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Evaluation of Seasonal Production of Some Browse Species under Different Levels of Supplementary Irrigation

إعداد

إبراهيم بن عايد المحيسن

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الإشراف الأكاديمي

المشرف الرئيس: د. عبد العزيز بن محمد السعيد
أستاذ بيئة المراعي المشارك

المشرف المساعد: د. عبد الله بن عبد العزيز الدوس
أستاذ تربية المحاصيل المشارك

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SUMMARY

Saudi Arabia is classified as an arid or semi-arid region. Nearly 76% of the country receives less than 100 mm of rainfall per year. Rangelands in Saudi Arabia occupy about 170 million hectares (or nearly 75% of the country). However, most of them are in fair or poor conditions. Rangeland deterioration in Saudi Arabia has been attributed to several factors. These include overgrazing, wood-cutting for fuel and other purposes, recreation and agricultural expansion at the expense of rangelands. The fragility of the rangeland desert ecosystem made more vulnerable to desertification. Despite the clear deterioration of rangelands in Saudi Arabia, the feeding habit of the society remained unchanged, favoring red meat over other sources of protein. In 1999, it was estimated that the Kingdom imported 4,818,825 heads of various types of livestock costing about 949,000,000 Saudi Riyals. Cost of imported red meat for the same year was 1,649 million Saudi Riyals. It has been estimated that red meat consumption per person per year in Saudi Arabia averages around 188 kg compared to 124 kg in the USA and 38 kg world-wide averages. In response to great expansion in sheep fattening and dairy projects, a parallel increase in conventional forage production occurred. The total area devoted for alfalfa was 131,000 hectares in 2000. conventional forage crops are known to consume huge amount of irrigation water in Saudi Arabia. alfalfa and rhodesgrass consume on between 30,000-37,000 and 17,000-24,000 m^3 ha^{-1} $year^{-1}$ respectively under pivot irrigation system. Also, amount of imported barley grain increased in the last few years. In 1992 about 5 million tons of barely were imported, costing about 1,86 billions of Saudi Riyals. Therefore, there is a need for alternatives for conventional forage crops, to reduce water consumption and the dependency on imported barely grains, since range rehabilitation is costly and economically infeasible, some farmers were encouraged to cultivate native range plants species under abandoned central pivots that used to be cultivated with the wheat at the time of early agricultural booming.

This study was aimed to investigate for the followings:

1- **The possibility of cultivating some range browse species under different levels of supplementary irrigation using sprinkler irrigation system.**

2- **Seasonal fluctuations in browse production.**

3- **Effect of supplementary irrigation on the nutritive value of species under study.**

4- **Ability of different browse species to persist under frequent cutting and supplementary irrigation.**

To accomplish these objectives, a field study was conducted at the Agricultural Experimental and Research Station at the College of King Saud University. The following browse species were chosen for the study:

1- ***Atriplex leucoclada*** **Boiss.**

2- ***Atriplex halimus*** **L.**

3- ***Farsetia egyptia*** **Turra**

4- ***Artemisia sieberi*** **Besser**

5- ***Salsola villosa*** **Del.ex Roem. Et Schult.**

These species were subjected to the following supplementary irrigation treatments:

1- **Irrigation year around with total amount of 480 mm year $^{-1}$.**

2- **Irrigation during summer and fall with an amount of 240 mm year $^{-1}$.**

3- **Irrigation during summer only with an amount of 120 mm year $^{-1}$.**

4- **Without irrigation (Rainfall only).**

Irrigation for the first three treatments was distributed at bi-weekly intervals with an amount equal to 20 mm per irrigation event. Seedlings were transplanted into the field at an age of 8 months in Nov. 1997. Every species was grown into two rows with one meter between every adjacent two plants. A total of 16 plants of each species were used per each experimental unit. Borders

were planted with the respective species occurring near the border.

