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Short communication

Effect of weed management practices on growth, yield and quality of onion

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ABSTRACT

The present experiment was conducted during 2014-15 and 2015-16 to appraise the efficacy of weed management practices on growth, yield and quality of onion. The results revealed that the growth and yield characters viz., plant height, number of leaves per plant, fresh and dry weight of plant, average bulb weight, neck thickness, polar and equatorial diameter of bulb and bulb yield were observed higher and equally effective under treatments T_{15} (weed free check), T_{12} (PRE - Oxyfluorfen @ 250 g a.i. ha^{-1} + one hand weeding at 35 DAT) followed by treatment T_6 (PRE - Oxyfluorfen @ 250 g a.i. ha^{-1} + Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT) and T_{10} (PRE - Pendimethalin @ 1000 g a.i. ha^{-1} + Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT). Also, treatment T_6 followed by T_{12}, T_{10} and T_{14} were economically feasible and viable and gave maximum B:C ratio of 2.20, 2.19, 2.18 and 2.16, respectively. The quality parameters *viz.*; total soluble solids (TSS %), total sugar (g 100g^{-1}) and dry matter content of bulb were not influenced by the various treatments of weed management.

Key words: *Allium cepa*, weedicide, growth parameters.

Onion is an ancient crop having utilized in medicines, rituals and as a food in India since 600 B.C. It is used for flavouring or seasoning the food, both at mature and immature stages, besides being used as salad and pickle. Bihar stands seventh in area and fifth in production accounting 7% of total onion production in India with the productivity of 22.97 t ha^{-1}. In Bihar onion occupies 54.3 thousand hectares area and the production to a tune of 1.25 million tonnes (Anonymous, 2). Increasing demand of onion obviate the necessity to increase its production. However, due to limitation of land it is not possible to raise the area and production of the crop horizontally except by increasing per hectare yield. Among several constraints, weeds pose serious problems in onion cultivation. Onion is inherently a poor competitor with weeds because of its narrow leave morphology, slow growth, non-branching habit, shallow root system and small leaf canopy. Subsequently, frequent irrigation water and fertilizer application allow for successive flushes of weeds in onion. Yield losses due to weeds infestation in onion are as high as 40 to 80% (Channapagoudar and Biradar, 4 and Vishnu *et al.,* 16). The bulb size and bulb yield are reduced under weedy conditions (Sharma *et al*., 12, Angiras and Suresh, 1). Weed problem is one of the major barriers responsible for low productivity of onion. Moreover, it increase production cost, decrease yield of the crop, harbour insects and plant diseases, decreases quality of farm produce and reduces the values of the land. Weed control is the most important production practice in crop husbandry, which includes cultural, mechanical, chemical and biological methods. Weed control through herbicide is popularizing and increasing day by day among the farmers because of economical and time saving as compare to manual method. The labourers also became unavailable in peak period of transplanting due to shifting towards industries to assured better wages.

Onion is shown/ planted at very narrow spacing, which poses problem in inter culturing operations and thus manual control becomes unaffordable. Therefore, the use of herbicides is popularising and increasing particularly in onion crop. The numbers of herbicides are recommended for field crops leads to residue accumulation in the soil. Herbicide should remain active in soil for a period enough to provide satisfactory weed control. On the contrary, chemical weed control or integrated weed management was found to be a cheaper and less laborious method. Nargis *et al.* (8) suggested that pendimethalin proved to the best herbicide in controlling weeds of onion field by producing maximum sized bulbs and highest yield. Bharathi *et al.* (3) reported that Oxyfluorfen and Oxadiargyl minimized the weed population and increased bulb yield. The yield of onion can also be improved through combination of proper chemical and mechanical weed control at appropriate time. However, the work done in relation to this aspect particularly for Bihar region is meagre. Therefore, the present experiment was

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undertaken to explore the possibilities to find out the appropriate weed management practices for onion practically effective and economically feasible for the farmers.

