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Weed control studies in pearlmillet (*Pennisetum glaucum*)–pigeonpea (*Cajanus cajan*) intercropping system under rainfed condition

CHANDRA PAL[1], S.K. KAUSHIK AND R.C. GAUTAM

Division of Agronomy, Indian Agricultural Research Institute, New Delhi 110 012

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ABSTRACT

A field experiment was carried out during rainy (*kharif*) season of 1997 and 1998 to assess the production potential of intercropping of pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz] with pigeonpea [*Cajanus cajan* (L.) Millsp.] in relation to various measures of weed control. Treatments consisted of 3 intercropping systems (sole pearlmillet, sole pigeonpea and pearlmillet + pigeonpea) and 4 methods of weed control (control hand-weeding twice, fluchloralin @ 1.0 kg/ha and pendimethalin @ 1.0 kg/ha). Intercropping did not influence the population and dry-matter accumulation by weeds. Grain yield of pearlmillet did not vary significantly due to various methods of cropping. However, sole pigeonpea gave significantly higher yield than pearlmillet + pigeonpea intercropping. Highest total productivity in terms of pearlmillet equivalent was recorded with pearlmillet + pigeonpea intercropping system. Weeding caused significant reduction in weed infestation and improvement in grain yield of pearlmillet and pigeonpea and total productivity compared with the control. Best results were achieved with hand-weeding twice closely followed by fluchloralin @ 1.0 kg/ha.

Key words : Pearlmillet–pigeonpea intercropping, Weed control, Yield

Pearlmillet is an important crop of rainfed areas. It is largely grown with low level of management and hence giving low yield. Intercropping of pearlmillet with short-duration grain legumes increases total productivity per unit area per unit time in these situations (Gautam *et al.*, 1985; Kaushik and Gautam, 1987). Control of weeds also increases the yield of dryland crops (Upadhyay *et al.*, 1981; Kumar, 1992). However, control of weeds in intercropping systems through cultural or mechanical methods may be difficult due to narrow inter-row spacing. The development of various wide-spectrum herbicides to control weeds in component crops of differential nature growing in association with each other is needed. Therefore

Present address : [1]Division of Seed Science and Technology, IARI, New Delhi 110 012

present investigation was undertaken to assess the production potential of intercropping system of pearlmillet with pigeonpea for various methods of weed control under rainfed conduction.

MATERIALS AND METHODS

A field experiment was conducted during the rainy (*kharif*) seasons of 1997 and 1998, on a sandy-loam soil at Indian Agricultural Research Institute, New Delhi. Treatments consisted of 3 intercropping systems (pearlmillet sole and pigeonpea sole both at 50 cm uniform row spacing and paired row planting of pearlmillet at 30 and 70 cm + pigeonpea) as main plot and 4 weed-control measures (unweeded control, hand-weeding twice, fluchloralin @ 1.0 kg a.i./ha and pendimethalin @ 1 kg a.i./ha) as subplot treatments, replicated 4 times in split plot design. The crops, i.e. pearlmillet var. 'Pusa bajri 266' and pigeonpea var. 'Pusa 33' were sown with the onset of monsoon on 13 July in 1997 and 9 July in 1998. Pearlmillet crop was harvested on 9 October in 1997 and 28 December in 1998. Recommended doses of N and P were applied in both crops.

The total rainfall during the crop season, i.e. from July to December, was 369.1 mm in 1997 and 518.2 mm in 1998. It was well distributed over entire growing period of the crops in 1997, but there was very little rainfall in the early stages of crop growth in 1998.

Hand-weeding treatment was given twice, i.e. 3 and 6 weeks after sowing. Fluchloralin and pendimethalin each @ 1.0 kg/ha were sprayed the next day of sowing as pre–emergence application.

RESULTS AND DISCUSSION

Weeds

Weed flora : The weed flora in the experimental field consisted of mixed population of grasses, viz. *Eleucine indica* (L.) Gaertn, *Digitaria sanguinalis* Scop, *Cynodon dactylon* (L.) Pers., *Echinochloa colonum* (L.) Link; sedge *Cyperus rotundus* L.; and broad-leaf weeds, viz. *Digera arvensis* (L.) Forsskal, *Convolvulus arvensis* (L.) and *Chenopodium album* L. were the most dominant species in the experimental plot.

