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Effect of integrated weed management on growth, yield and economic returns on onion (*Allium cepa* L.)

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ABSTRACT : A field experiment on integrated weed management was conducted during the *Rabi* season of 2015-16 at the farm of KVK, Yavatmal. The experiment was conducted in Randomized Block Design with six treatments and four replications. Treatments comprised of T_1- One hand weeding at 20 days after planting of seedlings, T_2- Two hand weedings at 20 and 40 DAT, T_3- Three hand weeding at 20, 40 and 60 DAT, T_4- Spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT + 1HW at 45 DAT, T_5- Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting + 1HW at 40-60 DAT and T_6- Control check *i.e.* without weed control practices. The experiment was carried out in order to evaluate best weed management practices in situation of limited weedicide registered in label claim. The observations on effect of IWM practices on weed parameters, crop growth, bulbs yield were recorded. Minimum weed count and dry matter of weed at 90 DAT with highest weed control efficiency was recorded by the treatment T_4- where spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT + 1HW at 45 DAT. Regarding the plant growth and bulb yield parameters, the treatment T_4- where spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT + 1HW at 45 DAT was found significantly superior over all the treatments as recorded maximum plant height, neck thickness, dry matter weight of plant, bulb diameter, fresh weight of bulb, cured weight of bulb, bulb yield per plot and per ha. Treatment T_4 obtained maximum yield and thereby recorded highest gross return as well as net return and scored highest cost benefit ratio 1:2.09. However, treatment T_5- Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting +1HW at 40-60 DAT ranked second in control of weed growth and gained the higher bulb yield with monetary returns.

KEY WORDS : IWM, Onion, Weed, Oxyfluorfen, Hand weeding, Yield

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Onion (*Allium cepa* L.) belonging to the family Alliaceae originated in Central Asia, is the most important biennial vegetable bulb crop grown throughout the world. It is the major vegetable cum spice crop grown for food therapeutic and medicinal value. In India it is an important ingredient in daily diet food, without which the daily diet cannot be completed. The annual average world production of onion is estimated around 72 million metric tonnes. In India onion occupies about 1.06 million ha area having 15.12 million metric tonnes/ha production (Anonymous, 2011). Maharashtra is a leading onion growing state with a 4904 thousands million tonnes of production, 11.82 tonnes/ha productivity from an area of 415 thousands ha (Anonymous, 2011).

Release of high yielding varieties tremendously boosted cultivation area under onion crop.

In Vidarbha region, onion is mostly a major *Rabi* season crop. As it is totally an irrigated crop, weed is major problem in the crop that directly affected the crop growth as well as yield. In onion, yield loss due to weed infestation is reported to the tune of 40-80 per cent (Channapagoudar and Biradar, 2007). Weeds compete with onions for nutrients, soil moisture, space, light and considerably reduce the yield, quality and value of the crop through increased production and harvesting costs (Hussain, 1983).

The conventional method of weed control *i.e.* hand weeding and hoeing are vary laborious, time consuming and expensive. Also only application of weedicide does not give the effective weed control. Post – emergence herbicides kill weeds and keep the hardy weeds under control by arresting their growth through various kinds of deformities in foliage and growing points (Panse *et al.*, 2014). Currently inclusion of a limited herbicide for weed management in onion crop as per label claim created a challenge to assess the most proper method of weed control with limited weedicide that gives quality higher yield with higher cost benefit ratio. Hence, it felt necessary to assess the different weed management practices alone and in combination with integrated approach at proper stage of crop growth. Keeping in view, the present field experiment was conducted to assess most feasible and economic weed management practices in onion crop for Vidarbha region.

RESEARCH METHODS

The field experiment on onion crop was conducted at farm of Krishi Vigyan Kendra, Yavatmal to study the effect of integrated weed management on growth, yield and economic returns of onion. The experiment was laid out in Randomized Block Design with six treatments and four replications during the *Rabi* season of 2015-16 using var. Akola Safed. The treatment comprised of T_1- One hand weeding at 20 days after planting of seedlings, T_2- Two hand weedings at 20 and 40 DAT, T_3- Three hand weeding at 20, 40 and 60 DAT, T_4- Spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT, T_5- Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting +1HW at 40-60 DAT and T_6- Control check l *i.e.* without weed control practices.

The nursery for raising of seedlings was sown on 3rd Nov., 2015. The healthy seedlings of eight weeks old were transplanted on flat beds at a spacing of 10 x 10 cm in a plot of 2.40 x 1.30 m. Various weed management practices as per treatments were applied to the replicated plots. The soil of the experimental plot was vertisol with pH 7.32 – 7.89, available N, P_2O_5 and K_2O content was 265.20 kg/ha, 24.2 kg/ha and 295 kg/ha, respectively. All the recommended package of practices was followed for raising of onion crop.

