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القسم العربي

القسم الإنجليزي

الجودة النوعية لتقاوي القمح المنتجة محليا في المملكة العربية السعودية

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الملخص :

يتم إنتاج تقاوي القمح في المملكة العربية السعودية من قبل بعض الشركات الزراعية المعتمدة من قبل وزارة الزراعة لإنتاج تقاوي القمح و الشعير ولكن العديد من الشركات و المزارعين يقومون بإنتاج وتسويق تقاوي قمح بدون موافقة الجهات المعنية ونظراً لأهمية تقييم الجودة النوعية لتقاوي القمح المنتجة محلياً فقد تم أجراء هذه الدراسة على ١٧ عينة من تقاوي القمح المنتجة عام ١٤١٩ و ١٤٢٠ هـ جمعت من ثلاث مناطق زراعية، شملت الدراسة عينات تقاوي لجميع الشركات المعتمدة و ٦ عينات لتقاوي غير معتمدة، تم فحص التقاوي باستخدام الطرق القياسية في اختبارات البذور حيث تم اختبار النقاوة وتقدير الوزن النوعي للبذور ونسبة الإنبات، كما تم حساب نسبة البذور المصابة بالنخر الحشري و نسبة الإصابة بالبقعة السوداء كما تم حساب نسبة ظهور الفطريات على البذور المستنبتة.

على الرغم من أن جميع العينات المدروسة كانت لصنف يكورا روجوا إلا أن النتائج أظهرت تفاوت كبير في الجودة النوعية للتقاوي المنتجة بين الموسمين كما وجدت فروق معنوية بين العينات في جميع الصفات المدروسة وكان هناك تباين بين العينات في نسبة النقاوة حيث فشلت عدة عينات في الوصول إلى نسبة نقاوة ٩٨٪ وهي النسبة التي تمثل أحد شروط اعتماد التقاوي. كانت هناك فروق كبيرة جداً بين عينات التقاوي في نسبة الإنبات حيث فشلت ٧ عينات من أصل ١١ عينة معتمدة في كلا الموسمين في الوصول إلى ٩٢٪ التي تمثل الحد الأدنى لنسبة الإنبات للتقاوي المعتمدة كما أظهر الوزن النوعي للبذور فروق معنوية بين عينات التقاوي و ظهرت الإصابة بالبقعة السوداء على جميع العينات في الموسم الأول بنسبة تراوحت

من ٦- ٤٨٪ بينما كانت الإصابة أقل في الموسم الثاني، أما بالنسبة للنخر الحشري فقد وجدت بعض البذور المصابة في ٦ عينات منها ٥ عينات معتمدة في الموسم الأول وفي عينتين معتمدتين في الموسم الثاني.

أظهرت الدراسة وجود تباين كبير في مستوى الجودة النوعية لتقاوي القمح المنتجة محليا مما يدل على ضعف الرقابة الفنية على عمليات إنتاج وإعداد التقاوي ولذلك فإن هناك حاجه ماسة لتطوير عمليات التفتيش الحقلي وتطبيق شروط إنتاج التقاوي و العمل على تخليص السوق من التقاوي الرديئة.

المقدمة :

تعتبر البذرة الركيزة الأساسية في التكاثر النباتي ويحظى إنتاج البذور عالمياً باهتمام كبير على جميع المستويات لتأمين الحصول على تقاوي محسنة وسليمة من المسببات المرضية وخالية من بذور الحشائش(الفاخري وخلف، ١٩٨٣). أن تنظيم إنتاج التقاوي في معظم دول العالم يتم من خلال هيئات حكومية أو منظمات متخصصة في تطوير الأصناف المحسنة ومراقبة إنتاج وتداول التقاوي، ولكن قد يتفاوت دور هذه الهيئات حسب نظام الدولة ومدى تطور القطاع الزراعي (Kelly, 1988). أن الاهتمام بجودة التقاوي تحت نظام تشريعي ينظم إدخال وتسجيل و إنتاج وتداول تقاوي المحاصيل يعكس مدى تطور القطاع الزراعي (Douglas, 1981).

اعتمد القطاع الزراعي في المملكة العربية السعودية خلال العقود الثلاث الماضية على استيراد البذور المحسنة من مصادر مختلفة في العالم لسد الطلب المتزايد في التوسع الزراعي ولعدم توفر الإمكانيات الفنية و البشرية المطلوبة في إنتاج التقاوي (سعد، ١٩٨٦). فقد أشار تاليفيرو (Taliferro, 1986) إلى أهمية إنتاج التقاوي محلياً و الحاجة إلى وجود لائحة لاعتماد التقاوي في المملكة العربية السعودية، كما ذكر الراوي (١٩٩٤) في دراسة أولية لإمكانية إنتاج التقاوي المحسنة لمحاصيل الحبوب في الوطن العربي إلى جدوى تكوين شركات متخصصة في إنتاج وتوزيع التقاوي المحسنة.

بدأ إنتاج بذور القمح والشعير محلياً عام ١٤١٢هـ نتيجة لتوجيه من وزارة الزراعة والمياه للشركات الزراعية بإنتاج تقاوي القمح والشعير محلياً بدلاً من استيرادها بكميات ضخمة من الخارج، إلا أن عدم إلمام بعض المزارعين بالنواحي الفنية في عملية إنتاج وإكثار التقاوي ساهم في ظهور تقاوي غير جيدة في أسواق البذور (ناصر، ٢٠٠٢)، ولقد أدركت وزارة الزراعة و المياه حالة الفوضى السائدة في قطاع إنتاج تقاوي القمح و الشعير فقامت بوضع شروط ومواصفات لبذور القمح و الشعير المنتجة محلياً وحثت الشركات المنتجة للتقاوي بالتزام هذه التعليمات (وزارة الزراعة والمياه، ١٩٩٨)، وخلال عام ١٤١٩هـ تم تكوين لجنة لمنتجي البذور في الغرفة التجارية تضم كبار منتجي تقاوي القمح و الشعير وقامت وزارة الزراعة و المياه بمنح مجموعة من الشركات وبعض كبار المزارعين حق طباعة شعار وزارة الزراعة و المياه على أكياس البذور المنتجة من قبلها كتوصية من الوزارة للمزارعين باستخدام التقاوي المنتجة من قبل تلك الشركات بناء على ما لدى تلك الشركات من إمكانيات (لجنة منتجي البذور، ٢٠٠٢).

ونظراً لعدم توفر دراسات علمية على الجودة النوعية لتقاوي القمح المنتجة محليا، فقد أجريت هذه الدراسة بهدف التعرف على مدى الاختلافات في الجودة النوعية لتقاوي القمح المنتجة محليا و معرفة مدى التزام الشركات المنتجة للبذور بشروط و متطلبات اعتماد التقاوي.

المواد وطرق البحث :

أجريت هذه الدراسة على عينات بذور قمح محلي صنف اليكوراروجو إنتاج عام ١٤١٩ و ١٤٢٠ هـ، حيث جمعت عينات بوزن ٥ كجم من ثلاث أكياس مختلفة (ثلاث مكررات) من كل مصدر بذور. وقد شمل المسح الميداني العينات المتوفرة في أسواق الرياض والقصيم وحائل بحث شملت الدراسة ١٧ مصدر بذور منها ١١ عينة لتقاوي معتمدة (عينتان مكررتان نظراً لاختلاف السعر) و ٦ عينات لشركات غير معتمدة، (جدول ١). العينة رقم ١٤ و ١٥ والتي جمعت من حائل و القصيم على التوالي لم تكن متوفرة في موسم ١٤٢٠هـ.

تم فحص التقاوي في معمل البذور في قسم الإنتاج النباتي باستخدام الطرق القياسية في اختبارات البذور(الحداد ، ١٩٩٦م) من عينة ٢كجم حيث تم حساب نسبة النقاوة وبذور المحاصيل الأخرى وبذور الحشائش و المواد الخاملة ووزن الألف حبة ، كما تم حساب نسبة البذور المصابة بالنخر الحشري، من العينة المتبقية. تم أجراء اختبار نسبة الإنبات على جميع العينات (١٧ مصدر بذور× ٣مكررات)، حيث تم استخدام ١٠٠ بذرة من كل عينة وزعت على أربع أطباق بتري تحتوي على أوراق ترشيح مبللة بماء مقطر (٢٥بذرة/طبق) ثم وضعت أطباق الإنبات في حضانة على درجة ٢٥°م لمدة سبعة أيام، وتم تسجيل الإنبات ابتداء من اليوم الثاني. كما تم تقدير نسبة الإصابة بالبقعة السوداء (Black point) وتم عزل الفطريات النامية على البذور ووجدت أنها تنتمي إلى جنس *Alternaria spp.* .

تم تحليل البيانات باستخدام البرنامج الإحصائي SAS (SAS Inst, 1988) في التصميم العشوائي التام بثلاث مكررات وتم تحليل كل موسم على حدة نظراً لاختلاف عدد المعاملات وتم تقدير الفروق بين متوسطات المعاملات باستخدام طريقة أقل فرق معنوي LSD (Gomez and Gomez, 1984).

النتائج و المناقشة

من المشاهدات التي وجدت خلال جمع العينات هو وجود عينتين مختلفتين في السعر لكل من شركتين معتمدتين لإنتاج التقاوي تحملان نفس بيانات الإنتاج (الشركة رقم ٢ و ٦). كما لوحظ تباين في أسعار التقاوي المنتجة محلياً سواء للشركات المعتمدة لإنتاج التقاوي أو غير المعتمدة، وكانت جميع عينات بذور الشركات المعتمدة معاملة بينما كانت هناك عينتان غير معاملتين من الشركات غير المعتمدة (جدول ١). كانت هناك اختلافات كبيرة بين العينات في كمية الصبغة الحمراء على البذور، ويبدو أن بعض الشركات تعمل على زيادة كمية الصبغة الحمراء لإخفاء الإصابة بالبقعة السوداء أو إيهام المشتري بأن البذور معاملة بشكل أفضل.

جدول (١)

عينات تقاوي القمح التي استخدمت في الدراسة و المنتجة من قبل شركات ومؤسسات معتمدة لإنتاج التقاوي وغير معتمدة من قبل وزارة الزراعة بالمملكة (١٤١٩هـ - ١٤٢٠ هـ)

رقم العينة	الجهة المنتجة	مصدر البذور	معاملة البذور	ملاحظات
١	معتمدة	الرياض	معاملة	
٢	معتمدة	الرياض	معاملة	
٢	معتمدة	الرياض	معاملة	عينة مختلفة
٣	معتمدة	حائل	معاملة	
٤	معتمدة	القصيم	معاملة	
٥	معتمدة	الرياض	معاملة	
٦	معتمدة	الرياض	معاملة	
٦	معتمدة	الرياض	معاملة	عينة مختلفة
٧	معتمدة	الرياض	معاملة	
٨	معتمدة	القصيم	معاملة	
٩	معتمدة	الرياض	معاملة	
١٠	غير معتمدة	القصيم	معاملة	
١١	غير معتمدة	الرياض	غير معاملة	
١٢	غير معتمدة	الرياض	معاملة	
١٣	غير معتمدة	الرياض	معاملة	
١٤	غير معتمدة	حائل	معاملة	
١٥	غير معتمدة	القصيم	غير معاملة	

أظهرت النتائج وجود فروق معنوية في نسبة النقاوة حيث كانت العينة رقم ٨ هي الأعلى في موسم ١٤١٩هـ (٩٩,٥١٪) وكانت العينة رقم ٥ هي الأعلى في موسم ١٤٢٠هـ (٩٩,٦٨٪) بينما كانت العينة رقم ١٣ هي أقل العينات في كلا الموسمين (٨٨,٤٣٪ و٨٩,١٠٪). ولقد كانت نسبة النقاوة في ١٢عينة منها عينتان لتقاوي غير معتمدة أعلى من ٩٨٪ وهي الحد الأدنى لنسبة النقاوة المحددة في شروط إنتاج التقاوي (وزارة الزراعة والمياه، ١٩٩٨)، بينما فشلت العينة رقم ٣ لتقاوي معتمدة في الوصول للحد الأدنى من نسبة النقاوة المطلوبة في كلا الموسمين (جدول ٢). كما وجد من دراسة مكونات النقاوة وجود بذور الشعير بمعدل أعلى من المسموح به (٥ بذور شعير/ ٢كجم بذور) في عينات ثلاث شركات معتمدة (٢، ٣، ٤) و ثلاث عينات بذور غير معتمدة(١١، ١٤، ١٥) في عام ١٤١٩هـ، بينما في عام ١٤٢٠هـ وجدت بذور الشعير في عينة واحدة غير معتمدة (عينة رقم١ ١)، كما وجدت بذور حشيشة الهيبان (*Lolium spp.*) في عينة رقم ٣ (بذور معتمدة) في كلا الموسمين، ووجدت بذور حشيشة ذيل القط (*Phalaris minor*) في تقاوي العينة رقم ١١ (بذور غير معتمدة) في كلا الموسمين (جدول ٢).

كانت هناك فروق معنوية بين عينات التقاوي في نسبة الإنبات و الوزن النوعي للبذور في كلا الموسمين (جدول ٣)، حيث تراوحت نسبة الإنبات في عام ١٤١٩هـ من ٣٩ إلى ٩٧٪ بينما تراوحت لعينات ١٤٢٠هـ من ٦٦ إلى ٩٤٪ ولقد فشلت ٧ عينات معتمدة من أصل ١١ عينة معتمدة من عينات موسم ١٤١٩هـ في الوصول إلى ٩٢٪ (الحد الأدنى لنسبة الإنبات المطلوبة في شروط إنتاج التقاوي)، بينما لم تصل لنسبة الإنبات المطلوبة في موسم١٤٢٠ سوى عينة معتمدة (العينة رقم ٧) وعينة غير معتمدة (العينة رقم ١٢).

كما أظهر الوزن النوعي للبذور فروقاً معنوية بين عينات البذور (جدول ٣) حيث تفاوت وزن الألف حبة من ٣٢,٤٩ إلى ٤٨,٦٨ جرام في عام ١٤١٩هـ ومن ٣٦,١٦ إلى ٤٩,٤١ في عام ١٤٢٠هـ وهو مدى واسع يوضح مدى التباين في العناية بالمحصول وتأثيره على درجة امتلاء الحبوب، ولقد كانت كل العينات المعتمدة عدا العينة رقم ٤ تتجاوز ٤٠جرام للألف بذرة وهو معدل جيد يدل على كفاءة التنقية والتدريج للبذور بينما كانت أربع

جدول (٢)

نسبة النقاوة وعدد بذور الحشائش و بذور المحاصيل الأخرى في عينة ٢كجم بذور من تقاوي القمح المنتجة عام ١٤١٩ و ١٤٢٠هـ من قبل شركات ومؤسسات معتمدة وغير معتمدة لإنتاج التقاوي.

رقم المنتج	الجهة المنتجة	نسبة النقاوة		بذور الحشائش❖		بذور محاصيل أخرى❖❖	
		١٤١٩هـ	١٤٢٠هـ	١٤١٩هـ	١٤٢٠هـ	١٤١٩هـ	١٤٢٠هـ
١	معتمدة	٩٨,٩٢	٩٩,١	٠	٠	٠	٠
٢	معتمدة	٩٩,٤٠	٩٩,٠٠	٠	٠	٠	٠
٢	معتمدة	٩٩,١٥	٩٨,٢٥	٠	٠	١٨	٠
٣	معتمدة	٩٦,٨٥	٩٨,٨٦	١٣	٨	٣٦	٠
٤	معتمدة	٩٧,٠٧	٩٩,٥٠	٠	٠	١٩	٠
٥	معتمدة	٩٨,٩٢	٩٩,٦٨	٠	٠	٠	٠
٦	معتمدة	٩٨,٦٣	٩٩,٦٠	٠	٠	٠	٠
٦	معتمدة	٩٨,٤٣	٩٩,٠٠	٠	٠	.	٠
٧	معتمدة	٩٨,٩١	٩٩,٢٥	٠	٠	.	٠
٨	معتمدة	٩٩,٥١	٩٨,٨٣	٠	٠	.	٠
٩	معتمدة	٩٩,٠٢	٩٨,٤٦	٠	٠	.	٠
١٠	غير معتمدة	٩٦,٧٥	٩٧,٢٥	٠	٠	.	٠
١١	غير معتمدة	٩٨,٧٥	٩٨,٥٠	٤٨	٢٧	١٤	٣٢
١٢	غير معتمدة	٩٨,١٤	٩٩,٢٠	٠	٠	.	٠
١٣	غير معتمدة	٨٨,٤٣	٨٩,١٠	٠	٠	.	٠
١٤	غير معتمدة	٩٦٢٣	-	٠	-	١٧	-
١٥	غير معتمدة	٩٧,١٥	-	٠	-	٤٢	-
أقل فرق معنوي LSD (0.05)		٢,٦٧	٢,١٢	-	-	-	-

❖ بذور الحشائش في العينة رقم ٣ هي لحشيشة الهيبان أما في العينة رقم ١١ فهي لحشيشة ذيل القط.

❖❖ بذور المحاصيل الأخرى كانت في جميع العينات بذور شعير .

جدول (٣)

نسبة الإنبات ووزن الألف حبة لعينات القمح المنتجة عام ١٤١٩ و ١٤٢٠هـ

من قبل شركات معتمدة وغير معتمدة

رقم المنتج	الجهة المنتجة	نسبة الإنبات ٪		وزن الألف حبة (جرام)	
		١٤١٩هـ	١٤٢٠هـ	١٤١٩هـ	١٤٢٠هـ
١	معتمدة	٩٠	٩٠	٤٤,٢٥	٤٧,٤٥
٢	معتمدة	٩٦	٨٦	٤٨,٠٤	٤٧,٦٥
٢	معتمدة	٨٣	٦٦	٤٤,٤٢	٤٧,٦٥
٣	معتمدة	٩٣	٩٠	٤١,٢٤	٤٢,١٩
٤	معتمدة	٨٣	٨٩	٣٦,٧٣	٣٨,٥٣
٥	معتمدة	٨٦	٧٣	٤٨,٢٣	٤٩,٤١
٦	معتمدة	٥٧	٧٣	٤٧,٠٢	٤٧,٥٣
٦	معتمدة	٣٩	٦٦	٤٨,٦٨	٤٧,٢٦
٧	معتمدة	٩٤	٩٤	٤٦,٣٠	٤٦,٣٤
٨	معتمدة	٩٦	٩٠	٤٦,١٢	٤٧,٢٦
٩	معتمدة	٥٩	٩٠	٤١,٦٣	٤٠,٨٠
١٠	غير معتمدة	٩٠	٩٢	٣٨,٧٦	٤١,١٥
١١	غير معتمدة	٩٥	٨٧	٣٢,٤٩	٣٦,١٦
١٢	غير معتمدة	٩٧	٩٣	٤١,٦٣	٤٦,٥١
١٣	غير معتمدة	٧٧	٨٥	٣٨,٦٨	٣٦,١٦
١٤	غير معتمدة	٨٠	-	٤٤,٥٦	-
١٥	غير معتمدة	٩٥	-	٣٧,٥٢	-
أقل فرق معنوي LSD (0.05)		١١	٨	١,٧٩	١,٤١

❖ بذور الحشائش في العينة رقم ٣ هي لحشيشة الهبان أما في العينة رقم ١١ فهي لحشيشة ذيل القط.

❖❖ بذور المحاصيل الأخرى كانت في جميع العينات بذور شعير .

عينات من أصل ٦ عينات غير معتمدة أقل من هذا المعدل في عام ١٤١٩هـ مما يدل على ضعف امتلاء الحبوب وينذر بالحصول على نسبة عالية من البادرات الضعيفة.

الإصابة بالبقعة السوداء هو عرض يظهر على بذور القمح نتيجة للإصابة بالعديد من الفطريات من أهمها فطريات *Alternaria spp.* و *Fusarium spp.* و *Helminthosporium spp.* التي تنتشر عند وجود نسبة عالية من الرطوبة أثناء نضج الحبوب (Wiese,1987)، وفي هذه الدراسة تم تعريف مجموعتين من الفطريات الموجودة على البذور هي *Alternaria spp.* و *Rhizopus spp.* . وقد أظهرت نتائج تحديد نسبة الإصابة بالبقعة السوداء تفاوت كبير بين موسمي الزراعة ونسبة الإصابة حيث ظهرت الإصابة على جميع العينات في عام ١٤١٩هـ وتراوحت من ٦ إلى ٤٨٪ بينما كانت الإصابة منخفضة و تراوحت من صفر إلى ١٣٪ في موسم ١٤٢٠هـ (جدول ٤)، وهذه النسب مرتفعة جداً خاصة بالنسبة للظروف المحلية في المملكة والتي تمتاز بالجفاف مع العلم أن النسب المسموح بها في الولايات المتحدة هي ٢ و ٤٪ لبذور الدرجة الأولى و الثانية على التوالي(Wiese,1987) ويمكن تفسير ارتفاع نسبة الإصابة بالبقعة السوداء إلى استخدام نظام الري بالرش والإفراط في الري أثناء نضج المحصول مما يزيد الرطوبة النسبية حول النباتات ويزيد من انتشار الفطريات.

لقد أظهرت بالمقابل معاملة البذور بالمبيدات تأثيراً فعالاً في خفض نسبة الإصابة بالفطريات حيث ظهرت مستعمرات الريزوبس *Rhizopus spp.* عند إنبات عينات البذور غير المعاملة فقط بينما ظهرت الإصابة بفطر الالتيرناريا *Alternaria spp.* في معظم العينات بنسبة تراوحت من صفر إلى ١٣٪ في الموسم الأول و من صفر إلى ٧٪ في الموسم الثاني للعينات المعاملة بينما وصلت نسبة الإصابة إلى ٣٤٪ في العينات غير المعاملة في الموسم الأول و إلى ٥٪ في الموسم الثاني (جدول٤) مما يدل على أن معاملة البذور تقلل من نسبة الإصابة بالفطريات مع أن بعض المسببات المرضية قد تخترق غلاف البذرة مما يقلل من فعالية المعاملة بالمبيدات (الحداد، ١٩٩٤).

جدول (٤)

نسبة الإصابة بالبقعة السوداء ونسبة ظهور فطر الالتيرناريا و عدد البذور المصابة بالنخر الحشري لعينات القمح المنتجة محلياً من قبل شركات معتمدة وغير معتمدة

رقم المنتج	الجهة المنتجة	نسبة الإصابة بالبقعة السوداء		نسبة ظهور فطر الالتيرناريا		البذور المصابة بالنخر الحشري♦	
		١٤١٩هـ	١٤٢٠هـ	١٤١٩هـ	١٤٢٠هـ	١٤١٩هـ	١٤٢٠هـ
١	معتمدة	٣١	١١	٤	٧	٠	٠
٢	معتمدة	٦	٧	٢	٧	٠	٠
٢	معتمدة	٢٨	٦	٢	٢	٩	٠
٣	معتمدة	١٩	٠	٠	٠	٠	٠
٤	معتمدة	١٢	٥	٠	٢	٤٥	١٢
٥	معتمدة	١٢	٦	٢	٢	٠	٠
٦	معتمدة	٢٠	٦	٤	٢	٢٧	٤
٦	معتمدة	٤٨	٣	١٣	١	٠	٠
٧	معتمدة	٢١	٣	٤	١	٧	٠
٨	معتمدة	٢٤	١٣	١	٤	٨	٠
٩	معتمدة	١٩	٥	٠	٣	٠	٠
١٠	غير معتمدة	١٢	٠	٢	٠	٠	٠
١١	غير معتمدة	٣٢	٠	٢٨	.	٠	٠
١٢	غير معتمدة	١٣	٠	٤	٢	٠	٠
١٣	غير معتمدة	٣١	٦	٨	٥	٠	٠
١٤	غير معتمدة	٢٩	-	١٦	-	٠	-
١٥	غير معتمدة	٢٧	-	٣٤	-	٣٧	-
أقل فرق معنوي LSD (0.05)		١٢,٥٤	٥,٨٢	٢,٦٧	١,٩٤	٢,٦٧	١,٩٦

- عدد البذور المصابة بالنخر الحشري في عينة تقاوي تزن ٢كجم.

أما بالنسبة للنخر الحشري فقد وجدت بعض البذور المصابة في خمس عينات بذور معتمدة وعينة بذور واحدة غير معتمدة في موسم ١٤١٩هـ بينما في الموسم التالي وجدت بذور مصابة بالنخر الحشري في عينتين معتمدتين (جدول ٤). ويعكس وجود البذور المصابة بالنخر الحشري ظروف التخزين السيئة للبذور حيث تنشط خنافس المستودعات عند توفر الرطوبة وضعف التهوية وعدم استخدام المبيدات الحشرية أثناء تخزين البذور (Justice and Bass, 1979).

لقد أظهرت هذه الدراسة مدى تدني مستوى الجودة النوعية للتقاوي المنتجة بحيث يصعب التوصية بأي تقاوي منتجة من تلك الشركات مما يدل على أن قطاع إنتاج تقاوي القمح و الشعير في المملكة العربية السعودية يعاني من مشكلات فنية وإشرافية. فقد أظهرت الدراسة وجود عينتين مختلفتين لكل من شركتين معتمدتين لإنتاج التقاوي تحمل نفس بيانات الإنتاج بدون ذكر لدرجة التقاوي كما أن التقاوي المنتجة من قبل بعض الشركات و المؤسسات المصرح لها لا ينطبق عليها بعض أهم مواصفات التقاوي المعتمدة وفي المقابل كانت هناك عينة تقاوي جيدة لشركة غير مصرح لها لإنتاج التقاوي (العينة رقم ١٢) مما يدل على أن توصية وزارة الزراعة للشركات المخولة لإنتاج التقاوي كان على أساس قدراتها الإنتاجية ووجود معامل لتنقية البذور ولم يكن على أساس الجودة النوعية للتقاوي المنتجة.

إن متطلبات إنتاج تقاوي القمح و الشعير ليست صعبة فهي محاصيل ذاتية التلقيح لا تتطلب مسافات عزل كبيرة أو ظروف إنتاج خاصة كما هي الحال في بعض المحاصيل خلطية التلقيح (Copeland, 1976; Thomson, 1979) مما يجعل الكثير من الشركات الزراعية العاملة في المملكة ترغب في الدخول في إنتاج تقاوي القمح و الشعير ومعظم تلك الشركات لديها تجهيزات تقنية وقدرات مالية جيدة يمكن أن توظف في تطوير وإنتاج التقاوي المعتمدة. وفي المرحلة الحالية أعتقد أن تدني الجودة النوعية للتقاوي المنتجة يعود لعدم الالتزام بشروط إنتاج التقاوي ولذلك يجب على وزارة الزراعة إصدار لائحة لاعتماد التقاوي و تشكيل فرق مؤهلة للتفتيش الحقلي لتخليص السوق من التقاوي الرديئة، وفي

نقس الوقت يجب على شركات إنتاج التقاوي التعاون مع مراكز الأبحاث في الجامعات على إنتاج أو إدخال أصناف حديثة يمكن أن تحل محل صنف اليكورا روجو، الذي تم إدخاله إلى المملكة العربية السعودية في عام ١٩٨٠م وأصبح صنف متدهور نتيجة تكرار الزراعة دون الرجوع إلى تقاوي الأساس للصنف.

إن هناك حاجة لتقييم أصناف حديثة أعلى إنتاجية ومتوافقة مع الظروف المحلية لإدخالها للزراعة في مناطق محددة بالمملكة. فمعظم أصناف القمح الحديثة في العالم هي أصناف خاصة لا يمكن الحصول على تقاويها إلا من الشركة المنتجة للصنف (الحداد، ١٩٩٤) مما يمكن لشركات التقاوي المحلية الحصول على حق إنتاج التقاوي المعتمدة في المملكة مقابل شراء التقاوي المسجلة من الشركة المنتجة للصنف مما يساعد على تنظيم إنتاج التقاوي وتضييع الفرصة على الشركات التي تعمل في إنتاج التقاوي غير المعتمدة.

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Seed Quality of Locally Produced Wheat in Saudi Arabia

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Abstract:

Wheat seed production in Saudi Arabia is conducted by some authorized agricultural companies. However some unauthorized companies and farmers produce and distribute wheat seeds in the local market. This study was conducted to evaluate seed quality of locally produced wheat seed. A total of 17 seed sources were collected from three agricultural regions including samples from all authorized companies and 6 unauthorized seed sources. Standard seed tests were conducted to determine purity, seed gravity and seed germination percentages. Also, the number of seeds with insect damage and seeds with black point were estimated. In addition, Fungus colonies on germinating seeds were counted.

Although, all tested samples belong to one variety "yocora rojo", results showed marked variation in seed quality between the two seasons and a significant variation among seed sources in all studied traits. Significant variation was observed in seed purity, in which several samples failed to reach 98% purity level required for seed certification. In addition, poor germination percentages were observed for most tested samples, in which 7 out of 11 authorized samples failed to pass the 92% germination required for certification in both seasons. Furthermore, seed gravity varied among samples. Significant variation was, also, observed for percentage of seeds with black point. All seed sources had seeds with black point in the first season ranging from 6 to 48%. However, low incidents of seeds with black point were observed in the second season. Seeds with insect damage were observed in 6 seed sources in the first season and in two seed sources in the second season.

This study has shown that wide variation in seed quality among locally produced wheat seeds exist as result of weak technical supervision on production and treatment of seeds. Therefore, there is an argent need to develop an effective field inspection and to apply seed production requirements to clear the market from poor quality seeds.

تأثير الغسيل بالماء و التعبئة في الأكياس للحوم الهدي و الأضاحي على نسبة التلوث بالميكروبات

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الملخص :

هدفت هذه الدراسة إلى بيان مدى تأثير غسيل لحوم الهدي و الأضاحي بالماء الجاري على إنخفاض نسبة التلوث الميكروبي الذي قد يحدث للحوم في المراحل الأولية للذبح والسلخ والتجويف. لقد تم أخذ مسحات بكتريولوجية من أسطح لحوم ذبائح أغنام الهدي و الأضاحي الأسترالية الأصل قبل وبعد الغسيل بالماء كما نم أخذ مسحات أسطح أكياس القماش المستخدمة للتعبئة. وقد تم تقدير العدد الكلي للبكتريا، والعدد الكلي للخمائر والأعفان، وكذلك تم التعرف على بعض البكتريا الممرضة.

وكان من أهم النتائج عزل البكتريا المعتدلة الهوائية Aerobic mesophilic bacteria/ سم2 بعد الغسيل بواقع 4.2×10^4 ومن الأكياس بواقع 1.2×10^4 / cm^2 ومن سطح اللحوم المعبأة بواقع 5.4×10^4 / cm^2 وكانت النسبة المئوية لعدد البكتيريا المتبقية بعد الغسيل 52,5 ٪ .

أما العدد الكلي للخمائر والاعفان / سم2 Yeasts and moulds بعد الغسيل $1.6 \times 10^3/cm^2$ وعددها على الأكياس $1.0 \times 10^3/cm^2$ وعددها على اللحوم المعبأة $2.6 \times 10^6/cm^2$. وكانت النسبة المئوية لعدد الخمائر والاعفان المتبقية بعد الغسيل بواقع 2٪ .

أما بالنسبة لأنواع وأعداد البكتيريا الممرضة فقد تم عزل بكتيريا المكورات السبحية البرازية / سم2 Streptococcus fecalis و الاشريكية القولونية /سم2 E.coli والقولونيات Coliform bacteria/cm^2 و المتقلبات Proteus vulgaris والانتروباكتر آجلو ميرنس Enterobacter agglomerans (Enterococcus fecalis).

بالإضافة إلى ذلك تم عزل البنسيليوم.Penicilium spp بعد الغسيل ولم يتم عزلها من على الأكياس. في جميع الحالات لم يصل عدد البكتيريا المعزولة عن $10^5/cm^2$ ، بينما كان عند الخمائر والاعفان للحوم المعبأة $2.6 \times 10^6/cm^2$. كما كان

للغسيل بالماء تأثير بواقع 47.5 ٪ لخفض عدد البكتيريا الملوثة للحوم الهدي والأضاحي ، كما نقترح تعقيم أكياس التعبئة قبل استعمالها وتحسين كفاءة ضغط المياه مع إستعمال الماء الساخن لغسيل الهدي والأضاحي أو الأخذ بنظام التعقيم بالبخار والبسترة وكذلك نقترح تطبيق نظام صحي مثل نظام HCCP لخفض رقم الحمل البدئي للبكتريا من على سطح لحوم الهدي والأضاحي والتصدي الفعال لمصادر التلوث.

المقدمة :

لقد تم إنجاز هذا البحث في موسم حج عام 1422هـ و هو جزء من مشروع بحثي تم تقديمه لمشروع المملكة العربية السعودية للإفادة من الهدي والأضاحي للبنك الإسلامي للتنمية. كما أتاحت فرصة مُشاركتنا(1414 -1424هـ) فيه خلال الأعوام السابقة، لتقديم الخدمات المتعلقة بالرقابة الصحية البيطرية و الإجراءات الصحية و التقنية اللازمة للحيوانات قبل الذبح Ante-mortem Inspection و أثناء ومابعد الذبح Post-mortem inspection.

و يتمثل الحجم التقريبي لإنتاج لحوم الهدي والأضاحي لسنوات طويلة للمشروع من خلال مايتم في فترة قصيرة من الزمن (72 -84 ساعة) وفي مكان واحد (مسالخ المعيصم 1 -6) ذبح ونحر وتجهيزيدوي لحوالي401.227 ذبيحة من الأغنام و 2.047 من الأبقار و2.859 من الإبل (موسم حج عام 1423هـ).

أما بالنسبة لحدوث تلوث ميكروبي للحوم ذبائح الهدي والأضاحي فلا بد منه، خاصة في ظروف ذبح هذا الكم الكبير للحيوانات، لاسيما في حال حدوث إخلال في تطبيق التكنولوجيا وتقنيات المراحل الأولية (للذبح والسلخ والتجويف) وتجهيز لحومها وغسلها وتجميدها وتداولها.

هدفت هذه الدراسة إلى توضيح مدى و نوع حجم التلوث و تأثير غسيل لحوم الهدي والأضاحي بالماء الجاري وتحقيق أفضل السبل لحماية لحومه من التلوث والإرتقاء بالتقنيات الحديثة لغسيلها.

ولقد كان لظهور الإشريكية القولونية E. coli 0157:H7 في العالم (والمتسببة في التسمم الغذائي ذات الأصل الحيواني) الدافع الأساسي للعلماء والباحثين للمضي قدماً في البحث عن طرق وقائية لطمأنة المستهلك عن صحة وسلامة اللحوم للاستهلاك الأدمي. وكان لحدوث حالات وفاة الأطفال والمسنين بسبب تناول اللحوم البقرية (لبرجر) الملوثة بحمل عددي ضئيل من البكتريا دافع قوي للمعنيين بالاهتمام الشديد بسلامة صحة اللحوم وخلوها من الجراثيم مثل الإشريكية القولونية E.coli والسلمونيلا. Salmonella spp والليستيريا .Listeria spp وغيرها.

ولذا اقترحت Food Safety Inspection service (FSIS) USDA هيئة رقابة سلامة الغذاء إنه على كل الذبائح المذبوحة حديثاً أن تعالج لحومها بمضاد جرثومي واحد على الأقل وعلى سبيل المثال لا الحصر : الماء الساخن، حموض عضوية، مضادات حيوية، هيدروجين بيروكسيد H_2O_2 و TSP الفوسفات ثلاثي الصوديوم والماء بالكلور وغيرها.