MATERIALS AND METHODS

The present investigation was carried out during two consecutive *Rabi* (winter) season of 2014-15 and 2015-16, respectively at Vegetable Research Farm, Bihar Agriculture University, Sabour, Bhagalpur Bihar. It is situated between 25°50' N latitude and 87°19' E longitude at an altitude of 52.73 meters above mean sea level. The centre enjoys the sub-tropical climate often subjected to extremes of weather condition i.e. cold winter and hot summer. Total sixteen treatment combinations (T_1 **:** PRE- Oxyfluorfen @ 250 g a.i. ha^{-1}, T_2 **:** PRE- Oxadiargyl @ 100 g a.i. ha^{-1} , T_3 **:** PRE- Pendimethalin @ 1000 g a.i. ha^{-1}, T_4 **:** PoE- Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT, T_5 **:** PoE- Oxadiargyl @ 100 g a.i. ha^{-1} at 35 DAT, T_6 **:** PRE- Oxyfluorfen @ 250 g a.i. ha^{-1} + Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT, T_7 **:** PRE- Oxyfluorfen @ 250 g a.i. ha^{-1} + Oxadiargyl @ 100 g a.i. ha^{-1} at 35 DAT, T_8 **:** PRE- Oxadiargyl @ 100 g a.i. ha^{-1} + Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT, T_9 **:** PRE- Oxadiargyl @ 100 g a.i. ha^{-1} + Oxadiargyl @ 100 g a.i. ha^{-1} at 35 DAT, T_{10} **:** PRE- Pendimethalin @ 1000 g a.i. ha^{-1} + Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT, T_{11} **:** PRE- Pendimethalin @ 1000 g a.i. ha^{-1} + Oxadiargyl @ 100 g a.i. ha^{-1} at 35 DAT, T_{12} **:** PRE- Oxyfluorfen @ 250 g a.i. ha^{-1} + One hand weeding at 35 DAT**,** T_{13} **:** PRE- Oxadiargyl @ 100 g a.i. ha^{-1} + One hand weeding at 35 DAT, T_{14} **:** PRE - Pendimethalin @ 1000 g a.i. ha^{-1} + One hand weeding at 35 DAT, T_{15} **:** Weed Free Check and T_{16} **:** Weedy Check) were arranged in a randomized block design (RBD) with three replications. Seedlings of Agrifound Light Red onion were raised in a nursery and all proper agronomic practices were carried out until the seedlings were transferred to the main field. The experimental field was ploughed three times using disk plough and cultivator followed by planking before transplanting seedlings. Experimental plots of 3 m × 2 m were prepared. Well decomposed farmyard manure was uniformly applied to the plots and mixed thoroughly 15 days before transplanting and N, P and K @ 120, 100 and 80 kg ha^{-1} was applied during transplanting. Healthy seedlings of six-week-old having 12-15 cm height were transplanted on 20 December 2014 and 16 December 2015 respectively, at the spacing 15 × 10 cm. In herbicidal treatments, Oxyfluorfen @ 250 g a.i. ha^{-1}, Oxadiargyl @ 100 g a.i ha^{-1} and Pendimethalin @ 1kg a.i. ha^{-1} were applied as pre-emergence (one day after transplanting) and post emergence at 35 days after transplanting (DAT). The herbicides were sprayed with the help of a hand operated Knapsack sprayer fitted with flat fan nozzle using 600 litres of water per hectare. Hand weeding was done with the help of a hand chisel locally known as *Khurpi* as per treatments. Weedy check plots were left without weeding, while weed free check plots were kept free from weed using hand weeding. Other recommended agronomic practices like irrigation, insect pest and disease control, etc., were kept uniformly for all treatments. Harvesting of onion bulbs was done when 70 % plants showed neck fall (EARO, 5). Harvesting of onion was done on April 28, 2015 and April 21, 2016, respectively.

