

Effect of different herbicides on growth and yield of onion (*Allium cepa* L.)

N. CHATTOPADHYAY, S. MAHALANABISH, J. K. HORE AND ¹T. K. MAITY

Department of Spices and Plantation Crops, ¹ Department of Vegetable Crops,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal

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ABSTRACT

The experiment was carried out at 'C' Block Farm of BCKV, Nadia, West Bengal, India for two consecutive years to study the efficacy of some herbicides on growth and yield of onion cv. Sukhsagar. Eight treatments were included. The experiment was laid out in RBD with 3 replications. The treatments were: T₁- Oxyfluorfen 23.5% EC as pre-planting and at 30 DAT, T₂- Oxyfluorfen 23.5% EC as pre-planting + Quizalofop Ethyl 5% EC at 30 DAT, T₃- Oxyfluorfen 23.5% EC + Quizalofop Ethyl 5% EC at planting and at 30 DAT, T₄- Pendimethalin 30% EC as pre-planting and at 30 DAT, T₅- Pendimethalin 30% EC as pre-planting + Quizalofop Ethyl 5% EC at 30 DAT, T₆- Pendimethalin 30% EC + Quizalofop Ethyl 5% EC at planting and at 30 DAT, T₇- Oxyfluorfen 23.5% EC as pre-planting + hand weeding at 30 DAT and T₈- Weedy check. The results revealed that application of pendimethalin (T₄) recorded maximum plant height (59.42cm), leaf number (7.17), bulb weight (76.06g), marketable yield (22.95t ha⁻¹) as compared to minimum values of 50.08, 5.33, 54.44g and 13.81 t ha⁻¹ under weedy check plots. The total dry weight of weeds was lowest (10.94g m⁻²) under T₇ treatment followed by T₄ (16.66 g m⁻²) and T₅ (19.51 g m⁻²). The same trend was also noticed in case of weed control efficiency i.e., maximum value (90.21%) in T₇ followed by T₄ (85.12%) and T₅ (82.44%). The highest additional benefit (Rs. 45750.00 per ha) over control was recorded in T₄ treatment. The pendimethalin may be recommended as most effective herbicide for onion cultivation under alluvial zone of West Bengal.

Keywords: Growth, onion, pendimethalin, quizalofop ethyl, weed and yield

Onion (*Allium cepa* L.) is cultivated throughout the country in an area of 756.2 thousand hectares producing 12158.8 thousand metric tonnes bulbs for local consumption as well as for export purposes. Maharashtra is the leading state with 200 thousand hectares area and 3146 thousand metric tonnes production followed by Karnataka. In West Bengal onion is cultivated in an area of 21 thousand hectares, producing about 290 thousand metric tonnes of bulbs (Anon., 2010). Weeds in onion are a global problem and loss due to weeds was as high as 70-75% (Mani and Gautam, 1976). Onion is slow to emerge after planting and slow to grow after emergence. Weeds on the other hand often emerge early and grow quickly, compete with the crop for inputs, results in reduction in yield. The close spacing of onion, create problem mechanical weeding. The present investigation was undertaken to study the efficacy of herbicides integrated with manual weeding on yield and yield attributing characters of onion.

MATERIALS AND METHODS

The experiment was conducted at the Kalyani 'C' Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India for two consecutive years 2009-10 and 2010-2011 with onion variety Sukhsagar.

