

A progress Report on WATER USE EFFECIENCY OF FOUR INDEGINOUS FORAGE GRASSES IN COMPARISON WITH EXOTIC FORAGE SPECIES

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Abstract:

Exotic forage species such as alfalfa (*Medicago sativa*) and Rhodes grass (*Chloris gayana*) are being grown in Arabian Peninsula region to accommodate the shortfall of forage from rangeland. These species, however, require large volumes of irrigation water, mainly ground water. This has compounded the problems of desertification by lowering the ground water levels and raising salinity levels that has lead to reduced potential productivity of agricultural land, and in severe cases to the abandoning of the cultivated land.

ICARDA-Arabian Peninsula Regional Program Phase I, was successfully launched in 1997 (1997-2000) to deal with the harsh environment of AP countries. Four themes were selected by the participating countries to be the main focus for the program. These were: (i) rangeland, shrubs, irrigated forages and livestock, (ii) protected agriculture, (iii) an abiotic stress and (iv) on farm water use and irrigation management

Utilizing the adapted genetic variation of indigenous forage species, seed multiplication and rehabilitation of degraded rangelands is the main strategy of the rangeland component of the program. During phase I, germplasm collection missions were conducted in various countries of the Peninsula (UAE and Oman), along with the development of herbaria, databases and enclosures. Seeds of priority species were multiplied and evaluation for water use efficiency and nutritive values are determined. Initial data show that such desert forages use less water than the introduced forages and has an acceptable nutritive value.

The purpose of this research activity is to determine the water use efficiency of four indigenous forage grasses

Objectives:

To compare the water use efficiency of four indigenous grass species: *Labeid* (*Cenchrus ciliaris*); *Thomam* (*Panicum turgidum*); *Themoma* (*pennisetium Divism*); and *Dakhna* (*Coelachyrum piercei*) and one exotic species: Rhodes grass (*Chloris gayana*), under the environmental conditions of the Central Saudi Arabia.

Experimental site: Riyadh, National Agriculture and Water Research Center of the Ministry of Agriculture and Water, Saudi Arabia.

Date of commencement of study: February 2003

Expected date of completion: April 2005

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Experimental Details:

1. Introduction:

In the Arabian Peninsula, the main fodder crops are alfalfa (*Medicago sativa*) and Rhodes grass (*Chloris gayana*). These species do not occur naturally and are not adapted to the prevailing harsh conditions of drought, temperature and salinity. They require vast quantities of water (up to 48 000 m³/ha/year) often derived from nonrenewable ground water sources (Guide for Crop Irrigation in the Kingdom of Saudi Arabia, 1988). Apart from being unsustainable, production of these forages has resulted in many countries of Arabian Peninsula in abandoning of forage cultivated lands, due to problems of salinity and shortage of water.

It is known that indigenous species are capable of surviving with less water than most introduced species such as Rhodes grass and alfalfa. However, unlike the latter, the productivity of the indigenous species as a function of the amount of water is not fully known. Results from a line source experiment at Dhaid (Sharjah), UAE, during 1999, comparing the water use efficiency of Rhodes grass with two indigenous forages (*Coelachyrum piercei* and *Cinchrus ciliaris*) was not conclusive. However, The values of WUE reported for the latter two species elsewhere (include UAE) are as good or even better than that of Rhodes grass (John Peacock, personal communication). A review of available research publications did not show such trials had been tried in Saudi Arabia.

In this study, four indigenous grasses (: *Labeid* (*Cenchrus ciliaris*); *Thomam* (*Panicum turgidum*); *Themoma* (*pennisetium Divism*); and Dakhna (*Coelachyrum piercei*) and an exotic species: Rhodes grass (*Chloris gayana*) will be compared for their productivity and water use efficiency. The study will also assess the performance of the different species under different irrigation regimes and repeated cutting.

2. Materials and Methods

Four indigenous grass species and one exotic forage (see above) will be compared for their productivity under three irrigation treatments. The Treatments are as follow: T1: Water application at full ET rate (no stress), T 2: Water application at fixed rate equivalent to 2/3 of T1, and T3: Water application at fixed rate equivalent to 1/3 of T1. Irrigation to be applied when soil moisture depletion reaches 50% of the field capacity.

The five grass species (the sub-plot treatments), will be randomly distributed within each main plot treatment. Each species will occupy a plot size of 2.75 m x 2.75 m in each main plot treatment. There will be a boarder of one meter between sub-plots and three meters between the main plots treatments.

Experimental design: Split Plot Design under Randomized Block Design with three replications.

