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# Effect of grass reseeding on dry matter production and species composition of a community rangeland in Jodhpur, Rajasthan

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## Abstract

The study was conducted on a community rangeland in Ajeetnagar, Bawarli, Jodhpur, Rajasthan, India from 2015 to 2017. The objective was to investigate the effect of reseeding and soil depth on plant biomass production, density and botanical composition. There were nine treatments and replicated six times. The design of the study was factorial randomized block design. The frequency of the grass reseeding and depth of the field were the two factors. The levels of reseeding comprised control, reseeding once and twice while the levels of soil depth comprised shallow, medium and deep soils. Higher ($P<0.05$) plant dry matter (1645 kg/ha) was recorded in the area reseeded twice compared with the unseeded area. Deep soils (>20 cm depth) recorded 24, 106 and 14% higher total dry matter, perennial grass dry matter and annual grass dry matter compared to the shallow soil depth (<10 cm). Perennial grass density was higher ($P<0.05$) in the area reseeded once (15 plants/m$^2$) compared to the area reseeded twice, while it was higher for annual grasses and forbs for the unseeded area (29 and 18 plants/m$^2$).The medium (<20 cm depth) and deep soils (>20 cm depth) recorded significantly higher density of perennial grasses which was 48 and 32% higher than the shallow soils that recorded 9.97 perennial grasses/m$^2$. In medium deep soils, annual grasses contributed 48.40% in the botanical composition followed by perennial grasses (30.67%) and forbs (20.93%). It was concluded that reseeding the rangeland once increased dry matter production and species composition. Based on the present investigation, rangeland rehabilitation strategies such as reseeding could be adopted to restore the ecosystem services in degraded rangelands.

**Keywords:** Botanical composition, Dry matter, Plant density, Rangeland, Reseeding, Soil depth

## Introduction

Arid and semi-arid regions make up about one third of the global land and are inhabited by 1.10 billion people, or approximately 20% of the total world population (Bainbridge, 2007). The arid and semi-arid regions are also home to about 24% of the total population in Africa, 17% in the Americas and the Caribbean, 23% in Asia, 6% in Australia and Oceania, and 11% in Europe. In India, arid areas cover approximately 31.8 million ha and spread in Rajasthan, Gujarat, Haryana, Punjab, Maharashtra and Andhra Pradesh. The 61% area of the Indian arid zone is under the 12 western districts of Rajasthan and animal husbandry plays an important role in the economy of these arid districts (Sivaperuman and Baqri, 2013). According to Rajasthan State Livestock Policy Document, livestock and animal husbandry activities contributed more than 50% in the total economy of these arid districts (Saha *et al*., 2009).

This sector has a great potential for rural self-employment at lowest possible investment per unit. As per the livestock census of 2012, there are 30.18 million animals in the arid Rajasthan of which 20.48% constituted by cattle, 13.08% buffalo, 22.79% sheep, 42.38% goat and rest by other animals. This high livestock population is maintained extensively on the ~5.5 m ha rangelands of arid Rajasthan (Kar *et al*., 2009) through grazing on gochars (community grazing lands), oran (sacred groves) and agor rangelands (pasture around the pond). However, both the human and livestock population pressures on these grazing lands have increased significantly over the decades (Singh, 2012). The grazing and resource harvesting pressures in arid regions of India are surpassing the recommended recovery rates at an enormous pace, resulting in the need to develop strategies which restore and maintain the production levels of these rangelands (Sharma and Mehra, 2009; Ghosh and Mahanta, 2014).

