

Weed Management Studies in Onion (*Allium cepa* L.) cv N 2-4-1 during Rabi Season

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ABSTRACT: Onion (*Allium cepa* L.) is short duration, shallow rooted bulb vegetable crops commonly cultivated throughout the India and it is more prone to weed menace. Weed infestation is the one of the limiting factor in quality bulb production in onion. Weeds interfere with development of bulbs also adds cost of cultivation. Removal of weeds through hand weeding method is laborious, costly and time consuming. This situation makes it necessary to use herbicides for effective and timely control of weeds in this crop. It is thus highly imperative to schedule suitable method of weed control by application of different herbicides for enhancing profits to the onion growers of the country. With this background, an experiment was conducted at Directorate of Onion and Garlic Research, Rajgurunagar, Pune in clay loam soil using rabi onion cultivar N 2-4-1 with different herbicides like Oxyfluorfen, Quizalofop Ethyl and Pendimethalin in comparison with weedy check. It was observed that among the various herbicides evaluated, application of Oxyfluorfen 23.5 % EC @ 1.5ml/L before planting and one hand weeding at 40-60 days after onion seedlings transplanting recorded the higher marketable bulb yield (43.5t/ha) with maximum weed control efficiency of 78.4%. The same treatment was also recorded higher cost benefit ratio of 1:3.06.

Keywords: Onion, rabi season, herbicides, growth, bulb yield

INTRODUCTION

Onion (*Allium cepa* L.) is bulb vegetable crop grown commercially throughout the India and it is important commodity of mass consumption. There has been spectacular increase in area and production over last 25 years in onion. However, productivity has remained almost static. The present level of productivity of onion of the country is very low as compared to major producers like USA, China and Netherlands and Korea Republic. One of the main reason for low productivity in onion crop is unawareness of the farmers about improved agronomic practices like micro irrigation, INM, IWM, use of micro nutrients, etc. There is vast scope for increasing the productivity by enhancing genetic potential of varieties through resistance breeding, innovations in agro-techniques, sustenance of productivity through better management of pest and diseases and improving post-harvest life. Onion crop is more prone to weed menace and usually infested by wide spectrum of broad leaf and grassy weeds. Weeds compete with the crop for water, soil nutrients, light and space and thus reduces the bulb yield of onion crops considerably. Weed infestation is the one

of the limiting factor in quality bulb production in onion. It exhibits greater susceptibility to weed competition than most other vegetable crops, mainly due to slow initial growth and inherent characteristics of onion such as short stature, non branching habit, sparse foliage, shallow root systems coupled with frequent irrigation and fertilizer application causes severe crop - weed competition. Weeds interfere with development of bulbs also adds cost of cultivation. Weed competition reduced the bulb yield of onion to the extent of 2.35 - 61.8 per cent depending upon the duration of crop weed competition and intensity (Sankar *et al*) [9]. Removal of weeds through hand weeding method is laborious, costly and time consuming. This situation makes it necessary to use herbicides for effective and timely control of weeds in this crop. Proper and timely weed control measures essential for good bulb development in onion. It is thus highly imperative to schedule suitable method of weed control by application of different herbicides for enhancing profits to onion growers of the country. With this background, an experiment was conducted at Directorate of Onion and Garlic Research, Rajgurunagar, Pune in clay loam soil using rabi onion

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cultivar N 2-4-1 with different herbicides like Oxyflurofen, Quizalofop Ethyl and Pendimethalin in comparison with weedy check.

