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Scheduling weed management practices for improving weed control efficiency and bulb yield in onion

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ABSTRACT

An experiment was conducted under All India Network Research Project on Onion and Garlic, operating at the College of Horticulture, Orissa University of Agriculture and Technology, Sambalpur, Odisha during *Rabi*, 2010-11 to compare the efficacy of different weed control methods in onion. The experiment was laid out in a randomized block design with eight combinations of weed management practices and replicated thrice. Results revealed that significantly highest marketable bulb yield (19.19 t/ha) and total bulb yield (22.80 t/ha) was obtained with a higher percentage 'A' grade bulb (34.04 %) and an average bulb weight (69.83 g) by the application of oxyfluorfen before planting + one hand weeding at 45 days after transplanting. The identical weed management practice recorded highest 66.09% of weed control efficiency along with the lowest number of monocot weeds (26.33/ m^2), minimum fresh weight of weeds (40.08 g/m^2) and minimum dry weight of weeds (14 g/m^2). Imposition of manual hand weeding at 45 DAT facilitates a weed-free situation to the crop. Hence, it was concluded that maximum bulb yield can be obtained with the application of oxyfluorfen before planting + one hand weeding at 45 DAT due to the influence of oxyfluorfen and one manual hand weeding on monocot weeds during the crop growth period.

Onion (*Allium cepa* L.) is an important export-oriented vegetable crop, valued for its distinctive flavor and spiciness. Being an indispensable ingredient of both vegetarian and non-vegetarian diets, its demand is getting increased as the only vegetable spices. India contributes 21.5% share in world onion production although it globally ranks ninth in terms of productivity (FAOSTAT 2019). The productivity of onion is reasonably low and remains almost static with negligible variation since a long period. Weed infestation is one of the vital limiting factors that cause comparatively more losses than those caused due to insect pests and diseases. Crop losses due to weeds vary from 30 to 95% in onion (Praksh *et al*. 2000, Rameshwar *et al.* 2001; Udit Kumar 2014).Weed seeds get dispersed to the field under dormant condition at the time of incorporation of farmyard manure during field preparation and unvaryingly nourished with the transplanted onion seedlings. Concurrently, the weeds compete with onion seedlings for nutrients, soil moisture, space and light. In fact, onion is a slow growing crop with a shallow root system and non-branching habit. Moreover, the cylindrical upright tapered leaves create a sparse foliage, making the crop unable to cover the soil surface for prevention of weed growth. Ultimately the crop facilitates the weed growth by encouraging favorable circumstances with sufficient sunlight, air coupled with regular irrigation and high fertilization. Very regrettable crop-weed competition has been reported in onion (Channapagoudar and Biradar 2007, Barla and Upasani 2019). Chemical weed control or use of herbicides is the only modern tool to manage the crop-weed competition. It is easy and convenient to use, apart from that, it reduces the cost of labour required for the hand weeding. However, like other agrochemicals, judicious application of herbicides is also essential to obtain maximum economic returns. The critical period of crop-weed competition ranges from 30 to 40 days

after transplanting (DAT) in onion (Sathyapriya *et al.* 2017), and it may even go up to 50 DAT (Qasem 2005). An effective weed management practice during the critical crop growth stage is very essential to obtain an optimum economic yield. Keeping this in mind the present experiment was formulated to assess the efficacy herbicides solely and in combination with different weed control practices at different crop growth stages in onion.

A field experiment was conducted under All India Network Research Project on Onion and Garlic operating at the College of Horticulture, Orissa University of Agriculture and Technology, Chiplima, Sambalpur, Odisha during *Rabi*, 2010-11 in a randomized block design with three replications. There were eight treatments *viz*. oxyfluorfen 235 g/ha before planting and at 30 DAT, oxyfluorfen 235 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT, oxyfluorfen 117.5 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT, pendimethalin 750 g/ha before planting and at 30 DAT, pendimethalin 750 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT, pendimethalin 375 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT, oxyfluorfen 235 g/ha before planting *fb* one hand weeding at 45 DAT and weedy check. The soil of the experimental site was sandy loam soil having pH of 5.89; available NPK 151.25:15.78:178.75 kg/ha and low sulphur content (9.75 ppm). The climatic condition of this locality was warm/sub-humid with the temperature ranging from 9°C to 44.2°C. This research site was a weed prone area under Western Table Land Zone of Odisha with wide diversities of monocot and dicot weeds.

