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WEED MANAGEMENT IN TRANSPLANTED ONION (*ALLIUM CEPA* L.) THROUGH EARLY POST-EMERGENCE HERBICIDES

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Abstract

A field experiment was conducted to evaluate different weed management practices in onion during rabi 2016-17 to 2017-18 at the Agricultural Farm, PalliSiksha Bhavana, Visva-Bharati, Sriniketan, West Bengal. Theexperiment was laid out in randomized block design having eleven treatments with three replications. The pooled results revealed that highest bulb yield (22.07 t ha^{-1}) was obtained from weed free treatment over the remaining treatments. Among herbicidal treatments, oxyfluorfen 20% DF at 3000 g ha^{-1} recorded significantly highest bulb yield (21.85 t ha^{-1}) than oxyfluorfen 23.5% EC (850 ml ha^{-1}), propaquizafop 10% EC (625ml ha^{-1}) and pendimethalin 38.7% EC (1750 ml ha^{-1}). However, bulb yield produced through the treatment oxyfluorfen 20% DF at 3000 g ha^{-1} was at par with other doses of oxyfluorfen 20% DF at 2000, 1000 and 750 g ha^{-1}. Among herbicidal treatments the weed control efficiency was highest in oxyfluorfen 20% DF at 3000 g ha^{-1} than the rest of the treatments. Highest B:C ratio (1.638) was obtained with oxyfluorfen 20% DF at 1000 g ha^{-1} but it was very close to oxyfluorfen 20% DF at 750 g ha^{-1} (1.626). Yield loss due to weeds was to the extent of 30.68 %.

Key words: Transplanted onion, early post-emergence, oxyfluorfen, weed complex

Introduction

Onion (*Allium cepa* L.) is one of the most important condiments extensively used in each household throughout the year. The green leaves, immature and mature bulbs are eaten raw or used in preparation of vegetables. Onion bulb is rich in phosphorus, calcium and carbohydrates. It is a crop of vital economic position with higher market demand and price for its culinary, dietary and medicinal importance like in preventing heart disease and other ailments (Kalhapure *et al.*, 2014). One of the major constraints in onion cultivation is weed menace. Onion cannot compete well with weeds because of being a shallow rooted, non-branching habit, narrow upright leaves and extremely slow growth in initial stage. Frequent application of irrigation and fertilizer in addition to above allows successive flushes of weeds in onion. The loss in yield due to weed infestation has been observed about 40-80% (Channapagoudar and Biradar, 2007 and Ramalingam *et al.,* 2013). Hence, it is essential to control weeds in order to ensure proper crop growth, especially in the early growth period. There also exists a good negative correlation between dry matter of weeds and grain yield of the crop (Singh, 2007). It may be minimized to a greater extent simply by adopting an appropriate weed management practice. Traditional hand weeding and other weed control methods are laborious, time consuming, costly and difficult, so under this circumstance weed management through herbicide is most cost effective and remunerative method and it has become a preferred practice (Singh *et al.*, 2003). Now -a -days farmers are using many pre and post emergence herbicide for controlling weeds in their crop field. The most effective herbicide suitable for weed destruction presently in onion and cabbage is oxyfluorfen as reported by Stall and Gilreath (2002). The greatest grass weed control efficiency (90.19 %), was exhibited by pendimethalin 38.7% CS at 1.75 litre ha^{-1} whereas the greatest broad leaved weed control efficacy (82.95 %) was exhibited by oxyfluorfen 23.5% EC at 1.0 litre ha^{-1} in onion (Shinde *et al.,* 2013). Ramalingam *et al.,* (2013) reported that oxyfluorfen at 0.2 kg ha^{-1} as pre-emergence resulted higher yield of onion, due to efficient control of weeds at critical phase of competition, providing an optimum condition of environment for proper growth and development that increased yield of onion. The

