DESERT GRASS REHABILITATION STRATEGIES FOR CHOLISTAN

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Abstract

Seeding and stump planting methods of five grasses were compared at Arid Zone Research Institute (PARC) farm in Cholistan during monsoon seasons of 1992-94. A seed rate of 250 seeds/m^2 was used in case of seeding while for stump planting the plant to plant spacing was kept at 0.5 m. Overall dry matter yield (DMY) was numerically higher in case of seeding than stump planting. Regardless of propagation method, *Cenchrus ciliaris* (US Buffel) and *Lasiurus scindicus* (Gorkha) out-performed in terms of DMY than rest of the grasses. Field observations confirmed that plants emerging from seed were morphologically more vigorous than those arising from root stumps. Thus seeding method if synchronized with suitable soil moisture can prove more effective in terms of DMY in desert areas like Cholistan

Introduction

Cholistan desert, occupying an area of 26,000 km^2 lies in the South-eastern corner of Punjab province, 69^0 52' and 73^0 05' E longitude and 27^0 42' and 27^0 45' N latitudes (Khan, 1987; Farid *et. al.*, 1992; Arshad & Rao 1994; Akbar *et. al.*, 1996). In spite of its low productivity, this desert sustains relatively high human and livestock populations (0.10 million and 0.2 million, receptively). There is a tendency to increase the livestock population since it is the only livelihood of pastoralists. This increase in the livestock population is at the expense of the fragile ecosystem.

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The average annual rainfall of the Cholistan desert varies from 100 to 250 mm (Akram *et. al.,* 1991; Akbar *et.al.,* 1996), falling mostly between July and September. During summer, the temperature reaches up to 50 ^{0}C with very low relative humidity (Fig.1). Low carrying capacity accompanied with overuse of depleted natural vegetation results in frequent out-migration of desert pastoralists and their livestock towards the surrounding irrigated areas especially during drought periods (Arshad & Rao 1994; Akbar *et. al.,* 1996).

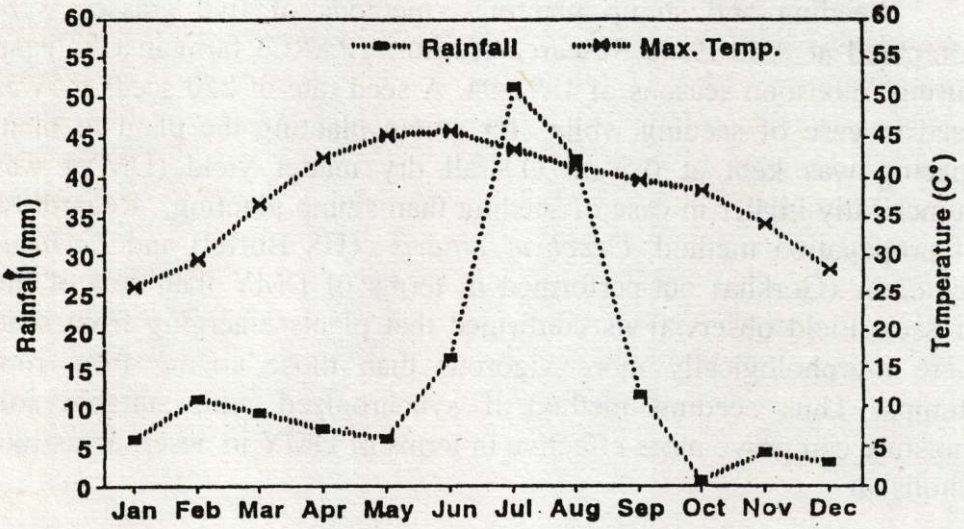

Figure 1: Ombrothermic diagram for Cholistan desert.

(30 years Average, 1961-1990)

The most spectacular landforms of the Cholistan desert are the sand dunes. In between the sand dunes, fine textured but lifeless hard plains called "dahars" exist. Being very saline and impervious to rain water the "dahars" remain predominantly plantless.

Erratic, uncertain and unpredictable rainfall, low humidity and extremes in diurnal temperatures are compounded by increasing livestock numbers and the consequent decrease in vegetation cover triggering the process of desertification.

