

IMPACT OF TIME OF WEED REMOVAL ON GARLIC (*Allium sativum* L.) YIELD

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ABSTRACT

Weeds compete with garlic crop for nutrients, moisture, space, and light, ultimately decreasing the bulb yield. Proper weed management is considered a key to get higher yields. A field experimental trial was conducted to compare the effect of different weeding intervals on garlic yield and yield related components. Randomized complete block design, having six treatments and five replications was used in the experiment. The data recorded in different plots, where weeds were uprooted manually at intervals of 15, 30, 45, 60, and 75 days, were compared with control, where weeds were left free to grow through out the crop season. The major weeds were *Avena fatua*, *Chenopodium album*, *Chenopodium murale*, *Convolvulus arvensis*, *Coronopus didymus*, *Euphorbia helioscopia*, *Medicago denticulata*, *Phalaris minor*, *Rumex dentatus*, and *Melilotus indica*. Garlic bulb yield and yield related parameters i.e. bulb diameter, bulb height and bulb weight were highly significantly ($p \leq 0.01$) influenced by different weeding intervals as compared to control (no weeding). The maximum bulb yield was found in plot with 15 days weeding interval whereas, minimum bulb yield was recorded in control. Similarly weed density, weed fresh and dry biomass reduced significantly ($p \leq 0.01$) with decrease in weeding intervals.

Key words: Garlic, *Allium sativum*, yield, weeds, competition, weed removal time.

INTRODUCTION

Garlic (*Allium sativum* L.) is considered as a valuable nutritive, medicinal and condimental crop produce used throughout the world. Its preparations are used as cures for some stomach diseases, sore eyes and earache. It is also recommended for heart patients as it reduces blood cholesterol level. It contains a considerable amount of

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calcium, phosphorus and vitamin C (Baloch, 1994). It is grown throughout Pakistan and is extensively used daily for many purposes. During 2004-05, the total area and production of garlic in our country were 6600 hectares and 55,900 metric tons, respectively (Anonymous, 2011). The average yield of garlic in our country is very low as compared to other leading countries due to many factors.

One of the main limiting factors is weeds infestation which competes with garlic crop for nutrients, soil moisture, space, and light, considerably reducing the yield, quality and value of the crop through increased production and harvesting costs (Hussain, 1983). Garlic is closely planted crop with very small canopy. Due to smaller leaf size, garlic cannot compete with weeds. Their competition with plants starts at very early growth stage because soon after transplanting of the garlic, the weeds emergence occurs and thus competes with the garlic crop plants. 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. Generally the yield of crop is reduced by 30 to 60 % due to weeds infestation (Baloch, 1994).

Most of the studies conducted on weeds control in garlic by chemicals showed significant effect on bulb yield (Sandhu *et al.*, 1997; Vora and Mehta, 1998 and 1999; Tewari *et al.*, 1998; Mahmood *et al.*, 2002). Similarly, Khan *et al.* (2002a) and Usman *et al.* (2010) also reported that different weed control methods had a substantial effect on crop yield.

Mehmood *et al.*, (2007) reported that few herbicides had phytotoxic effects on the garlic crop therefore hand weeding in combination with herbicides provided good results for weed control and garlic yield. Manual weeding is an important cultural practice to control weeds for marketable bulb. Usually farmers do not remove weeds earlier enough to prevent crop from major damages caused by weeds. Further, the poor farming communities of the area can not afford the expenses of herbicides and other expensive weed control methods. Hence, the farmers having small land holding usually practice hand weeding to decrease the cost of production.

Furthermore, no such work has been done in southern districts of Khyber Pakhtunkhwa province which addressed the importance of time of weeding in garlic crop. Therefore, an experimental trial was designed to compare the effectiveness of different weed removal intervals in garlic crop grown in field demonstration plot in order to transfer a weed control technology to the farming community of the area.

MATERIALS AND METHODS

A field trial was conducted at Government Seed Farm, Rakh Manghan, Dera Ismail Khan, Pakistan during winter 2007-8 to decipher the impact of time of weed control on the garlic (*Allium sativum* L.) yield and weeds. The experiment was laid out in randomized complete block design (RCBD) with plot size of 2×3 m. The trial comprised of the following six treatments, each replicated five times.