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lower values of total weed count, weed dry matter and higher efficiency of weed control at all the interval of growth was achieved by application of oxyfluorfen (23.5% EC) at 0.4 kg ha^{-1} as pre-emergence was evaluated by Ramalingam *et al.,* (2013). Vishnu *et al.,* (2015) stated that the spraying of propaquizafop at 0.09 kg ha^{-1} in combination with oxyfluorfen at 0.24 kg ha^{-1} followed by its second post emergence application at 45 days after transplanting was found to have equal effectiveness. Sahoo and Tripathy (2019) reported that application of oxyfluorfen 23.5% EC at 2 ml l^{-1} before transplanting followed by one hand weeding at 40-60 days after transplanting reduces the weed infestations and produce higher bulb yield in onion. As weeds reduce the profitability of onion crops, judicious and timely weed management practices should be taken for better onion yield. Therefore, an experiment was designed to study the efficacy of pre and post emergence herbicides to control the weeds flora in onion crop.

Materials and Methods

The field experiment was conducted for two consecutive years *i.e.* 2016-17 and 2017-18 in *rabi* season at the Agricultural Farm, Institute of Agriculture, Visva-Bharati, Sriniketan in West Bengal ($20^0 39^/N$ latitude and $87^0 42^/E$ longitude with an average altitude of 58.9 m above mean sea level under typical semi-arid tropical climate. The total rainfall received during the experimental period was 2.20 mm in the year 2016-17 and 9.56 mm in the year 2017-18. The soil texture of the experimental site was sandy loam. The experimental soil 0.48 % organic carbon (Walkley and Black, 1934), 132.24kg N ha^{-1}N (Subbiah and Asija, 1956), 12.33 kg P ha^{-1} (Bray and Kurtz, 1945) and 165.75kg K ha^{-1} (Hanway and Heidel, 1952). The pH of the experimental soil was 6.14 (Prasad *et al*., 2006). The selected experimental site was infested with monocots like *Cynodondactylon, Cyperusrotundus, Digitariasangunialis, Echinochloacolona* and *Eleusineindica*and dicot weeds like *Chenopodium album, Amaranthus viridis, Euphorbia hirta, Parthenium hysterophorus*and *Phyllanthus niruri*. Among them predominate weeds are *Cyperusrotundus, Echinochloacolona, Chenopodium album and Amaranthus viridis.* The randomized block design was adopted. There was eight different pre and post emergences herbicides along with hand weeding, weed free and weedy check and replicated thrice. The treatments comprised of T_1-oxyfluorfen 20% DF (500 g ha^{-1}), T_2-oxyfluorfen 20% DF (750 g ha^{-1}), T_3-oxyfluorfen 20% DF (1000 g ha^{-1}), T_4-oxyfluorfen 20% DF (2000 g ha^{-1}), T_5-oxyfluorfen 20% DF (3000 g ha^{-1}), T_6-oxyfluorfen 23.5% EC (850 ml ha^{-1}), T_7-propaquizafop 10% EC (625 $mlha^{-1}$), T_8-pendimethalin 38.7% EC (1750 $mlha^{-1}$), T_9-hand weeding at 15 & 30 days after transplanting (DAT), T_{10}-weed free and T_{11}-weedy check (control). The variety used in the experiment was '*Sukhsagar'*. The 40 days old onion seedling was transplanted on 1st November, 2016 and 30th October, 2017.The spacing between line was 15cm and plant to plant spacing was10 cm. the plot size was 6 m × 5 m. Light irrigation was given for the rapid seedling establishment immediately after transplanting. A general dose of N: P_2O_5: K_2O for onion was applied uniformly to each plot at the rate of 150:100:150 kg ha^{-1} along with farm yard manure at the rate of 15 t ha^{-1} and it was applied at 15 days before transplanting of onion seedlings. The half dose of N and full quantity of P_2O_5 and K_2O were applied as basal on the day of transplanting. Rest half quantity of nitrogen was applied in two equal splits as top dressing at 30 and 60 days after transplanting (DAT). Oxyfluorfen and propaquizafop herbicide was applied on ten days after transplanting of onion seedlings whereas pendimethalin was applied as preemergence. Appropriate dose of herbicides was applied through battery operated knapsack sprayer fitted with a flat fan type nozzle. The data on plant height and numbers of leaves $plant^{-1}$ were randomly recorded from ten selected plant. Yield attributing parameters and bulb yield were taken after the harvested of onion.

