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Research Article

ECONOMIC VIABILITY OF WEED MANAGEMENT PRACTICES ON PRODUCTIVITY OF BLACKGRAM (*Phaseolus mungo* L.)

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Abstract- The field experiment was conducted during *rabi* 2010-12 at Agricultural Research Station, Tamil Nadu Agricultural University, Pattukottai to evaluate the efficient weed management practices in blackgram. The treatments consisting of nine weed management methods were conducted in randomized block design (RBD) with three replications. The treatments are involving pre-emergence herbicide *viz.,* pendimethalin and post-emergence herbicide *viz*., imazethapyr, quizalofop-ethyl and in combination with hand weeding, power weeding and twin wheel hoe weeding at 30 DAS. In addition, hand weeding and power weeding twice at 15 and 30 DAS were tested with unweeded check. *Dactyloctenium aegyptium, Digitaria sanguinalis, Cynodon dactylon, Panicum repens, Cyperus rotundus, Cleome viscosa, Euphorbia hirta, Phyllanthus niruri, Portulaca oleracea* and *Trianthema portulacastrum* were the dominant weed species in the experimental field. The results showed that unchecked weeds caused a reduction of 73.8 per cent yield of black gram. Hence, the hand weeding twice at 15 and 30 DAS recorded higher plant height (30.9 cm), number of pods/plant (24.2), seed yield (798 kg/ha) and higher weed control efficiency (90 per cent). However, higher net return (₹ 34560/ha) was obtained in pre emergence application of pendimethalin @ 750 g/ha at 3 DAS (days after sowing) along with twin wheel hoe weeding or hand weeding at 30 DAS. Based on the results, it can be concluded that application pendimethalin followed by hand weeding or twin wheel hoe weeding can be recommended as an effective weed management practice with respect to yield and cost for the blackgram.

Keywords- Hand weeding, Pendimethalin, Imazethapyr, Seed yield, Benefit cost ratio.

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Introduction

Blackgram or Urdbean (*Phaseolus mungo* L.) is one of the important pulse crops grown in India, which belong to the family "leguminosae". It is consumed in various forms as whole or split, husked and unhusked. It is rich in protein, carbohydrate, fat, amino acids, vitamins and minerals and much richer than most of grains used as concentrate. Besides this, weed offer severe competition to this crop during early stage of growth and reduce the yield of blackgram to the extent of 75 per cent and sometimes leads to the total failure of crop [12]. The initial three to four weeks are considered to be crucial for weed crop competition in blackgram [9]. The magnitude of losses largely depends upon the composition of weed flora, period of weeds crop competition and its intensity. Costs on weed control are the largest variable cost in most of the crop cultivation. Therefore, weed management is one of the primary elements of crop management to realize higher food production targets to meet the food demand of exploding population. Manual weeding is labour intensive and tedious and does not ensure weed removal at critical stage of crop weed competition. Even non-availability and high wages of labour during critical period warrant an effective and economical weed control practice. Though chemical herbicides become cost-effective, their efficacies are greatly reduced due to uncertain rainfall [2]. Thus, it is a major challenge to maximize productivity of this important pulse crop. Under this situation, an integrated weed management (IWM) practice involving both chemical and other agronomic manipulation may be an efficient tool, as increasing crop density seems to be an alternative to shift crop weed competition in favour of crop [15]. Hence, use of herbicides in conjunction with manual practices would make the herbicidal control more acceptable to farmers and allow complete control of weeds.

Materials and Methods

A field experiment was conducted at Agricultural Research Station, Tamil Nadu Agricultural University, Pattukottai during *rabi* 2010-11. The soil of the experimental area was sandy clay loam in texture with low available nitrogen (268 kg/ha) and high in phosphorus (37kg/ha) and high in potassium (345 kg/ha) contents and was neutral in reaction (pH 6.8). The research trial was laid out in randomized block design (RBD) and replicated thrice. The treatment were pre-emergence herbicides (pendimethalin @ 750 g/ha) and post emergence herbicide (imazethapyr @ 60g/ha and quizolofop-ethyl @50 g/ha) either alone or combination with hand weeding, twin wheel hoe weeding and power weeding at 30 DAS. In addition, power weeding and hand weeding twice at 15 and 30 DAS were tested with unweeded check. In order to maintain uniformity in plant population, the seeds of blackgram ADT 5 was treated with *rhizobium* and dibbled by adopting a spacing of 30cm x 10cm. Nitrogen (N), phosphorus (P_2O_5), potassium (K_2O) @ 25:50:25 kg/ha was applied in the form of urea, single super phosphate and muriate of potash during the final land preparation or before sowing the seeds. Pre emergence herbicides were applied at 3 DAS and as post emergence herbicide at 10 DAS using knap sack sprayer fitted with a flat pan nozzle with 500 litre water/ha. Observations on weeds were recorded with the help

