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Effect of Different Weed Management Practices of Moth bean (*Vigna aconitifolia*)

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ABSTRACT: An experiment was carried out during *Kharif* season of 2020 at Crop Research Farm, NAI, SHUATS to evaluate the bio-efficacy of herbicides on growth and yield of moth bean (*Vigna aconitifolia*) and associated weeds. The experiment consisted of 9 treatments which includes hand weeding, pendimethalin as pre-emergence herbicide, fluchloral in as pre-plant incorporation and post emergence herbicide, imazethapyr as post-emergence herbicide and Unweeded (Weedy check).The results indicate the occurrence of broadleaf plants, grasses and sedges. Where seven weed species belonging to 5 families were identified. The dominant weed species are *Digera muricata, Phyllanthus niruri, Melothria pendula, Cynodon dactylon, Digitaria sanguinalis, Dactyloctenium aegyptium* and *Cyperus* spp. The result revealed that, application of Imazethapyr PoE 30 g/ha recorded maximum plant height (29.75cm), whereas Fluchloralin PPI 0.50 kg/ha obtained maximum crop growth rate (5.27 g/m^2/day), pods/plant (31.53), seeds/pod (4.03), seed yield (426.17 kg/ha), net return (INR 24926.30/ha) and B:C ratio (1.74). Where at 60 DAS, lowest weed population recorded with application of Imazethapyr PoE 50 g/ha (60.33/m^2), which was 39.49% higher effective from unweeded plot (99.67/m^2).

Keywords: Moth bean, weed control methods, herbicides and seed yield.

INRODUCTION

Moth bean (*Vigna aconitifolia*) which is also called *as Kheri, Dew Bean, Kidney Bean, Matki, Math* and *Turkish Gram*. These are mostly grown in arid and semi-arid regions of India. Moth bean is a good source of protein (24%) and high in dietary fiber. It also contains essential amino acids, particularly lysine and leucine and some vitamins. Uncooke draw moth bean (100 g) has 343 calories, 24 g of protein, 62g of carbohydrate and 1.6 g of fat. Also, green pods are delicious source of vegetable with more protein contain (Kumar *et al.,* 2003). In the country, Moth bean occupied 9.26 lac ha giving 2.77 lac tonnes production during the twelfth plan (2012-2015) period. Major moth bean growing states of India are Rajasthan, Uttar Pradesh, Maharashtra, Gujarat, Haryana and Punjab.

Weeds are unpleasant, undesirable, unwanted plants which interface negatively with human activities and adversely affect human welfare. Severe weed infestation is the major constraint and may reduce the yield by 30-50 % (Singh and Singh, 1979). There are three goals of any weed management system, reduce weed density, reduce the amount of damage that a given density of weeds inflicts on an associated crop and after the composition of weeds communities' towards less aggressive and easier to manage species. Conventional methods used for managing weeds in moth bean fields are time consuming and costly. In early stage of the crop, grasses are predominant as compared to others, but at later stage, sedges and broad leaf weeds create interference in crop growth. Hand weeding is very common and sometimes these methods become very difficult to accomplish because of frequent rains coupled with non-availability of labours in time. Under such conditions, use of herbicides to control the weeds is only the best option to reduce the losses caused by weeds is only the best option to reduce the losses caused by weeds (Manu, 2013). Pendimethalin is basically pre-emergence herbicide. In rainfed condition, if weeds have not yet germinated, this herbicide may be effective when applied after first shower (Singh *et al*., 2016). Fluchloralin is a selective herbicide which can be applied as pre-plant incorporation and post-emergence treatment. And Imazethapyr is a broad-spectrum herbicide, has soil and foliar activity that allows flexibility in its application timing and has low mammalian toxicity (Tan *et al*., 2005). Moreover, acute shortage of laboratcritical time makes manual weeding operation impossible. Keeping this point in view, an experiment was conducted to find out economical and effective weed management practices in moth bean.