مصادر التلوث البكتيري لأسطح لحوم الهدي والأضاحي :

تصل الميكروبات إلى اللحوم ومنتجاتها بأعداد كبيرة بعد عملية ذبح أو نحر الحيوانات وتتلوث من المحيط الخارجي خلال مراحل وتجهيزات العمليات الأولية للذبائح ولحومها . وتعتبر المصادر الرئيسية للتلوث بعد الذبح post-mortem contamination كثيرة وعديدة . ومنها قبل كل شيء الحيوان المريض و الجلود والشعر والصوف ومحتوى أمعاء الحيوانات المذبوحة و الضرع الملتهب والمعدات والأجهزة وأدوات تجهيز العمليات الأولية وتصنيع لحومها وأيادي وملابس العمال التي تلامس الجلود و اللحوم والدماء والماء وأرضية المسلخ والمخلفات الحيوانية والمجاري وغيرها (5,4,3,2,1).

وتذكر بعض المصادر العلمية (H.Beganovic A.1983)إنه في غرام الشعر الواحد من جلد الأبقار والعجول وجد حوالي 10^7 -10^8 من البكتريا المحللة للبروتين Proteolytic bacteria و 10^5 -10^6 من البكتريا المتحملة للبرودة Psyhrophilic bacteria ومن الأنواع الأخرى أيضاً .

والجدير بالذكر إنه يمكن تنظيف أنعام الهدي والأضاحي قبل الذبح بإستعمال حمام مائي (إدخالها بأحواض مليئة بالماء). كما يمكن استخدام بعض الكيماويات والمنظفات للتخلص من الأتربة والملوثات . لا نستطيع منع تلوث اللحوم بعد الذبح، ولكن من الممكن خفضها بشكل كبير بإستعمال الشروط الصحية ، لاسيما في مراحل تجهيز العمليات الأولية للذبائح وتصنيع لحومها . كذلك في إنتظام تطبيق الشروط الصحية في المسالخ والعنابر الإنتاجية.

وتذكر المصادر العلمية (Thoronton H.1968) عن إمكانية خفض حمل التلوث البدئي Initial contamination الميكروبي للحوم الذبائح بشكل مناسب ، وذلك بغسيل لحوم الذبائح بعد تجهيزها بالماء والضغط بحوالي 160 كغ/ سم2 ، والغسيل بالماء الحار . وبالرش بإستخدام محلول المطهرات الخفيفة aerosol من حمض الخل (Hoobs B.C.1993) .

ونعد من ميكروبات المحيط التي تلوث اللحوم أثناء تجهيزها وتصنيعها وتداولها بعض الأنواع من العائلات : Micrococcaceae, Enterobacteriaceae, Pseudomonadaceae, Achromobacteriaceae, Lactobacillaceae, Corynebacteriaceae, Bacillaceae, Spirillaceae. وغيرها من الخمائر والأعفان moulds and yeasts مثل :

Penicillium, Aspergillus, Mucor, Cladosporium, Alternaria, Sporotrichum, Thamnidum, Monilia, Mucotorula, Candida, Geotrichum, Blastodendrion, Rhodotorula.

توجد هذه الميكروبات بشكل دائم في صالات الذبح وتجهيز المراحل الأولية والتصنيع وتخزين اللحوم(Altabari G.1998). وتستطيع جميع هذه الميكروبات في ظروف وطريقة معينة التأثير على خواص اللحوم (4). ومعظمها يُسبب فساد اللحوم، وبعضها يُسبب التسمم الغذائي (H.Beganovic A.1983,Hoobs B.C.1993).

مستوى حمل التلوث البكتري لأسطح لحوم الذبائح:

يوجد فرق كبير بين مستوى التلوث في هذه الشروط التي يبلغ فيها الحمل البكتري

الكلي $10^2/cm^2$ وبين الشروط اللاصحية للعمليات الأولية للذبح التي يزيد فيها مستوى الحمل البكتري للتلوث عن $10^5/cm^2$. ويشارك في هذا التلوث مجموعة من الأنواع الميكروبية، معظمها من الميكروبات المعتدلة Mesophilic bacteria (Altabari G . H.Beganovic A.1983,Hoobs B.C.1993), 1998.

تمسك أو إلتصاق البكتريا بسطح لحوم الذبائح :

في بداية عملية التلوث تكون البكتريا المتحملة للبرودة Psychrophilic bacteria ضعيفة التمسك والإلتصاق وتفرز مجموعة السكريات العدادية الحامضية Polysaccharides في المحيط الخلوي الخارجي. وتقوم البوليمرات Polymer الخلوية الخارجية بتثبيت البكتريا بشكل دائم على سطح لحوم الذبائح . ومن ثم يتم تكاثرها حيث تشكل على السطح مستعمرات واضحة وبعد فترة زمنية تشكل طبقة فلم لزجة Slimming . وتحت شروط معينة تقوم البكتريا التي تملك صفات تكوين وفرز البروتاز في المحيط الخلوي الخارجي بتحليل شبكة الأنسجة الضامة وبذلك تفتح الطريق للدخول في أعماق اللحوم. كما إن عملية إلتصاق البكتريا وتكاثرها وسريانها ليس واحداً عند جميع أنواع البكتريا و تؤثر على ذلك عدة عوامل.

تأثير الغسيل والمعالجة الكيميائية والتبريد والتجميد والبسترة على خفض التلوث الميكروبي :

تم إجراء عدد من التجارب لتحديد تأثير التجفيف بالحرارة والغسل بالماء في التقليل من التلوث الجرثومي للحوم الذبائح البقرية . ولقد تم الغسيل بالماء (128° ف ، 15 ثانية ، 125 psi) بواسطة أدوات خاصة مصممة للحوم الذبائح لأغراض بحثية (Cutter C.N.1998).

كما تم استعمال التجفيف السريع بالحرارة (778° ف) أو (600° ف) لمدة 25 ثانية وفي التجربة الأولى : تم اختبار الغسيل بالماء والتجفيف بالحرارة بنسب مختلفة

وتقيميها . أما بالنسبة إلى أسطح لحوم الذبائح البقرية التي تم تجفيفها لمدة 15 ثانية والتي كانت تحوي على الروث المليء بالجراثيم تم إخضاعها مرة ثانية للغسيل بالماء والتجفيف لمدة 30 ثانية. وكانت النتيجة وجود القليل جداً من الجراثيم مثل السلمونيلا.spp Salmonella
والإشريكية القولونية E. coli والليستريا Listeria spp والمطثية Clostridia spp.

كما تم إجراء تجارب أخرى تم تطبيقها على درجة حرارة أقل من 600° ف ولمدة قصيرة. وقد تم ملاحظة إنه بتجفيف الذبيحة لمدة 10ثوان وغسلها بالماء ومن ثم تجفيفها مرة أخرى لمدة 25 ثانية قد أعطى أفضل النتائج بتخفيض الحمل الجرثومي لمستويات متدنية جداً. ففي جميع الحالات، إن تجفيف لحوم الذبائح مع غسلها بالماء أكثر فعالية من الغسيل بالماء لوحدة فقط وذلك في سبيل تخفيض عدد ومستويات التلوث الجرثومي للذبائح البقرية.

وفي مشروع لجامعة كولورادو في الولايات المتحدة تم إجراء دراسة حديثة لتقييم مدى فعالية الاختبارات الميكروبيولوجية المتتالية في مدى تحسين صحة وسلامة لحوم الذبائح البقرية ولقد تم أخذ أكثر من 1800 عينة جرثومية من أماكن مختلفة من على سطوح الذبائح من ثمان مصانع ومسالخ أبقار (Bacon R.T.1999) .

وقد تم تطبيق أنظمة مختلفة في معالجتها من أجل تقييم فعالية كل من هذه الأنظمة. فمثلاً كان لاستخدام ضغط البخار السلبي vacuuming steam والغسيل washing باستخدام حمض الخل acetic acid قبل التجويف pre-evisceration قد خفض مجموع العدد الكلي للبكتريا Total bacteria count (TBC) والعدد الكلي لبكتريا الكوليفورم Total coliform bacteria (TCB) والعدد الكلي لبكتريا القولون E. coli count (ECC) ومن على لحوم الذبائح بنسب مختلفة على التوالي : 25٪ ، 21٪ و 45٪ .

كما كان لاستخدام البسترة الحرارية thermal pasteurization والغسيل بالماء وحمض الخل أثر في تخفيض مجموع العدد الكلي للبكتريا (TBC) والعدد الكلي

لبكتريا الكوليفورم (TCB) والعدد الكلي لبكتريا القولون (ECC) من على لحوم الذبائح إلى 54٪ و 0.3٪ و 0.2٪ على التوالي .

وقد تم ملاحظة إن التلوث يعود مجدداً بعد عملية تجويف الأحشاء والتقطيع splitting وتزداد نسبة مجموع العدد الكلي للبكتريا (TBC) و عدد القولونيات (TCB) وعدد الإشريكية القولونية (ECC) من على لحوم الذبائح إلى 11.54٪ و 26.91٪ و 17.09٪ على التوالي .

علماً إن البسترة الحرارية والغسيل بالماء مع حمض الخل كان فعالاً في إعادة تخليص الذبائح من التلوث وتخفيض نسب الحمل البكتري للعدد الكلي للبكتريا (TBC) والعدد الكلي للقولونيات (ECC) والعدد الكلي الإشريكية القولونية إلى مستويات ما قبل التقطيع والتجويف .

ونخلص إلى أن هذه المعلومات أجازت تطبيق الأنظمة المتعددة المتعاقبة (multiple hurdle) والتي تعمل على تخفيض عدد الجراثيم في لحوم الذبائح.

المواد والطرق :

لقد تم أخذ 200 عينة بطريقة المسحات البكتريولوجية المعروفة H.Beganovic) (A.1975,1983,Speck L1992 من على أسطح لحوم ذبائح أغنام الهدي والأضاحي. وكذلك تم أخذ 100 مسحة بكتريولوجية من أكياس الخام ، المصنوعة من الشاش التي تم بها تعبئة لحوم الذبائح . ولقد تم أخذ المسحات البكتريولوجية بعد الانتهاء من عملية الذبح وسلخ الجلد وتجويف الأحشاء قبل وبعد غسيل لحوم الذبائح بالماء الجاري النظيف المستعمل للشرب والذي تم إختبار صلاحيته H.Beganovic A.1975,1983,Speck) (L1992. كما تم أخذ المسحات البكتريولوجية من على مختلف أجزاء أسطح الذبيحة كالأتي : الرقبة ، الصدر ، الظهر ، البطن ، الأفخاذ والأطراف.

ومن ثم تمت عملية تهيئة ومعاملة العينات حسب المصادر العلمية المحلية والعالمية (12 ، 11 ، 10 ، 9 ، 8 ، 7 ,6) H.Beganovic A.1975,1983,Speck)

(H.Beganovic وتم زراعتها على أوساط ميكروبيولوجية مختارة L1992) A.1975,1983,Speck L1992) . ومن ثم تم حضانتها على الدرجات الحرارية المناسبة (30 ، 37 ، 44م°) . ومن ثم تم قراءة النتائج (11 ، 12 ، 13 ، 14 ، 15 ، 16 ، 17) وعد وتعيين Identification البكتريا المرضة Pathogenic bacteria والغير ممرضة بإستخدام إختبار الصفات البيوكيميائية للبكتريا المرضة الموجبة الجرام والسالبة الجرام Identification of Api 20E system-bioMérieudx sa enterobacteriaceae by كما تم تشخيص الفطريات بالطرق العلمية المعروفة (H.Beganovic A.1983, Speck L1992) و كما تمت معاملة النتائج إحصائياً .

النتائج والمناقشة :

بالنظر إلى الجدول رقم 1 و2 نستنتج إنه في جميع الحالات (الجدول رقم 1) لم يصل عدد البكتريا المعزولة إلى $10^5/cm^2$ ، بينما بلغ عند الفطريات والعفن (الجدول رقم 2) $2.6 \times 10^6/cm^2$. كذلك لم يصل العدد الكلي للبكتريا المرضة pathogenic bacteria عن $10^5/cm^2$ (الجدول رقم 1) عند المكورات السبحية البرازية treptococcus fecalis (E.fecalis) والقولونيات (Coliform bacteria) وكانت نتائج التحليل الإحصائي للعينات معنوية. كما كانت مجرد عزل تلك الأنواع البكتيرية قد يُشير إلى تدني الصحة الشخصية للعمال العاملين على جزارة الذبائح وتلوث أياديهم ومعداتهم بمثل هذه الأنواع من البكتريا.

لذا نقترح بوضع أواني خاصة في وحدات الذبح مليئة بالمطهارات التي تستعمل لتطهير وتعقيم الأيادي والسكاكين يستعملها الجزار من حين لأخر .كذلك إصدار مواصفة خاصة بأخذ المسحات البكتريولوجية بهدف التحقق من درجة ومستوى التلوث البكتري لأسطح العمل والمعدات والأجهزة و أيادي العاملين في إنتاج وتداول الأغذية ذات المصدر الحيواني .

جدول رقم (1)

متوسط عدد البكتريا المعتدلة الهوائية والبكتريا المرضة و الفطريات /سم2 على سطح لحوم ذبائح الهدي والأضاحي قبل وبعد الغسيل

مجموعات ونوع الميكروبات المعزولة /سم2	عدد الميكروبات /سم2 على اللحوم قبل الغسيل	عدد الميكروبات / سم2 على اللحوم بعد الغسيل	النسبة المئوية لعدد الميكروبات المتبقية بعد الغسيل	النسبة المئوية لعدد الميكروبات المزالة بعد الغسيل
A. mesophilic bacteria	8.0×10^4	4.2×10^4	52.5	47.5
Yeasts and moulds	8.0×10^4	1.6×10^3	2	98
S. fecalis(E.fecalis)	1.3×10^4	4.2×10^3	32.30	67.70
Coliform bacteria	5.0×10^3	5.0×10^3	100.	-
E. coli	2.0×10^2	1.0×10^2	50	50
P. vulgaris	5.0×10^3	2.4×10^3	48	52
E. agglomerans	5.0×10^3	2.0×10^2	4.0	96.0
Penicillium spp.	4.0×10^2	3.0×10^2	75.0	25.0
Mucor spp.	1.0×10^2	1.0×10^2	100.	-

جدول رقم (2)

متوسط عدد البكتريا الهوائية والبكتريا المرضة والفطريات/سم2 على الأكياس قبل التعبئة وعلى أسطح لحوم الذبائح بعد التعبئة

مجموعات ونوع الميكروبات المعزولة /سم2	عدد الميكروبات /سم2 على اللحوم قبل التعبئة (بعد الغسيل)	عدد الميكروبات ا/سم2 على الأكياس	عدد الميكروبات /سم2 على اللحوم بعد التعبئة	النسبة المئوية لعدد الميكروبات الذي انتقل من الأكياس إلى اللحوم
A.mesophylic bacteria	$4.2 \text{ X } 10^4$	$1.2 \text{ X } 10^4$	$5.4 \text{ X } 10^4$	22.23
Yeasts and moulds	$1.6 \text{ X } 10^3$	$1.0 \text{ X } 10^3$	$2.6 \text{ X } 10^6$	99.94
S. fecalis(E.fecalis)	$4.2 \text{ X } 10^3$	$0.5 \text{ X } 10^2$	$4.3 \text{ X } 10^3$	2.32
Coliform bacteria	$5.0 \text{ X } 10^3$	$6.0 \text{ X } 10^3$	$1.1 \text{ X } 10^4$	54.54
E coli	$1.0 \text{ X } 10^2$	$0.2 \text{ X } 10^2$	$1.2 \text{ X } 10^2$	16.66
P. valgaris	$2.4 \text{ X } 10^3$	$1.2 \text{ X } 10^3$	$3.6 \text{ X } 15^3$	33.33
E.agglomerans	$2.0 \text{ X } 10^2$	$1.1 \text{ X } 10^4$	$1.1 \text{ X } 10^4$	98.18
Penicillium spp. Mucor spp.	$3.0 \text{ X } 10^2$ $1.0 \text{ X } 10^2$	- -	$3.0 \text{ X } 10^2$ $1.0 \text{ X } 10^2$	- -

كذلك أيضاً بالنسبة إلى تلوث لحوم الهدي والأضاحي بالقولونيات Coliform bacteria والمتقلبات Proteus vulgaris وإلانتروباكتر Enterobacter agglomerans حيث يصل العدد المعزول إلى $10^3/cm^2$ بينما هو عند الإشريكية القولونية E.coli $10^2/cm^2$ وكذلك بلغ عند البنسيليوم .Penicillium spp والمكور Mucor spp ($10^3/cm^2$) .

وفي الحقيقة إنه لا نستطيع الهروب من حدوث التلوث الميكروبي لأسطح لحوم الذبائح، حتى في حال تهيئة أفضل الشروط الصحية للعمليات الأولية من الذبح والسلخ والتجويف وتجهيز اللحوم.

وحسب المواصفات القياسية السعودية والخليجية (17) نجد أن مستوى الحد الميكروبي المطلوب توفرة في ذبائح اللحوم الطازجة المبردة يبلغ $10^6/g,ml$ وعلى أن لا يصل إلى $10^7/g,ml$ أو يزيد عنها في كل عينة من العينات ولا يسمح قط بوجود السلمونيلا .Salmonella spp ولا يشير إلى أي بكتريا أخرى . علماً إن بعض المواصفات القياسية الأوروبية لا تسمح بوجود بكتريا القولون E. coli 0157 أو بكتريا المتقلبات .Proteus spp و المطثية .Clostridia spp وهي من الأنواع المرضة والضارة بصحة اللحوم والصحة الشخصية .

وبشكل عام فالعدد الكلي للبكتريا لم يتجاوز الحدود القصوى الغير مسموح بها . ومن المعروف إن الحمل البكتري البدئي للبكتريا المرضة يجب أن لا يقل عن $10^5/g,ml,cm^2$ حتى يستطيع أن يكون مؤهلاً لعمل التسمم الغذائي (2). علماً إنه في حال الإهمال في شروط الحفظ وتداول اللحوم يحصل فسادها . و الجدير بالذكر إن غياب الرقابة المتشددة على اللحوم والإهمال السائد في مراحل العمليات الأولية (الذبح والسلخ والتجويف) يؤدي إلى نتائج وخيمة لاسيما في حال إتساع كمها الإنتاجي وإتساع مناطق تداولها (1،3) .

وبالنسبة إلى تلوث لحوم الهدي والأضاحي ببعض الأنواع البكترية من الأكياس الخام (الشاش) التي يتم فيها تعبئة الذبائح بعد الغسيل (الجدول رقم 2)، فقد تم أخذ

المسحات الميكروبيولوجية من الذبائح بعد إدخالها في الأكياس و في جميع الحالات لم يصل عدد البكتريا المعزولة إلى $10^5/cm^2$ بينما كان في الخمائر والعفن yeasts and moulds حيث بلغ $2.6 \times 10^5/cm^2$. أيضاً بلغ العدد الكلي للبكتريا المعتدلة الهوائية Aerobic mesophilic bacteria $5.4 \times 10^4/cm^2$. كذلك لم يزيد العدد الكلي للبكتريا المرضة pathogenic bacteria عن $10^4/cm^2$ عند القولونيات Coliform bacteria وبكتريا المتقلبات Proteus vulgaris وإلانتروباكتر Enterobacter agglomerans والمكورات السبحية البرازية Streptococcus fecalis(E.fecalis) . أما الإشريكية القولونية E. coli فبلغت $1.2 \times 10^2/cm^2$ كما تدل المجموعات البكترية المعزولة تدني مستوى نظافة أكياس التعبئة حيث يتم وضعها على الأرض أو على حافة الجدار القريب في أرضية المسلخ مما أدى لتلوثها .

لذا نقترح تشديد الرقابة الصحية على تعبئة ذبائح الهدي والأضاحي ووضع الأكياس (الشاشية) قبل إستعمالها في كيس كبير ويتم تعقيمها بالموصدة(الأوتوكلاف). من ثم يجب وضع الأكياس على عربات نظيفة على أن يتم أخذ الأكياس منها حين الحاجة وعلماً أن تكون هناك عربة خاصة بالأكياس لكل نقطة تعبئة . يجب على العاملين أن يقوموا بغسل أياديهم وتطهيرها ، لذلك يجب تأمين مطهرات توضع على كل نقطة عند خط تعبئة الذبائح . كذلك نقترح أخذ المسحات البكتريولوجية الروتينية كل عام لقراءة صحة وسلامة الصورة البكتريولوجية للحوم الذبائح .

كذلك نلاحظ إن أعلى نسبة مئوية للعدد البكتري الذي إنتقل من الأكياس إلى سطح اللحوم بلغت (99.94%) عند الخمائر والأعفان yeasts and moulds ومن ثم عند إلانتروباكتر (98.18%) Enterobacter agglomerans وعند الكولي فورم (54.54%) بينما بلغت أقل نسبة (2.32%) عند المكورات السبحية البرازية(E.fecalis) Ştreptococcus fecalis

أما بالنسبة إلى تأثير الغسيل بالماء الجاري فنجد (الجدول رقم 1) أن تأثيرة كان اقل من الوسط (47.5٪) لخفض عدد البكتريا الكلي من على سطح لحوم الهدي والأضاحي . كذلك هو عند الإشريكية القولونية (E. coli 50٪) وبكتريا المتقلبات Proteus vulgaris (52 ٪).

أما على الخمائر والأعفان yeasts and moulds فنجد إن للماء تأثير قوي (98٪) على إزالة الحمل البكتري البدئي الملوث لأسطح اللحوم . كذلك هو أيضاً(96 ٪) عند إلانتروباكتر Enterobacter agglomerans . كذلك بلغ عند المكورات السبحية البرازية (67,70٪) . بينما نجده عند البنسيليوم .Penicillium spp بتاثير منخفض (25 ٪) ولم نجد له تأثير على الموكرMucor spp ، في حين كان على الأعفان (98 ٪) مما يدلنا على عدم إمكانية تشبثها بقوة على سطح اللحوم حيث تم بسهولة إزالتها.

ومن الأهمية للناحية التطبيقية في صناعة اللحوم أن البكتريا في نفس الطريقة أو شبيهة بها تتثبت وتلتصق على الأسطح الملساء التي تلامس اللحوم مثل الزجاج والسرميكا والبلاستيك والستانيستيل وغيرها . وهذا يفسر لنا كيف تتواجد الميكروبات على الأسطح المختلفة وعلى المعدات والألياف والطاولات لتقطيع اللحوم في الصالات التي فيها درجة الحرارة حوالي 10مْ .

وتصف المصادر العلمية الأخرى (Gill C.O.1996) إن البكتريا على أسطح لحوم الذبائح تكون في بداية المرحلة خفيفة الإلتصاق حيث بالإمكان نزعها بالغسيل . بينما عندما تفرز كمية كافية من السكريات العدادية الحامضية تأخذ في الثبات النهائي .

كما تم الملاحظة في نتائجنا تفاوت تأثير الماء في خفض حمل التلوث الميكروبي حسب تشبث الأنواع البكترية الملوثة لسطح لحوم ذبائح الهدي و الأضاحي.

لقد أثبتت تجاربنا إن استخدام الماء الجاري لم يكن ذو منفعة كبيرة (47.5٪) في إزالة التلوث البكتري للحوم ذبائح الهدي والأضاحي . وتؤكد نتائجنا العديد من المصادر العلمية العالمية (Gracey J.F.1999,Hudson W.R.1996,H.Beganovic A.1983)

وتذكر هيئة الرقابة الصحية على الأغذية (VSDA Food Safety Inspection Service (Gracey J.F.1999) (FSIS إن استعمال الماء الساخن74مْ < لمدة 10 ثواني أفضل بكثير من الماء البارد في معالجة ذبائح اللحوم . وكذلك أيضاً من الطرق الناجحة غسيل لحوم الهدي والأضاحي بماء ساخن 85 -90مْ يحوي على الكلور بدرجة 10 ppm وضغط الماء 100 psi وبمعدل 18 ليتر بالدقيقة للأبقار و 9 ليتر بالدقيقة للأغنام .

كذلك أيضاً اعتمدت هيئة الرقابة الصحة على الأغذية طريقتين لتنظيف ذبائح اللحوم البقرية المذبوحة حديثاً.

الطريقة الأولى : المعالجة بالتعقيم بالبخار (الضغط السلبي) وحيث يتم تعريض الذبائح لماء درجة حرارته 88مْ وبخار ضغط سلبي 45 psi لإزالة التلوث وتعقيم الذبائح (Dorsa W.J.1996) .

الطريقة الثانية : نظام تعقيم بخاري بحيث يتم تمرير لحوم الذبائح المقطعة في حجرة مغلقة ذات ضغط منخفض وحرارة عالية تصل إلى أكثر من 85مْ لمدة ثمانية ثوان بعدها يتم تبريدها بماء الثلج (Phebus R.1996) .

وتذكر بعض المصادر (Phebus R.1996) بأن التعقيم المستمر لسكاكين ومعدات الذبح والسلخ والتجويف هو عمل أساسي في عملية تخفيض التلوث البكتري.

كذلك أيضاً بأن إزالة أماكن التلوث المرئية بعملية التشذيب Trimming للحوم الذبائح ومن ثم يتم غسلها قد أعطت أفضل النتائج في التقليل من التلوث البكتري.

أما بالنسبة للمعالجات الكيميائية فيتم استعمال بعضها للتقليل من التلوث الجرثومي للحوم بعد عملية الذبح ومنها الكلور Chlorine والأحماض العضوية Organic acids والهيدروجين بروكسيد H_2O_2 والمضدات الحيوية Antimicrobials والفوسفات وغيرها .

والجديد بالذكر إن المستهلكين يطالبون باللحوم المنتجة طبيعياً والخالية من العناصر الكيميائية مما يجعل استخدام العقارات الكيميائية ليس بذو أفضلية في المستقبل القريب .

أما بالنسبة إلى غسيل فضلات الذبيحة الصالحة للأكل مثل الكبد والكليتين والقلب والذيل فهو من المواضيع الهامة جداً . ويتم غسلها بالماء الغزير . أما بالنسبة إلى تنظيف اللسان فيتم تنظيفه بجهاز خاص للتنظيف يعمل بدوران القوة النابذة .

ومن الأنظمة الرقابية الحديثة في تقيم صحة اللحوم نذكر الهاسب HACCP التحاليل الخطرة في رقابة النقاط الحرجة Hazard Analysis Critical Control Points ويشمل هذا النظام المراحل المتتالية :

والجدير بالذكر إنه هناك عدد من التقنيات الجديدة للمراقبة الجرثومية أصبحت الأن متوفرة . وبعض هذه التقنيات تحدد العدد الكلي للجراثيم في العينة بينما بعض التقنيات الأخرى تحدد نوع الجراثيم المتواجدة في العينة . هذه التقنيات تستخدم Monoclonal antibodies (الأجسام المضادة وحيدة الفسيلة) وسلاسل DNA الحمض الريبي النووي منقوص الأكسجين، حيث يمكن الحصول على النتائج في غضون ساعات.

وكذلك التقنية البكتريولوجية الحساسة الإشعاعية Microbial ATP bioluminescence assay تعمل على تحديد مستويات الـATP الجرثومي وغير الجرثومي وحساسيتها مختلفة عند المستويات الجرثومية أقل من 10^4 (Siragusa G.R.1995) وهذه التقنية تحتاج إلى 5 دقائق فقط لإعطاء النتيجة .

وهناك أيضاً نظام تقيم مراقبة أسس العناية الصحية الغذائية (Hygiene Assessment Systems (HAS وهو مبني على أساس مبادئ التقييم الخطرة Risk assessment . وقد تم إجراء تقييم لنظام الـ HAS في مسالخ بريطانيا من قبل الهيئة العليا للأطباء البيطريين State Veterinary service حيث وجد أن هناك علاقة بين متوسط العدد الكلي البكتري لكل مسلخ ومتوسط نتائج الـ HAS (Hudson W.R.1996) .

الخلاصة :

1. بلغ تأثير الماء المستعمل لخفض نسبة التلوث الميكروبي من على سطح لحوم ذبائح الهدي والأضاحي 47.5٪.
2. بلغ العدد الكلي للبكتريا المعزولة من على سطح لحوم الهدي والأضاحي بعد الغسيل $10^4/cm^2$ بينما عند الخمائر والعفن $10^6/cm^2$. كذلك لم يزيد العدد الكلي للبكتريا الممرضة عن $10^4/cm^2$ الدال على سوء الصحة الشخصية للجزارين (المكورات السبحية البرازية ، القولونيات وغيرها) .
3. بلغ العدد الكلي للبكتريا المعزولة من على أكياس التعبئة $10^4/cm^2$ بينما عند الخمائر والعفن $10^3/cm^2$. كذلك لم يزيد العدد الكلي للبكتريا الممرضة عن $10^3/cm^2$ (الدال على سوء صحة ونظافة أكياس لحوم الهدي والأضاحي).

التوصيات :

1. تطبيق التكنولوجيا السليمة في جميع المراحل الأولية لذبح وسلخ وتجويف حيوانات الهدي والأضاحي وإعطاء السلخ الألي أولوية عن السلخ اليدوي مع التصدي لجميع مصادر التلوث وخفض الحمل البكتري البدئي.
2. زيادة كفاءة ضغط المياه المستعملة في الغسيل مع استعمال الماء الساخن (74مْ < لمدة 10 ثواني) لغسيل الذبائح أو الأخذ بنظام التعقيم بالبخار والبسترة.
3. وضع أواني مليئة بالمطهرات والماء الساخن في وحدات الذبح ولتطهير أيادي وسكاكين الجزارين.
4. إدخال الرقابة الصحية البيطرية المخبرية من خلال تطبيق مشروع هدفه الإرتقاء العلمي بصحة وسلامة لحوم الهدي والأضاحي.
5. تعقيم أكياس التعبئة ووضعها على عربات خاصة لكل نقطة تعبئة في المسالخ
6. استخدام التقنيات الحديثة في المراقبة الجرثومية لصحة اللحوم (نظام الهاسب، الأجسام المضادة، التقنية البكتريولوجية الحساسة الإشعاعية و نظام تقييم أسس

العناية الصحية الغذائية الهاس.

7. عمل دورات تدريبية خاصة بالرقابة الصحية على اللحوم لتدريب الجزارين وموظفين البنك مع عمل نشرات إرشادية وعرض أفلام فيديو للمحافظة على صحة وسلامة الهدي والأضاحي.

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The Effect of Washing and Packing of the Sacrificial Meat on the Level of Microbial Contamination

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Abstract :

The aim of this study is to show the result of clean water washing of sacrificial meat in reducing bacterial contamination of the meat which could take place during preliminary stage of slaughter, dressing and evisceration.

Bacterial swabs were taken from the surface of the carcasses before and after washing and additionally from the fabric bags used in packing these carcasses

Bacteriological swabs were made from the surface of carcasses before and after being washed with water and also from the cloth bags used for packing the carcasses. The total number of aerobic mesophilic bacteria/cm^2 was 4.2 X 10^4 in washed carcasses; 1.2 X 10^4 in cloth bags and 5.4 X 10^4 in surface of packed carcasses. The percentages of bacteria remaining on carcass surface after washing was 25-50٪. On the other hand, the total number of yeasts and moulds/cm^2 was 1.6 X 10^3 in washed carcasses ; in cloth bags and 2.6 X 10^6 in packed carcasses ; the percentage remaining after washing was 2٪ .

The species and numbers of pathogenic bacteria in washed carcasses, cloth bags and in packed carcass surfaces were as follows respectively: Streptococcus fecalis: 4.3 X 10^3; 0.5 X 10^2 and 4.3 X 10^3 remaining bacteria after washing was 32.3٪. E. coli: 1.0 X 10^2 , 0.2 X 10^2 and 1.2 X 10^3 . The remaining bacteria after washing was 50٪. Coliform bacteria: 5.0 X 10^3, 6.0 X 10^3; and 1.1 X 10^4. The remaining bacteria after washing constituted 100٪. Proteus vulgaris: 2.4 X 10^3, 1.2 X 10^3 and 3.6 X 10^3. The remaining bacteria after washing was 48٪.

Enterobacter agglomarens: 2.0 X 10^2, 1.1 X$10^4$and 1.1 X 10^4. Remaining bacteria after washing was 4٪. Penicilium spp.: 3.0 X 10^2; 0.0 and 3.0 X 10^2. 75٪ of the bacteria remained after washing.

In all cases the total number of isolated bacteria did not exceed 10^5/cm^2 and that of yeasts and moulds in packed carcasses was 2.6 X 10^6/cm^2. Washing of carcasses with water reduced bacterial contamination by 47.5٪. Therefore we recommend through washing of carcasses with hot water (74C for 10 sec.) under high pressure. Alternatively steam sterilization and pasteurization or HCCP Systems may be adopted to decrease initial bacterial load on carcass surfaces.

منهجية لدراسة حاضرة الدمام الإلكترونية

عمر قربة بنا و فهد بن نويصر الحريقي

قسم التخطيط الحضري و الإقليمي

كلية العمارة والتخطيط - جامعة الملك فيصل

الدمام –المملكة العربية السعودية

ملخص:

تهدف الدراسة إلى اقتراح منهجية مناسبة لتحليل المدينة الإلكترونية وذلك من خلال دراسة النشاطات الحضرية الإلكترونية لسكان في حاضرة الدمام. تتبعت الدراسة - من خلال مراجعة الأدبيات- تطور الاتصالات وتقنية المعلومات، وكذلك أساليب تحليل العلاقة بين التطور في هذه المجالات والتركيب العمراني الحضري. بناء على تقييم المناهج المختلفة لدراسة اختير أنموذج النشاط الحضري لتحليل حاضرة الدمام الإلكترونية باستخدام المعلومات المتاحة.

مفتاح الكلمات: حاضرة الدمام الإلكترونية، تقنية المعلومات، أنموذج النشاط الحضري، التنمية الحضرية.

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places and cyberspaces to carry out their activities related to goods and services production, transportation and distribution in the pursuit of profits and business growth, they created new cyber-pure firms to meet the demand for e-solutions, networked and transformed large malls, and developed hybrid business strategy that allows then to have presence in the urban places and cyberspace simultaneously. Institutions are also gradually using the cyberspace as well as the face-to-face interactions to carry out their human development and public services delivery activities to achieve their public interest goals, in the process of which new e-government strategy is emerging and public offices complexes are being transformed and fitted with IT-infrastructure.

In conclusion, this paper has achieved its basic aims of proposing and applying an approach for the analysis of Virtual DMAS. However, such claim cannot be made about the suggested substantive relationship. For example, despite the use of IT to initiate new processes with their supporting facilities in the form of e-community, e-commerce and e-government, we are neither certain about the durability and the pervasiveness of these processes, nor do we fully understand their implications on the pattern of physical interactions by the actors or on the DMA. These may be the subjects of future investigations.

SCECO (www.sceco-east.com) and Saline Water Conversion Corporation (www.swcc.gov.sa); and some important Non-government organizations (NGOs) such as Saudi Red Crescent Society (www.srcs.org.sa) and World Assembly of Muslim Youth (www.wamy.org).

There is room for improvement to make public presence online more effective. Currently the websites of most ministries merely present information about the functions and the structure of the agencies. Most on the NGOs, on the other hand, try to encourage interaction with the visitors to their websites. Many local institutions have so far missed the opportunity to inform and educate residents and potential tourists what DMA can offer with regards to improved living conditions, business opportunities in the area, the range of services provided by the municipalities and their vision for the future. To develop enlightened and participatory urban actors, the website could include news, events and highlights about the metropolis. For those who seek general and practical information, the website could provide directory for important public and private agencies, range of online services and application forms, as well as provide important official documents online. Also important is the need to make the website design attractive, easily navigable and with links to other relevant public and private agencies.

