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DETERMINATION OF FODDER POTENTIAL OF SORGHUM AND MILLET WITH MINIMUM IRRIGATION IN SOUTHERN PUNJAB

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ABSTRACT

Thirteen varieties of sorghum (*Sorghum bicolor* [L.] Moench) and nine varieties of millet (*Pennisetum glaucum* [L.] R. Br.) were grown on heavy soil slightly affected with salinity having pH range 8.0 to 8.5 during the *Kharif* season, 2004 for determining fodder production in the hot conditions of Bahawalpur, Pakistan. Two flood irrigations, first before sowing and the other 15-day before harvesting were given. Minimum fertilizer dose was also applied at the time of each irrigation at a rate of 30-30-00 NPK kg ha^{-1}. Crop was harvested at 50 percent flowering and a maximum above-ground dry mass of 15.70 and 20.30 tons ha^{-1} were recorded for the sorghum variety "JS-2002" and millet variety "Local Quetta", respectively.

Key-words: Fodder, Sorghum, Millet, Punjab

INTRODUCTION

Out of 79.61 million ha of Pakistan, sixty-eight million ha (85.4 per cent) lie in <300 mm annual rainfall zone (Anon., 2003). Livestock production is a dominant agricultural activity in this zone that depends mainly on the adequate supply of fodder. Fodder production under rainfed conditions is very limited in this zone due to low and unreliable rainfall. Bogdan (1977) reported that pearl millet is valued for its ability to grow under low rainfall using short wet seasons, rapid growth, good quality of fodder, easy seed production and ability to regenerate and produce new growth after grazing or cutting. Therefore, improvement in fodder productivity is crucial for livestock production. The average annual rainfall for crop production in southern Punjab is extremely low, i.e., 100 to 250 mm (Anon., 2003a). The low availability of moisture coupled with high temperature makes the plant growth and reproduction difficult. So fodder crops are generally grown under irrigated conditions. The irrigated soils of southern Punjab are generally affected with salinity/sodicity problem because of saline irrigation water. Therefore, we need to introduce such crop varieties that have not only high water use efficiency but could also withstand well with twin problem of drought and salinity. Toxic accumulation of any nutrient element, whether through excess fertilizer application or naturally occurring soil toxicities such as manganese, can have similar effects on plant growth as classical salinity, which is associated mainly with excessive concentration of Na+ and /or Cl.

About 323 million ha at the world's soils are considered saline or sodic (Brinkman, 1980). These soils occur mainly in arid and semi-arid regions, where evaporation considerably exceeds precipitation, leading to salt accumulation in soil surface. It is notable that the major chickpea and lentil growing areas of the world (FAO, 1988) are regions with a high frequency of saline or sodic soils (Brinkman, 1980).

Among other crops, sorghum (the fifth most important cereal crop) and millet are the important dietary staple crops that are grown extensively during *Kharif* season in different parts of southern Punjab. The biomass yield of local landraces of these crops is fairly low, particularly during the dry season of a year. Therefore, it becomes important to introduce such varieties of the crops that are not only high yielding but are also able to tolerate biotic and abiotic (drought and salinity) stresses, as well. Such varieties could offer good fodder to livestock during *Kharif* season. With this objective in mind, different exotic varieties of sorghum and millet were tested at the experimental fields of Arid Zone Research Institute (AZRI), Pakistan Agricultural Research Council (PARC), and Bahawalpur to select promising genotypes that could help maximize fodder supply at the expense of the minimum irrigation.

MATERIAL AND METHODS

Seeds of 13 varieties of sorghum and nine varieties of millet were obtained from the Coordinator (Fodder), National Agricultural Research Centre (NARC), PARC, Islamabad for conducting National Uniform Fodder Yield Trials for Kharif-2004 in the hot and dry conditions of Bahawalpur. Soil of the experimental area was heavy and slightly affected with salinity having pH range from 8.0 to 8.5. The varieties of sorghum and millet were grown