Low rangeland productivity also results from; forage shortage which eliminates desirable range species, soil erosion, increased runoff and a reduction of perennial plant species cover (Alemayehu, 1998). Due to this continuous increase in the degradation of rangelands in Rajasthan and other regions across the world (King and Stanton, 2008), a sustainable approach is needed to both rehabilitate and sustain these ecosystems within rural communities, where livelihoods depend heavily on the rangeland resources for sustenance (Hazra, 2014). Reseeding with suitable perennial grasses as well as shrubs is one of the techniques suggested for improving and restoring the productivity of rangelands of arid Rajasthan (Ahuja and Mann, 1975), and it has also been used successfully as a means of rehabilitating degraded rangelands in East Africa (King and Stanton, 2008). Seeding desired species into select areas is highly recommended, as it often leads to an improvement in forage productivity, wildlife habitat, soil, and water quality (Doucette *et al*., 2001). Practices such as reseeding with grasses, planting of perennial woody plants and protection from grazing have the potential to increase plant species composition, density and the productivity of rangelands (Simons and Allsopp, 2007). These interventions are influenced by climate, soil depth, soil texture and soil moisture availability, which play a critical role in determining the type of rangeland vegetation, its potential productivity and distribution (Motzkin *et al*., 2002). Temporal patterns in species composition and basal area were dependent upon soil depth. In a long term study depth of horizon has been found to be closely correlated with the site potential and thus is the best indicator of growth potential. Total soil depth is used in measuring the effective rooting zone or the capacity of the site to furnish water (Simons and Allsopp, 2007).

Therefore, the present study was conducted on the degraded community rangeland of Ajeetnagar village of Jodhpur district, to investigate the effects of repeated reseeding using *Cenchrus ciliaris* on the biomass productivity of the rangeland. This is because there was lack of studies on the effects of reseeding on degraded rangeland. If *Cenchrus ciliaris* can facilitate production and biodiversity recovery, rangeland rehabilitation can be simultaneously combined with sustainable rangeland grazing practices for a sustainable win-win combination of ecological and economic benefits.

**Materials and Methods**

***Study area***: The study was conducted on the community rangeland of village Ajeetnagar, Bawarli, Jodhpur, Rajas--than, India from 2015 to 2017. The study site was located in the heart of the arid zone of Rajasthan and placed at 26$^{o}$ 18' N latitude and 73$^{o}$ 01' E longitude and with altitude at 224 m. The total area of the community rangeland was of 845 ha out of which 10 ha was selected for the study. The selected area was hammock type and had a slope of 8-10%.The vegetation at the study site was dominated by grass species of *Dactyloctenium sindicum* and shrubs of *Acacia tortilis*. The soil of the experimental site was sandy, having pH 8.68, EC 8.5dS/m, OC 0.18%, available P 10.87 kg/ha, available K 232 kg/ha and available N 106kg/ha. The whole 10 ha was protected with the earthen bund of 5' height and trench to prevent any grazing by livestock. The rainfall received during 2015, 2016 and 2017 at the experimental site was 415, 476 and 398 mm, respectively.

***Experimental design***: The 10 ha area was divided into three blocks; two blocks each 4 ha in size and one block of 2 ha in size. The shape of the field was rectangular having length of 400 m and width of 250 m. The 4 ha blocks had dimension of 400 m x 100 m and 2 ha block of 400 m x 50 m. Each block was further divided into three sub-blocks as shallow soil (soil depth <10 cm), medium deep soil (soil depth <20 cm) and deep soil (>20 cm). Pits were dug at 65-70 meter interval along the slope to ascertain the soil depths in all the three blocks and a demarcation line was drawn for sub-division of each block according to soil depths as upper parts shallow (130 m x 100 m), middle part medium (130 m x 100 m) and lower part as deep soils (130 m x 100 m). However, the width of each control plot was 50 m. In a randomized block design, nine treatment combinations which were replicated six times, consisting of reseeding frequency and location (depth) within a landscape as the two main factors. Reseeding had three levels; i) seeding twice (4 ha) with the onset of the monsoon in July 2015 and reseeding this same area in July 2016 again with the onset of the monsoon ii) seeding once (4 ha) with the onset of the monsoon in July 2015 only and iii) a control of 2 ha in which neither seeding nor any tilling operation was done. In the study *Cenchrus ciliaris* was sown using seed rate of 5 kg/ha at 60 cm row spacing. The furrows at desired spacing were opened with the help of tractor mounted cultivator and wet sand mixed seeds (1 part seed mixed in 6 part wet sand by volume) were sown manually in the open furrows. These reseeding levels were imposed in all the three soil depths (shallow, medium and deep soil depths).