Generally it is clear that e-government in DMA is evolving gradually within the general guidance of the central government using ad hoc plans, projects and initiatives, so far without the benefit of an overall plan or strategy. While such a grand strategy is slowly emerging, much work is needed to increase public awareness regarding practical benefits of Internet technologies and their use in a wide variety of e-solutions. A program is needed for adult training in IT skills, somewhat similar to the Watani Schools Net Project, targeted to public servants and the general public so as to match the pace of automation of public institutions.

Summary and conclusions

The paper has proposed approach to analysis of Virtual DMA using the Activity Systems Model that views changes in both the virtual and actual spaces as a result of the application of the digital technologies by residents, firms and institutions to achieve the goals. It has been suggested that to achieve their socialization goals, residents of DMA undertake a variety of social transactions, social development and recreational activities using both face-to-face and cyberspace interactions which have introduced new functions to the home and triggered changes in the neighborhood where new facilities and new e-communities emerged, while gated communities were given IT-mediated capabilities. As firms use both the urban

the private and the public sectors display most recent IT advances of interest to them. Second, there are national e-commerce (and e-government) conferences and exhibitions organized by Saudi E-commerce Forum. These events cover a wide range of e-government and industry specific topics including e-solutions for many sectors such as health, education, transportation and manufacturing, as well as for e-banking e-procurement and venture capital.

IT induced transformations in the DMA

Two types of transformations may be linked the increased IT-based activities in the DMA. The first relate to physical changes resulting from the embedded networked infrastructure and its use, while the second is concerned with the emergence of complimentary cyber facilities and their effects of the physical elements of the metropolis.

Physical Changes

Government complexes are located in various parts of the metropolis and the form the hub for most public activities both in form of physical face-to-face interactions and in IT-mediated exchanges and transactions. Thus, these complexes are gradually connected by mean of IT infrastructure not only with each other but also with the headquarters in Riyadh. While these complexes previously relied on face-to-face interaction with public official, now however, thanks to the many IT devices they have become hybrid public activities centers based mainly physical face-to-face interactions with the local residents and firms. As more the IT-mediated interactions increase, the importance of the complexes as places for physical interactions is likely gradually decline.

Emerging Virtual DMA

The main purpose of the use of IT in the public sector is to advance the Public Interest. This takes the form of the improved delivery of services to the citizens by the public institutions, increase transparency and accountability in government, regulate the behavior of the private sector in the delivery of services its customers, increase citizen empowerment through information, and to improve the efficiency and cost-effectiveness of government purchasing system. Recent investigations reveal that many local public institutions have presence online. These institutions include those in human development sector such as Directorate of Education (www.edueast.gov.sa) and Dammam College of Technology (www.dct.gotevot.edu.sa); health institutions such the Teaching hospital (www.kfu.edu.sa/hospital.asp), and Public Health Department (www.alshha.net). They also include utilities agencies such as Saudi Telecom (www.sct.com.sa),

The other types of activities are those seeking to promote cyber activities, which include IT knowledge diffusion (dissemination of information and development of new IT skills), economic incentives (involve in the provision of favorable prices for network services and other incentives), regulation and legislation (liberalization and privatization of the telecommunication market and the various technical standards utilized in cyber business transactions).

E-Government Initiatives

The government of Saudi Arabia has embarked on e-government initiatives as means to promote its public interest goals. The initiatives that direct the activities of public institutions consist of a number of components. The first component is in the educational sector where the Ministry of Education has been increasing technology adoption in all schools, spending more than US$ 150 million every year on IT (Madar, 2003). Connected to this initiative is the Watani School Net Project through which some 1,300-computer laboratories are being set up and also to train the same number of computer teachers and install over 100,000 PCs in public secondary schools. Backed by Crown Prince Abdullah, the project is to cost about US$ 27 million but it is expected to attract private investment of about US$ 2 billion. A similar project is the GOVTEVOT Network Project in which a Wide Area Network (WAN) is to connect most of the 17 General Organization for Technical Education and Vocational Training (GOVTEVOT). The project involves the setup, implementation, administration and support of the Internet. Together these two projects are likely to ensure broader application of IT at work, home and at the educational institutions for the overall good of the society.

The second component is the so-far uncoordinated attempt to ensure government presence on online of about 60 percent of the 22 cabinet ministries. The Saudi Arabian Information Resource- a public sponsored agency- has been maintaining a mini portal for government, containing some 2000 web pages (Madar 2003). Many of the websites contain useful and often updated information in both Arabic and English, but most of them are not interactive and do not allow for the inputs of the residents and firms in public policies and hardly have they been used to advance e-commerce through e-procurement and similar incentives.

The third component is the role of major IT public events in the encouragement of progress towards e-government. First, there are the local annual IT exhibitions held at the Dhahran Exhibition Center and the exhibition at the campus of King Fahad University of Petroleum and Minerals where both

provision of IT manpower and implementing corporate Internet and Intranet infrastructure.. There are other, such New Horizons and Executrain firms that specialize in the training of software application and networking.

To sum up, we have explained how DMA firms, motivated by the need for profits, are increasingly using IT to organize their activities both in the urban places and in the cyberspace thereby changing existing facilities, creating new ones and initiating new process and products all of are gradually transforming DMA

DMA Institutions: Their Goals, Activities and Development Impact

Similar to the DMA residents and firms, the public institutions are motivated by the desire to promote the public interest as shaped by Islam values, and which in turn influence their choices and activities both in the urban places and in the cyberspace.

Goals of Institutions in DMA

The urban development activities of the public institutions of the central, provincial and local governments are usually guided by public interest in both their tangible and intangible forms. Some of these goals are sometimes explicitly stated and vigorously pursued, however at other times they are implicit but still powerful motive for urban activities. The tangible forms of the public interest may include the provision of public goods and services that seek to promote general welfare, human development, and environmental quality and to advance economic efficiency and social equity. The intangible types may include regulatory measures that are designed to ensure public security, safety and public order.

Institutional Activity Types and Means

To promote public interest in urban development process, many public institutions of the central government, local authorities in DMA and the local non-Government (NGOs) agencies have in various ways undertaken activities that have directly or indirectly advanced the growth of the metropolis both physically and in terms of cyber activities. There are generally two types of activities. There are those that seek to establish and strengthen conducive urban environmental that enable all urban actors to carry out their activities in the pursuit of their goals. Thus the institutions interact with the residents both physically and where possible by means IT devices to inform, educate, engage, and to solicit ideas. They also interact with private sector to encourage economic investment, as well as to regulate and guide their activities. The institutions also coordinate activities among the various public service delivery agencies and those related to public-private partnerships.

internal initiatives, Aramco is ensuring the increased use of the new technology in the local community. The company has a good track record in this regard. For example, it has sponsored 55,000 families for free Internet access at the same time it supported the emergence of e-commerce by its insistence that all its suppliers have to interact with it through the Internet (Madar, 2002). All these activities will eventually translate in better e-commerce prospects but also into concrete cultural, social and economic development in the DMA.

IT Induced Changes

The increased use of IT by almost all firms has led to a number of significant changes ranging from those related to the physical elements of the DMA, to the goal achieving strategies adopted by the established firms and to the creation of entirely new firms for provide new e-business solutions. Let us examine a new of these cases.

The first is the emergence of synergic and wired commercial complexes. Rashed Mall, Fouad Center, Gulf Center and Giant Store are examples of new types of development that encourage complex hybrid urban activities. Each of these centers has a large footprint and has a wide range of activities such as retailing, business, restaurants, sports facilities, entertainment facilities, simulated historical scenes, zoos, electronic games and Internet Cafes. Within the same roof they encompass activities similar to the Dammam and Al-Khobar Central Business Districts. More importantly these centers are centers of cyber activities that takes places not only in the Internet Cafes but also in most of the computer hardware and software retail stores located in them.

The second type is the emergence of "click and mortar" or hybrid strategies among some of the leading firms in the DMA. Established firms like Aramco, Al-Rashed, Al-Gbosaibi and Zamil, to mention just a few, tend to exploit their physical assets and capitalize on customer loyalty to use IT to make their traditional business more efficient and to automate routine activities so as to shift their capable staff to the more profitable aspects of e-commerce. These e-commerce strategies may take many forms ranging from approaches with limited interaction between the physical and virtual entities, to those where the two modes become inseparable.

The third indicator is the establishment on "cyber-pure" firms. They are new firms whose activities are purely to meet the needs of the market created by the activities in the cyberspace. GulfNet.com, Sahara.com and GuftZone.com are few examples of DMA-based firms that provide Internet solutions, which include Web design and hosting, domain name registration, set up of networking system,

have been boosting internal efficiency and driving down costs through the use of information technology. (Ingham, 2002)

The second indication of the prospects of e-commerce is the increased realization of its significance to the private sector development in the era of globalization. The financial sector may be the most advanced in the use of IT to support its activity and this is reflected by the recent rapid growth of the ATM banking services, speed cash and foreign exchange transactions outlets. In view of the impact on both the physical and cyber developments of the DMA it would be appropriate to use it to illustrate the potential influence of this sector.

All the major Saudi banks offer a varying degree of Telebanking products and services, which have great benefits for both customers and the banks themselves. To the customers it offers cost savings, time saving, safety of cash and convenience, while to the banks the advantages appear in the form of savings in manpower, time and office space and increased consumer confidence. Let's take NCB (Al-Ahli) to illustrate the range of services.

The Al-Ahli online and phone banking services provide an easy and secure direct access to accounts at anytime and from anywhere in the world via the Internet or WAP-enabled mobile phone. Al-Ahli Online (www.alahli.com) is available in Arabic or English for added convenience to customers. Some of the products and services offered the online and phone banking include the following services: online transactions with multi-currency, account enquiries, credit card enquiries and payment, investment fund enquiries and transactions, and utility bill payment. Other services offered include the option to view up-to-date foreign exchange rates and Deposit rates, view up-do-date Investment Prices, request for statement of account by mail, request for cheque book, send email enquiries or instructions to the bank, receive updates and inquiry responses through your email, register new accounts or new beneficiaries, register new Saudi Electricity Company or Saudi Telecommunications Company invoices.

The third indication is the positive role by semi-public Saudi Aramco in the development of e-commerce. As the largest employer in the DMA, it has taken positive steps to promote e-commerce environment both with the firm and among its business partners. To enable this business environment, Saudi Aramco's IT strategy seeks to create synergy between technology and human talent to excel and innovate in all company endeavors (www.aramco.com). Value-added IT solutions that are robust, reliable and scalable are embedded in the system so as to allow the creativity of users to provide innovative business solutions from their work locations anywhere, anytime, to increase their contributions to the company. In addition to its

display and storage spaces resulting multimedia displays and the use of just-in-time delivery systems. Furthermore, the decline in the number of employees translates into a reduction of parking spaces. The non-physical changes include the more efficient ways firms are managed, the improved productivity of the manufacturing sector, and the increased efficiency of the IT-mediated activities in commerce, finance and distribution of goods and services

Changes in Commercial Development

In an attempt to maximize the growth of their business and profits commercial firms tend to cluster together, as a result the following patterns are emerging. In the first place there is the growth of the Central Business Districts of Dammam and Al-Khobar as areas of mixed residential, business and retail activities but also as centers of electronic-mediated transactions. Second, is the emergence of Malls (such as Waha Mall, Al-Khobar Mall, Rahamaniyah Mall) and larger super markets (such as Tamimi, Fahad, Panda and Farm 9); and Exhibition places (such as Dhahran Exhibition and Seef Expo Center in Al-Khobar) as important centers that depend on IT. Third, is the growth of intensive IT use in the linear commercial streets within cities (such as Sweket and Khaled Streets in Al-Khobar) and the largely wholesale and warehousing activities along the highways connecting the cities (such as Khobar-Dammam Highway and Dammam-Dhahran Highway).

Increased Prospects for E-Commercial

The increasing widespread and intense use of IT tends to blur the boundaries between the various sectors of the new economy, yet the commercial sector appear to stand out due to its great appetite for IT. Since this sector tends to exert the most influence on urban development it seem appropriate to explore the prospects for e-commerce in the DMA for which there are many indicators.

The first indicators for high potentials for e-commerce include the planned public spending of about $5 billion by 2008 to establish e-government, a plan that will likely boot e-commerce (Madar 2003). In addition to this are the official enthusiasm and optimism that led to the support by the Ministry of Interior for Microsoft to build the "Saudi gateway" which will be a public web portal. To some extent this optimism is reflected by the views of the managing director of National Information Systems who forecasted that IT could become Saudi Arabia's largest industrial sector after oil and gas by 2020 (Ingham, 2002). This official optimism is reflected by the private's two giants SABIC and Aramco whose representatives informed the audience at an e-Commerce seminar in Riyadh in May 2002 that they

DMA Firms: their Goals, Activities and Development Impacts

Firms' Profit-making Goals

As indicated in the model, private firms are usually motivated by profit making and need for business growth in the pursuit of their business activities. These business goals are sometimes explicitly stated or they remain implicit but they are always vigorously pursued, usually within the bounds of Islam. In many complex ways this goals direct and shape choices and decisions by firms both in terms of their daily and long-range activities. Decisions on the location of a retail store, a factory, a warehouse or which type of IT device or software to use in order to increase productivity are always shaped by the need to maximize profit and business growth. The implementation of these decisions tends to affect not only the physical development of the DMA but also its embedded IT infrastructure.

Urban Activities and IT Use

In the pursuit of their mainly economic goals, DMA firms undertake three broad categories of activities, namely goods production, distribution and provision of services to other urban actors. The goods production activities include extraction or mining of raw materials including crude oil, agricultural production and processing, construction of buildings and urban infrastructure networks and facilities. Distribution activities include transportation, retail trade, wholesale, and warehousing, while services activity types relate to businesses such as banking, insurance, real-estate- and other services in agriculture, education, health, engineering, law, recreation, as well providing computer solutions such as factory control, software design, web design, and just-in-time inventory.

The means for undertaking these activities, and which directly affect the nature of urban development, are physical contact and electronic-mediated. The physical means are mainly the traditional place-based face-to-face interactions, while the electronic means include capacity data transmission systems, the Internet, Intranet, e-mail, fax, video, fixed line telephone and mobile devices frequently used in the distribution service. While residents tend to prefer ubiquitous mobile phones, firms tend to prefer the high-speed digital transmission system more.

Changing Pattern of Firms' Activities

The spatial and cyber activities by the DMA firms have influenced the pattern of commercial development, increased the opportunity for the emergence of e-commerce and has triggered some notable IT-induced changes. The place-based changes include the new opportunities to decentralize activities for institutions and firms, greater prospects to offer services to customers from afar, a reduction of

alternative is gradually emerging. Many young people, especially among college students and those who live in the digitally connected areas or who can afford to pay Internet Café fees, may be active members of overlapping e-groups many of whom behave like normal communities but whose members may be living in cities across the globe. On April 1, 2004 Yahoo e-groups (www.groups.yahho.com) listed 69, 33 and 43 e-groups in Dammam, Al-Khobar and Dhahran respectively. In conformity with the local culture, many of the Internet Cafes are designated for ladies only.

An important development is the emergence of a number of new IT facilities that encourage increased tempo of cyber activities in the neighborhoods of DMA. The first of these are new facilities for the sale and servicing of computers, including Internet services. According to Bu-Ali (2001) some 56 such facilities were surveyed in Dammam (along the CBD section of King Fahad Street) and 21 in Al-Khobar (clustered along King Fahad Road and some of the malls). The second new facility types are the Internet Café that are dispersed mainly the more densely populated areas of Dammam and Al-Khobar, with 24 and 31 facilities respectively in 2003. The third types are the Call Cabins, the number that is increasing despite the growth in the number and use of competing facilities such as Internet café and mobile shops that sell not only mobile sets but also many types of digital cards. The fourth new facility is the fixed and mobile phone outlet, the number and use of which are steadily increasing

Transformation of Some Large Urban Complexes in the DMA

Many large urban complexes in DMA that had for a long time functioned as residential entities, were transformed into centers for cyber activities as soon as the IT infrastructure is embedded in them. Many gated communities in the DMA such as the Aramco compound, the campus of the King Fahad University of Petroleum and Minerals and the many private compounds such Oasis, Jadawel and al-Rashed tended to acquire additional functions as soon as they became connected to World Wide Web of the Internet.

In many respects these communities are different from the nearby residential areas in Thuqbar, Subaikha and Dawasser not only in their electronic connection and higher use of the diverse IT devices, but also in other community characteristics such as level of density, income level, education level and quality of physical design. In this way, the IT is helping to accentuate the polarization of the DMA spatial structure.

Internet, use e-mail, surf the cyberspace, organize video conferencing and participate in many online social, educational, commercial and recreational activities. Through the networked system many home appliances like fridge, TV, video recorder are increasingly being manipulated from a distance.

These new advances in IT seem to offer new opportunities for the two largest groups among the DMA population: the women and the youth. Activity-centered home offers women more opportunities for more participation in the labor force in ways that are in conformity with local tradition and culture. On the other hand the need for child-rearing and the increased ability to set up home-based businesses are other forces that may be exerting changes in the function of the home. Considering the claim that over $100 billion belonging to Saudi women remain inactive in the banks, and the increasing use of the Internet by Saudi women as reported by Al-Sharq Al-Awsat of October 7, 2001, the potentials for ladies home-based business are tremendous. This is especially so if advantage is taken of the many possible roles of the home as a center for shopping/financial transactions, information gathering, learning and for communication not only for strengthening social ties but also engaging in the world of business, art and culture both close to home and afar. It is through these interactions that households can have everlasting affects both on the social and physical characteristics of their homes, neighborhoods and cities, such as DMA. Similarly, for the DMA youth, the activity-centered home offers the opportunity for educational advancement, learning new skills, use of diverse entertainment devices, interacting with diverse types of e-groups.

The Emergence of E-communities with the Neighborhoods

The DMA consists of distinct neighborhood like Dawasser, Dana, Rakah, Subeiha and others. They all have some distinguishing characteristics, which may include the presence of local public facilities, well designed, interesting and engaging streets, lively service shops that serve both economic and social functions, and public places as realm for social interaction. Each neighborhood derives special recognition, general agreement on a name for that part of the city, an effective organization of residents, a network of social acquaintances, a cluster of like-minded people, a service area of a facility such as mosque or a school, or a clearly bounded geographical area. Such an area also is distinct, imageable, manageable and containing a group of residents who generally share many common interests.

The intrusion of IT in everyday life of the community tends to trigger a process of change in which virtual community is added to a physical unit. In most of the DMA neighborhood physical activities and face-to-face interactions still remain the dominant form of effecting changes in urban places, however, e-community

performed using any of the IT tools. For example some self-sustaining activities such as cooking, eating, sleeping, and feeding babies cannot be carried out in the cyberspace, although searching and obtaining information on how to improve them can. Second, there are circumstances that limit the ability of a large proportion of the DMA residents in the use of the IT option, and these include affordability, lack of skills, lack or inadequate IT infrastructure at convenient places (such as homes, neighborhoods or workplaces). Many efforts are, however, underway to reduce the effects of some of these constraints. First, there is the global effort to increase- through the market mechanisms- the productivity and efficiency of the firms producing IT devices the prices of some of which are said to fall by about half every eighteen months (US Commerce Dept, 2000). Second there are the efforts the Saudi Government to develop skills among school children through Watani Project for example, and the efforts to improve manpower skills by private IT training firms such New Horizons, al-Alamia, and Executrain.

Pattern of Virtual Activities by the Residents

The increased use of IT by the residents of the DMA has contributed to noticeable developments in the homes, the neighborhoods and in some large urban complexes in the DMA. We shall review these changes highlighting specific examples where possible.

Changes in the Home- From Living Space to Activity Center

The frequent use of IT tools in the homes seems to be transforming it from a living space to an activity center. The living space concept, according to Venkatesh and Mazumdar (1999) conceives the home as consisting of three components. The first is the social space which composes of four main elements: the members of the household, the socio-economic activities performed by them in the home; the time spent on those activities; and the interactions between the members of the family. The second is physical space, which comprises of the physical layout of the home and its constituent parts (kitchen, bedrooms, bathrooms etc). The third is the technological space, consisting of the household technologies (such as cables, PCs, fax machine, TV, videos, wired and wireless phones) that are embedded in the physical space and used by the members of the family as part of the social space. These spaces tend to change to reflect the pattern of activity but the physical space, unlike the social space, changes less often and it more concerned with the location and sequence of activity spaces.

The home as a living space gets transformed into an activity center as a result of changes in the household technologies from stand-alone to full pledged networked devices. Thus the networked PCs make it possible for the household to access the

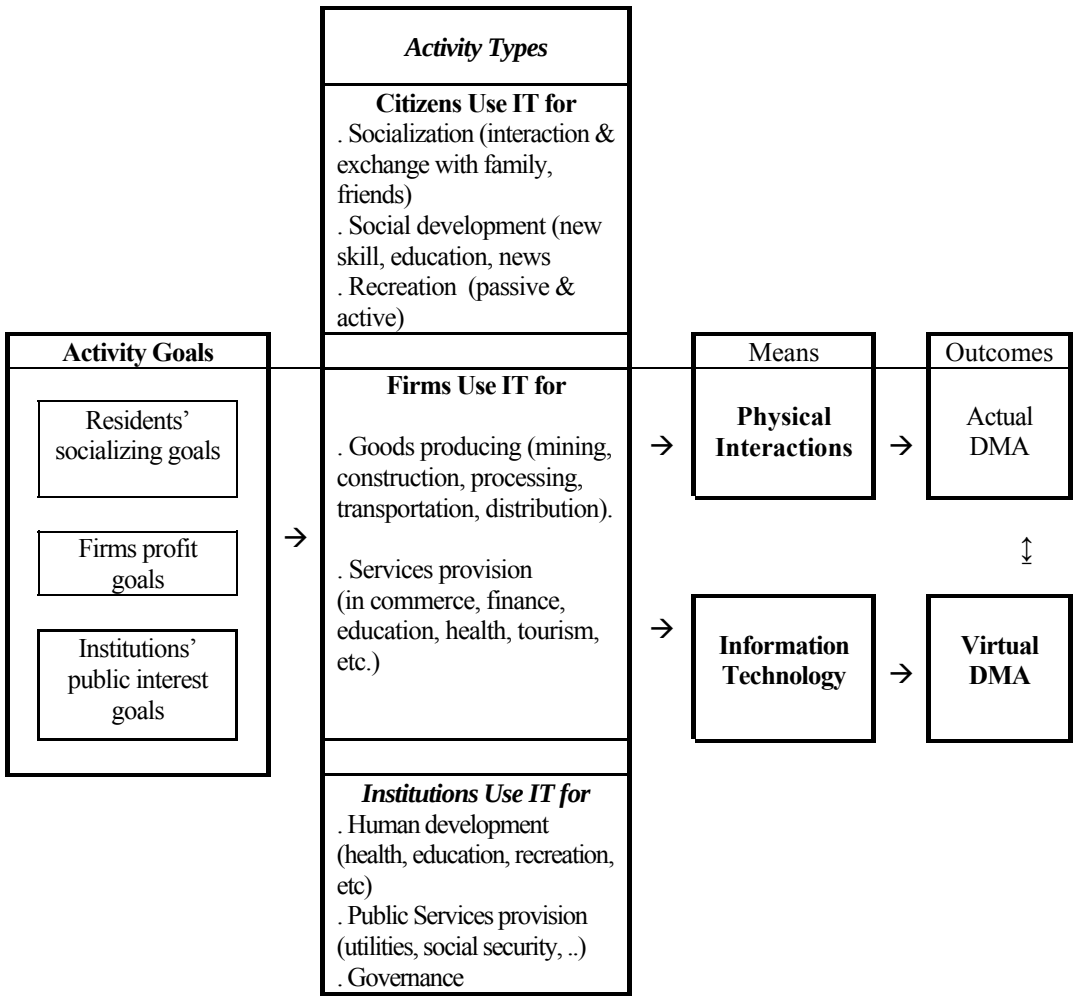

Figure 3: Conceptual Framework for Analyzing Virtual Dammam Metropolitan Area

The means for undertaking these activities have traditionally been based on place-based interactions, now the many and diverse IT tools are offering an alternative means of interactions. The Internet, e-mail, files transfer protocol, video, fax, mobile phone devices are among the most commonly used TI tools in the DMA to participate in cyberspace activities. There are many indications that many residents use both the urban places and cyberspaces.

There constraints that limit residents' ability to use the cyberspace in the same way they use urban places for their daily activities. First, some activities cannot be

Residents' Activities and Means

The residents' goals identified above tend to influence the types of activities pursued by them. The self-sustaining activities, for example, include those related to eating, drinking and sleeping. Socializing activities are those related to the social exchanges and interactions among family members, friends and neighbors. Social development activities are related to education and training such as schooling, continuing education, learning new skills, follow-up of new advances in education and may include managing personal business, office work, government interactions follow-up, business follow-up and charity-work. Recreational activities may be active (sports, games, shopping) or passive (playing chess, cards, and electronic games) in nature.

development and recreation, which in turn trigger secondary of subsidiary activities. Firms undertake three broad categories of activities, namely goods production, distribution and provision of services to other urban actors, while institutions generally carry out public investments, coordinative and regulatory activities that are essential for the functioning of urban socio-economic life.

Activity Outcomes: are the cumulative effects on urban places and cyberspaces of the activities by the three main urban actors. Thus intense urban commercial activities in close proximity created the Central Business District, while down town development is created by high-density residential and cultural activities. If, on the other hand the activities are undertaken by means of emerging IT tools, this increases the importance of the cyberspace and that in turn trigger changes on urban spatial development. The exact nature of the impacts these changes on urban spatial structure are still unclear, but some researchers suggest complex simultaneous dual activities whereby activities in the cyberspace tend to either substitutive, enhancement, complimentary or integrative with those activities in the urban places.

DMA Residents: their Goals, Activities and Development Impacts

Residential activities play an important role in shaping the growth and image of the city. These goals-directed activities have been based on face-to-face interactions in urban places to achieve the desired social and economic objectives of the individuals and the households. However, the activities are increasingly being carried out using the various IT tools, especially since the recent introduction of the Internet and mobile phones, which seems to have led to the emergence of networked homes in certain areas of the DMA.

Goals of DMA Residents

The normal daily activities of the DMA residents may be motivated by self-sustaining, socializing, personal development and recreation goals (Benna 2001). These goals that are shaped by Islamic value system appear in many forms, for example, the self-sustaining goals are those essential to the sustenance of life and balanced urban existence such as eating, drinking, relaxing and sleeping. Socializing goals appear in the urge to build and maintain social support system among family members, friends and neighbors. Personal development goals are reflected by the need to improve intellectual and emotional capability so as to be full and responsible member of the community. The recreational goals reflect the need for entertainment and relaxation in a suitable environment.

the wider society, especially the problems of the poor who might be excluded or marginalized from the benefits of IT-induced development. Thus a blend of these models may prove to be a better option.

On the basis of the value-laden "continuity-with-change" approach, the Activity Systems model that seems to strike the right accord not only with the Saudi society but also with those societies that want to apply the advanced technologies and yet hold dear their traditional/religious values. Central to this model, and the source of its greatest appeal, is its explicit assumption that the values of the society are the major forces for all major public decisions and actions on the development at the various levels. It also places great emphasis on the role of the forces of human agency, whether in the form of individuals, social groups, in the various types of firms, or in institutional settings. The model, however, needs to be modified to recognize the reality of urban activities being carried out by the means of physical interaction and/or by means of IT tools. The next section suggests this modification and proposes how the new version of the model may be applied to the analysis of DMA.

The Activity Systems Model Applied to DMA :

The revised Activity Systems Model sees the major urban actors –namely residents, firms and institutions- as the dominant shapers of urban development through their daily activities. These activities tend to influence the urban physical development if they are accomplished by means of face-to-face interactions. On the other hand, if the activities are carried out by means of the IT, they tend to affect the pattern of activities in the cyberspace. As shown in Figure 1, the model suggests a dynamic relationship between its four main components: goals of the main urban actors, their activities, the means of carrying out the activities and the resultant patterns of development, which will now be defined.

Goals: are value-derived motivators for the activities of key urban residents, firms and institutions. Sometimes expressed as objectives or aims in qualitative and quantitative targets, the social, economic and management goals tend to guide the decision and actions of urban actors.

Activity Types and Means: urban activities are the complex goal-directed actions undertaken by residents, firms and institutions and they may be carried out by means of personal presence in the traditional urban places or in the new electronically created virtual spaces by means of such tools as the Internet, Intranet, e-mail, fax, video, fixed and mobile phones. The primary activities of the residents may be categorized as self-sustaining, socializing, personal

development or the pattern of spatial or non-spatial development is the focus of research effort.

The model, however, fails to admit that even in the most technologically advanced societies with a much higher application of IT as means of urban activities, most of these activities are still accomplished by mean of face-to-face or physical contact. Thus, by far the highest proportion of activities takes place both in the urban places and in the cyberspaces.

Evaluation of the Models for Use in the Analysis of DMA

The suitability of any of these models for the study of the relationship between urban places and electronic spaces in the kingdom depends on its degree of flexibility to incorporate Saudi value system and its ability to accept changing levels of IT penetration into the society in which the access to the Internet, as the leading IT tool, became available only in 1999.

It seems clear that each of these models has a different way of viewing the city and has different implications to the wider issue regarding ways in which social systems and IT relate to urban activities. The merits and the different qualities of these models suggest to carefully assess their suitability for the purpose of the analysis of Virtual DMA.

The technological determinism and utopianism/futurism models are clearly unacceptable candidates in this case for a number of reasons. First, although they may be useful in highlighting the broad, macro-level historical urban changes, they over simplify the complex interaction between cities and IT. Second, they seem to ignore the vital social and political processes through which technologies are actually adopted and adapted within cities and societies in the developing world. Third, utopianism/ futurism model is biased towards the interests of the multinational firms or local decision-makers who would benefit materially from related contracts. Finally, the models seem to leave little scope for policy making at the local and national levels that would affect the IT-mediated development of the city. Thus, the worldview of these models is counter to the cautious and Islamic-derived approach to development pursued by Saudi Arabia.

Given this Saudi approach to development, it seems clear that the urban political economy and social constructivism approaches hold greater promise, although each has its own problems. For example, the urban economy model seems to exaggerate the effects capitalist structures have on the IT but downplays the effects of social processes on these technologies. The social constructivism model, on the other hand, seems to focus more on the role of the elites and neglect the potential imbalance in

As a result, according to the critics of these approaches suggest that IT are used to support capitalist restructuring of cities, nations and the world. Some suggest that this has led to exploitation, control and surveillance of groups of workers and consumers in distant locations, as well as to the easy management of all information (Slack, 1987). Others argue that IT induced changes may not lead to an ironing out of geographic differences, but are modified to support more efficiently new styles of production and consumptions and to meet the needs of influential agencies (Martin 1991).

Social and Political Construction of Technology

This group of ideas emerged as a result of the rejection of technological determinism by some researchers. The social constructivists that advocate for these ideas see technology, not as an external force, but as inextricably part of society. These researchers stress the degree to which space becomes a tool for political and social processes that can shape the ways in which IT are produced and used within cities and within wider society. Thus the purpose of research, according this tradition, is to understand how technology and its uses are socially and politically "constructed", over time, through complex processes of interactions by agencies and individuals (Guthrie, 1991).

The implication of this approach is that it is difficult to identify a single technological "cause" and equally hard to define a single, all-embracing impact of IT on cities or systems of cities. Rather, the implication is that the ways in which IT relate to changes in and between cities is likely to vary in time and space in many complex ways. Some suggest that IT uses are now so closely interwoven with humans and social life that a new "cyborg" culture emerges where human beings are intimately linked into webs of digital technologies at every level (Gregory, 1994 and Mitchell, 1995).

Activity Systems Model

Building on the work of Chapin and Keiser (1979), Benna (2001) proposed a schema for the analysis of Virtual Dammam Metropolitan Area. The simplest form of the model assumes that motivated by societal values, goals or specific objectives, the various activity agents or *actors* (individuals, households, firms and institutions), tend to take decisions or *actions* by means of physical or IT interactions that follow a defined behavior sequence that culminates in spatial and non-spatial development (i.e., Goals → Actions → Development). From this simple form, the model was modified for use whenever the identification of the socio-cultural variables of

sense, and in a direct and linear way, machines and technologies are viewed to arise and evolve in a different realm to alter the world (Thrift, 1993). The effects of this model are many and far reaching, as suggested by Graham and Marvin (1996: 83): "The decentralization, or even dissolution, of cities, the free availability of highly capable communications in all locations; the shift towards city economies based on information; the growth of a culture based on tele-interactions; the shift to an 'immaterial' urban life; the growth of telecommuting – all will be shaped by new innovations in IT in a deterministic and inevitable fashion."

Utopianism-Futurism

Many researches are forecasting on the effects of the recent advances in, and the use of, computing, media and telecom technologies upon the future of cities. These people generally have an optimistic view of the future impacts of telecom on cities and urban life. The electronic networks and spaces are speculated to have quite positive effects on city's physical development and on urban life, so that where externalities arise, they too may be solved through new technologies (Eubanks, 1994).

The concepts of futurism and utopianism have been used by many scholars in the search for radically better and new forms of social life. Their efforts have also tended to highlight the negative aspects of industrial cities. Since Ebenezer Howard and F. L. Wright, these activists abhor pollution, overcrowding, moral laxity and social disintegration in these cities and to them technology had always offered the key to unlocking these problems. Continuing this trend, the utopian thinking perceive the power of IT as offering a solution to these perceived issues in various ways such as toward smaller communities (Gold, 1990), electronic cottage – a household that becomes the locus of employment, production, leisure and consumption (Toffler, 1981), intelligent city – in which electronic homes are linked in a citywide system of intelligent networks as new ways of managing and organizing urban life (Toth, 1990).

Dystopian/Urban Political Economy

Another approach is the dystopian/urban political economy model, which stress is placed on the ways in which the development and application of IT technologies are fully embedded into the political, economic and social relations of capitalism. This suggests that city-IT relations – both within and between cities- can best be understood within the broader context of political, economic, social and cultural relations. Thus IT are biased, not neutral in their social and spatial effects, as they can be designed to serve certain special interests (McNiel, 1991).

advantage through its investment in IT infrastructure so as to attract small and medium enterprises as the key engine of growth. Fourth, it uses investments in IT infrastructure to shift jobs and populations to the desired locations. Fifth, the government uses IT for interaction with residents, conduct business, promote commerce, reduce traffic and increase efficiency (McCurtis, 2003 and Graham and Mervin 2002).

The basic aim of this paper, therefore, is to explore relevant approaches for the analysis and the implications of the application of IT in cities and propose one that can be used in the context of Saudi Arabia. Using DMA as a case study, the paper suggests an approach appropriate for the analysis of the activities of the residents, firms and institutions as key agents in urban places and in cyberspace, and the impact of these activities on the physical cities. The DMA is neither the largest nor politically the most important city in the kingdom, but it is probably the fastest growing being the center of oil production, the seat of the largest oil firm in the world and housing many technologically oriented higher institutions of learning.

The methodology used here includes the review of international and local literature to identify the relevant theoretical concepts and issues as well as the various strategies employed to resolve them. Field observations of major physical development and reviews and analysis of the contents of relevant websites were the methods used to define the emerging development trends in the DMA.

