

GRASS INTRODUCTION TRIALS IN MISSA RESEARCH PLOT OF RAWALPINDI DISTRICT

by

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Summary. The development of vegetation cover in depleted rangelands of Mangla Watershed through introduction of suitable grass species is important for the production of good quality water and for increasing effective life of the Mangla reservoir by retarding its siltation rate. To find out suitable species for introduction in the Mangla watershed project area (dry sub-tropical) grass introduction trials with 39 ecotypes of 14 species are being carried out in collaboration with Watershed Management Project of WAPDA in Missa Research Plot of Rawalpindi district since February, 1973. On the basis of 1-1/2 years' observations on establishment, vigour, longevity and forage yield of these introductions, seven ecotypes of *Bothriochloa pertusa*, *Cenchrus ciliaris*, *Chrysopogon aucheri*, *Dicanthium annulatum* and *Panicum antidotale* have been considered successful. The study is still in progress.

The Study Area. The study area is located at Missa, in the watershed of Mangla dam. The elevation is 460 metres, latitude $33^{\circ} 11' N$ and longitude $73^{\circ} 22' E$. The climatic data based on the average of the past five years are as follows:—

Month	Temperature C°		Rainfall (mm)
	Mean Max.	Mean Min.	
January	17.9	3.2	67.4
February	19.9	5.6	71.5
March	25.2	11.1	69.6
April	33.4	16.7	61.5
May	38.2	22.0	55.1
June	39.1	25.9	60.6
July	36.5	24.6	74.8
August	34.3	24.0	76.3
September	33.8	20.8	72.6
October	32.8	9.7	65.4
November	26.0	8.6	67.3
December	19.8	4.8	66.3

Annual rainfall: 808.4 mm

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The soil is made up of loess deposits, generally unconsolidated, unstratified and structureless.

The native vegetation of the area is as follows:

1. Trees *Acacia modesta*, *Capparis decidua*, *Acacia arabica*, *Dalbergia sissoo*, *Zizyphus mauritiana*, *Cordia vestita*.
2. Shrubs: *Zizyphus nummularia*, *Dodonaea viscosa*, *Gymnosporia* sp., *Ehretia laevis*, *Calatropis procera*, *Artimisia scoparia*, *Indigofera linifolia*, *Sapium sebiferum*, *Heliotropium* sp.
3. Forbs: *Polygonum* sp., *Polygala chinensis*, *Rhynchosia minima*, *Tragus racemosus*.
4. Grasses: *Chrysopogon montanus*, *Bothriochloa*, sp. *Eleusine flagellifera*, *Sorghum halepense*, *Desmostachya bipinnate*, *Cymbopogon schoenanthus*, *Eragrostis pectinacea*, *Eragrostis* sp., *Aristida depressa*, *Cenchrus ciliaris*, *Heteropogon contortus*.

Method. A total of thirty nine ecotypes of 13 species of grasses (Appendix-I) were sown in trenches in 3 replications during February, 1973 and in lines in 2 replications during June, 1973.

The replications included all the various sites in the plot i.e., top-land (uncultivated flat land), top slope, middle flat land (abandoned cultivation) middle slope and bottom and (uncultivated flat land). The seeding rate for all the ecotypes was kept as 9 kgms per hectare. Bi-monthly observations are being recorded on the following characteristics:

Establishment. The objective of this study is to find out those species which will establish themselves on extensive areas in the dry sub-tropical zone of Mangla Watershed under natural conditions without irrigation and fertilization. Therefore the species covering 75% or more of the sown area only were considered to be established. The observations were recorded as established or not established.

Vigour. The established plants must be vigorous enough to compete with the local weeds. Average height, leaf length and basal area of the plants was observed qualitatively and the relative vigour for surviving plants of all the grass introductions were recorded as dead, weak, fair, good, excellent (2).

Longevity. The desirable species from Watershed Management point of view will be those which remain green for maximum period of the year. Only those species/types have been considered desirable which were recorded green during 60% of the observations.

Forage Yield. The successful species should be able to produce reasonable quantity of forage for use by livestock. The introductions were not clipped during first

year of establishment. During second year of establishment it was noticed that only 8 ecotypes were producing more than 100 kgms/hectare of forage. Hence only these eight introductions were clipped during October, 1974 up to 1 cm. stubble height.

Results and Discussion. *Andropogon intermedius* R.M. No. 153, *Andropogon gayanus* R.M. No. 368, *Cenchrus ciliaris* R.M. No. 342, *Chloris gayana* R.M. No. 245 & 276, *Eragrostis superba* R.M. No. 279, *Pennisetum orientale* R.M. No. 402, *Sorghastrum nutans* R.M. No. 138 & 140, *Sorghum halepense* R.M. No. 344 and *Saccharum munja* R.M. No. 432 have altogether failed in all the desirable characters and have not been included in the following evaluation for determining the more successful ecotypes. For the remaining 29 ecotypes in the beginning each character is being taken up separately and at the end the overall performance will be considered.