***Measurements taken***: The data were recorded in the second week of September from six places in each soil depth representing six replications in all the reseeding blocks. The observations were taken from a quadrat of 1m$^2$ placed in the middle of each block (65 m either way of the demarcation line) at a regular interval of 15 m from the 4 ha blocks and 8 m from control block. Inside these quadrats, all standing grasses and forbs were cut at a height of 8 cm from ground level at the time of observation once in a year. The plant samples from the quadrats were separated as perennial and annual grasses and remaining dicots as forbs for computation of density and botanical composition. The classified plants were kept in paper bags and oven dried at 70$^o$ C for 72 hours, and then weighed species-wise for estimation of dry matter. The average standing herbage yield was calculated in kg/ha, while plant density was calculated as plant/m$^2$. Various vegetation attributes were calculated according to the following formulae employed by Ambasht (1969).

$$\text{Frequency} = \frac{\text{No of quadrats in which a species occurs}}{\text{Total no of quadrats sampled}} \times 100$$

$$\text{Abundance} = \frac{\text{Total no of individuals of a species in all quadrats}}{\text{Total no of quadrats in which the species occurred}}$$

$$\text{Density} = \frac{\text{Total no of individuals of a species in all quadrats}}{\text{Total no of quadrats taken in the study irrespective of the occurence of species}}$$

***Statistical analysis***: The observed data were analyzed statistically to test the significance of variation in experimental data obtained for various treatment effects. The critical differences were calculated to assess the significance of treatment means, wherever, the 'F' test was found significant at five per cent level of significance.

**Results and Discussion**

***Biomass yield***: The biomass of plants on dry matter basis varied considerably with the frequency of reseeding and soil depth (Table 1). Significantly higher plant dry matter of 1645 kg/ha was recorded with treatment in which reseeding was done twice which was 68% higher than the dry matter recorded with control. There were no significant difference between dry matter recorded for perennial grasses between once and twice reseeding frequency but both these treatments recorded statistically higher dry matter compared to control. The dry matter for annual grasses followed similar trend as was observed for total plant dry matter and twice reseeding treatment recorded 53% higher dry matter compared to control (474 kg/ha). The reseeding once recorded 128% and 216% higher dry matter of forbs compared to control (155 kg/ ha) and twice reseeding (112 kg/ha). The dry matter of perennial grasses, annual grasses and total dry matter increased with increase in soil depth. As compared to shallow soil depth, deep soils (having > 20 cm soil depth) recorded 24, 106 and 14% higher production of total dry matter, perennial grass dry matter and annual grass dry matter. However, dry matter from forbs was recorded considerably higher from shallow soil compared to medium and deep soils. The higher dry matter with reseeding was also reported by (Elhag and Fadlalla, 2012) in the rangelands of Sudan. Rehabilitation using grass reseeding technologies have been employed successfully in low rainfall areas around the world. For example, Thar Desert in India, which receives an average annual rainfall of 100-500 mm, Cholistan Desert in Pakistan, which receives an average annual rainfall of 100-250 mm and the semi-arid parts of Baringo district in Kenya, which receives an average annual rainfall of between 300-700 mm (Sinha *et al*. 1999). Abdelsalam *et al*. (2017) reported significant increase in vegetation cover, plant density and biomass production from Blue Nile State, Sudan rangelands with employment of practices such as protection and reseeding and decreased bare soil percentages. The higher dry matter in deep and medium deep soil was attributed to higher dry matter yield from perennial and annual grasses in these soils compared to shallow soils. Depth of horizon A was found to be closely correlated with the site potential in supplying plant nutrients and soil moisture and thus was the best indicator of growth potential (Khumalo *et al*., 2008). Further, the differences in biomass productivity among reseeding treatments was probably due to higher number of perennial grasses that increased plant density and led to a reduction in bare soil per cent consequence increased biomass productivity.