Literature Review of the Relationship Between IT and the City

Many researchers have proposed a wide variety of competing models for analysis of the relationship between the use of IT and urban development. Most of the differences may be due to ideological and theoretical emphasis and the reflection of the social and physical science background of the researchers themselves. We shall briefly discuss a selection of the dominant models so as to illustrate the range of alternative approaches, suggesting that this new field of research is quite open without a generally accepted consensus. The review includes variants from the techno-determinism, the utopianism-futurism, dystopian/political economy, and socio-political construction of technology models and will help us in determining the suitability of each of them for use in the analysis of the relationship between DMA and the application of IT technologies in the metropolis.

Technological Determinism:

There are many variations to these models, but the central idea is that the new telecom technologies are seen as directly causing urban change. In its broadest

An Approach to the Analysis of Virtual Metropolitan Dammam

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Abstract:

The paper seeks to set out a suitable approach to the analysis of the emerging "virtual cities" by examining activities in virtual space by three groups of urban activity agents in the Dammam Metropolitan Area (DMA). Using current literature, the paper reviews the development of IT in cities and models for the analysis of the relationship of IT to urban spatial structure. Based on the review of models, the Activity Systems Model is chosen to explore how virtual DMA could be analyzed using available information.

Keywords:

Virtual Dammam Metropolitan Area, Information Technology, Activity System, and Urban Development.

Introduction:

The convergence of computing, telecommunication and multimedia technologies has led to the emergence of Information Technologies (IT) as a cluster of these technologies (Graham and Marvin 1996:15). In this paper, IT is similar to the concept of Information and Communications Technologies (ICT) that includes not only the infrastructure but also the management processes of these converging technologies. Specially important is that the application of IT has also led to the evolution of the concept of virtual or cyber space, whereby city residents, firms and institutions are able to interact and carry out activities using the IT medium, without actually interacting with the physical city. The implication of this development to the planning and management of cities has made it an important research issue, focused on understanding the phenomena, and its implication for city planning and management.

To its advocate activities in the cyber or virtual city have some advantages over actual city. First, its e-commerce generates wealth but avoids traffic congestions and pollution. Second, the city encourages social equity by allowing access to goods, jobs, services and wealth as the right of all citizens. Third, it exploits competitive

التصميم بواسطة الحاسب الآلي لقاعات الاستماع

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قسم الهندسة المعمارية – كلية الهندسة – جامعة المنصورة – جمهورية مصر العربية

❖ قسم العمارة - كلية الفنون الجميلة – جامعة الإسكندرية – جمهورية مصر العربية

الملخص:

إن تصميم قاعات الاستماع وصالات المحاضرات العامة تعتبر من أكثر عمليات التصميم المعماري تعقيدا. فنجد فريق عمل مكون من تخصصات مختلفة كثيرة تشارك في عملية التصميم. مصممين متخصصين في الصوتيات والإضاءة وتكييف الهواء فضلا عن المصمم المعماري الذي يجب أن يكون ضمن هذا الفريق.

وخصصت هذه الورقة لمساعدة فريق المصممين لتفهم فكر تصميم قاعات الاستماع بصفة عامة مع مناقشة العوامل المؤثرة على عملية التصميم. وقد تم بحث معايير عناصر التصميم التي تؤثر على معدل الأداء الأمثل لهذه القاعات ودراسة تأثيرها بالإضافة إلي عمل تقييم لهذه العناصر على أداء القاعات.

التأثير المباشر لمظهر وسمة كل من عناصر التصميم على كل من معدلات الأداء تم تقييمه مستعملين برامج الحاسب الآلي المتخصصة والتي تختص بمثل هذه العمليات. ونظرا لتعقيد وكثر تفاصيل الدراسة وطول الفترة الزمنية التي استغرقها الباحثان في عمليات التقييم الذي تم تناولها وتنفيذها أثناء البحث فقد تم تقديم ملخصه واستنتاجاته في صور رسومات بيانية أو أشكال.

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- The plan form does not have a direct impact on the vertical viewing angle. It has effect on other physical parameters like number of rows, distance of first row from focal point, etc. These parameters could affect the vertical viewing angles.
- The rows' geometry (curved or straight) has strong impact on the horizontal viewing angles and has a very small impact on the vertical viewing angles.
- The seating format (staggered or non-staggered) has strong impact on the vertical viewing angles and it has no effect on the horizontal viewing angles.
- Audience to stage relationship affects stage visibility. Central stage has the worst average and standard deviation while the end stage gives the best average and standard deviation.
- With the exception of the central stage, audience to stage relationship does not affect the horizontal viewing angles.
- Straight rows give better horizontal viewing angles than the curved rows.
- The non-staggered seating arrangement gives smaller vertical viewing angles this has a flattening effect on the floor dish.
- Curved rows give a better stage visibility than the straight.
- Basic plan format has a great impact on the stage visibility and the viewing distance.

angles between the straight and the curved rows. Also it is obvious that the seating format (normal – staggered) does not have effect on the horizontal viewing angles.

- Viewing distance: The straight rows tends to have a longer viewing distance especially at the rear rows. The seating geometry (curved or straight) has a strong impact on the viewing distance. While the seating format (staggered or non-staggered) does not affect the viewing distance.

Conclusion

Table 6 summaries the concluded relationship between design factors and the different visual aspects.

Table (6)
Concluded relation between design factors and evaluation aspects

	Stage Visibility	Horizontal Viewing Angles	Vertical Viewing Angles	Distance from Stage
Auditorium basic plan fromat	●	●	●	●
Rows format. (Staggered – non-staggered)	●		●	
Rows geometry (Straight – curved)	●	●	●	
Audience to stage relationship	●	●	●	●

● Strong impact
● Small effect
No effect

The following comments are concluded out of table 6:

- Stage visibility is a very sensitive aspect. Each one of the design factors has strong impact on it.
- The vertical viewing angles are affected by the rows format, the rows geometry and audience to stage relationship.
- The horizontal viewing angles are affected by the stage format and the rows geometry.
- The viewing distance is affected by the basic plan format and the relationship between the seating are and the stage.

Table (5)
Average values of visual evaluation data and their corresponding standard deviation for different seating formats

	Stage visible percent		Vertical viewing angle		Horizontal viewing angle		Distance from focal point	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
1-Straight_Normal	95.95%	2.62	9.99°	3.75	14.81°	11.24	8.83 m	3.45
2-Straight_Staggered	74.93%	12.35	5.56°	1.85	14.30°	10.78	8.71 m	3.36
3-Curved_Normal	84.84%	12.60	8.88°	3.51	6.82°	6.13	9.09 m	3.22
4-Curved_Staggered	80.37%	10.80	4.95°	1.74	6.65°	5.90	8.96 m	3.13

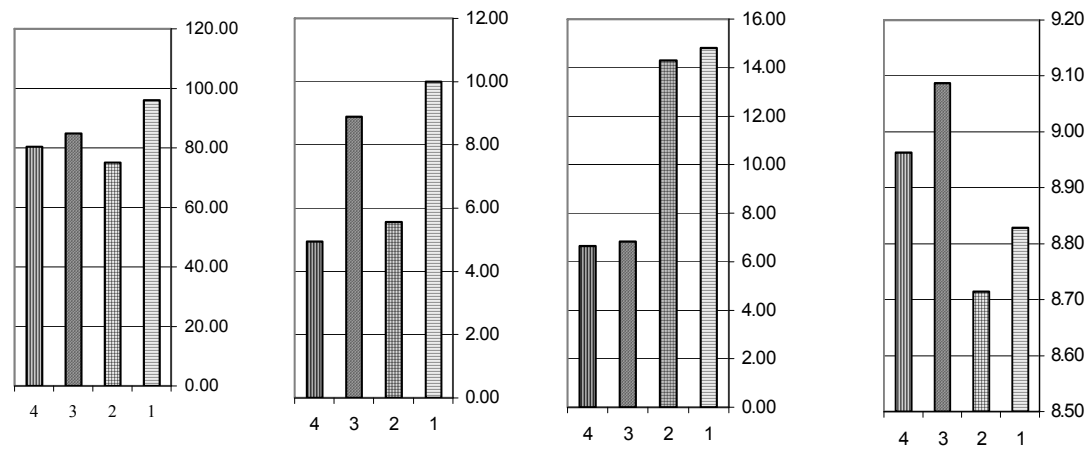


Figure 15. Visual qualities for different seating formats and row's geometries.

Both table 5 and figure 15 shows the following points:

- Stage visibility: There is no significant difference between the curved rows and the straight rows if they have a non staggered seating format. For the staggered seating format, the chart shows that the curved rows improve the average stage visible percentage. It could be concluded that rows' format (staggered or non staggered) has strong impact on the average visible percentage of the stage.
- Vertical viewing angles: There is no difference between the straight and the curved rows. The curves of the non-staggered format are higher than the curves of the staggered formats, which is logic.
- Horizontal viewing angles: There is big difference in the horizontal viewing

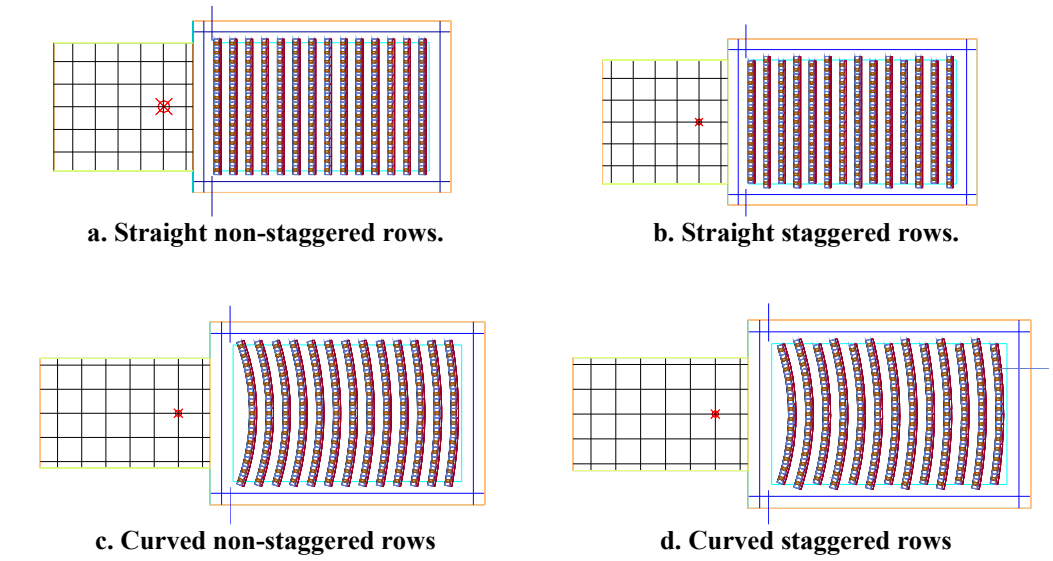


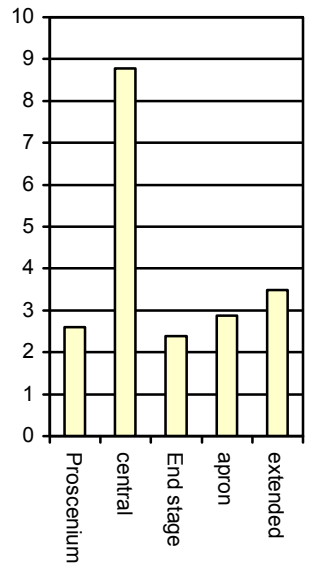
Figure 14. Plans of selected seating formats and row's geometries.

Evaluating Seating Arrangement effect:

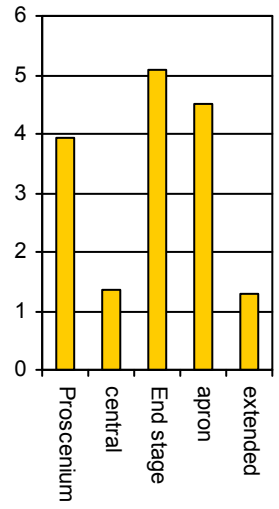
The next case studies present different seating formats and row's geometries for the conventional seating arrangements. They all have the next design features:

Total seating area:	135 m^2
Total stage area:	50 m^2
Stage format:	Proscenium stage.
Rows format:	Conventional.
Length to width ratios:	1: 1.5

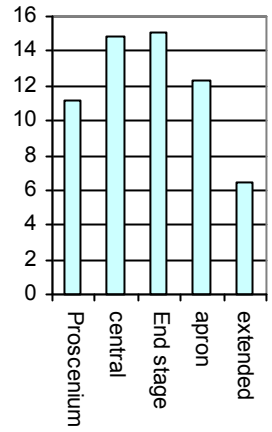
The visual conditions for each seat within the previous four cases were tested. Table 5 and figure 15 presents the average of the measured values for the visual evaluation aspects:



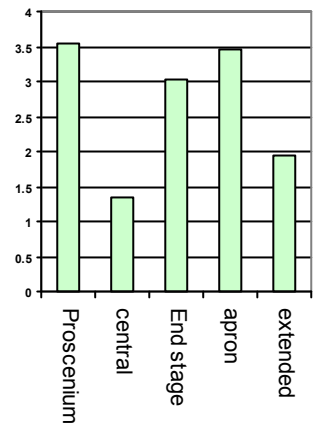
Stage visible percent



Vertical viewing angle



Horizontal viewing angle



Distance from focal point

Figure 13. Visual qualities of different stage formats.

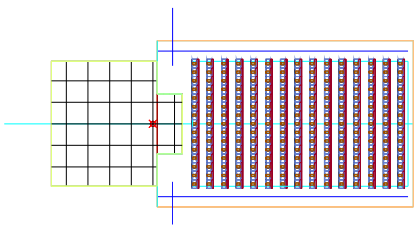
- Viewing distance: The central stage has the smallest average viewing distance and the smallest standard deviation. The four other cases have a very near averages and standard deviation. It could be concluded that some of the audience to stage relationships affect the viewing distance but most of them have no effect.

Table (4)
Average values of visual evaluation data and their corresponding standard deviation for different stage formats

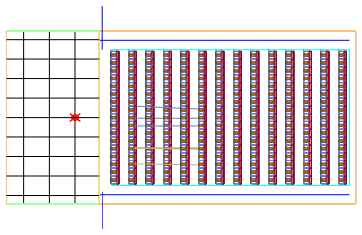
	Stage visible percent		Vertical viewing angle		Horizontal viewing angle		Distance from focal point	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Proscenium	95.98%	2.60	10.06°	3.94	14.65°	11.13	8.97 m	3.53
central	92.04%	8.78	5.81°	1.37	23.94°	14.87	5.81 m	1.34
End stage	99.30%	2.39	13.25°	5.07	19.49°	15.03	8.08 m	3.04
apron	96.97%	2.87	11.90°	4.52	15.50°	12.28	8.95 m	3.47
extended	93.12%	3.49	8.95°	1.28	10.11°	6.50	8.95 m	1.94

The following points could be concluded from table 3 and figure 12:

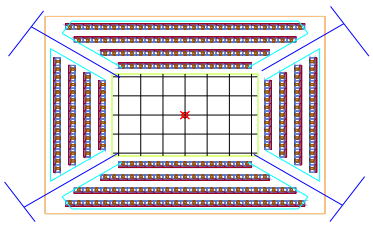
- Stage visibility: Both central stage and extended one have unexpected obstructed sight lines. This happened because of the position of the focal point and its relation to the total area of the stage. The proscenium stage and end stage give the best average visible percentage. The standard deviation for both of them also is very good in comparison to the other cases. From the table and the figure, it is concluded that the stage format has strong impact on the stage visibility to the audience.
- Vertical viewing angles: There is a very small difference in the average of the vertical angle between the extended, apron and end stage. The central stage has the best angles and the best standard deviation. The central stage has the smallest vertical viewing angles and the smallest standard deviation. This is because of the nature of this type of stage format, where most of the audience is very near to the stage. This leads us to conclude that some of the stage formats have a very strong impact on the average vertical viewing angle.
- Horizontal viewing angles: There is big difference in both the averages and the standard deviations. The extended stage has the smallest angle and the best standard deviation while the central stage has the biggest average angle and the biggest standard deviation. It is clear that the stage format has a very strong impact on the viewing angles.



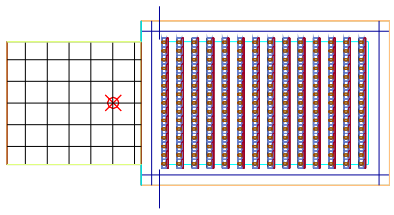
a. Apron.



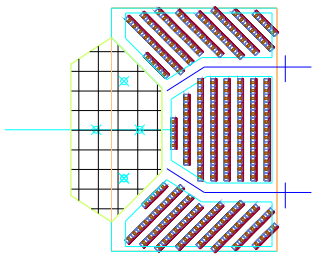
b. End stage.



c. Central Stage.



d. Proscenium.



e. Extended.

Figure 12. The Selected plan forms to test the stage format impact on the auditorium performance.

The five cases were tested to investigate the effect of the different audience to stage relationship on the visual conditions. Table 4 and figure 13 present the averages of the evaluation results.

The following points could be concluded from table 3:

- Stage visibility: The horseshoe and the hexagonal shapes give a better average visual percentage. This is because most of their audience populations are concentrated in the middle part of the hall. In the rectangle case, the populations are distributed equally on the hall. In the fan shape most of the audience population lies in the rear rows.
- Vertical viewing angles: There is a very small difference in the average of the vertical angle between the four tested cases. Also the standard deviations for the four cases are very similar. This lead us to conclude that the form does not have any effect on the viewing vertical angle.
- Horizontal viewing angles: There is a small difference between the four cases, The different distances between the first row and the focal point for each case cause this difference. The fan shape has a bigger difference in the angle in each row. This is because of the long rows that created by the fan shape. The hexagonal shape has the best standard deviation. This is because the majority of the audiences are concentrated in the middle of the hall. This creates smaller and more homogeneous viewing angles. The fan shape has the biggest average, which are not as good as the other cases. In addition, it has the biggest standard deviation, which implies that it has the biggest extremes as well.
- Viewing distance: that the difference between the average distances is less than 1.5 meter which is not significant difference. As a result, one can say that the form does not affect viewing distance.

Evaluating Stage Format Impact:

Figure 12 illustrates the selected basic stage formats to investigate the audience to stage relationship effect on the auditorium performance. They all have the same next design features:

a.	Total seating area:	135 m^2
b.	Total stage area:	50 m^2
c.	Stage format:	Proscenium stage.
d.	Row's geometry:	Straight rows.
e.	Rows format:	Conventional.
f.	Seating arrangement:	Non Staggered.
g.	Length to width ratios:	1: 1.5

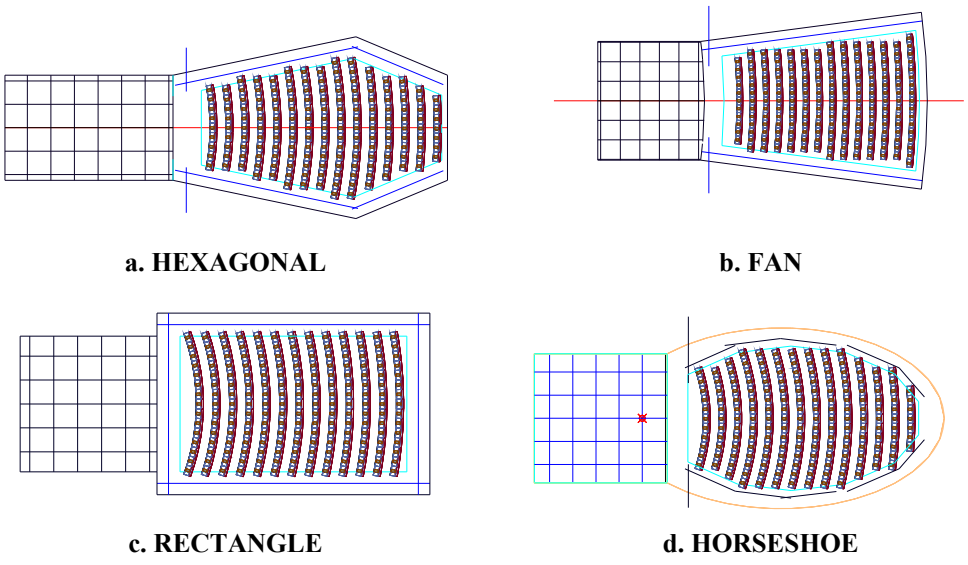


Figure 11. Selected plan formats to evaluate visual conditions.

Three aspects were investigated to evaluate the visual comfort. Stage visibility to every member of the audience, viewing angles to focal point and viewing distance. It should be noted that All the cases are designed up to the standard. This means that every seat in all the tested cases has clear sight lines to the selected focal point. This focal point lies on the stage surface (1.1 meter from the ground level of the first row) at 1.0 meter back from the stage edge. Table 3 presents the averages and the standard deviations for the evaluated cases.

Table (3)
Average values of visual evaluation data and their corresponding standard deviation for different plan forms:

Location of Audience	Stage visible percent (%)		Vertical viewing angle (Degree)		Horizontal viewing angle (Degree)		Distance from focal point (meter)	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Rectangle	98.47	2.17	8.98	4.98	6.73	6.10	9.20	3.29
Horseshoe	83.37	6.86	8.32	3.28	8.27	6.03	8.40	3.29
Fan	99.05	1.58	10.86	4.07	9.78	7.55	9.40	3.50
Hexagonal	73.84	13.35	9.48	3.46	4.95	4.03	9.99	3.45

A computer program applied on several design solutions. These solutions cover all the changes in the design parameters. The solutions divided into sets of design. Every set designed to test the impact of only one design parameter. Each case of these sets demonstrates one state of this parameter. The evaluation results of this case represent the impact of that parameter on the performance. The parameters represented in this scheme are:

1) Basic plan form: Rectangle, Square, Fan, Hexagonal, Horseshoe, circle.
2) Audience to stage relationship: Proscenium, Apron, Central, Extended, End stage.
3) Seating geometry: straight rows, curved rows and seating format: normal seating, staggered seating.

The measured evaluation aspects of performance are:

- The stage area percentage visible to the seated person.
- Horizontal angle subtended between of the seated person's eye to the focal point of the stage.
- Vertical angle between the eye of the seated person and the focal point of the stage.
- Viewing distance between the eye of the seated person and the focal point of the stage.

Evaluating Auditorium Form Impact on the Viewing Conditions:

The basic plan formats shown in figure 11 were selected to investigate the form impact on the auditorium performance. Both circular and square shapes were excluded for geometrical reasons. All tested cases have the following design features:

Total seating area:	135 m2
Total stage area:	50 m2
Stage format:	Proscenium stage.
Row's geometry:	Curved rows.
Rows format:	Conventional.
Seating arrangement:	Non Staggered.
Length to width ratios:	1: 1.5

Evaluating Design Parameters impact on visual Quality:

A full design scheme suggested in Table 2 to investigate the direct impact of the design physical parameters on the auditorium performance. This section investigates the impact of some of these parameters on the audience-space interaction quality. The data of the full population of this scheme, which the study was, depend on, is too large to be included.

Table (2)

A full design schemes for the evaluation aspects verses design parameters:

			Evaluation Aspects								
			Evacuation		Acoustics			Vision			
			Evacuation time	Walking distance	Reverberation time	Sound distribution	Echo	Stage visibility	Viewing angles	Viewing distance
Auditorium basic forms		Rectangle								
		Horseshoe								
		Hexagonal								
		Fan								
		Circular								
Audience to stage relationship		Arena								
		Apron								
		Extended								
		End								
		Proscenium								
Seating Arrangement	Straight	Normal								
		Staggered								
	Curved	Normal								
		Staggered								

Sight lines clearance: Traditionally, seating rack is deigned in section to allow every spectator to see a design focal point. But, this does not mean that every spectator within the hall will have the same clear sightlines. Also, it does not mean that the spectator will have this clear sightlines to all the stage area. Figure 10 illustrates the spectators' sightlines in section.

Visual Limits: In live shows, performers must be seen to satisfy the audience. Maximum distance from the stage should be limited by the eye capability. Theatres planned to house drama performances must have a depth not over 22.5 meter to allow detail of facial expression and small gesture to be seen. Grand opera and dance halls where broad gestures by single individuals are the minimum to be seen must have a depth of 37.5 meter. (Shehata, 1988).

Main Visual Measures:

Several aspects could be used to judge the visual quality of certain seat within any hall. The following factors are the objective ones:

- The percentage of the stage lattice at a given level that can be seen from any given seat allowing for obstruction by other members of the audience and by the structure elements.
- The distance between seat and stage focus - this focus being specified by the user.
- The vertical angle subtended by the stage plane to the spectator's eye.
- The angle of rotation of the line of direct vision from the seat to the focus.(Shehata 1988).

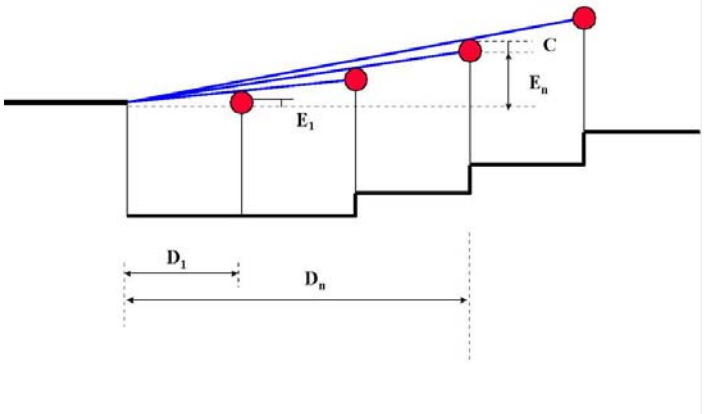


Figure 10. Sightlines in conventional seating.

Visual Quality and Sight lines:

The quality of the interface between any performance and the viewer is a function of the type of that performance and the interior space it is housed in. This interior should respond to certain fundamental human capabilities and constraints.

Head movement range: One of the most important architectural factors to be considered is the Bio-mechanical of the human body and the geometry of the visual field. Figure 10 illustrates the horizontal head movement range.

Visual angles: It is the part of the space, measured in angular magnitude, that can be seen when the head and the eye are still. Figure 7, 8, illustrates the horizontal visual range and the eye movement range. Figure 9 illustrates the vertical visual field. (Neufert 1985; Shehata, 1988)

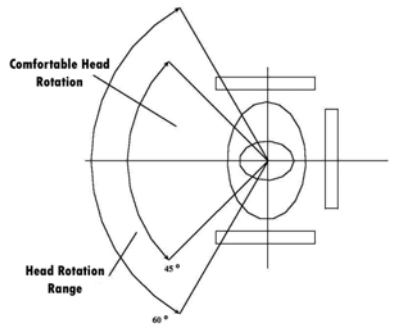


Fig.7. Range of horizontal head movement

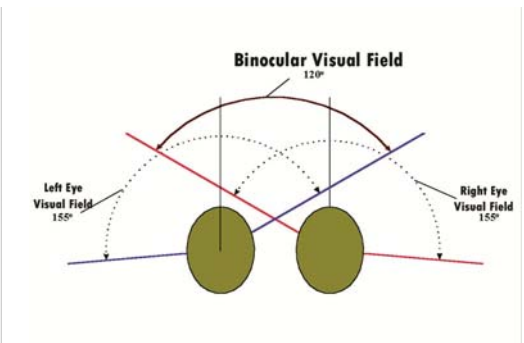


Fig. 8. Range of horizontal viewing range

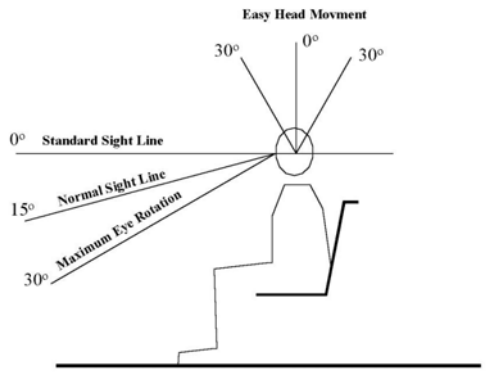
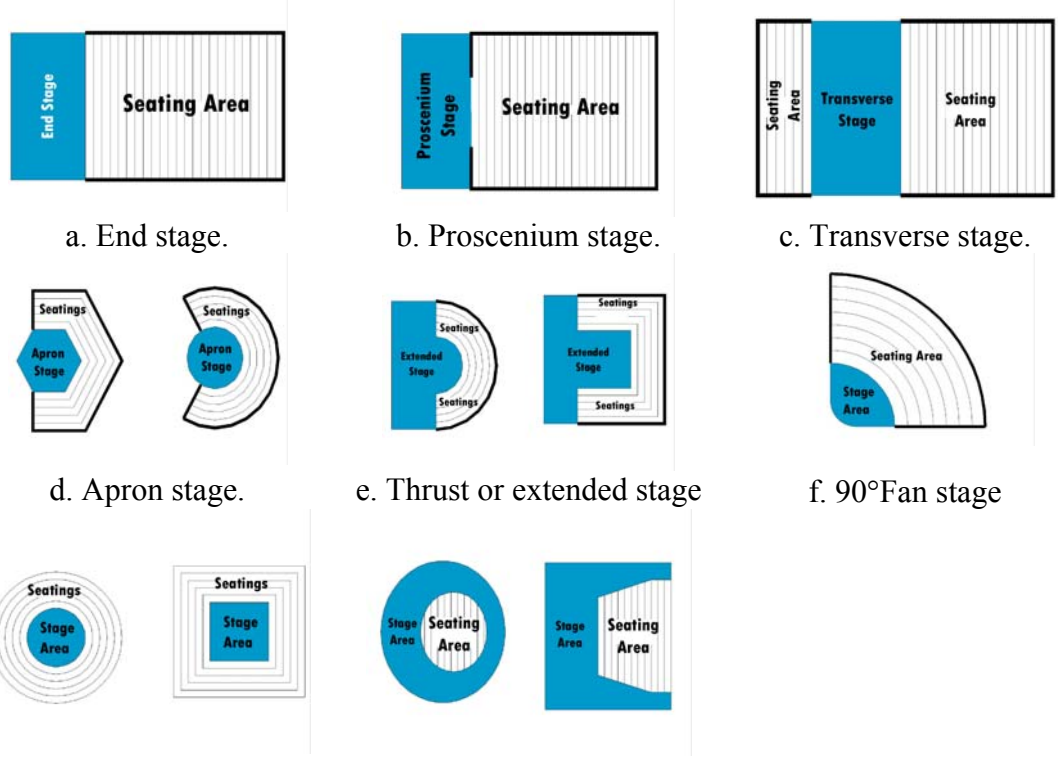


Fig. 9. Vertical head and eye range.

Audience to stage relationship :

Principally, the relationship between the actor and his audience is the basis of "theatre. So, the auditorium to stage relationship is one of the most important matters to be considered". (Christos 1983). The various forms, which have developed over the last decades, can be defined by the extent of the encirclement achieved. Figure 6 illustrates the basic stage formats: (Mils 1979; Roderick 1987).



a. End stage. b. Proscenium stage. c. Transverse stage.

d. Apron stage. e. Thrust or extended stage f. 90°Fan stage

g. Arena stage h. Surrounded stage

Figure 6. Common audience to stage relationship

Evaluation Criteria of Auditorium's Design :

The physical interior quality needs to be evaluated from several points of view. While the following points define the possible evaluation, aspects the scope of this study will be limited to the visual conditions

- Acoustics.
- Ventilation & thermal efficiency.
- Visual conditions
- Circulation and evacuation

Table (1)
Dimensions of self-rising verses self-rising push-back seats' types

	Self-rising	Self-rising push-back
B	67.5 cm	65.0 cm
C	51.56 cm	39.375 cm
H	81.25 cm	80.825 cm
S	41.875 cm	43.75 cm
F	60.00 cm	59.375 cm
E	97.5 cm	90.00 cm

Source: British Standard, 1991

It is important to mention that the self-rising seat is now a standard practice in Europe and it will be considered in this research.

- Types of aisles: Aisles are of questionable desirability except in the largest halls. Many bad sight-lines have resulted from putting the maximum legal number of seats, usually 14 into each row in every section.
- Seating formats: Two main type of seating arrangements are known, the traditional type and the continental type. The term 'continental' seating is generally used to describe seating where each row extends virtually the fully width of the auditorium without any intercepting gangways, i.e. rows in which there are more than twenty-two seats. The conventional seating has two aisle sub-systems. Figure 5 shows both of these subsystems.(Shehata, 1988; Mills, 1979)

a. Parallel asiles **b. Radial aisles**

Figure 5. Conventional aisles' sub-systems.

- Rows format: Seats could be arranged conventionally in stepped rows or they could be offset or staggered by a distance equal to half the seat spacing as shown in Figure 3. Spectator clocks between the heads of spectators in the next row and over the head of spectators in the rows after.

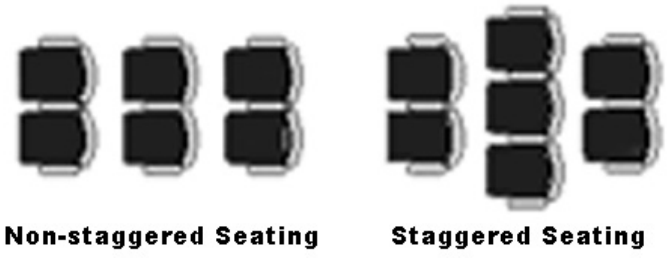


Figure 3. Arrangement of seats in staggered and conventional rows

- Chair types and Dimension: Investigating the alternative seating designs without considering the detailed design of the seats is very misleading. It is very important to decide on the individual chair that is to be used before going through the design stages. (Izenohr, 1992).

