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REVIEW ARTICLE **OPEN ACCESS**

Weed Management Through New Generation Herbicides in Blackgram (*VIGNA MUNGO* L.) – A Review

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ABSTRACT
Weed infestation in blackgram culminates in yield reduction up to an extent of 45 to 70 per cent. The critical period for crop weed competition in blackgram is the first 30 days of sowing. Manual weeding, which is a common physical method of weed management, is also difficult and uneconomical to practice due to non availability of labour in time and increased wages. In chemical method of weed management, the available herbicides are to be used as either pre sowing or pre emergence. These herbicides have comparatively shorter persistence, consequently the subsequent flushes of weeds compete with the crop. The use of low dose post emergence herbicides alone or in combination may broaden the window of weed management. Recently, some new post emergence herbicides viz., imazethapyr, fenoxaprop-p-ethyl, cyhalofop butyl, Clodinafop propargyl, quizalofop ethyl and aciflourfen sodium etc. are found to be effective in selective control of weeds in blackgram. Application of fenoxaprop-p-ethyl @ 75 g ha^{-1} or cyhalofop butyl @ 100 g ha^{-1} drastically reduced the density of grassy weeds. An environmental advantage derived from their very low application rates is the marked reduction in the chemical load in the environment resulting from herbicide usage.
Key words: Blackgram, Weed management, New generation herbicides

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INTRODUCTION

Pulses are the major source of dietary protein in India. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture. Among the pulses, blackgram, otherwise known as urd bean, contains about 26 per cent protein, 1.2 per cent oil, 56 per cent carbohydrates and has significant quantities of vitamin B_1, B_2 and niacin. It is grown in all seasons as *kharif* crop, rice fallow crop and *rabi* crop. Generally it is grown as a subsidiary crop because of which less inputs and care is given to the crop and above that weeds pose a serious threat for competing already limiting resources resulting in reduced growth and yield which can be counteracted by efficient weed management practices. Weeds, due to their competition with crop plants for nutrients, moisture, light and space cause yield reduction in blackgram to greater extent.

The conventional method of weed management is costly and non-available at critical stages of crop weed competition. Timely control of weeds is possible by chemical method. Based on income and labour use per hectare, herbicide technology was found superior to hoe-weeding alone. In chemical method of weed management, the available herbicides are to be used as either pre sowing or pre emergence which has comparatively shorter persistence and limited period of application. Under these circumstances, there is a need of suitable selective post emergence herbicides for controlling weeds in blackgram. Application of low dose post emergence herbicides may be effective in controlling broad spectrum of weeds.

COMMON WEED FLORA IN BLACKGRAM

The weed spectrum of blackgram differ widely with environment and soil conditions. Generally weeds are found in large numbers with more aggressive nature, because of their wider adoptability even under extremities of climatic, edaphic and biotic stresses. The information on the weed spectrum of blackgram fields is essential for the formulation of effective weed control practices.

Most problematic weeds in blackgram were Echinochloa colona, Digitaria sanguinalis, Trianthema portulacastrum, Amaranthus viridis and Cyperus rotundus in lateritic soils [5, 15, 21]. Blackgram was dominated by natural infestation of broad leaved weeds like Grangea maderaspatana, Gnaphalium polycaulon, Nasturtium indicum, Chrozophora rottleri, Cardanthera uliginosa, Xanthium strumarium and grasses like Echinochloa colona, Dinebra retroflexa, Leptochloa chinensis. [20]. Midya *et al*. [7] reported the overall the proportion of grassy weeds was more when compared with broadleaved weeds in rice blackgram intercropping system. Tomar [26] revealed that the dominant grass weed flora in kharif blackgram were Digitaria sanguinalis, Echinochloa colona, Echinochloa crusgalli and Eleusine indica, while among the sedge, weed flora was dominated by Cyperus rotundus. The dominant weed species found in kharif season blackgram crop were Celosia argentia, Cynodon dactylon, Phyllanthus niruri and Cyperus rotundus were found throughout the crop growth period [10].

LOSSES CAUSED BY WEEDS

Weeds are notorious pests and reduce yield of crop plants by competing for nutrients, moisture, light and space. Weeds offer severe competition for essential nutrients like nitrogen, phosphorus and potash (Vengris *et al*., 1955; Pandey and Rao, 1965). Undoubtedly weeds reduce the yield of urdbean. The degree of reduction varies from place to place depending upon prevailing climate conditions. Vats and Sawhney [28] indicated that the loss in grain yield under unweeded check was to the tune of 50 per cent whereas it was 41, 31, and 39 per cent when weeds were removed at 2, 4 and 6 weeks of sowing, respectively. Singh and Singh [24] reported that under uncontrolled weed situation throughout entire crop season, yield of urdbean and mungbean was reduced by 72 and more than 80 per cent, respectively. Parto and Prusty [14] from Bhubaneshwar reported 67.7 per cent reduction in grain yield of mungbean due to weeds.

