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Effect of Weed Management Strategies on the Growth and Yield Performance of Blackgram

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A B S T R A C T

Field experiment was conducted at farmer's field at Gudamalai village, Gangavalli taluk, Salem district during *Rabi* season 2019 to evaluate the performance of different pre-emergence and early post emergence herbicides on weeds and productivity of blackgram under irrigated conditions. The experiment was laid out in randomized block design with three replications. The experiment consists of ten treatments T_1- Pendimethalin @ 1.0 kg ha^{-1} on 3 DAS, T_2- PE Pendimethalin @ 1.0 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g/ha (Odyssey), T_3- PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS, T_4- PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + HW on 25 DAS, T_5- PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g/ha (Odyssey), T_6- PE Oxadiazone @ 250 g ha^{-1} on 3 DAS + EPOE Imazethapyr @ 70 g ha^{-1} (2 -3 leaf stage of weeds), T_7- PE Oxadiazone @ 250 g ha^{-1} on 3 DAS + EPOE Imazethapyr @ 70 g ha^{-1} + Quizalofop-ethyl @ 50g/ha (2-3 leaf stage of weeds, T_8- EPOE Imazethapyr @ 70 g ha^{-1} + Quizalofop-ethyl @ 50g/ha (2-3 leaf stage of weeds) – Tank mix, T_9- Hand Weeding twice @ 20 and 40 DAS, T_{10}- Unweeded check. Among the different weed control treatments imposed hand weeding twice at 20 and 40 DAS (T_9) registered the maximum growth (Plant height, leaf area index and dry matter production) yield attributes (Number of pods per plant, Number of seeds per pod) and yield (Grain yield kg ha^{-1}, Haulm yield kg ha^{-1}) of irrigated blackgram due to reduced weed growth, weed dry matter production and reduction in nutrient depletion by weeds and increased nutrient uptake by crop and this was followed by pre emergence application of Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g/ha (Odyssey) (T_5). The lowest growth and yield and yield attributes was recorded under unweeded check (T_{10}).

***Key words*:** Blackgram, Herbicides, Yield, Yield attributes

Pulses are the major source of supplementary protein to daily diets and starchy food for a predominantly vegetarian population. Pulses are cheaper than meat and therefore often regarded as poor man's meat. Pulses contain on an average of 20-25 percent protein [1]. Pulses are wonderful gift of nature with the unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrients and bringing qualitative changes in soil properties which make them known as soil fertility restorers [2]. The total world acreage under pulses is about 85.40 million hectares with a production of 87.40 million tonnes at 1023 kg ha^{-1} yield level. In India, pulses are being cultivated under an area of 29.36 million hectares with the production of 24.51 million tonnes and productivity of 835 kg ha^{-1}. The total area under pulses in Tamil Nadu is 8.16 lakh hectares with a production of 5.72 lakh tonnes (DES, Ministry of Agriculture & FW (DAC & FW), Govt of India, 2018). Their productivity of pulses can be doubled by improved cultivars and by modern production technologies [1].

Blackgram (*Vigna mungo* L.) is one of the most important pulse crops, which can be grown in tropical and subtropical regions. It is native of India and originated from *Phaseolussublobatus* a wild plant [3]. Blackgram is very nutritious as it contains a high level of carbohydrate (60g/100g), protein (20-25 g/100 g), phosphorus (385 mg/100 g), calcium (145 mg/100 g) and iron (7.8 mg/100 g). It is useful in mitigating elevated cholesterol levels. The total world acreage under blackgram is about 23.48 million hectares with a production of 15.43 million tonnes at 653.07 kg ha^{-1} yield level. The total area under blackgram in India is around 4.47 million hectares with a production of 2.83 million tonnes and productivity of 632 kg ha^{-1}. In Tamil Nadu, blackgram is cultivated in 4.30 lakh hectares with the production of 2.74 lakh tonnes and an average productivity

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of 637 kg ha^{-1} [4]. In blackgram there are various factors responsible for the reduction in growth and yield. The main constraint in blackgram production is weed infestation during its growth period which inflicts heavy losses on the crop yield by competing for essential growth factors. Weed management at the early stages of crop growth is essential, leading to severe competition between the crop and weeds [5]. Weeds compete for water, nutrient and space and cause up to 45% yield loss in blackgram [6]. An initial period of crop weed competition of 20-40 days is very critical and weed competition reduce blackgram yield to the extent of 87 percent [7]. Weed management is an important key factor for enhancing the productivity of irrigated blackgram since the crop is not very good competitor against weeds [8]. Hand weeding during critical crop growth stages is not possible due to increased cost and scarcity of human labour. Application of pre-emergence herbicide lasts long only a very short period of the crop growth period. After the loss of herbicide concentration weed seed bank start to emerge and compete with crops for natural resources. Delayed removal of weeds is not as effective in controlling weeds. Application of early post emergence herbicide controls late emerging weeds and obtains higher yields against the timely removal of weeds [9]. Under such circumstances, pre and early post emergence herbicides applied in sequence or combination will controls the weeds very effectively. Keeping these points in view, the present study was undertaken to find out the effect of pre and early post emergence herbicides and hand weeding practices on growth and yield of irrigated blackgram.

