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Influence of pre- and post-emergence herbicides on growth and yield of garlic (*Allium sativum* L.)

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Abstract

The present investigation was conducted at AICRP on vegetable crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during *rabi* season 2015-16. The finding revealed that, among the herbicide treatment Oxyfluorfen 23.5 EC PoE @ 0.150 kg a.i./ha + Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i./ha recorded maximum growth viz., plant height, number of leaves per plant. Significantly maximum number of cloves per bulb, bulb length, bulb diameter, average weight of bulb, yield per plot and per hectare also registered by same treatment. Further, lowest weed index (5.12%) and maximum weed control efficiency (84.17%) recorded by same herbicide treatment. This indicates application of Oxyfluorfen @0.150 kg a.i.+ Quizalofop Ethyl 0.05 kg a.i./ha as post emergence herbicide is better option for controlling weed population and obtaining better yield of garlic.

Keywords: Herbicide, weed flora, weed index, weed control efficiency

Introduction

Among various spices grown, garlic *(Allium sativum* L.), is the second most widely cultivated crop in the family after onion. Garlic is highly vulnerable to weed infestation due to its slow emergence and slow initial growth, non-branching habit, sparse foliage, shallow root system (Rahman et al. 2012), frequent irrigation and high fertilizer application. Weeds compete for nutrients, soil, moisture, space and light considerably reducing the yield, quality and value through increased production and harvesting costs. Garlic is closely planted crop with very small canopy. Due to smaller leaf size it cannot compete with the weeds. Their competition with the plants starts at very early growth stage because immediately after planting the cloves, the weed emergence occurs that competes with the tender seedlings. Weeds also harbor insect pests and disease-causing organisms. The losses caused by weeds have been estimated to be much higher than those caused by insect pest and diseases. Weed infestation in garlic is one of the major factors for loss in yield and bulb loss to the tune of 30-60%. Weed reduces the bulb yield to the extent of 40 to 80% (Verma and Singh 1996). In garlic shallow root system make mechanical method of weed control difficult and sometimes causes damage to developing bulbs. The predominant weed flora that hampers the growth and yield of crop vary with soil type, moisture, and other climatic factors.

Garlic is closely planted and shallow rooted bulbous crop. Therefore, intercultural practices are very difficult to undertake and manual weeding during the establishment stage of crop causes physical damage to crop plant. A most of troublesome problem faced by garlic grower is the control of weeds during early stage of crop growth. Because of higher plant density and slow growth of plant, intercultural operation is practically difficult and crop suffers heavily from weed competition during establishment of plant. The weeds compete for moisture, space, nutrients and light which affect growth and development of crop. Therefore, it is essential to keep field weed free during critical period of crop growth. However, manual hand weeding is a very tedious and labour expensive method of weed control. Sometimes due to shortage of labour and unexpected rains, hand weeding or mechanical weed operations are delayed or left altogether. The chemical weed control in garlic has received little attention and weeds are mostly managed manually. In such situation, herbicides offer the most practical, more effective and economical method of weed control for increasing bulb yield of garlic. Hence, present study was conducted to find out suitable herbicide for controlling weed growth and enhancing the bulb yield of garlic.

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Materials and Methods

The present investigation was carried out during *rabi* season of 2015-16 at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri Maharashtra. The recently released garlic variety Phule Nilima was planted on 25th October, 2015 at 15x10 cm spacing having 4.0x 2.0 plot size with 100:50:50 kg NPK + 20+ tonn FYM per ha. The plant protection measures were carried out during growing period of crop for better growth and controlling disease and pest. The total twelve treatments comprised of T_1: Pendimethalin 30% EC PE @ 0.75 kg a.i. ha^{-1}, T_2: Pendimethalin 30% EC PE @ 1.00 kg a.i. ha^{-1} , T_3: Oxyfluorfen 23.5% EC PoE @ 0.125 kg a.i. ha^{-1}, T_4: Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1}, T_5: Quizalofop ethyl 5% EC PoE @ 0.025 kg a.i. ha^{-1}, T_6: Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1} , T_7: Oxyfluorfen 23.5% EC PoE @ 0.125 kg a.i. ha^{-1} + Quizalofop ethyl 5% EC PoE@ 0.025 kg a.i. ha^{-1} , T_8: Oxyfluorfen 23.5% EC PoE @ 0.125 kg a.i. ha^{-1} + Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1}, T_9: Oxyfluorfen 23.5% EC PoE @0.150 kg a.i. ha^{-1}+ Quizalofop ethyl 5% EC PoE@ 0.025 kg a.i. ha^{-1}, T_{10}: Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1}+ Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1} , T_{11}: Weedy check and T_{12}: Weed free check. The experiment was conducted in randomized block design with three replications.The crop was harvested on 15th March, 2016. The growth and weed parameter observations were recorded at harvest and data obtained on various traits were analyzed by using mean standard error and coefficient of variation procedure given by Panse and Sukhatme (1985).

