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Effect of weed management practices on weed dynamics and growth, yield, economics of pigeonpea under rainfed condition

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ABSTRACT : A field trial was conducted during *Kharif* season of 2013 in farmer's field in Ragudiapada village of Angul district in Odisha to study the effect of weed management practices on weed dynamics and growth, yield, economics of pigeonpea under rainfed condition. The treatments comprised of different weed management practices *viz.*, T_1- Farmers practice of one hand weeding at 45 DAS, T_2-Pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS and T_3-Unweeded control. The experimental trial was laid out in Randomized Block Design with thirteen replications. The results revealed that pre-emergence application of pendimethalin 30 per cent 1.0 kg ha^{-1} *fb* one hand weeding at 45 DAS recorded maximum weed control efficiency at 90 DAS (70.12%) and at harvest (75.14%) with minimum dry weed biomass at harvest (37.41 g m^{-2}) and weed density m^{-2} at 120 DAS (62.23). The same treatment also produced significantly higher seed yield (18.36 q ha^{-1}), number of branches plant^{-1} (17.77), pods branch^{-1} (22.42), seeds pod^{-1} (4.46), nodules plant^{-1} (13.15), dry matter accumulation (6.54 to 175.52 g plant^{-1}), CGR(4.76 to 21.43 g m^{-2} day^{-1}), gross return (Rs.58560 ha^{-1}) and B:C ratio (2.27) with additional net return of Rs.6545 ha^{-1}as compared to farmers practice and weedy check. Thus, application of pendimethalin 1.0 kg ha^{-1} *fb* one hand weeding appeared to be effective, economically viable for weed control, crop growth, higher seed yield and net profit.

KEY **W**ORDS : Economic, Pendimethalin, Pigeonpea, WCE, Weed density, Yield

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Pigeonpea (*Cajanus cajan* L.) is one of the major grain legume crops of the tropics and subtropics and finds important place in the cropping systems adopted by farmers. It ranks second after chickpea in area and production in india comparision to other grain legumes such as beans, peas and chickpeas (Singh *et al.*, 2014). Pigeonpea is a tropical crop predominantly grown in india during *Kharif* season and a widely spaced row crop having initial slow growth is sensitive to weed competition during early stages of its growth period. A large proportion of uncovered land during early stages is taken over by rank weed growth, which may cause drastic reduction in growth and yield of pigeonpea. Pigeonpea with additional canopy may suppress weeds, due to shade (Rajesh *et al.*, 2014). The area under pigeonpea in Angul district is 9470 hectare with production of 7820 tonnes (Anonymous, 2013). In *Kharif* season, because of favourable climatic conditions, weeds have become a major problem. Weeds cause great losses than either insects or plant diseases. Tewari (1989) repported that

68 per cent yield losses caused in *Cajanus cajan* (L.) Millsp. In peninsular zone were due to weeds. It is therefore, necessary to control weeds so as to reduce the competition for nutrients, moisture, radiant energy and to obtain maximum fertilizer and water use efficiency. Maintaining a healthy, vigorously growing crop is one of the most important factors in reducing losses due to weed competition. The primary methods for weed control include exclusion, prevention, cultivation, hand weeding, mulching, solarization, and sometimes herbicides (Samant and Prusty, 2014a).

Hand weeding, is time consuming, highly expensive and is not feasible during critical period of weed competition due to scarcity of labour. Keeping this in view, present investigation was under taken to study effect of weed management practices on weed dynamics and growth, yield, economics of pigeonpea under rainfed condition.