The soil of the experimental site was new alluvial, sandy clay loam in texture, having good water holding capacity and soil pH of 7.8. The experiment was laid out in RBD with 3 replications. The treatments were T₁- Oxyfluorfen 23.5% EC as pre-planting and at 30 DAT, T₂- Oxyfluorfen 23.5% EC as pre-planting + Quizalofop Ethyl 5% EC at 30 DAT, T₃- Oxyfluorfen 23.5% EC + Quizalofop Ethyl 5% EC at planting and at 30 DAT, T₄- Pendimethalin 30% EC as pre-planting and at 30 DAT, T₅- Pendimethalin 30% EC as pre-planting + Quizalofop Ethyl 5% EC at 30 DAT, T₆- Pendimethalin 30% EC + Quizalofop Ethyl 5% EC at planting and at 30 DAT, T₇- Oxyfluorfen 23.5% EC as pre-planting + Hand weeding at 30 DAT, T₈- Weedy check. The seedlings were transplanted during middle of December at 15×10 cm spacing in 3 × 2m plots. The crop was fertilized with NPK @ 125:60:100 kg ha⁻¹ and harvested during end of March in both the years. The required amount of fertilizer for 144 sq m area was 4 kg Urea, 5.4 kg Single Super Phosphate and 2.4 kg Muriate of Potash. Urea was applied in 3 equal splits i.e. 1.33 kg first as basal and second and third at 21 and 42 DAT. The phosphatic and potassic fertilizer were applied dose. Healthy and disease free seedlings of seven weeks old were transplanted. Harvesting of bulb was done at mature stage. Maturity was indicated by toppling of the

tops (50-70% neck fall) and drying of leaves. Irrigation was stopped 15 days before harvesting. The observations on weed population count, dry matter of weeds, weed control efficiency were recorded at 60 DAT and vegetative parameters in onion like plant height, number of leaves, diameter of bulb, as well as fresh and dry weight of bulb, yield per plot and TSS of onion at harvest were recorded. Data were analyzed statistically by following the method of Panse and Sukhatme (1989).

RESULTS AND DISCUSSION

The data presented in table 1, showed the significant variations among different treatments. In case of monocot, that T₄ was found most effective in controlling the population (13.33 m⁻²), followed by T₇ (14.67 m⁻²) and T₅ (15.67 m⁻²). Population of weeds was fairly high in T₆ (46.00 m⁻²) followed by T₂ (37.50 m⁻²) but much less than the control (65.50 m⁻²). In case of dicot weeds, T₇ was most effective in controlling its population (2.5 m⁻²). T₂ recorded highest weed population of 27.83 m⁻² though it was much less than the control (44.17 m⁻²). The integrated treatment of oxyflourfen plus HW at 30 DAT (T₇) recorded significantly lower weed population than control. This may be attributed to initial checking of weed growth by oxyflourfen and HW at 30 DAT. Similar results have also been reported by Singh *et al.* (1986) and Nadagouda *et al.* (1996). Sole application of pendimethalin (T₄) showed better management of weed flora than oxyflourfen (T₁), indicating the ability of pendimethalin to suppress the growth of all types of weed flora through its higher persistency in the soil in comparison to oxyflourfen. These results are in good conformity with the observations of Al Kothayari and Hassan (1990). In case of monocot, both the treatments T₇ (8.62 g m⁻²) and T₄ (8.33 g m⁻²) recorded the minimum dry weight of weeds. Highest dry weight of weeds was obtained in control plot (68.99 g m⁻²). In case of dicot weeds, T₇ gave the best results recording 2.32 g m⁻² dry weight followed by T₅ (6.07 g m⁻²). Control plot gave highest dry weight of weeds over the years, recording 44.06 g m⁻². It is clearly revealed that T₇ showed lowest dry weight of weeds (10.94 g m⁻²) followed by T₄ (16.66g m⁻²) and T₅ (19.51g m⁻²). In control, total dry weight was fairly high *i.e.* 113.05g m⁻². This confirms that these treatments significantly reduced the dry weight of weeds over the control gave lowest dry weight as the weeds population was less due to the combination of hand weeding and herbicide. Among sole herbicide treatments, pendimethalin (T₄) was found to be the best treatment in comparison with oxyflourfen (T₁). This confirms that pendimethalin was able to control the population of weed flora more efficiently than other herbicides alone. Similar results were reported by