Trees, shrubs and even roots of the plants are indiscriminately cut for fuel, feed, fencing and the construction of thatched huts called "gopas". Moreover, a variety of desert plants serve as valuable source of food, medicine and for other domestic uses for the desert inhabitants. The over-exploitation of the natural vegetation to meet these requirements is adversely affecting the natural process of regeneration of these species thus severely crippling the life pattern and reversing the natural successional trends, ultimately degrading the environment.

The present condition of range vegetation in Cholistan calls for quick ameliorative measures to increase the productivity of deteriorated range ecosystem. The most important activity in range improvement is enhancement of forage production through introduction and establishment of ecologically suitable and high yielding forage species and their strains (Springfield 1957 and Kaul & Thalen 1971). In many tropical countries, improved selection of cultivars of perennial grasses have increased the forage yield manifold over that of native and naturalized grasslands (Walmsley *et. al.,* 1978). The increase in carrying capacity of highly depleted arid rangelands of Pakistan is possible through reseeding with promising grass species (Mohammad & Naqvi 1987).

Realizing the problem of vanishing desert flora at an increasing pace, the Arid Zone Research Institute of Pakistan Agricultural Research Council at Bahawalpur initiated a number of studies at its research farm located in Cholistan desert. Among others, this study focused its attention to different aspects of desert ecosystem by comparing the two different modes of propagation for introduction of ecologically suitable species of indigenous perennial grasses and potential cultivars of *Cenchrus ciliaris* of exotic source. The study was aimed to hasten the process of recovery of desert vegetation of exotic and indigenous sources.

Materials and Methods

Study site:

The study was carried out at Cholistan Farm of Arid Zone Research Institute situated at "Chah Sullah Wala", 100 km south of Bahawalpur city on the way to Fort Dirawar, 71° 28' E longitude and 28° 54' N latitudes at 120 m elevation above sea level. The study site is typical desert area comprising of sand dunes and inter-dunal flats representing the unique Cholistan environment (Arid Zone Res. Sub-station 1991).

Seeds of five grass species: *Panicum antidotale, Panicum turgidum, Lasiiurus scindicus, Octhochloa compressa* and six cultivars of *Cenchrus ciliaris* (including local) were sown using broadcast method in plots measuring 2.5 m x 10 m, laid out at inter-dunal flats and sub-dunal regions just before the onset of monsoon rains during 1992. A seed rate of 250 seeds/m^2 was used (Vallentine 1989). At the same time, in the same sized plots, root stumps of the same grass species and cultivars from grass nursery at Bahawalpur farm were planted in rows maintaining 0.5 m x 0.5 m spacing. Six rows of each species/cultivar were planted in the same areas (inter-dunal flats and sub-dunal regions) in separate plots. Seeding and planting of all the grasses was carries out just before rainfall and both the treatments were maintained under natural conditions during the entire length of study of three years, *i.e.*, 1992-94. The study was laid out in randomized complete block design with three factors and three replications.

At the end of monsoon season of first year, in 1992, germination percentage of seeded plots and survival percentage in case of stump planting was recorded. By the end of monsoon seasons of 1993 and 1994, data regarding germination percentage and biomass of grass species and their respective cultivars under both the treatments were recorded using 1 m^2 quadrat. Samples were clipped flush to the ground (leaving 3.5 cm stubble height) and green weight was recorded. These samples were dried at 60°C in the oven for 24 hours and dry matter yield (DMY) was recorded. The data obtained was analyzed statistically

and means were separated using Duncan's Multiple Range Test (Steel & Torrie 1980).

Results and Discussion

Total Dry Matter Yield of Introduced Grasses:

The initial observation collected at the end of first monsoon season of 1992, revealed an average germination of 68 percent of all the grasses (averaged over all grass species and cultivars) while the survival percentage in stumps was found as 45 percent (averaged over all the species and cultivars). Overall dry matter yield (DMY) of grass species planted in this study in seeding and stump planting methods averaged over two years is given in Fig.2. *Panicum antidotale* (Blue panic), *Cenchrus ciliaris* (U.S Buffel) and *Lasiurus scindicus* (Grokha) out-performed in terms of dry matter yield (DMY) and their yield did not differ significantly ($p< 0.05$) among each other. The dry matter yields of *Cenchrus ciliaris* (Nunbank) and *Cenchrus ciliaris* (Biloela) were found intermediate and significantly higher ($p< 0.05$) than from those of *Panicum turgidum, Ochthochloa compressa and Cenchrus ciliaris* (Cv. 267) . *Cenchurs ciliaris* (Local) produced significantly lowest ($p<0.05$) DMY among all the grass species raised in this trial (Fig.3).

