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# Influence of different weed management practices on growth and yield attributes of irrigated blackgram under Cauvery delta zone of Tamil Nadu

**M Jagadesh, M Raju and C Sharmila Rahale**

**Abstract**
A research trial was carried out during *Kharif* 2018 at Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu to evaluate the weed management practices in irrigated blackgram in Cauvery delta zone. The results revealed that all growth and yield characters of blackgram were significantly affected by distinct weed control practices. A similar trend was also observed in weed parameters. Higher seed yield (853 kg $ha^{-1}$) and higher weed control efficiency (87%) were recorded under application of pendimethalin @1 kg $ha^{-1}$ on 3 DAS (*fb*) acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g $ha^{-1}$ on 20 DAS and which comparable with pre emergence application of pendimethalin @ 1 kg $ha^{-1}$ *fb* propaquizafop (2.5%) + imazethapyr (3.75% ME) @ 125g $ha^{-1}$ on 20 DAS and hand weeding twice on 15 & 30 DAS. However, higher weed density observed for entire the crop season brought 49 percent decline in seed yield under unweeded plot. Among the various weed control measures, pendimethalin @ 1 kg $ha^{-1}$ on 3 DAS followed by acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g/ha on 20 DAS may possibly able to control weed menace which in turn increased weed control efficiency as well as yield and benefit-cost ratio for the irrigated blackgram.

**Keywords:** Blackgram, pre-emergence herbicide, acifluorfen sodium + clodinafop propargyl, propaquizafop + imazethapyr, nail weeder, integrated weed management

## Introduction
Blackgram (*Vigna mungo* L.) is a major pulse crop grown in India which occupies an area of 5.44 Million hectares with a production of 3.56 Million tons, during the year 2017-18. In Tamil Nadu, blackgram is one of the valuable crops among the pulses group grown under both irrigated and rainfed situation where it is cultivated in 3.54 lakh hectares with a production of 2.59 lakh tons and moderate yield of 731 kg/ha (Pulses in India: Retrospect and Prospects 2018) [9]. Most of the farmers are cultivating blackgram under poor and marginal soils with low input management. Biotic and abiotic stresses including severe weed competition are the important reasons for the low yields despite the crop's high yield potential. In blackgram due to uncontrolled weeds yield could be curtailed up to 46.8% (Jagraj *et al*., 2002) [3]. The degree of yield decline depends on the weed population, crop cultivars, climate conditions, and soil fertility. Generally, blackgram is grown at a row spacing of 30 cm and it takes 35-40 days for covering the inter-row space, which makes the crop highly prone to weed competition up to 4-5 weeks after sowing which is considered to be critical crop-weed competition period (Vivek *et al*., 2008) [11]. Various methods like cultural, mechanical, biological and chemicals are applied for weed management. The herbicide is becoming prevalent among farmers because of time-saving and cost-effective. The spraying post-emergence herbicides alone or in mixtures may bring broad-spectrum weed control in the crop. Keeping the above constraints, the present research was executed to reveal the appropriate and cost-effective weed management practice for irrigated blackgram.

## Materials and methods
The research trial was conducted on weed control measures in irrigated blackgram VBN 8 during *Kharif* (July to September) season of 2018 at Tamil Nadu rice research institute, Aduthurai, Tamil Nadu. The soil of the field was sandy loam, neutral in pH (7.4) and with available N (230 kg/ha), P (13kg/ha), K (283 kg/ha) content. Nine treatments consisted of $T_1$- Pendimethalin @ 1kg $ha^{-1}$ on 3 DAS + Hand weeding on 20 DAS, $T_2$- Pendimethalin @ 1kg $ha^{-1}$ + Nail Weeder on 20 DAS, $T_3$- (Premix) Acifluorfen sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g $ha^{-1}$ on 20 DAS, $T_4$- (Premix) Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g $ha^{-1}$ on 20 DAS, $T_5$- Pendimethalin @1kg $ha^{-1}$ on 3 DAS *fb*(Premix) Acifluorfen Sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g $ha^{-1}$ on

20 DAS, $T_6$- Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* (Premix) Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS, $T_7$- Two Nail weeder on 15 and 30 DAS, $T_8$- Two Hand weeding on 15 and 30 DAS, $T_9$- Weedy check were tested on crop in Randomized Block Design with three replications. Except weed management practices remain all the crop cultivation practices were followed for the proper establishment of the crop. By using knapsack sprayer with flat fan nozzle the herbicides were applied. Manual operated nail weeder was used in between crop rows. Square root transformation method (X + 0.5) was used to normalize the weed data distribution. (Panse and Sukhatme, 1978) [8]. Economics of different treatments were calculated taking into consideration of all output and input market prices.