RESULTS AND DISCUSSION

Among the various growth parameters plant height and number of leaves per plant were influenced (p=0.05) by the various treatments of weed management practices onwards 30 days after transplanting, however, these parameters were failed to touch the level of significance up to 30 DAT during both the years (Table 1). This might be due to a very less or no competition between onion crop and weeds during the early period of growth. With an advancement of crop the tallest plant and maximum number of leaves were recorded with the treatment T_{15} (weed free check) which, remained statistically at par with the treatments T_{14}, T_{13}, T_{12}, T_{10} and T_6 during both the years of study. The lowest plant height and number of leaves were recorded with weedy check (T_{16}) followed by PoE- Oxadiargyl @ 100 g a.i. ha^{-1} at 35 DAT (T_5). The increase in the parameters at the advance stages might only be due to the less weed population and dry matter accumulation by weeds along with least depletion of major nutrients by the weeds, which in turn reduced the crop weed competition and boosted the crop growth. These findings are in close agreement with those of Kolse *et al*. (6), Bharathi *et al.* (3) and Sable *et al.* (10).

Various weed management practices also brought the pronounced effect on fresh and dry weight of plant. Treatments T_{15} (weed free check) being at par with T_{14}, T_{13} and T_{12} recorded significantly higher fresh and dry weight than rest of the treatments. The increase in fresh and dry weight of plant might be due to better growth of plants in terms of plant height and number of leaves per plant under these treatments which ultimately reflected in higher fresh and dry matter production. Onion crop exhibits determinate growth habit and plant growth is the function of photosynthetic activity and their capacity to utilize available nutrients. It was due to favourable environment in the root zone resulting in absorption of more water and nutrient from soil and good control

Table 1. Effect of weed management practices on growth parameters of Onion.

Treatment	Plant height (cm)						Number of leaves (plant^{-1})						Fresh weight of plant (g plant^{-1})				Dry weight of plant (g plant^{-1})			
	2014-15			2015-16			2014-15			2015-16			2014-15		2015-16		2014-15		2015-16	
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT	60 DAT	90 DAT
T_1	22.33	42.67	45.40	25.65	43.53	54.75	2.40	4.37	5.40	2.67	4.83	5.50	21.38	46.84	21.38	46.84	2.24	5.35	2.69	5.82
T_2	22.67	39.63	42.82	25.80	40.75	49.95	3.00	4.07	4.78	2.77	4.13	5.27	19.30	40.03	19.30	40.03	2.10	4.56	2.58	4.80
T_3	23.42	42.12	45.10	25.67	43.22	53.42	2.93	4.35	5.32	2.33	4.83	5.42	21.18	45.41	21.18	45.41	2.27	5.09	2.68	5.63
T_4	21.67	42.87	46.13	23.60	44.88	55.17	2.60	4.67	5.57	2.67	4.94	5.73	22.54	49.32	22.54	49.32	2.30	5.63	2.60	5.73
T_5	21.11	37.17	40.83	23.56	38.50	46.47	2.73	3.87	4.49	2.67	3.96	5.11	17.24	34.19	17.24	34.19	1.88	3.91	2.57	4.32
T_6	23.67	48.81	51.50	25.55	50.05	59.83	2.73	5.47	6.48	3.09	6.38	7.11	27.12	70.58	27.12	70.58	2.98	8.11	3.19	9.11
T_7	23.55	43.55	46.67	25.81	46.77	56.25	2.67	4.63	5.62	2.33	5.15	5.80	22.26	50.09	22.26	50.09	2.47	5.80	2.54	6.25
T_8	23.33	43.33	47.22	25.27	47.22	57.55	2.93	4.70	5.72	2.67	5.08	6.13	23.66	52.11	23.66	52.11	2.60	5.99	2.92	6.71
T_9	23.62	42.40	46.17	25.42	45.83	55.17	2.93	4.33	5.60	3.00	5.15	5.80	21.83	48.80	21.83	48.80	2.37	5.54	2.96	6.02
T_{10}	23.83	48.90	51.20	25.49	50.67	59.17	2.53	5.30	6.44	2.67	6.23	6.93	26.85	69.45	26.85	69.45	2.93	7.93	3.00	8.88
T_{11}	23.33	43.83	46.80	25.30	46.30	56.32	2.77	4.83	5.54	3.33	4.92	5.87	22.33	50.64	22.33	50.64	2.38	5.65	2.78	6.20
T_{12}	23.06	49.63	53.52	25.20	51.27	61.08	2.67	5.80	6.83	3.20	6.35	7.40	29.91	75.82	29.91	75.82	3.29	8.71	3.63	9.80
T_{13}	23.92	49.23	52.25	25.46	50.08	59.48	2.87	5.43	6.51	2.77	6.22	7.20	28.57	72.68	28.57	72.68	3.10	8.25	3.42	9.44
T_{14}	23.12	49.40	53.05	25.76	51.06	60.83	2.93	5.63	6.75	3.22	6.27	7.27	29.43	74.86	29.43	74.86	3.20	8.52	3.55	9.61
T_{15}	24.74	51.20	56.63	26.28	53.12	63.65	2.67	6.27	7.08	3.67	6.83	7.67	30.33	78.85	30.33	78.85	3.33	9.06	3.75	9.96
T_{16}	21.34	32.44	34.51	23.44	33.17	38.17	2.73	3.51	4.13	2.33	3.72	4.67	11.93	24.32	11.93	24.32	1.31	2.80	1.98	3.51
SEm (±)	0.79	1.28	1.39	0.73	1.37	1.53	0.15	0.26	0.23	0.36	0.21	0.40	1.02	1.98	1.02	1.98	0.11	0.24	0.16	0.20
CD (p=0.05)	NS	3.69	4.01	NS	3.97	4.43	NS	0.75	0.67	NS	0.60	1.15	2.94	5.73	2.94	5.73	0.33	0.68	0.46	0.59

