



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2024; SP-7(10): 230-232

Received: 03-07-2024

Accepted: 08-08-2024

Varsharani T Bhoje

Student (M. Sc. Horticulture),
Department of Horticulture
(Vegetable Science), Post Graduate
Institute, Mahatma Phule Krishi
Vidyapeeth, Rahuri, Dist.,
Ahmednagar, Maharashtra, India

BT Patil

Senior, Vegetable Breeder, AICRP
Vegetable Crops, MPKV, Rahuri,
Maharashtra, India

Kalpana N Dahatonde

Assistant Professor, Department of
Horticulture, MPKV, Rahuri,
Maharashtra, India

Corresponding Author:

Varsharani T Bhoje

Student (M. Sc. Horticulture),
Department of Horticulture
(Vegetable Science), Post Graduate
Institute, Mahatma Phule Krishi
Vidyapeeth, Rahuri, Dist.,
Ahmednagar, Maharashtra, India

Weed management studies in onion (*Allium cepa* L.) seed crop

Varsharani T Bhoje, BT Patil and Kalpana N Dahatonde

DOI: <https://doi.org/10.33545/2618060X.2024.v7.i10Sd.1751>

Abstract

A field investigation entitled “Weed management studies in onion (*Allium cepa* L.) seed crop” was conducted in *Rabi* season of 2022 at the AICRP on Vegetables, MPKV, Rahuri to find out most suitable and efficient combination of different weed management methods in onion seed crop. The experiment was laid out in randomized block design (RBD) with four replications. The experiment consists of six treatments *viz.*, T₁-Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 days after planting, T₂-Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 and 45 days after planting, T₃-Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 DAP and one hand weeding at 60 days after planting, T₄- Oxyfluorfen 23.5% EC @250 g a.i/ha (PE) followed by 1 HW at 40 DAP, T₅-Hand weeding (weed free condition till harvest), T₆-Weedy check (control). The pre-plant application of Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by post emergence application of Quizalofop Ethyl 5% EC application at 25 DAP and one hand weeding at 60 days after planting resulted in effective control of various broad-leaf and grassy-weeds and recorded lowest weed density, weed dry weight, weed index and higher weed control efficiency. This treatment also produced higher Number of umbels stalks bulb⁻¹, length of umbel stalk, diameter of umbel, number of seeds umbel⁻¹, 1000 seed weight, and seed weight umbel⁻¹. It also produced higher seed yield, gross return, net return and B: C ratio over all other weed control treatments.

Keywords: Onion, oxyfluorfen, quizalofop ethyl and weed

1. Introduction

Onion (*Allium cepa* L.), belongs to family Alliaceae. It is an indispensable item in every kitchen as vegetable and condiment used to flavour many of foods stuffs. Therefore, onion is popularly known as “Queen of kitchen Garden” (Thamburaj and Singh, 2018) [12]. Onion seeds offer health benefits with approximately 5% essential oils and 38% edible oil. The Major Onion producing states are Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana and Telangana. Maharashtra rank first in onion production with a share of 39% followed by Madhya Pradesh with share of 17% in 2020-21 (Anonymous, 2021) [11]. Onion exhibits greater weed susceptibility to weed competition as compared to other crops due to its inherent characteristics such as slow germination, extremely slow growth in the essential stages, short stature, non-branching habit, sparse foliage and shallow root system. This favours quick and fast growth of weeds in initial stages and competition thus tends to be severe. Use of liberal dose of FYM, fertilizers and frequent irrigation creates susceptible conditions for weed growth (Singh *et al.*, 1986) [10]. It is an established fact that weeds compete with crop plants for space, nutrients, light and moisture there by reduces the quantity and quality of yield (Moolani and Sachan, 1966) [7]. If weeds are present throughout the crop growth period, there may be complete loss of marketable yield (Sahoo *et al.*, 2017) [9]. Weed infestation poses a significant challenge in onion seed production, resulting in a decrease in both bulb and seed yield ranging from 40 to 80% (Channapagoudar and Biradar, 2007) [2]. Nevertheless, the manual removal of weeds proves to be an arduous and labor-intensive approach to weed control. Instances of labour shortages and unforeseen rainfall often lead to delays or complete abandonment of hand

weeding and mechanical weed operations. Despite limited attention to chemical weed control in onion seed production, the predominant method remains manual management of weeds. In these circumstances, herbicides emerge as a more practical, efficient and cost-effective means of weed control to enhance onion seed production. Keeping in view the losses in onion seed production due to weed infestation and high cost of manual labour, the present study was undertaken to test the efficacy of herbicides for weed control in onion seed production.

