RESEARCH ARTICLE

# HERBICIDAL WEED CONTROL IN INDIAN MUSTARD (*BRASSICA JUNCEA* L.)

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**Abstract:** Field investigations were carried out at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) during the winter (*rabi*) seasons of 2010-11, 2011-12 and 2012-13 to assess the effect of different herbicidal weed control practices on yield and economics of Indian mustard (*Brassica juncea* L.).The treatments comprised pre-emergence applications of pendimethalin 1.0 kg/ha, oxadiargyl 0.09 kg/ha, oxyfluorfen 0.15 kg/ha and isoproturon 1.0 kg/ha, quizalofop 0.06 kg/ha, clodinafop 0.06 kg/ha and isoproturon 1.0 kg/ha 30 days after sowing (DAS), weedy check and weed free. Broadleaved weeds like *Chenopodium album* L., *Anagallis arvensis* L., *Melilotus indica* (L.) All., *Vicia sativa* L. and *Rumex acetosella* L. were more predominant than grass and sedge weeds, accounting for 57.9% of total weed flora.Based on the three years studies, weeds in mustard annually caused 23-42% loss in yield. Among all herbicidal treatments, oxadiargyl 0.09 kg/ha was found to be the most effective in reducing the population of broadleaved weeds, grasses and sedges as compared to other herbicidal treatments. Pre-emergence application of oxadiargyl at 0.09 kg/ha recorded minimum weed population and dry weight of weeds which was found to be the most effective and gave maximum seed yield of mustard. Herbicide, oxadiargyl 0.09 kg/ha gave higher net return due to weed control over other treatments and also resulted in highest net return per rupee invested (1.69) on weed control.

**Keywords***:* Herbicidal weed control, Mustard, Yield, Economics

## INTRODUCTION

Indian mustard (*Brassica juncea* (L.) Czernj and Cosson) is one of the most important winter oilseed crops of India. India occupies third position in rapeseed-mustard production in the world after China and Canada. In India, during 2013-14, the rapeseed-mustard crop had production of about 7.96 million tonnes from an area of 6.70 million hectares with an average productivity of 1188 kg/ha. As this crop is grown in poor soils with poor management practices, weed infestation is major causes of low productivity (Singh *et al*., 2013). Yield losses due to crop weed competition in rapeseed and mustard has been estimated to be in range of 10-58% (Bhan, 1992; Banga and Yadav, 2001; Singh *et al*., 2013). Weed competition at initial stages of crop growth causes maximum loss to the crop in terms of yield. Manual weeding is considered to be the best weed control measure for complete weed control without any harm to the crop and ecosystem. But on the other hand, scarcity of labour and increasing labour rates have made manual weeding a costly affair. So, it brings a need for search of other effective and feasible alternatives. The most common among them is herbicidal weed control method. Herbicidal weed control measure is very easy, effective and economical method of weed management. Different herbicides are available with respect to different modes of application like pre-emergence and post-emergence which are found helpful in managing weeds with various degree of efficacy. A limited number of herbicides have been tested against the weeds in mustard. These herbicides are applied as pre-emergence and can control weeds up to a limited period. During recent past a number of broad spectrum herbicides have been launched which are capable of reducing competition for a longer period of time. The efficacy and selectivity of these herbicides are yet to be explored in mustard. The information available on herbicidal weed control practices in Indian mustard in the northern region is also sparse and inadequate.

