INTRODUCTION

Onion is one of the most important commercial vegetable crops grown all over the world. Globally it is considered to be the second most important vegetable after tomatoes. China is the leading country in production of followed by India and then USA. Presently, an annual production of onion is 21,564 thousand MT from an area of about 1270 thousand hectare with a productivity of 17.0 MT/ha (Anon, 2017). Onion exhibits greater susceptibility to weed competition as compared to other crops due to its inherent characteristics such as slow germination, extremely slow growth in the initial stages, short stature, non-branching habit, sparse foliage and shallow root system. Therefore, quick and fast growth of weeds in the initial stages and competition thus tends to be severe. In addition to this, frequent irrigation water and fertilizer application allows for successive flushes of weeds in onion. It has been reported by Channapagoudar and Biradar (2007) that yield loss due to weed infestation in onions to the tune of 40 to 80 per cent. Conventional methods of weed control i.e. hand weeding is no doubt effective but it is time consuming, cumbersome, expensive and under many situations becomes uneconomical. Moreover, weeding during critical growth stages is

Effect of Integrated Weed Management on Growth and Yield of Kharif Onion (Allium cepa)

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ABSTRACT

The present study was carried out at the KrishiVigyan Kendra, Dewas during kharif 2015-16, 2016-17 and 2017-18 with the objectives to find out practically convenient and economically viable weed management practices on growth, yield and yield attributing characters of kharif onion. The experiment was laid out in randomized block design with 9 treatments viz., T1 = control (without hand weeding and chemical herbicides), T2 = three hand weeding at 20, 40 and 60 DAT, T3 = one hand weeding at 20 DAT, T4 = pendimethalin @ 1.0 kg/ha (pre-plant incorporation-PPI), T5 = oxyfluorfen @ 0.250 kg/ha (post emergence-PoE), T6 = pendimethalin @ 1.0 kg/ha (PPI) + one Hand weeding (HW) at 40 DAT, T7 = oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT, T8 = pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE), T9 = pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 Kg/ha (PoE) + one HW at 40 DAT with three replications. All the weed management practices resulted in significantly lower weed density relative to contrast. Highest plant height (59.69 cm), neck thickness (1.11 cm), leaves/plant (8.28) were recorded in hand weeding at 20, 40 and 60 DAT which was statistically at par with pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 Kg/ha (PoE) + one HW at 40 DAT but significantly higher than control. Hand weeding at 20, 40 and 60 DAT resulted in significantly higher bulb weight (92.12 g), bulb diameter (6.37 cm) and bulb yield (272.14 q/ha) as compared to rest of the treatments. Among chemical treatments, pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 Kg/ha (PoE) + one HW at 40 DAT resulted in significantly higher bulb weight (88.67 g), bulb diameter (6.14 cm) and bulb yield (267.84 q/ha). Highest net returns (Rs1,77,697/ha) and B:C(4.39) were obtained with the application of pendimethalin @ 1.0 Kg/ha (PPI) + oxyfluorfen @ 0.250 Kg/ha (PoE) + one hand weeding at 40 DAT making it practically more convenient and economically viable weed management practice.

Key Words: Hand weeding, Kharif onion, Oxyfluorfen, Pendimethalin.
very difficult due to increased cost of human labour and its scarce availability.

The critical period of crop-weed competition in onion lies between 15-60 days after transplanting. Hence, managing the weeds meticulously in early stages is an imperative task to get higher weed control efficiency and bulb yield. Herbicides when used in combination with one or two hand weedings showed improved efficiency in control of weeds. The control of weeds either through herbicide alone or in combination with hand weeding at 45 days after transplanting registered higher net returns as compared to weed free check (Ved Prakash et al, 2000). Spraying of pre-emergence herbicides keeps the crop in weed free conditions during early stages. Then, at later stages hand weeding or application of post emergence herbicides helps to reduce the cost of weeding and keep the weed population below economic threshold level throughout the crop growth period. Hence, an attempt was made to find out the appropriate combination of cultural and chemical weed management practices for weed control in onion may be practically effective and economically viable for farmers.

