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Effect of soil-moisture conservation and weed control on the nutrition and seed yield of pearlmillet (*Pennisetum glaucum*) under rainfed condition

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ABSTRACT

A field experiment was conducted during the rainy (*kharif*) season of 1988 and 1989 under rainfed condition, to study the effect of soil-moisture conservation and weed-control practices on N, P and K uptake, and yield of pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz]. Moisture-conservation practices proved beneficial only in scanty rainfall year of 1989. Straw mulch either used in flat bed or ridge and furrow seed-bed caused significant reduction in dry-matter accumulation and N, P and K depletion by weeds compared with flat bed and ridge and furrow alone. However, grain yield and nutrient uptake by pearlmillet improved significantly with ridge and furrow + straw mulch and ridge and furrow alone. Hand-weeding and atrazine @ 0.50 kg/ha were found most efficient treatments in reducing dry-matter accumulation and nutrient depletion by weeds in both years and in increasing grain yield and nutrient uptake by pearlmillet only in good rainfall year of 1988.

Pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz] generally faces mid-season drought, resulting in low yield. Many workers reported favourable effects of *in-situ* rain-water collection (Kaushik and Gautam, 1991) and various mulches (Pandey *et al.*, 1988; Lal, *et al.*, 1992) on the yield of the crop. Being a rainy-season crop, it also suffers from severe weed competition mainly for moisture and nutrients (Verma *et al.*, 1989; Kumar and Mohammad, 1993). Hence the present investigation was carried out to determine the most appropriate method of moisture conservation and weed control in relation to nutrients uptake and yield of pearlmillet.

MATERIALS AND METHODS

The field experiment was conducted during the rainy (*kharif*) season of 1988 and 1989 at the Indian Agricultural Research Institute, New Delhi. Treatments consisted of 4 moisture-conservation practices (flat bed, ridge and furrow, flat bed + straw mulch and ridge and furrow + straw mulch) as main plot and 5 weed-control measures (unweeded control, hand-weeding, atrazine @ 0.25 and 0.50 kg/ha and 2,4-D @ 0.75 kg/ha) as subplot treatments. The treatments were laid out in split-plot design replicated thrice. Hybrid 'BK 560-230' was sown with the onset of monsoon on 7 July 1988 and 24 July 1989 and fertilized with a uniform dose of 60 kg N/ha and 12 kg P/ha. In ridge and furrow treatment the seed was sown in furrows.

There was no dirth of moisture during the crop growth in 1988 except a short dry spell of 2 weeks in September. However, the crop faced drought condition during its

entire growth period, particularly i he second week of August in 1989. Hence w mulch of rice @ 5 tonnes/ha was appl. in the second week of September in 1988 and second week of August in 1989. Hand-weeding treatment was given 3 and 6 weeks after sowing. Atrazine @ 0.25 and 0.50 kg/ha was sprayed the next day of sowing as pre-emergence and 2, 4-D @ 0.75 kg/ha 4 weeks after sowing as post-emergence application.

RESULTS AND DISCUSSION

Weed

Weed flora: The major weed flora observed in the experimental field consisted of *Echinochloa colonum* (L.) Link., *Eleucine indica* (L.) Gaertn., *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Trianthema portulacastrum* L., *Digeria arvensis* (L.) Forsskal and *Dactyloctenium aegypticum* (L.) Willd.

Dry-matter accumulation: Straw mulch either coupled with flat bed or ridge and furrow registered significant reduction in dry weight of weeds compared with flat bed and ridge and furrow alone only in 1989 (Table 1). Reduction in the dry-matter accumulation by weeds under straw-mulch treatments could be attributed to its smothering effect on weeds.

Weeding remarkably reduced the dry-matter accumulation by weeds in the both years. Hand-weeding recorded the minimum dry weight of weeds. In 1988, it was significantly superior to rest of the treatments. Next best treatment was atrazine @ 0.50 kg/ha. Though the treatment was on a par with

Table 1. Effect of soil-moisture conservation and weed-control measures on dry-matter accumulation and total uptake of nutrients by weeds (at harvest) infesting pearlmillet

Treatment	Dry-matter accumulation by weeds (q/ha)		Total uptake of nutrients (kg/ha)					
			N		P		K	
	1988	1989	1988	1989	1988	1989	1988	1989
Soil-moisture conservation								
Flat bed	6.48	0.85	4.13	0.60	0.51	0.07	17.83	2.45
Ridge and furrow	8.51	0.84	4.03	0.57	0.51	0.07	18.23	2.35
Flat bed + straw mulch	6.14	0.72	3.86	0.49	0.49	0.06	17.19	2.02
Ridge and furrow + straw mulch	5.90	0.74	3.77	0.52	0.47	0.06	16.04	2.10
CD (P = 0.05)	NS	0.09	NS	0.07	NS	0.007	NS	0.34
Weed control								
Unweeded control	8.64	1.09	5.87	0.75	0.67	0.09	24.02	3.08
Hand-weeding	4.83	0.64	3.04	0.44	0.38	0.05	13.03	1.77
Atrazine @ 0.25 kg/ha	6.24	0.68	4.05	0.48	0.49	0.06	17.34	1.99
Atrazine @ 0.50 kg/ha	5.46	0.68	3.36	0.46	0.40	0.06	14.77	1.89
2, 4-D @ 0.75 kg/ha	6.02	0.74	3.79	0.53	0.47	0.07	16.86	2.16
CD (P = 0.05)	0.63	0.11	0.52	0.05	0.05	0.009	3.20	0.35

Seasonal rainfall (mm) : July 219.3, 45.4; August 496.1, 31.8; September 129.8, 95.0; total 845.2 and 172.2 respectively in 1988 and 1989

2, 4-D at 0.75 kg/ha, it maintained its superiority to its low dose of 0.25 kg/ha. In 1989, however, no measurable differences existed between the weed-control treatments for dry-matter accumulation by weeds.