## MATERIAL AND METHOD

The field experiment was conducted during winter (*rabi*) seasons of 2010-2011, 2011-12 and 2012-13 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (25°18′ N latitude, 83°03′E longitude and altitude of 129 m above mean sea level), Uttar Pradesh, India. Mean minimum and maximum temperature during crop seasons ranged from 5.8 to 22.1$^{o}$C and 17.1 to 39.2$^{o}$C, respectively. During the years, weather conditions were extremely favourable for both crop and weed growth. The soil of experimental site is sandy clay loam, slightly alkaline (*p*H 7.6) in reaction and moderately fertile being low in organic carbon (0.38%) and available nitrogen (190.4 kg/ha) and medium in available phosphorus (20.75 kg/ha) and potassium (205.0 kg/ha). Nine treatments consisting of pendimethalin 1.0 kg/ha (pre-emergence, P.E.), oxadiargyl 0.09 kg/ha (pre-emergence, P.E.), oxyfluorfen 0.15 kg/ha (pre-emergence, P.E.), quizalofop 0.06 kg/ha (30 DAS), clodinafop 0.06 kg/ha (30 DAS), isoproturon 1.0 kg/ha (pre-emergence, P.E.), isoproturon 1.0 kg/ha (30 DAS), weedy check and weed free were evaluated in randomized block design with three

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replications. 'Ashirwad' Indian mustard variety was sown in 30 cm apart at a seed rate of 5.0 kg seed/ha on the last week of October. The crop was thinned 15 days after sowing to maintain a plant to plant spacing of 10 cm. A fertilizer dose of 80 kg N/ha, 40 kg $P_2O_5$/ha and 40 kg $K_2O$/ha were applied in each season. Required amounts of nitrogen, phosphorus and potassium were supplied through urea, single super phosphate and muriate of potash, respectively. Full amount of phosphorus and potash and half of nitrogen was applied at the time of sowing. The remaining dose of nitrogen was top dressed 35 days after sowing. The recommended cultural practices and plant protection measures were followed to raise the healthy crop. Herbicides were applied using a spray volume of 800 litre water/ha with a knapsack sprayer fitted with flat-fan nozzle. Weed population was recorded by placing 25 cm x 25 cm quadrates at two random places in each plot and after drying them in hot air oven (70±1 $^oC$ for 72 hrs), weed dry weight was recorded. Data on weed population and weed dry weight were subjected to square root transformation to ($\sqrt{x}$ + 1). The seed yield and stover yield were computed from the harvest of net plot and expressed in kg/ha. Economics of the treatments were computed in terms of gross return (` /ha), net return (`/ha) and benefit: cost ratio, respectively based on the prevalent market prices and selling price of mustard seeds was ` 18.50/kg in 2010-11, ` 20.00/kg in 2011-12 and `30.00/kg in 2012-13.

## RESULT AND DISCUSSION

Among the grassy weeds, *Cynodon dactylon* (L.) Pers. was the predominant weed followed by *Phalaris minor* Retz. and accounted 32.5% of total weed flora. *Cyperus rotundus* L. was the only sedge present in the experimental field. The broadleaved weeds like *Chenopodium album* L., *Anagallis arvensis* L., *Melilotus indica* (L.) All., *Vicia sativa* L. and *Rumex acetosella* L. as a whole constituted 57.9% of total weed flora.

**Effect on weeds**

Grassy weeds population $m^{-2}$ reduced significantly with all herbicide weed control methods compared to weedy check. Amongst herbicides, pre-emergence application of oxadiargyl 0.09 kg/ha showed maximum effectively in controlling grasses population but remained at par with other pre-emergence applied herbicides like oxyfluorfen 0.15 kg/ha, isoproturon 1.0 kg/ha and pendimethalin 1.0 kg/ha except during 2011-12, where oxadiargyl 0.09 kg/ha maintained a lowest population of grassy weeds. Post-emergence application of herbicides remained least effective in decreasing grassy weeds population. Meanwhile, effect of treatments on broadleaved weeds was not very conspicuous during 2010-11 and 2012-13, however, during 2011-12, all treatments were significantly superior to weedy check in reducing their population. Pre-emergence application of oxadiargyl 0.09 kg/ha maintained the lowest population of broadleaved weeds and proved superior to all other herbicidal weed control methods during 2011-12. Similarly, oxadiargyl recorded minimum population of sedges and was significantly superior to all the other herbicides (Table 1). The application of oxadiargyl 0.09 kg/ha as pre-emergence being at par to oxyfluorfen 0.15 kg/ha, isoproturon 1.0 kg/ha and pendimethalin 1.0 kg/ha during 2010-11 and 2012-13, reduced significantly lower population of total weeds than other herbicides. Amongst herbicides, oxadiargyl recorded minimum total weed dry weight and was significantly superior to all other herbicidal treatments except pre-emergence application of oxyfluorfen, isoproturon and pendimethalin which were at par to them during 2010-11 and 2012-13. Consequently, pre-emergence application with oxadiargyl 0.09 kg/ha maintained comparatively higher weed control efficiency in comparison to other herbicidal weed control methods giving maximum weed control efficiency closely followed by oxyfluorfen (Table 2). Many researchers have reported lower weed population in mustard and similar crops with the use of herbicides like pendimethalin (Chauhan *et al.*, 2005), isoproturon (Yadav *et al.*, 2007), oxyfluorfen (Sharma *et al.*, 2001) and clodinafop (Sharma *et al.*, 2007).