CRITICAL PERIOD OF CROP WEED COMPETITION

The association of weeds occur naturally and throughout the crop growth period and hence there is a need to find out the exact time when the weeds cause maximum loss to the crop. This period during which maximum loss occurs to the crop in terms of yield is known as critical period of crop weed competition. Various workers have established the critical period of crop weed competition in blackgram. According to Vats and Sidhu [27] weed competition was more severe in the young crop during the first 30 to 40 days after sowing so as to cause reduction in pod yield. Panchal *et al.* [11] reported that the yields of blackgram were reduced greatly if the weeds were not controlled between two and four weeks after sowing.

Gogoi *et al*. [6] reported that at Jorhat, the critical period of crop weed competition in blackgram was between 10 and 30 days after sowing. According to Saraswat *et al*. [22], the first 25-40 days were very critical for crop weed competition. Bhandari *et al.* [2] observed that in summer blackgram maximum crop weed competition occurred during the period up to 30 days after sowing. Most of the studies indicated that the critical phase of weed competition in blackgram ranged from 30 to 40 days after sowing depending upon the type of weeds, seasonal conditions and soil type.

NEW GENERATION HERBICIDES

Recently some post emergence herbicides are begun marketed with the assurance of selective control of weeds in blackgram. Few post emergence herbicides like imazethapyr, fenoxaprop-p-ethyl, cyhalofop butyl, quizalofop ethyl and clodinafop-propargyl are found to control both broad leaved and grassy weeds and mixed application of these herbicides is usually recommended for effective weed control in blackgram crop.

FENOXAPROP-P-ETHYL

Pandey [12] observed that fenoxaprop-p-ethyl was ineffective against broad leaved weeds. He stated that for effective control of grass weeds, the chemical should be applied at 2 to 3 leaf stage. Rao [18] reported that post-emergence application of fenoxaprop-p-ethyl significantly reduced *Echinochloa colona* growth and increased blackgram yield by 27 to 42 per cent over weedy check without any crop injury. Herbicide application at 21 and 28 days after sowing (DAS) resulted in significantly higher reduction *in Echinochloa colona* density and total weed dry weight compared to its application at 14 DAS in relay blackgram. Among different herbicides and their doses, fenoxaprop 68 g ha^{-1} recorded the highest seed yield of blackgram (1332 kg ha^{-1}) and net monetary returns (Rs. 21,993 ha^{-1}) and B : C ratio of 1.95 and was on par with its lower dose of 56 g ha^{-1} [18].

Maximum seed yield of 401.0 kg ha^{-1} was obtained from hand hoeing followed by post emergence herbicide Puma super (fenoxaprop-p-ethyl) applied @ 1.2 lit ha^{-1} with 353.2 kg ha^{-1} seed yield against 212.2 kg ha^{-1} from weedy check treatment [1]. Application of fenoxaprop-p-ethyl at 20 DAS in

combination with hand weeding and interculture at 30 DAS was found to be relatively more effective in controlling weeds and giving better crop growth and yield than their sole application [3]. Weed control efficiency of fenoxaprop-p-ethyl applied @ 75 g ha^{-1} was found to be higher than that of fenoxaprop-p-ethyl applied @ 45, 60 g ha^{-1} and provide effective control of *Echinocloa colonum* and *Echinocloa crusgalli* on clay loam soils of Pantnagar [24].

IMAZETHAPYR

It is a selective systemic herbicide and belongs to imidazolinone group. Imazethapyr controls wide spectrum of annual broad leaved and grass weeds [17]. Imazethapyr is an imidazolinone herbicide, which is absorbed by both roots and shoots and can be applied as preplant incorporation (PPI), pre emergence (PE) and post emergence (PoE). Imazethapyr can control annual broadleaf and grass weeds including *Abutilon theophrasti* (velvet leaf), *Amaranthus retroflexus* (red root pigweed), *Chenopodium album* (common lambsquarters), *Sinapis arvensis* (wild mustard), *Ambrosia artemesiifolia* (common ragweed), *Solanum ptycanthum* (Eastern black nightshade), *Polygonum convolvulus* (wild buckwheat) and other *Polygonum* spp [25]. Chin and Pandey [4] from IARI reported that imazethapyr at 0.075 kg ha^{-1} lowered total weed population significantly and it controlled *Trianthema portulacastrum* better than fluchloralin at 1.0 kg ha^{-1}. Imazethapyr at 1.0 kg ha^{-1} and hand weeding at 20 DAS were statistically comparable, which is attributed to better spread of blackgram crop canopy there by restricting the light interception by weeds [30].