## Results and discussion

### Weed flora

Thirteen major weed species were documented in the field. Among them, grasses, sedges, and broad leaf weeds constitute 36%, 31%, and 33% respectively. Dominant weed species in grasses, sedges, and broad leaf weeds were *Echinochloa crusgalli*, *Cyperus rotundus*, and *Phyllanthus maderaspatensis* respectively. Other weed species such as *Panicum javanicum*, *Eleusine indica*, *Cyanotis cucullata*, *Cleome viscosa*, *Physalis minima*, *Malvastrum commendelianum*, *Euphorbia geniculata*, *Acalypha indica*, *Eclipta alba*, and *Ipomoea obscura* were also noted in the field.

### Weed density and biomass

All chemical, manual and integrated weed control treatments significantly curtailed the weed population and their biomass over the weedy check (Table 1). At 20 DAS, hand weeding twice on 15 and 30 DAS ($T_8$) documented lowest weed population (6.7 No/m$^2$) and weed biomass (1.7 g/m$^2$) followed by pendimethalin @ 1kg ha$^{-1}$ applied plots ($T_1$, $T_2$, $T_5$, $T_6$). At 40 DAS, lowest weed density (17.3 No/m$^2$) and biomass (14.4g/m$^2$) were observed in pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g/ha ($T_5$) on 20 DAS and on par with pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* propaquizafop (2.5%) + imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS ($T_6$) and ($T_8$) hand weeding twice on 15 and 30 DAS. At 60 DAS, ($T_5$) pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g/ha on 20 DAS showed lowest weed population (8 No/m$^2$) and biomass (11.2 g/m$^2$) on par with ($T_6$) pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* propaquizafop (2.5%) + imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS and ($T_8$) hand weeding twice on 15 and 30 DAS. Due to extended persistence of above premix post emergence herbicides the weeds population effectively got reduced as compared to manual and mechanical weedings. Analogous results were also observed by Aliveni *et al*. (2012) [1] and Panda *et al*. (2015) [7].

### Weed control efficiency

At 20 DAS, higher weed control efficiency was found with two hand weeding (95%) ($T_8$). Among the herbicide application, pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS ($T_5$) showed maximum weed control efficiency of 79% and 87% at 40 and 60 DAS respectively. This could be associated with minimum weed population and weed biomass at later stages due to the residual effect of herbicides for a longer period.

### Blackgram growth attributes

The growth attributes of blackgram in all the stages were significantly affected by weed control practices (Table 2). At 20 DAS, the weed control treatments had no influence on plant height and its biomass. Regarding a number of branches per plant was higher in the pre emergence pendimethalin applied treatments ($T_1$, $T_2$. $T_5$, $T_6$). At 40 DAS, applying pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS ($T_5$) recorded taller plant height (53.1cm) with increased number of branches/plant (6.2) which in turn enhanced higher dry matter production (3278 kg/ha) and these could be statistically on par with applying pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* propaquizafop (2.5%) + imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS ($T_6$) (48.7 cm, 5.7 Nos./plant and 2889 kg/ha respectively). The plant height, no. of branches/plant and dry matter production by 44.8%, 45.2%, 37.2% & 39.8%, 39.5%, 28.8% were higher under ($T_5$) and ($T_6$) respectively over the weedy check (control plot). The similar trend was also observed in later stages (60 DAS). The increased crop growth characters in these treatments over hand weeding twice and all other treatments were the result of effective control of weeds in earlier stages which ultimately lead to increased growth of blackgram. Analogous results were also observed by Jha *et al*. (2012) [4] and Meena *et al*. (2012) [5].

### Yield attributes and Grain yield of blackgram

Applying pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS ($T_5$) recorded highest number of clusters plant$^{-1}$ (12.3), pods plant$^{-1}$ (34.4), seeds pod$^{-1}$ (7.3) and which was statistically on par with pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* propaquizafop (2.5%) + imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS ($T_6$) (11.2, 28.8, 7.5 ) and two hand weedings on 15 & 30 DAS ($T_8$) (10.7, 27.3, 7.5) with increased clusters plant$^{-1}$, pods plant$^{-1}$, seeds pod$^{-1}$ by 48%, 68.3%, 15%, 42.8%, 62.1%, 17.3% & 40%, 60%. 17.3% respectively over unweeded control.