Nutrient depletion: Flat bed + straw mulch and ridge and furrow + straw mulch remarkably curtailed N, P and K depletion by weeds compared with flat bed and ridge and furrow alone only in 1989.

The depletion of N, P and K by weeds was significantly decreased by weed-control treatments compared with the unweeded control in both the years. However, nutrient depletion was the least in hand-weeding, followed by atrazine @ 0.50 kg/ha.

Crop

Yield: In general, the yield was higher in 1988 than in 1989, owing to more favourable rainfall during the crop-growth period in the first year (Table 1). Moisture conservation remarkably improved pearlmillet yield only in 1989 (Table 2). The maximum grain yield was recorded with ridge and furrow + straw mulch (13.3 q/ha), being on a par with ridge and furrow alone (13.0 q/ha). Kaushik and Gautam (1991) obtained 2.3 q/ha more pearlmillet yield due to ridge and furrow than flat-bed method of sowing. They also reported an increase of 4.3 q/ha of yield due to straw mulch compared with unmulched plots. However, flat bed + straw mulch did not show measurable improvement in grain yield. This was mainly because of very little moisture left in the top layer of flat-bed (3.40%) compared with ridge and furrow (6.20%) by the time the mulch treatment was applied in the field. Stover yield showed trends similar to grain yield. These results clearly indicate the utility of mulches only during the dry season.

Weed-control treatments significantly increased pearlmillet yield only in 1988 (Table 2). Atrazine @ 0.50 kg/ha gave highest yield (23.7 q/ha). It was on a par with hand-weeding (23.6 q/ha) but proved significantly superior to atrazine @ 0.25 kg/ha (21.7 q/ha) and 2, 4-D @ 0.75 kg/ha (21.5 q/ha). Similar results were obtained by Kaushik and Gautam (1984). However, for stover production hand-weeding proved the most efficient treatment, followed by atrazine @ 0.50 kg/ha. Both these treatments gave significantly higher stover yield than atrazine @ 0.25 kg/ha and 2, 4-D @ 0.75 kg/ha. There was no effect of weed control on the crop yield in 1989 because of very low intensity of weed infestation this year.

Nutrient uptake: Uptake of N, P and K was greatly increased due to moisture conservation with ridge and furrow coupled with straw mulch only in 1989. Adequate supply of moisture in general enhances the growth and dry-matter production of crop directly as well as indirectly by increasing, the availability and utilization of nutrients (Russel and Barbar, 1960).

Though the contents remained unaffected the augmented uptake of N, P and K could be assigned to higher grain and stover yields under ridge and furrow + straw mulch compared with rest of the treatments.

Nutrient uptake remarkably improved by weed control only in 1988. Atrazine @ 0.50 kg/ha and hand-weeding resulted in the maximum uptake of N, P and K. Nutrients uptake by plants depends on dry-matter production and nutrient content in them. In our study, there was no measurable variation in respect of N, P and K contents in pearlmillet. However, controlling weeds provided better environment for crop growth, particularly under atrazine @ 0.50 kg/ha and hand-weeding which resulted in significant improvement in grain and stover yields and

Table 2. Effect of soil-moisture conservation and weed-control measures on total dry-matter production and uptake of nutrients by pearlmillet

Treatment	Grain yield (q/ha)		Stover yield (q/ha)		Total uptake of nutrients (kg/ha)					
					N		P		K	
	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989
Soil moisture conservation										
Flat bed	21.2	12.0	52.8	32.5	64.2	41.4	9.2	5.5	161.2	96.3
Ridge and furrow	21.5	13.1	53.9	34.0	66.6	44.9	9.8	6.0	167.4	101.1
Flat bed + straw mulch	22.8	12.1	53.0	32.6	69.2	42.4	9.6	5.8	169.1	98.4
Ridge and furrow + straw mulch	22.2	13.3	53.7	35.5	69.4	46.7	10.1	6.2	171.3	108.5
CD (P = 0.05)	NS	0.8	NS	1.6	NS	4.4	NS	0.54	NS	10.7
Weed control										
Unweeded control	19.2	12.2	48.6	33.2	58.2	42.9	8.2	5.7	147.8	99.9
Hand weeding	23.6	13.0	56.6	34.1	75.2	47.2	10.4	6.2	176.5	108.2
Atrazine @ 0.25 kg/ha	21.7	12.6	52.8	33.3	66.4	44.7	9.5	6.0	165.1	103.1
Atrazine @ 0.50 kg/ha	23.7	13.0	56.1	34.0	75.6	45.5	10.4	6.1	180.0	109.7
2, 4-D @ 0.75 kg/ha	21.5	12.2	52.6	33.7	66.5	44.2	9.5	5.8	163.6	104.7
CD (P = 0.05)	1.9	NS	2.5	NS	3.5	NS	0.75	NS	16.4	NS

hence the nutrient uptake.

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