Weed population and dry-matter accumulation : In general, weed infestation was higher in 1997 than in 1998. This was mainly because of even distribution of rainfall over entire period of cropping season in 1997 compared to 1998. Weed population and dry-matter accumulation were not influenced markedly by intercropping treatments in both years (Table 1). Goswami (1997) also reported that weed infestation was not influenced due to intercropping of cowpea or gram in pearlmillet.

Weed control had noticeable effect on population as well as dry weight of weeds as compared to the control. Hand-weeding twice showed the maximum control of weeds which was significantly superior to other treatments. Next best treatment was fluchloralin @ 1.0 kg/ha. Significantly lowest reduction of population as well as dry-matter accumulation by weeds was recorded with pendimethalin @ 1.0 kg/ha among the weed-control treatments.

Crops

Yield attributes: Growth and yield

Table 1. Effect of intercropping and weed control on weed population and dry-matter accumulation at 90 days

Treatment	Weed population/ m^2		Dry weight of weeds (g/m^2)	
	1997	1998	1997	1998
Intercropping				
Pearlmillet sole	78.00	68.40	75.20	66.30
Pigonpea sole	77.50	69.20	74.80	64.20
Pearlmillet + pigeonpea	75.90	67.80	74.60	65.60
CD (P = 0.05)	NS	NS	NS	NS
Weed control				
Control	124.23	104.80	119.20	102.60
Hand-weeding	43.32	41.23	36.65	34.20
Fluchloralin @ 1.0 kg/ha	67.48	60.66	70.45	59.65
Pendimethalin @ 1.0 kg/ha	22.92	67.66	73.46	65.01
CD (P = 0.05)	3.00	2.82	2.55	1.78

attributes of pearlmillet, viz. plant height, effective tillers/plant and ear length at 90 days stage, did not vary significantly due to intercropping treatments in both the years (Table 2). These results confirm the findings of Kaushik and Gautam (1987). Similarly, plant height, branches/plant and seeds/plant of pigeonpea also remained unaffected due to intercropping treatments (Table 3).

Weed-control treatments brought about measurable improvement in growth and yield attributes of pearlmillet, viz. plant height, effective tillers/plant and length of ear, compared with the control (Table 2). Hand-weeding twice recorded maximum increase in all these attributes. This treatment was at par with fluchloralin @ 1.0 kg/ha but maintained its superiority to pendimethalin @ 1.0 kg/ha. However, weeding caused significant improvement only in the plant height and number of branches of pigeonpea intercrop over the control. No measurable differences were observed among weed-control treatments. Contribution of weed-control measures towards the improvement of yield attributes could be owing to their effect on reducing crop–weed competition and hence better utilization of inputs by crop plants. Kaushik and Gautam (1984) and Verma and Kumar (1985) also reported improvement in yield components due to elimination of severe crop–weed competition.

Yield: The grain and stover yields of pearlmillet did not vary significantly due to intercropping treatments (Table 2). Kaushik and Gautam (1987) also reported that planting system caused no variation in pearlmillet yield at constant level of 175,000 plants/ha. However, intercropping treatment significantly influenced the grain

Table 2. Effect of intercropping and weed control on growth and yield of pearlmillet

Treatment	Plant height (cm)		Effective tillers/plant		Ear length (cm)		Grain yield (q/ha)		Stover yield (q/ha)	
	1997	1998	1997	1997	1998	1997	1997	1998	1997	1998
Intercropping										
Pearlmillet sole	192.40	180.00	3.05	3.00	22.10	21.35	20.50	17.03	62.12	49.52
Pearlmillet + pigeonpea	191.13	179.70	3.15	2.90	21.90	21.29	19.59	16.63	57.34	47.52
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed control										
Control	180.73	169.63	2.61	2.46	18.91	17.50	15.50	13.31	59.69	36.10
2 hand-weedings	196.59	184.88	3.41	3.28	23.91	23.93	23.62	18.69	68.38	54.60
Fluchloralin 1.0 kg a.i./ha	194.38	183.38	3.35	3.11	24.08	23.46	21.87	18.63	64.63	54.60
Pendimethalin 1.0 kg a.i./ha	195.38	181.50	3.02	2.93	21.04	20.40	19.18	16.69	56.25	48.75
CD (P = 0.05)	1.33	0.50	0.32	0.39	1.51	1.07	2.32	1.41	5.60	3.50

