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Integrated weed management practices on productivity of irrigated blackgram

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Abstract
The field experiment was conducted during *rabi* 2011 at Agricultural College and Research Institute, Killikulam, Tamil Nadu to evolve the weed management practices in irrigated blackgram as part of M.Sc., research programme. *Dactyloctenium aegyptium*, *Chloris barbata*, *Cyperus rotundus*, *Trianthema portulacastrum*, *Boerhavia diffusa* and *Cleome viscosa* were the dominant weed species in the experimental field. The results showed that unchecked weeds caused a reduction of 63.2% in yield of black gram. The weed free treatment followed by hand weeding twice at 15 and 30 DAS recorded maximum number of pods plant^{-1} (32), number of seeds pod^{-1} (5.67), 100 grain weight (4.76 g), seed yield (710 kg ha^{-1}) and higher weed control efficiency (92 %) which was comparable with pre-emergence application of imazethapyr @ 0.075 kg ha^{-1} at 3 DAS + one hand weeding at 30 DAS.

Keywords: Blackgram, hand weeding, imazethapyr, seed yield

Introduction
Blackgram (*Phaseolus mungo* L.) is an important legume crop cultivated in tropical and sub-tropical countries for grains, green manuring, fodder and forage as sole crop, intercrop, mixed crop and in sequential cropping systems. 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 (Rao, 2008) [9]. The initial 4 to 5 weeks are considered to be crucial for weed crop competition in blackgram (Patel *et al.*, 2011) [7]. The magnitude of losses largely depends upon the composition of weed flora, period of weeds crop competition and its intensity. But manual weeding is labour intensive and tedious and does not ensure weed removal at critical stage of crop weed competition. Though chemical herbicides become cost-effective, their efficacies are greatly reduced due to uncertain rainfall (Bhowmick and Gupta, 2005) [2]. 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. 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 (Shweta and Singh, 2005). 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 College and Research Institute, Killikulam during *rabi* 2011-12. The experimental site is geographically located in the southern part of Tamil Nadu at 8°46' N latitude and 77° 42' E longitudes at an altitude of 40 meters above mean sea level. The weather conditions prevailed during the experimental period are as follows: The mean maximum and minimum temperatures were 34.7 ºC and 24.6 ºC, respectively. The average relative humidity was 87 per cent per cent with average bright sunshine hours of 6.1 per day, average pan evaporation was 7.7 mm day^{-1}. The total rainfall of 292.5 mm was received in 20 rainy days. The soil of the experimental area was sandy clay loam in texture with low available nitrogen (275 kg ha^{-1}) and high in phosphorus (41 kg ha^{-1}) and high in potassium (452 kg ha^{-1}) contents and was neutral in reaction (pH 6.9). Blackgram variety VBN (Bg) 4 with the duration

of 75-80 days, plant height of 40-45 cm, pod cluster of 8-10 and average grain yield of 900 kg ha^{-1} was used as test variety (Anon. 2005)**.** The experiment was laid out in randomized block design and replicated thrice. The treatments were pre-emergence (PE) herbicides *viz.,* pendimethalin, imazethapyr and post-emergence (PoE) herbicides *viz.*, fenoxaprop-p-ethyl, imazethapyr, quizolofop-ethyl either alone or combination with hand weeding or manual rotary weeding. In addition, manual rotary and hand weeding twice at 15 and 30 DAS and weed free condition were tested with unweeded check. In order to maintain uniformity in plant population, the seeds of blackgram VBN (Bg) 4 was treated with rhizobium and dibbled at a depth of 2-3 cm soil surface. There were twenty rows in gross plot and eighteen rows in net plot with a uniform distance of 30 cm between rows and ten cm distance between plant to plant. NPK @ 20:50:20 kg ha^{-1} was applied in the form of urea, single super phosphate and muriate of potash during the final land preparation. Pre and post emergence herbicides were applied at 3 DAS and 30 DAS respectively using a knap sack sprayer fitted with a flat pan nozzle using 500 litres of water ha^{-1}. Supplemental irrigation was arranged from bore well throughout the cropping period without crop water stress. Observations were recorded with the help of a quadrant 0.5 m × 0.5 m weeds placed randomly at two spots in each plot. The growth, yield attributes and yields were recorded from five selected plants in each plot at harvest stage. Since the data on weed density and dry matter production showed high variation, the data were subjected to square root transformation using the formula $\sqrt{x} + 0.5$ and the statistical analysis was done as per the procedures given by Gomez and Gomez (1984) [4]. The treatment differences were worked out at five per cent probability level. The non-significant treatment differences were denoted as NS. Weed control efficiency (WCE) (Mani *et al.,* 1973 and weed index (WI) (Gill and Vijayakumar, 1966) [3] were calculated as per the standard formulae.

