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# Efficacy of different herbicides for controlling weeds in onion

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**ABSTRACT**

*A field experiment was conducted to examine the efficacy of different herbicides for controlling weeds in onion (Allium cepa L.) during rabi 2012 and 2013. The experiment was laid out in randomized complete block design with different weed management practices viz. alachlor @ 1.25 kg ha$^{-1}$, oxyfluorfen @ 0.25 kg ha$^{-1}$, quizolofop ethyl @0.05 kg ha$^{-1}$, pendimethalin @ 0.75 ha$^{-1}$, pendimethalin@ 0.75 kg ha$^{-1}$+ one hand weeding (30 DAT), two hand weddings (30 and 60 days after transplanting (DAT) and control (unweeded). Application of all the herbicides caused a significant reduction in the weed population and weed dry matter over unweeded control in both the years of investigation. The parameters that significantly affected by different herbicides were bulb weight, bulb diameter and onion bulb yield. Application of pendimethalin @ 0.75 kg a.i ha$^{-1}$ + one HW (30 DAT) gave the highest bulb yield which was at par with two hand weedings (30 and 60 DAT). The highest net returns of Rs 194.2 × 10$^3$ ha$^{-1}$ with B : C ratio 2.72 was obtained in the pendimethalin @ 0.75 kg ha$^{-1}$+ one HW (30 DAT) followed by two hand weedings (30 and 60 DAT). Unweeded control treatment recorded lowest net returns of Rs 112.4 × 10$^3$ ha$^{-1}$ with benefit: cost ratio 1.64.*

***Keywords*:** Bulbs, competition, herbicides, onion, weeds

Onion (*Allium cepa* L.) is an important vegetable crop and it is used as a flavoring agent in both vegetarian and non vegetarian diets. It occupies a prominent place among vegetables and is cultivated commercially throughout the tropical and subtropical belt of the world. India is the second largest producer of onion in the world after China but productivity of onion in India is very low as compared to other leading countries in the world due to many factors. Weeds are one of the most important factors known to cause reduction in onion yield. Onion plants are poor competitors with weeds due to its short stature, non branching habit, sparse foliage and shallow root system. In addition, their long growing season allows several successive flushes of weeds. Weeds compete with the crop plants for nutrients, water, space and light resulting in losses in yield, quality and value of the crop through increased production and harvesting cost (Hussain 1983). A loss in yield due weed infestation upto 40-60 per cent in onion was reported also by Verma and Singh (1997). These days' modern weed control techniques involve the use of herbicides. Hence, the present study was planned to evaluate the efficacy of different pre and post emergence herbicides on weed growth and yield in onion.

## MATERIALS AND METHODS

The field experiment was conducted at Krishi Vigyan Kendra, Nurmahal, Jalandhar to study the efficacy of different herbicides for controlling weeds in onion during the year 2012 and 2013 in *rabi* season. Krishi Vigyan Kendra, Nurmahal, Jalandhar is geographically situated at 31°09'N latitude, 75°59' E longitude and at an altitude of about 237 m above mean sea level . The experimental site was sandy loam in texture, low in organic carbon (0.31) with available nitrogen (195 kg ha$^{-1}$), high in available phosphorus (28.7 kg ha$^{-1}$) and medium in available potassium (151 kg ha$^{-1}$) in 0-15 cm soil depth. Experiment was laid out in randomized complete block design and was replicated thrice. The treatments consists of $T_1$-Alachor @ 1.25 kg a.i. ha$^{-1}$, $T_2$-Oxyfluorfen@ 0.25 kg a.i. ha$^{-1}$, $T_3$-Quizalofop ethyl @ 0.05 kg a.i ha$^{-1}$, $T_4$- Pendimethalin @ 0.75 kg a.i. ha$^{-1}$, $T_5$- Pendimethalin @ 0.75 kg a.i. ha$^{-1}$+ one HW (30 DAT), $T_6$- Two hand weedings (30 and 60 DAT) and $T_7$- Unweeded control. The herbicidal treatments were imposed within three days of transplanting in case of pre emergence herbicides but $T_3$- Quizafop ethyl @ 0.05 kg a.i ha$^{-1}$ was sprayed at 15 days after transplanting as post emergence. The gross plot size was 25 m$^2$. The nursery of onion (cv. PRO-6) was sown on raised beds using seed rate 10 kg ha$^{-1}$in last week of October in

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both the years. The transplanting of the onion seedlings in the field was done in first fortnight of January in both the years following 15cm row to row spacing and plant to plant spacing followed was 7.5 cm. The crop was raised with recommended package of practices by Punjab Agricultural University, Ludhiana except weed control treatments. The uprooting of the bulbs was done manually in the first week of May during *rabi* 2012 and last week April during *rabi* 2013. After harvesting, the bulbs were cured and then leaves were cut 1-2 cm above the neck and bulb yield was recorded. The data on weed density (number $m^{-2}$), and weeds dry matter (g $m^{-2}$) were recorded at 60 DAS and at harvest. Weed control efficiency was also calculated 60 DAS and at harvest. The data on fresh bulb weight (g), plant height (cm), bulb diameter (cm) and onion yield (q $ha^{-1}$) was recorded at harvesting. To calculate economics, cost-benefit ratio, cost of cultivation and net return were calculated for the crop. The data collected on various parameters under study were statistically analyzed and comparisons were made at 5 per cent level of significance.

