Effects of Reseeding of Some Range Plant Species on the Biomass Production of Rangelands in Sheikan Locality - North Kordofan State - Sudan

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Abstract: This experiment was conducted at El Obeid Research Station Farm at Bannu area, Sheikan Locality, North Kordofan State, over two seasons 2009/10 and 2010/11. The objective was to investigate the effect of re-seeding on range plant biomass production, botanical composition, density and vegetation cover percent. On average, the total plant density at the reseeded range was 307 plant/m² compared with 224 plant/m² in the control. The vegetation cover percent at the flowering stage at the reseeded site was 74.8% compared with 43.0% in the control, while at the seed setting stage it was 70.6% and 41.8% at the reseeded and control sites, respectively. Biomass productivity at flowering stage was 2.13 (ton/ha) and 1.82 (ton/ha) at reseeded and control sites, respectively compared with that at seed setting stage of 1.89 (ton/ha) at the reseeded range and 1.68 (ton/ha) at the control. These differences were highly significant ($P<0.001$). The differences in biomass productivity between the two sites is probably due to the management system, where broadcasting of seeds of some species increased plant density and led to a reduction in bare soil percent consequence increased biomass productivity.
Key words: Gardud soil, plant productivity, plant density, plant frequency, broadcasting

Introduction

One of the means of rehabilitation, improvement and management of degraded rangeland resources in this area is reseeding practice. Because of constraints on reseeding rangeland seeds on hard surface of gardud soil, soil plowing is important. Sheikan locality has a large area of sandy clay/loam soil locally known as "gardud" soils that are characterized by hard compacted surface with high runoff potential. The degradation of the rangeland vegetation in the study area has led to the survival and dominance of short–lived un-preferred annual plant species rather than the palatable perennial ones. Reseeding is seen as a suitable management practice that may increase the production of vegetation from rangeland, thus leading to improved animal performance and productivity. The maximum production from a given range unit is dependent upon proper management and balanced use of resources. Such proper management involves grazing the range with the appropriate animals, balancing number of animals with forage resources, grazing at the correct season of the year and maintaining proper distribution of livestock over the range. The present experiment was conducted over two seasons 2009/10 and 2010/11 with the objective of investigating the effects of re-seeding on rangeland biomass productivity, plant botanical composition and plant density.

Materials and Methods

About 0.84 ha were plowed with chisel plow to facilitate broadcasting of seeds of some range plant species namely *Dactyloctenium aegyptium* (Abuasabi), *Blepharis linarifolia* (Begail) and *Crotalaria spp.* (Tagtaga). The seeds were broadcasted manually on 29/6/2010 and 25/7/2011 on 0.42 ha of the

total area while the other 0.42 ha was left to natural regeneration for two seasons.Loop method was used to determine botanical composition of the rangelands. At each transect plant species, bare soil, rock and litter were being recorded at every 10 m interval using ¾"loop Parker (1951).Plants %, bare soil %, litter % and rock % were calculated as follows:

$$\text{Plant \%} = \frac{\text{Total hits of plant}}{\text{Total number of all hits}} \times 100$$

$$\text{Bare soil \%} = \frac{\text{Total hits of bare soil}}{\text{Total number of all hits}} \times 100$$

$$\text{Litter \%} = \frac{\text{Total hits of litter}}{\text{Total number of all hits}} \times 100$$

$$\text{Rock \%} = \frac{\text{Total hits of rock}}{\text{Total number of all hits}} \times 100$$

In this experiment, at each site (0.42 ha) three transects were selected. A quadrate of 1×1m area was placed along each transect (70 m long) at 10m intervals and the herbaceous plants inside were cut at height of 3cm above ground level. A total of 7 quadrates/transect were harvested in order to determine biomass production. Each sample was oven dried at 105ºC to a constant weight. Three observers made an estimate of the area that was covered by vegetation in each quadrate, total percent vegetating cover within each of the 42 quadrates at the two sites was recorded at two seasons, including both live and dead material. Plant density (plant/m²) was done by counting the number of plants for two seasons both at flowering and seed setting stages. Seven quadrates within each transect were used to measure density and frequency (Holecheck. *et al*, 2004).