Results and Discussion

Growth characters: The data presented in Table 1 revealed that height of garlic plant at harvest was significantly influenced due to different herbicide treatments. The highest plant height (61.53) was noticed by treatment T_{10} Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1}+ Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1} however, it was at par with all treatments except treatment T_1, T_2 and T_{11}. The minimum plant height (51.07cm) was recorded in T_{11} (weedy check). This might be due to less weed density and weed competition during growing period and lowest plant height resulted due to continuous completion of weeds. Similar findings were reported by Aanarase (2014) in onion crop. The highest number of leaves per plant was observed with treatment T_{12}-weed free check (9.60). However, it was at par with treatments T_{10}, T_9, T_8, T_7, and T_4. The lowest number of leaves per plant was recorded by treatment T_{11}-weedy check (7.03). These results are in accordance with Sable et al. (2013) in onion crop.

Table 1: Effect of different pre and post emergence herbicides on growth, yield, weed index and weed control efficiency in garlic.

Treatments	Plant height (cm)	Number of leaves/ plant	Bulb length (cm)	Bulb diameter (cm)	Av. Wt. of bulb (g)	No. of cloves /bulb	Bulb yield/ plot (kg)	Bulb yield/ha. (q)	WI (%)	WCE (%)
T_1	55.53	7.20	2.90	3.18	18.07	25.47	9.61	120.08	26.76	67.44
T_2	57.53	7.27	3.08	3.21	19.93	25.27	9.74	121.70	25.77	67.62
T_3	59.13	8.13	3.13	3.27	22.33	26.73	11.39	142.33	13.18	76.69
T_4	59.40	8.67	3.19	3.28	22.87	27.00	11.60	144.94	11.64	78.24
T_5	58.27	7.73	3.11	3.23	21.00	25.00	10.84	135.48	17.36	70.72
T_6	58.83	7.67	3.10	3.25	21.73	26.53	11.11	138.83	15.30	71.62
T_7	58.60	8.73	3.26	3.28	22.80	27.73	11.79	147.40	10.06	80.21
T_8	59.87	8.87	3.32	3.29	22.87	27.87	12.14	151.75	7.45	80.69
T_9	60.80	9.20	3.36	3.30	23.00	28.67	12.25	153.10	6.63	82.87
T_{10}	61.53	9.27	3.37	3.31	24.13	28.73	12.45	155.60	5.12	84.17
T_{11}	51.07	7.03	2.76	2.96	15.33	23.07	7.02	87.79	46.46	0.00
T_{12}	61.47	9.60	3.38	3.33	23.33	28.87	13.12	163.96	-	97.16
S.E ±	1.18	0.36	0.08	0.06	0.71	1.14	0.41	5.13	3.13	0.62
C.D at 5%	3.47	1.07	0.24	0.18	2.08	3.35	1.20	15.04	9.17	1.82

T_1: Pendimethalin 30% EC PE @ 0.75 kg a.i. ha^{-1} **T_2** :Pendimethalin 30% EC PE @ 1.00 kg a.i. ha^{-1}
T_3 :Oxyfluorfen 23.5% EC PoE @ 0.125 kg a.i. ha^{-1} **T_4** :Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1}
T_5 :Quizalofop ethyl 5% EC PoE @ 0.025 kg a.i. ha^{-1} **T_6** :Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1}
T_7 :Oxyfluorfen 23.5% EC PoE @ 0.125 kg a.i. ha^{-1} + Quizalofop ethyl 5% EC PoE@ 0.025 kg a.i. ha^{-1}
T_8 :Oxyfluorfen 23.5% EC PoE @ 0.125 kg a.i. ha^{-1} + Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1}
T_9 :Oxyfluorfen 23.5% EC PoE @0.150 kg a.i. ha^{-1}+ Quizalofop ethyl 5% EC PoE@ 0.025 kg a.i. ha^{-1}
T_{10}:Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1}+ Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1}
T_{11}: Weedy check **T_{12}** : Weed free check

Bulb and yield parameters: The length of bulb differed significantly due to the different weed control treatments and highest bulb length (3.38cm) was registered by treatment T12- weed free check however, it was at par with treatments T_{10}, T_9, T_8, $T_7$and T_4. The minimum bulb length was produced by treatment T_{11}- weedy check (2.76 cm). These results are in concurrence with Ramani and Khanpara (2010) and Samapt et al. (2014) in garlic. The significantly maximum bulb diameter was recorded by treatment T_{12}-weed free check (3.33 cm). However, it was at par with all other treatments except T_{11} weedy check (2.96 cm). This might be due to more weed competition during entire growing period. Similar results were reported by Samapt et al. (2014) in garlic crop.