of quadrant 0.5m x 0.5 m placed randomly at two spots in each plot. The growth, yield attributes and yields were recorded from five selected plants in each plot. The treatment differences were worked out at five per cent probability level.

Weed Control Efficiency (WCE)

Weed control efficiency was calculated as per the procedure given by [8].

$$WCE\ (\%) = \frac{WDWc - WDW_t}{WDWc} \times 100$$

Where,

WCE - Weed control efficiency in percentage

WDWc - Dry weight Kg/ha of weeds in unweeded check

WDW_t - Dry weight of weeds in weed control treatments

Results and Discussion

Weed flora

The weed flora of the experiment was comprising with grasses, sedges and broad leaf weeds. Among the various weed flora, grasses were more dominant (40.15 per cent) than the broad leaved weeds (36.43 per cent) and sedges (23.42 per cent). The weed flora found in the experimental fields mainly consisted *Dactyloctenium aegyptium, Digitaria sanguinalis, Cynodon dactylon, Panicum repens, Cyperus rotundus, Cleome viscosa, Euphorbia hirta, Phyllanthus niruri, Portulaca oleracea* and *Trianthema portulacastrum*. Such wide weed flora in blackgram was reported by many workers [10,3,5].

Effect of weed control methods on weed parameters

Weeds interfere with crop at every stage of crop growth. Weed density and dry weight is the most important parameter to assess the weed competitiveness for the crop growth and productivity [Table-1].

Among the various weed management practices, hand weeding twice at 15 and 30 DAS recorded lower weed density (40.6/m^2) and weed dry weight (43.4 Kg/ha). At initially, this treatment has received higher weed density and weed dry weight because of not implementing the hand weeding operation at 15 DAS, latterly the weed population and dry weight drastically reduced by the control the weeds through hand weeding in the inter row space of line sowing and also responsible for excellent physical form to the crop in way of soil aeration through stirring of the soil. The next order of lesser weed density and dry weight of weeds were recorded by post-emergence application of imazethapyr @ 60g/ha at 10 DAS + quizolofop-ethyl @ 50 g/ha along with hand weeding at 30 DAS and followed by pre emergence herbicide as pendimethalin @750 g/ha subsequently hand weeding at 30 DAS. This might be greater reduction of weed seeds germination by application of pre emergence herbicide ascribed to lesser weed density at initial stage and followed by the destruction of weeds by hand weeding causing significant reduction in late emerged weeds accounting to minimal density and dry weight. The results were in agreement with the findings of [16,6].

Table-1 *Effect of various weed management practices on weed density and weed dry weight of blackgram*

T.No	Treatment	Weed density (No/m^2)		Weed dry weight (kg/ha)	
		15 DAS	45 DAS	15 DAS	45 DAS
T_1	PE as pendimethalin 750 g/ha + power weeding at 30 DAS	62.70 (7.91)	141.1 (11.88)	54.85 (7.41)	159.7 (12.63)
T_2	PE as pendimethalin 750 g/ha + twin wheel hoe weeding at 30 DAS	60.8 (7.79)	89.2 (9.47)	52.35 (7.23)	107.2 (10.35)
T_3	PE as Pendimethalin 750 g/ha + hand weeding at 30 DAS	59.45 (7.71)	43.4 (6.59)	53.15 (7.28)	44.9 (6.67)
T_4	PoE as imazethapyr 60g/ha + quizolofop-ethyl 50g/ha at 10 DAS	315.5 (17.76)	59.7 (7.72)	216.6 (14.71)	68.35 (8.24)
T_5	PoE as imazethapyr 60g/ha + quizolofop-ethyl 50g/ha at 10 DAS followed by hand weeding at 30 DAS	316.0 (17.77)	40.75 (6.36)	218.6 (14.76)	42.60 (6.51)
T_6	Power weeding at 15 DAS + hand weeding at 30 DAS	319.2 (17.86)	43.95 (6.63)	220.3 (14.84)	46.60 (6.81)
T_7	Power weeding at 15 and 30 DAS	321.3 (17.73)	156.6 (12.51)	218.0 (14.76)	189.0 (13.74)
T_8	Hand weeding at 15 and 30 DAS	314.4 (17.73)	40.6 (6.40)	219.1 (15.0)	43.40 (6.59)
T_9	Weedy check	325.7 (18.04)	385.9 (19.64)	224.4 (14.96)	398.4 (19.94)
	SEd	0.28	0.42	0.36	0.32
	CD(P=0.05)	0.60	0.92	0.76	0.66