3. Data collection

After establishment, grasses will be cut down to the same height (10-cm). This will mark the beginning of the experiment. Thereafter the plots will be irrigated with well water according to suggested water treatments, and harvested at interval of 4-6 weeks to ground level. Harvested forages (2m x 2m in the middle of sub-plot) will be weighed, and sub-samples taken for oven drying. The dried material will be weighed and stored. Sub-samples from the dried material will be used for chemical analysis (CP, NDF, ADF and Ash). The data will be statistically analyzed for split-plot design under randomized complete block.

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The grasses under study were:

Labeid (*Cenchrus ciliaris*); and Dakhna (*Coelachyrum piercei*) brought from UAE. Thomam (*Panicum turgidum*); Themom (*Pennisetium Divism*); Sabat (*Stipagrostis Ciliata* and/or *Stipagrostis Drarii*) collected on March, 2002 from Central Saudi Arabia.

Planting date: 25-02-2003

First havest:10- 8- 2003

Soil Analysis:

Sample #	Depth (cm)	EC (1:1) dsm^{-1}	Ca Co ₃ %	K ppm	P ppm	Texture Class
1	0-20	0.19	10.66	55.9	20.0	LS
2	0-20	0.17	11.85	48.1	17.0	LS/S
3	20-40	0.19	11.85	47.5	13.0	LS
4	20-40	0.45	14.61	43.0	07.0	LS

Irrigation;

All plots were irrigated equally with tap water in the beginning of the experiment in order to establish good germination, three times a week. Well water of 2400 ppm was used later (after the first harvest) for irrigation.

Observations:

Emergence was partial for all grasses except Rhodes. Table (1) shows the emergence status as of 5-5-2003. Where:

S1= Dakhna, S2= Labeid, S3= Thomam,

S4= Themom, S5= Rhodas

Themom shows the highest emergence followed by Dakhna.

(Table1) Plants emergence (total number of plants/rep.) as of 5-5-03

Rep	S1 Dakhna	S2 labied	S3 Thomam	S4 themom	S5 Rhodas
A1	14	12	14	31	108
A2	49	14	41	45	108
A3	31	7	28	25	108
G.Total	94	33	83	101	324

Table 2: Plant height, internodes length, spike length (cm) and biological weight (kg/m²) from the first harvest in 2003.(± standard error)

	Rhodas	Themom	Labied	Dakhna	Thomam
Plant H.	138 ±6.7	71 ±1.0	70 ± 1.3	81 ±0.5	95 ±1.2
Inter. L.	15.1±1.2	4.8 ±0.7	6.3 ± 0.4	8.6 ± 0.2	9.0 ±0.3
Spike L.	8.8 ±0.2	11.3 ±1.8	6.7 ±1.8	8.7 ±0.3	6.7 ±0.1
*Bio. W.	4.23±1.4	4.2 ±0.4	2.7 ± 1.8	3.2 ± 2.1	2.7 ±1.2

* These bio weights do not represent an equal number of plants/m²

Rhodes was the tallest species followed by Thomam, while Labied and Themom were the shortest. However, there was no different between Rhodas and Themom in biological weight per unit area. These two species were the heaviest, whereas Thomam and Labied observed the lowest weight.

Discussion:

Farming practices for indigenous grass species is not well documented in our region. Thus, all observations recorded during early trial are of a valuable reference.

Planting date, for example, of early summer (May) did not seem to be appropriate and resulted in low emergence which can be attributed, between other factors, to planting date and/or to seed quality.

In this experiments, late February was selected to be the planting date. However, emergence has not been noticed until late March and it was as low as in May planting date.

Emergence in JV-7 in the nursery is encouraging and transplants will be transferred to the field after establishing strong roots. The transplants will be used for gap filling the experimental plots.

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Harvest: A total of 4 harvests were obtained from this experiment since July 2003 and the data reported in 2003 were obtained from the first harvest. The following table shows the chemical analysis of the species under study:

Grass	Mo %	DM %	P %	Fat %	Fiber %	Ash %
Dokhna	2.8-3.3	96.7-97.2	5.4-9.4	1.9-2.6	41.5	8.4-8.9
Themom	2.2-2.6	97.4-97.7	6.6-7.9	1.5-1.7	34.3	7.9-14.2
Labid	2.5-2.7	97.2-97.4	6.0-8.7	1.0-1.5	31.0	10.6-18.8
Rhodas	2.4-3.1	96.9-97.6	6.6-10.8	0.9	32.5	7.4-11.6
Thomam	2.7-3.0	97-97.2	8.0-9.2	1.3-2.0	42.5	8.8-9.9

Gap filling: JV-7 transplanting was not successful due to infection in roots happened prior to transplanting. Therefore and based on information obtained from Sultanate of Oman, rhizomes were used in transplanting at a 5 cm planting depth and it was successful. Rhizomes transplanting was done on March 1st. 2004.