## RESULTS AND DISCUSSION

### *Effect on weeds*

Both grassy and broad leaf weeds infested the experimental plots**.** The major weed floras present in weedy plot of the experiment were *Poa annua, Cyperus rotundus*, *Anagallis arvensis*, *Convolvulus arvensis, Lepidium sativum* and *Medicago denticulate. Poa Annum* (52%) was the most prominent weed species present in experimental plots followed by *Cyperus rotundus* (20%), *Anagallis arvensis* (13%) and *Coronopus didymus* (12%).

The phototoxity data was also observed at an interval of 20 and 30 days after application of herbicides. There were no phototoxity symptoms recorded on onion crop. The result indicated that the weed density increased with increase in the age of the crop. It has been observed that all the treatments significantly affected weed density (number of weed $m^{-2)}$ both at 60 DAT and at the time of uprooting. The lowest weed density (13.9) at 60 DAT was observed where pendimethalin@ 0.750 kg a.i $ha^{-1}$ was applied in combination with one hand weeding which was *at par* with two hand weedings at 30 and 60 DAT followed by pendimethalin @ 0.75 kg a.i $ha^{-1}$ and oxyfluorfen @ 0.25 kg a.i $ha^{-1}$. Similarly at uprooting stage, pendimethalin @ 0.75 kg a.i $ha^{-1}$ + one HW(30 DAT) and two hand weedings at 30 and 60 DAT were found to be most effective in controlling weeds over all other treatments i,e, weed density was 30.1 and 33.5 weeds $m^{-2}$ ,respectively.

| Botanical name | Leaf morphology | Family | Proportion of total weeds (%) |
|---|---|---|---|
| *Poa annua* | Grasses | Gramineae | 52 |
| *Cyperus rotundus* | Sedges | Cyperaceae | 20 |
| *Anagallis arvensis* | Broad leafed | Primulaceae | 13 |
| *Coronopus didymus* | Broas leafed | Brassicaceae | 12 |
| *Convolvulus arvensis* | Broad leafed | convolvulaceae | 9 |
| *Rumex dentatus* | Broad leafed | Polygonaceae | 6 |
| *Medicago denticulata* | Broad leafed | Leguminoseae | 4 |

Highest weed density was observed in unweeded control plot at both the stages. The variability in weed population in different treatments could be attributed to the fact that some herbicidal treatments were more effective for weed control than the other. These results are in agreement with those of (Saini and Walia 2012). Similarly, at both the growth stages weed dry weight was lowest (0.13 and 11.6 g $m^{-2}$) in plots sprayed with pendimethalin @ 0.75 kg a.i $ha^{-1}$ + one HW. However, the maximum dry weed biomass (36.2 and 119.5 g $m^{-2}$) was recorded in unweeded plot where weeds were not controlled. These results are in agreement with the findings of Qasem (2006) and Muhammad Zubair *et al*. (2007). They also found similar results in that application of herbicides and hand weeding significantly reduced weed biomass. Significantly highest weed control efficiency was also observed with pendimethalin @ 0.75 kg a.i $ha^{-1}$ + one HW (30 DAT) followed by two hand weeding at 30 and 60 DAT (99.6 and 90.3, respectively). It was observed that the weedicide alachor was least efficient in controlling weeds amongst all the herbicides at both the stages *i.e*. 51.6 per cent at 60 DAT and 68.7 per cent at uprooting stage.

**Table 1: Effect of different treatments on weeds population and weed control efficiency (pooled)**

| Treatments | Weed density (No. $m^{-2}$) | | Dry matter accumulation (g $m^{-2}$) | | Weed control efficiency (%) | |
|---|---|---|---|---|---|---|
| | 60DAT | At harvest | 60DAT | At harvest | 60DAT | At Harvest |
| Alachor | 50.6 | 77.25 | 17.5 | 37.4 | 51.6 | 68.7 |
| Oxyfluorfen@ 0.25 kg a.i $ha^{-1}$ | 21.5 | 45.18 | 5.4 | 14.7 | 85.1 | 87.7 |
| Quizalofop ethyl @ 0.05 kg a.i $ha^{-1}$ | 30.6 | 54.56 | 9.2 | 28.8 | 74.5 | 76.6 |
| Pendimethalin @ 0.75 kg a.i $ha^{-1}$ | 20.4 | 42.83 | 5.3 | 14.5 | 85.4 | 87.8 |
| Pendimethalin @ 0.75 kg a.i $ha^{-1}$ + one HW(30 DAT) | 13.9 | 30.3 | 0.13 | 11.6 | 99.6 | 90.3 |
| Two hand Weedings (30 and 60 DAT) | 12.6 | 33.2 | 0.18 | 11.9 | 99.5 | 90.0 |
| Control | 87.6 | 144.6 | 36.2 | 119.5 | - | - |
| **LSD (0.05)** | **1.17** | **1.20** | **0.2** | **0.5** | **-** | **-** |

