Response of weed management practices on growth, yields and economics of *Rabi* onion (*Allium cepa* L.)

Abstract

The present investigation entitled, "Studies on weed management in Rabi onion (Allium cepa L.)" was carried out at the Vegetable Research Farm of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) during Rabi season 2021with the objectives of relative efficacy of herbicides and hand weeding on weed control in onion. The experiment was laid out in Randomized Block Design for nine treatments with three replications. It was observed that the growth attributes viz., plant height (80.25 cm), leaves/plant (10.82), fresh weight of bulb (32.65 gm) and dry weight of onion (17.51 gm) were significantly higher in (T_2) over rest treatments, respectively. The yields attributes viz., the polar diameter of bulb (56.70 mm), Equatorial diameter of bulb (68.58 mm) and total bulb diameter (5.97 cm) were significantly more recorded in T_2, while the minimum was recorded in control. The bulbs yield (27.03 t / ha). TSS (15.43) was significantly highest in weed free check over remaining all treatments, respectively. Among the herbicidal treatment pre and post emergence application of treatment T_8. The number of weeds (m2) and weed dry matter (g/ m^2) were significantly noticed that weed free check (T_2) was most effective treatment as it recorded less weed count 0.68/m^2 and dry matter 1.25g followed by 3.63/m^2 and 3.45g, respectively. The maximum weed control efficiency (93.3%) and minimum weed control index (0.00%) was significantly recorded by treatment T_2, compared to remaining treatments, respectively. The gross monetary returns (Rs.3,24,360.00) were recorded higher in the treatment weed free check (T_2) followed by among the herbicides T_8 Rs 3,15,240/ ha and net monetary returns were recorded statistically higher in the treatment T_8 Rs. 2,21,648.00. Whereas, the highest benefit cost ratio (1:3.71) was recorded in the treatment T_7 followed by T_6, in the present investigation.

Keywords- Weed control, Pendimethalin, quizalofop ethyl, Thrips

Introduction

The onion (*Allium cepa* L.) is a globally important vegetable crop. This biennial vegetable bulb crop is the most important crop grown all over the globe for culinary, medicinal, and medical applications. The chromosome number for this organism is 2n=16 and it is a member of the family Alliaceae. Raw or cooked, the immature and mature bulbs, as well as the green leaves, may all be utilized in culinary preparations including vegetables. The onion contains 87 percent water, 1.5 percent protein, 11 percent carbohydrates, 0.5 g of fiber, 30 mg of calcium, 0.5 mg of iron, 10 mg of ascorbic acid, 0.3 mg of niacin, 0.02 mg of riboflavin, 0.04 mg of thiamin, and traces of fat and beta carotene. Allicin, ajoene, allixin, thiosulfates, and sulfites are some of the beneficial components that may be found in onions, which contribute to the herb's potential as a

medicinal food. Studies have shown that onions may lower blood lipids and protect against heart disease. Onions are also delicious. Among the vegetable crops on the FAO's list, onion production is only second to that of tomatoes in terms of annual worldwide production. Only one kind of vegetable is grown in India and exported from the country. India is only second to China in terms of area under onion cultivation and total production, with a total of 1.62 million hectares under onion crop and 26.64 MT produced (*Anonymous*, 2022). The drop in bulb output may be anywhere from 48 to 80 % depending on the length of time weeds are allowed to grow, how intensely they do so, and how much competition they face (*Channapagoudar* and *Biradar*, 2007). When it comes to onions, the critical time for crop-weed competition occurs between 15 and 60 days after transplantation. In Uttar Pradesh, onion is adversely affected mostly by weeds. The weeds grow in all the places of onion fields. Dominant weed species associated with onion are *Cyperus rotundas, Cynodon dactylon, Dinebra retroflexa, Digera arvensis, Boerhavia diffusa, Parthenium hysterophorus, Chenopodium album, Medicago denticulate,* and *Rumax dentatus*. Because they are so simple to grow over the whole of the state, these weeds are mostly found in fields where onions are grown and are the primary cause of poor onion yields. It has been discovered that reducing weed density and increasing onion bulb production may be accomplished using a variety of weed management methods. These methods include manual weeding, as well as the use of several herbicides.

