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# STUDY THE PRODUCTIVITY OF RANGELAND PLANTED WITH *ATRIPLEX HALIMUS* SHRUBS IN THE NORTHERN BADIA OF JORDAN

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## ABSTRACT

The Jordanian rangeland was subjected to severe degradation due to drought and man misuse with the result of limited feed resources for livestock and desertification process. Fodder shrubs were used for rangeland restoration. The present experiment was conducted at Khanasri, Mansheit Bani Hassan and Breqa to study production of planted fodder shrubs and their effect in increasing rangeland productivity and stocking rate. Productivity of native vegetation and *Atriplex halimus* shrubs was estimated. High significant differences had noticed of native vegetation cover percentage and productivity between locations. Breqa showed the highest in coverage percentage, fresh and dry yield. However, Khanasri and Breqa indicated highest in the survival percentage, fresh, browse and dry yield of the *Atriplex* shrubs in comparison with Manshia. The total productivity of Breqa recorded elevated fresh dry, allowable yield and stocking rate in comparison with Khanasri and Manshia. The stocking rate of Breqa was 250% and 167% more than those of Khanasri and Manshia, respectively. *Atriplex* shrubs showed increase in the total productivity by 29%, 8% and 6% for Khanasri, Breqa and Manshia, respectively. It is recommended to plant *Atriplex* shrubs to improve rangeland productivity and stocking rate.

**KEYWORDS:** *Atriplex halimus*, Fodder Shrubs, Rangeland Productivity, Stocking Rate

## INTRODUCTION

Rangeland represents about 90% of the total land area in Jordan which is 89,342 km$^2$ (MOA, 2005, DOS, 2010) and receives less than 200 mm annual rainfall. Rangeland was subjected to severe degradation due to successive drought and man misuse during the past 5 decades. Man misuse is practiced through cultivation for barley planting, early and over grazing, shrubs cutting for fuel using and introducing heavy vehicles, especially the tractor to rangeland (Zaroug, 1985). Local feed resources are limited, thus there is a large gap between available resources and livestock requirements. Jordan produces less than 25% of feedstuff requirements. Therefore, indigenous resources need to be protected and developed (Abu-Zanat, 1997). For restoration of rangeland feed resources, technical options are needed. One of these is re-establishment and use of native and exotic fodder shrubs such as saltbushes (*Atriplex* spp.) and *Salsola* spp. Fodder shrubs play a role in rangeland rehabilitation programs in arid and semi-arid Mediterranean zone, not only as a feed reserve but also for soil water conservation in the degraded regions (Gintzburger *et al.*, 2000).

They have a vital role in improving extreme climatic effects, gully erosion control and in the provision of stock forage (Wills, *et al*., 1990). Le Houerou (2000) reported that rehabilitation of the degraded rangeland will be by protection, fodder shrubs planting and water harvesting techniques. Also, Abu-Irmaileh (1994) showed that rangeland improving by

planting fodder shrubs under water harvesting produced much more forage than those obtained by protection alone. *A. halimus* is the most planted native species in Syria, Jordan, Egypt, Saudi Arabia, Libya and Tunisia. In addition to their drought and salinity tolerance, *Atriplex* have high yield, good nutritive value (Makhadmeh, 1990) and palatability to sheep in non-saline soils (Masri, 1983). Thus, *A. halimus* shrubs were selected in this study. The study measurements were held on 2009 in northern Badia of Jordan.

**Objectives of the Study**

To determine the forage production of planted *A. halimus* and its effect in improving rangeland productivity and increase stocking rate.

## METHODS

**Locations:** Three locations were selected to assist rangeland productivity in the Northern Badia. These were Breqa, Manshiat Banihassan (Manshia) and Khanasri "Figure 1". They are located in Mafraq Governorate which represents rangelands conditions of the Northern Badia in Jordan. The average rainfall is 150, 180 and 200 mm for Khanasri, Manshia and Breqa, respectively. *A. halimus* shrubs were planted using water harvesting technique in contour ridges in January, 2008. Spacing between contour ridges was 9 m while 2 m between shrubs. The plant density was 556 shrubs per hectare. Productivity was estimated for native vegetation and *A. halimus* shrubs during spring 2009.