**Table 2: Effect of different treatments on yield attributes and economics of onion (pooled)**

| Treatments | Plant height (cm) | Bulb fresh weight (g) | Bulb dia. (cm) | Bulb yield (t $ha^{-1}$) | Gross income (Rs×$10^3$ $ha^{-1}$) | Net return (Rs ×$10^3$ $ha^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|---|
| Alachor | 62.9 | 47.6 | 4.50 | 24.1 | 216.9 | 145.2 | 2.02 |
| Oxyfluorfen@ 0.25 kg a.i $ha^{-1}$ | 68.5 | 55.3 | 5.40 | 27.6 | 248.4 | 178.4 | 2.55 |
| Quizalofop ethyl @ 0.05 kg a.i $ha^{-1}$ | 65.1 | 50.0 | 4.85 | 25.8 | 232.2 | 159.4 | 2.19 |
| Pendimethalin @ 0.75 kg a.i $ha^{-1}$ | 67.2 | 57.2 | 5.65 | 27.9 | 251.1 | 181.3 | 2.60 |
| Pendimethalin @ 0.75 kg a.i $ha^{-1}$ + one HW(30 DAT) | 69.9 | 59.9 | 5.80 | 29.5 | 265.5 | 194.2 | 2.72 |
| Two hand Weedings (30 and 60 DAT) | 69.7 | 55.6 | 4.01 | 28.5 | 256.5 | 184.3 | 2.50 |
| Control | 57.0 | 40.0 | 3.98 | 20.1 | 180.9 | 112.4 | 1.64 |
| **LSD (0.05)** | **0.9** | **5.1** | **0.36** | **2.4** | **-** | **-** | **-** |

***Effect on yield attributes, yield and economics***

The yield and yield attributes of onion also showed a significant variations among all the treatments (Table 2).The highest plant height (69.9 cm) was recorded with pendimethalin @ 0.75 kg a.i. $ha^{-1}$ + one HW (30 DAT) which was stastically *at par* with two hand weedings (69.7cm). The lowest plant height (57.0 cm) was recorded in control which might be attributed in case of weed free conditions the plants developed to full size without any stress or competition with weeds for nutrients, space and light. Bulb weight was significantly affected by different treatments of herbicides. The highest bulb weight (59.9g) was recorded in use of pendimethalin @ 0.75 kg a.i. $ha^{-1}$ + one HW (30 DAT), followed by two hand weeding (55.6g) which was *at par* with oxyfluorfen @ 0.25 kg a.i. $ha^{-1}$ ( 55.3g). However, minimum bulb weight (40.0g) was obtained in unweeded control followed by alachor (47.6g) and quizalofop ethyl @ 0.050 kg $ha^{-1}$ (50.0g). Weeds seriously affected bulb weight and drastically reduced yield. The variability is due to effectiveness of weed control methods which ultimately increased the nutrient availability for the crop (Marwat *et al.*, 2003). Bulb yield of onion was significantly influenced by weed control treatment during both the years of study. The statistical analysis of data exhibited that different herbicides had significant effect on onion yield. The highest bulb yield (29.5 t $ha^{-1}$) was recorded

in pendimethalin @ 0.75 kg a.i. $ha^{-1}$ + one HW (30 DAT) which was *at par* with two hand weedings (30 and 60 DAT). These treatments proved significantly better than unweeded control treatment due to less intensity of weeds and better yield attributes. Pre emergence herbicides as a whole produced better results. Pre emergence herbicides controlled the weeds throughout the critical stage of the onion. Thus, increased the availability of nutrients to the crop. These results are in line with those reported by Murty *et al*. (2008) that hand weeding as well as herbicidal treatment resulted in higher yield than unweeded control. Use of pendimethalin with combination is also found effective by Tripathy *et al*. (2013) The highest net return of Rs 194258 $ha^{-1}$ and benefit cost ratio (2.72) was obtained with pendimethalin @ 0.75 kg a.i. $ha^{-1}$ + one HW (30 DAT). Unweeded control treatment recorded the lowest net returns of Rs 112458 $ha^{-1}$ with B:C ratio 1.64. These results clearly indicated that all the herbicidal treatments gave optimum cost benefit ratio as compared to the yield in unweeded control.

The study revealed that application of all the herbicides caused a significant reduction in the weed population and weed dry matter over unweeded control. Application of pendimethalin @ 0.75 kg a.i. $ha^{-1}$ + one HW (30 DAT) gave the highest bulb yield which was *at par* with two hand weedings (30 and 60 DAT)**.** The highest net returns of Rs $194.2 \times 10^3$ $ha^{-1}$ with B : C ratio 2.72 was obtained in the pendimethalin @ 0.75 kg a.i. $ha^{-1}$ + one HW (30 DAT) followed by two hand weedings (30 and 60 DAT). It was concluded that integrated weed management practice should be followed in onion to get good control on weeds. Hand weedings although gives better control of weeds but it can only be practiced at small scale onion fields. But at large scale cultivation in state like Punjab, labour is very costly and limited so it is difficult to control weeds manually. So, the farmers should follow the combination of chemical as well manual practices for onion to increase productivity.

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