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Research Paper

Integarted weed management in onion (*Allium cepa*)

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ABSTRACT

An integrated weed management study on onion (*Allium cepa* L.) was conducted in two consecutive *kharif* seasons of years 2010 and 2011 in a randomized block design with 9 treatments, having combinations of hand weeding with application of pendimethalin @ 1.0 kg/ha pre-plant incorporation (PPI) and oxyfluorfen @ 0.250 kg/ha post-emergence (PoE). Weed management with three hand weedings (HW) at 20, 40 and 60 DAT recorded significantly lowest weed density, dry weight of weeds and higher weed control efficiency and maximum in all the growth and yield attributes of onion *viz*. plant height, neck thickness, bulb weight, bulb diameter and bulb yield. Highest net monetary returns (₹110.3 × 10^3/ha) and B:C ratio (2.76) were obtained with the application of pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + One hand wedding at 40 DAT, which was found practically more convenient and economically feasible weed management method in onion.

Key words : Hand weeding, Integrated weed management, Onion, Oxyfluorfen, Pendimethalin

Onion is one of the most important commercial vegetable crops grown all over the world. In India onion occupies about 1.06 million hectare area having 15.12 million metric tonnes of production and average productivity of 14.2 metric tonnes/ha (Anonymous 2011). Onion has culinary, dietary and medicinal importance in daily life of Indian people and due to its export trade, it is also a major vegetable crop to gain foreign currency.

Onion crop is slow growing, shallow rooted, narrow, upright leaves and non branching habit. Due to this type of growing habit, onion crop cannot compete well with weeds. In addition to this, frequent irrigation water and fertilizer application allows for successive flushes of weeds in onion. Yield loss due to weed infestation in onion is to the tune of 40 to 80% (Channapagoudar and Biradar, 2007).

The conventional methods of weed control (hoeing and weeding) are laborious, expensive and insufficient. Moreover, weeding during critical growth stages is very difficult due to increased cost of human labours and its scarce availability. On the other hand, use of herbicides alone does not prove effective for weed control due to their spectrum of weed kill. Hence an attempt was made to find out the appropriate combination of cultural and chemical weed management practices for weed control in onion, which is practically effective and economically feasible for farmers.

MATERIALS AND METHODS

A field experiment with 9 weed control treatments (Table 1) laid out in a randomized block design replicated thrice, was conducted during *kharif* seasons of 2010 and 2011 at breeder seed production farm of Mahatma Phule Krishi Vidyapeeth, Rahuri in onion. The experimental site was located at 19^0 47' N latitudes and 74^0 81' E longitudes with average annual rainfall of 520 mm. The soil of experimental field was medium deep with pH 6.5, organic carbon 0.57%, available N 375 kg/ha, P_2O_5 16 kg/ha and K_2O 275 kg/ha. All the recommended package of practices was followed for raising the onion crop. Two months old seedlings of onion 'Baswant 780', were transplanted in the month of August during 2010 and 2011 at a spacing of 45 cm × 10 cm on ridges and furrows type of layout. Pendimethalin was applied before one week of transplanting as pre planting, while oxyfluorfen was applied 25 days after transplanting when weeds are at 3-–4 leaf stage as per the treatment details given in table 1, 2 and 3 with knapsack sprayer.

Weed density and dry weight of weeds were recorded at 75 days after transplanting of crop by placing a quadrat of 50 cm × 50 cm randomly from three places in each plot. Weed control efficiency was calculated by the formula given below

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$$WCE\ (\%) = \frac{DMC - DMT}{DMC} \times 100$$

Where, DMC is dry matter weight of weeds in the control plot and DMT is dry matter weight of weeds in treated plot.

Data on growth attributes were recorded from 25 DAT up to harvest from 5 randomly selected plants, whereas the peak growth study at 75 days after transplanting were mention in the table. However, yield attributes and yield data recorded from net plot at harvest. For economic study, prevailing market price was used for different outputs and inputs. The similar trend of results was observed during 2010 and 2011 for all the characters. Hence the pooled analysis was done for the results and discussion.

RESULTS AND DISCUSSION

Effect on weeds

The prominent weed species in the experimental plot were *Chenopodium album, Portulaca oleraceae, Euphorbia spp., Cynodon dactylon, Parthenium hysteroiphorous, Cyperus rotundas, Amaranths viridis* etc. All treatments showed significant reduction in total weed density and dry weight of weeds as compared to unweeded control during both the years (Table 1). Significantly lower weed density was observed with the treatment of three hand weedings at 20, 40 and 60 DAT. It was on par with the treatment pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one hand weeding at 40 DAT. Highest weed density and dry weight of weeds was recorded in treatment weedy check.

Treatment of three hand weedings at 20, 40 and 60 DAT showed highest weed control efficiency, followed by the treatment pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one hand weeding at 20 DAT. In case of integrated weed management in onion combination of chemical and cultural weed control is found to be effective. PPI of pendimethalin causes reduction in germination of total weed population during initial period of crop growth, further the PoE application of oxyfluorfen 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 results obtained by the early workers as Kolhe (2001) and Warade *et al*. (2006).