Water Treatments: After plant establishments in all experimental plots, water treatments were applied on time intervals of 3, 6, 9 days starting on June 1st. 2004.
 Treatment A1: Irrigation of 0.3 m³ / plot every three days
 Treatment A2: irrigation of 0.3 m³ / plot every six days
 Treatment A3: irrigation of 0.3 m³ / plot every 9 days

Absorvations and conclusions:

- Gap filling using rhizomes was succesful for all species under study.
- As an obesrvation Rhodes was the most effected species due to water treatments.
- As mentioned earlier there were a total of 4 harvest during 2003 and 2004, but the data reported for bio. Weights in 2003 don't represent an equal numbers of plants/m². Therefor, harvest recoreds after the application of water treatment are not included in the 2004 progress report. These raw data need a further verification.

Camel-plant Interaction

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Introduction

Camel was grazed on range since the beginning of the humanity. They can find their complete diet in the range plants. Not only that, but they chose the preferable species due to the variety of range species. There was a natural balance between the components of the range ecosystem. Overstocking of the range was followed by a reduction of the feed resource. Likewise, such reduction gave chance to plants to grow. But now with the increase in the person income, availability of trucks for quick movement of animals and water, more pressure obtained on the range plant caused range condition to become extremely poor and deteriorated. Therefore grazing study becomes more important when it deals in the extremely arid condition such as Saudi Arabia.

Study site

This experiment is done in wadi Tamriat of northern Saudi Arabia (30° 30'N, 40° 41'E). It is about 70 Km north of Sakaka city. The mean annual precipitation is about 55mm. The area experiences hot temperature (40° C) and very low humidity (<20%) in summer. Winters are cold occasionally with frost sometimes. Relative humidity is high in the cold months reaching about 100%. A strong wind of 4 to 8 m/s is common blowing normally from southwest. These winds affect the vegetation growth by affecting the movement of the surface soil. The area is supporting dwarf shrubs such as *salsola vermiculata* and *Atriplex leucoclada*, *Artemisia herba-alba* and *Achillea fragrantissima*.

Materials and Methods

The experiment consists of three stocking rates: low one camel/5.4 ha per year; medium stocking rate one camel/3.6 ha per year and high stocking rate one camel/1.8 ha per year. These stocking rates were achieved by allocating 3 camels on three paddocks of 16.2 ha, 10.8 ha and 5.4 ha, respectively. The actual paddock sizes were much bigger (32.3 ha, 21.6 ha and 10.8 ha, respectively). However, only 50% of the paddock areas were covered with pasture, the rest were bare grounds. Each treatment is replicated three times. The above stocking rates were estimated based on vegetation cover of 822 kg/ha (average of the three replications). Considering only 50% of the vegetation is available for grazing (proper use factor), the pasture productivity is estimated to be 411 kg/ha. The large plot has therefore (16.2 ha X 411 kg/ha) 6658 kg of forage. This forage can support 2.5 camels (three camels) for a year (based on 2700 kg DM per camel per year i.e. 7.5 kg DM/day X 360 days). The available forage on the medium paddock (10.8 ha X 411 kg/ha) is enough for 1.6 camels (2 camels) while the small paddock (5.4 ha) has forage enough for 0.8 camels (one camel). Therefore having 3 camels on each plot means only the large plot has enough feed for these animals, while the other two are considered medium and high stocking rates, respectively.

The study will monitor vegetation productivity, quality and composition. On the animal side the parameters to be monitored will be animal body weight changes and supplementary feed. Animals will be weighed once every month. The flock composition in each grazing paddock will be one male and two females (dry animals).

The actual study is expected to commence early December 2004 and to continue for five years. Resources: The Range and Animal Development Research Center will provide the pasture and animals (camels). The center will provide also the weighing balance (1000 kg capacity), the drinking and feeding troughs and the supplementary feeds for the experiment. ICARDA will contribute towards the fence (5000-7000 USD). Also ICARDA has contributed an automatic weather station (11,000 USD) to be installed at Tamarite.

