



Assessment of Herbicidal Mixtures for Effective Weed Management in Blackgram under Irrigated Conditions of Pudukkottai District

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MPK, AY, KM and VV designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MG, GS and CP managed the analyses of the study. Authors GS and MMM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

An On Farm Trial was conducted to assess the herbicide for effective weed management in irrigated black gram in Pudukkottai district during the year 2022-2023 through ICAR-Krishi Vigyan Kendra, Vamban, Pudukkottai. Five farmer's fields were selected in the Mangalakoil village of Karambakudi block. The technological options adopted in the On Farm Trial were TO1: EPOE application of quizalofop ethyl @ 50 g a.i/ha and imazethapyr @ 50 g a.i /ha on 15 – 20 DAS, TO2: Sodium Acifluorfen 16.5% + Clodinafop- Propargyl 8% EC (ready mix) at 1000 ml/ha and Farmers practice: Two hand weeding on 15 and 30 DAS. Herbicide dose was calculated and were applied as per the treatment schedule in the farmer's field and observation on weed density was taken at periodical intervals. Weed dry weight and weed control efficiency were calculated. Outside the OFT plots, un weeded control plot was maintained for taking observation on weed count and to calculate weed control efficiency. During the cropping period one off campus training at Mankalakoil village was conducted to enrich the knowledge among farmers on the use of early post emergence herbicide for the control on weeds and critical technologies to be followed in blackgram. From the average yield obtained and economics worked out, it was concluded that Early post emergence application of Sodium Acifluorfen 16.5% + Clodinafop- Propargyl 8% EC (ready mix) at 1000 ml/ha is recommended to the farmers of Pudukkottai for the control of broad spectrum of weeds with higher yield and economic returns in blackgram.

Keywords: Assessment; blackgram; economics; herbicide; on farm trial; yield.

1. INTRODUCTION

“India is the world’s largest producer of pulses, accounting for about 25 per cent of global production. In India, pulses are the second most important group of food grain crops after cereals. These are an important part of the vegetarian diet of a large portion of India’s population” (Ghosh et al., 2023) “Among the various pulses, Black gram (*Vigna mungo* L. (Hepper)), which originated in India, stands out as one of the most valuable and nutritious pulse crops cultivated primarily in tropical countries, with a strong focus on India. In the country, black gram is cultivated across approximately 39.6 lakh hectares of land, resulting in a production of 2.84 million tonnes in the year 2021-22” (Mishra et al., 2024). “Black gram is primarily grown during the *Kharif* and summer seasons throughout India, with an exception in the eastern regions where it can also be cultivated during the *Rabi* or winter season. This versatile pulse crop has a relatively short growth duration. In the realm of cropping systems, pulses, including black gram, occupy a unique and significant position, serving various roles such as the primary crop, catch crop, cover crop, sequential crop, and even a fodder crop” (Bonepally et al., 2021). “As a leguminous crop, black gram not only enriches soil fertility but also contributes to the nitrogen economy of subsequent crops in the rotation” (Rathi et al., 2004).

“Blackgram is one of the important pulse crops in Pudukkottai district and cultivated around 5842

ha during *Rabi* and Summer seasons. Of the total loss caused by various pests in agriculture, weeds account for 37 per cent, followed by insects (29 per cent), diseases (22 per cent) and others including nematodes, rodents, mites, birds etc. (12 per cent). Pulses have smothering habit hence management of weeds is matter of concern only during their initial stage of establishment. Timely weed control is very essential for realization yield potential in pulses” (Sagar & Singh, 2020). India, being the largest pulses and as well as black gram producing country in the world, and importance of this pulse, the research on improvement of black gram production by efficiently reducing the effect of weeds on yield is the need of the hour now. Govt. of India also announced National Food Security Mission (NFSM) is a program that aims to increase the production of pulses in the country.