of weeds which, ultimately resulted less crop-weed competition throughout the growth of crop. Thus, enhanced availability of nutrients, water, light and space might have accelerated the photosynthetic rate, thereby increased the supply of carbohydrates, which ultimately resulted in increase in plant height, number of leaves, fresh and dry matter accumulation. The finding corroborates the results with those of Sable *et al.* (10), Tripathy *et al.* (14), Kumar *et al.* (7) and Sultana and Das (13).

It is clear from the data presented in Table 2 that various weed management treatments had significant effect on certain yield attributes *viz*., average bulb weight, neck thickness, polar and equatorial diameter and onion bulb yield during both the years of investigation.

The highest average bulb weight, neck thickness, polar diameter, equatorial diameter and bulb yield of onion was recorded under weed free check plot (T_{15}) which remained at par with PRE - Oxyfluorfen @ 250 g a.i. ha^{-1} + 1 HW at 35 DAT (T_{12}), PRE - Oxadiargyl @ 100 g a.i. ha^{-1} + 1 HW at 35 DAT (T_{13}) and PRE - Pendimethalin @ 1000 g a.i. ha^{-1} + 1 HW at 35 DAT (T_{14}) in the year of 2014-15 and T_{12} and T_{14} during 2015-16. However, the application of Oxyfluorfen @ 250 g a.i. ha^{-1} as pre - emergence followed by Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT (T6) and Pendimethalin @ 1000 g a.i. ha^{-1} as pre –emergence followed by Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT (T_{10}) also recorded highest bulb weight next only after weed free check and treatments supplemented with one hand weeding during both the years. Pooled mean regarding the yield of bulb showed that there was significant difference among the treatment and the highest yield (29.92 t ha^{-1}) was obtained from weed free plots (T_{15}) followed by 28.43 t ha^{-1} under PRE - Oxyfluorfen @ 250 g a.i. ha^{-1} + 1 HW at 35 DAT (T_{12}) which surpassed the (T_{16}) weedy check by the margin of 188.8 and 174.4 per cent, respectively. Weedy check (T_{16}) recorded lowest bulb yield (10.36 t ha^{-1}) followed by the treatment T_5 (PoE- Oxadiargyl @ 100 g a.i. ha^{-1} at 35 DAT). The progressive increase in bulb yield with these treatments was because of the fact that weed population and weed growth remained low from initial crop growth as compared to weedy check which, reduced the crop weed competition and might have provided better environment for proper development of growth characters *viz*., plant height, number of leaves per plant, weed fresh and dry weight, neck thickness as well as yield attributes viz., bulb diameter (polar and equatorial), Average bulb weight and ultimately leading to enhance bulb yield. Whereas the least bulb yield under the weedy check (T_{16}) may probably be due to the adverse effect of more crop - weed competition as weed population and weed growth remained un-interrupted from initial crop growth as compared to weed management adapted plots. The increased weed population suppressed the crop growth and finally yield by increasing the crop - weed competition for moisture, nutrient, light and space. The findings are in closed vicinity of those reported by Sable *et al.* (10), Kumar *et al.* (7), Vishnu *et al.* (16), Ningappa *et al*. (9), Sankar *et al.* (11) and Vikash *et al*. (15) with respect to onion bulb yield and yield attributing characters.

