experimental sample. All the experimental samples were then exposed to 5~7 days drying period at ambient temperature (15°C~20 °C). A wind tunnel (Model: NYB, The New York Blower Company, USA), has a dimension of (17 m×9.7 m×0.75 m) was used, and the wind speed in the tunnel was pre-adjusted according to the classified effects of wind erosion on soil (surface creep, saltation, and suspension). Accordingly, the wind speeds applied were 6 m/s, 8 m/s, 10 m/s, 12 m/s, 14 m/s, 16 m/s, and 18 m/s with a speed application interval of 5 min (i.e. raising speed gradually 2 m/s each 5 min), the speed was measured in the free opens of the wind tunnel using digital anemometer (Smart Sensor, Model AR836, Hong Kong Hen Gao Electric Group, Hong Kong, China). The data related to the effect of the wind tunnel speed on the treated sand soil samples were determined as soil weight lost.

Statistical analysis

Data were obtained from three separate samples and then averaged. Data were analyzed statistically by Analysis of variance and then means were separated using Microsoft Office Excel 2007 (Microsoft Corporation, USA), and the MATLAB 2011a (Mathematical Computing Software, Natick, USA).

the liquefaction process, and sulfuric acid (98.8%, v/v) as catalyst. Water and silicon were used as blowing agent and surfactant, respectively. All these chemicals were of analytical reagent grades, which were obtained from commercial sources in Beijing. Sand soil sample was dried in the open air for 7 days, and then sieved with 1.2 mm~0.16 mm sieve shaker. A soil sample was then stored in a plastic bag for size determination and some physiochemical analysis prior to stabilization experiment.

Laboratory preparation of corn stover liquids (CSLS)

The experiments were conducted at Agricultural Processing Laboratory, College of Engineering, China Agricultural University. Different amount of the dried corn stover powder (40 g, 45 g, 50 g, and 60 g) each was added to (200 g) ethylene carbonate. This prepared CS/EC mixtures of (20%, 22.5%, 25%, and 30%), was then liquefied under two levels of liquefaction temperature (140 °C and 160 °C), and 4 levels of liquefaction time (30 min, 50 min, 70 min, and 90 min).

The liquefaction chemicals (ethylene carbonate, 200 g; and sulfuric acid, 7 g) with dried corn stover powder whose amount was weighted according to the designed CS/EC mixtures were placed in a three-neck flask (1000 ml) equipped with a reflux condenser; a thermometer; and a motor driven-stirrer. The main function of the reflux condenser is to condense and reflux the

materials which would be produced in the liquefaction process and could be evaporated at the specified temperature. The mixed materials in the flask then refluxed at a desired temperature for a predetermined period of time, with continuous agitation during the liquefaction process to obtain homogeneous liquefied products. The flask was then immersed into cold water to quench the reaction. For all experiments, the liquefaction process was done at the atmospheric pressure.

Measurement of liquefaction rate

The insoluble residue (unliquefied corn stover) ratio (IRR) of the CSLS was measured as illustrated by [30], and then the rate which was used as index for liquefaction efficiency was calculated as suggested by [31]:

$$\text{liquefaction rate} = \frac{W_0 - W}{W_0}$$

Where: W_0 is the weight of the corn stover sample before liquefaction, and W is the weight of insoluble corn stover residue obtained after liquefaction.

Measurement of viscosity

The viscosity of the CSLs was determined following the method applied by [30], and by using a viscometer (Model: NDJ-85, Cany Precision Instrument, Shanghai, China) at 25 °C.

Soil particle size with some soil properties

Soil particle size was obtained referring to the USDA classification scheme [32], the soil moisture content and the soil bulk den-

may be done by using vertical barriers or horizontal protection. While vertical barriers consist of fences of appropriate height, thickness, porosity, and arrangement [14], [15]; horizontal protection involves adding clay and organic matter to sandy soil [16], using biological crusts on soil which empower soil dry aggregates on the surface against wind erosion [17], and applying water, oil (low-gravity asphaltic oil, high gravity waxy oil, and crude oil), and chemical soil stabilizers [18].

Practically, effective utilization of lignocellulosic biomass has been achieved by applying chemical and biochemical techniques, such as pyrolysis [19], modification [20], hydrolysis [21] and liquefaction [22]. Especially for liquefaction in solvents, biomass could be decomposed into liquid at mild temperature and atmospheric pressure [23], and the liquefaction was influenced mainly by liquefaction solvent and catalyst, as well as reaction temperature and reaction time [22]. Generally, the slow liquefaction rate or lower temperature generates higher levels of char, while the faster liquefaction rate or higher temperature generates higher levels of liquids and gaseous products [24]. In other words, liquefaction yield increased with increasing time and temperature and better liquefaction achieved at 2 hrs and 160 °C, and a further increase in time and temperature resulted in a depressed increase in liquefaction yield [25]. The costs as well as the mechanical properties are the main

constraints that limit the wide use of biodegradable materials [26]. Thus, [27] suggested that any increase in the corn stover (CS) charge could contribute to decrease in the liquefaction costs. However, liquid co-product produced during biofuel production using biomass that are rich in lignin contents have been used in many traditional applications which include but are not limited to concrete admixtures, binders, well drilling mud, vanillin production, dispersants, and soil particles and dust control [28].

Fewer research has been conducted until now on the material that utilizing biomass liquids for soil particles adhesive or binder [29]. Accordingly, this paper focused at study the applicability of using different corn stover liquids produced at different experimental conditions to serve as coarse sand soil particles horizontal barriers, mainly through enhance sand soil particles adhesive force against wind force and therefore can control or mitigate the rate of sand soil particles detachment.

Materials and methods

Materials

Corn stover (CS) was collected from a local farm in suburb areas around Beijing of China. Then corn stover was milled, screened, oven dried and weighted; only the fractions with particle size of 20~80 meshes and moisture content of 6%~9% were employed for the study. Ethylene carbonate (EC, 99.90%, v/v) was used as solvent in

Index Terms— corn stover, liquefaction, soil conservation, wind erosion.