***Vegetation density***: The density of plants/m$^2$ was varied significantly with the frequency of reseeding but showed inconsistency with soil depth under the study (Table 1). The highest density of 59 plants/m$^2$ was recorded with control followed by reseeding twice (52 plants/m$^2$). The density of perennial grasses were recorded significantly higher with reseeding once treatment (15 plants/m$^2$) and lowest with twice reseeding, while significantly higher density of annual grasses and forbs were recorded with control (29 and 18 plants / m$^2$) which was 28 and 103%

**Table1.** Effect of grass reseeding and depth of soil on the dry matter yield, density of plants and botanical composition of community rangeland of Ajeet nagar, Jodhpur (Average of 2016 and 2017)

| Treatment | Dry matter (kg/ha) | | | | Density of plants/m² | | | | Botanical composition (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Perennial grasses | Annual grasses | Forbs | Total | Perennial grasses | Annual grasses | Forbs | Perennial grasses | Annual grasses | Forbs |
| Reseeding frequency | | | | | | | | | | | |
| Control | 977 | 349 | 474 | 155 | 58.58 | 12.25 | 28.83 | 17.50 | 24.27 | 48.18 | 27.55 |
| Once | 1336 | 832 | 597 | 354 | 45.94 | 14.89 | 22.44 | 8.61 | 33.98 | 47.78 | 18.25 |
| Twice | 1645 | 810 | 723 | 112 | 51.67 | 10.75 | 25.64 | 15.28 | 22.92 | 50.10 | 26.98 |
| SEm± | 40 | 29 | 35 | 9 | 2.05 | 0.63 | 1.27 | 0.97 | 1.16 | 1.65 | 1.27 |
| CD at 5% | 114 | 81 | 98 | 25 | 5.77 | 1.76 | 3.59 | 2.73 | 3.27 | NS | 3.59 |
| Soil depth | | | | | | | | | | | |
| <10 cm | 1157 | 420 | 549 | 286 | 50.33 | 9.97 | 24.25 | 16.11 | 22.03 | 47.72 | 30.25 |
| <20 cm | 1363 | 704 | 617 | 159 | 52.67 | 14.75 | 25.19 | 12.72 | 30.67 | 48.40 | 20.93 |
| >20 cm | 1439 | 867 | 628 | 175 | 53.19 | 13.17 | 27.47 | 12.56 | 28.46 | 49.94 | 21.60 |
| SEm± | 40 | 29 | 35 | 9 | 2.05 | 0.63 | 1.27 | 0.97 | 1.16 | 1.65 | 1.27 |
| CD at 5% | 114 | 81 | NS | 25 | NS | 1.76 | NS | 2.73 | 3.27 | NS | 3.59 |

*NS: Non-significant

higher than the density recorded with reseeding once. The corresponding density of annual grasses and forbs with reseeding once was 22 plants and 9 plants/m². The density of annual grasses and forbs between control and reseeding twice were found non-significant. The higher density of total plants with control in the study was attributed to more number of annual grasses (*Dactyloctenium aegypticum*, *Aristida funiculata*, *Melanocenchris jacquemontii*) and forbs mostly *Tephrosia purpurea* and *Boerhavia diffusa* as compared to reseeding treatments in which tilling operation employed for sowing might have uprooted these plants. The depth of soil had considerable effect on the density of perennial grasses and forbs only in the study. The density of total plants and annual grasses were found non-significant. The medium (<20 cm soil depth) and deep soils (>20 cm soil depth) recorded significantly higher density of perennial grasses which was 48 and 32% higher than the shallow soils that recorded 9.97 perennial grasses/m². In contrast to perennial grasses, the density of forbs was recorded significantly higher with shallow soils and decreased with increase in soil depth. The higher density of perennial grasses in deep soil was self-explanatory as perennial grasses required deep soils. The number of forbs *Tephrosia purpurea* and *Boerhavia diffusa* were restricted to shallow soils compared to deep soils and might not compete with robust rhizosphere of perennial grasses for soil moisture and nutrients besides their habitat preference was the reason for higher density of these plants in shallow soils.

***Botanical composition***: The botanical composition of range plants was also recorded (Table 1). With both the factors under study, contribution of annual grasses was more than 47% in the botanical composition though it was recorded non-significant with seeding interval and soil depth. The contribution of perennial grasses was recorded statistically higher in the field where seeding was done once (33.98%) while contribution of forbs was recorded higher in non-seeded control (27.55%) and least with once seeding treatment (18.25%). In medium and deep soils, contribution of perennial grasses was 30.67% and 28.46% that was considerably higher than the shallow soils. In shallow soils forbs contributed 30.25% in the botanical composition and medium and deep soils recorded non-significant values of forb in the botanical composition. The botanical composition was calculated on the basis of plant per unit area and hence the trend of botanical composition followed the same trend as it was observed with reseeding treatments and soil depths for the density in the study.

