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Increase in growth and yield of pigeonpea with weed management

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ABSTRACT

A field experiment was carried out to study the effect of pendimethalin, imazethapyr and paraquat on plant growth and seed yield of pigeonpea. It was found that maximum increase in seed yield and B:C were obtained with pendimethalin as pre-emergence (PE) 1.0 kg/ha followed by (*fb*) paraquat 0.40 kg/ha at 8 weeks after sowing (WAS). The next best treatments were pendimethalin as PE 1.0 kg/ha *fb* paraquat 0.40 kg/ha 6 WAS, imazethapyr 0.075 kg at 20 days after sowing (DAS) *fb* paraquat 0.40 kg at 6 WAS and imazethapyr 0.075 kg at 20 DAS *fb* paraquat 0.40 kg at 8 WAS. Similar trend accrued with the economic returns, but B:C was highest in pendimethalin as pre-emergence 1.0 kg/ha *fb* paraquat 0.40 kg/ha at 8 WAS (2.50) followed by imazethapyr 0.075 kg/ha *fb* paraquat at 6 WAS (2.25) and 8 WAS (2.25) and pendimehalin as PE 1.0 kg/ha *fb* paraquat 6 WAS (2.20).

Key words: Paraquat, Pendimethalin, Pigeonpea, Imazethapyr

Yield loss due to weed competition in pigeonpea to the tune of 32-65% (Vaishya and Khan 1989, Kundra and Brar 1990). Slow growth habit of pigeonpea at initial stage encourages rapid growth of weeds and leads to severe crop-weed competition which finally reduces the crop yield. The traditional methods of weed control, *viz*. inter-cultivation or hand weeding is laborious, expensive and insufficient. Moreover, complete weeding during critical crop growth stages is not possible due to increasing cost and scarcity of human labour. In addition, continuous rains during early crop growth stages in the transitional tract hinder the cultural methods of weed control. Herbicides like fluchloralin as pre-plant-incorporation (PPI) and pendimethalin as pre-emergence (PE) have been recommended for weed control, however, these are effective only during initial period (up to 30 DAS). Thus, for the effective control of weeds throughout the crop season, use of post-emergence herbicides has been found safe and effective in crops with 100-110 days maturity. It is also observed that use of single post-emergence herbicides at 15-20 DAS may effectively control the weeds during initial growth period but could not during entire critical growth period (60-70 days) in mid-late pigeonpea cultivars.

Certain weed flora emerge late in the season among broad-leaved weeds like *Alternanthera triandra* that escape from early post-emergence herbicides. This warrants the use of early post-emergence herbicides followed by non-selective herbicides like paraquat at 40 or 60 DAS for weed control to widen the weed-control spectrum, including grasses and broad-leaved weeds and their phytotoxicity, if any, to the crop. Paraquat is cationic herbicides with zero persistence in soils. They desiccate green portions of the plants quickly. Legume did not respond to paraquat. Dalton (1992) reported substantial increases in the nodular glutathione content of the paraquat treated, 25-28 days old soybean plants. Paraquat is more phytotoxic to plants with low glutathione reductase (GR) activity than those with high GR. Potato, tobacco, sugarcane, cotton and pigeonpea has more GR activity. Under such circumstances, herbicides in combination with cultural practices offer economically suitable and effective control of weeds. Keeping these points in view, the present study was undertaken to know the effect of weed management practices on weed control efficiency, morpho-physiological, and yield in pigeonpea.

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MATERIALS AND METHODS

A field experiment to study the effect of post-emergence herbicides, *viz*. pendimethalin, imazethapyr, quizalofop-ethyl and paraquat on growth and yield of pigeonpea cultivar '*PKV TARA*' was carried out at Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during 2011-12 to 2012-13. The soil of experimental site is clayey with pH 8.0, having available N 200 kg/ha, available P 19.0 kg/ha, available K 340 kg/ha and organic C 4.0 g/kg. The experiment was laid out in randomized complete block design having three replications. The treatment comprised of weedy (without removal of weeds), weed-free (weeding done as on appearance of weeds to keep the plot

free of weeds), hand weeding twice at 25 and 50 DAS and pendimethalin as pre-emergence and, post-emergence application of imazethapyr at 20 days after sowing (DAS) followed by non-selective herbicides paraquat at 6 and 8 weeks after sowing (WAS) with knapsack sprayer fitted with a flat-fan nozzle using 500 liters water/ha. Data on weed density and dry weight of weeds were recorded at 60 DAS and at harvest using quadrate 1 x 1 m. The N (25 kg/ha) through urea and P (50 kg/ha) through diammonium phosphate were applied as basal.