**Effect on crop**

Herbicidal weed control treatments brought about significant variation on yield attributes, *viz.*, number of siliquae per plant, number of seeds per siliqua and 1000-seed weight of Indian mustard (Table 3). Pre-emergence application of oxadiargyl 0.09 kg/ha being at par to oxyfluorfen 0.15 kg/ha produced significantly higher number of siliquae $plant^{-1}$ than the rest of weed control treatments. It is also evident that weed free had significantly higher number of seeds $siliqua^{-1}$ and 1000-seed weight than all the herbicidal treatments, except pre-emergence application of oxadiargyl 0.09 kg/ha which was found at par to weed free treatment. Sharma and Jain (2002) had also obtained higher yield attributes with weed control treatments over untreated control.

The yield attributes were reflected in yield of Indian mustard. Significantly higher seed yield was recorded in weed free treatment which was statistically at par with pre-emergence application of oxadiargyl 0.09 kg/ha (Fig. 1). Weed free treatment also resulted in the highest stover yield, which was statistically at par with pre-emergence application of oxadiargyl 0.09 kg/ha, oxyfluorfen 0.15 kg/ha and isoproturon 1.0 kg/ha except during 2011-12 where weed free treatment was on par with oxadiargyl 0.09 kg/ha and clodinafop 0.06 kg/ha, all these treatments proved significantly superior to other weed control treatments. Weedy check had the lowest seed yield and stover yield due to higher weed population and dry weight (Table 4). Weeds in weedy check reduced

seed yield of mustard by 41.7% in 2010-11, 22.8% in 2011-12 and 41.5% in 2012-13.

**Economics**

The viability of any practice depends on its economic feasibility. A better treatment in terms of weed control if not fetching good returns may not be acceptable to the farmers. Among weed control treatments, pre-emergence treatment with oxadiargyl 0.09 kg/ha resulted in highest gross and net return due to weed control over other treatments (Table 5). The higher return under this treatment was attributed to higher seed yield of mustard owing to better control of weeds. All the herbicides obtained more net return and benefit: cost ratio as compared to weedy check. The pre-emergence of oxadiargyl 0.09 kg/ha also observed the highest net return per rupee invested i.e. benefit: cost ratio of 1.69) on weed control. Weed free treatment registered lower monetary returns due to high cost involved in repeated weedings to keep crop weed free despite having higher seed yield.

Therefore, it can be concluded that unrestricted growth of weeds affected seed yield of Indian mustard and pre-emergence application of oxadiargyl 0.09 kg/ha was the most remunerative and highly effective herbicide for reducing weed population and dry weight and gave seed yield comparable to the weed free condition in Indian mustard.