INTRODUCTION

Wind erosion is considered to be a principal mechanism and important form of soil degradation [1], and [2]. Accordingly, it is recognized as one of the most serious environmental and agricultural problems worldwide, which has intensified in recent years [3], and [4]. Wind erosion is mainly confined to the so-called drylands, which comprise arid, semi-arid, and dry sub-humid areas, in such ecosystem the following conditions frequently occur: a loose, dry, finely divided soil and a smooth land surface devoid of a vegetative cover, due to low precipitation, large fields, and strong winds [5]. Basically, wind erosion can be defined as the physical transport process of soil particles blown away by an air stream, so the wind is the forcing mechanism of wind erosion [1], and the threshold friction velocity (TFV) is the force of wind required to detach particles from soil surface and controlled by soil surface characteristic [6]. Consequently, wind speed as low as 5~7 m/s (11~15 mile/hr) at 3 m above the soil surface can initiate soil movement under high erodible field conditions by modes of transport creep, saltation, and suspension [7]. In addition, the size and stability of the soil aggregates are primary factors that affect soil susceptibility to wind erosion [8]. The binding agents of soil aggregate vary also [8], while aggregates > 2000 μm are held together by a fine network of

roots and hyphae in soils with high contents of organic carbon (> 2%), aggregates between 20 μm and 250 μm consist largely of particles 2~20 μm diameter, bonded together by various cements including persistent organic materials, crystalline oxides, and highly disordered aluminosilicates. By the same token, water-stable aggregates 2~20 μm consists of particles < 2 μm diameter bonded together very strongly by persistent organic bonds. Also aggregates between 2 μm and 20 μm are an association between live bacteria cells and clay particles [8], and [9]. Thereafter, aggregates smaller than 0.84 mm in diameter are considered as erodible by wind [9], and the proportion of those aggregates in the upper 25.40 mm of the soil surface defines the wind erodible fraction. As a result, aggregates resistance against disrupting forces can be estimated by means of their dry aggregate stability (DAS), which is considered an index of soil resistance against wind erosion [10].

Conventionally, many practices that have been used to control soil wind erosion [11]. But the practices which can stabilize sand soil particles against wind force were briefed by [12] in two steps: temporary stabilization which can be done by any material that stops surface sand movements, and then biological stabilization which consists of establishing a permanent vegetative cover and this step depends upon how efficient the temporary stabilizer. Furthermore, [13] illustrated that temporary stabilization

استخدام مخلفات الذرة الشامية المسالة معملياً بغرض تثبيت حبيبات التربة الرملية الخشنة ضد التعرية بالرياح دراسة عملية باستخدام النفق الهوائي

المستخلص:

أجريت هذه التجربة بغرض دراسة امكانية استخدام مسحوق مخلفات الذرة الشامية المسالة في تثبيت حبيبات التربة الرملية الخشنة ضد التعرية بالرياح داخل المعمل باستخدام النفق الهوائي. أسست التجربة على اذابة مسحوق مخلفات الذرة الشامية (CS) في كربونات الاثيلين (EC) كمذيب عضوي في وجود حامض الكبريتيك المخفف، استخدمت 4 مستويات وزنية مختلفة من خليط مسحوق مخلفات الذرة الشامية وكربونات الاثيلين (CS/EC) 25%، 22,5%، 20%، و30%. استندت التجربة على درجتي حرارة (140 و160 درجة مئوية) وزمن تفاعل يتراوح بين (90-30 دقيقة)، وأوضحت النتائج أن كفاءة اسالة مسحوق المادة المذابة (CS) في المادة المذيبة (EC) تعتمد على كمية المادة المذابة ودرجة الحرارة والزمن المستخدمان للتفاعل، فهي تزيد عند نقصان وزن المادة المذابة وزيادة درجة الحرارة والزمن، ووجد ايضا ان لزوجة السائل المستخلص تزيد بزيادة النسبة الوزنية (CS/EC) وزيادة درجة الحرارة وزمن التفاعل. لأجل دراسة أثر هذا المستخلص في تثبيت حبيبات التربة الرملية الخشنة ضد الرياح، وضعت عينات التربة في اطباق مستطالية الشكل وتمت تغطية هذه العينات بالمادة المسالة لكل النسب الوزنية لل (CS/EC) ثم جففت هذه العينات في درجة حرارة الغرفة لفترة 7 أيام. وضعت هذه العينات في فتحات مخرج النفق الهوائي الذي تم ضبطه مسبقا ليعطي سرعات مختلفة تتراوح بين (6-18 متر/ثانية). أوضحت نتائج التجربة أن القشرة المتكونة بين السائل المستخلص وحبيبات التربة الرملية الخشنة تتحمل سرعة رياح حتى 10 متر/ثانية بعدها وبزيادة السرعة تتفكك هذه القشرة مما يعرض حبيبات التربة للحركة. وخلصت التجربة الى ان قوة تماسك هذه القشرة الصلبة لكل عينات السائل المستخلص ضد سرعة الرياح لها نفس الأثر غرض النظر عن الاختلافات الحادثة في التجربة (نسبة CS/EC، زمن ودرجة حرارة التفاعل، اضافة الى لزوجة السائل المستخلص)، أيضا وخلصت التجربة الى أن القشرة الناتجة من تماسك السائل المستخلص مع حبيبات التربة مقاومة عالية ضد سرعة الرياح.

Corn Stover Liquids for Stabilizing Coarse Sand Soil Particles: A Laboratory Wind Tunnel Study

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Abstract

the applicability of using corn stover liquids as coarse sand soil particles stabilizer (bio-binder) material was studied. The corn stover powder (CS) was liquefied in ethylene carbonate (EC) in the presence of dilute sulfuric acid. The liquid samples were prepared with 4 levels of CS/EC mixtures (20%, 22.5%, 25%, and 30%, w/w), 2 levels of liquefaction temperature (140 °C, and 160 °C), and varied reaction times (30~90 min). The insoluble residue ratios for the CSLS increased with higher CS/EC mixture, lower reaction temperatures and shorter reaction times. While the viscosity in the CSLS increased with higher CS/EC mixture, higher reaction temperatures and longer reaction times. The air dried pre-treated coarse sand soil samples covered with CSLS were placed in a tunnel subjected to wind speeds ranging from 6 m/s to 18 m/s. The crusts developed with the CSLS on the coarse sand soil surface could withstand wind speeds up to 10 m/s, beyond this speed the deformation in the crust with a gradual increase in the erosion rate was observed. The present work concluded that the adhesive forces of all the CSLS samples had nearly the same resistance effects to the wind flow irrespective to the preparation conditions (CS/EC ratios, reaction temperature and reaction time) and the viscosity. Also the crust developed on the coarse sand soil samples showed high resistance to wind erosion to a limited wind speed; however, beyond that limit the coarse sand soil particles are no longer stabilized.