Onion seedlings (*cv.* Agrifound Dark Red) of eight weeks' old were transplanted in the main field at a spacing of 15 x 10 cm in individual plot size of 10 m^2. All recommended packages of practices other than weed management were adapted uniformly to all the treatments to raise a good crop. Data on different vegetative growth parameters (plant height and number of leaves) were recorded at 75 DAT, where as yield parameters (average bulb weight, marketable bulb yield, and total bulb yield) were recorded at harvest. Weed parameters (number of weeds/m^2, fresh and dry weight of weeds/m^2) were recorded at 90 DAT. Weeds were counted from an area of 1 m^2 for each treatment, and categorized into monocots and dicots. Fresh weights of weeds (g/m^2) were recorded immediately after weeding at 90DAT, whereas dry weights of weeds (g/m^2) were recorded after complete hot air oven drying at 80^0 C for 48 hrs.

Weed control efficiency (WCE) was calculated as per the following formula (Mani *et al.* 1973):

$$WCE\ \% = \frac{WDc - WDt}{WDc} X100$$

where,

WCE: Weed control efficiency (%),

WDc: Dry weight of weeds in weedy check plot, and

WDt: Dry weight of weeds in treated plot.

The observed data were subjected to statistical analysis (Sukhatme and Amble 1995).

The results in **Table 1** revealed a significant variation in vegetative growth of onion plants due to treatments. Highest 56.67 cm of plant height was observed under combined spray of pendimethalin 375 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT, which was *at par* with the application of oxyfluorfen before planting along with one hand weeding at 45 DAT (56.39 cm). Maximum number of leaves per plant (15.37) was recorded with the application of oxyfluorfen 235 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT which was also at par with the application of oxyfluorfen + one hand weeding. This might be due to considerable suppression of weeds throughout the cropping period. Application of Oxyfluorfen 235 g/ha before planting was reported as a pre-emergence herbicide that affects terrestrial plants. It strongly adsorbs to soil particles and comparatively motionless within the soil profile. It achieves toxicity in plants that restricts the emergence and growth of weeds in the early vegetative stage (Alister *et al*. 2009, Shaner 2014). Likewise, it allows a favorable condition to encourage appropriate vegetative growth of the crop like onion. An increase in number of leaves was proportionally related to the number of scale leaves in onion bulbs as well as the average weight of bulb. Imposition of manual hand weeding at 45DAT could facilitate a weed-free situation to the crop.

Application of oxyfluorfen before planting + one hand weeding (45 DAT) recorded the highest marketable bulb yield (19.19 t/ha) and total bulb yield (22.80 t/ha) as obtained under with a higher proportion 'A' grade bulb (34.04%) and an average bulb weight (69.83 g). This treatment was followed by the combined spray of pendimethalin 375 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT, registering the marketable bulb yield of 18.81 t/ha and total bulb yield of 216.77 q / ha with 27.39% 'A' grade bulb and an average bulb weight of 56.93 g (**Table 1**). Doubles and bolters in onion are very less consumer acceptability. Here in both of the above reveal weed management practices, the

Table 1. Effect of weed management practices on growth and yield of onion

Treatment	Plant height (cm)	Leaves/ plant	Average bulb weight (g)	Grading of bulb (%)			% Double	% Bolters	Total bulb yield (t/ha)	Marketable bulb yield (t/ha)
				A	B	C				
Oxyfluorfen 235 g/ha before planting and at 30 DAT	54.10	14.43	52.73	20.23	31.49	29.32	1.97	1.88	15.25	12.38
Oxyfluorfen 235 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT	53.65	15.37	57.07	25.63	32.53	27.79	1.85	2.15	20.49	17.62
Oxyfluorfen 117.5 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT	54.88	15.20	53.53	22.49	28.65	34.77	1.82	2.48	19.10	16.44
Pendimethalin750 g/ha before planting and at 30 DAT	49.51	14.77	56.00	22.15	31.62	16.48	2.55	3.01	15.09	10.60
Pendimethalin750 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT	49.41	13.90	52.87	24.26	37.00	23.85	2.08	2.77	13.97	11.82
Pendimethalin 375 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT	56.67	14.57	56.93	27.39	32.38	27.00	1.93	1.80	21.68	18.81
Oxyfluorfen 235 g/ha before planting *fb* one hand weeding at 45 DAT	56.39	15.33	69.83	34.04	29.39	20.91	1.94	1.81	22.80	19.19
Weedy check	49.33	13.00	52.03	16.97	32.66	34.78	2.65	3.70	11.40	9.61
LSD (p=0.05)	5.51	1.47	10.05	8.90	NS	NS	0.48	1.15	4.12	3.44

