Pak. j. sci. ind. res., vol. 36, nos. 6-7, June-July 1993

SITE VARIATIONS IN FORAGE YIELD, DRY MATTER YIELD, CRUDE PROTEIN AND CRUDE FIBRE CONTENTS OF PEARL MILLET CULTIVARS

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(Received March 2, 1992; revised June 19, 1993)

The present study was designed to determine variability in fodder yield and quality of pearl millet as influenced by different locations or sites. Three diverse agroecological sites *viz.* Ayub Agricultural Research Institute (AARI), Faisalabad. National Agricultural Research Centre (NARC), Islamabad and Agricultural Research Institute (ARI), Sariab, Quetta were selected on the basis of diverse environmental conditions. Mean green fodder yields varied from 28.47 to 42.01 t/ha, dry matter yields from 5.35 to 9.12 t/ha, crude protein contents from 5.54 to 10.51% and crude fibre contents from 27.98 to 34.58%. The highest green fodder and dry matter yields and the maximum crude protein and crude fibre contents were obtained at AARI, Faisalabad. The lowest green fodder, dry matter and crude fibre contents were observed at ARI, Sariab, Quetta, while the minimum crude protein contents were observed at NARC, Islamabad. The differences in fodder yield and forage quality at various locations might be due to different soil types, then fertility, temperature, moisture and various agro-climatic conditions prevailing at the three distinct environments.

Key words: Pearl millet, Cultivars, Locations, Forage yields, Forage quality.

Introduction

Pearl millet (*Pennisetum typhoides* (Burn Stapf et Hub.) is an important coarse grain and fodder crop in Pakistan. It is grown throughout the country under both irrigated and rainfed conditions in summer and spring seasons. Its green fodder is valued as livestock feed because of its higher protein content than maize and sorghum. Pearl millet is valued not only for its good fodder quality but also for its ability to grow and survive drought stresses in warmer semi-arid environments and to regrow rapidly following after grazing or cutting.

Pearl millet is grown in Pakistan under diverse environmental conditions. The genotype generally determines the chemical composition of the crop, but factors such as soil type, soil fertility, temperature, available moisture and season may also modify the fodder yield and quality of a crop [3,4].

Wermke and Theune [9] compared three maize cultivars at four diverse locations and observed locational variation among cultivars in growth rate and crude protein contents of the ear, stover and whole plant.

Mohammad [4] reported that grain, forage and dual purpose sorghum genotypes responded quite differently when grown under different environments. Highly significant variation was observed within and among different genotypes of sorghum. Overall, maximum grain yield, grain weight, acid detergent fibre, forage and stover yields were obtained under irrigation while maximum crude protein and harvest index were produced under rainfed conditions.

Mohammad *et al.* [5] evaluated five maize cultivars at 3 diverse locations in Pakistan and reported locational differences in green fodder yield, dry matter yield, crude protein and crude fibre contents of fodder. Hussain *et al.* [3] reported significant genotype x environment interactions in sorghum grown at 2 different locations.

No information is available on effects of location on forage quality of pearl millet. The objective of this study was to determine the effect of environmental variations on forage yield and chemical composition of pearl millet, among other things.

Materials and Methods

Five cultivars of pearl millet (D.G. Bajra, Synthetic-I/79. Synthetic-II/79, C-47 and Composite-75) were evaluated for green fodder yield, dry matter yield and nutritive value under diverse climatic conditions prevailing at AARI, Faisalabad; NARC, Islamabad and ARI, Sariab, Quetta. The experiments were planted in the first week of July and harvested in the second week of September during 1989 and 1990. A completely randomized block design with 2 replications was used at all the locations. The plot size was 3m x 6m. Fertilizer (57 kg N/ha as urea and 57 kg P_2O_5/ha as diammonium phosphate) was applied at planting. The experiments were harvested at 50% flowering stage to determine the following:

Crude protein content (CP), Crude fibre content (CF), Green fodder yield (GY) and Dry matter yield (DY).

The representative green fodder samples from each variety, replication and location were drawn at random and dried in an oven at 60x for 60 hrs. After drying, the samples were weighed and ground with a Wiley mill fitted with a 1mm screen.

Crude fibre was determined by the Van Soest method [8].

Crude protein (N% x 6.25) was estimated by the Reardon *et al.* method [7]. The data were combined over 2 years and analysed. Mean separation was performed using the Least Significant Difference technique as outlined by Goulden [6].

Results and Discussion

The average summer rainfall, mean temperature and soil type of the three sites were as follows.