separately in two separate blocks during the second week of July 2004. Completely Randomized Design (CRD) with three replications was applied for determining varietal difference in the fodder yield of each crop. Plots 1.8 m wide and 6.0 m long were used in the experiment. After light irrigation, minimum dose of fertilizer was broadcast over the experimental area at the rate of 30-30-00 NPK kg/ha. When soil was at field capacity, the sowing was done in hand drill drawn rows at a rate of 80 kg ha^{-1} for both of the crop varieties. The rows were drawn at 30 cm apart from each other and there were six rows in each plot. Second irrigation with the same dose of fertilizer was applied 15 days before crop was harvested. The entries were evaluated and selected against the prevalent biotic and abiotic stresses in the *Kharif* planting. Stability of genotypes, higher biological yield, and wider adaptability were also taken into consideration while screening the genotypes. Harvesting was done from the last week of September to the end of October 2004 depending upon when a variety attained 50 percent flowering stage. Observations were made before harvesting on plant height (cm), number of tillers per plant, number of leaves per plant, and leaf area (cm^2). Plots were harvested completely and average green fodder mass (Tons ha^{-1}) and dry fodder mass (Tons ha^{-1}) were calculated for each variety. Data were analyzed by applying MStat-C software package (Bricker, 1989).

Table 1. Performance of sorghum in national uniform yield trial 2004.

Sr. No.	Variety	Plant Height (cm)	No. of Tillers/Plant	No. of Leaves per plant	Leaf Area $(cm)^2$	Green Fodder weight Ton ha^{-1}	Dry weight Ton ha^{-1}
1.	Peshawer Local	162	3	6	258^{b}	25.3^{b}	9.6^{b}
2.	Local Tandojam	109	3	6	421^{ab}	28.7^{b}	9.8^{b}
3.	Sikander Local	175	4	7	264^{ab}	31.4^{b}	11.8^{ab}
4.	98CS007	168	3	6	392^{ab}	45.9^{ab}	14.7^{ab}
5.	Sundal Bar	208	4	6	397^{ab}	35.8^{ab}	12.0^{ab}
6.	F-2003	192	4	8	419^{ab}	43.8^{ab}	14.8^{ab}
7.	F-9902	220	4	6	426^{ab}	28.4^{b}	9.3^{b}
8	F-9909	174	5	6	417^{ab}	42.5^{ab}	13.9^{ab}
9.	F-9917	194	3	7	382^{ab}	43.6^{ab}	13.9^{ab}
10.	JS-2002	265	3	7	481^{a}	67.5^{a}	15.7^{ab}
11.	Local Quetta	170	3	6	357^{ab}	41.8^{ab}	12.9^{ab}
12.	Local Rawalpindi	168	4	7	262^{b}	25^{b}	9.4^{b}
13.	BR-319	186	4	6	389^{ab}	35.4^{ab}	11.1^{ab}
	Co. of Var.(%)	8.98	22.46	12.3	18.3	22.8	17.15
	LSD value (%)	111.3	1.98	1.853	217	35.62	9.7

RESULTS AND DISCUSSION

The climate of the Bahawalpur is arid to semi arid with an annual precipitation ranging from 100-250 mm (Anon., 2003a). It therefore becomes imperative to focus attention on the judicious and efficient use of limited moisture supply available in the area of the farmer. Keeping in view the existing problems of the area, two trials of National Uniform Yield Trial– Sorghum and Millet comprising thirteen and nine test entries were planted at AZRI Bahawalpur Farm in *Kharif*-2004. The variety # 10 (JS-2002) of Sorghum produced significantly ($P<0.05$) more

green fodder yield (67.5 t ha^{-1}), dry fodder yield (15.7 t ha^{-1}) and leaf area (265 cm^2) at test site in Table 1. Prakash (1983), also concluded that correlation coefficient studies revealed that plant height and leaf breadth had the highest direct effect on forage yield. The disease was not scored in any variety because of unfavourable climatic conditions. Due to insufficient conserved soil moisture from monsoon rains, the trial was irrigated once after planting. Due to less and scanty rain in the season, screening for drought was possible at the site. Table 1 revealed that the said line was strongly recommended for Southern Punjab area. Sorghum grain has high levels of iron (>70ppm) and zinc (>50ppm), and is hence a means to reduce micronutrients malnutrition globally, ICRISAT Report (Anon., 2008). Cultivation of this variety under rainfed conditions of southern Punjab would also help in the improvement of soil fertility.