الزراعة الرأسية بدون تربة تحت النظام المغلق في البيوت المحمية لمحصول الفراولة

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مقدمة :

- معظم الزراعات المحمية في المملكة العربية السعودية تعتمد على النظام الأفقي في الزراعة .
 - الزراعة الرأسية تتميز بالاستخدام الأمثل لوحدة المساحة .
 - النظام المغلق في البيوت المحمية يعمل على التقليل من هدر المياه .
 - الجمع بين النظام المغلق ونظام الإنتاج والمكافحة المتكامل هو المستقبل للزراعة المحمية في المنطقة
- أجريت تجربة الزراعة الرأسية بدون تربة تحت النظام المغلق لمحصول الفراولة في المركز الوطني لبحوث الزراعة والثروة الحيوانية بالرياض وذلك لأول مرة تحت إشراف برنامج شبه الجزيرة العربية لزراعة المناطق الجافة - إيكاردا .

تجهيز البيت المحمي :

تم تجهيز البيت المحمي وذلك ببناء القنوات الخاصة بالزراعة والتمديدات اللازمة لعمليات الري ، بعد ذلك تم تجهيز البيئة الزراعية والتي تحتوي على بتموس سعة 400 لتر ، بيرلايت سعة 100 لتر بنسبة 1:2 ، وبعد خلطها جيداً عُبئت في مراكن من الفلين ثم رصت فوق بعضها بشكل رأسي بواسطة داعم من أنابيب بلاستيكية من مادة p.v.c مثبتت من الأعلى بواسطة الأسلاك ، كذلك تم تغطية المرواح ووسائد التبريد بالقماش الأبيض الخفيف لمنع دخول الحشرات ووضع محلول معقم عند أرضية باب البيت المحمي لتعقيم الأحذية قبل الدخول .



- تم زراعة ثلاث أصناف من الفراولة بعد تعقيمها في محلول مبيد فطري للوقاية وهي :

1- كماروزا 2- شاندر 3- منتخب

وذلك بتاريخ 6 ، 7 / 12 / 2004م وتم زراعتها في خطوط بطريقة عشوائية حيث أن الهدف من ذلك أنها تعتبر تقنية جديدة لتعريف المزارعين بهذه النوعية من الزراعة .

● طريقة الري :

- بعد الزراعة في المراكن تم ري النباتات 3 مرات في اليوم لمدة يومين حتى تتأقلم في الوسط البيئي الجديد وكانت كل رية مدتها 10 دقائق ، بعد ذلك أُضيفت الأسمدة المطلوبة بعد خلطها من الماء في الخزان وكان الري بنفس المعدل 3 ريات في اليوم لكن بزمان دقيقة واحدة للريه لكن بعد أسبوعين من الزراعة ظهر اللون الأخضر في حبيبات البيرلايت دلالة على زيادة الري وخوفاً على النباتات من الإصابة بالأمراض الفطرية قُللت عدد الريات إلى ريتين في اليوم ، لكن لوحظ أن الوضع لم يتحسن ، بعد ذلك تم إختصارها إلى رية واحدة في اليوم لمدة دقيقة حيث بدأ التحسن في البيئة الزراعية واختفاء اللون الأخضر وما زالت مستمرة على ذلك حتى تاريخه .



الأسمدة المضافة :

- 1 - كرسنالون Kristalon TC + 36 : 12 : 12
- 2 - نترات الكالسيوم (Ca (No3)
- 3 - نترات الماغنسيوم .

طريقة التحضير :

- 2و2 كجم كرسنالون / 40 لتر ماء مضافاً إليه 875و0 جم نترات الماغنسيوم .
- 1و6 كجم نترات الكالسيوم / 40 لتر ماء .



وقد تم وضع كل نوع من السماد في وعاء مستقل سعة 40 لتر بعد ذلك تم إضافتها مع الماء في الخزان بكمية متساوية حيث يجب أن يكون مجموع الأملاح الذائبة في مياه الري 500 جزء في المليون وتضاف الأسمدة حتى تصل قراءة الـ EC إلى رقم 2 ويعدل الـ PH بإضافة حمض النيتريك لتكون القراءة بين 5و6 - 5و9 ، تؤخذ القراءة كل يومين لتثبيت التركيز .

مشاهدات التجربة :

في البداية تأقلمت النباتات بشكل جيد ما عدا فقد بسيط في بعضها لكن لا يزال النمو الخضري ضعيفاً وبدأ في التزهير بعد 45 يوماً من الزراعة تقريباً وذلك بتاريخ 2005/1/22م ، ومن ناحية وقائية قد علقت اللوحات اللاصقة ذات اللون الاصفر لتعمل كمصائد للحشرات وأية آفات أخرى ، وما زالت التجربة قائمة حتى تاريخه .