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tions of Sangral on leaf number of leaves of grapefruit scion shoot. Data taken after weeks from budding.

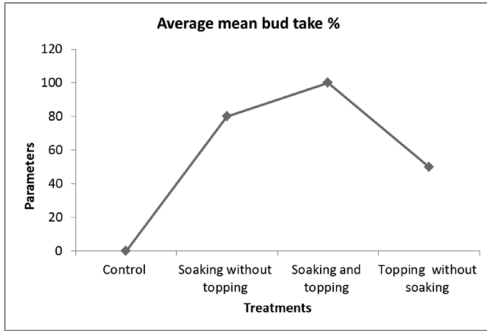
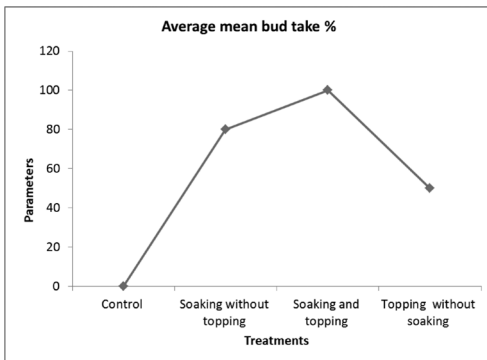


Fig.3. Effect of soaking/topping treatments on scion bud-take. Data taken 6 weeks after budding.



\sFig.3. Effect of soaking/topping treatments on scion bud-take of grapefruit. Data taken after 6 weeks from budding.

grapefruit scion buds. Data taken were after 6 weeks from budding.

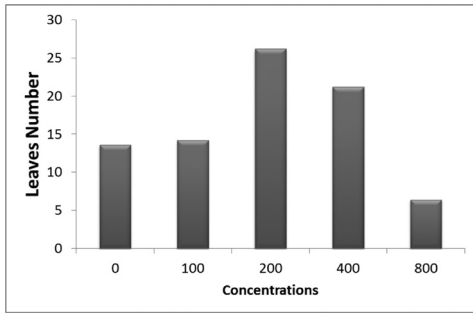


Fig. 2. Effect of different concentrations of Sangral on leaf number of scion shoot of grapefruit. Data taken after 6 weeks from budding.

grapefruit. Data were taken after 6 weeks from budding.

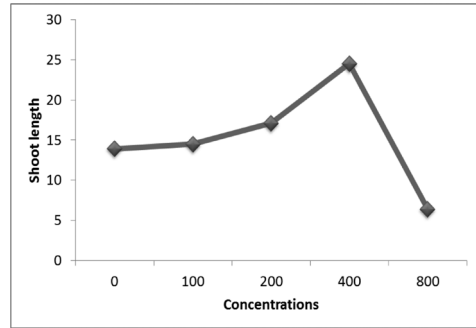


Fig.3. Effect of different concentrations of Sangral on scion shoot elongation. Data were taken after 6 weeks from budding.

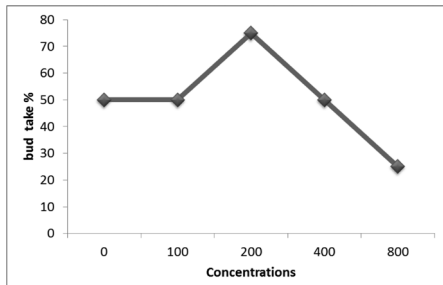


Fig.1. Effect of different concentrations of Sangral on scion bud-take of grapefruit. Data were taken after 6 weeks from budding.

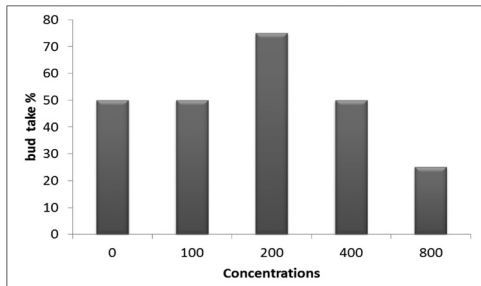


Fig.1. Effect of different concentrations of Sangral on scion bud-take of grapefruit. Data taken after weeks from budding.

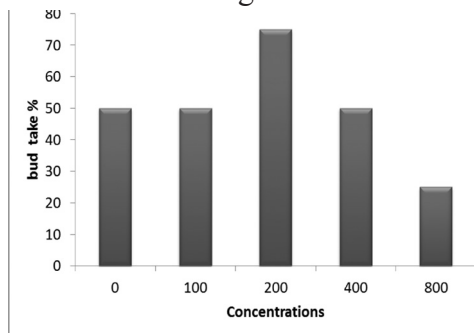


Fig.1. Effect of different concentrations of Sangral on scion bud-take of

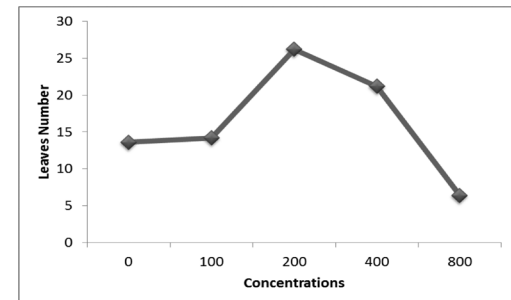
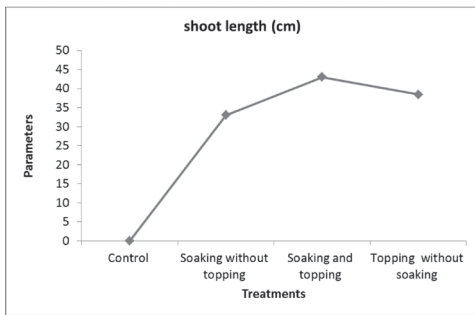
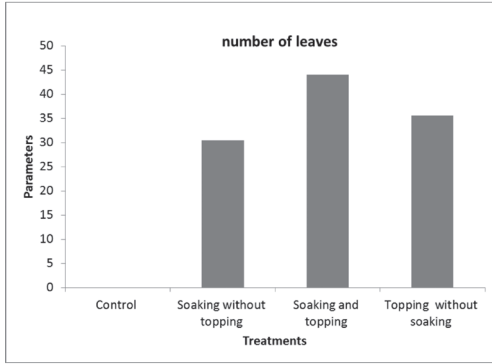


Fig.2. Effect of different concentra-

of grapefruit. Data taken after weeks from budding.