$$\text{Plants density} = \frac{\text{Number of species (A) counted in all quadrates}}{\text{Total number of quadrates}}$$

Results and Discussion

Botanical composition (%)

Data on percent plants, bare soil and litter at the reseeded and control sites under the flowering and seed setting stages, are shown in table 1. There are highly significant differences ((P<0.001) between flowering and seed setting stages at the reseeded and control sites. On average, at the flowering stage, plants percent in the reseeded range was 98.8% while in the control it was 94.6% and bare soil % was 1.2% and 5.4% at reseeded and control sites, respectively. At seed setting stage, plants percent in the reseeded range was 93.2% while in the control it was 88.3%; bare soil % at reseeded range was 4.2% and at control it was 8.1% and litter % was 2.6% and 3.6% at reseeded and control sites, respectively. This result may be due to the positive impact of reseeding of the rangeland with some range species coupled with protection practice and absence of grazing pressure that affects the plants percent and bare soil while the reseeded site had more biodiversity than the control. Lazim (2009), reported that, the variation between sites may have resulted due to light grazing coupled with protection

and burning practices which increased herbaceous cover. It is clear that reseeding has promoted these range health parameters and the variation between the amounts of the rainfall between seasons also affected the range health.

Table 1 : Vegetation measurements at reseeded and control sites, at flowering and seed setting stages at Bannu area, North Kordofan

Parameters	Reseeded site		Sig.	Control		Sig.
	Flowering stage	Seed setting stage		Flowering stage	Seed setting stage	
Plant %	98.8	93.2	***	94.6	88.3	***
Bare soil%	1.2	4.2	***	5.4	8.1	***
Litter %	0.0	2.6		0.0	3.6	
Total	**100**	**100**		**100**	**100**	

***Significant at P<0.001 level

Botanical composition in the reseeded and control sites at the flowering and seed setting stages

Table 2 shows the dominant species of plants in the reseeded and control range sites over the two seasons (2009/10 and 2010/11) at flowering and seed setting stages. Over two growing seasons, species established by reseeding practice were; *Blepharis linarifolia, Crotalaria spp.* and *Dactyloctenium aegyptium* which formed 6.78%, 4.55% and 0.72%, respectively. The result was probably due to natural distribution on range and good adaptability to the area, while *Dactyloctenium aegyptium* had lower distribution on range. The results were due to low germination of this species at the germination test which was17%.

The dominant species on the reseeded range at the flowering stage were *Ipomoea sp.* (15.37%), *Sesbania sesban* (14.66%), *Ipomoea blepharosepala* (13.37%), *Echinocloa colonum* (12.57%) and *Acanthus spp.* (11.95%). While at the seed setting stage, the dominant species were *E. colonum* (26.04%) and *S. sesban* (21.68%). Compared with the control, the dominant species at the flowering stage were *Acanthus spp.* (22.74%), *I. sp.* (19.39%) and *Echinocloa colonum* (17.67%), while at the seed set stage, the dominant species were *E. colonum* (26.57%) and *Ipomoea blepharosepala* (26.24%).

The dominant of forb species at the range was 72.7% compared with 24.3% of grass and 3.0% shrub. The practice of reseeding may have enhanced the species composition in the reseeded range compared with the control despite the absence of extra grazing pressure in the control. Sahar (2008) reported that, the absence of grazing pressure and the ability of some species to produce a large number of seeds resulted in their observed dominance in the protected site.