MATERIALS AND METHODS

The experiment was carried out during *rabi* season in a randomized block design with three replications at Directorate of Onion and Garlic Research (DOGR) farm at Rajgurunagar, Pune, Maharashtra. The experimental site is located at 18.32° N latitude and 73.51° E longitude with an altitude of 553.8m above from mean sea level with a temperature range of 5.5° - 42.0° C having an annual average rainfall of 669mm. The soil was clay loam in texture and had pH of 7.42. The onion variety used in the experiment was N 2-4-1 and healthy, matured seedlings were planted at a spacing of 10X15 cm in flat beds. The gross and net plot size was 3.5 X 2.5 and 3.0 X 2.0m. The treatment details were as follows: T1- Oxyflurofen @ 23.5% EC application before planting and second application at 30 days after transplanting. T2- Oxyflurofen @23.5% EC application before planting + Quizalofop Ethyl @ 5% EC application at 30 days after transplanting. T3- Combined spray of Oxyflurofen @ 23.5% EC and Quizalofop Ethyl @5% EC at the time of planting and second application at 30 days after transplanting. T4- Pendimethalin @ 30% EC application before planting and second application at 30 days after transplanting. T5- Pendimethalin @30% EC application before planting+ Quizalofop Ethyl@ 5% EC application at 30 days after transplanting. T6- Combined spray of pendimethalin @ 30% EC + Quizalofop Ethyl @5% EC at the time of planting and second application at 30 days after transplanting. T7- Recommended practices (Oxyflurofen@23.5% EC application before planting + one hand weeding at 40-60 days after transplanting) of DOGR and T8-Weedy Check (Control).

The herbicides were applied by using hand operated knapsack sprayer fitted with a flat fan type Nozzle was used for spraying the herbicides adopting spray volume of 500litres/ha. All herbicides were applied as per the treatment schedule. For hand weeding, depending upon the weed intensity, weeds were removed manually. The recommended fertilizer dose of 150:50:80 kg NPK/ha in the form of urea, single super phosphate and muriate of potash were applied to all plots uniformly and 50 percent dose of N (75kg/ha) was divided in to the two equal doses and applied at 30 and 45 days after transplanting. The recommended plant protection measures were taken as and when required. The irrigation was stopped at

15 days before harvesting. The bulbs were harvested at full maturity stage. After proper curing and neck cutting the observations on plant morphological characters, yield and yield contributing characters and marketable bulb yield (A, B and C grade bulbs) were recorded. Moreover, during the course of experiment, the data were recorded on predominant weed flora, weed density and weed fresh and dry weight.

The weed count was recorded species wise using 0.5 m x 0.5 m quadrat from four randomly fixed places in each plot and the weeds falling within the frames of the quadrat were counted, recorded and the mean values were expressed in number m⁻². The density of monocot and dicot and the total weeds were recorded and expressed in number m⁻². Weed control efficiency (WCE) was calculated as per the procedure.

$$WCE\% = \frac{WD_c - WD_t}{WD_c} \times 100$$

Where, WCE-weed control efficiency (per cent); WD_c - weed biomass (gm⁻²) in control plot and WD_t = Weed biomass (gm⁻²) in treated plot. The collected data were statistically analyzed according to the methods suggested by Panse and Sukhatme [7].

RESULTS AND DISCUSSION

There was significant effect on growth, yield and yield contributing characters of onion bulb as influenced by different herbicides application practices (Table 1-2). Plant height is an important yield attribute in onion. Any practice to alter the plant height would influence the bulb yield as reported by Vincent [12]. Plant height has a direct correlation with bulb yield. The plant height increased with the advancement of crop growth and it was the highest at 90th day of planting. The results from the present experiment revealed that there was no significant difference between treatments on plant height. A crop should produce sufficient number of leaves to harness light energy and synthesize adequate photoassimilates for biomass production. It was observed from the present experiment that more number of leaves were noticed in plots received herbicide spray of Pendimethalin 30% EC application before planting and second application at 30 days after transplanting followed by combined spray of pendimethalin 30% EC + Quizalofop Ethyl 5% EC at the time of planting and second application at 30 days after transplanting and recommended practices (Oxyflurofen @ 23.5% EC application before planting + one hand weeding at 40-60 days after transplanting). In the present experiment, the lowest neck thickness of the bulb was

Table 1
Effect of herbicide application on growth and bulb characters of onion Var N-2-4-1

Treatments	Plant height (cm)	No of leaves	Neck thickness (cm)	Bulb equatorial diameter (mm)	Bulb polar diameter (mm)	Average weight of bulb (g)	Bulb TSS (°brix)	Double bulbs (%)	Bolted bulbs (%)
T ₁	63.3	8.3	12.7	57.9	51.1	54.4	11.9	3.6	1.0
T ₂	64.5	8.1	14.9	56.9	49.5	53.0	12.1	2.1	3.1
T ₃	61.6	8.5	14.8	61.0	54.9	72.4	12.0	4.8	2.0
T ₄	61.8	9.1	13.6	62.5	55.5	61.2	13.5	5.5	2.4
T ₅	60.3	8.9	16.0	61.0	53.1	66.1	12.7	3.8	2.0
T ₆	61.8	9.1	15.6	62.0	54.0	64.9	12.7	4.1	1.8
T ₇	58.8	9.1	12.4	56.7	50.9	62.5	12.4	3.6	1.0
T ₈	60.4	7.3	15.3	55.6	45.0	38.4	11.7	0.3	1.5
SEm ±	3.0	0.5	1.82	3.51	1.11	5.87	0.46	0.79	0.95
CD at 5%	NS	1.09	3.89	NS	3.52	12.60	NS	2.13	2.04