**Table 1**. Effect of weed control methods on population of broadleaved weeds, grasses and sedges of Indian mustard

| Treatment | Broadleaved weeds (per $m^2$) | | | Grasses (per $m^2$) | | | Sedges (per $m^2$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2010-11 | 2011-12 | 2012-13 | 2010-11 | 2011-12 | 2012-13 | 2010-11 | 2011-12 | 2012-13 |
| Pendimethalin 1.0 kg/ha (P.E.) | 16.43 (269.77) | 11.88 (141.00) | 17.18 (294.65) | 11.35 (128.33) | 8.23 (67.63) | 12.10 (145.91) | 5.15 (26.03) | 5.82 (33.97) | 5.90 (34.31) |
| Oxadiargyl 0.09 kg/ha (P.E.) | 15.78 (248.63) | 9.15 (83.71) | 16.53 (272.74) | 10.27 (105.20) | 4.71 (23.33) | 11.02 (120.94) | 4.31 (18.13) | 2.73 (7.10) | 5.06 (25.10) |
| Oxyfluorfen 0.15 kg/ha (P.E.) | 16.12 (259.63) | 12.90 (166.05) | 16.87 (284.09) | 10.71 (114.30) | 9.40 (88.00) | 11.46 (131.29) | 4.76 (22.17) | 7.07 (49.47) | 5.51 (29.86) |
| Quizalofop 0.06 kg/ha (30 DAS) | 16.94 (286.67) | 13.21 (174.25) | 17.69 (312.43) | 11.68 (136.00) | 9.74 (94.67) | 12.43 (154.00) | 6.00 (35.50) | 7.40 (54.54) | 6.75 (45.06) |
| Clodinafop 0.06 kg/ha (30 DAS) | 17.15 (293.67) | 11.56 (133.25) | 17.90 (319.91) | 11.92 (141.67) | 7.86 (61.33) | 12.67 (160.02) | 5.05 (25.00) | 5.43 (29.17) | 5.80 (33.14) |
| Isoproturon 1.0 kg/ha (P.E.) | 16.33 (266.53) | 12.37 (153.46) | 17.08 (291.22) | 11.12 (123.73) | 8.77 (77.77) | 11.87 (140.39) | 5.03 (24.83) | 6.38 (41.68) | 5.78 (32.90) |
| Isoproturon 1.0 kg/ha (30 DAS) | 16.75 (280.00) | 13.54 (182.86) | 17.50 (305.75) | 11.48 (131.33) | 10.23 (104.33) | 12.23 (149.07) | 5.38 (28.50) | 7.26 (52.26) | 6.13 (37.07) |
| Weedy check | 17.23 (308.00) | 14.01 (198.03) | 17.98 (322.78) | 12.84 (166.27) | 10.58 (114.00) | 13.59 (184.18) | 6.50 (41.83) | 7.82 (60.63) | 7.25 (52.06) |
| Weed free | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) |
| SEm± | 0.84 | 0.49 | 0.84 | 0.39 | 0.60 | 0.40 | 0.12 | 0.43 | 0.13 |
| CD (P=0.05) | NS | 1.45 | NS | 1.16 | 1.77 | 1.19 | 0.35 | 1.27 | 0.37 |

DAS: Days after sowing; NS: Non-significant; Data is transformed to $\sqrt{x+1}$; Values in the parenthesis are original values

**Table 2**. Effect of weed control methods on total weed population, total weeds dry weight and weed control efficiency of Indian mustard