Effect of soaking/topping treatments on scion shoot elongation of grapefruit. Data were taken after 6 weeks from budding.

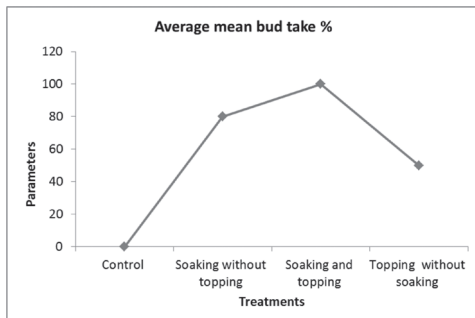


Fig.1 Effect of soaking/topping treatments on scion bud-take percentage of grapefruit. Data were taken after 6 weeks from budding.

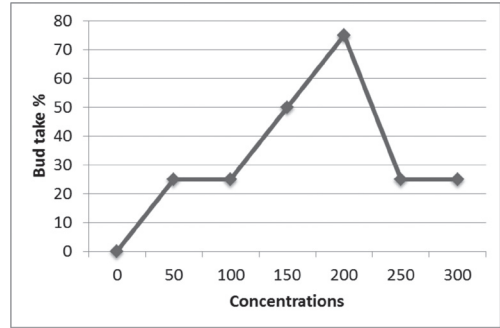


Fig.1. Effect of different concentrations of Sangral on percent scion bud-take. Data were taken after 6 weeks from budding.

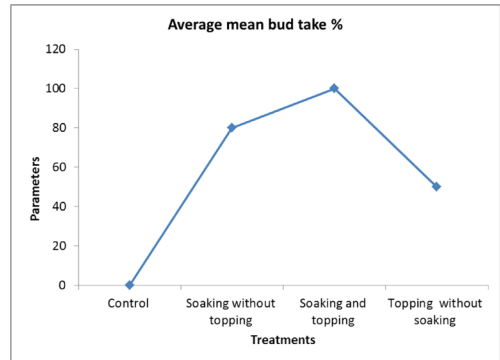


Fig.1. Effect of soaking/topping treatments on scion bud-take of grapefruit. Data were taken after 6 weeks from budding.

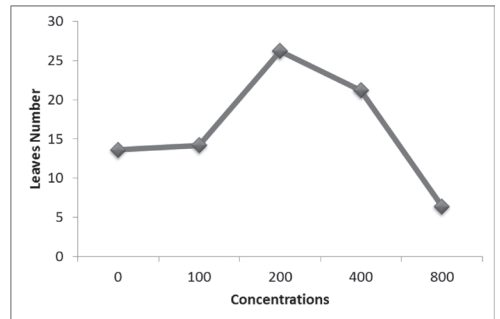


Fig.2. Effect of different concentrations of Sangral on leaf number of

6 weeks from budding.

Sangral conc (mg /l)	No. of leaves	(Shoot length (cm	Average mean bud- (%) take
mg/l BA 400	15.00a	17.00a	85a
0.00	13.6b	13.9a	50b
100.00	14.2b	14.5a	50b
200.00	26.2a	17.1a	75a
400.00	21.2a	20.5a	50b
800.00	6.4c	6.4a	25c

Means in a column followed by same letter are not significantly different at P=0.05, according to Duncan Multiple Range Test.

Table 3: Effect of combinations of 200 mg/l Sangral with or without topping on bud-take percentage, shoot elongation and number of leaves of grafted grapefruit scions, 6 weeks from budding.

Treatment	number of leaves	shoot length (cm)	Average mean bud take %
Control	0.0c	0.0c	0.0c
Soaking without topping	35.4b	33.0b	80b
Soaking and topping	44.0a	43.0b	100a
Topping without soaking	30.6b	38.4b	50c

Means in a column followed by same letter are not significantly different at P=0.05, according to Duncan Multiple Range Test.

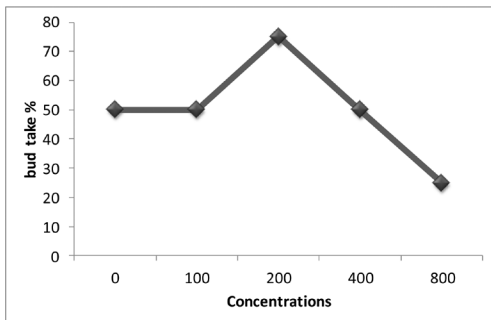


Fig.1. Effect of different concentra-

tions of Sangral on scion bud-take of grapefruit. Data taken after 6 weeks from budding.

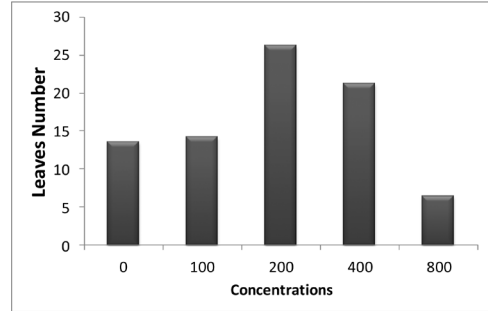


Fig. 2. Effect of different concentra-

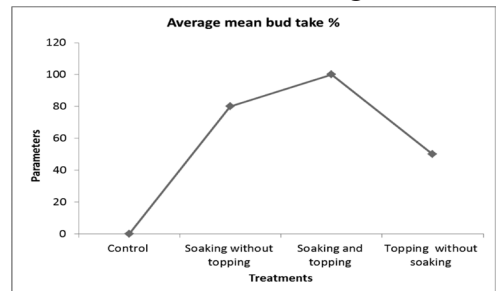


Fig.3 Effect of soaking/topping treat-

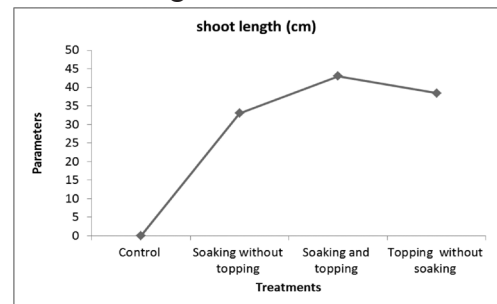


Fig. 4. Effect of soaking/topping treat-

Plant growth regulators alter translocation of photosynthetic products. *Nature* (London), 214:1024-1025.

Sidahmed, O.A. and Geneif, A.A. (1984). Performance of citrus in the irrigated heavy clay soils of central Sudan. 111. Grapefruit. *Acta Horticulturae*, 143:265-269.