  Two main types are used namely Self-rising (spring-loaded) type and Push-back type. Figure 4 illustrates the key dimensions of the chair in both plan and section. Table 1 illustrates the minimum dimensions for the two types. These dimensions are based on the Greater London Council recommendations and the British Standards.(British Standard, 1991)

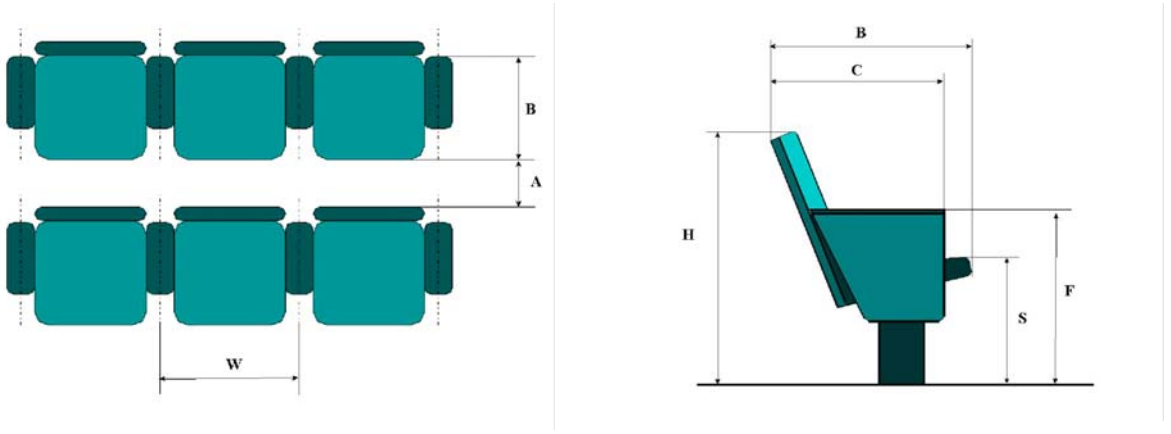
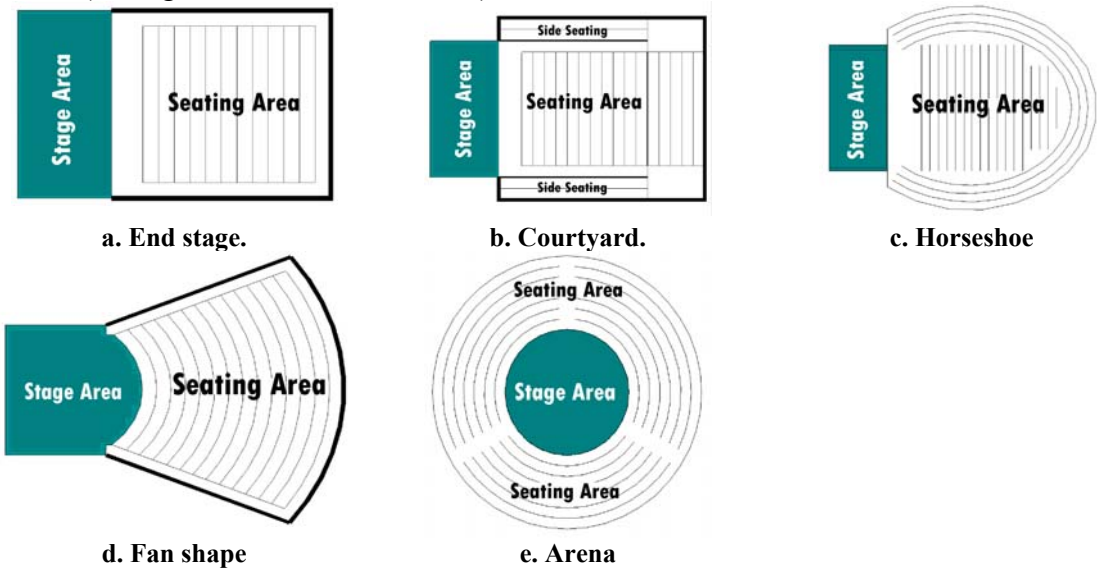


Figure 4. Chair dimensions in plan and section. Izenohr, 1992

(Strong , 1996; Roderick, 1987).



a. End stage. **b. Courtyard.** **c. Horseshoe**

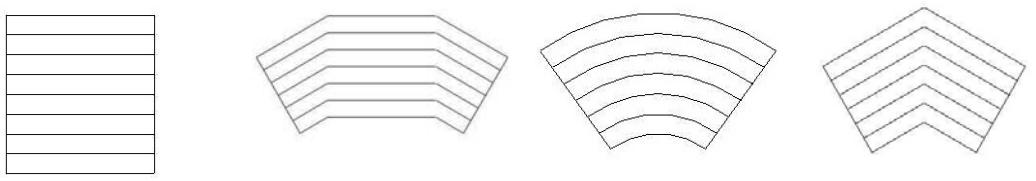
d. Fan shape **e. Arena**

Figure 1. Auditorium basic formats.

Seating Arrangement :

Comfort and circulation of the audience to and from each seat is the main concern here. For comfort, wide spacing for rows is desirable, but this may reduce the capacity of the auditorium to an uneconomic extent or push the rear rows beyond the acceptable distance from the stage. Dimensions of the seats and aisles as well as their geometry are the main factors affecting the design quality. The following sub-factors related to seating area design:

- Rows geometry: Auditorium seating geometry in plan is virtually infinite in variation and combinations. The four basic arithmetical, shown in Figure 2 are applied to many forms of theatre auditor by designers.(Izenohr, 1992).



a. Rectilinear **b. Double herringbone** **c. Curvilinear** **d. Single herringbone**

Figure 2. Basic seating formats.

introduced. Evaluation criteria aspects concerning the visual conditions were introduced in detail. The direct impact of each of the previously mentioned design factors on each evaluation aspect of these performance criteria was investigated.

A computer program, specially designed to evaluate certain performance aspects, was applyed in this process. This program works from within the AutoCAD as a drafting environment. It helps with evaluating design decision within the conceptual stage.
Several cases were tested using the computer program. The resulted evaluation data were introduced in a set of tables and in a group of design charts.

Auditoriums' Design Parameters
Designer has to weight many issues related to the interior design of auditoria as room geometry, stage design, human anthropometric variation and seating design and layout. Many parameters affect the designer choice and decision. The following sections discuss three of the main affecting parameters and how they related to each other:

Auditorium Basic Formats and definitions

As defined by the Arts British Council (1996), the following are the most common formats for theatrical performances:

- End Stage: As shown in Figure 1-a, it is a rectangular shape with acting area in one of the rectangle sides with all the seats facing the stage area.
- Courtyard theatre: As illustrated in Figure 1-b, it is a rectangular plan as well as the end stage but with additional galleries along the sides and back of the seating area. This format gives a deeper sense of enclosure.
- Horseshoe shape: Figure 1-c, shows that the basic plan shapes is rounded. This layout gives the same sense of enclosure as the courtyard but the side galleries are rounded. The side galleries in this format have a better viewing angle to the stage than the side galleries of the courtyard format.
- Fan shape: The fan shape could have range of angles between 90° and 180°. As shown in figure 1-d, this format has some characteristics of the end stage. As the angle increase, the stage extends into the audience and it takes on some of the characteristics of the theatre in the round seating area as in the case of horseshoe.
- Theatre in the arena: As illustrated in figure 1-e, the seating in this format surround the central stage. This format could be applied on circular plan or rectangular one. This arrangement suits a particular style of performance.

Application of Computer Aided Design in Designing Auditorium Assessment of the Viewing Conditions in Auditoria

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Abstract :

Auditorium design is one of the most complicated architectural tasks. Team of specialists is needed to participate in the process. Acoustical designer, lighting designer and air-conditioning consultant in addition to the architect should be among this team.

Within this paper, auditorium basic formats, seating arrangement, audience to stage relationship as design factors were studied in detail. Then the auditoriums' design parameters were discussed illustrating the auditorium Basic Formats, seating arrangement ended by audience to stage relationship. Therefore, the evaluation criteria of auditorium's design were followed, which include visual quality and sightlines and main visual measures. The study include by the evaluating design parameters impact on visual Quality, which discussed the evaluating auditorium form impact, evaluating stage format impact and the evaluating Seating Arrangement effect. Then the paper ended by giving a conclusion of the study.

Therefore, we can say that this paper was dedicated to help designers with the conceptual auditoriums' design. Factors affecting design were discussed. Performance criteria related to the visual conditions were investigated and the impact of the design factors on the performance is evaluated using a computer program that is specially designed to evaluate these aspects. This program works from within the AutoCAD as a drafting environment. It helps with evaluating design decision within the conceptual stage. Several cases were tested using the computer program. The resulted evaluation data were introduced in a set of tables. These data were represented in a group of design charts or could be defined as a design fingerprints.

Introduction :

Through this paper, the issue of auditorium design is studied; the following design factors are introduced in detail:

1) Auditorium basic formats.
2) Seating arrangement.
3) Audience to stage relationship.

Design quality is discussed as well. Several evaluation aspects were

تأثير الملوحة على محتويات بادرات العشر من الكلوروفيل والكربوهيدرات

عودة عواد الصبحي و حسن سعيد الزهراني و صبريه بشير الأحمدي

جامعة الملك عبدالعزيز- كلية العلوم- قسم علوم الأحياء

جده - المملكة العربية السعودية

الملخص:

لقد تم في هذا البحث دراسة تأثير تركيزات مختلفة من الملوحة (صفر، 5، 10، 20، 40، 80، 160 و 320 ملي مول كلوريد صوديوم) على محتوى الأوراق من كل من كلوروفيل أ و ب وكذلك محتوى كل من المجموع الخضري والجذري من الكربوهيدرات الذائبة وغير الذائبة لبادرات العشر .Calotropis procera (Ait.) Ait.

وقد أظهرت النتائج أن هناك تأثير واضح للملوحة على محتوى الورقة من الكلوروفيل خصوصا في التركيزات العالية من الملوحة (160 و 320 ملي مول كلوريد صوديوم) وكذلك مع زيادة عمر النبات. كما أن المحتوى الكلي من الكربوهيدرات الذائبة وغير الذائبة في المجموع الخضري والجذري اتجه للزيادة مع زيادة الجهد الملحي في المحلول الخارجي وكذلك مع زيادة عمر النبات والذي يعتقد أنه يلعب دورا مهما في الضبط الأسموزي.

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Table (4)
Effect of NaCl on the shoot and root content of insoluble carbohydrate (mg/g/fwt) of *Calotropis procera* seedlings.

Shoot

Age (days)	Control	NaCl concentration (mM)						
		5	10	20	40	80	160	320
28	0.74±0.19	0.51±0.11	0.53±0.16	0.56±0.12	0.78±0.04	0.81±0.11	0.74±0.02	0.71±0.08
35	1.06±0.08	0.77±0.08	0.63±0.07	0.67±0.35	0.98±0.09	1.06±0.15	1.20±0.37	0.75±0.07
42	1.12±0.12	0.89±0.14	0.67±0.05	0.92±0.22	0.90±0.17	1.87±0.11	1.26±0.38	0.81±0.02
49	1.16±0.44	0.95±0.18	0.74±0.11	1.02±0.24	1.08±0.27	2.19±0.71	1.36±0.03	0.93±0.10
LSD	Salinity stress: 0.520; age: 0.358; interaction between stress and age: 0.808.							

Root

28	0.17±0.04	0.18±0.06	0.18±0.02	0.23±0.03	0.24±0.05	0.23±0.06	0.30±0.08	0.31±0.08
35	0.19±0.02	0.27±0.06	0.30±0.05	0.40±0.05	0.43±0.03	0.47±0.07	0.43±0.00	0.33±0.07
42	0.25±0.05	0.36±0.05	0.42±0.04	0.44±0.11	0.48±0.13	0.49±0.08	0.44±0.24	0.39±0.07
49	0.42±0.08	0.68±0.26	0.74±0.12	0.74±0.07	0.76±0.03	0.87±0.14	0.50±0.17	0.41±0.11
LSD	Salinity stress: 0.247; age: 0.100; interaction between stress and age: 0.369.							

(Mean ±SE)

Table (3)
Effect of NaCl on shoot and root content of soluble carbohydrate (mg/g/fwt) of *Calotropis procera* seedlings.

Shoot

Age (days)	Control	NaCl concentration (mM)						
		5	10	20	40	80	160	320
28	0.13±0.01	0.19±0.04	0.20±0.01	0.20±0.01	0.20±0.01	0.23±0.02	0.24±0.04	0.26±0.03
35	0.17±0.03	0.23±0.02	0.23±0.02	0.25±0.08	0.30±0.01	0.31±0.02	0.33±0.14	0.48±0.11
42	0.18±0.02	0.23±0.01	0.24±0.01	0.27±0.10	0.29±0.05	0.48±0.18	0.51±0.04	0.68±0.07
49	0.20±0.04	0.23±0.02	0.28±0.02	0.30±0.10	0.40±0.35	0.58±0.04	0.62±0.12	0.84±0.11
LSD	Salinity stress: 0.283; age: 0.254; interaction between stress and age: 0.335.							

Root

28	0.08±0.01	0.12±0.04	0.12±0.01	0.12±0.03	0.13±0.01	0.12±0.01	0.13±0.04	0.23±0.02
35	0.11±0.02	0.12±0.03	0.14±0.02	0.13±0.08	0.13±0.03	0.12±0.02	0.20±0.01	0.24±0.10
42	0.13±0.01	0.15±0.01	0.16±0.02	0.17±0.03	0.18±0.02	0.18±0.02	0.20±0.05	0.23±0.10
49	0.18±0.03	0.19±0.04	0.19±0.02	0.18±0.03	0.17±0.03	0.20±0.02	0.22±0.06	0.18±0.07
LSD	Salinity stress: 0.330; age: 0.660; interaction between stress and age: 0.891.							

(Mean ±SE)

Table (2)
Effect of NaCl on the shoot and root content of total carbohyd+rate (mg/g/fwt) of *Calotropis procera* seedlings.

Shoot

Age (days)	Control	NaCl concentration (mM)						
		5	10	20	40	80	160	320
28	0.87±0.19	0.70±0.10	0.73±0.17	0.76±0.12	0.98±0.03	1.04±0.10	0.98±0.06	0.97±0.10
35	1.23±0.06	1.00±0.09	0.86±0.05	0.92±0.32	1.28±0.09	1.37±0.13	1.53±0.42	1.23±0.15
42	1.30±0.13	1.12±0.14	0.91±0.05	1.19±0.24	1.19±0.15	2.35±0.05	1.77±0.40	1.49±0.07
49	1.36±0.44	1.18±0.16	1.02±0.13	1.32±0.34	1.48±0.55	2.77±1.27	1.98±0.66	1.77±0.06
LSD	Salinity stress: 0.436; age: 0.262; interaction between stress and age: 0.522.							

Root

28	0.25±0.05	0.30±0.10	0.30±0.04	0.35±0.04	0.37±0.05	0.35±0.07	0.43±0.06	0.54±0.09
35	0.30±0.52	0.39±0.18	0.44±0.04	0.53±0.09	0.56±0.07	0.59±0.05	0.63±0.49	0.57±0.21
42	0.38±0.05	0.51±0.25	0.58±0.04	0.61±0.11	0.66±0.14	0.67±0.06	0.64±o.21	0.62±0.03
49	0.60±0.07	0.87±0.25	0.93±0.13	0.92±0.06	0.93±0.33	1.07±0.18	0.72±0.11	0.59±0.07
LSD	Salinity stress: 0.257; age: 0.095; interaction between stress and age: 0.428.							

(Mean ±SE)

Table (1)
Effect of NaCl on the leaf content of chlorophyll a, b and total chlorophyll (mg/g/fwt) of *Calotropis procera* seedlings

Chlorophyll a

Age (days)	Control	NaCl concentration (mM)						
		5	10	20	40	80	160	320
28	1.15±0.08	1.16±0.00	1.21±0.02	0.98±0.06	0.90±0.03	0.85±0.02	0.52±0.07	0.36±0.08
35	1.22±0.07	1.32±0.01	1.30±0.05	1.15±0.01	1.01±0.01	0.88±0.05	0.47±0.10	0.25±0.04
42	1.31±0.07	1.33±0.05	1.39±0.08	1.21±0.06	0.95±0.03	0.72±0.05	0.26±0.10	0.18±0.05
49	1.40±0.04	1.41±0.04	1.46±0.07	1.22±0.11	0.89±0.08	0.63±0.04	0.21±0.07	0.16±0.03
LSD	Salinity stress: 0.015; age: 0.087; interaction between stress and age: 0.207.							

Chlorophyll b

28	0.44±0.03	0.42±0.01	0.41±0.01	0.35±0.02	0.37±0.01	0.36±0.01	0.31±0.05	0.22±0.11
35	0.47±0.03	0.50±0.01	0.46±0.02	0.42±0.01	0.38±0.01	0.34±0.03	0.30±0.02	0.21±0.02
42	0.50±0.02	0.54±0.02	0.47±0.03	0.44±0.01	0.37±0.01	0.30±0.02	0.19±0.03	0.16±0.06
49	0.53±0.03	0.56±0.01	0.52±0.02	0.42±0.04	0.33±0.03	0.29±0.02	0.15±0.03	0.12±0.07
LSD	Salinity stress: 0.050; age: 0.153; interaction between stress and age: 0.208.							

Total chlorophyll

28	1.60±0.12	1.59±0.02	1.63±0.03	1.34±0.09	1.28±0.05	1.21±0.02	0.84±0.12	0.59±0.13
35	1.70±0.10	1.84±0.02	1.76±0.08	1.57±0.04	1.39±0.01	1.22±0.09	0.77±0.13	0.47±0.06
42	1.84±0.09	1.88±0.07	1.87±0.12	1.65±0.08	1.33±0.04	1.02±0.07	0.46±0.13	0.35±0.04
49	1.94±0.07	1.98±0.06	1.98±0.10	1.65±0.15	1.22±0.12	0.92±0.06	0.37±0.07	0.29±0.09
LSD	Salinity stress: 0.033; age: 0.548; interaction between stress and age: 0.804.							

(Mean ±SE)

widely regarded as response to salinity stress condition. While that the photosynthesis is the main source of carbohydrates accumulation, Munns (1993) has been reported that the concentration of sugars (and reserve polysaccharides) always rise after plants are exposed to salinity in both growing and fully expanded tissues. This is consistent with a blockage in utilization of sugars in the growing tissues and a subsequent build-up in the rest of the plant. A reduction in photosynthesis could be due to feedback inhibition by the high sugar concentrations in the mesophyll cells. It is appear in the begging of growth that Calotropis procera seedlings are not deficient in carbohydrates, and that the supply of carbon compounds are not limiting their growth, so, after prolonged periods (days or weeks) of exposure to salinity the levels of reserve carbohydrates increased, particularly in the shoot.

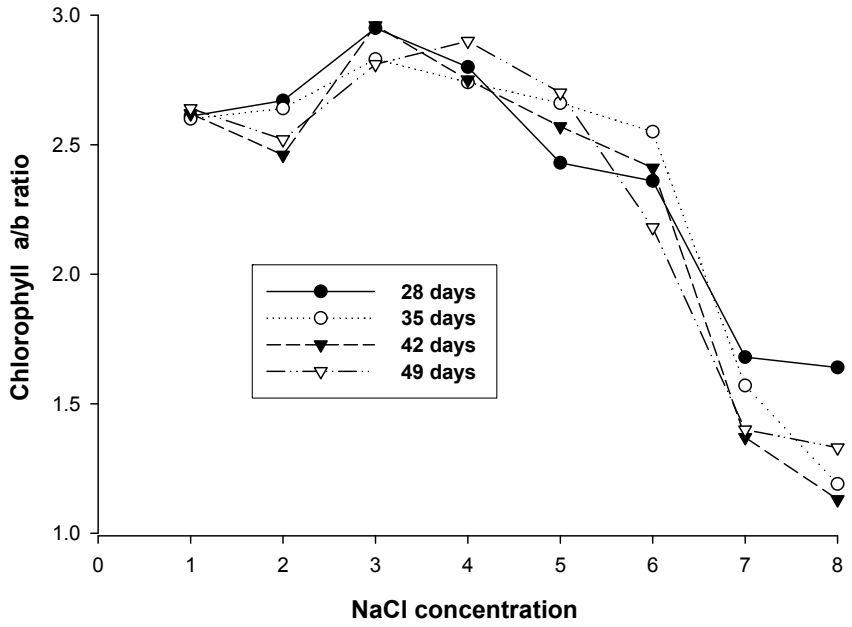

Figure (1): Effect of NaCl on the chlorophyll a/b ratio of *Calotropis procera* seedlings.
(1-8 are NaCl concentrations 0, 5, 10, 20, 40, 80, 160 and 320 mM respectively)

(Ch. a and b) and consequently of the total chlorophyll content as compared with control plants. The total chlorophyll content of the leaves of Calotropis procera seedlings exhibited a little increase when grown at 5 and 10 mM NaCl. While the pigment contents increased at the first three treatments (0, 5 and 10 mM NaCl) with increasing plant age and then decreased at the last five treatments. Generally, chlorophyll contents were reduced markedly at high salinity concentration treatments especially with aged plants. It may be due to the reason that the total chlorophyll and the proportion of its components depend on the biological process and development stages of the plant and also on the type and concentration of the salt. Ahmed et al (1978) and Hajar et al (1993) also obtained similar findings. It is also clear from Table (1) that chlorophyll a predominated over chlorophyll b but the values become closer with increasing salinity which is in agreement with other results for some plants (e.g. Hajar et al, 1993). The ratio of chlorophyll a/b (Figure 1) showed a reduction with increasing salinity concentration (especially from 40 mM NaCl and up). The decreased in chlorophyll content under stress is a commonly reported phenomenon and in various studies, this may be due to different reasons, one of them is related to membrane deterioration (Ashraf and Bhatti. 2000).

The contents of soluble and insoluble and total carbohydrates in the shoot and root of the treated seedlings of Calotropis procera plants are given in tables (2-4). It can be seen that the contents of carbohydrates (soluble and insoluble) in the shoot and root tended to increase with increasing salinity level and age (Tables 3 & 4). Many plants, which are stressed by NaCl salinity, accumulate starch and soluble carbohydrates (Greenway and Munns, 1980 and Rathert, 1984). This accumulation has been attributed to impaired carbohydrate utilization (Munns and Termaat, 1986). It is apparent from the results that the soluble carbohydrate content in the shoot was higher in salt stress plants compared with control. In contrast, the total carbohydrate in the shoot was much higher than in the root of the treated seedlings (Table 2).

There is strong evidence indicating that photosynthesis is the main source of accumulation of organic solutes under water stress. Meyer and Boyer (1981) showed that cutting the photosynthetic cotyledons from soybean seedlings prevented solute accumulation and osmotic adjustment as also concluded by Kutachera and Kohler (1994). The accumulation of organic solutes (soluble and insoluble carbohydrates) might play an important role in increasing the internal osmotic pressure (Zidan and Al-Zahrani, 1994) which is

Materials and Methods :

Seeds of Calotropis procera were collected locally from the freshly gathered ripe fruits, obtained from various shrubs growing in Jeddah area. Seeds were germinated on two layers of filter paper in flat trays, and irrigated with distilled water until they were large enough to handle (after 16 days). The seedlings were then transferred to boxes (3 liters) which had been painted black containing culture solution (Hogland and Arnon, 1950). Seedlings (30/box) were suspended above the solution by supporting them with non-absorbent cotton inside holes in the small depressions in the box lid.

The seedlings were grown in growth cabinet with a 12-hr photoperiod, the temperature ranging between 25^{o}C during the day and 20^{o}C during night periods and the relative humidity of about 70 %. Salinity treatments were imposed (when the seedling were 21 days old) by adding salt (NaCl) gradually at the rate of 50 mM or less per day up to the specific level of each treatment. The gradual addition of salt was to avoid instantaneous stressing of the seedlings by high salinity levels. The boxes were divided into 8 groups of three boxes and each group has one of the salinity treatments as follows: 0, 5, 10, 20, 40, 80, 160 and 320 mM NaCl. The solutions were aerated constantly by compressed air.

Four harvests were taken, at 7-days intervals after salinization. Five samples were taken for each measurement. The photosynthetic pigments (chlorophyll a and b) were determined according to Mitzener et al (1965). Fresh plant material (0.5 g) was extracted twice with 5 ml of 80% acetone/water solution (V/V), the combined extracts filtered through Whatman filter paper (N0 1) and made to 100 ml with 80% acetone. Chlorophyll was then determined using a pye Unicam series 2 UV and visible spectrophotometer and then the concentration of chlorophyll a, b and total chlorophyll were calculated using Mitzener's equations.

Soluble and insoluble carbohydrates were determined by the method of Fales (1951). Fresh weight (0.5 g) of the leaf tissue from each sample was used using the youngest fully expanded leaf.

Results and Discussion :

The results showed that there was clear effect of salinity concentration on the leaf pigment content of Calotropis procera seedling (Table 1 and Figure 1). It can be observed that the high levels of salinization (160 and 320 mM NaCl) induced a significant decrease in the contents of pigment fractions

Effect of Salinity on Chlorophyll & Carbohydrate Contents of Calotropis Procera Seedlings

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Abstract :

The effect of salinity concentrations (0, 5, 10, 20, 40, 80, 160 and 320 mM NaCl) on the leaf content of chlorophyll a and b and carbohydrate (soluble and insoluble) contents of shoot and root of Calotropis procera (Ait.) Ait. seedlings were investigated. The results showed clear effects of salinity on the chlorophyll content especially at high salinity concentration (160 and 320 mM NaCl) and with increasing plant age.

The total soluble and insoluble carbohydrates content in the shoot and root tended to increase with increasing salinity stress in the solution culture and also with plant age which considered playing an important role in the osmotic adjustment.

Introduction:

It has been generally recorded that salinity adversely affects seedling growth and some relevant metabolic processes of glycophytic plants (Shaddad and Zidan, 1989; Hampson and Simpson, 1990 and Zidan and Al-Zahrani, 1994). However, the direction and magnitude of these changes varied according to the level and duration of salinization treatment as well as the plant species used. Seeman and Critchley (1985) and Sharkey et al. (1985) reported that salinity can seriously change the photosynthetic carbon metabolize, leaf chlorophyll content, as well as photosynthetic efficiency. Carbohydrates are accumulated in plant tissues under saline stress, and these substances are suspected of contributing to osmotic adjustment (Munns and Termaat, 1986 & Delaumey and Verma, 1993).

Calotropis procera (Ait.) Ait. a plant species that has a reputation of wide amplitude in Saudi Arabia (Chaudhary and Al-Jowaid, 1999). The effect of salinity on growth (Al-Zahrani, 2002) and some physiological activities (Al-Zahrani et al, 2002) were studied. The present study was conducted to study the effect of NaCl salinity concentrations on the photosynthetic pigment in different plant ages.

تأثير فترات الريّ ومستويات النتروجين على نمو ومحصول الكانولا "صنف فيدو"

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الأحساء – المملكة العربية السعودية

الملخص :

نفّذت تجربة حقلية لدراسة تأثير فترات الريّ ومستويات النتروجين على نمو ومحصول نبات الكانولا "صنف فيدو" في تربة طميية رملية خلال موسمي 2001/2000 و2002/2001. وقد أشارت النتائج أن فترات الريّ أثّرت معنوياً على جميع صفات النمو و محصول الزيت والبذور، ماعدا نسبة الزيت في البذور. أدّى الريّ كلّ 7 أو 14 يوم إلى زيادة معنوية في طول النبات، قطر الساق، عدد القرون/نبات، عدد البذور/القرن، وزن بذور/ نبات بالإضافة إلى محصول الزيت والبذور/ هكتار. كما أظهرت النتائج أن معدلات التسميد النيتروجيني قد أحدثت تأثيرا معنويا على جميع الصفات المقدرة، ماعدا نسبة لزيت في البذور. وقد أدت الأضافه بمعدلات عالية من النتروجين (120- 180 كيلوغرام نيتروجين/ هكتار) إلى زيادة واضحة في جميع الصفات المقدرة، ماعدا نسبة الزيت في البذور والتي قد أخذت الاتجاه العكسي. كما أشارت النتائج أن التفاعل بين فترات الري ومعدلات النيتروجين أثر معنوياً على محصول الزيت والبذور للهكتار. وقد أدت معاملة الري كلّ 7 أو 14 يوم مع التسميد بمعدل 120- 180 كيلوغرام نيتروجين/هكتار إلى الحصول على أعلي محصول للبذور والزيت. زادت كفاءة استخدام الماء معنويا بالري على فترة 14 يوما، وقد بلغت هذه الزيادة أقصاها مع الزيادة في معدل التسميد النيتروجيني (180 كجم ن /هكتار).

توصي الدراسة بري الكانولا كل 14 يوما بمعدل 650 م^3 ماء / رية /هكتار و التسميد النيتروجيني بمعدل 120- 180 كجم ن /هكتار للحصول على أعلى محصول من البذور والزيت ولرفع كفاءة استخدام ماء الري تحت ظروف منطقة الإحساء.

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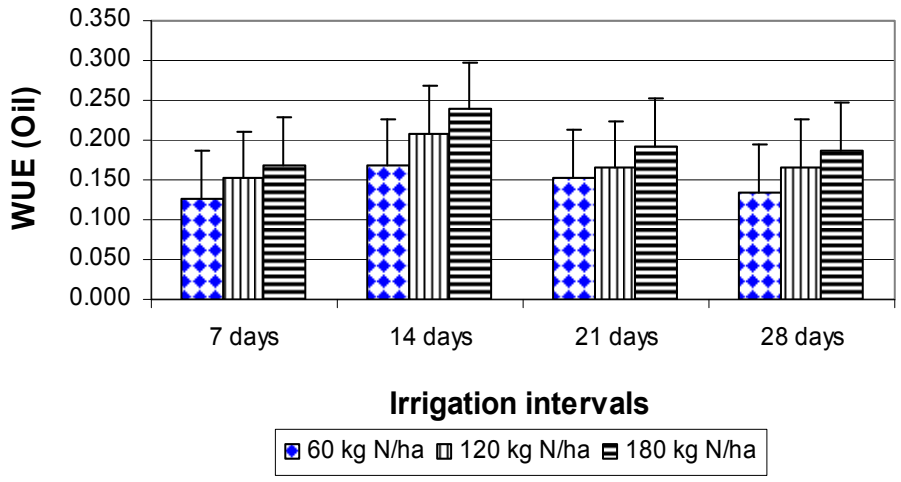

Fig. (2): Water use efficiency (kg oil/m3 water) for the evaluated irrigation treatments (Combined means, over both seasons). Bars = LSD (5%).

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Table (6)
Effect of the interaction between irrigation treatments and nitrogen levels on seed and oil yields /ha (Combined means, over both seasons)

N levels	Seed yield (t/ha)				Oil yield (t/ha)			
	7 days	14 days	21 days	28 days	7 days	14 days	21 days	28 days
60 N	3.322	3.146	2.587	2.025	1.382	1.313	1.036	0.7801
120 N	4.124	4.101	2.936	2.559	1.668	1.641	1.122	0.9690
180 N	4.756	4.786	3.486	2.931	1.863	1.872	1.313	1.086
F.Test	**				**			
LSD (5%)	0.326				0.2762			

In conclusion, canola crop responded positively to shortening irrigation interval and increasing nitrogen fertilizer rate. A seed yield up to 4.786 t ha-1 and oil yield up to 1.872 t ha-1 can easily be obtained at 14 days interval irrigation with the application of 180 kg N ha-1. The benefit of nitrogen application and irrigation intervals are integrated by greater seed and oil yields and higher WUE under the condition of this investigation.

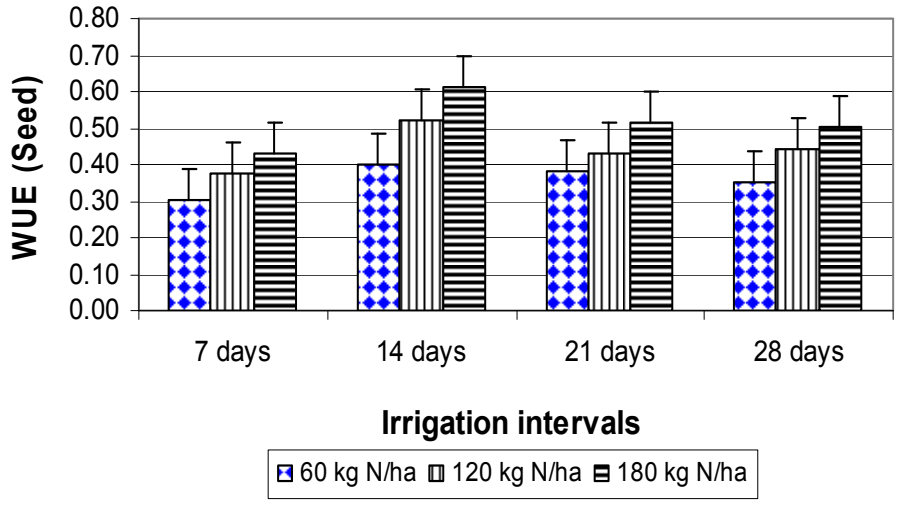

Fig. (1): Water use efficiency (kg seed/m3 water) for the evaluated irrigation treatments (Combined means, over both seasons). Bars = LSD (5%).

seed oil percentage with the increase of N fertilizer levels could be attri buted to the disturbance of carbohydrates translocation mechanism (Salisburg and Ross 1994) .

Interaction between irrigation interval and rate of nitrogen fertilizer: The interaction between irrigation intervals and nitrogen fertilizer rates had significant effects on seed and oil yields/ha. Data presented in Table (6) revealed that the highest seed yield/ha was obtained with irrigation canola plants every 7 or 14 days and addition nitrogen fertilizer with the rate of 180 kg N/ha, while the lowest seed yield was noticed with the irrigation every 28 days and fertilization with the rate of 60 kg N/ha. Oil yield/ha was significantly higher under irrigation every 7 or 14 days and fertilization with 120 and 180 kg N/ha. Great reduction in oil yield/ha was noticed with longer irrigation interval to 28 days and adding the lowest nitrogen level (60 kg N ha-1). Data graphically depicted (Figures 1 and 2) show effects of the evaluated irrigation intervals and nitrogen fertilizer rates on water use efficiency, expressed as seed and oil yields. The highest WUE value was produced with the irrigation interval of 14 days, particularly in case of application the highest N rate (180 kg N ha-1). However, the irrigation period of 7 days was associated with the lowest WUE in its corresponding N fertilizer rate. The difference in WUE with irrigating canola plants every 21 and 28 days did not reach the level of significant. Lower WUE with increasing irrigation interval more than 14 days (21 and 28 days) could be due to the decrease in seed and oil yields with increasing the drought period. Similar results were reported by Leilah and Al-Khateeb (2003) under the same conditions.

fertilizer application (Table 4). Similar results were reported by Allen and Morgan (1975); Singh *et al*. (1991) and Kjellstrtom (1993). Taylor *et al*. (1991) reported that despite seasonal differences, shoot dry matter significantly increased as application rate of fertilizer increased. Kumar *et al*. (1997) also reported higher total dry matter production with increased rate of fertilizer application.

Yield and yield components: Significant differences in the number of pods per plant were observed amongst the different fertilizer rates. The number of pods per plant increased linearly with increasing rates of N up to 180 kg N ha-1(table 4). The higher number of pods in this treatment could be largely due to higher leaf area index throughout development. These results are consistent with those reported by Mudholkar and Ahlawat (1981), Basak *et al*. (1990), Chauhan *et al*. (1995), Arthamwar *et al*. (1996) and Nielson (1997).

Number of seeds per pod was significantly increased with increasing levels of nitrogen fertilizer application. Similar results were reported by others (Allen and Morgan 1972, Scarisbrick et al., 1980; Chauhan *et al.*, 1995; Arthamwar *et al*., 1996). 1000-seed weight was significantly increased as nitrogen level increased. Results of the present study are in close agreement with findings of Tayo and Morgan (1975), who reported an average1000-seed weight of 3.28 g in Brassica napus (Table 5).

Seed yield of canola increased in response to higher nitrogen fertilizer application, with maximum yields (3.99 t ha^{-1}) being attained under the highest N rate, as shown in Table (5). Similar result of seed yield was reported by other authors (Mendham, *et al*., 1984; Hocking *et al*.(b), 1997; Kumar et al., 1997). Gammellvind et al. (1996), working in Copenhagen, reported a higher seed yield, varying from 2.8 to 4.8 t ha^{-1}, in winter oilseed rape. An adequate application of N fertilizer enables the crop to produce rapid leaf growth which may positively contribute in seed filling. This is reflected in efficient partitioning of assimilate into economic yield. The higher seed yield for the third treatment than for any of the other rates of fertilizer application was largely result from the greater number of pods per plant and number of seeds per pod (Table 4). This trend is supported by the findings of previous studies (Allen and Morgan 1975; Tayo and Morgan 1975; Mendham, *et al*., 1984). Fertilizer application did not significantly affect the seed oil content, but the highest rate was associated with light decrease in seed oil content similar results have been reported in canola by Hocking *et al*. (1997 a) and Leilah and Al-Khateeb (2003) working under Saudi Arabian condition. The reduction in

and 7 days. The seed yield obtained under this irrigation was comparable with these obtained by Leilah et al. 2003 and Leilah et al. 2004, in Saudi Arabia, Wright 1988, in Australia, Elsaidi et al. 1992, in Egypt. These results raise the possibility of little or no further increase will be gained for shortening irrigation intervals. Other studies reported similar results (Muchow and Wood, 1980; El-Saidi et al., 1992,). The higher seed yield for 7 and 14 days interval could be largely due to the greater number of pods per plant and number of seeds per pod (Table 4). The higher seed yield in canola may be associated with higher leaf area (Wright et al., 1988; Nielson, 1994 and Howell, 2000). Although leaf area was not estimated in the present study, leaf area is largely expected to be associated with both plant height and number of branches/plant. Irrigation interval did not significantly affect seed oil content (Table 5). The highest oil content of 40.4 % was found at 7 days interval of irrigation with no significant differences detected between 7, 14, 21 and 28 day intervals. The longer interval of irrigation reduced the oil content relative to the lower moisture content available. Similar results have been reported in canola (Barszczak et al., 1993). Decreasing interval of irrigation significantly increased oil yield. The lowest oil yield was produced by the 28 days interval of irrigation (Table 5). The higher oil yield with shorter interval of irrigation application was probably due to higher seed yield. Similar results were found by Barszczak et al. (1993) and AlJaloud et al., (1996).