RESEARCH PROCEDURE

A field trial was conducted during *Kharif* season of 2013 in farmer's field in Ragudiapada village of Angul district in Odisha to study the effect of weed management practices on weed dynamics and growth, yield, economics of pigeonpea under rainfed condition. The experimental site lies in 84^0 16´ to 85^0 23´ E longitude and 20^0 31´ to 21^0 41´ N latitude and average elevation of 195 m above sea level. Climate of the region is fairly hot and humid monsoon and mild winter. The total rainfall received during the crop season was 1273.9 mm as against normal of 1257.8 mm. The mean maximum and mean minimum temperature registered during the study period was 33.0^0 C in June and 14.0^0 C in December. The soil of the site was slightly acidic in reaction (pH-5.7), sandy loam in texture with medium organic carbon content (0.55 %), medium nitrogen (281.0 kg ha^{-1}), low phosphorus (10.2 kg ha^{-1}) and medium potassium (180.0 kg ha^{-1}) contents. The treatments comprised of different weed control methods *viz.*, T_1- Farmers practice of one hand weeding at 45 DAS, T_2-Pre-emergence application of pendimethalin 30 per cent 1.0 kg ha^{-1} *fb* one hand weeding at 45 DAS and T_3-Unweeded control. The experimental trial was laid out in Randomized Block Design with thirteen replications. The seeds of pigeonpea cv. ICP 8863 (*Maruti*) was sown on 4^{th} week of June as per treatment by dibbling method and harvested during 2^{nd} week of December and fertilizers were applied @ 20:40:40 kg NPK ha^{-1}. Full dose of P, K and half dose of N of RDF were applied as basal and rest N was applied at 30 DAS. Herbicide (Pendimethalin) was sprayed at 3 DAS with manually operated knapsack sprayer using a spray volume of 500 litres water per hectare. All other recommended agronomic and plant protection measures were adopted to raise the crop. The biometric observations on weeds and crops were recorded following standard procedures.Weed density m^{-2} was sampled randomly at ten places with the help of one square meter quadrates at 30, 60, 90, 120 DAS, at harvest and weed dry weight m^{-2} at 90 DAS and at harvest were recorded. The weed control efficiency (WCE) was calculated by using the formula (Kondap and Upadhyay, 1985).

$$WCE = \frac{DWC - DWT}{DWC} \times 100$$

where:

DWC = Dry weight of weeds under control plot; DWT = Dry weight of weeds under treated plot

Economic analysis was done by calculating cost of cultivation, gross return, net return and B:C ratio. Available soil nutrients were determined following the standard procedures (Jackson, 1973). The datas were statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05 (Cochran and Cox, 1977).

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Weed density :

The trial field was infested with three categories of weeds.The total number of weeds species was 11 out of which *Cynodon dactdylon*, *Commelina benghalensis* among grasses; *Xanthium strumarium*, *Parthenium hysterophous* among broaleaved and *Cyperus rotundus* as sedges were predominant throughout the cropping period. At 120 DAS grasses, broadleaved weeds and sedges, on an average, constituted 45.6, 46.4, 8.0 per cent of total weed population (Table 1). Herbicide treatment significantly reduced the weed population compared to those of farmer's practice or weedy check during this period. Maximum weed density was recorded in weedy check (221.4 m^{-2}) followed by farmer's practice

of one hand weeding and minimum weed density (62.2 m^{-2}) was observed in pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS. Similar observations were recorded by Dhonde *et al*. (2009) and Samant and Mishra (2014b).

Weed dry biomass and weed control efficiency:

Unweeded control recorded significantly higher weed dry biomass 173.2 g m^{-2} and 150.46 g m^{-2} at 90 DAS and at harvest, respectively. The lowest weed dry biomass was registered under pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS 51.75 g m^{-2} and 37.41 g m^{-2} at 90 DAS and at harvest, respectively (Table 2). Application of herbicides might have prevented the germination of susceptible weed species which reduced the growth of germinated weeds by inhibiting the process of photosynthesis (Muzik, 1970). Shetty and Rao (1977) also reported that weed dry matter weighed during harvest indicates the trend of lesser weed dry matter values for better weed management treatments.

The weed control efficiency (WCE) was significantly higher in herbicide treatment with hand weeding and lower in farmers practice. At 90 DAS pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS recorded the higher weed control efficiency (70.12%) as compared to farmers practices (62.59%). At harvest, herbicide treatment and farmers practice recoded the weed control efficiency 75.14 per cent and 63.68 per cent, respectively (Table

Table 1 : Effect of different treatments on weed composition m^{-2} in pigeonpea at 120 DAS

Sr. No.	Weed species	T_1	T_2	T_3
Monocot				
1.	*Cynodon dactdylon*	16.5	12.3	29.4
2.	*Digitaria sanguinalis*	9.8	4.0	26.9
3.	*Commelina benghalensis*	13.2	7.5	26.2
4.	*Echinochloa glabrescens*	-	2.5	16.0
	Total monocot	39.5	26.3	98.5
Dicot				
1.	*Parthenium hysterophous*	5.5	4.3	19.8
2.	*Phyllanthus niuri*	3.0	4.1	16.7
3.	*Xanthium strumarium*	-	3.3	30.6
4.	*Argimone mexicana*	5.1	5.3	17.7
5.	*Convolvulus arvensis*	8.6	7.4	11.6
6.	*Acalypta indica*	10.0	6.0	13.6
	Total dicot	32.2	30.4	110.0
Sedges				
1.	*Cyperus rotundus*	7.5	5.5	12.9
	Grand total	79.2	62.2	221.4