Table 3. Effect of intercropping and weed control on growth and yield of pigeonpea

Treatment	Plant height (cm)		Branches/ plant		Grains/ pod		Grain yield (q/ha)		Stalk yield (q/ha)	
	1997	1998	1997	1997	1998	1997	1997	1998	1997	1998
Intercropping										
Pigeonpea sole	137.30	134.60	16.40	15.38	3.45	3.34	12.09	9.53	34.03	28.93
Pearlmillet + pigeonpea	136.41	133.80	16.06	15.09	3.38	3.30	4.26	4.51	12.28	13.78
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	1.19	0.72	4.00	3.27
Weed control										
Control	126.21	120.63	12.83	11.55	3.37	3.27	6.03	5.22	17.56	16.31
2 hand-weedings	141.75	138.91	17.91	16.63	3.44	3.35	9.37	7.94	26.43	23.87
Fluchloralin 1.0 kg a.i./ha	139.85	139.17	17.51	16.37	3.42	3.33	8.50	7.87	24.56	23.75
Pendimethalin 1.0 kg a.i./ha	139.62	139.08	16.67	16.40	3.41	3.31	8.81	7.06	24.06	21.50
CD (P = 0.05)	3.05	3.61	1.60	1.70	NS	NS	1.04	1.15	2.67	3.43

and stalk yields of pigeonpea intercrop (Table 3). Sole pigeonpea gave appreciably higher yield than pearlmillet + pigeonpea intercropping. Higher yield in pigeonpea sole was mainly because of comparatively higher plant population in this treatment.

Weed control greatly increased grain and stover yields of pearlmillet compared with the control. Apparently by virtue of their marked effects on improving various growth and yield parameters and the yield of pearlmillet. An increase in yield of pearlmillet was also reported by Sandhu *et al.* (1988). Hand-weeding twice resulted in the highest grain yield, followed by fluchloralin @ 1.0 kg/ha. Both these treatments were equally efficient, giving significantly higher yield than pendimethalin @ 1.0 kg/ha. Weed control significantly improved the grain and stalk yields of pigeonpea compared with the control. There was no measurable difference among the weed-control treatments in this respect.

Intercropping treatments resulted in appreciable increase in total productivity and land-equivalent ratio (Table 4). On an average, significantly highest total productivity in terms of pearlmillet equivalent was recorded with pearlmillet + pigeonpea intercropping, being 56.55 and 7.11% higher than pearlmillet sole and

Table 4. Effect of intercropping and weed control on total productivity (pearlmillet equivalent) and land-equivalent ratio

Treatment	Pearlmillet equivalent (q/ha)			Land-equivalent ratio		
	1997	1998	Mean	1997	1998	Mean
Intercropping						
Pearlmillet sole	19.72	17.03	18.37	1.00	1.00	1.00
Pigeonpea sole	30.23	23.44	26.83	1.00	1.00	1.00
Pearlmillet + pigeonpea	30.21	27.32	28.76	1.28	1.42	1.35
CD (P = 0.05)	2.14	1.88	1.37	0.056	0.053	0.03
Weed control						
Control	20.33	17.38	18.85	1.28	1.48	1.38
2 hand-weedings	31.37	25.80	28.58	1.30	1.37	1.33
Fluchloralin 1.0 kg a.i./ha	28.66	24.50	26.58	1.32	1.50	1.41
Pendimethalin 1.0 kg a.i./ha	26.52	22.70	24.61	1.29	1.31	1.30
CD (P = 0.05)	2.74	1.51	1.56	NS	0.032	0.02

Paired row planting 30/70 cm denotes 2 rows of pearlmillet 30 cm apart, 2 such pairs being 70 cm apart.

For computing total productivity in terms of pearlmillet equivalent 2.5 kg pearlmillet was considered to be equal to 1 kg pigeonpea

pigeonpea sole respectively. Land-equivalent ratio was also significantly influenced by intercropping treatments and the highest values were associated with pearlmillet + pigeonpea intercropping in individual years as well as when the pooled analysis was carried out.

Weed-control treatments markedly improved the total productivity compared with the control (Table 4). On an average, significantly highest total productivity in terms of pearlmillet equivalent was recorded under hand-weeding twice and lowest under pendimenthalin @ 1.0 kg/ha among weed-control treatments. However, highest land-equivalent ratio was recorded under fluchloralin @ 1.0 kg/ha.

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