	AARI Faisalabad	NARC Islamabad	ARI Sariab, Quetta
Av. summer rainfall	268 mm	425 mm	475 mm
Mean temperature	30.0-39.5°	30-39.5°	20.0-32.0°
Soil types	Clay loam	Calcareous	Calcareous loamy

Combined analyses of variance across 3 sites and 2 years for green fodder yield, dry matter yield, crude protein and crude fibre contents are shown in Table 1.

Year and site effects were highly significant (P<0.01) for all the traits except for effects of years on dry matter yield, crude protein and crude fibre contents. Differences between varieties were significant for all traits measured. However, there was a highly significant (P<0.01) variety x site interaction for green fodder yield, dry matter yield and crude protein contents. These significant differences confirmed the variability among the genotypes grown under various climatic conditions for various characters. Significant differences among varieties for different traits might be due to the fact that most of the varieties included in the experiment were selected from genetically diverse germplasm sources. Also, because all the five cultivars in the experiment were developed, widely adapted and commonly grown in the Punjab province, these cultivars exhibited large variety x site interactions.

A comparison of means for crude protein, crude fibre, green fodder yield and dry matter yield of 5 varieties grown in the 3 environments are presented in Tables 2 and 3. Significant differences were observed among sites and varieties for all the traits studied.

The average crude protein contents of the five millet cultivars across the 3 locations ranged from 4.75% at NARC, Islamabad to 11.37% at AARI, Faisalabad (Table 2). The highest and similar crude protein contents were recorded in cultivars Synthetic I/79, D.G. Bajra and Synthetic II/79 at AARI, Faisalabad. Varieties C-47 and C-75 also planted at AARI, Faisalabad were at par with those of D.G. Bajra and Synthetic II/79 at AARI, Faisalabad in crude protein contents. The maximum crude protein contents at ARI, Sariab were recorded in varieties C-47, C-75, D.G. Bajra and Synthetic II/79 but significantly lower than all the cultivars at AARI, Faisalabad. Minimum crude protein contents at ARI, Sariab were observed in variety Synthetic I/79 and it was at par with cultivar Synthetic II/79. The lowest crude protein contents were recorded in cultivars planted at NARC, Islamabad. D.G. Bajra and Synthetic I/79 produced higher crude protein contents than other cultivars at NARC, Islamabad. The lowest crude protein contents were observed in variety Synthetic II/79 at NARC, Islamabad. Arora *et al.* [1] also reported variability in crude protein content from 4.81 to 7.44% in forage sorghum. They also concluded that crude protein was affected by the age of plant, soil fertility and environmental parameters. Mohammad *et al.* [5] observed variation in maize for

TABLE 1. ANALYSIS OF VARIANCE FOR SITE DIFFERENCES IN YIELD AND QUALITY OF FODDER MILLET.

		Mean squares			
SOV	DF	GY	DY	CP	CF
Years (Y)	1	27.27**	0.19	0.16	0.005
Site (S)	2	1047.80**	84.26**	126.91**	218.10**
Y x S	2	178.77**	11.58**	0.08	0.03
R (Y x S)	6	9.61**	0.51**	0.15	0.09
Variety (V)	4	362.91**	10.51**	0.93**	1.76**
Y x V	4	1.08	0.23	0.12	0.38
S x V	8	60.37**	1.65**	1.16**	0.58
Y x S x V	8	0.18	0.07	0.09	0.37
Error	24	1.32	0.10	0.19	0.32

**,Significant at P<0.05 and P< 0.01 respectively.

TABLE 2. SITE VARIATIONS IN CRUDE PROTEIN AND CRUDE FIBRE CONTENTS IN FORAGE MILLET.

Varieties	Crude protein (%)			Crude fibre (%)		
	AARI Faisal-abad	NARC Islama-bad	ARI Sariab Quetta	AARI Faisal-abad	NARC Islama-bad	ARI Sariab Quetta
D.G. Bajra	10.56	6.07	7.59	34.62	30.60	27.44
Synthetic I/79	11.37	6.01	6.70	34.81	31.83	28.29
Synthetic II/79	10.53	4.75	6.95	34.46	30.86	27.59
C-47	10.06	5.69	7.70	34.65	31.66	28.89
C-75	10.05	5.20	7.62	34.35	31.78	27.67

LSD (0.01) for interaction = 0.86; LSD (0.01) for site = 0.45; LSD (0.01) for interaction = 0.28; LSD (0.01) for site = 0.35

TABLE 3. SITE VARIATIONS IN GREEN FODDER AND DRY MATTER YIELDS OF FORAGE MILLET.

