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Effect of post-emergence herbicides on growth and yield of *Rabi* onion (*Allium cepa* L.)

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Abstract
A field investigation was conducted at Research farm, Department of Agronomy, College of Agriculture, Parbhani. The experimental field was levelled and well drained. The soil was vertisol, low in nitrogen, medium in phosphorus and alkaline in reaction. The experiment was laid out in Randomized block design with eight treatments and three replications. Transplanting of seedling was done with a spacing of 20 cm x 15 cm. It was observed that the application of Haloxyfop 10.8% EC @ 108 g a.i. ha^{-1} at 15 days after transplanting (T_2) recorded higher values of growth and yield contributing characters and maximum yield with better weed control and it was at par with the application of Haloxyfop 10.8% EC @ 135 g a.i. ha^{-1} at 15 days after transplanting (T_3) and Haloxyfop 10.8% EC @ 270 g a.i. ha^{-1} at 15 days after transplanting (T_4).

Keywords: Herbicides, *Rabi* onion *Allium cepa* L.

Introduction
Onion (*Allium cepa* L.) is popularly known as "Queen of kitchen" because of its characteristic flavour. India is the second largest producer of onion in the world, next to China. Onion is an important and indispensable item in every kitchen as condiment and vegetable and hence, commands an extensive internal market. It is a commercial vegetable crop grown from ancient times in India. 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.
In India, the area under onion cultivation is 1177.6 lakh ha with a production of 20333.1 MT. The average yield of onion in India is reported to be around 16.1 MT ha^{-1}. The major onion growing states are Maharashtra, Karnataka, Andhra Pradesh, Gujrat and Madhya Pradesh. Maharashtra is the leading state in the onion production and trade in India. The area under onion cultivation was 441.9 lakh ha with production 5361 MT followed by Karnataka (3227 MT), Madhya Pradesh (2842 MT), Bihar (1247.3 MT), Gujrat (1126.6 MT) and Andhra Pradesh (575.6 MT) and In Maharashtra major area being concentrated in Nashik, Ahmadnagar, Satara and Pune District (Anonymous, 2016) [2].
The average yield of onion in India is very low as compared to other leading countries due to many factors. One of the limiting factors is weed infestation. Its poor competitive ability with its slow initial growth and lack of adequate foliage makes onion weak against weeds. In addition, their cylindrical upright leaves do not shade the soil to smother weed growth. Yield loss due to weed infestation in onion has been recorded to the tune of 40 to 80% (Angiras *et al.*, 2008) [1]. Reduced bulb yield from 48 to 85 % depending upon the weed competition and intensity of weeds (Bhalla, 1978) [3]. Onion is slow growing, shallow rooted, narrow upright leaves and non-branching habit. Spraying of post-emergence herbicides helped to minimize the crop weed competition during such critical growth stages resulted in higher crop yields. Improved weed control practices that include chemical weed control with newer formulations and cultural methods.

Material and Methods
The experiment was conducted during *Rabi* season of the year 2015 at Department of Agronomy, College of Agriculture, Parbhani. The topography of experimental field was uniform and levelled. The soil of the experimental site was deep, black in colour with good drainage. The experiment was laid out by using randomized block design with eight treatments and three replications. The treatments included are *viz.*, Haloxyfop 10.8 % EC @ 81 g a.i. ha^{-1} at 15 DAT (T_1), Haloxyfop 10.8 % EC @ 108 g a.i. ha^{-1} at 15 DAT (T_2), Haloxyfop 10.8 % EC @ 135 g a.i. ha^{-1} at 15 DAT (T_3), Haloxyfop 10.8 % EC @ 270 g a.i. ha^{-1} at 15 DAT (T_4), Quizalfop ethyl 5 % EC @ 40 g a.i. ha^{-1} at 15 DAT (T_5), Two hand weeding at 30 and 45 DAT (T_6), Weed free (T_7), Weedy check (T_8). Six week old seedlings of onion were transplanted

manually on raised beds with spacing of 20 cm x 15 cm. The crop was fertilized with 100 kg nitrogen, 50 kg phosphorus and 50 kg potash per hectare. The data collected for all the characters were subjected to statistical analysis by adopting 'Analysis of Variance' techniques as described by Panse and Sukhatme (1978) [7].

Result and Discussion

All the growth parameters and yield like Leaf length, number of functional leaves, fresh weight of bulb, dry weight of bulb, girth of bulb, fresh weight of whole plant, dry weight of whole plant and bulb yield increased significantly with treatments which were kept weed free till harvest due to least crop weed competition for nutrients, moisture, space and sunlight between crop and weeds. All the weed management treatments were significantly superior over weedy check in respect of all growth and yield parameters (Table 1.) and bulb yield (Table 2).