Weed density was recorded at 45 and 55 days after transplanting of crop by placing a quadrat of 0.5 m × 0.5 m randomly from three places in each plot. The population of weed count was recorded species-wise and expressed as number m^{-2}. The weeds from each category dried in hot air oven at 70°C till the weight becomes constant. The dry weight was expressed as g m^{-2} separately for each category.

Weed control efficiency (WCE)

Weed control efficiency was calculated by using the following formula given by Mani *et al.,* (1973) as follows:

$$WCE\ (\%) = \frac{Weed\ dry\ weight\ in\ weedy\ check\ (g) - Weed\ dry\ weight\ in\ treatment\ (g)}{Weed\ dry\ weight\ in\ weed\ check\ (g)} \times 100$$

Weed index (WI)

"Weed index is the per cent reduction in crop yield under a particular treatment due to the presence of weeds in comparison to weed free plot" as stated by Gill and Kumar (1969).

Table 1: Effect of weed management practices on weed population, dry weight and weed control efficiency in onion (pooled).

Treatments	Dose	Total weeds m^{-2}		Total dry weight (g m^{-2})		Weed control efficiency (%)		Weed index
		40 DAT	55 DAT	40 DAT	55 DAT	40 DAT	55 DAT	(%)
T_1-Oxyflourfen 20% DF	500 g ha^{-1}	4.31(18.1)	4.67(21.27)	2.98(8.38)	3.28(10.25)	69.75	69.61	16.27
T_2- Oxyflourfen 20% DF	750 g ha^{-1}	3.60(12.44)	3.95(15.08)	2.61(6.33)	2.83(7.58)	77.18	77.63	4.71
T_3- Oxyflourfen 20% DF	1000 g ha^{-1}	3.54(12.04)	3.90(14.76)	2.53(5.91)	2.67(6.64)	78.72	80.26	3.26
T_4- Oxyflourfen 20% DF	2000 g ha^{-1}	3.45(11.43)	3.80(13.94)	2.44(5.47)	2.61(6.34)	80.31	81.09	1.68
T_5- Oxyflourfen 20% DF	3000 g ha^{-1}	3.26(10.16)	3.55(12.1)	2.28(4.71)	2.33(4.94)	82.98	85.32	1.00
T_6-Oxyflourfen 23.5% EC	850 ml ha^{-1}	4.19(17.07)	4.78(22.35)	2.94(8.16)	2.97(8.40)	70.56	74.99	16.72
T_7-Propaquizafop 10% EC	625 ml ha^{-1}	4.87(23.25)	5.42(28.84)	4.21(17.23)	4.67(21.35)	37.73	36.75	30.68
T_8-Pendimethalin 38.7% EC	1750 ml ha^{-1}	4.74(22.01)	5.28(27.43)	4.06(16.00)	4.25(17.55)	42.41	47.87	16.45
T_9-HW at 15 & 30 DAT	-	2.68(6.72)	3.57(12.26)	1.77(2.62)	2.52(5.84)	90.54	82.72	19.30
T_{10}-Weed Free	-	0.71(0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)	100.0	100.0	0.00
T_{11}-Control		8.64(74.12)	9.20(84.07)	5.31(27.75)	5.85(33.74)	——	——	30.18
Sem(±)		0.09	0.09	0.08	0.10	——	——	
LSD at 5%		0.25	0.26	0.25	0.30	——	——	

The original figures in parentheses were subjected to square root transformation $\left(\sqrt{x+0.5}\right)$ before statistical analysis.

$$WI(\%) = \frac{X - Y}{X} \times 100$$

Where, WI = Weed index; X = Crop yield from weed free plot and Y = Crop yield from the treated plot for which weed index is to be worked out. Before statistical analysis, the data on density of weeds and dry weight of data were subjected to square root $\left(\sqrt{x+0.5}\right)$ transformation to improve the homsogeneity of the variance (ANOVA) separately for each year. The observed data were then subjected to statistical analysis by following the procedure for Randomized Block Design (Sukhatme and Amble, 1995). The significant treatment effect was judged with the help of 'F' test at the 5% level of significance.