Materials and Methods

The experiment was carried out during *Rabi* season in a Randomized Block Design with three replications at Vegetable Research Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur is geographically located at 26^0 29' 35''N latitude and 80^0 18' 35'' E longitudes at an altitude of 125.9 meters above from mean sea level. It lies in the alluvial belt of Gangetic plain and is located in the central part of Uttar Pradesh. The experimental field had a fairly levelled topography and a good drainage system. The soil was sandy loam in texture and had pH of 7.5 with a low level of both accessible nitrogen and organic carbon. The onion variety used in the experiment was Bhima Shakti healthy matured seedlings were planted at a spacing of 10X15 cm in flat beds. The treatment details were as follows: T_1 –Control, T_2 – Weed free check, T_3 – Hand weeding at 20, 40 and 60 DAT, T_4 – Pre- emergence spray of Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha^{-1} followed by 1 hand weeding at 40-60 DAT, T_5 – Pre-emergence spray of Pendimethalin 30% EC @ 1 kg a.i. ha^{-1} followed by 1 hand weeding at 40-60 DAT, T_6 – Pre- emergence spray of Oxyfluorfen 23.5% EC @ 0.25 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT, T_7 – Pre-emergence spray of Pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT, T_8 – Pre-emergence spray of pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by 1 hand weeding at 45 DAT and T_9 – Pre-emergence spray of Pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-

emergence spray of quizalofop ethyl 5% EC @ 0.05 kg ha^{-1} at 40 DAT + followed by 1 hand weeding at 60 DAT. The herbicides were applied by using hand operated knapsack sprayer fitted with a flat fan type Nozzle was used for spraying the herbicides adopting spray. On December 18, 2021, the seeds were planted on raised beds in row to row fifteen centimetres with spacing of ten centimetres between each row. At the 30-day mark following planting, each seed bed received an application of 30g of nitrogen in the form of urea. The first two weeks of the treatment consisted of irrigations every three to four days with subsequent treatments happening once per week. Once by hand, the weeds were pulled from the nursery beds. In each treatment, the recommended amount of fertilizer for onion, the bulbs were harvested at full maturity stage. After proper curing and neck cutting the observations on weed control efficiency (WCE) was calculated as per the procedure.

$$WCE\ (\%) = \frac{DWC - DWT}{DWC} X100$$

DWC- Dry weight of weeds in weedy check plot (g/m^2) in control plot

DWT- Dry weight of weeds in the treated plot (g/m^2) in treated plot

Weed index is an indicator of the loss or increase in yield of weeded and treated plots caused by crop weed competition. This index is generated using the following formula and it shows the effect of crop weed competition.

$$\text{Weed Index} = \frac{X-Y}{X} X\ 100$$

In where,

X= Yield of weed free check

Y= yield of treatment plot

Other management practices during crop period were adopted as per recommendations in *Rabi* Onion grown.

Result and discussion:

The highest growth parameters recorded as like plant height (80.25 cm), leaves/plant (10.82), bulb fresh weight (32.65g) and dry weight/plant (17.51g) in weed free check (T_2) followed by Pre-emergence spray of pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by 1 hand weeding at 45 DAT (T_8). This result confirms the finding of *Husain et. al* (2008) and *Marwat et. al* (2005). Yield attributes viz. bulbs polar diameter (56.70 mm), bulbs equatorial diameter (68.58 mm) and bulb diameter (5.97cm) were significantly more in T_2 treatment over remaining treatment, respectively followed by T_8. The total bulb yield and TSS were significantly highest achieved in T_2 followed by T_8 due to higher produced of growth and yield attributes. The very poor yield was recorded in control plot

which was attributed due to more weed growth, weed dry matter and poor yield attributing characters. These results were findings out by *Shinde et. al.* (2013), *Mallik et.al* (2017) *Minz et al. (*2018).