Data were collected during 1999 and 2000. Cuts were taken four times a year at the end of each season (i.e. 8 cuts were taken during the study). Only current year growth was taken in every cut. Total fresh weight was taken and a sub-sample was used to determine the dry weight. Border plants were also cut but they were not considered in determining the forage production. Persistence was determined in each cut. Nutritive value (crude protein, phosphorus, potassium, crude fiber and ash) was also determined according to the standard laboratory methods. Soil moisture was also monitored monthly. Some soil chemical and physical properties were also determined at the beginning of the experiment. The experiment was designed as a restricted split-plot design with four replicates. Data were statistically analyzed using SAS Software Program.

Phenological changes in all studied species indicated that under the conditions of the experiment undergo a state of slow growth during winter and spring seasons and an active growth during summer and fall seasons. The main results could be summarized as follows:

1- **Seasonal variations affected dry matter percentage (DM%) significantly. Dry matter % ranged between 51.8% in spring and 37.1% in fall season. Dry matter production also varied from season to another. It reached a peak during winter (491.1 kg. ha^{-1}) while least dry matter production was attained during summer (208.8 kg. ha^{-1}). Protein content varied significantly between 12.2% in fall and 9.2% in spring. Phosphorus was significantly higher in winter (0.22%) than in spring and fall, which averaged about 0.16%. ash content was significantly higher in summer (22.3%) compared to other seasons. No significant differences were detected between seasons.**

2- **No significant differences in dry matter production were found between the three irrigation treatments, which averaged 1724 kg. ha^{-1} . However, the non-irrigated treatment was significantly less (504 kg. ha^{-1}) than the irrigated treatments. Also there were no significant differences between irrigation treatments in DM%. This suggests that supplementary irrigation during summer and fall or during summer only is more feasible than year-round irrigation. Crude protein was varied significantly with the amount of irrigation (9.95-11.62%). Crude fiber and potassium did not respond significantly to irrigation treatments. Year-round irrigation increased phosphorus and ash content compared to other irrigation treatments although results had similar values ranging between 0.21% under year-round irrigation and 0.17% under summer and fall irrigation for phosphorus and between 21.4 % ash under year-round irrigation and 20% under summer irrigation.**

3- **Comparing species in terms of DM% and dry matter production indicated that *Artemisia sieberi* had the highest DM% (54.3%) while *Atriplex halimus* had the lowest DM% (36.2%). Species also differed in their persistence. *Atriplex leucoclada* had the lowest persistence (68%) compared to the other three species (93.3-95.9%). Species also differed in dry matter production. *Atriplex halimus* had the highest production (3120kg. ha^{-1}. year $^{-1}$) followed by *Atriplex leucoclada* (1994 kg. ha $^{-1}$ year $^{-1}$). The two *Atriplex* species differed**

significantly than other three species, which averaged 663 kg. ha $^{-1}$ year $^{-1}$). These results indicate that *Atriplex halimus* had excellent characteristics such as high production and persistence. *Atriplex leucoclada* was similar to *Atriplex halimus* in production in the first year. But it deteriorated as it could not resist frequent cutting. When species are compared in terms of their nutritive value, it was found that *Farestia egyptia*, *Atriplex halimus* and *Artimisia sieberi* had the highest crude protein while *Atriplex leucoclada* and *Salsola villosa* had the lowest crude protein value (9.9-11.66%). Crude fiber was siginificantly highr in *Farestia egyptia* (23.07%) than that of *Atriplex halimus* and *Atriplex leucoclada* (11.82%). Ash content significantly highest in *Atriplex halimus* (26.62%) and lowest in *Artimisia sieberi* (14.91%). Highest potassium content was found in *Atriplex halimus* (1.12%). These results again indicate that *Atriplex halimus* had good forage value compared to other species in this study.

From this study, it could be concluded that:

1- **Supplementary irrigation during active growth period have positive effect in increasing the productivity of the range plant species under study.**

2- **There were significant seasonal variations in terms of dry matter production under supplementary irrigation.**

3- **There were differences in species response to supplementary irrigation. *Atriplex halimus* had the highest positive response.**

4- **Supplementary irrigation had positive effect on nutritive value.**

5- **Summer and fall have the highest nutritive value of forage.**

6- **Phenological study of the species indicated that plants have a state of slow growth during winter and spring as they produced little dry matter while summer and fall were the active period of growth unlike other studies in the northern region where these plants undergo a period of dormancy during fall and winter.**