Results and Discussion

Total weed count

The results revealed that different herbicides had significant effect on weed population, dry weight and weed control efficiency table 1. The weed population and dry weight decreased irrespective of weed management practices except the weedy check at 45 and 55 DAT Fig. 1 and 2. Significantly, minimum weed population and dry weight were recorded with oxyfluorfen at 3000 g ha^{-1} but it was at par with remaining lower dose except 500 g ha^{-1}. Among herbicidal treatment weed control efficiency was significantly highest in oxyfluorfen at 3000 g ha^{-1} (82.98 and 85.32%) followed by 2000 g ha^{-1} (80.31 and 81.09%), 1000 g ha^{-1} (78.72 and 80.26%) and 750 g ha^{-1} (77.18 and 77.63%) at 40 and 55 DAT, respectively. Oxyfluorfen is a nitrodiphenyl ether herbicide which is applied for controlling pre- and post-emergent monocot and dicot weeds (Sean May *et al.,* 2015). Alister *et al.,* (2009); Shaner (2014) also reported that oxyfluorfen strongly adsorbs to soil particles and remain stable within the soil profile. It inhibits protoporphyrinogen oxidase, leading to irreversible cell membrane damage. Post emergence application of oxyfluorfen causes necrosis on leaf within two days (Sahoo and Tripathy, 2019). The sign of

Table 2: Effect of different herbicidal treatments on growth, yield attributes and weed index of Onion (pooled).

Treatments	Dose	Plant height (cm)	Number of leaves $plant^{-1}$	Bub weight (g)	Bulb yield (t ha^{-1})	B:C ratio
T_1-Oxyflourfen 20% DF	500 g ha^{-1}	55.1	5.7	67.78	18.48	1.332
T_2- Oxyflourfen 20% DF	750 g ha^{-1}	55.6	6.4	70.76	21.03	1.626
T_3- Oxyflourfen 20% DF	1000 g ha^{-1}	56.2	6.6	73.26	21.35	1.638
T_4- Oxyflourfen 20% DF	2000 g ha^{-1}	59.3	6.7	75.11	21.70	1.575
T_5- Oxyflourfen 20% DF	3000 g ha^{-1}	60.3	6.8	76.93	21.85	1.493
T_6-Oxyflourfen 23.5% EC	850 ml ha^{-1}	54.4	5.7	70.10	18.38	1.279
T_7-Propaquizafop 10% EC	625 ml ha^{-1}	53.8	5.7	69.0	15.30	0.916
T_8-Pendimethalin 38.7% EC	1750 ml ha^{-1}	53.8	5.0	67.67	18.44	1.295
T_9-HW at 15 & 30 DAT	-	54.5	5.5	68.85	17.81	1.182
T_{10}-Weed Free		56.5	6.7	75.59	22.07	1.515
T_{11}-Control		48.7	4.7	52.68	15.41	0.987
SEm(±)		1.5	0.1	1.60	0.79	
LSD at 5%		4.4	0.4	4.71	2.33	

phytotoxicity due to oxyfluorfen are week chlorosis, deformation of leaf and vegetation tips (Anastoasov, 2010). Therefore, the application of oxyfluorfen provides a favourable ecological environment to onion crop resulting in better bulb development and yield through early inhibition of growth of weeds.

Effect on vegetative growth of onion

The pooled results revealed significantly highest vegetative growth with the application of herbicides over weedy check plot table 2. The application of oxyfluorfen 20% DF at 3000 g ha^{-1} treatment recorded longest plant of 60.3 cm closely followed by 59.3, 56.2 and 55.6 cm with the oxyfluorfen 20% DF at 2000, 1000 and 750 g ha^{-1}, respectively. Oxyfluorfen 20% DF at 3000 g ha^{-1} treatment recorded highest numbers of leaves $plant^{-1}$ (6.8), closely followed by application of oxyfluorfen 20% DF