Table 2. Analysis of variance of complete randomized design of sorghum varieties

Source of Variation	*d.f.*[1]	Mean Square					
		Plant Height (2)	Tillers $Plant^{-1}$(3)	Leaves/Plant (4)	Leaf area(5)	GF Ton ha^{-1} (6)	DM Ton ha^{-1} (7)
Varieties	12	3913.5	1.24	1.085	14940.47	400.87	12.93
Within	26	273.4	0.641	0.641	4745.66	75.55	2.88
CV(%)	-	8.98	22.46	12.3	18.3	22.8	17.15
F—value	-	14.310	1.940	1.693	3.148	5.306	4.491

- [1]Degrees of Freedom
- [2] Plant Height
- [3] Tillers/plant
- [4] Leaves/Plant
- [5] Leaf area
- [6]Green fodder yield
- [7]Dry matter yield
- [*]= significant at 5 % level.
- [ns] = non-significant

In the *Kharif*-2004, performance of nine test entries of millet was evaluated at the site in Table 3 and 4. Plant height is an important parameter while determining the green fodder and dry fodder yield of different millet varieties. Variety # 7(Local Quetta) produced the significantly maximum green (55.7 t ha^{-1}) and dry fodder yield (20.3 t ha^{-1}) which was effectively contributed due to more plant height and more number of leaves per plant. Podriguez, (1973) also reported that plant height was significantly correlated with yield and leaf-stem ratio. Foliar disease, *Fuserum* was a peculiar feature of the crop in favourable climatic conditions at Bahawalpur . Late sowing practice allowed us to escape from stem and leaf infestation of the forage crops like millet , maize and sorghum and this practice is commonly employed by the farming community of the area. At later stages drought screening was also possible because of the dry weather conditions of the area. Under these biotic and abiotic stresses the variety # 7 proved itself the best both in green and dry fodder production.

CONCLUSION

The objective of this study was to identify varieties with highest yield potential and characters contributing to higher green fodder and dry fodder yields of sorghum and millet. It is concluded that variety JS-2002 of sorghum and Local Quetta of millet produced the highest green and dry fodder yields, which were due to greater plant height, tillers/plant, leaves/plant and leaf area. These results also provided us the information about the fodder varieties which could be used in hybridization for further improvement.

Table 3. Performance of millet national uniform yield trial 2004.

S.#	VARIETY	Plant Height (2)	Tillers/Plant^{-1}(3)	Leaves/Plant (4)	Leaf area(5)	GF Ton ha^{-1} (6)	DM Ton ha^{-1} (7)
1	Peshawar Local	188	5	9	225	46.1	16.6
2	Local Tandojam	182	4	10	218	54	18.0
3	BS-99	193	4	9	249	48.4	14.5
4	BS-2000	155	5	9	201	44.1	12.6
5	AF-POP	171	5	10	250	52	17.4
6	MB-87	186	5	11	213	48.7	16.8
7	Local quetta	180	5	10	233	55.7	20.3
8	Local Rawalpindi	199	6	11	277	52.6	19.1
9	Composite	210	5	10	296	47.6	14.1
	Co. of Var. (%)	13.0	25.3	13.2	18.7	25.4	22.8
	LSD value (%)	52.4	1.45	2.4	101.6	12.5	8.0

Table 4. Analysis of variance of complete randomized design over year of millet.

Source of Variation	*d.f.*[1]	Mean Square					
		Plant Height (2)	Tillers/Pla(3)	Leaves/Plant (4)	Leaf area(5)	GF Ton ha^{-1} (6)	DM Ton ha^{-1} (7)
Varieties	08	777.25	0.593	1.731	2909.23	44.29	18.45
Within	18	583.3	1.70	1.778	2025.48	161.67	14.50
F-value		1.332	0.348	0.974	1.436	0.274	1.273
CV.(%)		13.0	25.3	13.2	18.7	25.4	22.8

- [1]Degrees of Freedom
- [2] Plant Height
- [3] Tillers/plant
- [4] Leaves/Plant
- [5] Leaf area
- [6]Green fodder yield
- [7]Dry matter yield
- *= significant at 5 % level.
- ^{ns} = non-significant

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