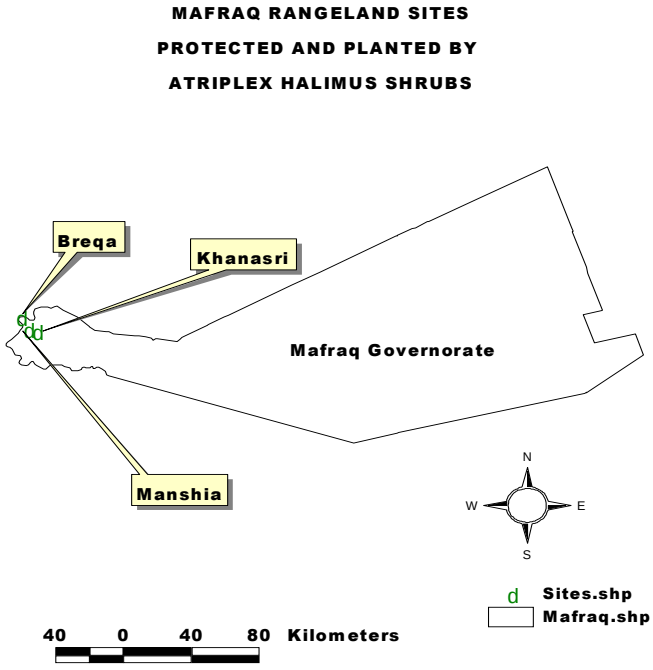


**Figure 1: Breqa, Manshia and Khanasri Range Sites in Mafraq Governorate**

Native vegetation (NV): Clipping was the most common direct method to estimate native vegetation biomass production (Bonham, 1989). The native vegetation productivity was estimated by selecting 50 random samples of (0.5 * 0.5) $m^2$ at Khanasri, Manshia and Breqa. The coverage percentage was estimated, native plants were clipped and weighted for fresh weight estimation and drying in an oven at 72 $^0$C for 72 hours and reweighed. Fodder shrubs (FS): The *A. halimus* shrubs productivity was estimated using Reference Unit technique (Andrew *et al.,* 1981). A single branch was selected for each location, and then the volume of other shrubs was estimated according to the selected branch. Fresh weight (weight of the branch), browse weight (weight of leaves and twigs less than 5 mm wood diameter) and dry weight (browse drying in an oven at 72 $^0$C for 72 hours) were measured. Shrubs yield per hectare was calculated.

**Total productivity:** Total fresh and dry yield (NV & FS) was calculated per hectare and allowable yield was estimated by 50% of the total dry yield. Stocking rate was calculated in the dry basis allowable productivity and sheep requirement of 1.5 kg DM/head/day for 3 months. Experimental design and statistical analysis: The experiment data was analyzed using Randomized Complete Block Design (RCBD). The independent variable included in the model was locations and the dependant variables were the coverage percentage, fresh and dry yield of native vegetation, survival percentage, fresh yield, browse yield, dry yield of *Atriplex* shrubs, total fresh yield, dry yield, allowable yield and stocking rate. A general linear model (GLM) procedure (SAS 2001) was used for analyzing the data.

## RESULTS

Native vegetation: The native vegetation coverage percentage, fresh and dry yield at Khanasri, Breqa and Manshia are shown in Table (1). In general, the coverage percentage was low and indicates rangeland deterioration in the targeted locations. The coverage percentage was highly significant (P=0.0027) in Breqa and Manshia in comparison with Khanasri. However, fresh and dry yield were highly significant (P<0.0001) in Breqa in comparison with Manshia and Khanasri.

Fodder shrubs: Table (1) shows the survival percentage, fresh, browse and dry yield of the *A. halimus* shrubs at Khanasri, Breqa and Manshia regions. While, significant differences were observed in fresh (P<0.0001), browse (P=0.0022) and dry (P=0.0022) yield in Khanasri and Breqa in comparison with Manshia “Table 1”.

Total productivity: high significant differences (P<0.0001) had been noted in the average of the total fresh, dry and allowable yield productivity and stocking rate (P<0.0001) at Khanasri, Breqa and Manshia “Table 1”. The increased in productivity and stocking rate were lead to good rangeland establishment and rehabilitation through shrubs planting and rangeland protection. Current results of *Atriplex* shrubs (109.39 kg DM $ha^{-1}$) were not in agreement with those of Stringi, *et al.,* (2009), who reported production about 1000 kg DM $ha^{-1}$. The reported production was very high in comparison with the results of present study because the shrubs were 12 years old *A. halimus* shrubs, plant density of 3704 shrubs $ha^{-1}$ and the high rainfall amount (551 mm) during the study growing season in Italy. In the other hand the total productivity in the current study was more due to addition of NV dry matter.