Highest seed yield of 853 kg/ha was achieved with pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS ($T_5$) and which was comparable with pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS ($T_6$) (748 kg/ha) and hand weeding twice ($T_8$) (714 kg ha$^{-1}$) with increased seed yield by 48.5%, 42.8% & 38.5%, over weedy check. Increased in yield attributes and yield might be due to shifting crop-weed competition in favor of crop resulting in better accumulation of photosynthates. Analogous results were also observed by Harithavardhini *et al.* (2016) [2], Marimuthu *et al.* (2016) [6] and Suryavanshi *et al*. (2018) [10].

### Economics

With respect to economics, applying pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS ($T_5$) found more profitable with respect to highest net return (Rs. 44653/ha) and benefit cost ratio (2.1) with investing lowest expenditure (Rs. 39240/ha) followed by applying pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* propaquizafop (2.5%) + imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS ($T_6$) (Rs. 33079 /ha; 1.8).

**Table 1:** Effect of different weed management practices on weed density, weed biomass, and weed control efficiency

| Treatments | 20 DAS | | | 40 DAS | | | 60 DAS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Weed density (No/m$^2$) | Weed biomass (g/m$^2$) | WCE (%) | Weed density (No/m$^2$) | Weed biomass (g/m$^2$) | WCE (%) | Weed density (No/m$^2$) | Weed biomass (g/m$^2$) | WCE (%) |
| $T_1$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS + HW on 20 DAS | 22.0 | 7.0 | 78 | 49.0 | 38.7 | 43 | 61.0 | 49.4 | 41 |
| $T_2$ - Pendimethalin @ 1kg ha$^{-1}$ + Nail Weeder on 20 DAS | 28.7 | 9.0 | 72 | 65.0 | 49.4 | 27 | 57.7 | 64.9 | 23 |
| $T_3$ - Acifluorfen sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 84.7 | 31.1 | 3 | 34.3 | 30.8 | 54 | 29.7 | 33.2 | 61 |
| $T_4$ - Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 66.0 | 28.6 | 11 | 48.0 | 38.4 | 43 | 34.3 | 40.6 | 52 |
| $T_5$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Acifluorfen Sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 23.0 | 8.4 | 74 | 17.3 | 14.4 | 79 | 8.0 | 11.2 | 87 |
| $T_6$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 24.0 | 9.4 | 71 | 21.7 | 16.8 | 75 | 11.3 | 17.0 | 80 |
| $T_7$ - Two Nail weeder on 15 and 30 DAS | 73.3 | 26.6 | 17 | 79.3 | 54.0 | 20 | 61.7 | 62.4 | 26 |
| $T_8$ - Two Hand weeding on 15 and 30 DAS | 6.7 | 1.7 | 95 | 23.0 | 19.8 | 71 | 15.3 | 23.5 | 72 |
| $T_9$ - Weedy check | 84.7 | 32.0 | 0.0 | 82.7 | 67.3 | 0.0 | 92.3 | 84.3 | 0.0 |
| SEd | 0.6 | 0.4 | - | 0.7 | 0.5 | - | 0.3 | 0.4 | - |
| CD (P=0.05) | 1.2 | 0.8 | - | 1.4 | 1.0 | - | 0.7 | 0.8 | - |

**Table 2:** Effect of different weed management practices on growth characters of blackgram

| Treatments | 20 DAS | | | 40 DAS | | | 60 DAS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | No. of branches (g/m$^2$) | Crop DMP (kg/ha) | Plant height (cm) | No. of branches (g/m$^2$) | Crop DMP (kg/ha) | Plant height (cm) | No. of branches (g/m$^2$) | Crop DMP (kg/ha) |
| $T_1$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS + HW on 20 DAS | 24.3 | 2.4 | 467 | 39.3 | 4.1 | 2578 | 48.7 | 4.5 | 2967 |
| $T_2$ - Pendimethalin @ 1kg ha$^{-1}$ + Nail Weeder on 20 DAS | 23.0 | 2.0 | 367 | 34.4 | 3.1 | 2222 | 43.2 | 3.8 | 2567 |
| $T_3$ - Acifluorfen sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 23.5 | 2.1 | 411 | 41.6 | 4.4 | 2622 | 53.6 | 4.9 | 3089 |
| $T_4$ - Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 24.2 | 2.2 | 322 | 37.4 | 3.6 | 2467 | 49.2 | 4.4 | 2667 |
| $T_5$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Acifluorfen Sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 24.0 | 2.3 | 444 | 53.1 | 5.3 | 3278 | 61.2 | 5.9 | 3889 |
| $T_6$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 25.3 | 2.3 | 433 | 48.7 | 4.8 | 2889 | 55.4 | 5.6 | 3378 |
| $T_7$ - Two Nail weeder on 15 and 30 DAS | 21.2 | 1.9 | 578 | 36.1 | 3.1 | 2122 | 43.4 | 3.8 | 2400 |
| $T_8$ - Two Hand weeding on 15 and 30 DAS | 23.5 | 2.0 | 533 | 44.8 | 4.4 | 2789 | 55.0 | 5.2 | 3511 |
| $T_9$ - Weedy check | 22.4 | 2.0 | 456 | 29.3 | 2.9 | 2056 | 40.1 | 3.5 | 2356 |
| SEd | 1.1 | 0.14 | 101.4 | 2.9 | 0.44 | 211.4 | 2.6 | 0.38 | 212.6 |
| CD (P=0.05) | NS | 0.29 | NS | 6.2 | 0.94 | 448.1 | 5.6 | 0.81 | 450.8 |