Yield attributes and seed yield of pigeonpea were recorded at the time of harvest. The economic analysis of each treatment was done on the basis of prevailing market rates of the inputs used and out-puts (excluding stover) obtained under each treatment. The crop was sown on 29 June 2010 and 6 July 2011 was harvested on 25 December 2010 and 20 December 2011 respectively. The total rainfall received during the crop growth was 1006.5 mm in 43 rainy days during 2010 and 464.3 mm in 34 rainy days during 2011. The required plant population (90 cm row to row and 20 cm plant to plant) was maintained by thinning plants after three weeks of sowing.

RESULTS AND DISCUSSION

Effect of weeds

The weed flora emerged during the period of experimentation were: grasses like *Cynodon dactylon* (L.) and *Bracharia* sp. (L.); sedges like *Cyperus rotundus* (L.) and broad-leaved weeds like *Alternathera triandra* (L.), *Acalypha indica* (L.), *Digeria arvensis* (L.), *Amaranthus viridis* (L.), *Phyllanthus niruri* (L.), *Cyanotis axillaris* (L.), *Commelina benghalensis* (L.), *Parthenium hysterophorus* (L.). Grasses and sedges especially *C. rotundus* appeared during the initial growth stages, whereas broad-leaved weeds especially *A. triandra* emerged late so it escape from the post-emergence herbicides spray. These weeds emerged during 15 to 20 DAS, thereafter up to continuously throughout the growth stages. The result revealed that among the herbicides, combination of imazethapyr at 20 DAS *fb* paraquat at 6 WAS or 8 WAS and pendimethalin *fb* paraquat at 6 WAS or 8 WAS recorded the lowest dry weight of weeds at all the growth stages. In the first year, weed dry matter and yield were higher than in others, which could be due to good quantum of rainfall received. Singh *et al.* (2002) also reported higher weed infestation in pigeonpea in a highly rainfall year. Imazethapyr did not provide satisfactory weed control of *A. indica* in pigeonpea fields.

Effect on crop

The highest yield attributes, *viz.* branches/plant, pods/plant, grain weight/plant and 100-grain weight were recorded in season long weed free plots mainly due to lowest dry weight of weeds (Table 2). The lowest numbers of pods were obtained from plots where the crop was kept weedy throughout the growing period and it was due to severe weed competition for resources, nutrients, moisture, light and space (Bhalla *et al.* 1998). The development of grain reflects the photosynthetic potential of a crop plant and its capacity to transport it assimilates to economically valuable plant organs. On the basis of pooled data statistically equivalent yield was recorded with pendimethalin as PE *fb* paraquat at 8 WAS closely followed by

Table 1. Weed dry matter, yield and economics of pigeonpea as influenced by different treatments

Treatment	Dry matter of weed (g/m^2)				Seed yield (t/ha)			Total cost (x10^3 `/ha)	NMR (x10^3 `/ha)	B:C
	2010-11		2011-12							
	60 DAS	At harvest	60 DAS	At harvest	2010-11	2011-12	Pooled			
HW twice at 25 and 50 DAS	20.4	12.0	17.19	1.90	1.48	1.23	1.36	16.89	30.67	1.82
PM 1.0 kg as PE *fb* HW at 50 DAS	24.6	13.1	17.08	0.85	1.17	1.24	1.21	18.70	23.55	1.26
IM 0.075 kg at 20 DAS *fb* 1HW at 50 DAS	23.2	13.0	10.26	1.04	1.47	1.23	1.35	16.68	30.62	1.84
PM 1.0 kg as PE *fb* PQ 0.40 kg at 6 WAS	15.20	5.75	10.20	0.97	1.45	1.43	1.44	15.75	34.63	2.20
IM 0.075 kg at 20 DAS *fb* PQ 0.40 kg at 6 WAS	18.31	4.99	13.31	0.99	1.49	1.30	140	15.05	33.90	2.25
PM 1.0 kg/ha *fb* PQ 0.40 kg at 8 WAS	14.31	5.95	10.31	0.88	1.56	1.39	1.48	14.77	36.88	2.50
IM 0.075 kg at 20 DAS *fb* PQ 0.40 kg at 8 WAS	18.28	6.05	12.28	0.80	1.50	1.26	1.38	14.91	33.48	2.25
Weedy check	58.91	45.2	24.56	12.86	1.50	0.86	1.18	9.94	31.41	3.16
Weed free	00	00	00	00	1.01	1.53	1.27	21.39	23.02	1.08
LSD (P=0.05)	-	-	-	-	0.13	0.13	0.07	-	5.17	-