| Treatment | Total weed population (per $m^2$) | | | Total weeds dry weight (g per $m^2$) | | | Weed Control Efficiency (WCE) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2010-11 | 2011-12 | 2012-13 | 2010-11 | 2011-12 | 2012-13 | 2010-11 | 2011-12 | 2012-13 |
| Pendimethalin 1.0 kg/ha (P.E.) | 20.60 (424.13) | 15.55 (242.60) | 21.35 (455.32) | 4.70 (21.67) | 4.36 (18.57) | 5.20 (26.54) | 39.25 | 35.14 | 35.22 |
| Oxadiargyl 0.09 kg/ha (P.E.) | 19.30 (371.97) | 10.66 (114.15) | 20.05 (401.50) | 4.02 (15.67) | 3.22 (9.88) | 4.52 (19.93) | 56.07 | 65.48 | 51.35 |
| Oxyfluorfen 0.15 kg/ha (P.E.) | 19.91 (396.10) | 17.43 (303.52) | 20.66 (426.33) | 4.22 (17.33) | 4.70 (21.64) | 4.72 (21.77) | 51.40 | 24.43 | 46.86 |
| Quizalofop 0.06 kg/ha (25-30 DAS) | 21.41 (458.17) | 17.98 (323.46) | 22.16 (490.56) | 5.05 (25.00) | 4.83 (22.80) | 5.55 (30.30) | 29.91 | 20.37 | 26.04 |
| Clodinafop 0.06 kg/ha (25-30 DAS) | 21.46 (460.33) | 14.97 (223.76) | 22.21 (492.78) | 5.51 (29.87) | 4.12 (16.49) | 6.01 (35.62) | 16.26 | 42.41 | 13.06 |
| Isoproturon 1.0 kg/ha (P.E.) | 20.38 (415.10) | 16.43 (272.91) | 21.13 (445.97) | 4.56 (20.33) | 4.60 (20.72) | 5.06 (25.10) | 42.99 | 27.65 | 38.74 |
| Isoproturon 1.0 kg/ha (30 DAS) | 20.98 (439.83) | 18.43 (339.45) | 21.73 (471.69) | 4.81 (22.67) | 4.95 (24.05) | 5.31 (27.69) | 36.45 | 16.01 | 32.41 |
| Weedy check | 22.55 (516.10) | 19.20 (372.66) | 23.30 (542.39) | 5.94 (35.67) | 5.40 (28.63) | 6.44 (40.97) | - | - | - |
| Weed free | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 100.00 | 100.00 | 100.00 |
| SEm± | 0.69 | 0.79 | 0.70 | 0.23 | 0.09 | 0.24 | - | - | - |
| CD (P=0.05) | 2.07 | 2.35 | 2.12 | 0.70 | 0.26 | 0.73 | - | - | - |

Data is transformed to $\sqrt{x+1}$; Values in the parenthesis are original values

**Table 3**. Effect of weed control methods on yield attributes of Indian mustard

| Treatment | Siliquae/ plant | | | | Seeds/siliqua | | | | 1000-seed weight (g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010-11 | 2011-12 | 2012-13 | Mean | 2010-11 | 2011-12 | 2012-13 | Mean | 2010-11 | 2011-12 | 2012-13 | Mean |
| Pendimethalin 1.0 kg/ha (P.E.) | 274.7 | 312.0 | 274.8 | 287.2 | 12.39 | 14.82 | 12.42 | 13.21 | 4.77 | 4.20 | 4.79 | 4.59 |
| Oxadiargyl 0.09 kg ha$^{-1}$ (P.E.) | 317.3 | 349.0 | 317.4 | 327.9 | 13.23 | 16.03 | 13.21 | 14.16 | 5.00 | 4.95 | 5.04 | 5.00 |
| Oxyfluorfen 0.15 kg ha$^{-1}$ (P.E.) | 300.7 | 326.0 | 300.9 | 309.2 | 12.87 | 15.21 | 12.93 | 13.67 | 4.90 | 3.85 | 4.94 | 4.56 |
| Quizalofop 0.06 kg/ha (30 DAS) | 254.3 | 270.0 | 254.4 | 259.6 | 11.60 | 12.02 | 11.62 | 11.75 | 4.49 | 3.75 | 4.50 | 4.25 |
| Clodinafop 0.06 kg/ha (30 DAS) | 224.7 | 278.0 | 225.0 | 242.6 | 10.60 | 13.01 | 10.61 | 11.41 | 4.31 | 4.45 | 4.32 | 4.36 |
| Isoproturon 1.0 kg ha$^{-1}$ (P.E.) | 285.0 | 286.5 | 285.2 | 285.6 | 12.45 | 14.03 | 12.51 | 13.00 | 4.83 | 3.95 | 4.84 | 4.54 |
| Isoproturon 1.0 kg ha$^{-1}$ (30 DAS) | 265.7 | 252.0 | 265.8 | 261.2 | 12.01 | 11.51 | 12.03 | 11.85 | 4.71 | 3.25 | 4.73 | 4.23 |
| Weedy check | 176.0 | 240.0 | 176.0 | 197.3 | 8.50 | 10.62 | 8.52 | 9.21 | 3.90 | 3.00 | 3.93 | 3.61 |
| Weed free | 339.9 | 367.0 | 340.0 | 349.0 | 13.90 | 16.72 | 13.91 | 14.84 | 5.05 | 5.40 | 5.06 | 5.17 |
| SEm± | 7.41 | 9.28 | 7.42 | - | 0.36 | 0.43 | 0.37 | - | 0.13 | 0.15 | 0.14 | - |
| CD (P=0.05) | 22.22 | 27.54 | 22.27 | - | 1.09 | 1.29 | 1.12 | - | 0.40 | 0.46 | 0.43 | - |