**Table 3:** Effects of different weed management practices on yield attributes and yield of blackgram

| Treatments | Cluster pod$^{-1}$ | Pods plant$^{-1}$ | Seeds pod$^{-1}$ | Seed index (g) | Grain yield (Kg/ha) |
|---|---|---|---|---|---|
| $T_1$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS + HW on 20 DAS | 9.1 | 20.7 | 6.8 | 4.8 | 626 |
| $T_2$ - Pendimethalin @ 1kg ha$^{-1}$ + Nail Weeder on 20 DAS | 7.8 | 15.3 | 6.5 | 4.5 | 544 |
| $T_3$ - Acifluorfen sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 9.7 | 23.5 | 6.9 | 4.6 | 687 |
| $T_4$ - Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 8.8 | 19.0 | 7.2 | 4.8 | 595 |
| $T_5$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Acifluorfen Sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 12.3 | 34.4 | 7.3 | 4.6 | 853 |
| $T_6$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 11.2 | 28.8 | 7.5 | 4.4 | 768 |
| $T_7$ - Two Nail weeder on 15 and 30 DAS | 7.1 | 12.4 | 6.1 | 4.7 | 477 |
| $T_8$ - Two Hand weeding on 15 and 30 DAS | 10.7 | 27.3 | 7.5 | 4.9 | 714 |
| $T_9$ - Weedy check | 6.4 | 10.9 | 6.2 | 4.6 | 439 |
| SEd | 1.1 | 1.9 | 0.2 | 0.3 | 73.0 |
| CD (P=0.05) | 2.3 | 4.0 | 0.4 | NS | 154.8 |

**Table 4:** Effect of different weed management practices on the economics of blackgram

| Treatments | Cost of cultivation (Rs./ha) | Gross Return (Rs./ha) | Net Return (Rs./ha) | B:C |
|---|---|---|---|---|
| $T_1$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS + HW on 20 DAS | 39925 | 63888 | 23963 | 1.6 |
| $T_2$ - Pendimethalin @ 1kg ha$^{-1}$ + Nail Weeder on 20 DAS | 39365 | 56701 | 17336 | 1.4 |
| $T_3$ - Acifluorfen sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 37900 | 69227 | 31326 | 1.8 |
| $T_4$ - Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 40175 | 61131 | 20955 | 1.5 |
| $T_5$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Acifluorfen sodium (16.5%) + Clodinafop propargyl (8% EC) @ 187.5 g ha$^{-1}$ on 20 DAS | 39240 | 83893 | 44653 | 2.1 |
| $T_6$ - Pendimethalin @ 1kg ha$^{-1}$ on 3 DAS *fb* Propaquizafop (2.5%) + Imazethapyr (3.75% ME) @ 125g ha$^{-1}$ on 20 DAS | 41515 | 74595 | 33079 | 1.8 |
| $T_7$ - Two Nail weeder on 15 and 30 DAS | 40825 | 50805 | 9980 | 1.2 |
| $T_8$ - Two Hand weeding on 15 and 30 DAS | 41945 | 71632 | 29687 | 1.7 |
| $T_9$ - Weedy check | 35225 | 47432 | 12207 | 1.3 |

## Conclusion

It could be resolved that applying pendimethalin @ 1kg $ha^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g $ha^{-1}$ on 20 DAS ($T_5$) and pendimethalin @ 1kg $ha^{-1}$ on 3 DAS *fb* propaquizafop (2.5%) + imazethapyr (3.75% ME) @ 125g $ha^{-1}$ on 20 DAS ($T_6$) was found superior in respect of decreasing the density and biomass of weeds and recorded higher economic yield with higher net return per rupee as compared to other treatments. Hence, applying pendimethalin @ 1kg $ha^{-1}$ on 3 DAS *fb* acifluorfen sodium (16.5%) + clodinafop propargyl (8% EC) @ 187.5 g $ha^{-1}$ on 20 DAS is recommended to irrigated blackgram especially under Cauvery Delta zones of Tamil Nadu.

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