Unrath, C.R. and Shaltout, A, D. (1985). Branch induction on young "Delicious" apple trees by application of growth regulators. *HortScience* 20, 230-131.

Young, E. and Werner, D.J. (1986). 6-BA applied after shoot and/or root chilling and its effect on growth resumption in apple and peach. *HortScience*, 21:280-281.

Young, E. (1987). Effects of 6-BA, GA4+7, and IBA on growth resumption of chilled apple roots and shoots. *HortScience*, 22:212-213.

Wainwright, H. and Price, D.J. (1984). Forcing dormant, isolated buds of blackcurrent. *HortScience* 19, 103-105.

Williamson, J.G. and Castle, W.S. (1989). A survey of Florida citrus nurseries. *Proceeding of Florida State Horticultural Society*, 102:78-82.

Williamson, J.G.; Castle, W.S. and Koch, K.E. (1992). Growth and 14C-photosynthate allocation in citrus nursery trees subjected to one of three

bud-forcing methods. *Journal of the American Society for Horticultural Science*, 117:37-40.

Williamson, J.G. and Maust, B.E. (1994). Rootstock shoot contributions to scion growth of containerized citrus nursery trees. *Proceeding of Florida State Horticultural Society*, 106:52-54.

Williamson, J.G. and Maust, B.E. (1995). Growth of budded, containerized citrus nursery plants when photosynthesis of rootstock shoots is limited. *HortScience* 30, 1363-1365.

Table 1. Effect of different concentrations of benzylamino-purine (BAP) on the percentage of bud take, shoot elongation and number of leaves of grafted grapefruit scions, 6 weeks from budding.

BAP conc. (mg/l)	No. of leaves	Shoot length (cm)	Average mean bud-take (%)
0.00	9.00 c	11.12 a	10 c
100.00	12.00 bc	13.25 a	48 b
200.00	14.30 b	14.00 a	46 b
400.00	18.00 a	13.67 a	91 a
800.00	12.50 b	11.37 a	44 b

Means in a column followed by same letter(s) are not significantly different at P=0.05, according to Duncan Multiple Range Test.

Table 2. Effect of different concentrations of Sangral on the percentage of bud take, shoot elongation and number of leaves of grafted grapefruit scions,

- dan Journal of Agricultural. Research 2, 85-88.
- Khalil, M.I. (1985). Growth, yield potential and quality attributes of thirteen grapefruit cultivars in central Sudan. M.Sc. Thesis University of Gezera.
- Krajewski, A.J. and Rabe, E. (1995). Bud age affects sprouting and flowering in clementine mandarin (*Citrus reticulata* Blanco). *HortScience* 30, 1366-1368.
- Little, C.H.A. (1985). Increasing lateral shoot production in balsam fir Christmas trees with cytokinin application. *HortScience* 20, 713-714.
- Malik, H. and Archbold, D.D. (1992). Manipulating primocane architecture in thornless blackberry with uniconazole, GA3 and BA. *HortScience*, 27:116-118.
- Miller, S.S. (1982). Growth and branching of apple seedlings as influenced by pressure-injected plant growth regulators. *HortScience*, 17: 775-776.
- Nauer, E.M. and Boswell, S.B. (1981). Stimulating growth of quiescent citrus buds with 6-benzylaminopurine. *HortScience* 16, 162-163.
- Nauer, E.M.; Boswell, S.B. and Holmes, R.C. (1979). Chemical treatments, greenhouse temperature, and supplemental day length affect forcing and growth of newly budded orange trees. *HortScience* 14, 229-231.
- Ohkawa, K. (1979). Promotion of renewal canes in greenhouse roses by 6-benzylaminopurine without cut-back. *HortScience*, 14:612-613.
- Parups, E.V. (1971). Use of 6-benzylaminopurine and adenine to induce bottom breaks in greenhouse roses. *HortScience*, 6:456-457.
- Phillips, I.D.J. (1975). Apical dominance. *Annual Review of Plant Physiology*. 26:341-367.
- Platt, R. G. and Opitz, K.W. (1973). The propagation of citrus, p. 1-47. In: W. Reuther (ed.). *The citrus industry*, vol. Univ. of California Press, Berkeley.
- Rouse, R.E. (1988). Bud-forcing method affects bud-break and scion growth of citrus grown in containers. *Journal of Rico Grande Valley Horticultural Society* 41, 69-73.
- Schneider, H. (1973). The anatomy of citrus, p. 1-85. In: W. Reuther, Batchelor, L.D. and Webber, H.J (eds.). *The Citrus Industry*, Vol. 2. Univ. of California Press, Berkeley.
- Shaheen, M.A. and Said, A.E. (1988). Effects of 6-benzylaminopurine on growth and development of lateral buds in date palm (*Phoenix dactylifera* L.). *Journal of the College of Agriculture*, King Saud University, 10, 275-285.
- Shindy, W.W. and Weaver, R.T. (1967).

the rootstock shoot to levels inducing scion bud-take and subsequent scion shoot growth and development might also be consequence. This conclusion is supported by the speculations of Shindy and Weaver, (1967) and Phillips, (1975) that exogenous application of growth regulators to intact plants results in changes in the balance between growth regulators regulating apical dominance and the concentrations of stored nutrients in the plant tissue.

In conclusion, the results indicate that enhancement of grapefruit scion bud-take can be achieved by chemical manipulation prior to budding exists. High rates of scion bud-take in the budding process of citrus can be obtained on year-round basis circumventing the constraint of seasonality for commercial propagation. It is obvious that much more research efforts are needed to develop this procedure into a practical means for the clonal propagation of grapefruit and may become the preferred means of propagating citrus in general as the methodology become more refined and familiar to citrus growers. The economics and best methodology for the application of these results to commercial citrus nursery operation merit further investigation.