Effect on crop growth and yield attributes

Weed management treatments under investigation showed significantly superiority over control in respect of all growth and yield attributes of onion during both the years (Table 2). Highest growth attributes (*viz*. plants height, neck thickness, bulb weight and bulb diameter) 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 20 DAT was at second place in respect of all these attributes. Similar trend was observed in respect of dry matter per plant. This was due to lesser crop–weed competition at earlier stage for growth resources, thus providing favorable environment to crop for better expression of growth and yield. 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. Khokhar *et al*. (2006) and Chandrika *et al*. (2009) also reported similar results from their studies.

Table 1. Effect of integrated weed management on various weed parameters in onion.

Treatment	Weed density at 75 DAT (no./m^2)	Dry matter weight of weeds at 75 DAT (g/m^2)	Weed control efficiency at 75 DAT (%)
Three HW at 20, 40 and 60 DAT	37.8	32.5	74.3
One HW at 20 DAT	71.6	73.9	41.7
Pendimethalin @ 1.0 kg/ha (PPI)	80.5	74.2	41.4
Oxyfluorfen @ 0.250 kg/ha (PoE)	78.3	70.1	44.7
Pendimethalin @ 1.0 kg/ha (PPI) + one HW at 40 DAT	57.7	56.0	55.8
Oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT	51.4	52.2	58.8
Pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE)	60.4	58.9	54.5
Pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT	39.3	38.9	69.3
Weedy check (Control)	152.7	126.7	0
SEm±	3.6	3.8	—
CD (P=0.05)	10.7	11.5	—

HW: Hand weeding; PPI: Pre-plant incorporation; PoE: Post emergence

Table 2. Effect of integrated weed management practices on various growth and yield attributes and yield of onion.

Treatment	Plant height at 75 DAT (cm)	Neck thickness 75 DAT (cm)	Bulb weight 75 DAT (g)	Bulb diameter 75 DAT (cm)	Dry matter weight 75 DAT (g/plant)	Bulb yield (t/ha)
Three HW at 20, 40 and 60 DAT	51.43	1.35	74.25	6.20	21.93	26.09
One HW at 20 DAT	31.43	1.21	42.66	3.33	12.28	19.06
Pendimethalin @ 1.0 kg/ha (PPI)	28.28	1.18	38.66	3.55	11.07	15.17
Oxyfluorfen @ 0.250 kg/ha (PoE)	26.76	1.16	38.82	3.35	11.19	15.99
Pendimethalin @ 1.0 kg/ha (PPI) + one HW at 40 DAT	35.99	1.23	55.58	4.03	16.17	20.77
Oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT	34.65	1.24	60.23	4.29	17.89	21.02
Pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE)	29.03	1.27	44.63	3.89	13.06	19.04
Pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT	46.19	1.29	68.17	5.19	20.7	23.71
Weedy check (Control)	21.38	1.16	27.82	2.25	8.09	9.11
SEm±	1.5	0.04	1.04	0.07	0.46	0.74
CD (P=0.05)	4.52	0.13	3.13	0.21	1.39	2.22

Table 3. Effect of integrated weed management practices on various economic parameters of onion.

Treatment	Cost of cultivation ($\times 10^3$₹/ha)	Net returns ($\times 10^3$₹/ha)	B : C ratio
Three HW at 20, 40 and 60 DAT	44.1	108.1	2.45
One HW at 20 DAT	32.9	73.9	2.24
Pendimethalin @ 1.0 kg/ha (PPI)	26.5	52.2	1.96
Oxyfluorfen @ 0.250 kg/ha (PoE)	27.9	57.9	2.07
Pendimethalin @ 1.0 kg/ha (PPI) + one HW at 40 DAT	35.5	83.9	2.36
Oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT	35.4	87.7	2.47
Pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE)	32.5	77.3	2.38
Pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one HW at 40 DAT	39.9	110.3	2.76
Weedy check (Control)	9.6	11.8	1.22

Effect on yield

The highest bulb yield of 26.09 t/ha was obtained under three hand weedings at 20, 40 and 60 DAT, whereas pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ ha (PoE) + one hand weeding at 40 DAT at second place with bulb yield of 23.71 t/ha. Increase in bulb yield with these treatments was because of the fact that the weed population and weed growth remain low during the entire crop growth period, which leads to increase in various growth characters of crop. These results in respect of yield attributes and yield were in close conformity with the earlier findings of Sukhadia *et al*. (2002) and Chopra and Chopra (2007).

Economics

From the economic point of view, the highest net monetary return of ₹110.3×10^3/ha was obtained with application of pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one hand wedding at 40 DAT with benefit: cost ratio of 2.76. Though weeds were controlled more efficiently and bulb yield production was highest in treatment three hand weedings at 20, 40 and 60 DAT, its cost of cultivation was also higher (₹44.1×10^3/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 ratio in treatment pendimethalin @ 1.0 kg/ha (PP)+ oxyfluorfen @ 0.250 kg/ha (POE) + one hand wedding at 40 DAT. Economical parameters of onion in respect of methods of weed control were also studied by Nandal and Singh (2002) and Patel *et al*. (2011)

On the basis of two years experimentation, it was concluded that application of pendimethalin @ 1.0 kg/ha (PPI) + oxyfluorfen @ 0.250 kg/ha (PoE) + one hand wedding at 40 DAT is more efficient, practically convenient and economically feasible method for weed control in onion.

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