MATERIALS AND METHODS

The experiment was conducted at Gudamalai village, Gangavalli Taluk, Salem District, Tamil Nadu. The experimental farm is at 11°46 N and 78°59 E an altitude of 230 meters above MSL. The mean annual rainfall of the place is 952.2 mm. The mean maximum and minimum temperature prevailed during the cropping period was 34.9°C and 26.3°C respectively. The mean relative humidity ranges from 60.5 to 77.4 percent. The texture of the experimental field soil was sandy clay loam with neutral pH and low, medium and high in available nitrogen, phosphorus and potassium respectively. The popular variety Vamban (Bg) 5 was chosen for the study. The experiment was laid out in randomized block design with three replications and ten treatments. The treatment schedule were as follows: T_1- PE Pendimethalin @ 1.0 kg ha^{-1} on 3 DAS, T_2 - PE Pendimethalin @ 1.0 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g/ha (Odyssey), T_3- PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS, T_4- PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + HW on 25 DAS, T_5 - PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g/ha (Odyssey), T_6 - PE Oxadiazone @ 250 g ha^{-1} on 3 DAS + EPOE Imazethapyr @ 70 g ha^{-1} (2 -3 leaf stage of weeds), T_7 - PE Oxadiazone @ 250 g ha^{-1} on 3 DAS + EPOE Imazethapyr @ 70 g ha^{-1} + Quizalofop-ethyl @ 50g/ha (2-3 leaf stage of weeds), T_8- EPOE Imazethapyr @ 70 g ha^{-1} + Quizalofop-ethyl @ 50g/ha (2 -3 leaf stage of weeds) – Tank mix, T_9- Hand weeding twice @ 20 and 40 DAS, T_{10}- Unweeded check. The seeds were dibbled at the rate of 15 kg ha^{-1} with the spacing of 30 × 10 cm. The pre-emergence herbicides and early post emergence herbicides were applied on 3 DAS and 12 to 15 DAS as per the treatment schedule. Hand weeding was done on 20 and 40 DAS as per treatment schedule. Observations were recorded using quadrant (0.5 × 0.5 m). The biometric observations on growth and yield characters were recorded from five randomly selected plants.

RESULTS AND DISCUSSION

Effect of weed control methods on growth and yield

Effect on growth attributes

Among the weed control treatments, the plant height, leaf area index and DMP significantly influenced by various treatments. On 30 and 45 DAS higher plant height (20.42,36.00 cm), leaf area index (4.95 on flowering), DMP (872, 2284 kgha^{-1}) was registered in hand weeding twice on 20 and 40 DAS (T_9) and this was followed by the herbicidal treatment PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g ha^{-1} (Odyssey) (T_5) with a plant height (18.89 and 33.48 cm) leaf area index (4.52 on flowering stage), DMP (840, 1928 kgha^{-1}) on 30 and 45 DAS respectively. A weed free environment until the critical period of the crop growth by hand weeding facilitated good growth of the crop.

Table 1 Influence of weed management practices on growth

Treatment	Plant height (cm)		Leaf area index	Dry matter production at harvest (kg ha^{-1})	
	30 DAS	45 DAS		30 DAS	45 DAS
T_1	12.68	24.28	2.92	664	1531
T_2	15.82	28.59	3.69	773	1774
T_3	11.20	21.79	2.51	627	1448
T_4	17.38	31.01	4.1	809	1852
T_5	18.89	33.48	4.52	840	1928
T_6	14.98	27.38	3.43	726	1668
T_7	15.41	27.95	3.57	749	1722
T_8	13.20	24.87	3.03	687	1587
T_9	20.42	36.00	4.95	872	2284
T_{10}	9.62	19.27	2.10	585	1351
S.Ed	0.26	0.55	0.17	15.66	39.34
CD (P= 0.05)	0.52	1.12	0.34	31.64	79.47

Improved nutrient uptake and vigour due to elimination of weed competition right from the beginning of the crop might have contributed to favorable growth components, higher nutrient uptake and consequently higher plant height, LAI and DMP in hand weeding twice treatment. The superiority of hand weeding practice at 20

and 40 DAS may be attributed to better weed control, least nutrient accumulation by weeds and better aeration of the crop [10]. Similarly, in herbicide application of Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g ha^{-1} (Odyssey) (T_5) applied plots caused reduction in weed density, which might have improved the availability of resources viz., space, soil, moisture, light and nutrients to the irrigated blackgram, thus resulted in higher growth parameters. The increase in growth attributes under these treatments might be attributed due to the reduction in weed competitiveness with the crop, which ultimately favored better environment for growth and development of crop [11]. The least plant height, leaf area index, DMP was recorded under unweeded check (T_{10}).