The observations on weed density (no./sq.m.) and dry matter weight of weeds (g/sq.m.) were recorded at 90 days after transplanting of seedlings in standing crop by placing a quadrat of 50 cm x 50 cm randomly from three places in each plot. Based on weed control, weed count efficiency was calculated using the following formula.

$$\text{WCE (\%)} = \frac{\text{DMC} - \text{DMT}}{\text{DMC}} \text{x} 100$$

where,

DMC was dry matter weight of weeds in control plot and DMT was dry matter of weeds in treated plots.

The observations on crop growth and yield parameters *viz.*, plant height (cm), neck thickness (cm), dry matter weight of plant (g), bulb diameter (cm), fresh weight of bulb (g) and cured weight of bulb (g) were recorded at 90 days after transplanting of onion seedlings from 5 randomly selected plants from each plot in all replications. Yield data regarding per plot yield were recorded from net plot at harvesting and accordingly yield per ha for different treatments in all replications were calculated. For economic assessment of integrated weed management practices, prevailing market price was compared for different outputs and inputs. The overall mean data on different parameters were statistically analyzed as per the methods suggested by Sukhatme and Amble (1995).

RESEARCH FINDINGS AND DISCUSSION

The observations recorded on different parameters of weed control, crop growth, yield and economic returns as affected by different integrated weed management treatments are discussed as below.

Effect on weed parameters:

The prominent weed species found in experimental plots were *Cynodon dactylon, Cyperus rotandus, Chenopodium album, Portulaca oleraceae, Amaranthus viridis, Euphorbia* spp., *Parthenium*

historophorous etc. Similar types of weeds in onion field were also reported by Panse *et al.* (2014).

The data presented in Table 1 on weed parameters in onion revealed significant variations among the treatments. All the treatments applied for weed management in onion crop recorded significant reductions in total weed density and dry matter weight of weed as compared to control. Minimum weed density (32.64/m^2) and dry matter weight of weed (30.49 g/m^2) at 90 DAT were recorded significantly superior in the plots treated under treatment T_4- *i.e.*Spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT. However, the highest weed density and weed dry matter weight was recorded in the treatment plots of T_6- *i.e.* weedy check without weed control. Based on the weed dry matter weight at 90 DAT, the highest weed control efficiency was calculated and it was found to be highest with the treatment T_4 *i.e.* spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT closely followed by T_5 and T_3 *i.e.* 81.08, 79.82 and 74.88 per cent, respectively.

In case of weed management practices, combination of chemical and cultural weed control practices was found most effective to keep the weed population under control during the critical crop growth period. Spraying application of oxyfluorfen 15-20 days after transplanting and also pre-transplanting have checked all the weed growth during the initial crop growth stage, that kept the plot in check for nearly upto 20-25 days and one hand weeding at 45 days after transplanting kept the next 20 to 25 days crop growth stage in weed free by removing the grassy and broad leaves weeds germinated in the later period of herbicide spraying during the first month of crop period. Similar results have been reported by Kolhe (2001); Warade *et al.* (2006); Malik *et al.* (1981); Verma and Singh (1997) and Tripathy *et al.* (2013).

Table 1 : Effect of integrated weed management practices on various weed parameters in onion crop 90 DAT

Sr. No.	Treatment details	Weed density (no./m^2)	Per cent weed control efficiency	Dry matter weight of weeds (g/m^2)
T_1	One HW at 20 DAT	99.82	42.14	102.49
T_2	Two HW at 20 and 40 DAT	75.66	56.14	77.26
T_3	Three HW at 20, 40 and 60 DAT	43.34	74.88	44.12
T_4	Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT	32.64	81.08	30.49
T_5	Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting +1HW at 45 DAT	34.81	79.82	31.73
T_6	Control (without weed control)	172.52	0	158.35
	S.E.±	1.81		1.79
	C.D. (P=0.05)	5.30		5.24

Table 2 : Effect of integrated weed management practices on growth and yield attributes of onion crop 90 DAT

Sr. No.	Treatments	Plant height (cm)	Neck thickness (cm)	Dry matter weight of plant (g/plant)	Bulb diameter (cm)	Fresh weight of bulb (g)	Cured weight of bulb (g)	Bulb yield/plot (kg/ha)
T_1	One HW at 20 DAT	31.17	1.12	17.78	3.60	34.54	24.21	3.07
T_2	Two HW at 20 and 40 DAT	42.95	1.10	25.06	4.29	43.42	32.37	3.86
T_3	Three HW at 20, 40 and 60 DAT	57.37	1.07	27.35	5.33	72.80	59.95	6.50
T_4	Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT	60.30	1.02	30.52	5.64	84.14	72.75	8.90
T_5	Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting +1HW at 45 DAT	59.21	1.04	30.06	5.41	80.13	69.25	8.30
T_6	Control (without weed control)	21.51	1.17	9.99	2.82	28.76	18.89	2.30
	S.E.±	1.06	0.03	0.63	0.13	1.38	1.22	0.23
	C.D. (P=0.05)	3.10	0.09	1.85	0.39	4.04	3.57	0.66

Effect on crop growth parameters :