MATERIALS AND METHODS

The experiment was conducted at Central Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during *Kharif* 2020. The soil of the experimental site was sandy loam with normal soil reaction (pH = 7.54). The soil was low in organic carbon (0.24%), medium in available nitrogen (256.49 kg/ha), low in available phosphorus (6.90 kg/ha) and medium in available potassium (256.30 kg/ha) (District Agriculture Office, Jajpur, Odisha). The experiment

was laid out in Randomized Block Design with nine treatments including hand weeding at 25 DAS; pendimethalin 0.75 &1.00 kg/ha applied as pre-emergence; fluchloralin 0.50 & 0.75 kg/ha as pre plant incorporation & post emergence; imazethapyr 30, 40 & 50 g/ha applied as post-emergence and unweeded, which replicated thrice (Table 1). Variety used for trial "RMO-40", which was sown with seed rate 12 kg/ha and keeping 45cm × 10cm spacing. Herbicide applied with knapsack sprayer through 500 liters of water per hectare. The pre-plant incorporation of herbicide was applied one day before sowing, whereas pre-emergence herbicides applied two days after sowing and post-emergence herbicides applied 25 days after sowing. Weeds were recorded using quadrate 25 cm × 25 cm and converted the values in m^2. The average temperature varies from 26.08°C- 35.47°C, relative humidity 51.10-80.55 % and rainfall 126.60-279.00 mm during crop period, respectively. Regular observation of crop and weed with key factor like weed parameters and growth attributes of crop were recorded at regular during the crop growth, however the observation data at peak stage means at 15, 30, 45 and 60 DAS. The data collected on crop and weeds was subjected to statistical analysis as per procedure (Gomez and Gomez, 1984).

Data on weed density (no./m^2) and weed population (no./m^2) recorded species wise separately in each plot at 15, 30, 45 and 60 DAS. Calculation of this parameters through their formula described below:

Weed Density (D): Amount of particular weed spieces in side of a determined crop area. It is expressed in no./m^2 (Sharma, 2014).

$$D = \frac{\Sigma iZ}{A}$$

Where,

D = Density (in number/m^2) of species in field

Z = Number of plants of a species in quadrat i

A = Area in m^2 of N quadrats in field.

Table 1: Treatments.

Treatment No.	Treatment Combinations
1.	Handweeding@25DAS
2.	Pendimethalin PE0.75kg/ha (at 2DAS)
3.	Pendimethalin PE1 kg/ha (at 2 DAS)
4.	Fluchloralin PPI0.50kg/ha (one day before sowing)
5.	Fluchloralin PoE0.75kg/ha (at 25DAS)
6.	Imazethapyr PoE30gm/ha (at 25DAS)
7.	Imazethapyr PoE40gm/ha (at 25DAS)
8.	Imazethapyr PoE50gm/ha (at 25DAS)
9.	Unweeded (Weedy check)

RESULTS AND DISCUSSION

A. Weed Flora

Weeds are unpleasant, undesirable, unwanted plants which interfere negatively with human activities and adversely affect human welfare. Through the weed survey of experimental field consisted of broad leaved weeds, grassy and sedges. The common weed species are *Digera muricata*, *Phyllanthus niruri*, *Melothria pendula*, *Cynodon dactylon*, *Digitaria sanguinalis*, *Dactyloctenium aegyptium* and *Cyperus* spp. located (Table 2). Weeds compel with the beneficial vegetation in crops lands, forests etc. weeds are troublesome in many ways. Primarily, they reduce crop yield, reduce crop quality by competing for water, soil, light and nutrients etc.

Table 2: Weed flora.

Botanicalname	Commonname	Family	Lifecycle	Infestation(%)
Digera muricata	False amaranth	Amaranthaceae	Perennial	6.02
Phyllanthus niruri	Bhumi amla	Euphorbiaceae	Annual	4.01
Melothria pendula	Creeping cucumber	Cucurbitaceae	Perennial	3.01
Cynodon dactylon	Bermuda grass	Poaceae	Annual	66.89
Digitaria sanguinalis	Crab grass	Poaceae	Annual	8.03
Dactyloctenium aegyptium	Crow footgrass	Poaceae	Annual	5.02
Cyperus rotundus	Motha purple nutsedge	Cyperacea	Perennial	7.02

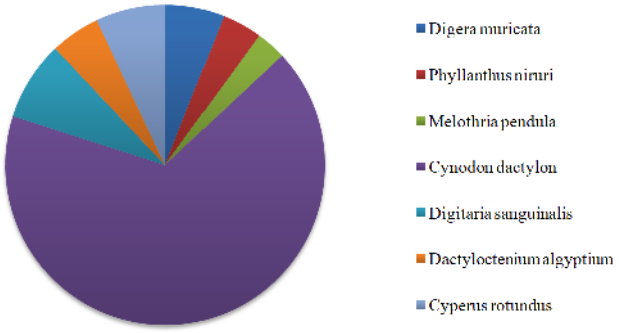

Fig. 1. Weed infestation.