MATERIALS AND METHODS

A field experiment was conducted at the Krishi Vigyan Kendra Farm, Dewas during kharif 2015-16, 2016-17 and 2017-18. The experiment was conducted on medium deep black soil and the texture of the soil was clay loam type. The soil pH of the plots was found to be in the range of 7.7. The soil of the experimental site had 0.38%, 247 kg/ha, 20.8 kg/ha, 332 kg/ha organic carbon, available N, P and K, respectively. The experiment was laid out in a randomized block design with three replications. The experiment consist of nine treatments viz., T_1 = control (without hand weeding and chemical herbicides), T_2 = three hand weeding at 20, 40 and 60 DAT, T_3 = one hand weeding at 20 DAT, T_4 = pendimethalin @ 1.0 kg/ha (pre-plant incorporation-PPI), T_5 = oxyfluorfen @ 0.250 kg/ha (PoE), T_6 = pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 Kg/ha (PoE) + one HW at 40 DAT, T_7 = oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT, T_8 = pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE), T_9 = pendimethalin @ 1.0 kg/ha (PPI) +oxyfluorfen @ 0.250 Kg/ha (PoE) + one HW at 40 DAT. 45 days old seedlings of onion ‘Agrifound Dark Red’, were transplanted in the month of August during all the years at a spacing of 20 cm × 10 cm. Pendimethalin was applied before one week of transplanting as PPI, while oxyfluorfen was applied 25 days after transplanting when weeds are at 3-4 leaf stage. Weed density was recorded at 75 days after transplanting of crop by placing a quadrat of 50 cm×50 cm randomly from three places in each plot. The data for vegetative parameters (plant height, number of leaves and neck thickness) was recorded at 75 DAT and yield parameters (bulb weight, bulb diameter and total bulb yield) were recorded at harvest. For economic study, prevailing market price was used for different outputs and inputs. Statistical analysis of the data obtained in different set of experiments was calculated following the standard procedure as stated by Panse and Sukhatme (1989).

RESULTS AND DISCUSSION

Effect on weeds

All treatments showed significant reduction in total weed density as compared to unweeded control during all the 3 years (Table 1). Significantly lower weed density (31.37/m^2) was observed in three hand weedings at 20, 40 and 60 DAT. Highest weed density (140.13/m^2) of weeds was recorded in control plot. These results might be due to the fact that Pre-plant incorporation (PPI) of pendimethalin causes reduction in germination of total weed population during initial period of crop growth, further the application of oxyfluorfen as post emergence herbicide (PoE) might have control to the first flush of broad leaf weeds in onion, when applied at 25 DAT. This was combined with hand weeding at 40 DAT, be efficient for the control of remaining grassy weeds and second flush of broad leaf weeds. This was also in consonant with Warade et al (2006).
Effect on crop growth and yield attributes
The data (Table 1) showed significant variations among treatments in respect of all vegetative growth parameters and yield attributes. Highest growth attributes viz. plant height (59.69 cm), neck thickness (1.11 cm), number of leaves per plant (8.28), bulb weight (92.12 g) and bulb diameter (6.37 cm) were observed with three hand weedings at 20, 40 and 60 DAT. However application of pendimethalin @ 1.0 Kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one hand weeding at 40 DAT was at second place in respect of all these attributes. Whereas, all growth and yield attributes were significantly lowest under control plot. It might be due to less weed crop competition throughout crop growth period by manual weeding, which in turn maintain the soil fertility status by way of removing less plant nutrients through weeds and ultimately have favourable effect on growth parameters and yield attributes. Suppression of weed competition by pre and post emergence herbicide application was further enhanced by integrating hand weeding at 40 DAT in weed control treatments, which offers efficient and prolonged weed control and kept the crop weed free during the critical periods of competition. These findings were in close conformity with those reported by Chandrika et al (2009), Bharathi et al (2011), Kalhapure et al (2013) and Gandolkar et al (2015).