Water use efficiency (WUE) for the evaluated irrigation treatments (Table 5 & Fig. 1 and 2) recognize the ratio between seed yield and oil yield and volume of irrigation water. It reveals that irrigation canola plants every 14 days associated with the highest values of WUE over both seasons of study. So, it can be reported that with absent of significant differences in both seed yield and oil yield between 7 and 14 days, irrigation canola every 14 days was the most benefit irrigation treatment under the conditions of this study. Leilah and Al-Khateeb (2003) came to similar conclusion in other canola cultivars grown under Saudi Arabia condition.

Effect of N fertilizer: Growth parameters: The maximum rate of fertilizer application (180 kg N ha^{-1}) produced a significantly higher plant height and stem diameter than all other rates. Similar results were reported by Kumar et al. (1997) in India and by Allen and Morgan (1975) in the United Kingdom. This trend was also observed on number of branches/plant without significant difference between 180 and 120 kg N/ha. The highest rates of fertilizer application gave significantly higher total dry weight than the lowest rate of

treatments, but mean seed weight did not differ significantly between them (Table 5). These results support the findings of Tayo and Morgan (1975), who reported an average 1000-seed weight of 3.28 g in *Brassica napus*.

Table (5)
Effect of irrigation intervals and nitrogen levels on weight of seeds/plant (g), 1000-seed weight, seed oil percentage as well as seed and oil yields/ha and WUE (Combined means, over both seasons).

Treatments	Seeds weight (g/plant)	1000-seed weight.(g)	Seed oil (%)	Seeds yield (ton/ha)	Oil yield (Kg/ha)	WUE (kg/m3water) Seeds	Oil
A: Irrigation intervals							
7 days	33.4	2.95	40.4	4.067	1637.35	0.37	0.15
14 days	30.2	2.85	40.3	4.0105	1608.55	0.51	0.20
21 days	18.8	2.55	38.7	3.002	1156.8	0.44	0.17
28 days	14.9	2.35	37.85	2.505	944.8	0.43	0.16
LSD (5%)	3.50	0.20	N.S	0.2335	156.6	0.11	0.03
B: Nitrogen levels							
60 kg N/ha	14.6	2.45	40.5	2.769	1127.6	0.36	0.14
120 kg N/ha	25.8	2.70	39.15	3.4295	1349.8	0.44	0.17
180 kg N/ha	32.6	2.90	38.3	3.9895	1533.2	0.52	0.20
LSD (5%)	2.8	0.20	N.S	0.163	138.1	0.08	0.02

Differences in mean seed weight may be much related to a shorter period between anthesis and maturity. At this time, the supply of assimilates to the pod (seed) plays a crucial role in the development of the seed, and plants supplied with more nutrients and water are probably at an advantage over those supplied with less (Taylor *et al*., 1991; Gary, 2001) which seems to be occurred under shorter intervals of the present study.

In the present study, seed yield of canola increased in response to shortening irrigation intervals with maximum yields (4.067 t ha^{-1}) being attained with 7 days irrigation intervals. However, these were no significant differences between 7 and 14 days irrigation intervals. This indicates that with shortening irrigation intervals increase in seed yield was not proportional. This increase was 25% between 21 and 14 days and it was just 1.4% between 14

Table (4)
Effect of irrigation intervals and nitrogen levels on plant height (cm), stem diameter (cm), total weight (g/plant), number of branches and pods/plant and number of seeds/pod (Combined means, over both seasons).

Treatments	Plant height	Stem diameter	Branches /plant (No.)	Total weight. (g/plant)	Pods/plant (No.)	Seeds/pod (No.)
A: Irrigation intervals						
7 days	149.85	2.45	16.80	284.50	218.25	51.75
14 days	148.70	2.50	16.80	276.50	214.60	49.10
21 days	134.55	2.15	13.85	211.60	170.40	42.95
28 days	117.80	1.85	12.05	162.90	160.10	39.75
LSD(5%)	8.75	0.35	0.90	24.95	25.05	4.95
B: Nitrogen levels						
60 kg N/ha	121.05	2.10	13.80	214.45	161.15	37.00
120 kg N/ha	140.60	2.25	15.15	233.95	195.75	48.75
180 kg N/ha	151.55	2.40	15.65	253.30	215.60	51.90
LSD(5%)	5.65	0.10	0.70	22.21	21.25	3.10

Yield and yield components: Significant differences in the mean number of pods per plant were observed amongst the different irrigation intervals. The average number of pods per plant decreased with increasing irrigation intervals. The 7 and 14 days intervals treatments produced a significantly higher number of pods than any of the other treatments (Table 4). These results are consistent with those reported by Wright et al., (1988); AlJaloud, *et al*., (1996); Nielson, (1997) and Leilah *et al*., (2002). The higher number of pods/plants under shorter intervals could be attributed to higher number of flower/plant.

Significant differences were found in the mean number of seeds per pod amongst the irrigation intervals. The shortest interval (7 days) produced more seeds per pod than any of the other treatments and the second treatment (14 days) gave the next highest (Table 4). Similar results were reported by El-Saidi, *et al*., (1992); Barszczak, *et al*., (1993) and Abbas, *et al*., (1999).

There were marked differences found in 1000-seed weight amongst the irrigation intervals, except 7 and 14 days intervals. Both 7 and 14 days intervals gave significantly higher mean seed weights than any of the other

relatively bad permeability of the soil in connection with the existing efficient drainage system the salt balance in the root zone could be kept on desired low level by leaching. The irrigation water was mainly characterized by the low concentration of Ca^{+2}, Mg^{+2}, Na^{+}, K^{+}, HCO_3^{-}, Cl^{l-} and SO_4^{2-}. The corresponding electrical conductivity value was 2.03 dSm-1. The SAR value of 4.4 indicates a medium sodium hazard.

Effect of Irrigation:

Growth parameters: Plant height and stem diameter were significantly decreased as irrigation intervals increased with no significant differences obtained between 7 and 14 days. Higher plant height was reported at 7 and 14 days compared with 21 and 28 days. This trend was also reported in stem diameter but the negative effects of long irrigation intervals have been occurred in 21 days interval. This may indicate role of water available in cell elongation. Number of branch/plant showed similar trend as reported for plant height (Table 4).

Generally, a shorter interval gave significantly higher total plant weight than the longer period of irrigation interval (21 days and more), as shown in Table 4. Similar results were found in Brassica crops, which were reported by others (Kjellstrom 1993; Nielson, 1994; AlJaloud *et al*.,1996,). Higher dry matter production with shorter irrigation were also reported in canola by others (Krogman and Hobbs, 1975 ; Singh *et al*., 1991). Overall, canola and other Brassica spp. appear very responsive to soil water availability. At end of harvest, the average of total plant weight varied from 162.9 g/plant in longer interval (28 days) to 284.5 g/plant in shorter interval (7 days). However, Taylor *et al*., (1991) reported that despite seasonal differences, shoot dry matter significantly increased as more irrigation water was applied. Marked differences in total dry weight yield among different interval irrigation period application, especially between shorter and longer period, were probably caused by differences in plant height, stem diameter and number branches (Table 4).

Table (3)
The chemical analysis of the used irrigation water

pH	7.40		Na+ (meq/l)	8.90		Cl-(meq/l)	10.20
EC (dSm^{-1})	2.03		K+(meq/l)	0.60		SO4-2(meq/l)	5.80
Ca^{+2} (meq/l)	5.80		CO3-2(meq/l)	Trace		SAR	4.00
Mg^{+2} (meq/l)	4.20		HCO3- (meq/l)	1.50		Class	C3-S1

Estimated characters: Plants were harvested at 155 days after sowing (first week of April), i.e. when plants turned a straw color and seeds became dark brown. 10 guarded plants were taken at random from each sub plot to estimate the following characters: Plant height (cm), stem diameter (cm), number of lateral branches/plant, number of pods/plant, number of seeds/pod, seed weight/plant (g) and 1000-seed weight (g). Seed counter was used to count the number of 1000-seed. Plants in the two centeral ridges in each sub-plot were harvested for biological and seed yields/m2, which was converted to recorded seed yields (t/ha). Seed oil content was estimated using Soxholt apparatus, according to A.O.A.C. (1980). Oil yield was estimated by multiplying seed yield by seed oil content. Water use efficiency (WUE) was calculated as oil yield (kg)/ irrigation water (m^3).

Statistical analysis: Collected data for each season were statistically analysed by analysis of variance (ANOVA) for the split plot design, thenafter the assumption of normality and the homogenity of variances of the experimental errors was checked according to Bartlet method which reported an appropriate homogeous of errors variance according to the method stated by Gomez and Gomez (1984). Therefore, the combined analysis was done using the SAS statistical program 8.0 (SAS Institute Inc., NC, USA). The least significant differences (LSD) at the 0.05 probability level was applied to compare treatment means according to Waller and Duncan (1969).

Results and discussion

Physical and chemical properties of studied area are presented in Table 2. The experimental site soil was characterized by sandy loam texture, calcareous soil with low organic matter, low available moisture which is probably due to the texture of soil. Soil had low available phosphorous and total nitrogen which might be due to the low fixation of P and N under calcareous soil conditions and with nearly neutral to slightly alkaline pH. The soil salinity is mainly characterized by the high concentration of Ca^{+2}, Mg^{+2}, Na^{+}, K^{+} due to the

main irrigation pipe. Plants were irrigated every 7, 14, 21 and 28 days after sowing with amount of 500, 650, 800, and 950 m3/ha water, consuming 11000, 7850, 6800 and 5800 m3/ha/season, with 18,9,6, and 4 times of irrigation, respectively (Table 1). These amounts were justified to represent the range amount of flood irrigation usually used in Al-Hassa Oasis.

Table (1)
Volumes of water in the evaluated four irrigation regimes

Irrigation regime	Volume of water (m3/ha) received before treatments application++	Volume of water (m3/ha) received after treatments application	Total volume of water (m3/ha) received during season+	irrigation Number
Irrigation every 7 days	2000	9000	11000	18
Irrigation every 14 days	2000	5850	7850	9
Irrigation every 21 days	2000	4800	6800	6
Irrigation every 28 days	2000	3800	5800	4

\+ Rainfall not included, however it was rare (may be neglected) during both seasons of study.
++ Volume of water before treatments application (2000 m3/ha) was 1000 m3/ha, immediately after sowing and two irrigations were applied at 10 and 20 days after sowing, each with 500 m^3/ha.

Hand hoeing was done twice to keep the crop free from weeds. Urea was used as N fertilizers at rates of 60, 120 and 180 kg N/ha. Air-dried soil samples were analysed for physical and chemical properties (Table 2) according to Rowell (1994). Irrigation water was analysed (Table 3) according to Rowell (1994). All measurements relating to growth and yield data were uniform in the two seasons. The total dry weight was determined after oven drying at 70 °C to a constant weight.

Table (2)
Some physical and chemical properties of experimental soil field at depth 0-45 cm

Sand %	Silt %	Clay %	Texture	CaC_{O3} %	pH	T.S.S %
46.2	38.9	14.9	Sandy loam	22.6	7.8	0.68
Av. P, ppm	Total N %	O.C. %	O.M %	F.C %	P.W.P %	Av. Mois. %
2.9	0.14	0.048	0.083	23.13	13.8	9.3

Av. P, ppm= Available phosphor O.C.= Organic Carbon, O.M.= Organic matter, F.C.= Field capacity, P.W.P.= Permanent wilting point. Av. Mois. = Available moisture.

The interaction between irrigation treatments and nitrogeen rates had significant effects on seed and oil yields ha^{-1} (Leilah *et al*., 2003). The highest seed and oil yields ha^{-1} were obtained with irrigation canola plants every 7 or 14 days and fertilizing with 150- 200 kg N ha^{-1}.
The objectives of this study were to determine: (1) the suitable irrigation intervals, optimum nitrogen fertilizer rates and their interaction on growth, yield components, seed oil content as well as seed and oil yields/ha under Al-Hassa conditions.

Materials and methods :

A field experiment was conducted on canola "CV. Fido" at the Agricultural and Veterinary Training and Research Station, King Faisal University, Al-Hassa (latitude 25° 21' and 25° 37' N and longitude 49° 33' and 49° 46' E) during the winter seasons of 2000/2001 and 2001/2002. A split plot design with four replicates was used. Four irrigation intervals (7,14, 21 and 28 days) were assigned to the main plots and three nitrogen fertilizer rates (60, 120 and 180 kgN/ha) were assigned to the subplots. Each subplot included 5 ridges; each ridge was 3.5 m long and 0.60 m (2.1 m^2).

The soil of the experiment site was sandy loam with soil pH = 7.8, EC= 4.4 dS m^{-1}, Total soluble solid (TSS) between 0.60%-0.74%, N, Na, K and Ca average contents were 16.0, 14.1, 27.3 and 12.1 meq/l, respectively, over the two seasons.

Canola seeds used in this study were obtained from the Agricultural Research Center, Giza, Egypt. Seeds were sown during the last week of October in both seasons period, which were placed in hills, 15 cm apart within ridges, plants were thinned two times, the last one was at 35 days after emergence, leaving one plant/hill. Nitrogen in the form of Urea (46%) as aforementioned rates was manually sidedressed into three equal portions, the first was added prior of planting. The second portion was applied after thinning (30 days after sowing) and the rest was added at the first of flowering stage. Plots were weeded as needed through hand hoeing. Other normal agronomic practices for canola production were followed as recommended for ordinary canola production, except the studied treatments.

Flood system irrigation which is the normal irrigation system used by farmer in Al-Hassa area was performed in this study. The water from reservoir was pumped with an electrical pumped to the irrigation system for irrigation. The water was measured through a flow meter installed at the beginning of the

saline soil conditions (Nielson, 1997). Canola (*Brassica napus L.*) recently moved up to the world's, third most important edible oil source after soybean and palm, and have the largest annual growth rate of the 10 major edible oils (Downey 1990). Its oil also has potential in the developing biodiesel market (Economic Research Service, 1996).

Little information is available in the literature on the suitable irrigation interval for growing canola under Saudi Arabian conditions, particularly with regard to increasing their vegetative growth. Irrigation studies on this plant have focused on increasing seed yields in canola (Taylor *et al.*, 1991; Boochereau *et al*., 1996; Champolivier and Merrien, 1996).

Sims *et al*., (1993) reported that canola yields in Montana increased greatly with increased availability of water, but higher water content lowered mean oil content. Although most growers would irrigate this crop using flood or furrow irrigation, subsurface drip irrigation was used to minimize losses caused by evaporation, runoff and deep percolation when estimating crop water requirements (Phene *et al.*, 1990). Leilah *et al*., (2002) stated that irrigation canola plants every 14 days associated with the highest values of water use efficiency (WUE) in the two seasons of study. Al-Habeeb and Al-Hamdan (2002) found that the optimum seasonal irrigation volume as 3000 m3 per hectare.

Nitrogen (N) and phosphorous (P) fertilizers play a vital role in enhancing canola yield. A high rate of N application increases leaf area development, improves leaf area duration (LAD) after flowering and increases overall crop assimilation, thus contributing to increased seed yield (Wright *et al.*, 1988). Allen and Morgan (1972) concluded that N fertilizer increases yield by influencing a variety of growth parameters such as the number of branches per plant, the number of pods per plant, the total plant weight, the leaf area index (LAI), and the number and weight of pods and seeds per plant. Excess nitrogen rate, however, can reduce seed yield and quality appreciably. Leilah *et al*. (2002) considered the most effective dose in maximizing the final canola yield/ha was 150 kg N ha-1 with no significant differences appeared when N fertilization increased to 200 kg N ha-1 under Al-Hassa condition. Ibrahim et al. (1989) concluded that yield increased with rates of N up to 213 kg N ha^{-1}. High N applications were found to cause lodging (Sheppard and Bates 1980; Wright *et al*., 1988; Bailey 1990). Taylor *et al*. (1991), working in Australia, observed that split applications of N were not more effective than application of the total amount of N at seeding.

Irrigation Interval and Nitrogen Level Effects on Growth and Yield of Canola (*Brassica napus L.*)

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Abstract :

A field experiment was carried out to determine the effect of irrigation intervals and nitrogen levels on canola "cv. Fido" on a sandy loam soil during 2000/2001 and 2001/2002 seasons. Irrigation intervals had significant effects on growth characters as well as seed and oil yields/ha, but it did not induce maked effect on seed oil percentage. The highest values of plant height, stem diameter, number of pods/plant, number of seeds/pod, seed weight/plant as well as seed and oil yields/ha were produced with irrigation every 7 or 14 days. Nitrogen rates had significant effects on all estimated characters, except the harvest index and seed oil percentage. The highest nitrogen rates (120-180 kg N/ha) were associated with an increase in all estimated characters, except seed oil percentage, which took the reverse trend. The interaction between irrigation intervals and nitrogen rates had significant effects on seed and oil yields/ha. Irrigation canola every 7 or 14 days and fertilizing with 120-180 kg N/ha produced the highest seed and oil yields/ha. The optimum water use efficiency was obtained with the irrigation every 14 days, particularly with the addition of 180 kg N ha-1.

In general, it can be concluded that irrigation canola plants at the regular interval of 14 days with 650 m3 water/irrigation/ha and adding nitrogen fertilizer with the rate of 120-180 kg N ha-1 produced the highest seed and oil yield/ha and increase the water use efficiency under the environmental condition of Al-Hassa region.

Introduction :

Water is becoming scarce not only in arid and drought prone areas but also in regions where rainfall is abundant (Malano and Burton 2001). Water scarcity concerns the quantity of resource available and the quality of the water because degraded water resources become unavailable for more stringent requirement. Water scarcity may be due to different causes, relative to different xeric regimes, nature produced and man-induced (Pereira 1999).New crops with high water use efficiency and increased drought tolerance are being sought for production in arid regions. One plant species with excellent potential as alternative to more traditional crops grown under irrigated conditions is canola. This crop grows well in dry environments and can also tolerate moderately

دراسة بيئية على طفيل الذانون
Cistanche phelypaea (L.) Cout. (*Orobanchaceae*)
في واحة الأحساء بالمملكة العربية السعودية

فرح عوض فقير و فهد بن ناصر السبيعي

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الأحساء – المملكة العربية السعودية

الملخص :

إن نبات الذانون Cistanche phelypaea (L.) والذي ينتمي إلى الفصيلة الهالوكية (Orobanchaeceae) يعتبر طفيلاً جذرياً إجباري التطفل، ويعتمد كلياً في غذائه على العائل للحصول على الماء والعناصر المعدنية والمواد العضوية. وقد وجد أن هذا النبات يتطفل على عدد من النباتات البرية والمزروعة في منطقة واحة الأحساء في المملكة العربية السعودية.

وتشمل العوائل الطبيعية نباتات الشنان Arthrocnemum macrostachyum والعجرم Anabasis articulata والضمران Salsola barysoma والحمض Seidlitzia rosmarinus وثلاثة أنواع من جنس السويد (Suaeda) وثلاثة أنواع من جنس الرطريط Zygophyllum. بينما تشمل النباتات المزروعة: نبات الشمندر Beta vulgaris ونبات السلق Beta vulgaris subsp. Cicla والقطف Atriplex leucoclada، في حين وجد أن نباتات السبانخ Spinacia oleracea مقاوم لتطفل الذانون.

were highly susceptible hosts. Thus chard may be characterized by having relatively a greater tolerance factors to tha-noun.

It could be concluded that Tha-noun as a potential root parasite affects the natural vegetation population size, and the growth and development of the cultivated vegetation e.g. beet, Chard and Atriplex.

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Discussion :

Parasitic flowering plants have documented as playing a striking role in the ecology of their hosts (Reuter, 1986), particularly by controlling population sizes of their host plants. In the present study not all of the tested host plants were found to be affected by Tha-noun (Cistanche phelypaea). Among the thirty-three families recorded in this study, Cistanche phelypaea restricted its host range in two families only, Chenopodiaceae and Zygophyllaceae. However, in an earlier study, Tamaricaceae was recorded to include hosts of Tha-noun (Farah, 1987). Among the study plant species of Al-Ahsa Oasis, only ten plant species were found to be parasitized by tha-noun, namely Anabasis articulata, Arthrocnemum macrostachyum, Solsola baryosma, Seidlitzia rosmarirus, Suaeda aegyptiaca, S. monoica, S. vermiculata, Zygophyllum coccineum, Z. qatarense and Z simplex. If we add to this list, other recorded host plants e.g. Suaeda priunosa and Tamarix aphylla (Farah, 1987) as well as the cultivated host plants species: Atriplex leueoclada, Beta vulgaris and Beta vulgaris subsp. cicla, a group of 15 plants species will classified as the most preferable host plants by tha-noun in Al-Ahsa area. Zygophyllum qatarense, the most important species (50.14 IV) was found to accommodate the highest number of Tha-noun plants (268) compared with other hosts. Thus Z. qatarense could be considered as the most important host of Tha-noun in Al-Ahsa Oasis. However, continued spread of this noxious parasite in the natural vegetation of Al-Ahsa Oasis, could results in unforeseen problems such as limitation of the growth and productivity of the important forage plants. This is in agreement with the finding reported by Scharpf *et al*., (2001) for Viscum album and alder (Alnus) stands in California.

Under greenhouse conditions, the tested host plants showed great variation in their response to the parasitism of the root parasite, tha-noun. All the tested host plants, except spinach, were affected significantly ($P < 0.01$). The losses of the biomass of the tested host plants ranged from 0.0%, with Spinach up to 56% with Atriplex. The Spinach plants treated with the parasite, tha-noun was found to be resistant and thus showed no significant differences in all the studied growth characters (plant height, root length, biomass) compared with the untreated plants (control). On the other hand, tha-noun decreased the growth components of beet, Chard and Atriplex, substantially. Similar results were reported by Gwargwer and Weber (2001) in Striga hermonthica and millet. The relatively better performance of growth characters of Chard (i.e. lesser loss percentage) compared with beet and Atriplex (higher loss percentage) revealed that chard was less susceptible, while beet and atriplex

Table (4 b)

The effect of tha -noun treatments on the growth characters of its host plants, averaged overall hosts and overall seasons.

(each figure is an average of 40 readings = 4 hosts × 5 replicates × 2 years)

Treatments	Plant height (cm)	Root length (cm)	Dry weight biomass (g)
T_1	77.9a*	34.3a	51.3a
T_2	57.5b	27.3b	32.7b
T_3	58.0b	26.1b	33.3

T_1: Plants not treated with Tha-noun (control).
T_2: Plants treated with Tha-noun seeds of 2000.
T_3: Plants treated with Tha-noun seeds of 2001.
* Means with the same letter in each column for each trait are not significantly different according to Duncan's multiple range test.

Table (5 a)

Number of tha-noun plants per host and dry matter of tha-noun (g) per host.
(Each value is an average of 20 readings = 2 treatments × 2 years × 5 replicates).

Treatment	**Number of tha-noun plants/host**	**Dry matter of tha-noun plants/ host**
Beet	10.10a*	16.83b
Chard	3.90b	7.01c
Spinach	0.00c	0.00d
Atriplex	5.50b	22.9a

* Means with the same letter in each column for each trait are not significantly different according to Duncan's multiple range test.

Table (5 b)

Number of tha-noun plants per host and dry matter of tha-noun (g) per host. (Each value is an average of 30 readings = 3 host plants × 2 years × 5 replicates).

Treatment	Number of tha-noun plants/host	Dry matter of tha-noun plants/ host
Th_1	8.63a*	18.10a
Th_2	4.37b	13.10b

Th_1 = Tha-noun plants developed from tha-noun seeds of 2000.
Th_2 = Tha-noun plants developed from than-noun seeds of 2001.
Th_n = Number of tha-noun plants per host.
Th_w = Tha-noun dry matter (g) per host.
* Mean with the same letter in each column for each factor are not significantly different at P = 0.05 according to Duncan's multiple range test.

Table (4 a)
The effect of Tha-noun on growth traits of its host plants (average over two seasons (2001/2002 – 2002/2003), (Mean ± s.d.),
(Each value is an averaged of 10 readings, 2 years × 5 replicates)

Host	Treatment	Plant height (cm)	Root length (cm)	Dry weight (g)
Beet	T_1	36.24±6.1a*	35.7±10.7a	28.7±7.1a
	T_2	34.6±6.4a	23.4±8.2b	19.84.8b
	T_3	35.1±6.7a	25.0±5.9b	23.9±6.1b
Chard	T_1	96.4±2.6a	27.2±1.5a	43.1±1.0a
	T_2	86.5±1.7b	24.8±5.7b	39.8±5.8b
	T_3	87.80±1.4b	26.7±5.0a	40.7±2.7b
Spinach	T_1	19.4±2.7a	11.0±1.8a	10.3±2.3a
	T_2	19.6±2.1a	11.6±1.3a	10.6±2.1a
	T_3	19.4±2.6a	11.4±1.5a	10.5±2.0a
Atriplex	T_1	159.4±6.2a	63.1±2.7a	126.3±+6.0a
	T_2	89.2±5.0b	44.4±2.4b	60.8±5.3b
	T_3	89.2±6.0	46.2±2.8b	55.2±4.7b

T_1: Plants not treated with Tha-noun (control).
T_2: Plants treated with Tha-noun seeds of 2000.
T_3: Plants treated with Tha-noun seeds of 2001.
* Means with the same letter in each column for each trait are not significantly different according to Duncan's multiple range test.

Table (3)
Number of Tha-noun plants per host plant at Al-Ahsa Oasis, recorded during December 2001 - December 2002

Host plant	No. of individuals of host plant	No. of parasi-tized host plant	No. of Tha-noun plants per host plant	Percentage of Tha-noun plants per host plant (%)
Zygophyllum qatarense Zygophyllum coccineum	456 217	245 (53.7%)* 166 i76.50%)	268	23.5
Zygophyllum coccineum	217	166 (76.50%)	180	15.8
Zygophyllum simplex	166	98 (59.0%)	122	10.7
Suaeda aegyptiaca	214	139 (65.0%).	156	13.7
Suaeda monoica	157	78 (49.70%)	84	7.4
Suaeda vermiculata	166	84 (50.60%)	95	8.3
Anabasis articulata	95	46 (48.40%)	58	5.1
Arthrocnemum macrosta-chyum	89	35 (39.30%)	45	39
Salsola baryosma	233	129 (55.40%)	133	11.7
Seidlitzia rosmarinus	96	38 (39.60%)	44 •	3.9
Total	1889	1058 (56.0%)	1141	

* Number in parenthesis is percentage of parasitized host plant.

Table (2)
Density, Relative density, Frequency, and Relative dominance of the most important plant species of Al-Ahsa Oasis.
(Analysis based on 1.5 m radius circle quadrates)

Species	D	RD (%)	F	RF (%)	PC (%)	IV (%)
Arthrocnemum macrostachyum	0.02	2.02	0.08	2.30	1.80	6.12
Rostaria pumila	0.11	11.11	0.23	6.61	1.10	18.82
Aleuropus logopoides	0.06	6.06	0.20	5.75	8.35	20.16
Suaeda aegyptiaca	0.03	3.03	0.13	3.74	8.26	15.03
Panicum turgidum	0.06	6.06	0.30	8.62	13.84	28.52
Zygophyllum qatarense	0.14	14.14	0.67	19.30	16.70	50.14
Sasola baryosma	0.07	7.07	0.27	7.80	6.14	21.01
Suaeda monoica	0.07	7.07	0.18	5.20	6.23	18.50
Stipa capensis	0.05	5.05	0.09	2.60	3.14	10.79
Panicum repens	0.06	6.06	0.15	4.31	1.50	11.87
Bassia muricata	0.03	3.03	0.13	3.74	1.43	8.20
Eragrostis barrelierii	0.03	3.03	0.07	2.01	1.70	6.74
Anabasis articulata	0.03	3.03	0.13	3.74	5.50	12.27
Zygophyllum simplex	0.02	2.02	0.13	3.74	5.00	10.76
Cyperus conglomerates	0.04	4.04	0.12	3.45	4.52	12.01
Zygophyllum coccineum	0.03	3.03	0.15	4.31	2.30	9.64
Stipagrostis ciliata	0.06	6.06	0.21	6.03	3.60	15.69
Seidlitzia rosmarinus	0.02	2.02	0.14	4.02	4.02	10.06
Suaeda vermiculata	0.06	6.06	0.10	2.87	5.06	13.99

Table (1)
Number of families, genera and species of the flora of Al-Ahsa Oasis.

Family	Genera	Species
Dicotyledons		
Amaranthaceae	2	4
Apiaceae	2	2
Asteraceae	22	36
Brassicaceae	9	9
Boraginaceae	3	7
Capparaceae	2	2
Caryophyllaceae	5	7
Chenopodiaceae	14	26
Convolvulaceae	2	3
Cucurbitaceae	2	2
Cuscutaceae	1	3
Cynomoriaceae	1	1
Euphorbiaceae	3	7
Fabaceae	11	22
Geraniaceae	2	2
Lamiaceae	4	6
Malvaceae	1	2
Neuradaceae	1	1
Orobanchaceae	2	3
Plantaginaceae	1	7
Polygonaceae	2	2
Portulacaceae	1	1
Primulaceae	1	2
Resedaceae	1	2
Rhamnaceae	1	2
Solanaceae	5	7
Tamaricaceae	1	5
Zygophyllaceae	3	9
Subtotal	105	182
Monocotyledons		
Arecaceae	1	1
Cyperaceae	1	3
Juncaceae	1	1
Poaceae	21	29
Typhaceae	1	1
Subtotal	25	35
Total	130	217

Table 2 shows the standard statistical measurements for the vegetation of Al-Hassa Oasis and the adjacent areas. These measurements include the frequency, the relative frequency, the density, the relative density, the relative dominance, (i.e. the percentage cover) and the importance value. The importance value was calculated only for the most abundant species of the area.

Table 3 shows the most important host plants of Tha-noun, and number and percentage of tha-noun per host plant. Ten plant species were found to be the most important host plants. They belong to six genera, namely: Zygophyllum, Suaeda, Anabasis, Arthrocnemum, Salsola and Seidlitzia.

The greenhouse experiment :

All the studied characters (plant height, root length and dry weight (biomass) of the studied host plants, exceat, spinach, were highly significantly ($P < 0.01$) affected by tha-noun treatments (Tables 4a and 4b). The effect of tha-noun was more severe on atriplex compared to other host plants while spinach was not affected by the parasite.

The host plants significantly affected the means of the tested parameters of tha-noun, i.e. number of tha-noun plants per host and the dry matter of thanoun per host. Beet exceeded the other host plants in sustaining more number of tha-noun plants per host, while atriplex exceeded them in accommodating more dry matter of tha-noun per host (Tables 5a and 5b). However, Tha-noun 1 was found to exceed Tha-noun 2, both in number and dry matter per host plant.

The greenhouse experiment :

The selected host crops: garden beet (Beta vugaris), chard (B. vulgaris subsp. cicla), spinach (Spinacia olerace) and atriplex (Atriplex leucoclada) were tested in a greenhouse environment. The experiment was conducted at the Agricultural and Veterinary Training and Research Center, King Faisal University, to investigate their response to the parasitism of Tha-noun. Sixty 30-cm plastic pots were arranged in four sets (15 pots per set). The selected crop plants were raised in the pots, where the top half of the soil was thoroughly mixed with 1.0 g of tha-noun seeds of 2000 (Th 2) in the first set. In the second set the top half of the soil was also thoroughly mixed with 1.0 g of Tha-noun seeds of 2001 (Th3). The third set was used as untreated control (Th1). Treatments were arranged in a completely randomized design with five replicates. A total of 120 pots were used in this experiment during two seasons. Five seeds per pot were sown on 27 November, 2001 and 27 November, 2002. Three weeks after emergence, all pots received a compound fertilizer in the form of N.P.K. (20%, 20%, 20%) at the rate, of 70 kg. Ha. The pots were placed in the greenhouse (day and night temperatures were 28^0C/23^0C). Irrigation has been carried out using tap water every week. Data were collected for the following host characters: Plant height (cm), root length (cm), total dry weight (biomass) (g). For the parasite (tha-noun), the number of individual plants per host and the dry matter of the parasite per host were recorded.

Statistical analysis :

Analysis of variance was conducted using the General Linear Models (GLM) procedure of Statistical Analysis System (SAS, 1990).

Results :

The natural vegetation

The following results represent the vegetation studies carried out during several excursions, by the investigators, during two consecutive seasons (December-April 2001/2002 and December-April 2002/2003).

Two hundred seventeen species (182 dicots and 35 monocots) of flowering plants were recorded for the studied areas (Table 1). From the thirty three families recorded in the area, only four families were characterized with high species richness namely, Asteraceae (36 species), Chenopodiaceae (26 species), Fabaceae (22 species) and Poaceae (29 species).

and its surrounding areas (Ugair, Salwa, Faidaht Um Al-Sous). A total of 600, 1.5 m radius circle quadrates were used in this study. The quadrates were laid along 360-m transect lines. 20 such transects were used. Each transect was marked by posters at 12 m intervals. Tha-noun and its host plant species were collected. Only those plants attached to the parasite were recorded as hosts. Nomenclature follows Migahid (1978). The standard statistical measures of vegetation were applied according to Curtis (1959) and Mathew *et al* (1993) as follows:

$$\text{Frequency (F)} = \frac{\text{Number of quadrates (plots) in which a species occurs}}{\text{Total number of quadrates (plots) sampled}}$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency value for a species}}{\text{Total of frequency values for all species}} \times 100$$

$$\text{Density (D)} = \frac{\text{The total number of individuals of a species}}{\text{The total area of quadrates examined}}$$

$$\text{Relative Density (RD)} = \frac{\text{Density for a species}}{\text{Total density for all species}} \times 100$$

$$\text{Relative dominance (percentage cover) (PC)} = \frac{\text{The total lengths of lines covered by a species}}{\text{Total length of lines examined}} \times 100$$

Importance value (IV) =

The total of the three relative measures (RF + RD -PC).

Ecological Studies on Tha-noun (*Cistanche phelypaea L*) Cout. (Orobanchaceae) in Al-Ahsa Oasis, Saudi Arabia

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Abstract :

The angiospermic root parasite Cistanche phelypaea L. Cout. (Orobanchaceae) is an obligate root parasite, which totally depends its host for water, minerals and organic nutrients. In Al-Ahsa Oasis, Saudi Arabia, it was found to occur on a number of natural and cultivated plant species. The natural hosts include: Arthrocnemum macrostachyum, Anabasis articulata, Salsola baryosma, Seidlitzia rosmarinus, Suaeda aegyptiaca, Suaeda monoica, Suaeda vermiculata, Zygophyllum coccineum, Zygophyllum simplex, Zygophyllum qatarense. The cultivated species were Beta vulgaris, Beta vulgaris subsp. cicla, and Atriplex leucoclada. However, Spinacia oleracea, a cultivated species, was found to be resistant.