Table 2: Effect of different treatments on weed density, dry weed biomass and weed control efficiency

Treatments	Weed density m^{-2}					Dry weed biomass (g m^{-2})		Weed control efficiency (%)	
	30 DAS	60 DAS	90 DAS	120 DAS	AT harvest	90 DAS	At harvest	90 DAS	At harvest
T_1 : Farmers practice (one hand weeding at 45 DAS)	175.47	73.51	86.05	79.14	74.28	64.80	54.65	62.59	63.68
T_2 : Pre-emergence application of pendimethalin 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS	62.47	41.3	68.59	62.23	51.33	51.75	37.41	70.12	75.14
T_3: Weedy check (Control)	186.28	215.64	228.07	221.39	204.53	173.20	150.46	-	-
S.E.±	3.938	5.627	3.57	4.875	5.644	4.203	2.152		
C.D. (P=0.05)	11.492	16.420	10.418	14.226	16.472	12.265	6.282		

DAS=Days after sowing

2). This may be due to effective control of weeds during early stages of crop growth by herbicides and in later stages removal of both intra and inter row weeds by hand weeding (Patra and Nayak, 2001).

Plant height, number of branches plant^{-1}, number of pods branch^{-1}, number of seeds pod^{-1}, number of nodules plant^{-1} and 100 seed weight :

Pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS recorded (Table 3) the maximum number of branches plant^{-1} (17.77), pods branch^{-1} (22.42), seeds pod^{-1} (4.46) which is 13.6, 13.9 and 2.5 per cent higher than farmer's practice due to lesser weed population, weed dry biomass and removal of weeds regularly at early and later stages by hand weedings (Samant and Prusty, 2014a and Yadav and Singh, 2009). Maximum plant height (203.25 cm) and 100 seed weight (7.84 g) was produced in farmers practice whereas minimum was found in weedy check might be due to the improved nutritional condition for plant growth and development (Singh *et al.*, 2012). Maximum number of nodules plant^{-1} (13.15) were recorded with pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS followed by farmers practices (11.52). Minimum numbers of nodules plant^{-1} were observed in weedy check(9.23). This might be due to *in vitro* growth of *Rhizobium* in pendimethalin ammended medium which is in agreement with the results of Khanna *et al*.(2012).

Dry matter acucumulation plant^{-1} and crop growth rate :

At all the stages of crop growth, weedy check recorded (Fig. 1) significantly lower crop dry matter accumulation (4.82 to 127.33 g plant^{-1}). This might be attributed to severe competition of weeds with crop for growth factors which restricted the development of the crop. Maximum dry matter accumulation (5.57 to 178.22 g plant^{-1}) produced in pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS which was at par with farmers practice might be attributed to better control of weeds. This is in confirmation with the finding of Vivek *et al.* (2003).

Pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS recorded (Fig. 2) the higher CGR value 4.76, 21.58 and 21.43 g m^{-2} day^{-1} during 60-90, 90-120 and 120-150 DAS, respectively which were at par with farmers practices. Weedy check recorded the lowest CGR value 4.25, 17.08 and 12.56 g m^{-2} day^{-1} during 60-90, 90-120 and 120-150