NS: Not significant

Table 2. Effect of weed management practices on growth and yield of onion var. agrifound dark red

Treatment	MCW/ m^2	DCW/ m^2	FWMC (g/m^2)	FWDW (g/m^2)	DWMC (g/m^2)	DWDW (g/m^2)	WCE (%)	BCR
Oxyfluorfen 235 g/ha before planting and at 30 DAT	28.00	24.33	50.38	111.40	20.12	26.00	64.45	1.35
Oxyfluorfen 235 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT	29.00	26.67	45.71	105.30	19.56	23.99	62.21	3.41
Oxyfluorfen 117.5 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT	35.00	23.00	83.39	123.50	18.30	27.45	60.63	2.83
Pendimethalin750 g/ha before planting and at 30 DAT	33.33	26.67	63.26	93.22	16.53	21.88	59.28	1.02
Pendimethalin750 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT	31.33	16.00	82.31	63.45	16.55	14.66	67.90	1.14
Pendimethalin 375 g/ha + quizalofop-ethyl 43.7 g/ha at the time of planting and at 30 DAT	29.00	22.67	54.29	79.22	15.44	17.98	64.94	2.97
Oxyfluorfen 235 g/ha before planting *fb* one hand weeding at 45 DAT	26.33	23.67	40.08	106.22	14.00	23.67	66.09	2.64
Weedy check	79.67	67.67	115.40	163.40	30.11	36.98	0	
LSD (p=0.05)	3.75	3.39	14.67	11.13	5.11	6.36	3.61	-

MCW: No. of monocot weeds/m^2, DCW: No of dicot weeds/m^2, FWMC: Fresh weight of monocot weeds (g/m^2), FWDC: Fresh weight of dicot weeds (g/m^2), DWMC: Dry weight of monocot weeds (g/m^2), DWDW: Dry weight of dicot weeds (g/m^2), WCE: Weed control efficiency, BCR: Benefit-cost ratio

percentage of doubles and bolters are comparatively less which supports to the achieve the higher marketable bulb yield in onion.

There was a significant variation in the number of monocot and dicot weeds along with WCE among different weed management practices. Application of oxyfluorfen + one hand weeding recorded the lowest number of monocot weeds (26.33/ m^2), fresh weight of weeds (40.08 g/m^2) and dry weight of weeds (14 g/m^2). It was followed by pendimethalin + quizalofop-ethyl, registering these values at 16.00 nos. 63.45 and 14.66 g/m^2, respectively.

Results in **Table 2** revealed that both the treatments with the application of pendimethalin 750 g/ha before planting *fb* quizalofop-ethyl 87.5 g/ha at 30 DAT and oxyfluorfen 235 g/ha before planting *fb* one hand weeding at 45 DAT had a significant impact on weed suppression. Pendimethalin in integration with quizalofop-ethyl could suppress the dicot weed population, whereas oxyfluorfen along with one hand weeding suppressed the monocot population.

The crop field was dominated more with the monocot weeds. Most of the weeds were found to be kept under control with the influence of oxyfluorfen + one hand weeding during the crop growth period, leading to the production of the highest bulb yield in onion. An optimum WCE of 67.90% was observed with the application of pendimethalin (before planting) + quizalofop-ethyl (30 DAT), and was followed by oxyfluorfen (before planting) + one hand weeding (45 DAT) with WCE of 66.09%.

An optimum benefit-cost ratio of 3.41 was recorded with the application of oxyfluorfen (before planting) + quizalofop-ethyl (30 DAT). Maximum bulb yield was obtained with the application of oxyfluorfen (before planting) + one hand weeding (45 DAT). Thus, the application of oxyfluorfen 235 g/ha before planting along with one hand weeding at 45 DAT might be recommended for ensuring an appropriate weed management as well as achieving higher bulb yield in onion.

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