**Table 4.** Effect of weed control methods on yield of Indian mustard

| Treatment | Seed yield (kg/ha) | | | | Stover yield (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2010-11 | 2011-12 | 2012-13 | Mean | 2010-11 | 2011-12 | 2012-13 | Mean |
| Pendimethalin 1.0 kg/ha (P.E.) | 1663 | 1754 | 1665 | 1694 | 5650 | 4894 | 5660 | 5401 |
| Oxadiargyl 0.09 kg/ha (P.E.) | 1836 | 1824 | 1838 | 1833 | 5876 | 5274 | 5882 | 5677 |
| Oxyfluorfen 0.15 kg/ha (P.E.) | 1742 | 1700 | 1750 | 1731 | 5739 | 4700 | 5741 | 5393 |
| Quizalofop 0.06 kg/ha (30 DAS) | 1590 | 1691 | 1595 | 1625 | 5438 | 4679 | 5439 | 5185 |
| Clodinafop 0.06 kg/ha (30 DAS) | 1546 | 1788 | 1548 | 1627 | 5332 | 5080 | 5334 | 5249 |
| Isoproturon 1.0 kg/ha (P.E.) | 1704 | 1721 | 1708 | 1711 | 5665 | 4730 | 5666 | 5354 |
| Isoproturon 1.0 kg/ha (30 DAS) | 1614 | 1651 | 1620 | 1628 | 5502 | 4652 | 5509 | 5221 |
| Weedy check | 1141 | 1513 | 1147 | 1267 | 4884 | 4283 | 4885 | 4684 |
| Weed free | 1957 | 1961 | 1961 | 1960 | 6038 | 5512 | 6040 | 5863 |
| SEm± | 63.4 | 55.3 | 64.9 | - | 161.6 | 154.1 | 163.6 | |
| CD (P=0.05) | 190.1 | 164.3 | 195.4 | - | 484.4 | 457.7 | 484.9 | |