“Weeds compete with crops for vital growth resources (moisture, nutrients and solar radiation) resulting in severe yield loss. Development of efficient weed management technologies in pulses is vital for increasing productivity, sustainability and farmers’ income. Weeds can sometimes cause allelopathic effects on crop plants, owing to their depressive root exudates. Weeds also act as an alternate host for a variety of diseases and insect pests. The critical period of crop-weed competition for short duration pulses like blackgram and greengram is up to 30 days. Effective weed control during the critical period of crop weed competition to

achieve genetic potential of crops” (Kavitha et al., 2023). Cost effective weed management practices are need of the hour for effective control of weeds besides reduction in cost of cultivation and soil health. In short duration crops, application of early post emergence herbicides is advisable to for the control of weeds and to reduce the cost of cultivation incurred towards hand weeding.

2. MATERIALS AND METHODS

An On Farm Trial (OFT) was conducted to assess the herbicide for effective weed management in irrigated black gram for Pudukkottai district during the year 2022-2023 through ICAR-Krishi Vigyan Kendra, Vamban, Pudukkottai. Five farmers field were selected in the Mangalakoil village of Karambakudi block and were provided with early post emergence herbicides viz., quizalofop ethyl and imazethapyr and Sodium Acifluorfen 16.5% + Clodinafop-Propargyl 8% EC (ready mix).

The technological options are as follows:

TO1: EPOE application of quizalofop ethyl @ 50 g a.i/ha and imazethapyr @ 50 g a.i/ha on 15 – 20 DAS

TO2: Sodium Acifluorfen 16.5% + Clodinafop-Propargyl 8 % EC (ready mix) at 1000 ml/ha

FP*: Two hand weeding on 15 and 30 DAS

*Farmers Practice

Farmer's were given with Quizalofop ethyl @ 50 g a.i/ha (1000 ml/ha), Imazethapyr @ 50 g a.i/ha (500 ml/ha) and Sodium Acifluorfen 16.5% + Clodinafop- Propargyl 8% EC (1000 ml/ha). Sowing was taken up during Rabi season under irrigated condition. An off campus training was conducted to enrich the knowledge on critical technologies to be followed in blackgram cultivation. Herbicide dose was calculated and were applied as per the treatment schedule in the farmer's field by knap sack sprayer. Hand weeding was done on 15 and 30 DAS. Observation on weed density was taken at periodical intervals. Weed dry weight and weed control efficiency were calculated. Outside the OFT plots, un weeded control plot was maintained for taking observation on weed count and to calculate weed control efficiency.

Weed Control Efficiency was calculated using the following formula,

WCE =

$$\frac{(\text{Weed DMP in control plot}) - (\text{Weed DMP in treated plots})}{\text{Weed DMP in control plot}} \times 100$$

Where,

DMP- Dry matter Production

The average on weed density, weed dry matter production, grain yield and economics from five farmer's field were arrived and tabulated. Worked out economics for treatments based on the prevailing market price and labour wages.

During the cropping period one off campus training at Mankalokoil village was conducted to enrich the knowledge among farmers on the use of early post emergence herbicide for the control on weeds and critical technologies to be followed in blackgram. In the training programme, technical lectures were delivered to the farmers on importance of land preparation, selection of quality seeds, seed treatment with bio fertilizers and bio control agents, soil test based fertilizer application and foliar spray of pulse wonder during flower initiation stage. Demonstrations were taken as per the advisory of scientists of ICAR-Krishi Vigyan Kendra, Pudukkottai.

Field day was conducted at harvesting stage with the Officials from Department of Agriculture and farmers to observe the yield and yield parameters in the given technological options and farmers practice treatments.

3. RESULTS AND DISCUSSION

Common weed flora observed in the field were *Cynodon dactylon*, *Chloris barbata* and *Dactyloctenium aegyptium* in grasses, *Cyperus rotundus* in sedges, *Commelina benghalensis*, *Acalypha indica*, *Boerhavia diffusa*, *Digera arvensis*, *Euphorbia hirta* and *Trianthema portulacastrum* in broad leaved weeds. *Cynodon dactylon*, *Cyperus rotundus* and *Boerhavia diffusa* were the dominant weed species respectively recorded under grasses, sedges and broad-leaved weeds.