2. Materials and Methods

The experiment was conducted during *Rabi* season 2022-23 at All India Co-ordinated Research Project at Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The soil of the experimental plot was medium black with good drainage and neutral to slightly alkaline (pH 7.6) with low soluble salt (non-saline) and clay loam in texture. There were six treatments viz., T₁-Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 days after planting, T₂-Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 and 45 days after planting, T₃-Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 DAP and one hand weeding at 60 days after planting, T₄-Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by 1 HW at 40 DAP, T₅-Hand weeding (weed free condition till harvest), T₆-Weedy check (control). These are replicated four times in randomized block design. Good quality bulbs of Phule Samarth variety of onion used. Medium to large sized bulbs selected and soaked in Carbendazim fungicide @ 1 g/litre to avoid soil born disease infection. Healthy bulbs were planted in plots of size 15 x 5 m². Planting of bulbs was done with spacing of 60 cm between the lines (rows) and 20 cm between two plants. The recommended fertilizer dose of farm yard manure 20 t ha⁻¹ was applied at the time of land preparation. 50:50:50 kg NPK per hectare were applied as basal dose at the time of planting. The remaining half dose of nitrogen 50 kg per hectare was applied in the form of urea as top dressing after one-month planting. Regular observations were recorded at specific time intervals by selecting randomly five plants in each treatment. The growth, seed yield and yield contributing observation were recorded.

The data recorded were statistically analyzed by using technique of analysis of variance (Fisher, 1970) [3] and significance was determined as given by Panse and Sukhatme (1985) [8].

3. Results and Discussion

The results obtained from the present investigation have been presented in the following sub heads:

Effect on weed

During experimentation nine weed species were mainly found. The monocot weed species like *Cynodon doctylon*, *Brachiaria eruciformis*, *Eragrostis minor* and dicot weed species like *Portulaca oleracea*, *Parthenium hysterophorus*, *Amaranthus viridis*, *Euphorbia hirta*, *Cardiospermum halicacabum* were observed in the experimental plot. While, sedge weed *Cyperus rotundus* was found in the experimental plot. Among the all weed species dicot weed were chiefly observed with larger intensity as compared to weed species in all weed control treatments at all stages of crop growth. The impact of herbicide on *Cyperus rotundus* L. was not observed among all the treatment. Different weed parameters in onion seed crop were significantly affected by application of various pre-plant and post-emergence herbicides (Table 1). Application of Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 DAP and one hand weeding at 60 days after planting (i.e. T₃) recorded lower density of grassy and broad-leaved weeds (7.95 and 11.46), weed dry weight (36.50 g m⁻²) and weed index (12.85%) and higher weed control efficiency (71.47%) as compared to all the other herbicidal treatments. This might due to the combined action of pre-planting and post-emergence herbicides used in onion. Oxyfluorfen disturbs the chlorophyll synthesis pathway of susceptible weeds by inhibiting the enzyme called 'protoporphyrinogen oxidase'. It also causes break down the cell membrane of leaf by which weed dies. Quizalofop-ethyl hinders the function of the acetyl-CoA carboxylase enzyme, essential for the synthesis of fatty acids in grassy weeds. Highest number of grassy and broad leaf weeds, dry weight of weed and weed index and lowest weed control efficiency were observed in control treatment. These results were in close conformity with the results of Gupta *et al.* (2019) [4] and Siwna *et al.* (2023) [11].