The weed management practices failed to record any significant improvement towards total soluble solids, total sugars and bulb dry matter content during both the years of experimentation. The result clearly showed that there was no adverse effect of different herbicides applied either as pre or post - emergence on total soluble solids, total sugars and dry matter content of onion bulb. Thus, it may be concluded that the application of Oxyfluorfen @ 250 g a.i. ha^{-1} as pre and post emergence after 35 DAT (T_6) is the most appropriate in view of labour scarcity followed by T_{10} (PRE- Pendimethalin @1000 g a.i. ha^{-1} + Oxyfluorfen @ 250 g a.i. ha^{-1} at 35 DAT). However, treatment T_{12} (PRE - Oxyfluorfen @ 250 g a.i. ha^{-1} + one hand weeding at 35 DAT) can be used where the labourers are available.

REFERENCES

1. Angiras, N. N. and Kumar, S. 2008. Paper presented in National Biennial conference on recent advances in weed management held at Raipur during March 3 to 6, 2010.

2. Anonymous, 2015. Horticultural Statistics at a glance. National Horticulture Board, Gurugram, Haryana, India.

3. Bharathi, S., Rao, A. S. and Kumari, S. S. 2011. Effect of weed management practices on weed control and yield of onion (*Allium cepa* L) in vertisols. *J. Res. ANGRAU*, **39**: 10-13.

4. Channapagoudar, B. B. and Biradar, N. R. 2007. Physiological studies on weed control efficiency in direct sown onion. *Karnataka J. Agric. Sci.* **20**: 375-76.

5. Ethiopian Agricultural Research Organization (EARO). 2004. Directory of released crop varieties and their recommended cultural practice, Addis Ababa.

6. Kolse, R.H., Gaikwad, C.B., Jadhav, J.D. and Yadav, S.T. 2010. Influence of various weed

Table 2. Effect of weed management practices on yield and quality attributes of onion.

Treatment	Average bulb weight (g)		Neck thickness (mm)		Bulb polar diameter (cm)		Bulb equatorial diameter (cm)		Bulb yield (t ha^{-1})			TSS (°brix)		Total sugar (g 100g^{-1})		Dry matter content of bulb (%)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	Pooled	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_1	25.57	32.04	9.55	11.65	3.56	3.72	3.66	3.89	17.12	18.36	17.74	9.8	10.9	5.2	6.0	11.0	11.2
T_2	23.40	29.43	9.03	12.44	3.29	3.40	3.39	3.66	13.57	14.31	13.94	9.9	10.8	5.2	5.8	11.1	11.3
T_3	25.37	31.51	9.63	12.37	3.53	3.68	3.62	3.86	16.80	18.30	17.55	9.8	10.8	5.2	6.0	11.1	11.2
T_4	26.29	33.68	9.59	11.92	3.66	3.81	3.77	4.12	17.91	19.41	18.66	9.6	10.9	5.5	6.2	10.9	11.2
T_5	20.67	27.65	8.39	12.74	3.18	3.31	3.31	3.52	13.01	13.39	13.20	9.6	10.7	5.2	5.9	11.2	11.3
T_6	51.15	57.97	13.55	16.47	5.38	5.90	5.47	6.34	25.11	27.45	26.28	10.7	11.7	5.5	6.1	10.9	11.1
T_7	31.95	41.82	9.33	13.06	4.29	4.59	4.39	4.62	18.10	19.14	18.62	10.2	11.1	5.5	6.3	10.8	11.0
T_8	35.65	42.39	9.93	12.82	4.43	4.71	4.55	4.97	18.66	19.52	19.09	10.2	11.2	5.4	6.1	10.7	10.9
T_9	30.55	35.15	9.69	12.70	4.24	4.36	4.37	4.48	17.55	17.92	17.73	10.3	11.2	5.5	6.2	10.9	11.1
T_{10}	50.52	57.21	13.75	16.40	5.37	5.85	5.42	6.28	24.69	27.28	25.98	10.8	11.6	5.6	6.4	10.9	11.1
T_{11}	32.74	41.26	10.12	12.41	4.32	4.57	4.37	4.75	17.55	19.00	18.27	10.2	11.1	5.3	6.0	10.6	11.0
T_{12}	55.59	63.50	14.54	16.43	5.68	6.30	5.78	6.88	27.29	29.57	28.43	10.5	11.9	5.6	6.5	10.8	11.0
T_{13}	52.15	60.10	14.61	16.33	5.54	6.05	5.63	6.46	26.10	28.39	27.25	10.4	11.9	5.5	6.5	10.9	11.1
T_{14}	54.55	62.75	14.55	16.46	5.61	6.28	5.74	6.77	27.14	29.16	28.15	10.4	11.8	5.7	6.4	10.8	11.0
T_{15}	57.55	65.52	15.32	16.74	5.84	6.46	5.94	7.04	28.96	30.87	29.92	10.6	11.9	5.7	6.5	10.9	11.2
T_{16}	15.55	18.42	7.19	11.31	2.86	2.99	2.95	3.14	9.23	11.48	10.36	9.4	10.5	5.1	5.6	11.5	11.7
SEm (±)	1.78	1.58	0.60	1.02	0.14	0.20	0.15	0.22	0.75	0.89	0.57	0.4	0.3	0.3	0.2	0.4	0.3
CD (p=0.05)	5.13	4.57	1.73	2.96	0.40	0.58	0.45	0.62	2.17	2.57	1.65	NS	NS	NS	NS	NS	NS