IM-Imazethapyr; PM-Pendimethalin; PQ-Paraquat; Selling price: Seed yield-35/kg

Table 2. Yield attributes of pigeonpea as influenced by different treatments (mean of two years)

Treatment	Plant height (cm)	No. of branches/plant	No. of pods/ plant	Seed weight/ plant (g)	100 seed weight (g)
HW twice at 25 and 50 DAS	162	18.4	126	26.6	10.65
Pendimethalin 1.0 kg as PE *fb* HW at 50 DAS	164	18.6	128	27.1	10.59
Imazethapyr 0.075 kg at 20 DAS *fb* 1HW at 50 DAS	166	17.8	110	22.6	10.39
Pendimethalin 1.0 kg as PE *fb* paraquat 0.40 kg at 6 WAS	163	18.2	119	23.6	10.15
Imazethapyr 0.075 kg at 20 DAS *fb* paraquat 0.40 kg at 6 WAS	164	19.8	133	28.4	10.33
Pendimethalin 1.0 kg/ha *fb* paraquat 0.40 kg at 8 WAS	167	19.3	131	27.6	10.49
Imazethapyr 0.075 kg at 20 DAS *fb* paraquat 0.40 kg at 8 WAS	166	18.9	130	28.4	10.29
Weedy check	183	16.7	86	17.4	9.77
Weed free	156	23.9	135	27.7	10.34
LSD (P=0.05)	151	0.3	89	3.8	0.02

pendimethalin as PE *fb* paraquat at 6 WAS, imazethapyr at 20 DAS *fb* paraquat at 6 WAS and imazethapyr at 20 DAS *fb* paraquat at 8 WAS, respectively. Similar result was obtained by Khanna (2012). This might be due to lowest dry matter of weeds without causing any crop phytotoxicity. Highest yield levels was recorded during first year of investigation due to onset of good quantum of post-monsoon rains during terminal growth period; hence crop growth was good and the experimental results largely influenced by this. The magnitude of herbicide effects varied significantly with season, indicating that environmental parameters play a key role in determining the extent of herbicide damage. Soil moisture availability appears to be a key factor influencing plant health, herbicide uptake and metabolism, nodulation, N_2 fixation, and ultimately the ability of the plant to recover from a stress such as a herbicide application. Herbicide absorption and translocation to the site of action in plants varies with environmental factors and crop health and is difficult to predict (Devine *et al*. 1993, Green and Strek 2001).

Economics

Among the different weed management practices, pre-emergence application of pendimethalin 1.0 kg/ha *fb* paraquat 0.40 kg/ha at 8 WAS recorded higher gross and net returns (Table 1). The next best treatments were pendimethalin 1.0 kg/ha as PE *fb* paraquat 0.40 kg/ha at 6 WAS, imazethapyr at 20 DAS *fb* paraquat at 6 WAS and imazethapyr at 20 DAS *fb* paraquat at 8 WAS. The lower net returns and benefit : cost (1.26) with pre-emergence application of pendimethalin 1.0 kg/ha *fb* HW at 50 DAS might be owing to higher cost incurred in hand weeding.

It may be concluded that a practice that involves a pre-emergence application of pendimethalin 1.0 kg/ha and paraquat at 6 or 8 WAS could be an effective options for controlling weeds as well as for getting higher yield of pigeonpea.

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