B. Weed Density

At 15 DAS, in case of broad leaf weeds, minimum weed density was recorded in Pendimethalin PE 0.75 kg/ha (0.67/m^2). Whereas application of Fluchloralin PPI 0.50 kg/ha recorded most effective on grassy (8.67/m^2) and sedges (0.67/m^2). At 30 DAS, Hand weeding @ 25 DAS recorded minimum weed density in broad leaf (0.67/m^2), grassy (6.67/m^2) and sedges

(1.33/m^2), respectively. At 45 DAS, minimum weed density recorded by application of Imazethapyr PoE 50 g/ha in broad leaf weeds (1.33/m^2), Fluchloralin PPI 0.50 kg/ha in grassy (18.00/m^2) and Fluchloralin PoE 0.75 kg/ha (1.33/m^2). At 60 DAS, lowest weed density of broad leaf was recorded with Pendimethalin PE 0.75 kg/ha (3.67/m^2), whereas Imazethapyr PoE 50 g/ha (53.00/m^2) in grassy and Fluchloralin PoE 0.75 kg/ha (2.67/m^2)in sedges (Table 3). Lowest weed density due to Pendimethalin inhibits root and shoot growth. It controls weed density and prevents weed emerging, particularly during the crucial development phase of the crop and Imazethapyr translocated freely in plants through the roots and shoots could effectively controlled broad leaf as well as grasses (Ram *et al.*, 2012).

C. Weed Population

At 15 DAS, the weed population increase normally, where application of Fluchloralin PPI 0.50 kg/ha (10.67/m^2) observed effective as comparison to weedy check (25.00/m^2). At 30 DAS, after Hand weeding @ 25 DAS (8.67/m^2) observed low weed population as compare to herbicide application. At 45 DAS, application of Fluchloralin PPI 0.50 kg/ha (23.67/m^2) observed lower weed population. At 60 DAS, lowest weed population recorded with application of Imazethapyr PoE 50 g/ha (60.33/m^2), which was 39.49% higher effective from unweeded plot (99.67%) and Hand weeding @ 25 DAS (66.30/m^2), Pendimethalin PE 0.75 kg/ha (66.67/m^2), Pendimethalin PE 1 kg/ha (66.67/m^2), Fluchloralin PPI 0.50 kg/ha (67.00/m^2) and Imazethapyr PoE 40 g/ha (70.00/m^2) was closely followed the same trend and reducing weed population, respectively (Table 3). The reduction of weeds due to imazethapyr translocated freely in plants through the roots and shoots and compress the growth, which effectively controlled broad leaf as well as grasses (Ram *et al.*, 2012).

Table 3: Effect of different weed management practices on weed density and population of moth bean.

	Weed Density (no./m^2)												Weed Population (no./m^2)			
	15 DAS			30 DAS			45 DAS			60 DAS			15 DAS	30 DAS	45 DAS	60 DAS
Treatments	Broad leaf	Grassy	Sedges	Broad leaf	Grassy	Sedges	Broad leaf	Grassy	Sedges	Broad leaf	Grassy	Sedges				
Hand weeding @ 25 DAS	2.33	17.33	3.00	0.67	6.67	1.33	2.33	20.00	3.00	4.33	57.67	4.33	22.67	8.67	25.33	66.30
Pendimethalin PE 0.75 kg/ha	0.67	11.00	2.33	1.67	16.67	1.67	3.00	27.00	3.67	3.67	58.67	4.33	14.00	20.00	33.67	66.67
Pendimethalin PE 1 kg/ha	1.00	12.33	0.67	2.00	17.67	1.67	3.33	24.33	3.33	4.67	58.00	4.00	14.00	21.33	31.00	66.67
Fluchloralin PPI 0.50 kg/ha	1.33	8.67	0.67	2.33	15.00	2.00	2.67	18.00	3.00	5.00	57.00	5.00	10.67	19.33	23.67	67.00
Fluchloralin PoE 0.75 kg/ha	2.33	18.00	2.00	1.67	26.67	1.33	2.67	26.67	1.33	4.00	68.33	2.67	22.33	29.67	30.67	75.00
Imazethapyr PoE 30gm/ha	2.33	23.00	3.00	1.67	29.00	2.00	3.33	42.33	3.00	5.00	71.67	4.33	28.33	32.67	48.67	81.00
Imazethapyr PoE 40gm/ha	1.67	20.00	2.33	1.67	27.00	2.33	3.33	34.33	4.67	4.67	59.67	5.67	24.00	31.00	42.33	70.00
Imazethapyr PoE 50gm/ha	1.33	16.00	1.33	1.67	17.00	1.67	1.33	27.00	3.33	4.00	53.00	3.33	18.67	20.33	31.67	60.33
Unweeded (weedy check)	1.67	21.00	2.33	3.33	32.67	3.33	4.00	42.00	7.00	7.00	85.67	7.00	25.00	39.33	53.00	99.67
SEm (±)	0.43	1.87	0.69	0.28	1.37	0.43	0.38	2.78	0.91	1.00	4.38	0.89	2.53	1.59	3.05	4.59
CD (P=0.05)	NS	5.63	NS	0.86	4.12	NS	1.15	8.36	2.74	NS	13.14	NS	7.59	4.78	9.16	13.78