Regarding economics as influenced by weed management indicated that a higher cost of cultivation (Rs.1,32,910.00 ha^{-1}) was noticed under the treatment of weed free check (T_2). On the basis of yield, gross income was more received in treatment of T_2 followed by T_8. While the lowest cost of cultivation (Rs.79,172.00 ha^{-1}) was recorded in control (T_6). It is revealed from the data, that the maximum net return of Rs. (2,21,648.00 Rs ha^{-1}) were found under treatment Pre-emergence spray of Pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by 1 hand weeding at 45 DAT (T_8), followed by treatment Pre-emergence spray of Pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by 1 hand weeding at 60 DAT (T_9) with net return of Rs. 2,16,368/ha. While the lowest net return of Rs. 73,850.00/ha recorded in control (T_1). The C:B Ratio found maximum recorded (1:3.71) in Pre-emergence spray of Pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT (T_7) and minimum recorded (1:1.96) in control (T_1). In onion, it is not advised to mechanically maintain the crop weed free owing to the increasing expense of human labour and their scarcity. The very close spacing of the onion transplants and the shallow root system of seedlings makes the operation of mechanical techniques rather useless against the uprooting of weeds. On the other hand, the seedling cannot sustain damage. Manual weeding cannot be an efficient strategy in a short term for commercial production. Thus the paucity of labour encourages farmers to employee herbicides for reducing weeds. These findings collaborate with the results obtained by *Jangre et al.,* (2019).

Table-1: Effect of herbicide application on growth attributes of onion variety Bhima Shakti.

Treatments	Plant height (cm)	Leaves/plant	Bulb fresh weight (g)	Dry weight onion plant (g)
T_1	66.11	6.58	19.5	9.41
T_2	80.25	10.82	32.65	17.51
T_3	72.60	8.27	24.11	12.03
T_4	72.25	8.16	22.07	10.77
T_5	72.10	8.63	23.70	11.85
T_6	73.55	8.81	25.70	13.29
T_7	74.08	8.99	26.49	13.41
T_8	75.45	9.71	27.45	15.76
T_9	74.85	9.39	26.88	13.98
SE(d)	**1.16**	**0.24**	**0.55**	**0.55**
CD at 5%	**3.37**	**0.70**	**159**	**1.61**

Table-2: Effect of herbicide application on yield attributes & quality of onion variety Bhima Shakti.

Treatments	Bulb polar diameter (mm)	Bulb equatorial diameter (mm)	Bulb diameter (cm)	Bulb yield (t/ha)	TSS (Brix)
T_1	40.56	49.68	4.53	12.50	12.28
T_2	56.70	68.58	5.97	27.03	15.43
T_3	45.45	56.65	5.72	20.40	14.43
T_4	43.35	53.26	5.57	19.35	13.90
T_5	44.75	54.64	5.66	20.10	14.15
T_6	49.91	61.72	5.76	24.11	14.28
T_7	50.69	63.73	5.79	24.59	14.74
T_8	54.47	64.08	5.89	26.27	15.23
T_9	51.82	65.42	5.88	25.83	15.09
SE(d)	**1.04**	**0.55**	**0.12**	**0.55**	**0.21**
CD at 5%	**3.04**	**1.61**	**0.35**	**1.61**	**0.60**

The total number of weds and weeds dry matter were significantly noticed that weed free check (T_2). Treatment were most effective treatment as it recorded less number of weed count 0.68/ m2 and 1.25g/m2 followed by 6.36/m2 and 3.45g/m2 in (T_8) treatment, respectively. The maximum weed control efficiency 93.30 % was recorded with weed free check (T_2) followed by the application of (T_8). The lowest weed control index was significantly noticed in weed free check (T_2). Treatment followed by among the herbicides treatment in Pre-emergence spray of pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by 1 hand weeding at 45 DAT(T_8). This result confirms the finding of *Singh et. Al.* (2019) & *Singh et al.* (2021).

Table-3: Effect of herbicide application on weed parameters of onion variety Bhima shakti.