Effect on yield attributes

All the treatments had a pronounced effect on the yield attributes of irrigated blackgram. Among the weed control treatments showed a noticeable influence on the number of pods plant^{-1}on harvest (36.85) and pod length (5.5 cm) was recorded in hand weeding twice on 20 and 40 days after sowing (T_9) and this was followed by the herbicidal treatment PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g ha^{-1} (Odyssey) (T_5) with the number of pods plant^{-1} of 33.84 and pod length (5.1 cm) on harvest respectively. Among the treatments, hand weeding twice on 20 and 40 DAS (T_9) provided a perfect weed free environment throughout the critical period of crop growth and offered the highest value of yield components in the crop. This might be attributed to reduced crop weed competition in the critical stages which helped in synchronization of their production by increasing the number of pods plant^{-1}, number of seeds pod^{-1} and pod length [12-14]. Among the various chemical weed control methods, pre-emergence application of Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g ha^{-1} (Odyssey) (T_5) recorded the highest values of yield components and the herbicide treatment pre-emergence application of Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + HW on 25 days after sowing (T_4) was next in the order. It could be attributed to significantly lower weed population, dry matter accumulation and higher weed control efficiency of weeds and also due to weed free environment provided by this treatment which might have increased the translocation of assimilates from source to sink and hence the yield attributes viz., number of pods plant^{-1}, number of seeds pod^{-1} and pod length increase in this treatment [15]. The lowest yield attributes were recorded under unweeded check (T_{10}). Severe weed competition exerted by weeds for the available resources throughout the crop growth might have reduced the yield components.

Table 2 Influence of weed management practices on yield parameters and yield

Treatment	No. of pods plant^{-1}	No of seeds pod^{-1}	Pod length (cm)	Test weight (g)	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1	23.38	5.72	3.6	3.8	621	835
T_2	29.11	6.08	4.3	4.3	758	1057
T_3	20.91	5.64	3.2	3.6	540	693
T_4	31.47	6.17	4.7	4.5	805	1182
T_5	33.84	6.29	5.1	4.7	857	1328
T_6	27.03	5.97	4.1	4.1	700	992
T_7	28.01	6.03	4.2	4.2	733	1026
T_8	24.58	5.88	3.7	3.9	652	880
T_9	36.25	6.40	5.5	4.9	912	1459
T_{10}	18.33	5.30	2.9	3.5	466	597
S.Ed	1.12	-	0.17	-	19	31
CD (P= 0.05)	2.27	NS	0.35	NS	38	62.43

Effect on yield

Among the different treatments hand weeding twice @ 20 and 40 DAS (T_9) registered the maximum grain and haulm yield and it was 51.09 and 40.91 percent higher over unweeded check (T_{10}). The highest grain yield (912 kg ha^{-1}) and haulm yield (1459 Kgha^{-1}) was recorded in hand weeding twice on 20 and 40 DAS (T_9) and the application of herbicidal treatment PE Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g ha^{-1} (Odyssey) (T_5) was next best and recorded 54.37 and 44.95 percent of grain yield (857 Kg ha^{-1}) and haulm yield (1328 Kg ha^{-1}) over unweeded check (T_{10}). This would be due to effective control of weeds which reduced the crop weed competition and increased yield of blackgram [16]. This would be due to effective control of weeds which reduced the crop weed competition and increased yield of blackgram. The unweeded check showed the real depiction of the aggressive nature of weeds on the growth of irrigated balckgram. The lowest grain (466 Kg ha^{-1}) and haulm yield (597 Kg ha^{-1}) were recorded in unweeded check (T_{10}). This might be due to the severe competition between crop and weed for different resources.

CONCLUSION

Based on the above findings, hand weeding twice at 20 and 40 DAS (T_9) recorded the higher growth attributes, yield attributes, grain yield and haulm yield in irrigated blackgram and it was followed by pre-emergence application of Pendimethalin (38.7%) @ 0.75 kg ha^{-1} on 3 DAS + EPOE Imazethapyr + imazamox (RM) 70 g ha^{-1} (Odyssey) (T_5) holds promise as an agronomically sound, ecologically safe and economically viable technology for enhancing the yield of irrigated blackgram.

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