**Table 2.** Species frequency, abundance and density of range plants under different soil depths in reseeded community rangeland of Ajeet nagar, Jodhpur

| Plant species | % Frequency | | | | | | Abundance | | |
|---|---|---|---|---|---|---|---|---|---|
| | Once seeded | | | Twice seeded | | | Once seeded | | |
| | U | M | L | U | M | L | U | M | L |
| *C. ciliaris* | 16.67 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 1.00 | 6.50 | 8.33 |
| *D. sindicum* | 66.67 | 83.33 | 100.00 | 100.00 | 83.33 | 83.33 | 15.75 | 8.40 | 20.33 |
| *T. purpurea* | 100.00 | 66.67 | 66.67 | 100.00 | 50.00 | 16.67 | 3.33 | 1.75 | 5.25 |
| *C. setigerus* | 100.00 | 83.33 | 83.33 | 66.67 | 66.67 | 66.67 | 15.17 | 3.20 | 3.00 |
| *A. funiculata* | 16.67 | 66.67 | 33.33 | 16.67 | 33.33 | 66.67 | 2.00 | 4.75 | 5.50 |
| *F. cretica* | 16.67 | 0.00 | 0.00 | 16.67 | 16.67 | 16.67 | 1.00 | 0.00 | 0.00 |
| *R. adscendens* | 16.67 | 16.67 | 66.67 | 16.67 | 33.33 | 16.67 | 4.00 | 1.00 | 1.25 |
| *B. ramosa* | 16.67 | 16.67 | 33.33 | 0.00 | 66.67 | 50.00 | 3.00 | 1.00 | 3.50 |
| *C. biflorus* | 0.00 | 0.00 | 16.67 | 0.00 | 16.67 | 16.67 | 0.00 | 0.00 | 6.00 |
| *C. depressus* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.67 | 0.00 | 0.00 | 0.00 |
| *C. tridens* | 0.00 | 0.00 | 0.00 | 0.00 | 16.67 | 0.00 | 0.00 | 0.00 | 0.00 |
| *D. tomentosa* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 33.33 | 0.00 | 0.00 | 0.00 |
| *E. tenella* | 16.67 | 0.00 | 0.00 | 0.00 | 0.00 | 16.67 | 1.00 | 0.00 | 0.00 |
| *I. cordifolia* | 0.00 | 0.00 | 16.67 | 0.00 | 33.33 | 0.00 | 0.00 | 0.00 | 2.00 |
| *I. linnaei* | 16.67 | 50.00 | 50.00 | 0.00 | 33.33 | 33.33 | 1.00 | 3.33 | 7.00 |
| *T. terrestris* | 0.00 | 33.33 | 16.67 | 0.00 | 16.67 | 0.00 | 0.00 | 1.00 | 1.00 |
| *M. jacquemontii* | 16.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.00 | 0.00 | 0.00 |
| *B. diffusa* | 16.67 | 16.67 | 16.67 | 0.00 | 0.00 | 0.00 | 3.00 | 1.00 | 4.00 |
| *C. viscosa* | 0.00 | 0.00 | 16.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| *D. muricata* | 0.00 | 0.00 | 16.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 |