PE- Pre emergence; PoE- Post emergence; DAS- Days after sowing (Figures in parenthesis are square root transformation values)

Weed control efficiency (WCE) indicates the magnitude of effective reduction of weed dry weight by weed control treatments over unweeded check [Table-2]. This was highly influenced by different weed control treatments. Higher WCE (90 per cent) was received with hand weeding twice at 15 and 30 DAS. Which was closely comparable with post-emergence application of imazethapyr @ 60g/ha at 10 DAS + quizolofop-ethyl @ 50 g/ha after that hand weeding at 30 DAS (89.3 per cent) and followed by pre emergence herbicide as pendimethalin @750 g/ha along with hand weeding twice at 15 and 30 DAS. Relatively in the pre emergence herbicide applied plots and hand removal of early emerged grassy weeds and sedges along with the broad leaved species allowed lower accumulation of dry matter and resulted in better crop growth, which in turn smothered the weed growth in comparison to others treatment, recording maximum weed control efficiency. Similar findings were also reported by [16,4,13]. Invariably weedy check registered the highest total weed density, weed dry weight and lower weed control efficiency at all stages with maximum grass, sedge and broad leaved weed populations. This is in accordance with the findings of [11,1] in Blackgram.

Effect of weed control methods on crop parameters

The weed management practices adopted have marked effect on growth and yield attributes of blackgram by the way of elimination of competition of weeds during the critical period of crop weed completion occurred in different stages of crop growth [Table-2].

Among the various weed management methods, crop biometric characters like plant height (30.9 cm), number of pods/plant (24.2) and yield (798 kg/ha) were significantly increased with hand weeding twice at 15 and 30 DAS which was meticulously comparable with post-emergence application of imazethapyr @ 60g/ha at 10 DAS + quizolofop-ethyl @ 50 g/ha followed by hand weeding at 30 DAS and followed by pre emergence herbicide as pendimethalin @750 g/ha followed by hand weeding at 30 DAS were provided a weed free situation by timely control of weeds during the critical period of crop weed competition in blackgram. This might be due to better control of all categories of weeds. In addition to that a uniform required plant population per unit area and increased number of leaves resulted in higher photosynthesis assimilation rates in metabolic activity and cell division, which consequently increased the yield attributes and yield of blackgram.

The results are analogous to those reported by [14] and [9]. The lowest number of pods/plant, number of seeds/pod and yield were recorded in unweeded check. This clearly indicated that severe competition exerted by weeds on the crop in unweeded check resulted in such reduction as reported by [17].

Economics

Economic efficiency and viability of crop cultivation are mainly the outcome of crops with high yields. Higher crop productivity with lesser cost of cultivation could result in better economic parameters like higher net returns and benefit cost ratio [Table-3]. The experimental results indicated that the maximum net returns (₹ 34560/ha) was obtained with pre-emergence application of pendimethalin @ 750g /ha at 3 DAS followed by one hand weeding at 30 DAS which was closely followed by power weeding at 15 DAS and hand weeding at 30 DAS. The above treatment with regard to net return with marginal reduction of weed when compared to other treatments. Similar results were observed by [16] and [4]. The benefit cost ratio (B:C ratio) was the highest with values of 2.33 with application of pendimethalin as pre emergence fb twin wheel hoe weeding at 30 DAS, which was meticulously followed by pre-emergence application of pendimethalin @ 750g/ha at 3 DAS followed by one hand weeding at 30 DAS and next to best treatment with power weeding at 15 DAS and hand weeding at 30 DAS. It is interesting to observe that higher benefit cost ratio with application of pendimethalin followed by twin wheel hoe weeding duo to the herbicides killed the weed germination at early stage and at later, weed control by twin wheel hoe weeder, while low price rate for weeding implement with moderate weed control efficiency.