Treatments	Weed count (no/m^2)	Weed dry matter (g/m^2)	Weed control efficient (%)	Weed control index
T_1	14.55 (211.70)	12.88 (165.89)	0.00	43.9
T_2	0.68 (0.4624)	1.25 (1.56)	90.30	0.00
T_3	8.11 (65.77)	4.22 (17.80)	67.20	24.53
T_4	8.47 (71.74)	4.74 (22.46)	63.20	28.41
T_5	8.3 (68.89)	4.91 (24.10)	61.90	25.63
T_6	7.44 (55.35)	3.95 (15.60)	69.30	10.80
T_7	7.33 (53.72)	3.67 (13.46)	71.50	9.02
T_8	6.36 (40.44)	3.45 (11.90)	73.20	2.81
T_9	6.47 (41.86)	3.63 (13.17)	71.80	4.44
SE(d)	**0.54**	**0.31**	**1.50**	**0.340**
CD at 5%	**1.62**	**0.92**	**4.40**	**1.102**

Table-4: Effect of herbicide application on cost of cultivation, gross income, net return and cost benefit ratio

Treatments	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
T_1	169920.00	73850.00	1:1.96
T_2	324360.00	191450.00	1:2.44
T_3	244800.00	125960.00	1:2.06
T_4	232200.00	140250.00	1:2.53
T_5	241200.00	148900.00	1:2.61
T_6	289320.00	210148.00	1:3.65
T_7	295080.00	215558.00	1:3.71
T_8	315240.00	221648.00	1:3.37
T_9	309960.00	216368.00	1:3.31

Conclusion:

On the basis of an experiment conducted, it is concluded that weed free plot was found superior among all other treatments including an unweeded check for growth and yield characters of onion. Hand weeding (weed free plot) and pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by one hand weeding at 45 DAT and T_9 pre-emergence spray of pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by one hand weeding at 60 DAT depicted the reduction in weed density, crop-weed competition and ultimately resulted in better growth, development and yield of onion. Maximum net returns were obtained by application of pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT + followed by one hand weeding at 45 DAT and hence, benefit: cost ratio was a found maximum with Pre-emergence spray of Pendimethalin 30% EC @ 1 kg a.i. ha^{-1} + post-emergence spray of Quizalofop ethyl 5% EC @ 0.05 kg a.i. ha^{-1} at 40 DAT. So, use of Quizalofop ethyl 5% EC can be recommended as a cost-effective method for weed control.

Reference:

1. Anonymous (2022) National Horticulture Board, 2021-22.
2. Channapagoudar, B.B and N.R. Biradar, 2007. Physiological studies on weed control efficiency in direct sown onion. Karnataka J. Agric. Sci. 20.(2):375-376.
3. Husain, H.F., El- Hariri, D.M. and Hassanein, M.S.(2002). Response of some flax cultivars associated weeds to weed treatments. Egyptian J. Agronomy 24, 23-42.
4. Jangre, N., C. R. Gupta and N. Rathore (2019) "Efficacy of pre and post-emergence herbicides on bulb yield of onion (*Allium Cepa* L.) in Chhattisgarh plains". Journal of Pharmacognosy and Phytochemistry; SP2: 771-773.
5. Mallik, S., A. B. Sharangi and N. Datta (2017) "Herbicidal option in managing weeds towards growth and yield dynamics of single clove garlic". International journal of Agricultural Science, 9 (1): 3627-3630.

6. Marwat K.B. , Khan, I.A., Khan M.I. and Khan, Z.H.H (2005). Herbicides evaluation for weed control in chick pea, Pak. J. of weed Science Research 11(3/4): 147-150

7. Singh, D. Kumar,P, Verma, V. K. , Verma, C.B. (2019). effect of weed management practices on weed density and yield of linseed (*linum usitatissimum* L.) international journal. C.S.7(5):165-167.

8. Singh. J, Singh. D., Pyare. R., Verma. V.K., Singh. A.K., Yadav. A.K. and Kumar Harshit (2021). Effect of weed management practices on weed density, weed dry weight and yield of irrigated Linseed (*linum usitatissimum* L.) Fronteirs in crop improvement, 9 (Special III): 1209-1212

9. Minz A., P. Horo, S. Barla, R. R. Upasani & R. Rajak (2018) "Herbicide effect on growth, yield and quality of onion" Indian journal of weed science 50 (2): 186-188.

10. Sahoo B.B and P. Tripathi (2019) "Efficacy of herbicides against weed flora in onion (*Allium cepa* L.)" Journal of crop and weed, 15 (1): 158-163.

11. Shinde, K. G., Bhalekar, M. N. and Patil, B. T. (2013) "Weed management in rabi onion (*Allium Cepa* L.)" Journal of agriculture research and Technology, 38 (2): 324-326.