Effect on yield
Significant variations were also observed for bulb yield in onion. The highest bulb yield of 272.14 q/ha was obtained under three hand weedings at 20, 40 and 60 DAT followed by pendimethalin @ 1.0 Kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one hand weeding at 40 DAT (268.84 q/ha). Lowest bulb yield was recorded in control treatment which was significantly different from rest of the treatments. Increase in bulb yield with hand weeding and herbicide can be attributed to reduction in weed density low during the entire crop growth period leading to increased growth and yield attributes. These results were in close conformity with Chopra and Chopra (2007).

Economics
The data related to cost of cultivation, gross return, net return, benefit: cost ratio under various weed management practices are presented in Table 2. The highest net monetary return of Rs 1.78 lakhs/ha was obtained with application of pendimethalin @ 1.0 Kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha...
Table 2. Effect of weed management practices on bulb yield and economics of *kharif* onion.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Bulb Yield (q/ha)</th>
<th>Cost of cultivation (Lakh/ha) (Rs.)</th>
<th>Gross Return (Lakh/ha) (Rs.)</th>
<th>Net Return (Lakh/ha) (Rs.)</th>
<th>B:C</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>236.54</td>
<td>0.48</td>
<td>2.03</td>
<td>1.55</td>
<td>4.19</td>
</tr>
<tr>
<td>T₂</td>
<td>272.14</td>
<td>0.59</td>
<td>2.34</td>
<td>1.75</td>
<td>3.97</td>
</tr>
<tr>
<td>T₃</td>
<td>255.80</td>
<td>0.51</td>
<td>2.20</td>
<td>1.68</td>
<td>4.28</td>
</tr>
<tr>
<td>T₄</td>
<td>257.51</td>
<td>0.50</td>
<td>2.21</td>
<td>1.71</td>
<td>4.40</td>
</tr>
<tr>
<td>T₅</td>
<td>258.13</td>
<td>0.51</td>
<td>2.22</td>
<td>1.71</td>
<td>4.37</td>
</tr>
<tr>
<td>T₆</td>
<td>264.57</td>
<td>0.52</td>
<td>2.27</td>
<td>1.75</td>
<td>4.38</td>
</tr>
<tr>
<td>T₇</td>
<td>265.83</td>
<td>0.52</td>
<td>2.28</td>
<td>1.76</td>
<td>4.37</td>
</tr>
<tr>
<td>T₈</td>
<td>260.78</td>
<td>0.51</td>
<td>2.24</td>
<td>1.73</td>
<td>4.39</td>
</tr>
<tr>
<td>T₉</td>
<td>267.84</td>
<td>0.52</td>
<td>2.30</td>
<td>1.78</td>
<td>4.39</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.69</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LSD(p=0.05)</td>
<td>1.31</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

(POE) + one hand weeding at 40 DAT with benefit: cost of 4.41. Though weeds were controlled more efficiently and bulb yield production was highest in treatment three hand weedicings at 20, 40 and 60 DAT, its cost of cultivation was also higher (Rs0.59 lakh/ha) because of the higher human labour requirement and their higher wages. The cost of human labours for controlling weeds was reduced with application of pre and post emergence herbicides in combination with hand weeding, which was responsible for reduction in total cost of cultivation, resulting maximum B:C in treatment pendimethalin @ 1.0kg/ha (PP) + oxyfluorfen @ 0.250kg/ha (POE) + one handweeding at 40 DAT. Economical parameters of onion irrespective of methods of weed control were also studied by Patel *et al* (2011).

**CONCLUSION**

From the results, it can be concluded that application of pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (POE) + one hand weeding at 40 DAT was more effective, practically convenient and economically viable practice for weed control in *kharif* onion.

**REFERENCES**


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