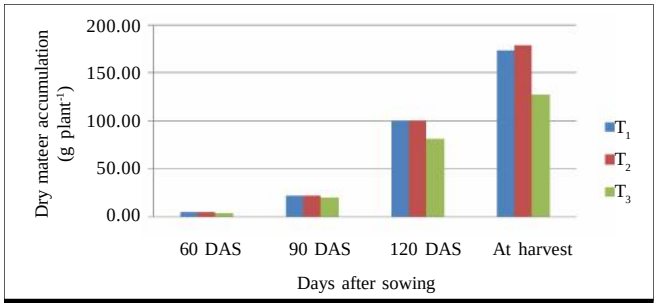

Fig. 1 : Effect of different treatments on dry matter accumulation in pigeonpea

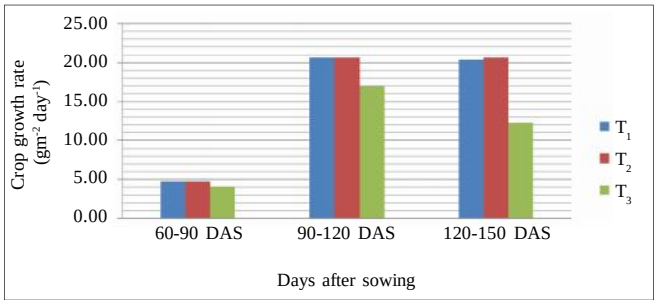

Fig. 2 : Effect of different treatments on crop growth rate in pigeonpea

Table 3 : Effect of different treatments on plant height, no. of branches plant^{-1}, no. of pods plant^{-1}, no. of seeds pod^{-1}, no. of nodules pod^{-1} , 100 seed weight and seed yield

Treatments	Plant height (cm)	No. of branches plant^{-1}	No. of pods branch^{-1}	No. of seeds pod^{-1}	No. of nodules plant^{-1}	100 seed weight	Seed yield (q ha^{-1})
T_1 : Farmers practice (one hand weeding at 45 DAS)	203.25	15.64	19.69	4.35	11.52	7.84	16.41
T_2 : Pre-emergence application of pendimethalin 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS	192.77	17.77	22.42	4.46	13.15	7.16	18.36
T_3: Weedy check (Control)	165.44	10.43	13.78	3.85	9.23	7.00	9.22
S.E.±	0.071	0.13	0.559	0.167	0.289	0.749	0.339
C.D. (P=0.05)	0.206	0.381	1.632	0.486	0.844	2.186	0.988

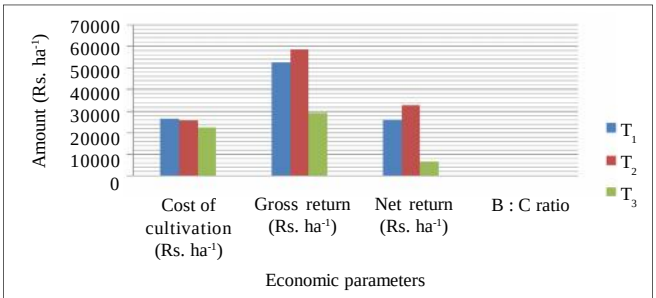

Fig. 3 : Effect of different treatments on economics in pigeonpea

DAS, respectively. The observation might be due to the increase of metabolically active tissue and as obtained less to the plant growth (Samant *et al.*, 2014c). The crop growth rate (CGR) values were increasing progressvely with time reaching the highest at 90-120 DAS in all the treatments attributed to high vegetative biomass production.

Seed yield :

Pre-emergence application of pendimethalin 30 per cent 1.0 kg ha^{-1} *fb* one hand weeding at 45 DAS (Table 3) produced seed yield (18.36 q ha^{-1}) which is significantly higher (11.9%) than the farmers practice because of the herbicides prevented the germination of weed and reduced the growth of weed and minimum crop weed competition through out crop growth period. Similar results were also reported by Kolage *et al.* (2004). Minimum seed yield was recorded in weedy check (9.22 q ha^{-1}) may be due to vigorous weed growth and suppression in crop growth (Anonymous, 2009).

Economics :

Among the treatments, pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS recorded (Fig. 3) the maximum gross return (Rs.58560 ha^{-1}) and B:C ratio(2.27) with additional net return of Rs.6545 ha^{-1} as compared to farmers practice owing to higher seed yield and production of pods. Similar kinds of results were obtained in pigeonpea by Talinikar *et al*.(2008); Shinde *et al.* (2003) and Singh and Sekhon (2013). Minimum cost of cultivation (Rs.22552 ha^{-1}) occurred in weedy check in comparison to other treatments due to saving of cost towards weeding (Malviya and Singh, 2007).

Conclusion :

Application of pre-emergence application of pendimethalin 30 per cent 1.0 kg ha $^{-1}$ *fb* one hand weeding at 45 DAS considerably reduced the weed infestation registering higher weed control efficiency, higher seed yield. Thus, it appeared to be effective, economically viable for weed control, crop growth, higher seed yield and net profit.

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