D. Effect on growth parameter

Plant height: At 15 DAS, maximum plant height was recorded with application of Fluchloralin PPI 0.50 kg/ha (5.85 cm), there is no significant variance among the all the treatments. At 30 DAS, maximum plant height was recorded with application of Imazethapyr PoE 40 g/ha (18.17 cm), Which was significantly superior over Pendimethalin PE 1 kg/ha (12.94 cm) and Fluchloralin PoE 0.75 kg/ha (15.93 cm), Whereas rest of the treatments are at par with Imazethapyr 40 g/ha. At 45 DAS, maximum plant height was recorded with application of Imazethapyr PoE 30 g/ha (26.36 cm), which was significantly superior over all the treatment except Imazethapyr PoE 40 g/ha (24.71 cm). At 60 DAS, maximum plant height was recorded with application of Imazethapyr PoE 30 g/ha (29.7 cm), which was significantly superior over all the treatments (Table 4). Increase in height was due to the reduced weed infestation in early stage of crop and resulted in less competition between crop and weed for growth factors. All these have to be enabled the crop to more nutrient and moisture (Kumbar *et al.*, 2014; Komal *et al*., 2015 and Choudhary *et al*., 2017).

Branches/plant: At all the growth stages there is no significant variation was found in no. of branches per plant. Whereas, at 15 DAS no branch formation occurred. At 30 DAS, maximum number of branches obtained with Imazethapyr PoE 30 g/ha (1.60). At 45 DAS, maximum number of branches were obtained with Hand weeding @ 25 DAS (2.93) and at 60 DAS, maximum number of branches were obtained with Imazethapyr PoE 40 g/ha (3.60) (Table 4). Increase in growth parameters was due to the reduced weed infestation in early stage of crop and resulted in less competition between crop and weed for growth factors. All these have to be enabled the crop to more nutrient and moisture during pre-flowering stage finally leading to more primary branches per plant (Kumbar *et al.* 2014).

Crop growth rate (g/m^2/day): At 15-30 DAS, maximum crop growth rate was recorded with application of Imazethapyr PoE 30 g/ha (1.78

g/m^2/day), which was significantly superior over Pendimethalin PE 1 kg/ha (1.05 g/m^2/day) and weedy check (1.27 g/m^2/day). At 30-45 DAS and 45-60 DAS, maximum crop growth rate was recorded with application of Fluchloralin PoE 0.75 (4.16 g/m^2/day) and Fluchloralin PPI 0.50 (5.27 g/m^2/day) respectively, there was no significant variation was found among the treatments (Table 4). Maximum crop growth rate due to better management of weeds during early crop growth which resulted in higher dry weight (Hanumanthappa *et al.*, 2012).

Table 4: Effect of different weed management practices on growth attributes of moth bean.