$$\text{WCE (\%)} = \frac{\text{Wpc - Wpt}}{\text{Wpc}} \text{x} 100$$

Where,

Wpc = Weed density in the control plot
Wpt = Weed density in the treated plot

$$\text{WI (\%)} = \frac{\text{X - Y}}{\text{X}} \text{x} 100$$

Where,

X = Yield from weed free plot
Y = Yield from treated plot

Results and Discussion

Weed flora

Weeds belong to various species of grasses, sedges and broadleaf weeds were found to be associated with irrigated blackgram. In the experimental plots the dominant grasses were *Dactyloctenium aegyptium* and *Chloris barbata* while the sedge was *Cyperus rotundus* and among the broadleaf weed *Cassia nigricans*, *Trianthema portulacastrum*, *Boerhavia diffusa* and *Cleome viscosa* were dominant species. Such wide spectrum of weeds in blackgram was reported by Malliswari *et al.* (2011).

Effect on weed parameters

Distinct reduction of total weed density and weed dry weight were observed with hand weeding twice at 15 and 30 DAS followed by pre-emergence application of imazethapyr @ 0.075 kg ha^{-1} at 3 DAS + one hand weeding at 30 DAS and PE as pendimethalin 0.75 kg ha^{-1} at 3 DAS + PoE as imazethapyr 0.075 kg ha^{-1} at 30 DAS. The maximum weed density and weed dry weight were registered in weedy check plot. Among the various weed management practices, two hand weeding at 15 and 30 DAS resulted in higher value of weed control efficiency followed by pre-emergence application of imazethapyr @ 0.075 kg ha^{-1} at 3 DAS + one hand weeding at 30 DAS (Table 1). This might be due to greater reduction of wide spectrum of grasses and broad leaved weeds at early stages of crop growth, reduced the biomass and ultimately the more weed control efficiency. The continuance of earlier effect made the herbicides perform equally with hand weeding treatment at the later stages of the crop growth. Weed index of treatments varied from 4.28 to 63.19%. The lesser yield reduction due to the effective check on the weed growth reduced the competition by weeds and the provided favourable environment enhanced the yield levels compared to inefficient weed control treatments.

Effect on crop parameters

All the weed control treatments recorded significantly higher yield attributing character *viz*., number of pods plant^{-1}, number of seeds pod^{-1}, 100 grain weight and yield as compared to weedy check. This was due to least competition from weeds for the light, space, as well as above and below ground resources. Weed free treatment recorded higher values of yield components *viz*., number of pods plant^{-1} and number of seeds pod^{-1}. It was comparable with hand weeding twice at 15 and 30 DAS and pre-emergence application of imazethapyr @ 0.075 kg ha^{-1} at 3 DAS + one hand weeding at 30 DAS. The death of susceptible species of grasses and broad leaf weeds by imazethapyr application was due to inhibition of acetolactate synthase (ALS) enzyme which is essential for leucine, valine and iso leucine synthesis in weeds (Perucci and Scarponi, 1994). The lowest number of pods plant^{-1} and number of seeds pod^{-1} were recorded in unweeded check. This clearly indicated the severe competition exerted by weeds on the crop in unweeded check resulted in such reduction as reported by Vyas and Kushwah (2008). The significantly higher yield was recorded in weed free check which was on par with hand weeding twice at 15 and 30 DAS and pre-emergence application of imazethapyr @ 0.075 kg ha^{-1} at 3 DAS + one hand weeding at 30 DAS (Table 2). 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 and yield attributes of blackgram. The results are analogous to those reported by Shaikh *et al*. (2010) [10].

The integrated weed management practice of pre-emergence application of imazethapyr @ 0.075 kg ha^{-1} at 3 DAS followed by one hand weeding at 30 DAS can be recommended as an effective weed management practice with respect to yield and cost for the irrigated Blackgram.