Table 1: Effect of different herbicidal treatments on various weed parameters in onion seed crop at harvest

Treatments	Weed density m ⁻²		Dry weight of weeds m ⁻² (g)	Weed control efficiency (%)	Weed index (%)
	Grassy weeds	Broad-leaved weeds			
T ₁	11.02	11.81	186.50	66.25	27.46
T ₂	10.82	11.38	65.00	68.17	22.18
T ₃	7.95	11.46	36.50	71.47	12.85
T ₄	10.28	17.68	187.35	58.29	31.73
T ₅	0.50	0.74	21.58	93.38	0.00
T ₆	28.34	39.65	327.75	-	48.66
S.Em. ±	-	-	26.35	2.42	2.22
CD at 5%	-	-	79.44	7.30	6.69

Effect on growth and yield

Maximum number of umbels stalks bulb⁻¹ (6.51), length of umbel stalk (74.30 cm), diameter of umbel (6.05 cm), number of seeds umbel⁻¹ (1008.05), 1000 seed weight (3.50 g) and seed weight umbel⁻¹ (4.23 g) were recorded in treatment in weed free check (Table 2). Considering the herbicidal application Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 DAP and one hand weeding at 60 days after planting i.e T₃ was proved more

dominant in respect of these growth and yield attributing character. However, it was at par with application Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 and 45 days after planting in respect of all the growth and yield attributing characters. This might be due to the decreased competition of weed with crop for space, water, air, nutrients and sunlight because of their effective weed control as a result of application of different pre- and post-emergence herbicides. It provides better environment and other resources in

sufficient quantity for the proper growth and development of crop. All the growth and yield attributing characters were found

lower in control treatment. The similar results also reported by Kalhapure *et al.* (2014) ^[5].

Table 2: Effect of different herbicidal treatments on various growth and yield attributing characters in onion seed crop

Treatments	Number of umbel stalk bulb ₋₁	Length of umbel stalk (cm)	Diameter of umbel (cm)	Number of seeds umbel ⁻¹	1000 seed weight (g)	Seed weight umbel ⁻¹
T ₁	5.38	66.13	5.52	831.50	3.20	3.50
T ₂	5.50	67.30	5.79	862.20	3.30	3.75
T ₃	5.70	68.95	5.84	948.70	3.50	4.00
T ₄	4.60	63.50	5.24	822.65	3.10	3.35
T ₅	6.51	74.30	6.05	1008.05	3.50	4.23
T ₆	3.80	62.35	4.35	669.90	2.58	2.45
S.Em. ±	0.53	2.47	0.26	53.85	0.09	0.33
CD at 5%	1.60	7.45	0.79	162.32	0.28	1.00

Effect on yield and economics

Significantly highest seed yield of onion (406.86 Kg ha⁻¹), gross returns (814000 /ha), net returns (585632 /ha) and B: C ratio (3.56) were recorded in treatment weed free check. This might due to maximum yield in weed free treatment seems to be due to favourable environment created by clean crop culture resulting in more absorption of solar radiation and plant nutrients resulting in more photosynthetic rates. Among the herbicidal weed control treatment application of Oxyfluorfen 23.5% EC @

250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 DAP and one hand weeding at 60 days after planting i.e T₃ produced significantly higher onion seed yield (354.39 Kg ha⁻¹), gross returns (708000 /ha), net returns (483312 /ha) and B: C ratio (3.15) as compare to all other treatments (Table 3). Lowest seed yield of onion was recorded in control which was 208.93 Kg ha⁻¹ due to heavy infestation of weeds. These results are in accordance with the results Kalhapure *et al.* (2014) ^[5], Gupta *et al.* (2019) ^[4] and Maske *et al.* (2022) ^[6].

Table 3: Effect of weed control treatments on seed yield and economics

Treatments	Seed yield (Kg ha ⁻¹)	Gross monetary returns (Rs.)	Net monetary returns (Rs.)	Cost of cultivation (Rs.)	B: C ratio
T ₁	294.66	590000	366732	223268	2.64
T ₂	316.39	632000	406817	225183	2.81
T ₃	354.39	708000	483312	224688	3.15
T ₄	277.66	556000	332934	223066	2.49
T ₅	406.86	814000	585632	228368	3.56
T ₆	208.93	418000	200680	217320	1.92

Conclusion

Based on the results obtained from one year experimentation, it is concluded that, for effective weed control and higher seed yield of onion, hand weeding at regular intervals is better. However, it was expensive and during severe scarcity of labours, it is not possible to carry out timely weed control in onion. The most economical and comparable effective weed management practice is application of Oxyfluorfen 23.5% EC @ 250 g a.i/ha (PE) followed by Quizalofop Ethyl 5% EC application at 25 DAP and one hand weeding at 60 DAP is still better option for reducing weed population and getting maximum seed yield in onion seed production.

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