| Plant species | Abundance | | | Density (plants/$m^2$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Twice seeded | | | Once seeded | | | Twice seeded | | |
| | U | M | L | U | M | L | U | M | L |
| *C. ciliaris* | 4.83 | 6.17 | 9.00 | 10.50 | 6.50 | 8.33 | 4.83 | 6.17 | 9.00 |
| *D. sindicum* | 9.67 | 24.00 | 7.40 | 3.33 | 7.00 | 20.33 | 9.67 | 20.00 | 6.17 |
| *T. purpurea* | 13.83 | 1.00 | 6.00 | 0.17 | 1.17 | 3.50 | 13.83 | 0.50 | 1.00 |
| *C. setigerus* | 5.00 | 5.00 | 2.00 | 0.17 | 2.67 | 2.50 | 3.33 | 3.33 | 1.33 |
| *A. funiculata* | 9.00 | 10.00 | 11.25 | 0.00 | 3.17 | 1.83 | 1.50 | 3.33 | 7.50 |
| *F. cretica* | 4.00 | 2.00 | 1.00 | 0.33 | 0.00 | 0.00 | 0.67 | 0.33 | 0.17 |
| *R. adscendens* | 3.00 | 1.00 | 1.00 | 0.17 | 0.17 | 0.83 | 0.50 | 0.33 | 0.17 |
| *B. ramosa* | 0.00 | 3.75 | 4.33 | 0.17 | 0.17 | 1.17 | 0.00 | 2.50 | 2.17 |
| *C. biflorus* | 0.00 | 4.00 | 3.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.67 | 0.50 |
| *C. depressus* | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.17 |
| *C. tridens* | 0.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 |
| *D. tomentosa* | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 |
| *E. tenella* | 0.00 | 0.00 | 3.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 |
| *I. cordifolia* | 0.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.67 | 0.00 |
| *I. linnaei* | 0.00 | 3.00 | 1.50 | 1.17 | 1.67 | 3.50 | 0.00 | 1.00 | 0.50 |
| *T. terrestris* | 0.00 | 1.00 | 0.00 | 0.00 | 0.33 | 1.17 | 0.00 | 0.17 | 0.00 |
| *M. jacquemontii* | 0.00 | 0.00 | 0.00 | 0.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| *B. diffusa* | 0.00 | 0.00 | 0.00 | 0.50 | 0.17 | 0.67 | 0.00 | 0.00 | 0.00 |
| *C. viscosa* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.00 | 0.00 |
| *D. muricata* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 |

Where U stands for Upper; M for Middle and L for Lower parts of the field

***Vegetation attributes***: The data on frequency, abundance and density of range species were recorded from plots reseeded once and twice (Table 2). Though the plant species differed in both the reseeding treatments, the number of species remained same. For the ease of understanding, vegetation attributes of reseeded twice are described here because the behavior of most prominent species remained almost similar in both the treatments. The frequency of *Cenchrus ciliaris* was 100% in the upper, middle and lower parts of the field that represents three soil depths of shallow, medium and deep, respectively. The frequency of grass *Dactyloctenium sindicum* was 100% in the upper part and 83.33% both in the middle and lower parts of the field. The frequency of *Tephrosia purpurea* decreased with increases in soil depth and 100% was recorded from the upper shallow parts of the field and 50 and 16.67% in the middle and lower parts of the field. The frequency of *Cenchrus setigerus* recorded uniformly @ 66.67% in all the three depths of the field. In contrast to *Tephrosia*, frequency of *Aristida funiculata* increased with increase in soil depth and maximum frequency of 66.67% was observed in the lower deep part of the field. The plant species *Cenchrus biflorus*, *Corchorus depressus*, *Dicoma tomentosa*, *Eragrostis tenella* and *Indigofera linnaei* were restricted to lower deep portions of the field while *Corchorus tridens*, *Indigofera cordifolia* and *Tribulus terrestris* present in the medium depth of the field. The abundance of *Cenchrus ciliaris* increased gradually with increase in soil depth from shallow to deep and maximum value of 9 was recorded in lower deep portion of the field. The trend in abundance with *Tephrosia purpurea,* however, recorded as reverse and maximum value was recorded in the upper portion of the field dominated by the calcium carbonate concretions. In the medium part of the field *Dactyloctenium sindicum* was found abundantly than the other plant species. The density also showed the similar trend as was noticed with abundance. Maximum density of *Cenchrus ciliaris* (9) was recorded in the lower deep portions of the field. The maximum density of non-palatable *Tephrosia purpurea*, was recorded in the shallow upper portions of the field.

**Conclusion**

The reseeding of suitable grass species has considerable effect on the dry matter production from the degraded rangelands. The plant dry matter yield increased from 977 to 1645 kg/ha due to technical intervention of grass reseeding. Further, depth of soil also played important role in providing area for root ramification and supply of soil moisture and plant nutrients. Soil depth of 20 cm increased the dry matter production by 24% than low soil depth. Thus, from the study it was concluded that reseeding of perennial grasses in the medium and deep soils is an effective rangeland improvement practice and can be adopted for the low rainfall rangelands of Jodhpur.

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