REFERENCES

- Abedrabo, I.R. and Said, A.E. (2012). Effect of BA on bud grafting in grapefruit. University of Khartoum Journal of Agricultural Science 20, 259-274.
- Boswell, S.B.; Nauer, E.M. and Storey, W.B. (1981). Axillary bud sprouting in Macadamia induced by two cytokinins and a growth inhibitor. HortScience 16, 46.
- Carpenter, W.J. (1975). Foam sprays of plant growth regulating chemicals on rose shoot development at cut back. HortScience, 10: 605-606.
- Cody, C.A.; Larson, F.E. and Fritts, Jr.,R. (1985). Stimulation of lateral branch development in tree fruit nursery stock with GA4+7 +BA. HortScience 20, 758-759.
- Dinar, H.M. and Osman, A.M. (1984). Performance of several citrus cultivars in the arid region of north Sudan. Acta Horticulturae 143, 239-243.
- Erez, A. (1987). Chemical control of budbreak. HortScience 22,1240-1243.
- Garren, R., Jr. (1969). The physical and chemical properties of surfactant and their effects on formulated herbicides. Weeds,12:255-258.
- Hamid, G.A.; Sidahmed, O.A. and Geneif, A.A. (1999). Evaluation of some sweet orange cultivars under heavy clay conditions of central Sudan. Su-

number of leaves (44) and the longest shoots (43.0 cm) were obtained with the soaking and topping combination treatment. Topping without soaking was the least effective in promoting bud-take and subsequent scion shoot growth and development (Fig.3 and Fig.4).

Consistent with these results were those reported by others (Parups, 1971; Carpenter, 1975; Nauer, et al.1979; Ohkawa, 1979 Nauer and Boswell, 1981) who obtained bud-break when the chemical treatment is combined with pruning or topping. However, Rouse, (1988) and Abedrabo and Said, (2012) obtained better budded citrus nursery trees when the rootstock shoot remain intact during and after budding than when they are topped, lopped or notched. This is likely due to the differences in plant genotype, chemical and concentration used, time of application and the environmental conditions experienced in the location of the experiment.

Uniform and timely growth of inserted is essential for efficient production of high quality citrus nursery trees. scion buds Scion bud take in citrus nurseries is usually promoted by the physical removal of the rootstock terminal shoot above the inserted scion bud (topping) or by bending of the attached rootstock (lopping) or by half-ringing of

the rootstock shoot (notching) 3-10 cm above the inserted scion bud (Rouse, 1988; Williamson and Castle, 1989).

Generally nursery trees grow better when rootstocks remain intact after bud-take than when they are topped, bent or notched (Rouse, 1988; Williamson, et al. 1992). The downwards translocation of nutrients and growth regulators from the terminal portion of the rootstock to the scions and roots of young actively growing budded citrus nursery trees has been documented (Williamson, et al.1992; Williamson and Maust, 1994; 1995).

The results clearly demonstrate that both, soaking and topping are needed to enhance scion bud-take and to maximize growth variables of inserted scion buds in grapefruit. The combination of soaking and topping was however, superior to both other treatments, resulting in significantly higher values of all measured parameters. Neither soaking alone nor topping alone was able to optimize percent scion bud-take and subsequent growth and development of scion shoots as was obtained with the combination treatment. This would appear to be the result a synergistic positive effect on scion bud-take and subsequent growth of scion shoot. An alteration in the endogenous balance between growth regulators and a shift in assimilates in

shoots appeared healthier, vigorous and with darker green leaves relative to the other treatment concentrations tested. Bud-take was increased significantly by Sangral but this chemical had little or no effect on scion shoot length. This is an unexpected result since Sangral is marketed as a rooting “hormone” not as a promoter of scion bud-break and scion shoot elongation. The significant increase in bud-take in Sangral treated scion buds reported herein would appear to be the result of a loss in apical dominance. The concentration of 200 mg Sangral/l effectively increased bud take response as well as leaf formation but had no effect on scion shoot elongation. There were no significant differences between the 200 mg/l Sangral and the 400 mg/l BAP treatments in all growth variables measured, however, both treatments significantly increased all growth variables measured compared to all other treatments tested.

At present, no explanation can be offered for the effect of Sangral concentrations on scion shoot elongation. One can speculate on scion buds competition between the scion bud and the scion shoot for assimilate (source / sink relationship). Competition for the available nutrients between the newly formed shoots may inhibit their elongation. Most food reserves and

growth substances in the rootstock tissues might have been diverted for bud forcing and bud-take. Initiated scion shoots cannot compete with the newly forced buds and the subsequent bud-take. It is also possible that Sangral resulted in an alteration in the balance between endogenous growth regulators that are involved in controlling apical dominance in plants. It is to be noted that the 200 mg/l Sangral and the 400 mg/l BAP, which was included in this experiment for comparison produced positive responses of equivalent magnitude. Sangral exhibits a cytokinin-like effect on all measured growth responses.

Soaking and topping

The results of the experiment conducted to evaluate appropriate treatment combination of topping and the concentration of 200 mg/l Sangral for maximum percentage of scion bud-take, scion shoot length and production of leaves are depicted in Table 3. The most effective appropriate combination treatment was the soaking and topping combination treatment.

Growth differences between treatments were evident for all parameters measured. The combination treatment of soaking and topping had the greatest effect on the various growth variables measured. The highest bud-take percentage (100), the greatest

A significant increase in bud-take in BAP-treated scion buds would appear to be a result of a loss of apical dominance. All BAP concentrations tested increased the number of scions that took. Direct contact of the axillary scion buds with the right concentration of BAP seems to be important for bud-take. The soaking operation allows for the direct contact of the right BAP concentration to all quiescent axillary buds present on the soaked bud-wood stick at the time of treatment. BAP permits the development of shoots from budded scion buds which normally would remain dormant BAP has to be absorbed by the quiescent buds to be effective (Carpenter 1975; Little 1985). The results parallel those of Nauer et al. (1979) on navel orange, where BAP test solutions were applied directly to individual budded scions with cotton swabs for positive effective.

Variation in response to BAP application within citrus species has been well documented (Nauer et al. 1979). The effectiveness of BAP soaking probably caused most of the dormant buds present at time of treatment to start active growth during the time following excision and insertion. The failure of some of inserted and wrapped treated buds to take could be attributed to variation in the age of scion

buds and/or scion bud position along the bud-stick. This speculation is supported by previous findings by others (Unrath and Shaltout 1985; Krajewski and Rabe 1995) that indicate that scion bud age and position on the scion bud-wood stick influence the response of buds to exogenously applied growth regulators.

Sangral concentrations:

Sangral, a proprietary commercially available rooting formulation, had been widely used, but at a single concentration, for root formation under nursery conditions. The composition of this chemical is confidential to the manufacturer.