Table 2: Botanical composition of the range in the reseeded and control sites, at flowering and seed set stages, Bannu, North Kordofan

Scientific name	Type of plant	Reseeded site		Control	
		Flowering stage	Seed setting stage	Flowering stage	Seed setting stage
Ipomoea sp.	Forb	15.37	0.54	19.39	7.53
Sesbania sesban	Forb	14.66	21.68	12.69	13.17
Ipomoea blepharosepala	Forb	13.37	15.60	17.20	26.24
Acanthus spp.	Forb	11.95	14.28	22.74	18.36
Blepharis linarifolia	Forb	6.78	4.45	0.00	0.00
Solanum dubium	Forb	5.15	3.89	0.50	0.67
Crotalaria spp.	Forb	4.55	4.00	0.00	0.00
Indigofera spp.	Forb	4.19	1.39	1.13	0.00
Ipomoea concinperma	Forb	1.43	0.00	0.75	0.00
Tephrosia spp.	Forb	1.07	0.27	0.38	0.28
Polygala eriotera	Forb	0.73	1.02	0.73	0.00
Acanthospermum hespidum	Forb	0.72	1.39	0.38	0.54
Tribulus terrestris	Forb	0.48	0.00	0.24	0.00
Commelinia subulata	Forb	0.48	0.00	0.24	0.00
Dicoma tomentosa	Forb	0.48	0.00	0.24	0.00
Farsetia longisclizua	Forb	0.25	1.07	0.73	1.10
Cassia tora	Forb	0.25	0.00	0.00	0.00
Ocimum basilicum	Forb	0.24	1.28	0.50	0.82
Seddera spp.	Forb	0.00	0.27	0.38	0.28
Abutilon glaucm	Forb	0.00	0.00	0.50	0.54
Corchorus olitorius	Forb	0.00	0.27	0.00	0.00
Colocynthis citrullus	Forb	0.00	0.27	0.00	0.00
Euphorbia aegyptiaca	Forb	0.00	0.27	0.00	0.00
Justicia kotschyi	Forb	0.00	0.00	0.00	0.28
Echinocloa colonum	Grass	12.57	26.04	17.67	26.57
Eragrostis tremula	Grass	1.79	0.00	2.50	0.54
Dactyloctenium aegyptium	Grass	0.72	0.00	0.00	0.00
Cyprus spp.	Grass	0.72	0.64	0.63	1.44
Cenchrus biflorus	Grass	0.60	0.64	0.24	0.00
Chloris gayana	Grass	0.48	0.00	0.00	0.00
Schoenefoldia gracils	Grass	0.25	0.00	0.00	0.00
Aristida mutablis	Grass	0.00	0.74	0.24	1.10
Acacia nubica	Shrub	0.72	0.00	0.00	0.54
Total		**100**	**100**	**100**	**100**

Plant density (plant/m^2), relative density

(%) and frequency (%)

Table3 illustrates plant density, relative density (%) and frequency (%) of the species over two seasons in the reseeded and control sites. On average, the total plant density at the reseeded range was 307 plant/m² compared with the control which was 224 plant/m². Differences in plant density between the two range sites may be due to the intervention where some species were broadcasted and also may be due to the variability of the rainfall between seasons. Some plants are removed by animals through consumption or trampling while broadcasting has contributed to plant density.

Relative density (%) was highest for *Acanthus spp.*, *Echinocloa colonum* and

Ipomoea blepharosepala on both sites (reseeded and control).

The most frequent plant species for the reseeded range were *Echinocloa colonum* (84.53%), *Sesbania sesban* (83.33%), *Acanthus spp.* (73.81%), *Ipomoea blepharosepala* (69.05%), *Blepharis linarifolia* (46.43%) and *Crotalaria spp.*(29.76%) which these plants had normal distribution on the range. The plant with least frequencies were *Colocynthis citrullus, Dicoma tomentosa*, *Commelinia subulata, Farsetia longisclizua, Aristida mutablis* and *Dactyloctenium aegyptium* had 2.38% for each plant species, respectively. On the control the most frequent species were *Acanthus spp.* (78.57%), *Ipomoea sp.* (76.19%) and *Echinocloa colonum* (75.00%). The least plants frequency was for *Crotalaria spp.*, *Colocynthis citrullus, Commelinia subulata* and *Cenchrus biflorus* had 2.38% for each plant.