The highest Leaf length (31.39 cm) was observed with weed free treatment (T_7) which was at par with Haloxyfop 10.8 % EC @ 108 g a.i. ha^{-1} at 15 DAT (T_2), Haloxyfop 10.8 % EC @ 135 g a.i. ha^{-1} at 15 DAT (T_3) and Haloxyfop 10.8 % EC @ 270 g a.i. ha^{-1} at 15 DAT (T_4) was significantly superior over rest of the treatments and weedy check (T_8) followed by Haloxyfop 10.8 % EC @ 81 g a.i. ha^{-1} at 15 DAT (T_1), Quizalfop ethyl 5 % EC @ 40 g a.i. ha^{-1} at 15 DAT (T_5) and Two hand weeding at 30 and 45 DAT (T_6). Similar results were also found by Kalhapure *et al.* (2014.). The maximum Number of functional leaves plant^{-1} (7.30), fresh weight of bulb (129.18 g), dry weight of bulb (9.67 g), girth of bulb (5.33 cm), fresh weight of whole plant^{-1} (134.18 g), dry weight of whole plant^{-1} (11.67 g), per plot bulb yield (67.00 kg) and bulb yield (34.68 t ha^{-1}) were observed in weed free treatments (T_7) which was at par with Haloxyfop 10.8 % EC @ 108 g a.i. ha^{-1} at 15 DAT (T_2), Haloxyfop 10.8 % EC @ 135 g a.i. ha^{-1} at 15 DAT (T_3) and Haloxyfop 10.8 % EC @ 270 g a.i. ha^{-1} at 15 DAT (T_4) was significantly higher than rest of the treatments and weedy check (T_8). It might be due to less weed crop competition throughout crop growth period 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. Whereas, significantly the lowest all growth and yield attributes and bulb yield were reported under application of weedy check (T_8) followed by Haloxyfop 10.8 % EC @ 81 g a.i. ha^{-1} at 15 DAT (T_1), Quizalfop ethyl 5 % EC @ 40 g a.i. ha^{-1} at 15 DAT (T_5) and Two hand weeding at 30 and 45 DAT (T_6). Among chemical weed control treatments application of treatment Haloxyfop 10.8 % EC @ 108 g a.i. ha^{-1} at 15 DAT (T_2), recorded significantly higher growth, yield and yield parameters over rest of the treatments except that it was found at par with treatment Haloxyfop 10.8 % EC @ 135 g a.i. ha^{-1} at 15 DAT (T_3) and Haloxyfop 10.8 % EC @ 270 g a.i. ha^{-1} at 15 DAT (T_4) but significantly superior over rest of the treatments.

Minimum growth, yield and yield parameters was recorded with weedy check (T_8) and it was significantly lower than all other tretments. This might be due to the competition between crop and weed for soil moisture, plant nutrients, solar radiation and space during active growth period. These results are in close vicinity with those reported by Mondal *et al.* (2005) [6], Saini and Walia (2012) [8], Shinde *et al.* (2012) [9] and Kalhapure and Shete (2013) [5].

Conclusion

The weed free (T_7) treatment recorded significantly higher results in all growth, yield and yield parameters. Among chemical treatments Haloxyfop 10.8 % EC @ 108 g a.i. ha^{-1} at 15 DAT (T_2), Haloxyfop 10.8 % EC @ 135 g a.i. ha^{-1} at 15 DAT (T_3) and Haloxyfop 10.8 % EC @ 270 g a.i. ha^{-1} at 15 DAT (T_4) was significantly superior over rest of the treatments and weedy check (T_8). Application chemical treatments was found most effective as it kept less weed crop competition throughout crop growth period 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 and thereby increasing productivity of *Rabi* onion.

Table 1: Leaf length, number of functional leaves plant^{-1}, fresh weight of bulb, dry weigh of bulb and girth of bulb of onion at harvest as influenced by different treatments.

Treatments	Leaf length (cm)	Number of functional leaves plant^{-1}	Fresh weight of bulb (g)	Dry weight of bulb (g)	Girth of bulb (cm)
T_1- Haloxyfop 10.8 % EC @ 81 g a.i. ha^{-1} at 15 DAT	25.82	5.10	98.18	7.90	4.20
T_2- Haloxyfop 10.8 % EC @ 108 g a.i. ha^{-1} at 15 DAT	28.71	6.53	124.33	9.54	4.97
T_3- Haloxyfop 10.8 % EC @ 135 g a.i. ha^{-1} at 15 DAT	28.23	6.47	124.25	9.51	4.67
T_4- Haloxyfop 10.8 % EC @ 270 g a.i. ha^{-1} at 15 DAT	26.77	6.37	123.13	9.46	4.50
T_5- Quizalfop ethyl 5 % EC @ 40 g a.i. ha^{-1} at 15 DAT	26.14	5.25	93.04	7.18	4.13
T_6- Two hand weeding at 30 and 45 DAT	23.59	4.43	85.38	6.61	4.03
T_7- Weed free	31.39	7.30	129.18	9.67	5.33
T_8- Weedy check	20.33	3.53	66.06	5.40	2.80
S.Em ±	1.37	0.72	2.01	0.25	0.40
C.D at 5%	4.14	2.19	6.09	0.76	1.20

Table 2: Fresh weight of whole plant^{-1}, dry weight of whole plant^{-1}, Absolute growth rate for dry matter, relative growth rate for dry matter, per plot bulb yield and bulb yield of onion at harvest as influenced by different treatments.

Treatments	Fresh weight of whole plant^{-1} (g)	Dry weight of whole plant^{-1} (g)	Per plot bulb yield (kg)	Bulb yield (t ha^{-1})
T_1- Haloxyfop 10.8 % EC @ 81 g a.i. ha^{-1} at 15 DAT	103.06	8.84	56.31	29.15
T_2- Haloxyfop 10.8 % EC @ 108 g a.i. ha^{-1} at 15 DAT	129.66	11.18	64.86	33.57
T_3- Haloxyfop 10.8 % EC @ 135 g a.i. ha^{-1} at 15 DAT	128.25	11.16	62.36	32.28
T_4- Haloxyfop 10.8 % EC @ 270 g a.i. ha^{-1} at 15 DAT	128.21	11.07	62.07	32.13
T_5- Quizalfop ethyl 5 % EC @ 40 g a.i. ha^{-1} at 15 DAT	98.03	9.32	51.33	26.57
T_6- Two hand weeding at 30 and 45 DAT	89.71	8.54	47.30	24.48
T_7- Weed free	134.18	11.67	67.00	34.68
T_8- Weedy check	72.06	6.60	27.47	14.32
S.Em ±	1.55	0.59	1.64	0.85
C.D at 5%	4.70	1.79	4.98	2.58

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