Veeraputhiran and Chinnusamy [29] reported that imazethapyr as post emergence application at 0.09 kg a.i. ha^{-1} was superior over 0.06 and 0.075 kg a.i ha^{-1} and the herbicide applied at 21 and 28 DAS were at par followed by 14 DAS. Nandan *et al*. [9] reported that imazethapyr at 250ml ha^{-1} post emergence treatment at 15-20 DAS has given similar seed yield as of weed free check succeeded by pendimethalin @ 1 kg a.i ha^{-1} with 1HW at 30 DAS. The lowest density and dry matter production of weeds, weed intensity, weed growth rate, relative weed density and weed control efficiency were recorded under imazethapyr @ 25 g ha^{-1} as reported by Nirala *et al*. [10].

QUIZALOFOP ETHYL

Tomar [26] reported that post emergence application of quizalofop - p–ethyl @ 1000 ml ha^{-1} at 15 DAS has given significant weed control of grassy weeds and increased the seed yield of blackgram. Application of quizalofop-p-tefuryl 4.41 per cent EC @1000 ml ha-1 significantly reduced weed density at 15 and 30 days after application. Rao [16] reported that post emergence application quizalofop ethyl at 50 g ha^{-1} recorded the highest seed yield of blackgram (1877 kg ha^{-1}), net monetary returns (Rs. 35,625 ha^{-1}) and B:C ratio of 3.15 and was on par with hand weeding at 15 and 30 DAS which recorded the highest seed yield of 1928 kg ha^{-1}.

Mundra and Maliwal [8] reported that quizalofop-p-ethyl 50 g ha^{-1} recorded the lowest narrow-leaved weed density and dry weight at 30 DAS and at harvest. The weed control efficiency of quizalofop-p-ethyl 50 g ha^{-1} was 81.3 per cent than the highest (85.6 per cent) under two hand weedings against grassy weeds at harvest. Number of branches and pods $plant^{-1}$, seeds pod^{-1} and grain and stover yields of blackgram were also superior in plots treated with quizalofop-p-ethyl 50 g ha^{-1}. Post emergence herbicides are quiet important for controlling weed in the later part of crop growth. Since grasses are dominant so more of grass killers may be evaluated and keeping in view of weed shift new generation herbicides may be used to meet the current demand.

CLODINAFOP PROPARGYL

It belongs to aryloxyphenoxy herbicide group. It inhibits the enzyme acetyl CoA carboxylase which is essential for lipid biosynthesis. Growth of susceptible grass species ceases within 48 hours after application. It controls only annual grass weeds and it has no effect on dicot weeds. Clodinafop propargyl as post emergence spray @ 30-60 g a.i ha^{-1} effectively controlled wild oat in winter wheat and the application is best when the grasses are at tillering stage.

Rao and Rao [19] reported that post-emergence application of clodinafop propargyl at 52.5 to 75.0 g ha^{-1} recorded the highest per cent of weed control efficiency (from 89 to 94%) which was on a par with hand weeding at 25 DAS in blackgram.

CYHALOFOP BUTYL

Sasikala *et al*. [23] conducted a field experiment to evaluate different methods of sowing and post emergence herbicides for efficient weed control in zero till sown rice fallow blackgram during rabi season of two consecutive years. The results of the study indicated that, among different weed management practices, post emergence application of imazethapyr @ 100 g ha^{-1} increased the crop growth parameters

viz., leaf area index, crop growth rate, net assimilation rate and total dry matter production next to fenoxaprop-p-ethyl and cyhalofop butyl.

CONCLUSION

The use of post-emergence herbicides alone or in combination may broaden the window of weed management by broad-spectrum weed control. Recently, some new post emergence herbicides *viz*., Imazethapyr, Acifluorfen sodium and Clodinafop propargyl, Quizalofop ethyl, Fenoxaprop-p-ethyl, Cyhalofop-butyl *etc*. are being marketed with the assurance of selective control of weeds in blackgram.

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