control methods on growth and yield contributing character of onion seed. *Int. J. Pl. Protec.* **3**: 23-27.

7. Kumar, U., Prasad, B. and Chandra, G. 2014. Effect of different herbicides on growth, yield and weed flora of onion (*Allium cepa* L.). *J. Hill Agric.* **5**: 207-210.

8. Nargis, B., Jilani, M. S. and Waseem, K. 2006. Integrated weed management in different varieties of onion. *Indus J. Biol. Sci.* **3**: 678-84.

9. Ningappa, R. B., Tuppad, G. B. and Madhu, G. 2014. Sequential application of pre and post emergence herbicides for weed management in chilli + onion + cotton intercropping systems. *Trends Biosci.* **7**: 2818-23.

10. Sable, P. A., Kurubar, A. R. and Hugar, A. 2013. Study of weed management practices on weeds dry weight, growth, yield and economics parameter of onion (*Allium cepa* L.). *Asian J. Hort.* **8**: 269-73.

11. Sankar, V., Thangasamy, A. and Lawande, K. E. 2015. Weed management studies in onion (*Allium cepa* L.) cv. N4-2-1 during *Rabi* season. *Int. J. Trop. Agric.* **33**: 627-31.

12. Sharma, G. D., Rameshwar, Dogra, Vishal and Singh, Gurdev. 2001. Crop weed competition in onion (*Allium cepa*) under dry temperate high hills condition of Himachal Pradesh. *Indian J. Weed Sci.* **33**: 168-70.

13. Sultana, S. and Das, S. 2015.Weed control efficiency of some herbicides in transplanted onion. *Envi. & Ecol.* **33**: 1604-07.

14. Tripathy, P., Sahoo, B. B., Patel, D. and Dash, D. K. 2013. Weed management studies in onion (*Allium cepa* L.). *J. Crop and Weed* **9**: 210-12.

15. Vikas, V., Asodaria, K. B. and Ashok, S. 2015. Weed management in *Rabi* onion (*Allium cepa* L.). *Agric. Sci. Digest* **35**: 130-33.

16. Vishnu, Vikas, Asodariya, K. B., Suthar, Ashok and Meena D. K. 2014. Effect of herbicides on phytotoxicity and weed reduction in *Rabi* onion (*Allium cepa* L.). *Trends Biosci.* **7**: 4011-15.

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