Propagation techniques:

While considering the effect of propagation techniques of all the grass species in this trial averaged over two years (1993 and 1994), seeding method produced numerically higher yields than stump planting (Table 1).

Within seeding method, *Panicum antidotale* gave numerically highest DMY (566 kg ha^{-1} but it did not differ significantly ($p<0.05$) than *Cenchrus ciliaris* (U.S Buffel). *Lasiurus scindicus* (Gorkha), a local potential grass, was found the third highest producer of DMY (414 kg ha^{-1}) but its yield did not differ significantly ($p< 0.05$) than those of *Cenchrus ciliaris* (Nunbank) (356 kg ha^{-1}) and *Cenchrus ciliaris* (Biloela) (410 kg ha^{-1}). *Ochthochloa compressa*, another local grass,

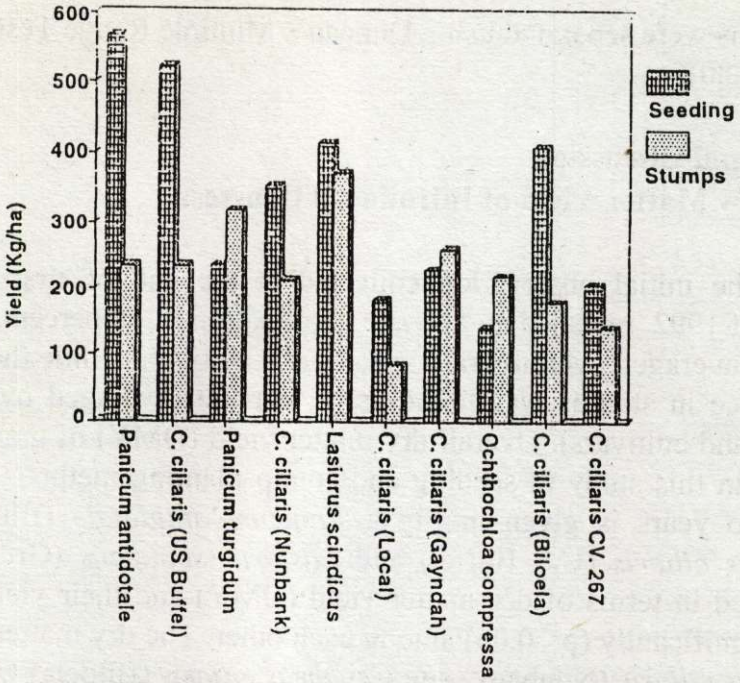

Figure 2 Dry matter yield of grasses in seeding and planting methods averaged over two years

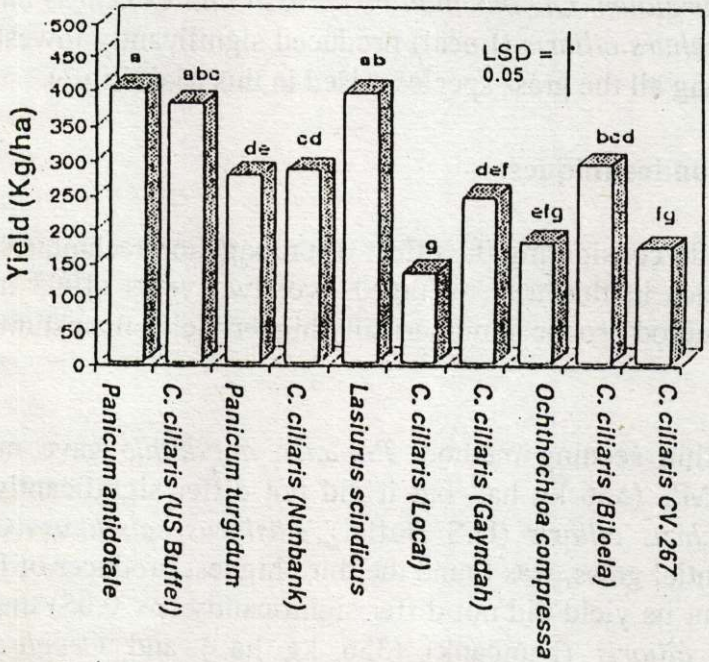

Figure 3 : Yield of grass species averaged over two years and two planting methods. Bars with the same letters do not differ significantly ($p < 0.05$)

produced numerically the lowest DMY that, however, did not differ significantly from the DMY of *Cenchrus ciliaris* (Local) and *Cenchrus ciliaris* (Cv.267)