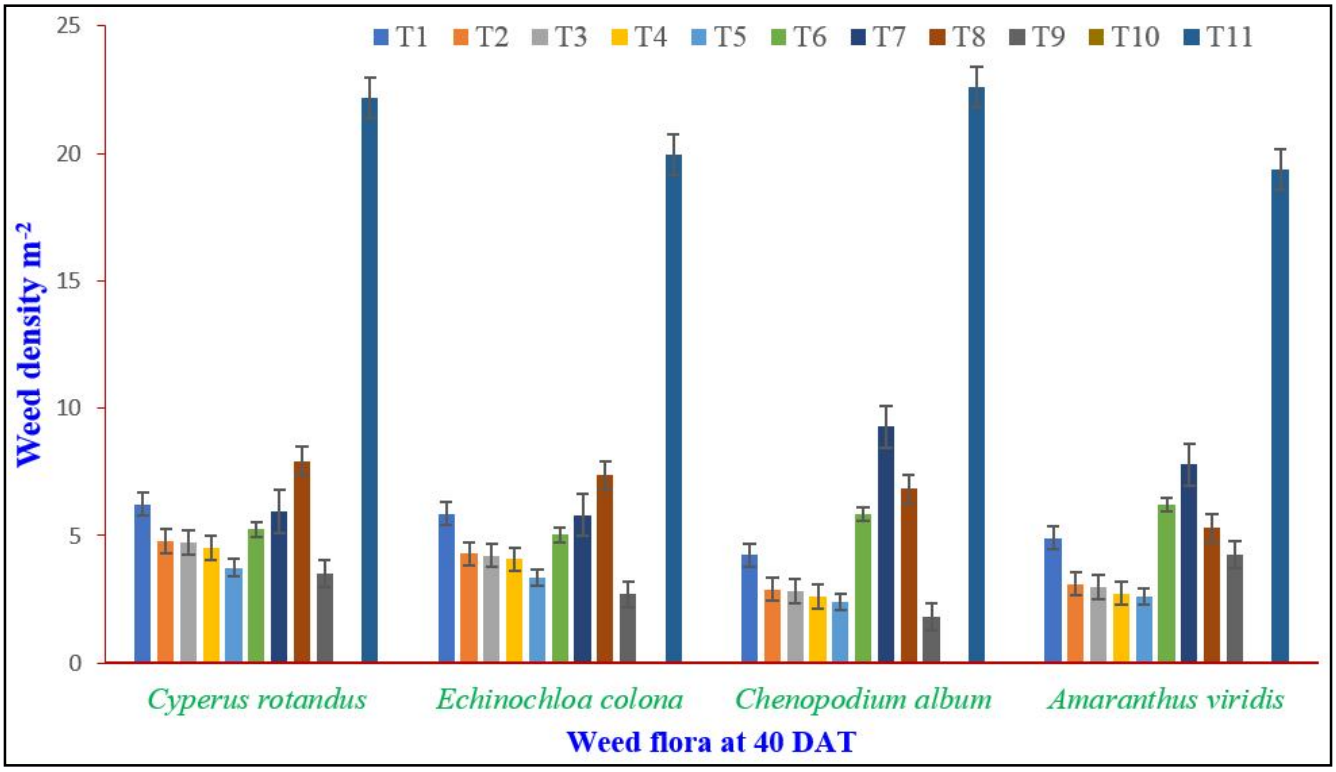

Fig. 1: Effect of different herbicidal treatments on density of weeds in Onion at 40 DAT.