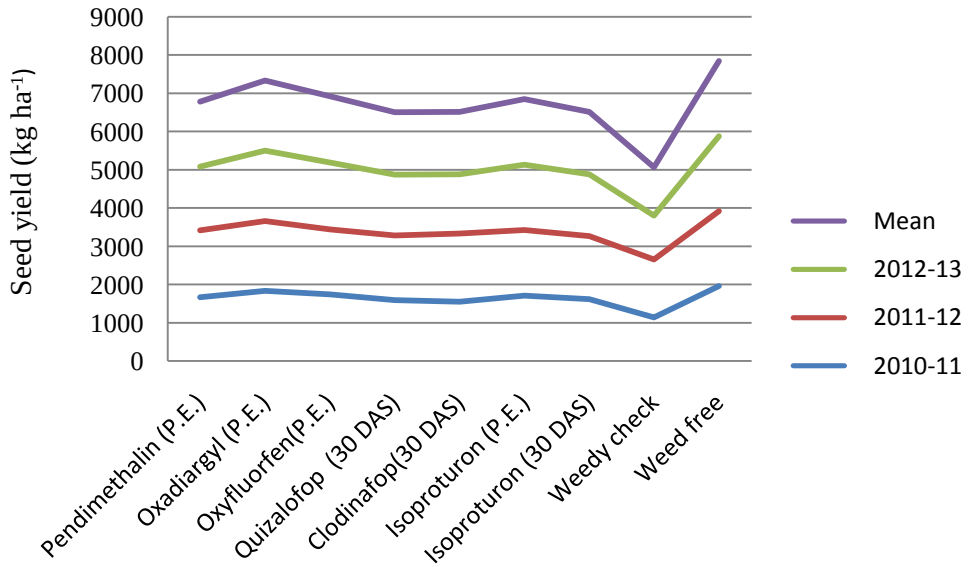


**Fig 1**. Effect of weed control methods on seed yield of Indian mustard

**Table 5.** Effect of weed control methods on economics of Indian mustard

| Treatment | Gross return* (x $10^3$ `/ha) | | | | Cost of cultivation (x $10^3$ `/ha) | | | | Net return (x $10^3$ `/ha) | | | | Benefit: cost ratio | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010-11 | 2011-12 | 2012-13 | Mean | 2010-11 | 2011-12 | 2012-13 | Mean | 2010-11 | 2011-12 | 2012-13 | Mean | 2010-11 | 2011-12 | 2012-13 | Mean |
| Pendimethalin1.0 kg/ha (P.E.) | 30.77 | 34.90 | 49.95 | 38.54 | 14.57 | 17.24 | 15.67 | 15.83 | 16.20 | 17.66 | 34.28 | 22.71 | 1.11 | 1.02 | 2.19 | 1.44 |
| Oxadiargyl 0.09 kg/ha (P.E.) | 33.97 | 36.38 | 55.14 | 41.83 | 14.37 | 16.99 | 15.47 | 15.61 | 19.60 | 19.39 | 39.67 | 26.22 | 1.36 | 1.14 | 2.56 | 1.69 |
| Oxyfluorfen 0.15 kg/ha (P.E.) | 32.23 | 33.80 | 52.50 | 39.51 | 14.32 | 16.99 | 15.42 | 15.58 | 17.91 | 16.81 | 37.08 | 23.94 | 1.25 | 0.99 | 2.40 | 1.55 |
| Quizalofop 0.06 kg/ha (30 DAS) | 29.42 | 33.62 | 47.85 | 36.96 | 14.07 | 16.74 | 15.18 | 15.33 | 15.35 | 16.89 | 32.67 | 21.64 | 1.09 | 1.01 | 2.15 | 1.42 |
| Clodinafop 0.06 kg/ha (30 DAS) | 28.61 | 35.62 | 46.44 | 36.89 | 14.17 | 16.84 | 15.27 | 15.43 | 14.44 | 18.78 | 31.17 | 21.46 | 1.02 | 1.12 | 2.04 | 1.39 |
| Isoproturon 1.0 kg/ha (P.E.) | 31.52 | 34.20 | 51.24 | 38.99 | 14.32 | 16.99 | 15.42 | 15.58 | 17.20 | 17.22 | 35.82 | 23.41 | 1.20 | 1.01 | 2.32 | 1.51 |
| Isoproturon 1.0 kg/ha (30 DAS) | 29.86 | 32.87 | 48.60 | 37.11 | 14.32 | 16.99 | 15.43 | 15.58 | 15.54 | 15.89 | 33.12 | 21.51 | 1.09 | 0.93 | 2.15 | 1.39 |
| Weedy check | 21.11 | 30.13 | 34.41 | 28.55 | 13.57 | 16.24 | 14.68 | 14.83 | 7.54 | 1.39 | 19.74 | 9.55 | 0.56 | 0.86 | 1.34 | 0.92 |
| Weed free | 36.21 | 39.03 | 58.83 | 44.69 | 16.82 | 19.49 | 17.92 | 18.08 | 21.39 | 21.55 | 42.91 | 28.62 | 1.27 | 1.11 | 2.39 | 1.58 |
| SEm± | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CD (P=0.05) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

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