Table (3): Plant density (plant/m^2), relative density (%) and frequency (%) at the reseeded and control sites

Scientific name	Type of plant	Density (plant/m^2)		Relative density (%)		Frequency (%)	
		Reseeded site	Control	Reseeded site	Control	Reseeded site	Control
Acanthus spp.	Forb	89	78	32.62	38.66	73.81	78.57
Ipomoea blepharosepala	Forb	40	27	12.20	12.19	69.05	64.29
Ipomoea sp.	Forb	24	11	7.75	5.61	54.77	76.19
Sesbania sesban	Forb	21	16	7.30	7.27	83.33	67.86
Solanum dubium	Forb	11	2	3.26	0.83	58.34	9.53
Acanthospermum hespidum	Forb	6	2	1.89	0.83	21.43	22.62
Blepharis linarifolia	Forb	5	0	1.68	0.00	46.43	0.00
Ipomea concinperma	Forb	5	2	1.46	0.83	17.19	3.57
Crotalaria spp.	Forb	4	1	1.21	0.24	29.76	2.38
Indigofera spp.	Forb	4	2	1.12	0.62	22.62	7.15
Ocimum basilicum	Forb	4	3	1.17	1.24	8.33	14.29
Indigofera aspera	Forb	3	0	0.88	0.00	3.57	0.00
Justicia kotschyi	Forb	2	1	0.58	0.24	4.76	7.15
Polygala eriotera	Forb	2	1	0.68	0.42	17.86	14.29
Corchorus olitorius	Forb	2	2	0.58	0.62	21.43	9.53
Colocynthis citrullus	Forb	1	1	0.18	0.24	2.38	2.38
Tephrosia spp	Forb	1	2	0.29	0.62	14.29	9.53
Dicoma tomentosa	Forb	1	0	0.39	0.00	2.38	0.00
Commelinia subulata	Forb	1	1	0.39	0.24	2.38	2.38
Farsetia longisclizua	Forb	1	1	0.18	0.42	2.38	9.53
Cassia tora	Forb	0	1	0.00	0.41	0.00	3.57
Tribulus terrestris	Forb	0	1	0.00	0.42	0.00	4.76
Euphorbia aegyptiaca	Forb	0	1	0.00	0.42	0.00	4.76
Echinocloa colonum	Grass	50	39	15.13	15.86	84.53	75.00
Cyprus spp.	Grass	13	7	3.84	2.48	22.62	11.91
Aristida mutablis	Grass	7	2	2.42	0.83	2.38	7.15
Eragrostis tremula	Grass	5	18	1.36	7.21	8.33	10.72
Cenchrus biflorus	Grass	2	0	0.68	0.42	13.10	2.38
Dactyloctenium aegyptium	Grass	1	0	0.18	0.00	2.38	0.00
Acacia nubica	Shrub	2	2	0.58	0.83	3.57	8.33
Total		**307**	**224**	**100**	**100**		

Vegetation cover (%), biomass productivity (ton/ha) and carrying capacity of rangeland at reseeded and control sites

Table 4 shows that the vegetation cover percent, biomass productivity (ton/ha) and carrying capacity at two seasons. On average, the vegetation cover percent at the flowering stage was 74.8% compared with 43.0% at the reseeded and control sites, while at the seed setting stage it was 70.6% and 41.8% at the reseeded and control sites respectively, the values are significantly different (P<0.001). These results may be due to reseeding of some species of rangeland which increased the vegetation cover percent at reseeded range. The biomass productivity (ton/ha), at flowering stage was 2.13 (ton/ha) and 1.82 (ton/ha) at reseeded and control sites, respectively compared with seed setting stage it was 1.89 (ton/ha) at the reseeded range and 1.68 (ton/ha) at the control; these differences were highly significant (P<0.001). The difference in biomass productivity between the two sites is probably due to the management system, where broadcasting of seeds of some species increased plant density and led to reduction in bare soil. The differences between seasons may be due to the variability in rainfall between seasons. Fatour (2009) reported that the differences in the productivity may be attributed to the variations in rainfall, grazing pressure and human activities.