Treatments	Plant Height (cm)				Branches/plant (no.)			Crop Growth Rate (g/m^2/day)		
	15 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	15-30 DAS	30-45 DAS	45-60 DAS
Hand weeding @ 25 DAS	5.81	16.37	23.13	25.68	1.33	2.93	3.47	1.64	2.30	4.80
Pendimethalin PE 0.75 kg/ha	5.12	16.51	22.86	24.90	1.20	2.87	3.47	1.66	2.87	4.25
Pendimethalin PE 1 kg/ha	5.63	12.94	18.37	23.27	1.00	1.67	3.53	1.05	2.40	4.32
Fluchloralin PPI 0.50 kg/ha	5.85	17.07	20.92	24.97	0.93	2.20	3.33	1.76	3.91	5.27
Fluchloralin PoE 0.75 kg/ha	5.81	15.93	21.03	25.32	0.87	2.47	3.40	1.54	4.16	3.46
Imazethapyr PoE 30 g/ha	5.38	17.80	26.36	29.75	1.60	2.47	3.47	1.78	3.08	5.07
Imazethapyr PoE 40 g/ha	4.43	18.17	24.71	26.25	1.20	2.40	3.60	1.38	2.31	4.95
Imazethapyr PoE 50 g/ha	4.69	16.47	22.32	24.13	1.20	2.60	2.80	1.48	2.73	4.80
Unweeded (weedy check)	5.18	17.45	23.52	26.91	1.33	2.60	3.47	1.27	3.00	2.81
SE(m)±	0.62	0.89	1.30	1.16	0.16	0.31	0.28	0.13	0.52	1.64
CD (P=0.05)	NS	1.89	2.77	2.46	NS	NS	NS	0.40	NS	NS

Effect on yield attributes and yield: Maximum seed yield depends upon the maximum no. of pods/plant and seeds/pod. Application of Fluchloralin PPI 0.50 kg/ha recorded maximum pods/plant (31.53) and seed yield (46.17 kg/ha) followed by Pendimethalin PE 0.75 kg/ha, Fluchloralin PoE 0.75 kg/ha and Imazethapyr PoE 50 g/ha. Fluchloralin PPI 0.50 kg/ha gave 41.28% higher seed yield over Unweeded. Also, application of Fluchloralin PPI 0.50 kg/ha recorded maximum seeds/pod (4.03), Which was no significant variance among the treatments (Table 5). Stover yield was obtained maximum with the application of Pendimethalin PE 0.75 kg/ha (2655.10 kg/ha) followed by Fluchloralin PPI 0.50 kg/ha, Hand weeding @ 25 DAS and Imazethapyr PoE 30 g/ha. Pendimethalin PE 0.75 kg/ha gave 25.68% higher stover yield over Unweeded (Table 5). The reduction in yield may be due to presence of higher no. of weeds which reduced plant growth and number of plants & number of pods per plant. The loss in yield due to heavy rainfall was occurred during crop growing period which result to flower drop and pod damaged. Pulses are very sensitive, especially in early vegetative stage, flowering and pod formation stage and during that period heavy rainfall cause yield loss (Rosenzweig and Liverman, 1992).

Economics: Higher Net return (INR 24926.30/ha) and B:C ratio (1.74) was obtained with the application of Fluchloralin PPI 0.50 kg/ha (Table 5). Higher Net return in these treatments were primarily due to higher seed and straw yields obtained from moth bean. The effective herbicide control lead to increase yield and ultimately increase return more. Pre-plant incorporation of Fluchloralin gave high return due to low cost in weed control with their application. Similar finding also observed by (Saxena *et al.*, 2003).

Table 5: Effect of different weed management practices on yield attributes, yield and economics of moth bean.

Treatments	Pods/Plant (No.)	Seeds/Pod (No.)	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Net Return (INR/ha)	B:C Ratio
Hand weeding @ 25 DAS	24.27	3.28	306.91	2368.99	14167.30	0.89
Pendimethalin PE 0.75 kg/ha	27.07	3.67	395.35	2655.10	23318.35	1.63
Pendimethalin PE 1 kg/ha	23.07	3.60	309.46	1905.63	14572.50	1.02
Fluchloralin PPI 0.50 kg/ha	31.53	4.03	426.17	2448.91	24926.30	1.74
Fluchloralin PoE 0.75 kg/ha	28.13	3.91	395.57	2081.27	21454.30	1.49
Imazethapyr PoE 30 g/ha	25.13	3.76	319.57	2187.52	16349.80	1.15
Imazethapyr PoE 40 g/ha	21.87	3.07	271.73	1869.54	11594.70	0.82
Imazethapyr PoE 50 g/ha	28.82	3.43	398.24	2093.09	21926.70	1.54
Unweeded (weedy check)	23.40	3.26	250.21	1973.11	11091.45	0.82
SE(m)±	1.84	0.25	10.54	171.46	–	–
CD (P=0.05)	5.54	NS	31.60	514.04	–	–

CONCLUSION

The application of Imazethapyr PoE 50 g/ha was found more effective on weeds in moth bean under Uttar Pradesh climatic condition, whereas Fluchloralin PPI 0.50 kg/ha found more effective on yield and economics in moth bean.

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