Khurana *et al.* (1985), Sandhu *et al.* (1987), Mohamed (1988) and Al Kothayari and Hassan (1990). Highest weed control efficiency was found in T₇ (90.21 %). This is because this treatment showed lowest weed population due to combination of hand weeding along with herbicide application. Similarly, Yumnam *et al.* (2009) reported that in onion hand weeding at 40 days after transplanting along with application of quizalofop-ethyl 5% EC @ 2.5ml L⁻¹ of water at 20 DAP significantly reduced weed density (25.5) and dry weight (55.3g) of weed compared to other treatments. The treatment T₄ was the second best with a weed control efficiency of 85.12% followed by T₅ (82.44 %). Weed control efficiency was lowest in T₆ (49.71). The integrated treatment of oxyflourfen and HW at 30 DAT (T₇) recorded significantly lower weed population and dry weight than the control. This may be attributed to initial checking of weed growth by oxyflourfen and HW at 30 DAT. These results are good agreement with Singh *et al.* (1986) and Nadagouda *et al.* (1996).

It was evident from table 1 that under T₄ treatment plants were the tallest (59.42 cm), having highest number of leaves (7.17). In control plot, the plant height and number of leaves were the lowest (50.08 cm and 5.33 respectively). Sole application of pendimethalin (T₄) showed better management of weed flora indicating the ability of pendimethalin to suppress the growth of all types of weed flora through its higher persistency in the soil. As a result it reduced the crop-weed competition and facilitated the vegetative growth. The maximum bulb diameter (collar, equatorial and polar) was obtained in T₄ (5.86 mm, 37.49 mm and 32.70 mm respectively). T₄ performed best because pendimethalin was able to control all types of weed flora more efficiently than oxyflourfen or other herbicides. The control plot recorded the lowest bulb diameters than all the treatments because the treatment had the highest weed competition resulting in unfavourable growing conditions for the crop. The integration of HW at 30 DAT to the chemical herbicide oxyflourfen (T₇) gave the next best result. This could be attributed to the initial suppression of the weed growth by herbicide and HW at 30 DAT further reduced the crop weed competition.

Data presented in table 2, revealed that maximum fresh weight of bulb weight was obtained in T₄ (76.06 g) closely followed by T₂ (75.67g). In respect of dry weight, T₄ recorded maximum dry weight (9.60 g) as compared to control (T₈). T₄ recorded the highest yield as well as marketable yield of 23.81 t ha⁻¹ and 22.95 t ha⁻¹ respectively followed by T₃ (21.79 t ha⁻¹ as yield and 20.98 t ha⁻¹ as marketable yield). The control plot recorded 14.69 t/ha and 13.81 t ha⁻¹ as yield and marketable yield respectively. T₄ recorded the highest

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TSS (12.95^o brix) followed by T₇ (12.86^o brix). Lowest TSS was found in the bulbs of the control plot. Treatment T₄ recorded the highest weight of bulbs among all the treatments. Sole application of pendimethalin was found to be more effective than its combination with quizalofop ethyl or oxyflourfen alone or combination of oxyflourfen and quizalofop ethyl which confirms pendimethalin as better alternative herbicides for suppressing the different weed flora without integration of hand weeding. The result may be attributed to higher persistence of the herbicide in the soil there by suppressing the weed flora for longer duration, resulting in less crop-weed competition and for this reason higher

bulb yield was obtained. Hence the treatment recorded highest bulb yield than other treatments. Data presented in table- 2, also revealed that, the marketable yield of onion cv. Sukhsagar was found to be maximum in T₄ (22.95 t ha⁻¹), followed by T₃ (20.98 t ha⁻¹) and T₅ (20.50 t ha⁻¹). The treatment T₄ gave highest additional benefit (Rs. 45750 ha⁻¹) as compared to control. Likewise, maximum net profit was also obtained from T₄ (Rs 42150 ha⁻¹), followed by T₃ (Rs. 29900 ha⁻¹) and T₅ (Rs. 28820 ha⁻¹). But it was observed that the highest cost benefit ratio was obtained from T₄ (1:11.70) followed by, T₅ (1:6.15) and T₃ (1:4.98).