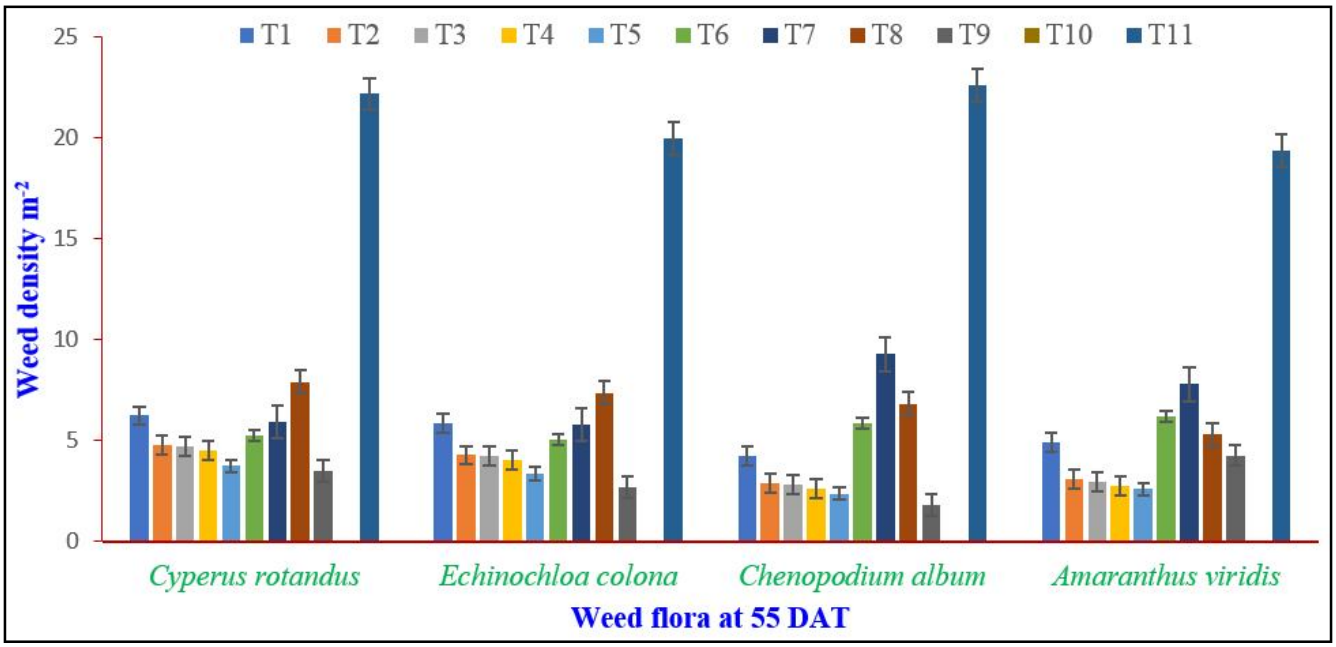

Fig. 2: Effect of different herbicidal treatments on density of weeds in Onion at 55 DAT.

at 2000g ha^{-1}(6.7) and oxyfluorfen 20% DF at 1000g ha^{-1} (6.6). Here, it was very much clearly observed that the application of oxyfluorfen 20% DF significantly provide a congenial condition to onion crop for its optimum vegetative growth and subsequently decrease the crop and weed competition. Weedy check plot recorded significantly dwarf plant (48.7 cm) and along with minimum number of leaves plant^{-1} (4.7). The results confirm the findings of Kumar (2014); Panse*et al.* (2014); Sahoo and Tripathy (2019).

Effect on yield of onion

The results on bulb weight and marketable bulb yield were presented in table 2. Application of oxyfluorfen 20% DF at 3000 g ha^{-1} recorded significantly highest bulb weight of 76.93 g and 21.85 t ha^{-1} of marketable bulb yield and it was statistically at par with T_4, T_3 and T_2. It indicates the relevance of application of oxyfluorfen 20 % DF herbicide for effective reduction of the weed population during the critical stages of crop growth. The higher bulb yield of onion due to effective control of weeds with oxyfluorfen was also reported by Priya *et al.,* (2012); Sahoo and Tripathy (2019). Weed index of oxyfluorfen 20% DF (3000 g ha^{-1}) was lesser than oxyfluorfen 23.5% EC (850 ml ha^{-1}), propaquizafop 10% EC (625 ml ha^{-1}) and pendimethalin 38.7% EC (1750 ml ha^{-1}).

Economics

From the economic point of view, the highest B:C ratio (1.638) was obtained with application of oxyfluorfen 20% DF at 1000 g ha^{-1} but it was very closely to oxyfluorfen 20% DF at 750 g ha^{-1} (1.626). Though weeds were controlled more efficiently and bulb yield production was highest in weed free treatment but engaged more human labour and cost of cultivation is more as a result B:C ratio is low.

Conclusion

On the basis of two years experimentation, it was concluded that application of oxyfluorfen 20% DF at 750 g ha^{-1} as early post emergence is more efficient and convenient for reducing the biomass of weeds and increasing yield attributes and yield and economically viable method for weed control in transplanted onion.

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