Table 1: Effect of various weed management practices on weed density, weed dry weight, weed control efficiency and weed index of irrigated blackgram

T. No	Treatment	Weed density (No. m^{-2})	Weed dry weight (kg ha^{-1})	WCE (%)	Weed index (%)
T_1	Pe Pendimethalin 0.75 kg ha^{-1} + Hand weeding at 30 DAS	43.00 (6.55)	385.00 (19.62)	88.00	34.00
T_2	PE Imazethapyr 0.075 kg ha^{-1} + Hand weeding at 30 DAS	30.68 (5.53)	255.00 (15.96)	91.44	4.95
T_3	Pe Pendimethalin 0.75 kg ha^{-1} + Manual rotary weeding at 30 DAS	66.00 (8.12)	633.33 (25.16)	81.58	35.34
T_4	PE Imazethapyr 0.075 kg ha^{-1} + Manual rotary weeding at 30 DAS	53.33 (7.30)	620.00 (24.89)	84.56	31.45
T_5	Pe Pendimethalin 0.75 kg ha^{-1} + PoE Quizolofop-Ethyl 0.050 kg ha^{-1}	107.33 (10.36)	1266.66 (35.59)	70.05	39.75
T_6	PE Imazethapyr 0.075 kg ha^{-1} + PoE Quizolofop-Ethyl 0.050 kg ha^{-1}	88.00 (9.38)	895.00 (29.91)	75.44	31.59
T_7	Pe Pendimethalin 0.75 kg ha^{-1} + PoE Fenaxoprop-p-ethyl 0.010 kg ha^{-1}	116.66 (10.80)	1306.66 (36.14)	67.44	38.82
T_8	PE Imazethapyr 0.075 kg ha^{-1} + PoE Fenaxoprop-p-ethyl 0.010 kg ha^{-1}	96.65 (9.83)	920.00 (30.33)	73.02	34.80
T_9	Pe Pendimethalin 0.75 kg ha^{-1} + PoE Imazethapyr 0.075 kg ha^{-1}	37.33 (6.10)	353.00 (24.28)	89.58	10.17
T_{10}	Hand weeding twice at 15 and 30 DAS	28.66 (5.35)	250.66 (15.83)	92.00	4.28
T_{11}	Manual rotary weeding twice at 15 and 30 DAS	68.33 (8.26)	680.00 (26.07)	80.93	39.22
T_{12}	Weed free plot	0.00 (0.71)	0.00 (0.71)	100	0.00
T_{13}	Weedy check	358.33 (18.92)	3733.33 (61.10)	-	63.19
	SEd	0.44	1.34	-	-
	CD(P=0.05)	0.91	2.77	-	-

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

Table 2: Effects of various weed control measures on yield attributes and yield of irrigated blackgram

T. No	Treatment	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	100 grain weight (g)	Seed yield (kg ha^{-1})
T_1	Pe Pendimethalin 0.75 kg ha^{-1} + Hand weeding at 30 DAS	29.30	5.46	4.40	493
T_2	PE Imazethapyr 0.075 kg ha^{-1} + Hand weeding at 30 DAS	32.00	5.67	4.76	710
T_3	Pe Pendimethalin 0.75 kg ha^{-1} + Manual rotary weeding at 30 DAS	27.96	5.33	4.30	483
T_4	PE Imazethapyr 0.075 kg ha^{-1} + Manual rotary weeding at 30 DAS	28.33	5.26	4.56	512
T_5	Pe Pendimethalin 0.75 kg ha^{-1} + PoE Quizolofop-Ethyl 0.050 kg ha^{-1}	26.10	5.13	4.33	450
T_6	PE Imazethapyr 0.075 kg ha^{-1} + PoE Quizolofop-Ethyl 0.050 kg ha^{-1}	27.40	5.46	4.53	511
T_7	Pe Pendimethalin 0.75 kg ha^{-1} + PoE Fenaxoprop-p-ethyl 0.010 kg ha^{-1}	27.00	5.26	4.31	457
T_8	PE Imazethapyr 0.075 kg ha^{-1} + PoE Fenaxoprop-p-ethyl 0.010 kg ha^{-1}	27.30	5.46	4.46	487
T_9	Pe Pendimethalin 0.75 kg ha^{-1} + PoE Imazethapyr 0.075 kg ha^{-1}	31.00	5.66	4.76	671
T_{10}	Hand weeding twice at 15 and 30 DAS	33.00	5.73	4.79	715
T_{11}	Manual rotary weeding twice at 15 and 30 DAS	28.45	5.40	4.48	454
T_{12}	Weed free plot	35.00	5.80	4.81	747
T_{13}	Weedy check	20.06	5.06	4.11	275
	SEd	1.28	0.06	0.11	23
	CD(P=0.05)	2.64	0.13	NS	48

PE- Pre emergence; PoE- Post emergence; DAS- Days after sowing

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