Table-2 *Effect of various weed management practices on weed control efficiency (%) of blackgram*

T.No	Treatment	Weed control efficiency (%)	
		15 DAS	45 DAS
T_1	PE as pendimethalin 750 g/ha + power weeding at 30 DAS	75.6	60.0
T_2	PE as pendimethalin 750 g/ha + twin wheel hoe weeding at 30 DAS	76.6	73.1
T_3	PE as Pendimethalin 750 g/ha + hand weeding at 30 DAS	76.3	88.7
T_4	PoE as imazethapyr 60g/ha + quizolofop-ethyl 50g/ha at 10 DAS	3.45	82.9
T_5	PoE as imazethapyr 60g/ha + quizolofop-ethyl 50g/ha at 10 DAS fb hand weeding at 30 DAS	2.59	89.3
T_6	Power weeding at 15 DAS + hand weeding at 30 DAS	1.79	88.3
T_7	Power weeding at 15 and 30 DAS	2.85	52.3
T_8	Hand weeding at 15 and 30 DAS	2.35	90.0
T_9	Weedy check	-	-

PE- Pre emergence; PoE- Post emergence; DAS- Days after sowing; Data not statistically analyzed

Table-3 *Effect of various weed management practices on growth, yield and benefit cost ratio of blackgram*

T. No	Plant height (cm)	No. of pods/plant	Yield (kg/ha)	Net income (Rs/ha)	Benefit cost ratio
T_1	23.4	17.3	511	22973	1.60
T_2	27.6	21.9	704	31658	2.33
T_3	30.1	23.7	768	34560	2.32
T_4	25.6	21.0	673	30263	2.19
T_5	26.2	21.4	688	30960	2.09
T_6	30.0	23.5	758	34088	2.13
T_7	21.6	15.4	442	19890	1.32
T_8	30.9	24.2	798	35910	2.16
T_9	17.1	11.1	209	9405	0.84
SEd	0.83	0.61	20.73	-	-
CD(P=0.05)	1.84	1.28	43.9	-	-

However, hand weeding was received higher yield and gross return but B:C ratio would be less compared to above mentioned weed control treatment. This might to be labour intensive for escalates the cost of cultivation due to high wages and non-availability of manual labour at peak period of crop weed competition. The lowest net return and B:C ratio was recorded with weedy check on account of severe reduction in grain yield due to weed competition throughout the cropping period compared to best treatment albeit of the low cost of cultivation. Similar results were also reported by [11,1,7].

Conclusion

The investigation conclusively proved that application of pendimethalin @ 750 g/ha as pre emergence followed by hand weeding or twin wheel hoe weeding at 30 DAS was effectively controlled the weeds and increased the seed yield of black gram and higher monetary returns. Based on the resource available to have adopting the best suitable weed control strategies as (Mechanical or physical, chemical controls) integrated approaches or individual will significantly decrease the weeds, which will lead to even greater yields. Finally, integrated weed management is the key to sustainable crop production throughout the world and will remain the mainstay for weed control for the foreseeable future.

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Author Contributions

Dr. S. Sanbagavalli is Assistant Professor as Soybean Agronomist in the Department of Pulses, Tamil Nadu Agricultural University, Coimbatore. She has experience in teaching/research/extension for 12 years and published nearly 16 research papers both as national and international journals.

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Abbreviations

The following abbreviations are used:

PE: Pre emeregence, PoE; Post emergence, DAS: DAS after sowing, @: at the rate, RBD: Randomized block design, AICRP-WM: All India Coordinated Research Project on Weed management, ₹: Indian Rupees, IWM; Integrated Weed Management, N: Nitrogen, P_2O_5: Phosphorus, K_2O: Potassium, WCE: Weed control efficiency, %: Per cent, WDWc: Dry weight g/m^2 of weeds in unweeded check, WDW_t: Dry weight of weeds in weed control treatments.

Conflict of Interest: None declared

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