Introduction :

The genus Cistanche that belongs to the family Orobanchaceae includes 16 species. They form an attractive group of phanerogamic root parasites. The occurrence of the genus is restricted to certain arid and semi arid regions of Africa, Asia and the Mediterranean area including parts of Southern Europe (Blatter, 1921; Agrawal, 1984; Musselman, 1984).

In Saudi Arabia, three species of the genus Cistanche Hoffmgg et. Link have been reported: C. Phelypaea (L.) Cout, C. tubulosa (Schenk.) R. Wight and C. violacea (Desf.) G. Beck (Collenette, 1985). The first species is the most common and is distributed throughout nearly all phytogeographical zones of Saudi Arabia (Farah, 1991). However, little information is available regarding the ecology of these plants. Hence the present study was carried OUT to investigate the occurrence, host range, and the effect of tha-noun (Cistanche phelypaeavm on its host plants in Al-Ahsa Oasis, Saudi Arabia.

Materials and Methods :

Field Study

Several excursions were carried out to survey the occurrence of the root parasite tha-noun and its host plants among the native plants communities (natural vegetation) of Al-Ahsa Oasis (25° 22′ N' latitude; 49°34′ E longitude)

تأثير عدد الريات، مستويات السماد النيتروجيني ونسب خلط بذور البرسيم المصري – الشوفان على محصول العلف

سليمان علي الخطيب و عبدالرحيم عبدالرحيم ليله و سامي بن سعد الثابت

قسم المحاصيل والمراعي، كلية العلوم الزراعية والأغذية- جامعة الملك فيصل
الأحساء – المملكة العربية السعودية

الملخص :

استخدم تصميم القطع المنشقة ثنائيا بنظام القطاعات كاملة العشوائية في أربع مكررات لتقييم تأثير فترات الري ومستويات النيتروجين ونسب خلط بذور البرسيم المصري مع الشوفان على محصول العلف. وزعت فترات الري (الري كل 7، 14، 21 يوم بمعدل 500، 650، 800 م3/ هكتار/ رية، باستهلاك مائي قدره 13000، 9200، 7600 م3/هكتار/ موسم) عشوائيا على القطع الرئيسية، ووزعت مستويات النيتروجين (45، 90، 135 و 180 كجم ن/ هكتار) على القطع الشقية الأولى، في حين وزعت عشوائيا نسب الخلط (100٪ برسيم أو شوفان، 75٪ برسيم+ 25 ٪ شوفان، 50٪ برسيم + 50 ٪ شوفان، 25٪ برسيم+ 75 ٪ شوفان) على القطع الشقية الثانية. وقد أشارت نتيجة التحليل التجميعي للبيانات على مدى موسمي الدراسة أن الري كل سبعة أيام أدي إلى الحصول على أكبر محصول علف طازج وجاف/ هكتار. كما أظهرت النتائج أن زيادة مستويات النيتروجين حتى 180 كجم/ هكتار أدت إلى زيادة محصول العلف الطازج والجاف / هكتار. كما أفادت النتائج أن زراعة البرسيم منفردا قد سجل أعلى محصول علف رطب، في حين أدى خلط 25 أو 75 ٪ برسيم مصري مع 75 أو 25 ٪ شوفان أعلى محاصيل علف جاف/ هكتار/ موسم. أشارت النتائج أن التفاعل بين فترات الري x مستويات النيتروجين وكذلك التفاعل بين فترات الري x نسب الخلط و أيضا التفاعل بين مستويات النيتروجين x نسب الخلط أثر معنويا على محصول العلف الرطب والجاف. وبصفة عامة، فقد أدت معاملة الري كل سبعة أيام و خلط 25 ٪ من معدل بذر البرسيم مصري مع 75 ٪ من معدل بذر الشوفان والتسميد بمعدل 180 كجم/ هكتار إلى الحصول على أعلى محصول علف من مخلوط البرسيم المصري والشوفان تحت ظروف محافظة الأحساء، المملكة العربية السعودية.

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The stimulation effects of nitrogen fertilization in clover production may reflect the low nitrogen fixation under the hot climate area (Maheshwari and Anand 2003 and Huang *et al*. 2004). The monoculture of oat fertilized with 45 kg N ha-1 produced the lowest fresh forage yield in all cuts and their total which probably due to low nitrogen level of the soil (15.4 meq/L). Also, it had been reported that N fertilizer depressed clover content in the mixture (Davidson and Robson, 1986; Caradus *et al.* 1993). However, this trend was often reflected under the high level of N fertilizer as reported by Frame (1992) who used 250-350 kg N ha^{-1} which was not reached under the present study.

In the present study, the increase in dry forage yield with the addition of 180 kg N ha^{-1} in Egyptian clover was 13.8 %, compared with 45 kg N ha^{-1}, while in oat was 20.0 %. Since nitrogen fertilizers affected the growth of both Egyptian clover and oat differentially, it is expected that significant responses will be appear in their mixture due to N fertilization. Berdahl *et al*. (2001) reported that supplemental nitrogen fertilizers did not increase total forage yield of the grass–alfalfa mixture in all cuts, but they reported that N fertilizers favored the growth of grass components.

Generally, it is accepted that nitrogen fertilization stimulates the grass component of grass-legume mixtures (Nuttal *et al.* 1991; Caradus *et al.* 1993; Berdahl *et al.* 2001).

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Table (8)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	5.828	15.941	15.588	4.251	41.609
45	Oat 100%	16.450	11.044	3.200	0.111	30.806
45	75% Clov+25% Oat	12.800	13.219	11.427	3.371	40.817
45	50% Clov+50% Oat	13.491	12.552	10.727	2.146	38.917
45	25% Clov+75% Oat	14.235	12.362	10.225	1.062	37.884
90	Clover 100%	5.870	16.228	16.942	4.246	43.287
90	Oat 100%	17.109	11.502	3.359	0.141	32.111
90	75% Clov+25% Oat	12.973	14.988	11.983	3.308	43.254
90	50% Clov+50% Oat	13.764	13.891	11.530	2.261	41.446
90	25% Clov+75% Oat	14.867	12.735	11.440	1.640	40.682
135	Clover 100%	6.043	16.449	16.827	4.425	43.744
135	Oat 100%	17.708	11.886	3.535	0.186	33.316
135	75% Clov+25% Oat	13.276	13.388	12.141	2.943	41.750
135	50% Clov+50% Oat	14.280	13.567	11.556	2.04	41.444
135	25% Clov+75% Oat	15.888	13.337	11.456	1.957	42.639
180	Clover 100%	6.471	17.158	17.692	4.568	45.890
180	Oat 100%	18.316	12.600	3.828	0.212	34.956
180	75% Clov+25% Oat	12.468	15.034	12.684	3.344	43.531
180	50% Clov+50% Oat	14.058	14.901	12.412	2.311	43.683
180	25% Clov+75% Oat	16.764	14.180	12.658	1.736	45.338
NLSD(5%)		0.917	0.838	0.628	0.571	1.024

Table (9)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	0.699	2.328	2.697	0.791	6.514
45	Oat 100%	1.712	2.237	1.800	0.416	6.166
45	75% Clov+25% Oat	2.319	2.225	1.397	0.371	6.312
45	50% Clov+50% Oat	1.966	2.190	2.032	0.578	6.767
45	25% Clov+75% Oat	2.093	2.181	1.938	0.296	6.507
90	Clover 100%	1.365	2.269	2.439	0.482	6.557
90	Oat 100%	1.800	2.322	1.908	0.414	6.444
90	75% Clov+25% Oat	2.359	2.374	1.515	0.400	6.649
90	50% Clov+50% Oat	2.047	2.519	2.199	0.551	7.317
90	25% Clov+75% Oat	2.207	2.337	2.191	0.405	7.140
135	Clover 100%	1.460	2.427	2.670	0.591	7.148
135	Oat 100%	1.971	2.471	1.918	0.449	6.810
135	75% Clov+25% Oat	2.561	2.495	1.581	0.312	6.949
135	50% Clov+50% Oat	2.168	2.364	2.263	0.554	7.350
135	25% Clov+75% Oat	2.537	2.406	2.205	0.413	7.561
180	Clover 100%	1.596	2.633	2.833	0.669	7.732
180	Oat 100%	2.062	2.627	2.018	0.461	7.169
180	75% Clov+25% Oat	2.548	2.563	1.708	0.431	7.252
180	50% Clov+50% Oat	2.110	2.595	2.422	0.554	7.682
180	25% Clov+75% Oat	2.580	2.598	2.471	0.455	8.104
NLSD(5%)		0.276	0.284	0.248	0.218	0.396

Table (6)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	6.701	18.016	18.852	5.568	49.137
7	Oat 100%	19.111	13.009	4.024	0.219	36.363
7	75% Clov+25% Oat	15.495	16.369	14.285	4.124	50.272
7	50% Clov+50% Oat	16.005	15.856	13.635	2.857	48.354
7	25% Clov+75% Oat	17.360	15.394	13.564	2.186	48.505
14	Clover 100%	5.920	16.718	16.797	4.272	43.707
14	Oat 100%	17.725	11.686	3.327	0.156	32.895
14	75% Clov+25% Oat	12.817	14.551	12.035	3.208	42.610
14	50% Clov+50% Oat	13.910	13.921	11.493	2.064	41.388
14	25% Clov+75% Oat	15.607	12.974	11.261	1.563	41.404
21	Clover 100%	5.538	14.599	14.639	3.277	38.052
21	Oat 100%	15.351	10.579	3.091	0.113	29.135
21	75% Clov+25% Oat	10.327	11.554	9.857	2.393	34.131
21	50% Clov+50% Oat	11.780	11.406	9.541	1.647	34.376
21	25% Clov+75% Oat	13.348	11.093	9.509	1.049	34.999
NLSD(5%)		0.791	0.727	0.539	0.510	0.887

Table (7)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

Irrigation intervals	Mixing rate	Cut				*Total*
		First	Second	Third	Fourth	
7	Clover100%	0.826	2.654	3.251	1.026	7.758
7	Oat 100%	3.095	2.430	0.828	0.047	6.400
7	75% Clov+25% Oat	2.149	2.807	2.590	0.827	8.374
7	50% Clov+50% Oat	2.320	2.765	2.528	0.587	8.202
7	25% Clov+75% Oat	2.608	2.717	2.603	0.461	8.390
14	Clover 100%	0.779	2.571	3.005	0.806	7.162
14	Oat 100%	3.015	2.248	0.700	0.034	5.997
14	75% Clov+25% Oat	1.917	2.499	2.262	0.678	7.357
14	50% Clov+50% Oat	2.127	2.416	2.203	0.431	7.176
14	25% Clov+75% Oat	2.437	2.323	2.216	0.336	7.312
21	Clover 100%	0.811	2.435	2.661	0.631	6.539
21	Oat 100%	2.729	2.063	0.667	0.026	5.486
21	75% Clov+25% Oat	1.706	2.079	2.049	0.524	6.359
21	50% Clov+50% Oat	1.988	2.098	1.972	0.363	6.422
21	25% Clov+75% Oat	2.296	2.074	1.987	0.236	6.594
NLSD(5%)		0.239	0.244	0.217	0.187	0.343

Table (4)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons)

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	14.240	14.857	11.651	2.765	43.514
7 days	90 kg N/ha	14.570	15.482	12.685	3.185	45.922
7 days	135 kg N/ha	15.257	15.891	13.170	3.029	47.348
7 days	180 kg N/ha	15.670	16.684	13.982	2.984	49.321
14 days	45 kg N/ha	12.459	13.013	10.079	2.125	37.677
14 days	90 kg N/ha	12.945	13.68	10.992	2.164	39.782
14 days	135 kg N/ha	13.663	14.297	11.219	2.293	41.472
14 days	180 kg N/ha	13.717	14.889	11.640	2.427	42.673
21 days	45 kg N/ha	10.983	11.200	8.970	1.674	32.828
21 days	90 kg N/ha	11.235	12.445	9.476	1.608	34.765
21 days	135 kg N/ha	11.398	10.989	8.921	1.608	32.916
21 days	180 kg N/ha	11.460	12.750	9.942	1.892	36.045
NLSD(5%)		1.063	1.022	0.935	0.798	1.338

Table (5)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons)

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	1.981	2.482	2.059	0.521	7.043
7 days	90 kg N/ha	2.098	2.601	2.277	0.628	7.605
7 days	135 kg N/ha	2.293	2.781	2.469	0.612	8.155
7 days	180 kg N/ha	2.428	2.834	2.635	0.599	8.496
14 days	45 kg N/ha	1.841	2.181	1.858	0.419	6.299
14 days	90 kg N/ha	1.940	2.315	2.076	0.440	6.772
14 days	135 kg N/ha	2.208	2.531	2.128	0.467	7.335
14 days	180 kg N/ha	2.232	2.617	2.247	0.501	7.598
21 days	45 kg N/ha	1.811	1.936	1.733	0.341	5.823
21 days	90 kg N/ha	1.872	2.201	1.876	0.331	6.280
21 days	135 kg N/ha	1.970	2.060	1.816	0.344	6.191
21 days	180 kg N/ha	1.977	2.405	2.047	0.408	6.838
NLSD(5%)		0.318	0.332	0.247	0.265	0.378

Interaction effects:

The interaction between irrigation intervals and nitrogen fertilizer levels had significant effects on fresh and dry forage yields in all cuts and their total (Tables 4 & 5). Shortening irrigation interval to 7 days with the addition of 180 kg N ha^{-1}, produced the highest fresh forage yield (49.321 t ha^{-1}) and dry forage yield (8.496 t ha^{-1}). On the contrary, the lowest fresh and dry forage yields (32.828 and 5.823 t ha^{-1}) were produced under 21 days irrigation interval and fertilizing with 45 kg N ha^{-1}. However, the increase in fresh and dry forage yields under 21 days intervals and 180 kg N ha^{-1} was lower compared with 7 days irrigation intervals and 180 kg N ha^{-1} which indicates a significant role of frequent irrigation in N absorption and utilization.

Fresh and dry forage yields were significantly affected by the interaction between irrigation intervals and seeding rates of Egyptian clover and oat mixture (Tables 6 & 7). The highest fresh forage yields in all cuts and their total was noticed with the mixture of 75 or 50 % Egyptian clover with 25 or 50 % oat under the irrigation period of 7 days. Monoculture of clover and oat was relatively equal in their response to water deficit. The reduction in forage yield in the monoculture of Egyptian clover and oat under water deficit (irrigation every 21 days) reached about 29.1 and 24.8 % in fresh forage yield and 18.4 and 16.7% in dry forage yield, respectively. This trend was also reported by Al-Khateeb (2004) on monoculture of clover and ryegrass. Therefore, it is expected that mixing Egyptian clover and oat will not be affected by drought probably due to the high rate of compatibility of both crops under drought conditions. However, Thomas (1984) reported that clover was much affected by drought in the mixture of clover and ryegrass.

The highest dry forage yield was obtained from the treatment of mixing clover with oat and from the monoculture of the Egyptian clover when irrigated every 7 days. The monoculture of oat with prolonging the irrigation intervals to 21 days showed the lowest dry yield, and this tend was noticed in all cuts (Table 7).

Fresh and dry forage yields were significantly affected by the interaction between nitrogen levels and seeding ratio of Egyptian clover and oat. The highest dry forage yields in all cuts and their total were produced from the mixture of 25 % Egyptian clover + 75% oat when fertilized by 180 kg N ha^{-1}. It was followed by the mixture of 50 % Egyptian clover + 50 % oat and monoculture of oat with the addition of 180 kg N ha^{-1}.

Nitrogen fertilizer levels:

Fresh and dry forage yields in all cuts and their total were significantly affected by nitrogen levels (Tables 2 & 3). Each increase in nitrogen level from 45 to 180 kg N ha^{-1} was associated with significant increases in fresh and dry forage yields in all cuts and their total. Total fresh yields also increased from 38.006 to 42.680 t ha^{-1}. This increase in fresh forage yield represented 12.3 %. Dry forage yield was increased from 6.388 to 7.644 t ha^{-1} as nitrogen level increased from 45 to 180 kg N ha^{-1} (Table 3). The corresponded increases in dry forage yield with an increase in nitrogen levels from 45 to 180 kg N ha^{-1} was 1.256 t ha^{-1}, representing an increase of 19.7 % in dry forage yield. The increase in forage yield might be attributed to the active role of nitrogen in enhancing mixture plants growth and development. The nitrogen supply to the plant increases the amount of protein, protoplasm and chlorophyll formed. In turn, this influences cell size and leaf area, and thus photosynthetic activity (Gardner *et al*. 1985; Salisbury and Ross 1994). Increasing forage yield of mixture under N fertilization have been reported by Frame (1992), Schenk *et al.* (1997) and Al-Khateeb (2004).

Mixing ratio:

Significant differences were found in the fresh and dry forage yields in all cuts and their total due to the variation in the evaluated mixing ratio of the Egyptian clover and oat mixture (Tables 2 & 3). The monoculture of oat recorded the highest fresh (17.396 t ha^{-1}) and dry (2.946 t ha^{-1}) forage yields in the first cut, while it recorded the lowest fresh and dry yields in the second, third and fourth cuts and in the total. Similar finding was observed by Ross *et al.* (2004). However, the monoculture of Egyptian clover produced the lowest fresh and dry forage yields in the first cut only, while it surpassed all tested mixing ratio in the second, third and fourth cuts as well as in the total fresh yield/ ha/ season. Mixing 25 % Egyptian clover with 75 % oat produced the highest dry forage yield (7.437 t ha^{-1}). While, mixing 75% clover with 25 % oat ranked the second in total fresh and dry forage yields (7.363 t ha^{-1}). However, fresh and dry forage yields of mixing Egyptian clover and oat with any ratio significantly surpassed the monoculture of oat. Holland and Brummer (1999) found that adding oat to clover increased total crop biomass and forage plant health. This trend was also noticed by other working with other grasses-clover mixtures (Bassal and Zahran 2003; Al-Khateeb 2004).

Table (2)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons)

Treatments	Cut				*Total*
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	14.934	15.729	12.872	2.991	46.526
14 days	13.196	13.969	10.983	2.252	40.401
21 days	11.269	11.846	9.328	1.696	34.138
BLSD(5%)	1.285	1.217	1.134	0.895	1.761
B. Nitrogen Levels					
45 kg N/ha	12.561	13.024	10.234	2.188	38.006
90 kg N/ha	12.917	13.869	11.051	2.319	40.156
135 kg N/ha	13.439	13.726	11.103	2.310	40.578
180 kg N/ha	13.615	14.775	11.855	2.434	42.680
BLSD(5%)	0.608	0.594	0.542	0.457	0.772
C. Mixing rate					
Clover100%	6.053	16.444	16.762	4.373	43.632
Oat 100%	17.396	11.758	3.481	0.163	32.797
75% Clov+25% Oat	12.879	14.157	12.059	3.242	42.338
50% Clov+50% Oat	13.898	13.728	11.557	2.190	41.373
25% Clov+75% Oat	15.439	13.153	11.445	1.599	41.636
BLSD(5%)	0.458	0.418	0.311	0.289	0.512

Table (3)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons)

Treatments	Cut				*Total*
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	2.200	2.675	2.360	0.590	7.825
14 days	2.055	2.411	2.077	0.457	7.001
21 days	1.907	2.151	1.868	0.356	6.283
BLSD(5%)	0.208	0.200	0.228	0.191	0.382
B. Nitrogen Levels					
45 kg N/ha	1.878	2.2	1.883	0.427	6.388
90 kg N/ha	1.970	2.372	2.076	0.467	6.885
135 kg N/ha	2.157	2.458	2.137	0.474	7.227
180 kg N/ha	2.212	2.619	2.310	0.503	7.644
BLSD(5%)	0.180	0.189	0.139	0.148	0.218
C. Mixing rate					
Clover100%	0.806	2.553	2.973	0.821	7.153
Oat 100%	2.946	2.247	0.732	0.036	5.961
75% Clov+25% Oat	1.924	2.462	2.300	0.676	7.363
50% Clov+50% Oat	2.145	2.426	2.235	0.461	7.267
25% Clov+75% Oat	2.450	2.373	2.270	0.345	7.437
BLSD(5%)	0.138	0.141	0.123	0.108	0.199

Table (1)

Temperature, Relative humidity, RH (%), rainfall (mm/month) and transpiration rate, TR (mm/day), over 2000/2001 and 2001/2002 seasons in Al-Hassa area.

Month	Temperature			RH%	Rainfall mm/month	TR mm/day
	Maximum	Minimum	Average			
October	38	22	30	52	0	12
November	32	17	25	60	0	8
December	26	12	19	66	6	6
January	21	9	15	65	9	5
February	24	12	18	64	12	7
March	29	16	23	55	15	10
April	34	20	27	48	3	14

Results and discussion:

Irrigation treatments:

Fresh and dry forage yields of Egyptian clover-oat mixture in all cuts and their total over both seasons were significantly affected by irrigation intervals (Tables 2 & 3). Irrigation every 7 days showed the highest fresh and dry forage yields in all cuts and their total. Total fresh forage yield decreased from 46.526 to 40.401 and 34.138 t ha^{-1}, with about 13.2 and 26.6 % reduction as water deficit increased due to increasing the irrigation intervals from 7 to 14 and 21 days, respectively. Also, increasing the irrigation frequency from 14 to 21 days resulted in 15.50 % reduction in the fresh forage yield. The dry forage yield in all cuts and total showed the same trend of the fresh forage yield which was significantly decreased from 7.825 to 6.283 t ha^{-1} with increasing irrigation intervals from 7 to 21 days (Table 3). The reduction in the total dry fodder yield was 10.53 and 19.71 % with increasing irrigation frequency from 7 to 14 and 21 days, respectively. The reduction in dry forage yield due to the increase of irrigation intervals was much pronounced with the increase of water deficit time. The reduction in dry forage yield under 21 days irrigation interval was 13% in the first cut compared with 40% in the fourth cut. Such effects were also noticed by other investigators on grass-clover mixture (Lucero *et al.* 1999; Al-Khateeb 2004).

Soil samples from the experimental site were taken at random from the upper 30 cm of the soil surface for physical and chemical analysis. Results of soil analysis showed that the soil was sandy loam in texture (sand= 55.2 %, silt = 36.0 %, clay = 8.3 %) with pH 7.5, ECe = 4.5 $dsm^{-1,}$ $CaCO_3$ = 20.8 % and organic matter= 0.11%. N, Na, K, and Ca contents were 15.8, 13.7, 20.4 and 10.4 meq L^{-1}, respectively.

Temperature, rainfall, relative humidity and transpiration rate readings at the experimental field site during the experiment period are shown in Table 1. Seedbed for the experimental field was well prepared and the field area was divided into experimental units by constructing alleys and shallow irrigation channels.

Seeds of the mixture with the aforementioned seeding rates were hand-sown in 10 cm apart rows. Seeds of Egyptian clover (*Trifolium alexandrinum* L.) cv. "Meskawi" at the rate of 75 kg ha^{-1} and oat (*Avena fatua* L.) cv. "Coker 227" at 120 kg ha^{-1} were used. Sowing took place during the last week of October in both seasons. After sowing, all plots were fertilized with 50 kg P_2O_5 ha^{-1}. Nitrogen in the form of urea (46 % N) with the previously mentioned rates was added into 4 equal portions, 30 days after sowing and after the first, second and third cuts. Four cuts were taken. The first cut was 60 days after sowing, while the other three cuts were taken at about 40 days between. In each cut, fresh forage yield in the inner 2.0 m^2 was estimated to the nearest gram and converted to record fresh yield (t/ha). Plant samples of forage yield were dried at 85 °C for 48 hours to determine dry matter content (DM %). The dry forage yield was estimated by multiplying fresh forage yield x DM %.

Data of each cut and their total in every season were statistically analysed using the technique of the Analysis of variance of the split split plot design (Gomez and Gomez 1984). Thereafter, the assumption of normality and the homogeneity of variance of the experimental errors was checked according to Bartlet method which showed an appropriate homogenous of errors variance. Therefore, the combined analysis over both seasons was done using the SAS version 8.0 (SAS, 2001). The treatment means were compared using the Baysian Least Significant Difference (BLSD) at 5 % level of probability (Waller and Duncan, 1969).

Water soil deficit reduced the productivity of legume-grass mixture (Lucero *et al.*1999; Al-Khateeb 2004). If the component of the mixture is different in responses to drought conditions, the response of mixtures productivity will be substantially disturbed (Lucero *et al.*1999).

Numerous investigators found advantages in forage yield and quality for mixing clover with oat (Ghaffarzadeh 1997; Holland and Brummer 1999; Thorsted *et al.* 2002; Bassal and Zahran 2003; Ross *et al.* 2003; McAnderws *et al.* 2004; Ross *et al.* 2004). Grass-clover mixtures have been reported to out yield clover or grass in solid planting (Ghaffarzadeh 1997; Al-Khateeb *et al.* 2001; McAnderws *et al.* 2004; Ross *et al.* 2004).

The grass/clover relationship is highly affected by nitrogen fertilization (Davidson and Robson 1986; Caradus *et al*.1993; Shareif *et al*. 1996). Frame (1992) reported that increasing level of nitrogen fertilization on grass/white clover sward increased total herbage production linearly up to N rates of 250–350 kg N ha^{-1}. However, 90 % of maximum herbage production was achieved with only 50-60 % of the nitrogen needed to attain the maximum production. Al-Khateeb (2004) showed that increasing nitrogen levels up to 180 kg N ha^{-1} was associated with marked increases in fresh and dry forage yields of Egyptian clover-ryegrass mixture.

This study was aimed to evaluate effects of irrigation frequency, nitrogen fertilizer levels and mixing ratio of Egyptian clover and oat on fresh and dry forage yields.

Materials and methods:

Two field experiments were conducted at the Agricultural and Veterinary Training and Research Station, King Faisal University, Al-Hassa (latitude 25° 21' and 25° 37' N and longitude 49° 33' and 49° 46' E) during the winter seasons of 2000/2001 and 2001/2002. A split split-plot in randomized complete block design with 4 replicates was used. Three irrigation intervals, 7, 14 and 21 days with 500, 650 and 800 m^3/ha/irrigation, consuming water of 13000, 9200 and 7600 m^3 ha^{-1}/season, respectively were assigned to the main plots. Four nitrogen fertilizer levels, 45, 90, 135 and 180 kg N ha^{-1}, were assigned to the sub plots. The sub sub-plots were assigned to the following mixing ratio: solid Egyptian clover or oat (100%), 75% Egyptian clover + 25% oat, 50% Egyptian clover + 50% oat and 25% Egyptian clover + 75% oat. The experimental unit dimension was 2.5 x 4.0 m.

Effect of Irrigation Frequency, N- Fertilizer Levels and Mixing Ratio of Egyptian Clover-oat on Forage Yield

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Abstract:

Effects of irrigation frequency, nitrogen fertilizer levels and mixing ratio of Egyptian clover-oat on forage yield were evaluated in a split split plot design with four replicates. Three irrigation intervals, 7, 14 and 21 days consuming 500, 650 and 800 m^3 ha^{-1} /irrigation with water consumption of 13000, 9200 and 7600 m^3 ha^{-1} in the season, respectively were assigned to the main plots. Four nitrogen fertilizer levels, 45, 90, 135 and 180 kg N ha^{-1} were assigned to the sub plots. The sub sub-plots were assigned to the following mixing ratio: solid Egyptian clover or oat (100%), 75% Egyptian clover + 25% oat, 50% Egyptian clover + 50% oat and 25% Egyptian clover + 75% oat. Combined analysis of data over all cuts in both seasons showed that irrigation every 7 days showed the highest fresh and dry forage yields ha^{-1}. Increasing nitrogen level (180 kg N ha^{-1}) produced the highest fresh and dry forage yields. The monoculture of Egyptian clover produced the highest fresh yield/ ha /season. However, the mixtures of 25 or 75 % Egyptian clover and 75 or 25 % oat produced the highest dry forage yields ha^{-1} in the season. The interaction between irrigation intervals X nitrogen levels, irrigation intervals X mixing ratio and nitrogen levels X mixing ratio had significant effects on forage fresh and dry yields. Mixing 25 % Egyptian clover with 75 % oat seeds and fertilizing with 180 kg N ha^{-1} under irrigating interval of 7 days showed the highest dry forage yield under Al-Hassa conditions, Saudi Arabia.

Introduction:

The sustainability of grass cropping system could be improved by adding legumes. Egyptian clover (*Trifolium alexandrinum* L.) is one of the most important forage legume crops in some world countries particularly that has long winter season with cold-moderate temperature. In the Kingdom of Saudi Arabia, Egyptian clover has been introduced with special emphasis to the agriculture sector as untraditional forage crop. The importance of this crop lies on its low irrigation water requirements and the high forage productivity and quality during winter and spring seasons (Al-Khateeb 2004). It can be grown during winter seasons to overcome the water shortage recently appeared in Saudi Arabia. Recent studies have been done under the Saudi Arabia conditions to evaluate the cultivation of Egyptian clover and grasses mixtures in terms of forage quality and quantity (Al-Khateeb *et al*. 2001 and Al-Khateeb 2004).

الخواص الإبادية والطاردة لسبع زيوت نباتية ضد خنفساء الحبوب المنشارية (*Oryzaephilus surinamensis*) وخنفساء الدقيق الصدئية (*Tribolium castaneum*)

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الأحساء – المملكة العربية السعودية

الملخص :

تم تقييم الفعل الإبادي والطارد لسبع زيوت نباتية هي: الكافور، والسترونيلا، اللافندر والنعناع واللوز المر وحصالبان والجوجوبا ضد خنفساء الحبوب المنشارية وخنفساء الدقيق الصدئية تحت الظروف المعملية. حيث تم اختبار خمس تركيزات هي 0.125 ، 0.25 ، 0.5 ، 0.75 ، 1 ٪ . تم تعريض الحشرات الكاملة من خنفساء الحبوب المنشارية وخنفساء الدقيق الصدئية للقمح المعامل بالزيوت النباتية لمدة أسبوعين. سجلت نسب الموت بعد ثلاثة أيام، أسبوع وأسبوعين من التعرض. أوضحت النتائج حدوث نسبة موت 100٪ من خنفساء الحبوب المنشارية عند تعريضها لتركيزات أعلى من 0.5٪ من زيوت النعناع واللافندر والكافور. بينما أظهر تركيز 1٪ من زيوت اللوز المر والسترونيلا 100٪ موت للطور الكامل من خنفساء الدقيق الصدئية بعد أسبوعين من المعاملة. كان زيت حصالبان هو أقل الزيوت تأثيراً على تلك الحشرتين. كما لوحظ زيادة ملموسة في نسبة الموت بزيادة وقت التعرض. كانت خنفساء الدقيق الصدئية أكثر تحملاً من خنفساء الحبوب المنشارية للزيوت المستخدمة. ومن ناحية أخرى بينت نتائج التأثير الطارد أن زيت اللافندر عند تركيز 1٪ كان أعلى الزيوت النباتية في نسبة الطرد حيث بلغت 81.94 ٪ ، 84.73 ٪ لكل من خنفساء الحبوب المنشارية وخنفساء الدقيق الصدئية على التوالي.

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Table (5)
Repellency of essential oils to *T. castaneum*.

Plant Oil	Repellency at concentrations (%)					Means
	0.125	0.25	0.5	0.75	1	
C. camphora	27.84	40.57	38.95	37.04	54.35	39.75 c
C. winterianus	37.17	34.72	43.4	49.41	42.77	41.49 c
M. chamomilla	75.26	72.31	76.83	73.71	84.73	76.57 a
M. viridis	18.11	24.49	25.34	21.33	22.34	22.32 d
P. amygdalus	47.07	63.25	62.21	65.55	55.2	58.66 b
R.. officinalis	37.69	33.13	46.83	44.71	45.12	41.50 c
S. chinensis	41.49	37.31	41.78	47.74	42.26	42.12 c
Mean	40.66 a	43.68 a	47.91 a	48.50 a	49.54 a	

Means followed by the same letter (s) are not significantly differ at 5% level of probability
LSD (5%) for oil x concentration = N.S

Also, Tripathi *et al*., (1999) reported that fruit oil of *Piper retrofractum* exhibited high repellency against *T. castaneum* (52, 76 and 90 %) at 0.5, 1 and 2% concentrations.

Pasccual-Villalobos (1999) screened wild species of 21 botanical families and reported that compositae species had a tendency to induce either growth inhibition (with or without mortality) or repellency on *T. castaneum*. Moreover, Abubakr *et al*., (2000) reported a repellent and antifeedant properties of *Cyperus articulatus* against *T. castaneum.* From These results it appeared that, complete mortality of *O. surinamensis* was achieved by *M. viridis, M. chamomilla* and *C. camphora* at concentration more than 0.5%, While, 1% of *P. amygdalus* or *C. winterianus* gave complete mortality of *T. castaneum* after two weeks of exposure. Therefore, one can conclude that these potent essential oils might be useful for management control of stored product beetles.

Table (3)
Toxicities of the essential oils against *O. surinamensis* and *T. castaneum* at different concentrations of essential oils and exposure time

Treatments	Mortality (%)	
	O. surinamensis	*T. castaneum*
Plant oils		
C. camphora	72.8 b	52.2 b
C. winterianus	66.7 bc	49.7 b
M. chamomilla	69.7 b	32.7 c
M. viridis	92.0 a	47.1 b
P. amygdalus var amara	56.3 d	61.8 a
R. officinalis	42.7 e	17.1 d
S. chinensis	61.3 cd	47.0 b
Concentration		
0.125 %	50.8 d	28.7 d
0.250 %	60.1 c	35.6 c
0.500 %	66.4 b	46.5 b
0.750 %	73.8 a	51.0 b
1.000 %	78.5 a	57.9 a
Exposure time		
24 h	49.8 c	20.4 c
48 h	67.7 b	34.7 b
72 h	80.3 a	76.7 a

Table (4)
Repellency of essential oils to *O. surinamensis*.

Plant Oil	Repellency at concentrations (%)					Means
	0.125	0.25	0.5	0.75	1	
C. camphora	39.35	28.46	38.79	39.55	39.46	37.12 c
C. winterianus	30.52	41.32	45.55	45.94	43.33	41.33 c
M. chamomilla	74.15	68.67	69.22	64.9	81.94	71.78 a
M. viridis	33.63	34.23	31.04	31.93	33.99	32.96 c
P. amygdalus	42.35	41.27	68.46	68.72	67.84	57.73 b
R.. officinalis	40.45	45.79	48.44	69.97	61.78	53.29 b
S. chinensis	14.13	32.97	44.92	48.78	64.66	41.09 c
Mean	39.23 b	41.82 b	49.49 a	52.83 a	56.14 a	

LSD (5%) for oil x concentration = 18.40

Table (2): Toxicities of the essential oils against *T. castaneum*.