Integrated applications of various weed management treatments studied under field experimentations showed significant superiority over all the other treatments regarding crop growth and yield parameters in onion. The highest plant height (60.30 cm), neck thickness (1.02 cm), dry matter weight of plant (30.52 g), bulb diameter (5.64 cm), fresh weight of bulb (84.14 g) and cured weight of bulb (72.75g) were reported with the treatment T_4- *i.e*. spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15kga.i./ha 15-20 DAT + 1HW at 45 DAT. Treatment T_5 *i.e.*spraying of oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting +1HW at 40-60 DAT scored the second position in achieving the increased crop growth regarding plant height, neck thickness, dry matter weight of plant, bulb diameter and bulb weight. Significantly shortest crop growth in all aspects was observed in weedy check plots (Table 2).

Increased crop growth and bulb weight with the application of integrated application of herbicide followed by hand weeding was due to favourable environment received to the crop to express better plant growth. This increased in crop growth was due to less crop weed competition at the earlier stage of crop growth. Integrated application of herbicide followed by hand weeding at critical crop growth period kept the weeds under check and thus efficiently controls the weed population, provided favourable environment for crop growth, thus, hastened the crop growth and ultimately the quality of the produce. The findings are in confirmation with the findings of Chandrika *et al*. (2009) who have reported the similar results in IWM in onion crop. Similar finding were also reported by Kumar and Mourya (2006); Tripathy *et al*. (2013) and Panse *et al*. (2014). However, reduced crop growth due to heavy weed population increased the weed crop competition and stress on onion crop. Similar finding have been reported by Wilson and Scheffer (1981).

Effect on crop yield :

Treatment T_4 *i.e.* spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15kga.i./ha 15-20 DAT+1HW at 45 DAT have recorded significantly superior results over all the treatments as reported the highest bulb yield 285.26 q/ha followed by treatment T_5 with the application of spraying of oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting +1HW at 40-60 DAT followed by the treatment T_3 *i.e.* three hand weeding at 20, 40 and 60 DAT (Table 3).

The increased in yield with the integrated application of weedicide followed by hand weeding have kept the weed population under control during the initial crop growth stages, thus facilitates the better environment for plant growth. The better crop growth affected increased in size and weight of bulbs. The manual hand weeding treatments have recorded the lesser crop yield. It might be due to less effective weed control or more number of weeds in plot as compared to plots applied with integrated weed management practices. These results are in close conformity with the findings of earlier workers (Sukhadia *et al.,* 2002 and Chopra and Chopra, 2007).

Effect on economic returns :

The highest net monetary returns of Rs. 103947.10 with cost benefit ratio 1:2.09 was reported with weed management treatment T_4 *i.e.* spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT followed by the treatment T_5 where spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg

Table 3 : Effect of integrated weed management practices on economic returns of onion crop

Sr. No.	Treatments	Bulb yield (q/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Cost : Benefit ratio
T_1	One HW at 20 DAT	98.40	69238.30	68880	- 3.86	1: - 0.99
T_2	Two HW at 20 and 40 DAT	123.72	77479.30	86604	9124.70	1: 1.12
T_3	Three HW at 20, 40 and 60 DAT	208.33	90247.90	145831	55583.10	1: 1.62
T_4	Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT	285.26	95734.90	199682	103947.10	1: 2.09
T_5	Spraying Oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha before planting +1HW at 45 DAT	266.02	92384.30	186214	93829.70	1: 2.02
T_6	Control (without weed control)	73.72	65743.30	51604	-14139.30	1: - 0.78

a.i./ha before planting +1HW at 40-60 DAT was applied (Table 3). Though cost of cultivation in hand weeding treatments were less than the integrated weed management treatment *i.e.* treatment T_4 and treatment T_5 because of cost of weedicide but due to achieved highest bulb yield/ha recorded higher gross returns than manual hand weeding practices. The highest net monetary returns with cost benefit ratio was obtained in the treatment T_4 *i.e.* spraying of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT followed by the treatments T_5 and T_3. Treatment T_3 with three manual hand weeding proved more laborious, expensive and time consuming for effective weed control. Control treatment *i.e.* T_6 and treatment T_1 *i.e.* one hand weeding at 20 DAT recorded minus cost : benefit ratio *i.e.* 1: -0.78 and T_1: -0.99 due to poor yield as compared to cost of cultivation. The results regarding gain of highest monetary returns and cost benefit ratio with integrated weed management practices are supported with the results of Nandal and Singh (2002); Pugalendhi *et al.* (2011); Patel *et al.* (2011) and Tripathy *et al.* (2013) who have studied the economic returns parameters in INM in onion crop under various climatic conditions.

Conclusion:

On the basis of the experiment conducted on various weed management treatments to study the crop growth, yield and economic returns in onion crop, it was concluded that, application of herbicide oxyfluorfen 23.5% EC 0.1-0.15 kg a.i./ha 15-20 DAT+1HW at 45 DAT is more practically convenient and economically feasible method for weed control in onion.

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