Table 1: Effect of different treatments on population dynamics, dry weight, weed control efficiency and vegetative growth of onion (Pooled data of 2 years)

Treatments	Population dynamics (No. m ⁻²)		Dry weight (g m ⁻²)		Total	Weed control efficiency	Plant height (cm)	Number of	Bulb diameter (mm)		
	Monocot	Dicot	Monocot	Dicot					Collar	Equatorial	Polar
T ₁	20.50	13.67	11.13	13.20	24.33	78.24	56.84	6.33	5.15	32.84	31.31
T ₂	37.50	27.83	24.37	23.21	47.58	57.60	56.21	6.33	5.18	32.62	31.24
T ₃	18.50	17.83	14.02	16.26	30.29	73.26	56.77	6.50	5.15	32.33	30.37
T ₄	13.33	7.83	8.33	8.33	16.66	85.12	59.42	7.17	5.86	37.49	32.70
T ₅	15.67	11.17	13.44	6.07	19.51	82.44	55.71	5.83	5.10	32.75	30.29
T ₆	46.00	25.83	33.63	23.67	57.30	49.71	56.82	5.67	5.23	32.35	30.93
T ₇	14.67	2.50	8.62	2.32	10.94	90.21	56.28	6.17	5.43	34.57	30.69
T ₈	65.50	44.17	68.99	44.06	113.05	0.00	50.08	5.33	4.41	30.33	28.26
SEm(±)	1.34	1.49	0.94	0.75	1.38	1.16	0.59	0.34	0.10	0.79	0.36
LSD (0.05)	3.81	4.26	2.68	2.13	3.94	3.32	1.70	0.96	0.28	2.25	1.02

Note: (Angular transformed values were used for analysis)

Table 2: Effect of different treatments on bulb weight, yield, TSS and cost : benefit analysis of onion (pooled data of 2 years)

Treatments	Weight of bulb(g)		Yield (t ha ⁻¹)		TSS (^o Brix)	Additional benefit over control	Cost of treatment (Rs ha ⁻¹)	Net profit (Rs ha ⁻¹)	Cost: benefit (Rs. ha ⁻¹)
	Fresh	Dry	Total	Marketable					
T ₁	61.91	7.87	19.45	18.19	12.55	21950	6240	15710	1:2.51
T ₂	75.67	7.62	20.64	19.34	12.59	27650	6000	21650	1:3.60
T ₃	65.03	7.47	21.79	20.98	12.76	35900	6000	29900	1:4.98
T ₄	76.06	9.60	23.81	22.95	12.95	45750	36	42150	1:11.70
T ₅	67.73	7.85	20.80	20.50	12.71	33500	4680	28820	1:6.15
T ₆	62.83	8.10	18.36	17.79	12.58	20000	4392	15608	1:3.55
T ₇	63.19	8.45	20.47	19.74	12.86	29900	7620	22280	1:2.92
T ₈	54.44	6.46	14.69	13.81	12.32	-	-	-	-
SEm(±)	0.82	0.32	0.82	0.80	0.10	-	-	-	-
LSD (0.05)	2.34	0.90	2.35	2.27	0.29	-	-	-	-

During the course of experiment, several weeds like *Amaranthus viridis* L., *Parthenium hysterophorus* L., *Eleusine indica* L., *Cyperus rotundus* L., *Chenopodium album* L., *Gnaphalium luteo-album*, *Nicotiana plumbaginifolia*, *Alternanthera philoxeroides*, *Euphorbia hirta* L., and *Physalis minima* L. were observed. The results revealed that sole application of pendimethalin (T₄) recorded the maximum bulb yield (23.81 t ha⁻¹), bulb weight (76.06 g) and TSS (12.95 ° brix). This may be due to the reason that application of initial pendimethalin controlled the germination of the weed seeds satisfactorily. In addition another application at 30 DAT controlled the weed flora completely. Therefore less competition from weeds was observed with the crop. Among the combined applications of herbicide, pendimethalin before planting plus quizalofop ethyl at 30 DAT (T₅) gave satisfactory results in comparison with other combined applications.

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