T1 - Oxyflurofen @23.5% EC before planting and 30 DAT, T2 - Oxyflurofen@ 23.5% EC before planting and Quizalofop Ethyl@ 5% EC 30 DAT,

T3 - Oxyflurofen@ 23.5% EC + Quizalofop Ethyl@ 5% before planting and 30 DAT, T4 - Pendimethalin @30 % EC before planting and 30 DAT

T5 - Pendimethalin@ 30% EC before planting and Quizalofop Ethyl@ 5% EC 30 DAT, T6 - Pendimethalin @30% EC + Quizalofop Ethyl 5% before planting and 30 DAT

T7 - Recommended practices (Oxyflurofen@ 23.5% EC before planting and hand weeding at 40-60 DAT, T8 - Weedy check, DAT-Days After Transplanting.

Table 2
Effect of herbicide application on yield, yield contributing characters and weed parameters of onion Var N-2-4-1

Treatments	A grade bulbs (%)	B grade bulbs (%)	C Grade bulbs (%)	Total bulb yield (tha ⁻¹)	Marketable bulb (tha ⁻¹)	Monocot weed population (No.m ²)	Dicot weed population (No.m ²)	Weed control efficiency (%)	Benefit cost ratio
T ₁	28.0	54.3	13.1	45.6	42.6	12.2	8.70	71.1	2.98
T ₂	14.8	46.2	33.8	34.4	32.7	8.51	17.3	64.3	2.27
T ₃	29.2	49.4	14.5	43.8	40.8	22.3	19.7	41.9	2.84
T ₄	34.9	45.1	12.0	47.3	42.2	16.3	10.1	63.6	3.03
T ₅	32.6	49.3	12.3	43.5	41.0	20.3	11.0	56.7	2.89
T ₆	27.4	47.9	18.7	41.2	38.7	5.60	24.3	59.1	2.73
T ₇	28.0	54.3	13.1	45.6	43.5	4.61	11.2	78.4	3.06
T ₈	3.60	30.5	64.2	17.2	16.6	40.3	32.0	-	1.37
SEm ±	5.82	3.39	11.1	1.74	1.33	15.5	15.1	-	-
CD at 5%	14.6	9.28	23.8	4.16	3.29	33.7	32.3	-	-

T1 - Oxyflurofen @23.5% EC before planting and 30 DAT, T2 - Oxyflurofen@ 23.5% EC before planting and Quizalofop Ethyl@ 5% EC 30 DAT,

T3 - Oxyflurofen@ 23.5% EC + Quizalofop Ethyl@ 5% before planting and 30 DAT, T4 - Pendimethalin @30 % EC before planting and 30 DAT

T5 - Pendimethalin@ 30% EC before planting and Quizalofop Ethyl@ 5% EC 30 DAT, T6 - Pendimethalin @30% EC + Quizalofop Ethyl 5% before planting and 30 DAT

T7 - Recommended practices (Oxyflurofen@ 23.5% EC before planting and hand weeding at 40-60 DAT, T8 - Weedy check, DAT-Days After Transplanting.

recorded in recommended practices *ie.* Oxyflurofen@ 23.5% EC application before planting + one hand weeding at 40-60 days after transplanting. In general, in onion storage, thin necked onion bulbs having more

storage life than thick necked one according to Kale *et al.* [3].

The bulb polar and equatorial diameter (Table 1), average weight of bulb and marketable bulb yield

were significantly influenced by various herbicides application. The higher bulb diameter and more weight of bulbs were noticed in all herbicides applied plots when compared to weedy check. However, differences were not significant among themselves except for bulb weight and equatorial diameter. Bulbs obtained from weedy check plots were small, inferior and under developed bulbs than herbicides applied. This in accordance with results of Verma and Singh [11]. It was observed from the results that there was no significant difference was observed in bulb TSS content among the treatments.