Plant oil	Concentration (%)	Mortality (%) after			Mean
		3 Days	1 Week	2 Weeks	
C. camphora	0.125	15.0	28.3	76.7	40.0
	0.250	35.0	11.7	56.7	34.4
	0.500	40.0	58.3	93.3	63.9
	0.750	38.3	51.7	90.0	60.0
	1.000	33.3	61.7	93.3	62.8
	Mean	32.3	42.3	82.0	52.2
C. winterianus	0.125	5.0	18.3	78.3	33.9
	0.250	18.3	20.0	73.3	37.2
	0.500	13.3	33.3	80.0	42.2
	0.750	38.3	51.7	98.3	62.8
	1.000	41.7	75.0	100.0	72.2
	Mean	23.3	39.7	86.0	49.7
M. chamomilla	0.125	5.0	11.7	63.3	26.7
	0.250	16.7	8.3	33.3	19.4
	0.500	5.0	23.3	83.3	37.2
	0.750	3.3	25.0	88.3	38.9
	1.000	6.7	26.7	90.0	41.1
	Mean	7.3	19.0	71.7	32.7
M. viridis	0.125	6.7	1.7	38.3	15.6
	0.250	31.7	20.0	70.0	40.6
	0.500	23.3	45.0	96.7	55.0
	0.750	13.3	61.7	100.0	58.3
	1.000	46.7	66.7	85.0	66.1
	Mean	5.3	10.0	36.0	17.1
P. amygdalus	0.125	13.3	16.7	95.0	41.7
	0.250	45.0	43.3	95.0	61.1
	0.500	18.3	61.7	100.0	60.0
	0.750	11.7	70.0	100.0	60.6
	1.000	60.0	96.7	100.0	85.6
	Mean	29.7	57.7	98.0	61.8
R. afficinalis	0.125	5.0	5.0	36.7	15.6
	0.250	5.0	6.7	25.0	12.2
	0.500	5.0	8.3	35.0	16.1
	0.750	5.0	13.3	36.7	18.3
	1.000	6.7	16.7	46.7	23.3
	Mean	5.3	10.0	36.0	17.1
S. chinensis	0.125	6.7	15.0	61.7	27.8
	0.250	43.3	16.7	73.3	44.4
	0.500	15.0	38.3	100.0	51.1
	0.750	15.0	58.3	100.0	57.8
	1.000	21.7	48.3	91.7	53.9
	Mean	15.0	28.3	76.7	40.0

LSD 5% (Oil x Concentration) = 13.8
LSD 5% (Oil x Killing time) = 10.7
LSD 5% (Concentration x Killing time) = 9.0
LSD 5% (A x B x C) = 23.9

Table (1) Toxicities of the essential oils against *O. surinamensis*.

Plant oil	Concentration (%)	Mortality (%)			Mean
		3 Days	1 Week	2 Weeks	
C. camphora	0.125	25.0	46.7	58.3	43.3
	0.250	55.0	61.7	88.3	68.3
	0.500	90.0	96.7	100.0	95.6
	0.750	60.0	65.0	78.3	67.8
	1.000	86.7	86.7	93.3	88.9
	Mean	63.3	71.3	83.7	72.8
C. winterianus	0.125	31.7	55.0	90.0	58.9
	0.250	43.3	60.0	66.7	56.7
	0.500	36.7	68.3	73.3	59.4
	0.750	70.0	85.0	88.3	81.1
	1.000	56.7	85.0	90.0	77.2
	Mean	47.7	70.7	81.7	66.7
M. chamomilla	0.125	16.7	55.0	88.3	53.3
	0.250	25.0	61.7	86.7	57.8
	0.500	35.0	66.7	80.0	60.6
	0.750	75.0	98.3	100.0	91.1
	1.000	65.0	93.3	98.3	85.6
	Mean	43.3	75.0	90.7	69.7
M. viridis	0.125	56.7	78.3	83.3	72.8
	0.250	95.0	98.3	98.3	97.2
	0.500	86.7	98.3	98.3	94.4
	0.750	96.7	100.0	100.0	98.9
	1.000	96.7	96.7	96.7	96.7
	Mean	86.3	94.3	95.3	92.0
P. amygdalus	0.125	21.7	51.7	83.3	52.2
	0.250	21.7	45.0	68.3	45.0
	0.500	21.7	41.7	78.3	47.2
	0.750	33.3	73.3	86.7	64.4
	1.000	46.7	90.0	81.7	72.8
	Mean	29.0	60.3	79.7	56.3
R. afficinalis	0.125	13.3	41.7	56.7	37.2
	0.250	23.3	41.7	80.0	48.3
	0.500	41.7	55.0	71.7	56.1
	0.750	25.0	33.3	35.0	31.1
	1.000	38.3	35.0	48.3	40.6
	Mean	28.3	41.3	58.3	42.7
S. chinensis	0.125	28.3	45.0	40.0	37.8
	0.250	35.0	40.0	66.7	47.2
	0.500	46.7	43.3	65.0	51.7
	0.750	66.7	86.7	93.3	82.2
	1.000	75.0	90.0	98.3	87.8
	Mean	50.3	61.0	72.7	61.3

LSD 5% (Oil x Concentration) = 1.51 NLSD 5% (Oil x Killing time) = 11.7
LSD 5% (Concentration x Killing time) = 9.9
LSD 5% (A x B x C) = 26.1

insecticides against *T. castaneum* and *O. surinamensis* has been studied. Those beetles have shown susceptibility to plant-derived chemicals (Jilani *et a.l*, 1988; Tripathi *et al*., 2000; Kim *et al*., 2003). Owsu (2001) on the other hand reported that, extracts of *Ocimum viride* leaves at 0.1 mg/ml proved to be the most effective in the control of *T. castaneum* and *S. oryzae* after ten days of treatments.

Repellent action of essential oils to *O. surinamensis*

The repellent action of the above mentioned essential oils was also studied. Data in (table 4) showed that *M. chamomilla* had strong repellent action (81.94%). Moreover, the statistical analysis revealed a significant difference between this oil and the other oils. However, *M. viridis* had less repellent action (32.96%). The rest of essential oils had a moderate repellent action.

Repellent action of essential oils to *T. castaneum*

The repellent action of the above mentioned essential oils was also studied against *T. castaneum*. Data in (table 5) showed that *M. chamomilla* had the lead in repellent action where repellent percentage reached 84.73% at 1% concentration. Statistical analysis revealed a significant difference between *M. chamomilla* and other tested essential oils in their repellent actions. *Mentha viridis* had less repellent action (22.32%) against *T. castaneum*. The rest of essential oils had moderate repellent actions between 22.32-76.57 %. In general, *M. chamomilla* had strong repellent action and *M. viridis* had a weak one to both insect species. Similar data were obtained by Owsu (2001) who reported that extracts of *Ocimum viride* leaves at 0.1 mg/ml showed strong repellent activity and deterred *T. castaneum* feeding after ten days of treatments.

significant was used to compare treatment means (Waller and Duncan, 1969). Computations were done using SAS (1996).

Results and Discussions

Efficacy of essential oils to *O. surinamensis*

The insecticidal activity of the following essential oils: *C. camphora, C. winterianus, M. chamomilla, M. viridis, P. amygdalus var amara, R. afficinalis* and *S. chinensis* were tested against *O. surinamensis* (Table 1). The data indicated that, *C. winterianus* at a concentration of 0.125 % was the most toxic oil followed by *M. chamomilla*, *M. viridis* and *P. amygdalus* where 90, 88.5, 83.3 and 83.3 % of mortality were achieved, respectively. *Simmondsia chinensis* was the least toxic essential oil among the others (45% of mortality). Complete mortality was achieved at a concentration of 0.75% of *M. viridis* and *M. chamomilla or* at 0.5% of *C. camphora.* The highest concentration (1%) of *S. chinensis* gave 98.3% of mortality followed by *M. viridis, C. camphora,* and *C. winterianus* where 96.7, 93.3 and 90% of mortality were achieved along two weeks of exposure. Mortality percentage increased with exposure time of the same concentration. Statistical analysis (Table 3) revealed that *M. viridis* had a significant efficacy to *O. surinamensis* than other essential oils. Moreover, *O. surinamensis* was more susceptible to tested oils than *T. castaneum*.

Efficacy of essential oils to *T. castaneum*

The insecticidal activity of the previous essential oils against *T. castaneum* is shown in (table 2). Data of the accumulative mortality of *T. castaneum* adult along two weeks of exposure to essential oils revealed that *P. amygdalus* was the most effective essential oil against the adults that gave 95% of mortality at 0.125% concentration and a complete mortality at a concentration of 0.5 %. *Rosmarinus afficinalis* was the least toxic essential oil to *T. castaneum* where < 50% of mortality was achieved at 1% concentration. Complete mortality of *T. castaneum* was achieved at concentration of 1% of *C. winterianus* , 0.75% of *M. viridis* and 0.5 % of *P. amygdalus* and/or *S. chinensis.* Mortality was increased with increasing exposure time. Statistical analysis revealed that *P. amygdalus* along two weeks of exposure had a significant efficacy compared with the other tested essential oils. Data also revealed that *R. afficinalis* was the less toxic essential oils to both insect species (table 3). The effectiveness of many plant extracts and essential oils as repellents, antifeedents and

Contact toxicity

Five dilutions of each oil (1, 0.75, 0.5, 0.25 and 1.25 % w/w) were prepared in acetone. Aliquots of 1 ml of each dilution were sprayed on twenty grams of wheat by using Potter Precision Laboratory Spray Tower (Burkard, Co. Limited, Rickmansworth, Herts, England) to achieve homogeneous distribution of oil. Wheat moisture content was 12.5%. Treated wheat was placed in 250 cc flasks. After acetone evaporation for an hour, ten unsexed adults of O. surinamensis or T. castaneum were introduced to each flask. Flasks were covered with a piece of muslin by the aid of rubber band. The control and treatments were replicated four times. Flasks were kept under laboratory conditions for two weeks. Insect mortalities were determined and calculated after 3, 7 and 14 days from exposure, according to the formula of Abott (1925).

Repellency

Pervious concentrations of plant essential oils were also assayed for their repellency to *O. surinamensis* or *T. castaneum.* An apparatus consisted of two plastic pipes (5 cm dia. and 25 cm long/ each) was designed. The two pipes were joined together with a T-shape pipe to form one 50 cm long pipe with three openings. Two polyethylene bags contain treated and non-treated wheat was tied to both ends. Groups of twenty newly emerged adults of *O. surinamensis* or *T. castaneum* were released in the test arena between the two joined pipes through converted T-shape tube (⩢), then the upper end closed with a piece of muslin by the aid of rubber band. The control and treatments were replicated four times. The apparatus were kept under laboratory conditions for 48 hours then insects were counted in both treated and non-treated bags.

The repellency percentage (RP) was calculated using the method of Jilani *et al*., (1988). All repellency assays were conducted in the laboratory. Insects that died during experimental period were replaced by the same aged adults from the same treatments.

Statistical analysis

Collected data were statistically analyzed according to Gomez and Gomez (1984) method. The Least significant difference (LSD) at 0.05 % level of

attention and several were of natural products evaluated for their insecticidal efficacy. For instance, Singh and Singh (1991) screened 31 essential oils from different botanical sources against the house fly *Musca domestica* L., and reported repellent and insecticidal activities against this species. The effectiveness of many botanical oils against stored grain insects has already been demonstrated (Su, 1990, Dunkel and Sears, 1998 and Tripathi *et al*., 2000). Many types of spices and herbs are known to possess anti-insect activities (Tripathi *et al*., 1999) especially in the form of essential oils (Shaaya *et al*., 1995). Also, it may be possible to use botanical extracts, edible oil and/or develop environmental manipulation strategies for effective insects control (Evans, 1987; Jacob and Fleming, 1989; Zewar, 1993; Xie *et al*., 1995; Trematerra and Lanzotti, 1999). In the meantime, the repellent, deterrent and biological effects of some plant materials against stored product insects have been studied by many researches (Harish *et al*., 2000; Tripathi *et al*., 2002; Kim *et al*., 2003).

This study was initiated to evaluate the toxicity and repellency of some essential oils against *T. castaneum* and *O. surinamensis*

Materials and Methods

Insect

Tribolium castaneum and *O. surinamensis* cultures were reared under laboratory conditions (27ºC and 70 $\pm$ 5 RH.). Adult insects 1-3 weeks old were collected and used for the bioassay tests.

Plant essential oils

Seven commercially available essential oils were tested in this study. Four of them were obtained from Shanghai Chemical Industrial Co., Shaanghai, China (Mint, *Mentha viridis;* Camphor, *Cinnamomum camphora*; Citronella, *Cymbopogon winterianus;* Hasa Luban, *Rosmarinus afficinalis*), one from Human Provincial Native Co., China (Almond, *Prunus amygdalus var amara*) and two from Givaudan-Roure, France (Babonj, *Matricaria chamomilla* and Jojoba, *Simmondsia chinensis*). These oils were assayed against *O. surinamensis* and *T. castaneum* adults.

Toxicity and Repellency of Seven Plant Essential Oils to *Oryzaephilus surinamensis (Coleoptera: Silvanidae) and Tribolium castaneum (Coleoptera: Tenebrioidae*)

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Abstract :

Seven essential oils of *Cinnamomum camphora, Cymbopogon winterianus, Matricaria chamomilla, Mentha viridis, Prunus amygdalus var amara, Rosmarinus afficinalis* and *Simmondsia chinensis* were evaluated in the laboratory for their toxicities and repellent effectiveness against adults of saw-toothed grain beetle, *Oryzaephilus surinamensis* (L.) and rust-red flour beetle, *Tribolium castaneum* (Herbst). Five concentrations of every essential oil (0.125, 0.25, 0.5 and 0.75 and 1 %) were tested. Adult beetles were exposed to the treated wheat for 2 weeks. Percent of mortality was recorded after 3 days, one week and two weeks from exposure. The repellent action of the previous essential oils was also studied using same concentrations used in toxicity tests. Results showed that complete mortality of *O. surinamensis was* achieved by M. *viridis, M. chamomilla* and C. *camphora* at concentration more than 0.5%. Although, 1% of *P. amygdalus* or *C. winterianus* gave complete mortality of *T. castaneum* after two weeks of exposure. Conversely, *R. afficinalis* was the least toxic to both insect species. The rest of essential oils gave an adequate toxicity to both insect species. Pronounced increase of mortality was observed for most of essential oils with increasing time of exposure. *Tribolium castaneum* was less susceptible to tested oils compared with *O. surinamensis.* Moreover, *M. chamomilla* exhibited high repellency 81.94% and 84.73% at 1% concentration against *O. surinamensis* and *T. castaneum,* respectively.

Introduction :

Stored product insects are a perennial problem in retail stores, where they damage and contaminate susceptible merchandise such as food products and animal feed. In stored grain, insect damage may account for 10-40% of loss worldwide (Matthews, 1993). *Oryzaephilus surinamensis and Tribolium castaneum* are the most common species attacking stored grain and other products. Insect control in stored product relies heavily on the use of gaseous fumigants and residual insecticides, both of which can pose serious hazards to warm-blooded animals and environment. Natural products are well known to have a range of useful biological properties against insect pests (Arthur, 1996). Recently, research on natural products in the form of extracts has received

نحو تخفيض وقت ضغط الصور "فراكتال" باستعمال تقنيات الجينات الصناعية

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الملخص :

إن أدوات الجينات الصناعية و الهندسة التطورية كانت من الموضوعات الأكثر إثارة لدى الباحثين في العشر سنوات الأخيرة، حيث أنها برهنت عن تفوقها و فعاليتها في مسائل و تطبيقات البحث عن الحل الأمثل في فضاءات متعددة الأبعاد.

لقد شدت تقنيات ضغط الصور "فراكتال" أيضا انتباه الباحثين حيث شكلت تطبيقات التكنولوجيات الحديثة المعتمدة على الويب تحديا جديدا. لقد تم اقتراح عدد من تقنيات ضغط الصور من طرف الباحثين الا أنها كانت بأغلبيتها تهتم بالتوازن بين نسبة الضغط و نوعية الصورة بعد الاسترجاع.

بهذا البحث نقترح خوارزميات جينية ديناميكية لتحسين عملية ضغط صور "فراكتال" بالتركيز على نظم الدوال التكرارية (IFS). يتم استعمال ترميز خاص لكل معطيات و متغيرات الصورة في سلسلة كروموزومية محددة. كود و معطيات الخوارزميات الجينية. لقد قمنا باستعمال طريقة تقسيم الصورة بغض النظر عن حجم كائنات الصورة و موقعها في الإطار. تمكن هذه الطريقة من تسريع مرحلة الترميز بتغيير مدة الترميز أثناء البحث عن أكبر تشابهات بين كائنات الصورة.

لقد أجرينا عدد من الاختبارات لهذا البرنامج على صور "فراكتال" حيث برهنت عن تخفيض نسبي لوقت التشغيل (الضغط و فك الضغط) دون خسارة جودة الصورة و هذا بسبب البحث المتوازي عن الكائنات و المجالات (blocks and ranges) التي توفرها الجينات الصناعية.

الكلمات الأساسية: ضغط صور "فراكتال"، الخوارزميات الجينية، نظم الدوال التكرارية.

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Image	Standard Algorithm			Genetic Algorithm			Classification Algorithm		
	Rate	Quality	Time	Rate	Quality	Time	Rate	Quality	Time
Boat using 8x8 decomposition schema	17.06:1	23.95 db	28m 35s	17.06:1	22.93 db	16 s	17.06:1	22.91 db	1m 10s
Boat using 4x4 decomposition schema	4.2:1	31.95 db	16m 28s	4.2:1	30.88 db	36 s	4.2:1	31.12 db	1 m
Boat using QuadTree decomposition schema	11.48 :1	32.01 db	1:10:11	9.88 :1	33.25 db	42 s	9.73 :1	30.05 db	2m 55s

Conclusion :

It is clear that the best image quality is always obtained using the standard schema, but its computation time makes it unpractical. So we must accept less quality in favor of quick compression. The Fisher's approach was proposed to satisfy this constraint. Our main goal was to accelerate standard compression schema, without greatly decreasing both image quality and compression ratio.

The results presented above prove that the genetic fractal compression algorithm seems to be the best. Further more this work demonstrates the genetic algorithm ability to solve complex problems.

RMS Limit	Execution Time	Quality (db)	Compression Ratio	Ranges count
0.0	2 m 44 s	35.66 db	4.29 :1	4069 block
2.0	1 m 56 s	35.03 db	6.35 :1	2770 block
4.0	49 sec	34.89 db	9.28 :1	2023 block 1792
5.0	43 sec	34.80 db	9.82: 1	block
8.0	36 sec	34.5 db	9.95 :1	1768 block
10.0	33 sec	30.5 db	10.05 :1	1750 block
15.0	21 sec	22.33 db	13.66 :1	1288 block
20.0	14 sec	19.36 db	19.34 :1	910 block
25.0	15 se	19.01 db	26.25 :1	670 block

Figure 10. Different compression results of Boat image while applying different values of RMS error limit

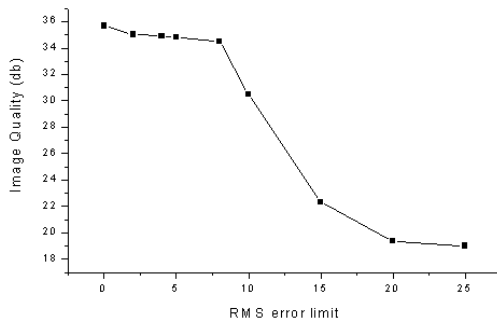

Figure 11. Boat image quality variation according to RMS limit values

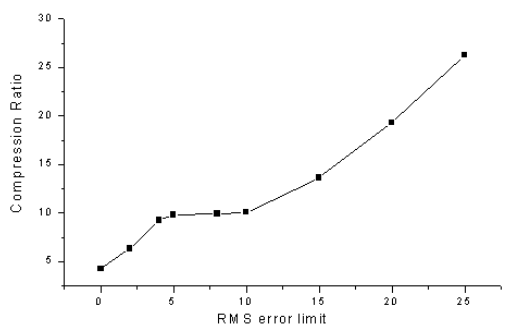

Figure 12. Boat image compression rate variation according to RMS limit values

Figure 13- Original Image of the Boat

Figure 14- Image of the Boat after restitution RMS=5.0 (Ratio 9,14:1)

4x4 Decomposition :

High quality is always obtained in this schema with all proposed algorithms, but the genetic algorithm increases greatly compression speed. The compression ratio is very low. Figures 8 and 9 shows decompressed and original image of Lena with RMS=5.0. Table in figure 10 gives results for genetic, standard and classification compression schema applied to Boat image.

Figure 8- Original Image of the Boat

Figure 9- Decompressed Image with 4X4 decomposition scheme using genetic algorithm

Genetic Algorithm With Quadtree Decomposition :

The QuadTree schema is the best way to decompose compressed image, and to make range blocks suitable to the image content. The major problem is the high computation time. The quality of the decompressed image
depends only on RMS error because different size of range blocks can be used according to the current image area. Genetic algorithm, used with this method, improves compression speed. If we decrease the error limit, we obtain good image quality without greatly slowing the compression process: this is the main advantage of our implementation. The following table show different performances with different value of RMS error limit using fixed value for other parameters: population size=100, mutation rate = 0.1, crossover rate = 0.7 and maximum generations count =20. figures 11 and 12 shows that image quality is inversely proportionate to RMS error limit. And compression ratio is proportionate to that value. The compromise value of this parameter is 5.0, it gives very acceptable performances.

Tests and Results

Genetic Compression Algorithm With Regular Partition

The decomposition schema is a regular partition with 8x8 and 4x4 block size. The genetic algorithm optimises the domain block search. Results are as follow:

8X8 Decomposition

With crossover rate fixed to 0.7, mutation rate to 0.1 and population size to 100. Figure 5 gives results for genetic, standard and classification compression schema applied to Boat image. It is clear that genetic schema greatly reduces compression time without significant loss of image quality. Figures 8 and 9 shows restitution of Boat and Barb images. Figures 6 and 7 show quality and compression ratio variations for different RMS error.

	RMS = 2.0	RMS = 5.0	RMS = 10.0	RMS = 15.0
Standard Algorithm Results	PSNR=24.25 db Time= 35 m 18 s	PSNR=23.95 db Time=28 m35 s	PSNR= 23.12 db Time= 21 m 69 s	PSNR=22.62 Time= 18 m 32 s
Genetic Algorithm Results	PSNR=23.56 db Time=24 s	PSNR=22.93 db Time=16 s	PSNR=22.51 db Time=12 s	PSNR=22.01 db Time=9 s
Classification Algorithm Results	PSNR= 22.11 db Time= 1m 56 s	PSNR=22.11 db Time=1m 09 s	PSNR= 20.01 db Time= 56 s	PSNR= 19.66 db Time= 44 s

Figure5. Results for the three presented algorithms with 8x8 regular partition Applied to Boat image.

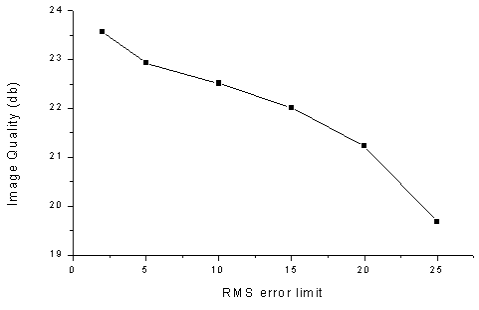

Figure 6. Boat image Quality variation for different RMS error

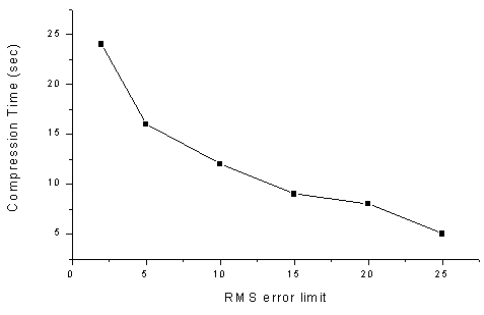

Figure 7. Boat image Compression ratio variation for different RMS error

Parameters inherent to the genetic algorithm:

- Population size;
- Crossover rate;
- Mutation rate;
- Number of generations.

Parameters inherent to the fractal image compression schema are :

- The range blocks decomposition size (used with regular partitioning);
- The lowest block size used for ranges decomposition (in the case of QuadTree schema);
- The number of flips and isometrics applied to each domain block;
- The decomposition error limit, this parameter is introduced to improve the QuadTree decomposition schema;
- The RMS error limit fixed to decide if a given transformation is accepted.
- The number of bits used to quantify and code luminance and contrast parameters, fixed experimentally to 5 and 7 bits respectively.

Population Size	100
Maximum generations	20
Crossover rate	From 0.7 to 0.8
Mutation rate	0.1
RMS limit	5.0
Decomposition error limit	10.0
Flips and isometrics count	8

Figure 4. Optimal set of parameters

The values of range blocks size and lowest decomposition level depends on the used decomposition schema, they are fixes in the case of regular partitioning. For the QuadTree decomposition, we set the lowest block size to 4x4 pixels to achieve highest reconstruction quality, and to 8x8 to obtain acceptable quality with high compression ratio. In the following, we present the obtained results for different decomposition methods and with different parameters combinations, A comparison with both standard and classification based algorithms is also presented and discussed.

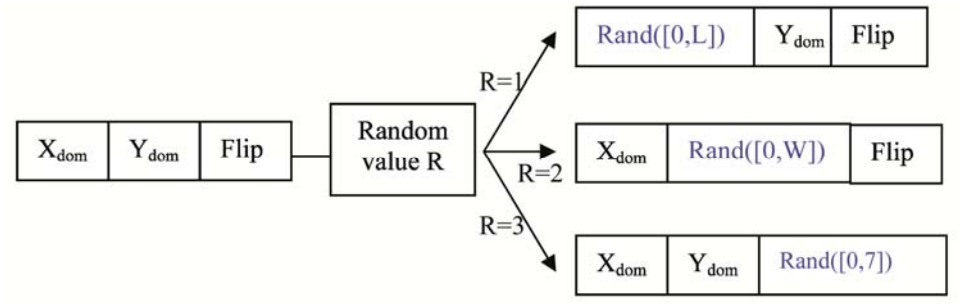

Figure 3. Mutation operator schema

Selection Process :

To avoid the premature convergence effect, linear scaling is applied to each individual fitness. Then, the Roulette wheel method is used as a selection process.

Termination Criteria

When applied to a given range block, two criteria can cause the genetic algorithm termination:

- An individual with an acceptable fitness is found;
- The last generation is reached (either by setting up a finite number of generations or a fitness limit (.99) as criteria to terminate the search algorithm).

Genetic-Compression Algorithm *(Input I :256x256 gray scale image, Output W: Coded IFS);*

Decompose the input image into range blocks according to the decomposition schema;
For *each block R in Ranges(I)* ***do***
- Generate a random population of chromosomes;
- Compute fitness for all individuals;
While *(No optimal domain block is found)* ***and*** *(last generation is not reached)* ***do***
- Generate a new population:
{Use selection process,
Apply Crossover and Mutation operators};
- Compute fitness for all individuals of the new generation;

End While*;*
- Write obtained transformation parameters to the output W;
End For*.*
End GCA.

Crossover Operator :

The crossover operator combines two individuals (the parents) of the current generation and produces two offspring individuals. According to our chromosome specification new schema of the crossover operator is proposed: the offspering individuals coordinates are obtained by a linear combinaison of the parents coordinates and the offspering flip value is randomely choosen from one of the parents flip value. The new offspring coordinates are computed according to the following formula:

For the first offspring :

$$X_{dom} = a * X_{dom}^{p1} + (1-a) * X_{dom}^{p2}$$
$$Y_{dom} = a * Y_{dom}^{p1} + (1-a) * Y_{dom}^{p2}$$

For the second offspring:

$$X_{dom} = (1-a) * X_{dom}^{p1} + (1-a) * X_{dom}^{p2}$$
$$Y_{dom} = (1-a) * Y_{dom}^{p1} + (1-a) * Y_{dom}^{p2}$$

Where the constant "a" is a random number in the interval [0 , 1]

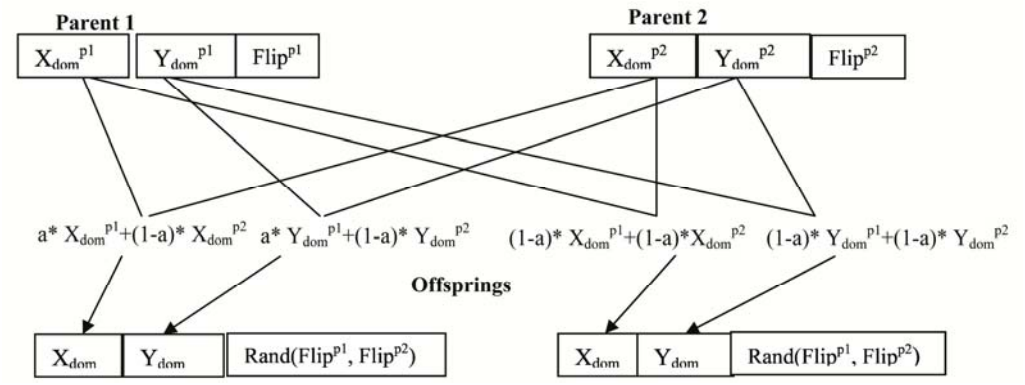

Figure 2. crossover operator schema

Mutation Operator :

Xdom, Ydom and flip are changed with a random generated value respectively in [0, L],[0, W], and [0, 7] intervals. The figure 3. illustrate the mutation operator schema

The Fitness Function :

The fitness function assigns to each individual in the population a numeric value that determine its quality as a potential solution. The fitness denotes the individual ability to survive and produces offspring. In our case, the fitness is given by the inverse of the RMS error
between the coded range block, and the domain block.

Mutation operator modifies the chromosome genes randomly according to the mutation probability. the genes

determined by the transformation co-ordinates Xdom and Ydom, and transformed with corresponding luminance and contrast values.

The smaller is the RMS, the better is the image quality. We normalize the fitness to 1 by taking the inverse value of the RMS, so that the quality is best when fitness is close to 1.

The RMS equation and the fitness function and the transformation parameters formulas are given in the following, where ai are domain elements, and bi denote the range elements :

Fitness function (T)= 100 / (RMS(Ri ,T(Ri))).

$$RMS=\frac{1}{n}\left[\sum_{i=1}^{n2} b_i^2+S(S.\sum_{i=1}^{n2} a_i^2-2\sum_{i=1}^{n2} a_i b_i+2.o.\sum_{i=1}^{n2} a_i)+o.(on_2-2\sum_{i=1}^{n2} b_i)\right]$$

$$s=\frac{n^2.\left(\sum_{i=1}^{n^2} a_i b_i\right)-\left(\sum_{i=1}^{n^2} a_i\right).\left(\sum_{i=1}^{n^2} b_i\right)}{n^2\sum_{i=1}^{n^2} a_i^2-\left(\sum_{i=1}^{n^2} a_i\right)^2}$$

and

$$o=\frac{1}{n^2}.\left[\sum_{i=1}^{n^2} b_i-S\sum_{i=1}^{n^2} a_i\right]$$

Genetic Operators :

The crossover and mutation operators ensure the production of offspring. These genetic operators must be defined according to the chromosome specification.

image, not in exhaustive way as standard algorithm does, and without omitting any possible block (solution) as classification schema does.

In this paper we use genetic algorithms (GA) [Dasg2000] to satisfy such goal and to optimize the domain blocks search.

This is feasible by the fact that: GAs act randomly, are implicitly parallel and are directed by the fitness only.

This paper presents essentially the GA implementation. We have also implemented both Bernesly standard algorithm [Bans93] , and Y. Fisher algorithm based on classification schema [Hutch81] , [Saup94], [Venc94], [Shon91].

A performance comparison between different algorithms is also presented. Section 2 specify the GA characteristics, section 3 deal with regular partitioning and QuadTree genetic implementation, tests and results summary.

Standard Schema With Ga :

GAs are used to improve compression schema, principally to accelerate coding time. For each range domain Ri, the set of all possible domain blocks is genetically browsed until we find an appropriate solution.

The GA search space parameters are the domain block coordinates and the isometric flip.

The luminance and contrast (S and O) parameters are computed as done in the standard algorithm.

Chromosome Codification :

According to the search space parameters a chromosome is constituted by three genes : Xdom , Ydom the domain block coordinates and the isometric flip. Xdom, Ydom and flip are integers.

Xdom $\in$ [0, L], L is the image length.
Ydom $\in$ [0, W], W is the image width.
flip $\in$ [0, 7], eight isometric flip.

X_{dom}	Y_{dom}	Flip

Figure. 1. Chromosome representation

These various research papers emphasize essentially on how genetic algorithm-based techniques handle tradeoffs on compression ration or compression time versus image quality.

In [Alan95] , authors propose a bibliography of GA's in optics and image processing.

[Kim2002] focuses on unsupervised image segmentation using a distributed GA.

In [Xuan96], the author used a modified distributed GA for image segmentation by adding the capabilities of fuzzy systems to overcome contour effects.

[Redmi96] and [Mitra98] propose an improved GA for solving IFS code of fractal images.

[Beret 95] proposes modified and improved GAs for fast search in fractal image coding. These rarely take into consideration constraints on image parameters, image decomposition and segmentation schemes. This had instead proved affecting substantially image overall quality.

Fundamentally, the fractal image compression problem can be defined as : “given a Ranges(I), the set of all ranges blocks obtained by the decomposition schema, how to construct the set of all possible domain blocks Dom(I) such that it exists a transformation T : Dom(I) $\rightarrow$ Ranges(I) ; T must guaranty $\forall i, \exists j / T(Dj) = Ri$ ”. The compressed image is constituted of a set of IFS and Dom (I). A transformation is associated to each Ri, it codes the Dj coordinates and the specific parameters of the transformation T.

The image compression problem put forward three major requirements: speeding up the compression algorithm, improving image quality or increasing compression ratio. The compression ratio depends on the size of Ranges(I).

Fundamentally, the compression algorithm speed depends on the manner of exploring the search space to determine a block domain Dj.

The image quality is not absolutely separable of the previous two criteria.

The main problem of all fractal compression implementations is the execution time. Algorithms can take hours to compress a single image. So, the major variants of the standard algorithm were proposed to speed up computation time. But most of them lead to a bad image quality, or a lower compression ratio.

For example, the Fisher’s proposed classification schema has greatly accelerated the algorithm, but image quality was poor, due to the search space reduction imposed by the classification, witch eliminate a lot of good solutions. Then, the main problem is how to explore all domain blocks presents in the

On Improving Processing Speed of Image Fractal Compression Using Artificial Genetics Techniques

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Abstract :

Artificial Genetics tools have been for decades a subject for intensive investigations. From Genetic Algorithms and Hierarchical GA's to Evolutionary Engineering tools such as Genets, these tools have proven their efficiency in search and optimization problems in multi-dimensional spaces.

Fractal image compression has also been for decades a challenge for researchers facing the emergence of new web based technologies and applications.

Several works have been proposed in the literature of GA-Based Fractal compression emphasizing on Compression rate-Image quality tradeoffs.

In this paper we propose a dynamic Genetic Algorithm to improve performance of Fractal image compression based on local IFS. An adequate GA coding is used to address the different image parameters. The algorithm is set to fit all possible decomposition schemes regardless the range block size and position.

Furthermore, to avoid premature convergence, a linear scaling is applied to each individual fitness, then a roulette wheel method is applied for selection process.

Such modified GA is intended to speed up the coding phase by varying coding period through tuning GA parameter settings according to maximum bloc similarities.

Several computer simulation tests have been performed on Fractal images. Results show a major reduction in processing time during bloc-range search process without major loss of image quality .

Introduction :

The tremendous advances of information technologies as well as the emergence of new web-based technologies have created new needs in dealing with multimedia internet-based information and applications.

Several works in the literature have investigated ways to better compression time and ratio without loss of image quality.

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