Among the two technologies tested, EPOE application of Sodium Acifluorfen 16.5% + Clodinafop- Propargyl 8% EC (ready mix) at 1000 ml/ha (TO 2) recorded lesser weed dry weight and there by higher Weed Control Efficiency (WCE) at 40 DAS. This treatment recorded 8.2 g/m² and 89.2 per cent weed dry weight and weed control efficiency respectively) compared to farmers practice of two hand weeding on 15 and 30 DAS and recorded weed dry weight of 18.8 g/m² and weed control efficiency of 76.5 per cent (Table 1).

Table 1. Effect of weed management practices on weed control, growth, yield and economics of blackgram (Average of five farmers field)

Title	No. of trials	Yield (kg/ha)	Net returns (Rs./ha)	B:C ratio	Data on Other performance indicators*	
					Weed dry matter production on 40 DAS (g/m ²)	Weed Control Efficiency on 40 DAS (%)
Farmers Practice- Two hand weeding on 15 and 30 DAS		934	23619	1.64	18.80	76.5
Technology 1 (EPOE application of quizalofop ethyl @ 50 g a.i/ha and imazethapyr @ 50 g ai ha ⁻¹ on 15 – 20 DAS)	5	981	35636	2.27	13.96	82.6
Technology 2 (EPOE application of Sodium Acifluorfen 16.5% + Clodinafop- Propargyl 8% EC (ready mix) at 1000 ml/ha)		1005	39363	2.36	8.20	89.8

Weed dry weight in check = 80 g/m²
 *EPOE- Early Post Emergence Application

EPOE application of Sodium Acifluorfen 16.5% + Clodinafop- Propargyl 8% EC (ready mix) at 1000 ml/ha recorded the maximum grain yield of 1005 kg/ha due to reduction in competition of weeds and better weed control efficiency. This treatment recorded higher net returns of Rs. 39363 / ha and Benefit cost ratio of 2.36 due to higher grain yield and higher weed control efficiency followed by EPOE application of quizalofop ethyl @ 50 g a.i./ha and imazethapyr @ 50 g a.i./ha on 15 – 20 DAS. (TO 1). This treatment recorded average yield of 981 kg/ha with net returns of Rs. 35636 /ha and Benefit cost ratio of 2.27 and recorded 12 per cent increased yield over farmer's practice (Table 1).

“Cost incurred towards the control of weeds through hand weeding was more when compared to herbicide application. Since it is the short duration crop application of early post emergence herbicide control both the early and later emerging weeds. Weed management with conventional hand weeding was observed to be highly expensive among different weed control methods due to the non-availability and increased cost of labour at some of the most important and critical stages of the crop weed competition. In addition, the unusual and incessant rains make it difficult to enter into the fields for hand weeding. Hence, the timely control of weeds in blackgram using herbicides would be preferable and the use of post-emergent herbicides could be better option for the control of weeds during the early stages of the crop growth” (Mudalagiriappa et al., 2022). “The decreased weed biomass with the sodium acifluorfen + clodinafop-propargyl was mainly because of its effective control of grasses and broad-leaved weeds throughout the crop growth as it recorded lower weed drymatter production and higher weed control efficiency. Investigation carried out in pigeon pea shows that broad spectrum weeds were suppressed efficiently with the application of 16.5% sodium acifluorfen + 8% cladinofop propargyl @ 1 kg/ha followed by Imazethapyr @ 0.05 kg/ha as post emergence aiming to get maximum profit” (Barla et al., 2018). Similar results were observed by Choudhary et al. (2017) and Biswal (2017) in groundnut. Farmers were highly satisfied and convinced regarding the technological interventions through KVK, Pudukkottai.

4. CONCLUSION

It is imperative to implement cost-efficient weed management strategies to achieve optimal weed

control while simultaneously minimizing cultivation expenses and preserving soil health. In the context of short-duration crop pulse crops, the application of early post-emergence herbicides is recommended for the effective management of weeds and the reduction of labor costs associated with manual weeding. From the On farm Trials conducted at Pudukkottai District it was concluded that early post emergence application of Sodium Acifluorfen 16.5% + Clodinafop- Propargyl 8% EC (ready mix) at 1000 ml/ha is recommended to the farmers of Pudukkottai for the control of broad spectrum of weeds with higher yield and economic returns in blackgram.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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