Table 2 summarizes the results of an experiment conducted with the objective of evaluating the influence of different concentrations of Sangral on bud break, shoot length and number of leaves of grapefruit bud wood soaked in different concentrations of Sangral solution for 2 hours prior to bud excision and insertion. Growth differences between treatments were evident for all parameters measured. Not only was percentage of bud-take greater with 200 mg/l Sangral, but all other growth attributes measured were likewise better and greater (Fig.1 and Fig.2). Bud-take percentage and leaf formation were significantly promoted by soaking in 200 mg Sangral/litre. The scion

wood-sticks in 200 mg/l Sangral plus topping, soaking in 200 mg/l Sangral only without topping and topping only without soaking in 200 mg/l Sangral. In all experiments the T-budding technique was used. The inserted scion buds were wrapped with clear plastic tapes. All budding operations and the incubation of budded seedlings were carried out under naturally lit greenhouse conditions. Budded seedlings were watered once every other day with tap water and rootstock suckers were removed as soon as they appeared.

Experiments were terminated after 6 weeks from budding. Parameters measured included scion bud-take percentage, number of scion leaves, and scion shoot length (cm). Only inserted buds that break and form a branch were considered to have taken. Grafted buds that swollen and remain green without forming a visible branch were not included in the total count. Treatments were arranged in a completely randomized block design replicated 4 times. Each treatment consisted of 10 budded rootstock seedlings and each treated budded rootstock is a replicate. All observations were based on 10 grafted rootstocks per treatments. The percentages refer to the proportion of buds that took and produced a scion shoot. Data on scion bud-take

percentage were analyzed after arcsin transformation and then converted back to the original values for inclusion in tables. Data were analyzed using the analysis of variance procedure on Excel computer programme and Duncan Multiple Range Test was used to separate treatment means.

Results and Discussion

BAP concentrations.

All BAP concentrations tested promoted bud-take at varying degrees. The magnitude of the response of scion buds to take and scion shoot to grow and develop varied with BAP concentration tested (Table 1). Soaking of bud-wood in 400 mg/l BAP resulted in significant increases in number of scion buds that took and number of leaves that were formed, compared to the control untreated plants or plants treated with lower or higher concentrations of BAP. Bud-take and leaf formation were highest at 400 mg/l BAP, decreased at 100 and 200 mg/l BAP and were greatly decreased at 800 mg/l BAP. On the other hand, scion shoot elongation was not affected by all BAP concentrations tested in accordance with the findings of other investigators (Miller, 1982; Young, 1987; Malik and Archbold, 1992) that BA has no effect on new shoots elongation.

open-pollinated seeds in a soil mix of 2:1 sand: clay in 15cm diameter black plastic bags (one seedling per bag), watered daily with tap water and no fertilizer was applied.

The chemical substances and concentrations were chosen on the basis of preliminary experiments, (not reported here), in which various concentrations of a number of substances were tested on a variety of plant species under greenhouse and in vitro conditions.

Benzyl amino purine, (BAP), powder was weighed using a precision balance in amounts of 100; 200; 400; or 800 mg. Each weighed amount was dissolved separately in 1N HCl and made to 1000 ml volume with distilled de-ionized water containing 0.05% the surfactant Tween-20, (polyoxyethylene sorbitan monolaurate), to increase solubility of the chemical (Garren, 1969). Distilled de-ionized water containing an equivalent volume of each of 1N HCl and 0.05% Tween-20 was used as control.

The non-flowering, intact, and actively growing branches were cut and the leaves were acropetally removed and bud-wood, 10-15 cm in length, were tied in bundles and wrapped in paper with moist saw dust and taken to the greenhouse for chemical treatments and budding. For each treatment, five bud-wood sticks were soaked in the

appropriate test solution prior to scion bud excision and insertion onto the rootstock.

In all experiments the technique of T-grafting was used. Sour orange (*Citrus aurantium* L.) seedlings, 9-months-old, 60 cm in height, grown in the greenhouse from open-pollinated seeds were used as rootstock.

In the first experiment, the potential efficacy of BAP was tested at 0, 100, 200, 400 or 800 mg/l.

Experiment 2 was performed to examine the effect of different concentrations of Sangral, with the concentration of BAP held constant at 400 mg/l, on budded grapefruit scion bud forcing and growth of scion shoot bud-ded. The following concentrations of Sangral in (mg/l): 0, 50, 100, 150, 200, 250, or 300 were tested with 400 mg/l BAP for comparison.

The third experiment was conducted, after the results of experiment 2 were analyzed, to study the influence of topping of the rootstock and soaking of the scion bud wood-sticks in 200 mg/l of Sangral, on bud-break and scion shoot growth and development. The 200 mg/l Sangral was chosen because it was found to be the most effective concentration in increasing scion bud-take in experiment 2. Treatments in this experiment consisted of a control (no treatment), soaking of scion bud

Grapefruit scion bud-break in Sudan is commonly hastened by the physical removal of the terminal portion of the rootstock seedling above the inserted scion bud (topping) 3–10 cm above the inserted scion bud. Reliable and rapid bud-break and scion shoot elongation are desirable for the production of citrus nursery trees.

Scion buds of citrus require chilling for release from dormancy. Poor bud-break and consequently low bud-take percent and reduced and delayed scion shoot development and/or cessation of early growth, are attributed to inadequate chilling for release from dormancy (Erez 1987). BA resulted in the enhancement of bud break of insufficiently chilled fruit trees substituting for the chilling requirements (Young and Werner 1986).

Benzyl amino purine (BAP), a synthetic cytokinin, has been identified as one of the most effective dormancy-breaking agent for a variety of fruit trees (Boswell et al.1981; Nauer and Boswell 1981; Wainwright and Price 1984; Cody et al. 1985; Shaheen and Said 1988; Abedrabo and Said 2012). The optimum concentration and time of application of the chemical for stimulation of lateral shoot growth is not always the same for all plant species; each species appears to have a growth period when it is most sensi-

tive to a cytokinin treatment.

Inducing growth of the scion buds before excision and insertion may promote bud-take and subsequent scion shoot growth and development. To the best of our knowledge, only very scanty information on the use of growth regulators to artificially break scion bud dormancy in citrus (Nauer et al.1979; Nauer and Boswell 1981; Abedrabo and Said, 2012) is available. Therefore, it seems reasonable to determine if growth regulators would be effective in increasing bud-break and subsequent bud-take and shoot elongation of budded scion buds of mature grapefruit trees.