Varieties	Green fodder yield (T/ha)			Dry matter yield (T/ha)		
	AARI Faisal-abad	NARC Islama-bad	ARI Sariab Quetta	AARI Faisal-abad	NARC Islama-bad	ARI Sariab Quetta
D.G. Bajra	36.61	39.24	25.30	8.36	8.37	4.64
Synthetic I/79	34.19	35.34	19.76	7.73	7.94	3.82
Synthetic II/79	46.85	35.54	28.74	9.75	8.06	5.42
C-47	52.67	43.22	37.50	10.87	9.02	6.81
C-75	39.73	44.99	31.03	8.88	9.77	6.04

LSD (0.01) for interaction = 2.27; LSD (0.01) for sites = 3.63; LSD (0.01) for interaction = 0.63; LSD (0.01) for sites = 0.83.

crude protein content from 7.60% at ARI, Sariab, Quetta to 8.74% at FRI, Sargodha. They also found that crude protein contents were higher at dry and warm location (FRI, Sargodha) than at wet and cool place (ARI, Sariab, Quetta). Deosthale and Mohan [2] analysed 5 sorghum varieties grown at 13 locations and found significant locational and varietal differences for total protein and lysine contents in grain sorghum. Wermke and Theune [9] also reported locational variation among maize cultivars in crude protein contents.

Regarding structural components, the average crude-fibre contents in all the millet cultivars at the three sites ranged from 27.44% at ARI, Sariab to 34.81% at AARI, Faisalabad (Table 2). The variation in crude fibre contents in the genotypes ranged from 30.89% for D.G. Bajra to 31.73% for C-47. The average crude fibre contents at the 3 sites varied from 27.98% at ARI, Sariab to 34.58% at AARI, Faisalabad. These results accord with those of Mohammad *et al.* [5] who reported 30.88, 31.58 and 32.45% crude fibre contents in forage maize at ARI Sariab Quetta, NARC Islamabad and FRI Sargodha, respectively.

The average green fodder yield of the 5 millet genotypes across the 3 diverse locations ranged from 19.76 t/ha at ARI, Sariab, Quetta to 52.67 t/ha at AARI, Faisalabad (Table 3). Millet cultivar C-47 at AARI, Faisalabad recorded significantly the highest green fodder yield across all the cultivars and sites. Variety Synthetic II/79 at AARI, Faisalabad was followed cultivar C-47 at AARI, Faisalabad in green fodder production. Genotype C-75 at NARC, Islamabad was at par with that of variety Synthetic II/79 at AARI, Faisalabad and cultivar C-47 at NARC, Islamabad with that of C-75 at NARC, Islamabad in green fodder yield. Cultivars D.G. Bajra at NARC and C-47 at ARI, Sariab were similar in green fodder yield. Significantly the lowest green fodder yield across the 5 genotypes and 3 locations was recorded in cultivar Synthetic I/79 planted at ARI, Sariab, Quetta. Hussain *et al.* [3] also found significant genotype x location interaction which indicated that the 8 forage sorghum genotypes responded differently for green forage yield during 3 years of testing at the various individual locations.

The average dry matter yield of 5 varieties across the three sites varied from 3.82 t/ha at ARI, Sariab, Quetta to 10.87 t/ha at AARI, Faisalabad (Table 3). Significantly the highest dry matter yield was recorded in variety C-47 at AARI, Faisalabad. Cultivars C-75 at NARC, Islamabad and Synthetic II/79 at AARI, Faisalabad were similar and followed cultivar C-47 at AARI, Faisalabad in dry matter production. Variety C-47 at NARC, Islamabad produced significantly lower dry matter yield than cultivars C-75 at NARC and Synthetic II/79 at AARI. Significantly the lowest dry matter yields were observed in all the varieties planted at ARI, Sariab, Quetta. The maximum dry matter yields at AARI, Faisalabad and NARC, Islamabad might be due to higher temperature during the growth period. Mohammad *et al.* [5] also observed increased dry matter production in maize cultivars at higher temperatures. Arora *et al.* [1] and Mohammad *et al.* [5] also observed significant varietal and locational differences for dry matter yields in forage sorghum and maize genotypes respectively. Naeem *et al.* [10] also reported 15.08 and 13.58 t/ha dry matter yields in millet cultivars C-47 and Y-84.

It was observed that mean crude fibre contents, green fodder yields and dry matter yields in millet at 3 locations increased with the increase in temperature and decrease in precipitation. Crude protein contents were maximum at the warmer, drier location (AARI, Faisalabad) and minimum at the cooler, wetter location (ARI, Sariab). Similar results were reported by Mohammad *et al.* [5] in maize.

The genotypes behaved differently at 3 sites for green fodder and dry matter yields, crude protein and crude fibre contents. This wide variability within genotypes or cultivars in the fodder yield and quality traits at various sites could be due to variations in soil types and their fertility levels, available moisture and temperature. It is suggested that experiments should be conducted under controlled conditions to separate the effects observed.

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