At the flowering stage the reseeded site sustained 0.85 TAU/ha/Y whereas at the control it was 0.73 TAU/ha/Y while in the seed setting stage the reseeded and control ranges was 0.77 TAU/ha/Y and 0.67 TAU/ha/Y, respectively. This result may be due to the intervention of reseeding and protection practices.

Table (4): Vegetation cover (%), biomass productivity (ton/ha) and carrying capacity (TAU/ha/Y) at reseeded and control sites

Parameters	Reseeded site		Control		Sig.
	Flowering stage	Seed setting stage	Flowering stage	Seed setting stage	
Cover %	74.8	70.6	43.0	41.8	***
Biomass (Ton/ha)	2.13	1.89	1.82	1.68	***
Carrying capacity (TAU/ha/Y)	0.85	0.77	0.73	0.67	***

***Significant at P<0.001 level
*(TAU) Tropical Animal Unit

Chemical composition of herbage biomass in the reseeded and control sites

Table 5 illustrates the results of chemical composition of the herbage biomass at the reseeded and control under flowering and seed setting stages. Crude protein was high in herbage from the reseeded site compared with the control. Crude fiber was lower in herbage from the reseeded site than the other site. This may be a result of inclusion of some species with higher nutritive value as a result of reseeding with diverse species such as the forbs which dominated the reseeded site by 72.7% compared to grasses which were 24.3%. These results agreed with Fatour (2009) who stated that, the type of plants in the protected range (forbs 50% and grasses 50%) that affected on herbage protein and also in the open range grazing by animals might have resulted in a reduced amount of leaves in the vegetation thereby leading to reduced crude protein content.

Table (5): Chemical composition of herbage biomass in the reseeded and control sites, Bannu area, North Kordofan at flowering and seed setting stages

Parameters	Reseeded site		Control	
	Flowering stage	Seed setting stage	Flowering stage	Seed setting stage
DM %	97.9	96.0	96.9	95.9
Ash %	17.1	16.0	15.0	13.5
C.P %	11.9	10.3	11.5	9.2
C.F %	31.5	38.0	33.2	39.7

Conclusion:

Based on the results obtained it can be concluded that the reseeding practice is a more effective method of management in this area when compared with natural regeneration range. It resulted in higher indicators of range productivity and quality. Dry matter production, density, cover, species composition and frequency were enhanced when reseeding practice was adopted.

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أثر إعادة إستزراع بعض نباتات المراعي على إنتاجية المراعي في محلية شيكان – ولاية شمال كردفان – السودان

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المستلخص:

أجريت هذه الدراسة في مزرعة البحوث الزراعية في منطقة بنو، محلية شيكان، ولاية شمال كردفان، خلال المواسم 10/2009 و11/2010 لمعرفة أثر إعادة الإستزراع علي إنتاجية المراعي الطبيعية والتركيب النوعي للنباتات وكثافة النباتات ونسبة الغطاء النباتي. في المتوسط، مجموع كثافة النباتات في المرعى المستزرع كانت 307 نبات/م² مقارنة ب224 نبات/م² بالمرعى الطبيعي (الشاهد). في المتوسط نجد ان نسبة الغطاء النباتي في فترة الإزهار في المرعى المستزرع كانت 74.8% مقارنة مع 43.0% في الشاهد، بينما في فترة تكوين البذور كانت 70.6% و41.8% في المرعى المستزرع والشاهد على التوالي. إنتاجية المرعى في فترة الإزهار كانت 2.13 (طن/هكتار) و1.82 (طن/هكتار) في المرعى المستزرع والشاهد على التوالي مقارنة بفترة تكوين البذور كانت 1.89 (طن/هكتار) في المرعى المستزرع و1.68 (طن/هكتار) في الشاهد. هذه الإختلافات بها فروقات معنوية عالية ($P<0.001$). الإختلافات في إنتاجية المراعى بين الموقعين يحتمل أن تكون نتيجة لنظام الإدارة، مع إعادة إستزراع بعض النباتات يؤدي لزيادة كثافة النباتات وإنخفاض في نسبة الأرض المعراة وبالتالي زيادة إنتاجية المراعي.