## DISCUSSIONS

The Jordanian rangeland was subjected to sever degradation due to successive drought, man misuse and shortage of the local feed resources. Planted of native and exotic fodder shrubs such as saltbushes (*A. halimus*) were used for restoration of rangeland.

In Jordan, rainfall increases when moving from east to west and from south to north. Thus, good native vegetation coverage in Breqa and Manshia because of rainfall amounts increases due to their location which is more close to western part of Jordan. Productivity differences between locations attributed to rainfall amount and rainfall distribution. *Atriplex* shrubs increased productivity by 18% in comparison to native vegetation for all locations, which increased the stocking rate of rangeland location. The survival percentage of *A. halimus* shrubs didn't show any significant differences over locations, due to suitable environmental conditions for growth, good establishment and rangeland management. In comparison to native vegetation productivity, *A. halimus* shrubs increased productivity by 29%, 8% and 6% for Khanasri, Breqa and Manshia, respectively.

Those differences were due to different rainfall amounts and rainfall distribution. Also, native vegetation productivity was higher in Breqa and Manshia which made the effect of *Atriplex* shrubs in increasing yield were very low compared to the results of Khanasri. In addition to increasing productivity, shrubs played an important role in soil erosion

control and increasing organic matter percentage in the surface soil layer, which increased the micro organisms activity and improved the soil physical and chemical statues, such as increasing water infiltration, water storage in the root zone area and better soil reservoir. Current results were in agreement with those of Abu-Irmaileh, 1994. Our study shows the beginning of rehabilitation and improvement of productivity due to rangeland protection and shrubs planting using water harvesting techniques.

## CONCLUSIONS

Interventions using rangeland protection and *Atriplex* shrubs planting under water harvesting techniques (contour rides) were recommended for rehabilitation of the deteriorated rangelands (Badia). On the other hand, protection were controlled early and over grazing and increase rangeland productivity and stocking rate.

**Table 1: The Average of the Native Vegetation, Fodder Shrubs and the Total Productivity at Khanasri, Breqa and Manshia Regions in Spring 2008**

| Treat | Breqa | Manshia | Khanasri |
|---|---|---|---|
| **Native Vegetation** | | | |
| Coverage percentage (%) | 37.06 a | 31.02 ab | 25.34 b |
| Fresh yield (kg $ha^{-1}$) | 4287.8 a | 3138.5 b | 1786.6 c |
| Dry yield (kg $ha^{-1}$) | 1580.35 a | 965.24 b | 583.32 c |
| **Fodder Shrubs** | | | |
| Survival (%) | 98.0 a | 90.0 a | 88.0 a |
| Fresh yield (kg $ha^{-1}$) | 651.69 a | 263.50 b | 591.86 a |
| Browse yield (kg $ha^{-1}$) | 435.65 a | 214.48 b | 376.16 a |
| Dry yield (kg $ha^{-1}$) | 109.39 a | 44.14 b | 93.93 a |
| **Total Yield** | | | |
| Total Fresh Yield (kg $ha^{-1}$) | 4939.3 a | 3401.9 b | 2378.4 c |
| Total Dry Yield (kg $ha^{-1}$) | 1689.59 a | 1009.44 b | 677.29 c |
| Total Allowable yield (kg $ha^{-1}$) | 844.80 a | 504.72 b | 338.65 c |
| Stocking rate (Head/ha/3months) | 6.19 a | 3.70 b | 2.48 c |

Means with the same letter in the same row are not significantly different.

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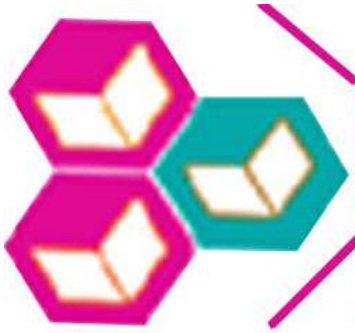
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