Establishment. All the species were slow to establish. *Cenchrus ciliaris* R.M. No. 391 was recorded better established than any other species. *Bothriochloa pertusa* R.M. No. 272 was the second most well established ecotype while *Chrysopogon aucheri* R.M. No. 420, *Panicum antidotale* R.M. No. 264, *Panicum antidotale* R.M. No. 248 and *Cenchrus ciliaris* R.M. No. 228 ranked third, fourth and fifth in their ability to establish.

Cenchrus ciliaris produced excellent crops of viable seeds and many vigorous seedlings. Seedlings from many ecotypes of this species invaded other plots and unseeded area. This species appears to be the easiest to establish of all species tested.

Vigour. *Cenchrus ciliaris* R.M. No. 353 exhibited more vigour than any other introduction. *Chrysopogon aucheri* R.M. No. 420 was the second most vigorous ecotype while *Cenchrus ciliaris* R.M. No. 242, *Cenchrus ciliaris* R.M. No. 240 *Cenchrus ciliaris* R.M. No. 391 and *Bothriochloa pertusa* R.M. No. 272 ranked third, fourth, fifth and sixth in their relative vigour.

Longevity. *Cenchrus ciliaris* R.M. No. 228, 240, 242, 267, 353, 391 and *Panicum antidotale* R.M. No. 264 and 335 were shown green in all the recorded observations. *Panicum antidotale* R.M. No. 248 & 263 were the next longest living introductions. *Panicum antidotale* R.M. No. 249 and 250, *Chrysopogon aucheri* R.M. No. 420, *Cenchrus ciliaris* R.M. No. 265 269,, 270, and 272 were next to follow.

Forage Yield. *Cenchrus ciliaris* R.M. No. 391 out-yielded all other introductions. *Panicum antidotale* R.M. No. 248 was the second most productive grass while *Hyparrhenia rufa* R.M. No. 387, *Cenchrus ciliaris* R.M. No. 269, *Cenchrus ciliaris* R.M. No. 265 and *Dicanthium annulatum* R.M. No. 318 ranked third, fourth, fifth and sixth in their productive capacity.

Appendix I

Ecotypes sown in grass introduction trials in Missa (Rawalpindi).

S.No.	Species	R.M. No.	Local Name	Source
1.	<i>Andropogon intermedius</i>	153	Khawi	Pakistan
2.	<i>Andropogon gayanus</i>	368	—	Sudan
3.	<i>Bothriochloa pertusa</i>	272	Palwan	Pakistan
4.	<i>Cenchrus ciliaris</i>	228	Dhaman	Thal
5.	<i>Cenchrus ciliaris</i>	231	Dhaman	Thal
6.	<i>Cenchrus ciliaris</i>	232	Dhaman	Thal
7.	<i>Cenchrus ciliaris</i>	233	Dhaman	Thal
8.	<i>Cenchrus ciliaris</i>	240	Dhaman	Thal
9.	<i>Cenchrus ciliaris</i>	242	Dhaman	Thal
10.	<i>Cenchrus ciliaris</i>	243	Dhaman	Sudan
11.	<i>Cenchrus ciliaris</i>	265	Dhaman	India
12.	<i>Cenchrus ciliaris</i>	266	Dhaman	India
13.	<i>Cenchrus ciliaris</i>	267	Dhaman	India
14.	<i>Cenchrus ciliaris</i>	268	Dhaman	India
15.	<i>Cenchrus ciliaris</i>	269	Dhaman	India
16.	<i>Cenchrus ciliaris</i>	270	Dhaman	India
17.	<i>Cenchrus ciliaris</i>	274	Dhaman	Pakistan
18.	<i>Cenchrus ciliaris</i>	342	Dhaman	Arizona
19.	<i>Cenchrus ciliaris</i>	353	Dhaman	Unknown
20.	<i>Cenchrus ciliaris</i>	391	Dhaman	Pakistan
21.	<i>Chloris gayana</i>	245	—	U.A.R.
22.	<i>Chloris gayana</i>	276	—	Unknown
23.	<i>Chloris gayana</i>	321	—	Sudan
24.	<i>Chrysopogon montanus</i>	396	Kharr	Unknown
25.	<i>Chrysopogon aucheri</i>	420	Chitta Ghaa	Nara
26.	<i>Dicanthium annulatum</i>	318	Palwan	Texas
27.	<i>Eragrostis superba</i>	279	—	Arizona
28.	<i>Hyparrhenia rufa</i>	387	—	Pakistan
29.	<i>Panicum antidotale</i>	248	Garm Ghaa	Sudan
30.	<i>Panicum antidotale</i>	249	Garm Ghaa	U.A.R.
31.	<i>Panicum antidotale</i>	250	Garm Ghaa	Hyderabad
32.	<i>Panicum antidotale</i>	263	Garm Ghaa	Boraka
33.	<i>Panicum antidotale</i>	264	Garm Ghaa	Unknown
34.	<i>Panicum antidotale</i>	319	Garm Ghaa	U.A.R.
35.	<i>Panicum antidotale</i>	335	Garm Ghaa	Unknown
36.	<i>Pennisetum orientale</i>	402	Maniara	Unknown
37.	<i>Sorghastrum nutans</i>	138	—	U.S.A.
38.	<i>Sorghastrum nutans</i>	140	—	U.S.A.
39.	<i>Saccharum munja</i>	432	Saroot	Sehala.