Among the different weed management treatments T_{10} Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1}+ Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1} recorded significantly highest average weight of bulb (24.13g) which was at par with T_{12}, T_9, T_8, T_7, T_4 and T_3. The treatment T_{11} weedy check (15.33g) recorded lowest bulb weight. This may be attributed due to reduced crop weed competition and better utilization of resources by the crop. The data presented in Table 1 revealed that treatment T_{12} weed free check recorded significantly highest bulb yield per plot and per hectare (13.12kg and 163.96q/ha) respectively. However, it was at par with treatments T_{10}, T_9 and T_8. Maximum bulb yield in weed free treatment seems to be due to favorable environment created by clean crop culture resulting in more absorption of solar radiation and plant nutrients resulting in more photosynthetic rates and more dry matter accumulation in cloves following the good cultural practices in weed free treatments, while the weedy check treatment (T_{11}) registered significantly lowest bulb yield (7.02kg and 87.79 q/ha, respectively). This may be due to low chlorophyll content and photosynthetic rates due to unchecked weed growth there by reducing availability of moisture, light and nutrients to the crop and resulted loss of yield in unweeded (weedy check). These results are in accordance with Mahmood et al. (2002), Mehmood et al. (2007), Turk and Tawaha (2002), and Sampat et al. (2014) in garlic crop.

Weed parameters: Weed index (WI) was significantly influenced by different weed control treatments. Among the herbicide treatments T_{10} Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1} + Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1} recorded lowest weed index (5.12%). However, it was at par with treatments T_9, T_8, T_4 and T_3. The highest weed index (46.46%) was recorded by weed check treatment (T_{11}). This might be due to prominent weed competition, suppression of crop plants by emerging weeds and more utilization of nutrients and moisture by weed canopy hence giving the lowest yield. Lower weed index was due to higher bulb yield in corresponding treatments and vice-versa. Similar findings were reported by Rahman et al. (2012) and Ghadge et al. (2012) in garlic, and Patel et al.(1986), Warade et al. (2006), Sharma et al. (2009) and Anarase (2014) in onion. Significantly the highest weed control efficiency (WCE) was recorded by treatment weed free check (97.16%) followed byT_{10} Oxyfluorfen 23.5% EC PoE @ 0.150 kg a.i. ha^{-1}+ Quizalofop ethyl 5% EC PoE @ 0.050 kg a.i. ha^{-1} (84.17%), T_9 (82.87%), T_8 (80.69%) and T_7 (80.21%). The lowest weed control efficiency was registered with treatment T_1 (67.44%). The highest WCE in the treatment weed free check attributed to frequent removal of weeds as and when seen resulted in less weed density compared to the T_{11} weedy check treatment. In herbicide weed management treatments better WCE be due to herbicidal effect of post emergence herbicides. The Oxyfluorfen acts as broad spectrum contact herbicide whereas Quizalofop ethyl functions systematically, get translocated into the plant system thus restricting the weed growth and yielding significant weed control efficiency in weed free treatment. Similar results were reported by Ghadge et al. (2012) and in garlic where as Tewari et al. (1999) and Warade et al. (2006) in onion.

सारांश

वर्तमान अध्ययन लहसुन (*एलियम सटाइवम* एल.) के जमाव पूर्व व उपरान्त खरपतवारनाशी का पौध विकास एवं उपज पर पड़ने वाले प्रभाव को ज्ञात करने के लिए अखिल भारतीय समन्वित शोध परियोजना (सब्जी फसल) के माध्यम से उद्यान विभाग, महात्मा फूले कृषि विद्यापीठ, राहुरी (महाराष्ट्र) में वर्ष 2015–16 के रबी मौसम में किया गया। परिणाम से स्पष्ट हुआ कि खरपतवारनाशी उपचारों में आक्सी फ्लूओरफेन 23.5 ई.सी.पी.ओ.ई. की 0.150 किलोग्राम/हे. सक्रिय तत्व की दर + क्वीजालोफोप इन्थाइल 5 प्रतिशत ई.सी.पी. ओ.ई को 0.050 किलोग्राम/हे. सक्रिय तत्व के प्रयोग से पौध ऊँचाई व पत्तियों की संख्या प्रति पौध में पाया गया। अधिकतम जवा/कंद, कंद लम्बाई, कंद व्यास, कंद का औसत भार, प्रति क्यारी तथा प्रति हेक्टेयर उसी उपचार से सार्थक रूप से अधिक पाया गया। आगे, कम खरपतवार गुणांक (5.12 प्रतिशत) तथा अधिकतम खरपतवार नियंत्रण क्षमता (84.17 प्रतिशत) उसी खरपतवारनाशी उपचार से पाया गया। इससे स्पष्ट होता हे कि आक्सीफ्लूओरफेन की 0.150 किग्रा सक्रिय + क्वीजालोफोप ईथाइल की 0.05 किलोग्राम सक्रिय तत्व/हे. का जमाव उपरान्त खरपतवारनाशी का प्रयोग खरपतवार को नियंत्रित करने तथा लहसुन की अधिक उपज प्राप्त करने का बेहतर विकल्प है।

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