Materials and Methods

The study was carried out at the plastic greenhouse of the Date palm Company of the Agriculture Research Corporation Shambat Research Station, Khartoum North. All experiments were conducted using scion buds obtained from a single 10-years-old “Redblush” grapefruit tree grown in the open fields of the Department of Horticulture, Ministry of Agriculture and Forestry, Al-Mogran (Latitude 15 35 N; Longitude 32 33 E), selected for its uniformity of fruiting and vigorous growth habits. Sour orange (*Citrus aurantium* L.) seedlings, 9-months -old and 60 cm in length were used as rootstock. The seedlings were grown from

INTRODUCTION

Grapefruit, (*Citrus paradisi* Macf.), is one of the more important species in the genus *Citrus*. It is a major cash crop and a popular fruit throughout the tropics and subtropics and is one of the most important citrus fruits in Sudan, cultivated successfully throughout the country where there are suitable soils and sufficient water to sustain vigorous tree growth. Sudanese grapefruit is well known for its large size, excellent quality and good coloration (Khalil 1985). Several grapefruit cultivars have been introduced into Sudan and were evaluated for their growth, yield, and fruit quality (Dinar and Osman 1984; Sidahmed and Geneif 1984; Hamid et al. 1999). The introduced cultivar "Redblush" proved to be high yielder with excellent fruit qualities and vigorous growth habits.

Nowadays, grapefruit cultivation in Sudan is receiving much attention from private and governmental sectors and there is an increasing awareness of the potential and importance of grapefruit as a fruit crop and the area under cultivation is increasing steadily due to an expanding consumer demand.

Grapefruit is mainly cultivated in the Northern, River Nile, Kassala and Kordofan States. The fruits are consumed locally as fresh fruit and juice, with negligible tonages exported to

Europe and the Gulf States.

Superior grapefruit cultivars are typically propagated asexually by eye-budding on open-pollinated suitable rootstock seedlings (Platt and Opitz 1973). The method is too slow for producing many plants in a short time. Success is often low and variable, seasonal and is often tedious and impractical when carried out on a large scale. Routine production of large numbers of nursery grapefruit trees has not yet been described. Uniform, vigorous and normally appearing growth and development budded scion buds in grapefruit propagation is essential for efficient production of high quality nursery grapefruit trees. The potential demand for clonal grapefruit nursery trees to replace alternate and shy bearer trees and for establishing new grapefruit groves is enormous.

The perennial evergreen *Citrus* grows in flushes (Schneider 1973) that are synchronous under Sudan conditions. The main flushes arise in February and September, periods of increased atmospheric humidity. Experience in Sudan has shown that successful bud-take can be obtained only during February through April. Citrus buds inserted during most other months of the year are often slow to start growth even under greenhouse conditions indicating that bud-take is seasonal.

تحفيز التطعيم في القريب فروت

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المستخلص:

أجريت هذه الدراسة ببيوت شركة تقانة نخيل التمر المحمية التابعة لهيئة البحوث الزراعيه، محطة ابحاث شمبات، الخرطوم بحري لإختبار تأثير تراكيز من البنزايلا ادينين (BAP) والسانقرال، كمعاملات ما قبل التطعيم، لحفز نمو براعم الطعم وإستطالة سيقانها في القريب فروت (Citrus paradisi Macf) صنف "رد بلاش". أجريت كل التجارب بإستخدام براعم طعم مأخوذه من شجرة قريب فروت واحده بعمر 10 سنوات وطول 60 سم مزروعه في الحقل المكشوف. أستخدمت شتلات لارنجه (Citrus aurantium L). بعمر 9 شهور وطول 60 سم كأصل للتطعيم. أظهرت نتائج تأثير التراكيز المختلفه من البنزايلا امينو بيورين، (BAP)، ان إستجابة براعم الطعم كانت افضل في معاملة التركيز 400 مليجرام BAP / لتر. نتج عن معاملة "سانقرال" بتركيز 200 مليجرام/لتر إستجابته إيجابيه واضحه على نسبة تفتح براعم الطعم وعدد الاوراق، حيث تم الحصول على اعلى نسبة تفتح لبراعم الطعم واكبر عدد للاوراق بمعاملة الغمر في محلول الإختبار 200 مليجرام "سانقرال"/لتر مقارنة بمعاملة الشاهد او تراكيز السانقرال الاعلى او الادنى التي أختبرت. ولم يكن لتراكيز "السانقرال" المختبره تأثير معنوي على طول سيقان براعم الطعم مقارنة بمعاملة الشاهد. لم ترصد فروق معنوية بين النتائج التي تم الحصول عليها من معاملة التركيز 400 مليجرام/BAP والنتائج التي تم الحصول عليها من معاملة 200 مليجرام/ لتر "سانقرال" مما يشير إلى وجود تأثير مشابه لتأثير ال BAP في المركب الكيميائي سأنقرال. اظهرت النتائج ان المعاملة المشتركه لل "سانقرال" والتطويش كانت هي الامثل لتفتح براعم الطعم وعدد الاوراق ولم يكن لها تأثير معنوي على إستطالة السيقان.

Enhancement of bud Graft in Grape fruit

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Mohamed

Sudan University of Science and Technology

Abstract

This study was carried out at the greenhouse of Shambat Research Station, Khartoum to evaluate the effects of concentrations of benzyl-amino-purine (BAP), and Sangral, as pre-budding treatments, on scion bud-take and scion shoot elongation of grapefruit (*Citrus paradisi* Macf.), cv. "Redblush". All experiments were conducted using scion bud-wood obtained from a single 10-years-old "Redblush" grapefruit tree grown in the open fields. Sour orange (*Citrus aurantium* L.) seedlings, 9-months-old and 60 cm in length were used as rootstock. The results of the effects of showed that the response of scion buds was best at 400 mg BAP /litre concentration. Soaking of scion buds in Sangral at a concentration of 200 mg/litre resulted in a positive and marked effect on percent scion bud-take and number of leaves relative to the control. The highest percentage of bud-take and the largest number of leaves were obtained with soaking in 200 mg Sangral / litre treatment compared with the control or the higher or lower Sangral concentrations tested Shoot elongation was not significantly affected by all Sangral concentrations tested relative to the control. No significant differences were obtained between the 200 mg Sangral /litre and the 400 mg BAP /litre, denoting that Sangral might have cytokinin-like effects. The combination treatment of 200 mg Sangral /litre and topping was optimal for scion bud-take and leaf formation and had no significant effect on shoot elongation.

Keywords: Grafting, scion bud. BAP, Citrus, rooting hormone

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