In case of stump planting technique, highest dry matter yield was found in case of *Lasiurus scindicus* (Gorkha) (373 kg ha^{-1}) followed by *Panicum turgidum* (319 kg ha^{-1}). Numerically lowest DMY was found in case of *Cenchrus ciliaris* (Local) (86 kg ha^{-1}) that did not differ significantly ($p< 0.05$) from the DMY of *Cenchrus ciliaris* (Biloela) (178 kg ha^{-1}) and *Cenchrus ciliaris* (Cv.267) (141 kg.ha^{-1}). Rest of all the species, *i.e.*, *Panicum antidotale*, *Cenchrus ciliaris* (U.S Buffel). *Cenchrus ciliaris* (Nunbank). *Cenchrus ciliaris* (Gayndah) and *Ochthochloa compressa* produced intermediate dry matter yields in this planting technique (Table 1).

While looking at the analysis of variance (Table 2), grass species and the method of propagation also reflected highly significant values and their interaction was also significant ($p=0.00020$).

Overgrazing, soil erosion, salinization and removal of natural vegetation for various household purposes are the long outstanding issues of desertification particularly in the developing world (Dregne 1986). Cholistan desert is not exception to these problems. Explosion of human and livestock population during the last decade, development of road networks, encroachments of desert areas by irrigated agriculture and farming settlements have contributed enormously to the degradation of natural vegetation in Cholistan. Accompanied with these problems are long drought spells that reduce the reproductive capacity of natural vegetation on one hand and reduction of seed bank in the desert soil, on the other.

Table 1. Dry matter yield of grasses under two modes of propagation at Cholistan Farm, 1993-94. (Kg ha^{-1})

S.No	Species	Seeding	Stump lating
1.	*C.ciliaris* (Gayndah)	230^{efg}	261^{defg}
2.	*C.ciliaris* (Nunbank)	356^{cde}	213^{fgh}
3.	*C.ciliaris* (Biloela)	410^{bc}	178^{gh}
4.	*C.ciliaris* (Local)	185^{fgh}	86^{h}
5.	*C.ciliaris* (CV.267)	207^{fgh}	141^{gh}
6.	*Cenchrusciliaris* (US Buffel)	524^{ab}	236^{defg}
7.	*Lasiurus scindicus*	414^{bc}	373^{cd}
8.	*Ochthochloa compressa*	141^{gh}	218^{efgh}
9.	*Panicum antidotale*	566^{a}	236^{defg}
10.	*Panicum turgidum*	237^{defg}	319^{cdef}

Means in the same column with the same superscript do not differ significantly ($p<0.05$)., (LSD = 141.1, n = 6)

Table 2. Analysis of variance for dry matter yield of grass species under two propagation techniques (1993-94)

Source	Df	SS	MS	F	P
Replic.	2	36731.150	18365.575	1.6811	0.3730
Year (Y)	1	15870.000	15870.000	1.4527	0.3514
Error	2	21849.050	10924.525		
Methods (M)	1	304819.200	304819.20	20.0142	0.0000
Y x M	1	83002.800	83002.800	5.4499	0.0222
Species	9	971107.467	107900.83	7.0847	0.0000
Y x S	9	495530.667	55058.963	3.6151	0.0009
M x S	9	582811.133	64756.793	4.2519	0.0002
Y x M x S	9	340276.200	37808.467	2.4825	0.0153
Error	76				
Total	**119**	**1157493.133**	**15230.173**		

Conclusion

The study provided an opportunity to compare the efficiency of propagation methods through seeding and planting of root stumps of grasses. Results obtained very clearly signify the importance of seeding method compared to stump planting (Table 1). Field observations also revealed that plants emerging from seeding were morphologically more vigorous than those arising from root stumps. The results also emphasize that in order to hasten the anti-desertification measures on one hand and to conserve the vanishing plant wealth in Cholistan desert on the other, not only natural vegetation be protected from misuse, but introduction of suitable grass and shrub germplasm be carried out through careful evaluation, as well.

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