A Progress Report on Water Use Efficiency of Four Indigenous Forage Grasses In Comparison With Exotic Forage Species for Year 2003

A. Alshankiti[1], A. Alhamdan[1], A. Habib[1], Asadullah Alajmi[2]
1-National Agricultural and Water Research Center, Riyadh, K.S.A
2-Arabian Peninsula Regional Project (APRP)-ICARDA
Saudi Arabia

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.

Date of commencement of study February 2003
Expected date of completion April 2005
Research supervisors: A.Alshankiti; A. Alhamdan; A. Habib; Asadullah Alajmi.

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

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

Table 1- Soil Analysis

Sample #	Depth (cm)	EC (11) 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 three times a week. This was during the period between sowing and first harvest, thereafter all plots are irrigated from the well (2400 ppm).

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. The main plots will be assigned to irrigation treatments and the sub plots will be used for species.

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.

The Progress Report for 2003

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- 2- 2003
First havest10- 8- 2003

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.

Rhodas 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.

Table2- 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	17	14	31	87
A2	49	14	41	45	79
A3	31	7	28	25	86
G. Total	94	38	83	101	252

Table 3 Plant height, internodes length, spike length (cm) and biological weight (gm/0.5m2) 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

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 experiment, 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.

Research Activities of the 2003/2003 Season in Al-Jouf Area, Kingdom of Saudi Arabia

Abdullah Al-Hajoj
Range and Animal Development Research Center
Saudi Arabia

Introduction

Utilization of the indigenous species as alternative forage plants is one of the major theme in the Arabian Peninsula Regional Program Arabian Peninsula Regional program (APRP). Choosing the alternative forage plants was the main objective in last phase of the APRP. In Al-Jouf area northern of Saudi Arabia shrubs were the main plants we worked on. We produce more than 10 tons of native shrubs seeds of more the 40 species.

The Kingdom of Saudi Arabia (KSA) has a large land area of the Arabian Peninsula. It covers an area of about 2.25 million square kilometers, which occupies about four-fifth of the Arabian Peninsula. More than 70% of the total land area can be classified as a range lands. Experiments of range rehabilitation were conducted in the northern region of Saudi Arabia.

Due to the rapid economic development and a large population increase, the population of domestic animals has also dramatically increased. Nomads practice free grazing. Each herder has the right to graze his herds in any range site and at any particular time and duration he likes. There are no restrictions on the size and movement of herds, which make animal population increased gradually. The result is that range condition became extremely very poor and deteriorated

APRP has contributed in rehabilitation rangeland in Saudi Arabia by establishing three experiments in Al-Jouf region northern of Saudi Arabia. These experiments started during phase I and continue to phase II. Those experiments are as follows

1. Transplanting of native shrubs under natural condition with supplementary irrigation. The goal of this experiment was to evaluate re-vegetation of degraded rangeland with native rangeland shrubs. Shrubs survival was more than 95% during the first three years and seeds were produced. Survival, however, drops to less than 50% in year 2001 due to the continuously drought for two years.
2. Comparison of two different methods of rangeland reseeding. The goal of this experiment is to compare two cultural methods (contour furrowing and pitting) for providing better seed bed and increase water infiltration and herbage yields. The drought have negative effect on this experiment and reduced survival to less than 1%.
3. Water use efficiency of currently used and indigenous forage *Medicago sativa* and *Atriplex leucoclada*. The goal of this experiment was to compare water use efficiency between *Medicago sativa (Medicago sativa*) and *Atriplex leucoclada*. It is also aimed to have enough information on *Atriplex leucoclada* such as irrigation requirements and harvesting procedure.

Summaries of the results of the three experiments are

a) Native range shrubs adapted to low water requirements.
b) A few amount of water at the planting time is sufficient to establish range shrubs.
c) Species that are naturally distributed in the area adapted better with transplanting methods.
d) Re-vegetation of perennial species on rangeland often requires reseeding.
e) The results show that Medicago sativa was at the highest productivity with high moisture content.
f) Productivity of Atriplex increases while the amount of water decrease until 6mm depth of water then decreased
g) Productivity of Medicago sativa increased with cut while Atriplex productivity decreased with more cuts.

Productivity of Medicago sativa and Atriplex leucoclada

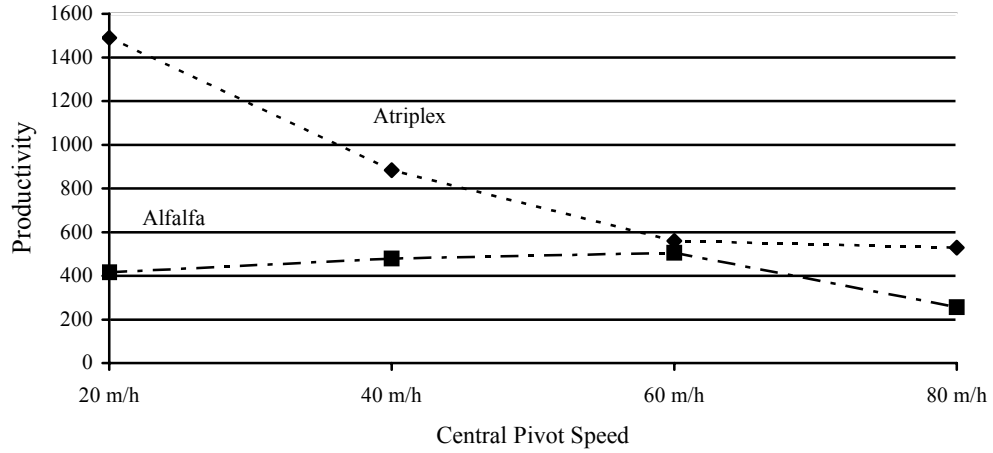

Table 1-Chemical content of Medicago sativa and Atriplex leucoclada

Plant	%						
	Total Protein	**Crude protein**	**Ash**	**Ether Extract**	**Nitrogen (NFE)**	**Calcium**	**Phosphorous**
Medicago sativa	14.8	27.3	8.6	4.3	45	1.53	0.25
Atriplex leucoclada	13.10	23.07	21.3	0.96	40.9	1.28	0.38

*Data of Medicago sativa was taken from Goh, 1981. While data of Atriplex was taken from Mirreh 1990.

Current and Future working plan

The last experiment in phase II is the establishment of two native grass *Stipagrostis drarii* and *Stipagrostis obtusa* as alternative forage plants. View amount of seeds of these two species were collected from the range during last spring and more will be collected in this spring. *Stipagrostis drarii* and *Stipagrostis obtusa* are tow tufted perennial grass. *Stipagrostis drarii* grow in deep sand occasionally in adjoining shallow sand. *Stipagrostis obtusa* grow in sandy depressions on limestone gravel plain. Seeds were planted in the green house and will be transfer to the field. More study need to be done on these two species.

The next experiment propose in the coming phase is plant-animal interaction. The overall objective of this project is to provide technical management packages for sustainable animal production with rangeland rehabilitation in Saudi Arabia. That is can be reached by identify promising forage and fodder species for rangeland rehabilitation and fodder production in different region of Saudi Arabia, to conserve promising and fodder species, and find out the right number and type of animals in each range area. This experiment will be conducted at Tamriat station in Aljouf region.