The ultimate goal to be achieved in any management system is the maximization of yield. In the present investigation, higher marketable bulb (43.5tha^{-1}) yield of onion was observed in recommended practices (Oxyflurofen @ 23.5% EC application before planting + one hand weeding at 40-60 days after transplanting) due to better control of weeds at critical stages thus providing favourable environment for better growth and development leading to enhance marketable bulb yield. This treatment was comparable with Oxyflurofen@ 23.5% EC application before planting and second application at 30 days after transplanting which is also recorded good marketable bulb yield (42.6tha^{-1}). The beneficial effects of pre emergence application of Oxyflurofen was improved the bulb yield as reported by Vora and Mehta [13] and Ramalingam *et al* [8]. Another reason for getting higher yield in these treatments were due to the more uniform size of A and B grade bulbs and lesser un marketable bulbs like doubles and bolted bulbs. The higher per cent of B grade bulbs and lesser per cent of C grade bulbs were obtained in Oxyflurofen@ 23.5% EC application before planting + one hand weeding at 40-60 days after transplanting. This may be attributed to proper aeration, reduced crop weed competition and better utilization of resources (Space, light, moisture and nutrients etc) by the crop. Our results corroborate the findings of Mishra *et al* [6] and Singh *et al* [10]. Hand weeding at 40-60 days after transplanting in combination with herbicides in general, further enhanced the bulb yield compared to herbicides alone. These results are in accordance with the findings of Malik *et al* [5] and Singh *et al* [10]. Better performance of herbicide + hand weeding treatments over respective alone herbicides treatments was owing to effective control of weed through herbicides during initial stage and later on by hand weeding.

The common weed flora found in onion crops are *Cyperus rotundus*, *Cynodon dactylon*, *Chenopodium*

album, *Amaranthus viridi*, *Convolvulus arvensis*, *Echinochloa colonum*, *Portulaca sp*, *Parthenium hysterophorus*, *Euphorbia hirta*, *Commelina sp*, *Oxalis corniculata*, *Digeria arevnesis*, *Cyanotis axillaris* and *Erigeron canadensis*. All the weed control treatments caused significant reduction in weed population both monocots and dicots weeds compared with the weedy check. However, magnitude of reduction in density and biomass of weeds varied depending on control measures adopted. Pre emergence application of Oxyflurofen@ 23.5% EC before planting + one hand weeding at 40-60 days after transplanting resulted in effective control of broad leaves (dicot), grasses (monocot) and to some extent sedge due its broad spectrum action when compared to weedy check. Thus, broad leaved weeds were effectively controlled due to the herbicidal effect over cell membrane causing disruption of the cells, ionic balance and ultimately death of weeds with the herbicide. Moreover, this treatment was comparable with pre and post emergence application of Oxyflurofen@ 23.5% However, post emergence application of Oxyflurofen@ 23.5% showed phytotoxicity symptoms like bleaching, leaf tip burn and leaf curling was observed for 10-15 days after herbicide application after that crop appeared normal. Post emergence application of Oxyflurofen showed phytotoxicity symptoms were also observed by Banga *et al* [1] and Channappagoudar and Biradar [2]. Bulb yield reduction in onion under weedy check is directly related to presence of weed population throughout the crop period. (Kathepuri *et al*) [4] Weed control efficiency of various treatments ranged from 41.9 - 78.4%. Pre emergence application of Oxyflurofen @23.5% EC before planting and inclusion of one hand weeding at 40-60 days after transplanting improved the weed control efficiency and decreased weed density compared with respective herbicide alone. Pre emergence application of Oxyflurofen@ 23.5% EC before planting + one hand weeding at 40-60 days after transplanting recorded higher benefit cost ratio of 3.06 which was on par with all treatments. It was mainly due to higher cost involved in manual weeding to keep field free from weeds.

From the present investigation, it could be concluded that pre emergence application of Oxyflurofen@ 23.5% EC before planting + one hand weeding at 40-60 days after transplanting recorded higher marketable bulb yield, weed control efficiency, benefit cost and keep the weed density lower level in *rabi* season grown onion under western Maharashtra conditions.

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