Appendix II

Grass Introductions in Missa (Rawalpindi) showing percentage of bimonthly observations recording these as established from February, 1973 to October, 1973

S.No.	Species	R.M. No.	Establishment percentage of observations
1.	Cenchrus ciliaris	391	78
2.	Bothriochloa pertusa	272	76
3.	Chrysopogon aucheri	420	44
4.	Panicum antidotale	264	42
5.	Panicum antidotale	243	38
6.	Cenchrus ciliaris	228	33
7.	Cenchrus ciliaris	233	33
8.	Cenchrus ciliaris	353	33
9.	Panicum antidotale	249	33
10.	Panicum antidotale	263	33
11.	Cenchrus ciliaris	242	29
12.	Cenchrus ciliaris	268	21
13.	Cenchrus ciliaris	269	20
14.	Cenchrus ciliaris	243	17
15.	Cenchrus ciliaris	266	17
16.	Panicum antidotale	250	13
17.	Cenchrus ciliaris	267	11
18.	Chloris gayana	321	11
19.	Cenchrus ciliaris	232	8
20.	Cenchrus ciliaris	265	8
21.	Cenchrus ciliaris	270	8
22.	Chrysopogon montanus	396	8
23.	Dicanthium annulatum	318	8
24.	Cenchrus ciliaris	274	4
25.	Panicum antidotale	335	4

Appendix III

Grass Introductions in Missa (Rawalpindi) showing percentage of bimonthly observations recording these as in excellent vigour from February, 1973 to October, 1974

S.No.	Name of Species	R.M. No.	Vigour/Percentage of observations
1.	Cenchrus ciliaris	353	78
2.	Chrysopogon aucheri	420	78
3.	Cenchrus ciliaris	242	71
4.	Cenchrus ciliaris	240	67
5.	Cenchrus ciliaris	391	67
6.	Bothriochloa pertusa	272	58
7.	Cenchrus ciliaris	270	58
8.	Panicum antidotale	263	58
9.	Cenchrus ciliaris	228	56
10.	Hyparrhenia rufa	387	56
11.	Cenchrus ciliaris	269	47
12.	Cenchrus ciliaris	265	46
13.	Cenchrus ciliaris	268	46
14.	Panicum antidotale	264	46
15.	Panicum antidotale	248	42
16.	Panicum antidotale	250	42
17.	Panicum antidotale	249	38
18.	Cenchrus ciliaris	232	33
19.	Panicum antidotale	335	33
20.	Cenchrus ciliaris	231	29
21.	Cenchrus ciliaris	243	29
22.	Dicanthium annulatum	318	25
23.	Panicum antidotale	319	22
24.	Chrysopogon montanus	396	21
25.	Cenchrus ciliaris	274	17
26.	Cenchrus ciliaris	233	13
27.	Cenchrus ciliaris	266	13
28.	Cenchrus ciliaris	267	11

Appendix IV

Grass Introductions in Missa (Rawalpindi) showing percentage of bimonthly observations recording the Longevity (greenness) from February, 1973 to October, 1974

S.No.	Species	R.M. No.	Longevity/Percentage of observations
1.	Cenchrus ciliaris	228	100
2.	Cenchrus ciliaris	240	100
3.	Cenchrus ciliaris	242	100
4.	Cenchrus ciliaris	267	100
5.	Cenchrus ciliaris	353	100
6.	Cenchrus ciliaris	391	100
7.	Panicum antidotale	264	100
8.	Panicum antidotale	335	100
9.	Panicum antidotale	248	96
10.	Panicum antidotale	263	96
11.	Panicum antidotale	249	92
12.	Panicum antidotale	250	92
13.	Chrysopogon aucheri	420	92
14.	Cenchrus ciliaris	270	88
15.	Cenchrus ciliaris	274	88
16.	Cenchrus ciliaris	269	87
17.	Cenchrus ciliaris	265	87
18.	Cenchrus ciliaris	232	79
19.	Chloris gayana	321	79
20.	Panicum antidotale	319	78
21.	Cenchrus ciliaris	268	75
22.	Bothriochloa pertusa	272	71
23.	Hyparrhenia rufa	387	67
24.	Cenchrus ciliaris	231	63
25.	Cenchrus ciliaris	266	63

Appendix V

Forage Yields (Kgms/hectare) from grass introductions in Missa (Rawalpindi) harvested during October, 1974

S.No.	Species	R.M. No.	Forage Yield Kgms/hectare
1.	Cenchrus ciliaris	391	1298
2.	Panicum antidotale	248	839
3.	Hyparrhenia rufa	387	708
4.	Cenchrus ciliaris	269	613
5.	Cenchrus ciliaris	265	528
6.	Dicanthium annulatum	318	333
7.	Chrysopogon aucheri	420	317
8.	Bothriochloa pertusa	272	179