- T1: Hand weeding with 15 days interval
- T2: Hand weeding with 30 days interval
- T3: Hand weeding with 45 days interval
- T4: Hand weeding with 60 days interval
- T5: Hand weeding with 75 days interval
- T6: Control (Weedy check)

Land was prepared and recommended dose (20-25 tons ha⁻¹) of farm yard manure (FYM) was incorporated into the soil. Nitrogen, phosphorus and potassium (NPK) were applied @ 100-90-60 kg ha⁻¹ using urea, single super phosphate (SSP) and sulphate of potash (SOP), respectively. Full doses of phosphorus and potassium and half dose of nitrogen were applied before sowing, while remaining dose of nitrogen was added to the experimental plot at six-leaf stage of the garlic crop.

A garlic cultivar "Faisalabad White" was planted on 15th November, 2007. Row to row and plant to plant distances were kept 25 cm and 10 cm, respectively. No weeding was done in the weed control plots (weedy check). The crop was irrigated when needed. As there was no attack of any disease or insects therefore no such pesticides were applied during the course of the experimentation.

Data Collection and Analysis

During the course of the study, data were recorded on parameters such as bulb diameter, bulb height, bulb fresh weight, weed density (g m⁻²), fresh weed biomass (g m⁻²), dry weed biomass (g m⁻²), and bulb yield (tons ha⁻¹). For recording fresh weed biomass, the weeds in individual plots were harvested at the crop maturity stage and then fresh biomass was recorded and then the values were subsequently converted to kg ha⁻¹. For recording dry weed biomass, weeds were kept in electric oven (set at 70°C) for 72 hours and then the dry biomass was recorded. All the data recorded were statistically analyzed using statistical software MSTATC. The purpose of analysis of variance was to determine the significant effect of treatments on weeds and garlic. LSD test was applied when analysis of variance showed significant effects for treatments (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Crop growth parameters

The analysis of variance of bulb diameter depicts that bulb diameter was highly significantly ($p \leq 0.01$) affected by different weeding intervals (Table-1). The mean values are presented in Table 2. The highest bulb diameter (5.54) was obtained in plots, where weeds were uprooted with 15 days interval, while lowest bulb diameter (2.00) was obtained in control plots, where no weeding was done at all. Thus, the data showed a decrease in diameter with increase in weeding intervals (Table-2). With an increase in weeding intervals, bulb height decreased respectively. Maximum bulb height of 5 cm was obtained in plots with 15 days weeding interval, followed by 30 days weeding interval (3.7 cm), while minimum bulb height (1.9 cm) was obtained in plots, where no weeding was performed throughout the crop season. Similarly, bulb weight was also significantly ($p \leq 0.01$) influenced by different weeding intervals (Table-1). The mean values of bulb weight (Table-2) clearly depicted that maximum bulb weight (19.5 g) was obtained in plots where weeding was performed after every 15 days while minimum (12.4 g) was obtained in control in which no weeding was done throughout the crop season. Table-2 also explains that bulb weight gradually decreased with increase in weeding intervals. As garlic has a very small canopy and there is enough space for weeding at early growth stages therefore it necessitates weeding as an important cultural practice for getting higher marketable bulb yield. In a crop-weed competition studies, Khan *et al.* (2002b) reported that decreasing the period of weed competition, the yield of the crop was increased. Therefore, an early weed control in garlic provides opportunity to the crop plants to grow faster and utilize the resources which otherwise are used by the weeds.

Bulb yield plot^{-1} was also highly significantly ($p \leq 0.01$) influenced by different weeding intervals (Table-1). The Table-2 demonstrates that with an increase with weeding intervals, bulb yield plot^{-1} progressively decreased. The plot in which weeding was performed every 15 days, showed maximum bulb yield plot^{-1} (9) while minimum bulb yield plot^{-1} (4.2) was obtained in control treatments where weeds were allowed to compete with the crop throughout the crop season. Analysis of variance indicated that bulb yield (tons ha^{-1}) was highly significantly ($p \leq 0.01$) affected by different weeding intervals (Table-1). The results displayed (Table-2) that the highest yield (15 t/ha) was recorded in plots with 15 days manual weeding interval. This bulb yield was higher (almost 50%) than that of control plots (no weeding), where weeds were allowed to grow freely, which affected the garlic growth and development resulting reduced bulb yield of 7 t ha^{-1} . Vora and Mehta (1998; 1999) conducted experiments

to study the impact of different herbicides on weed control in garlic and found the highest bulb yield in weed free treatment. Further Tewari *et al.* (1998) reported highest net monetary returns from garlic crop with manual weeding. Mahmood *et al.* (2002) also found highest garlic bulb yield in weeds free treatment. Ghosh *et al.* (2004); Gorad *et al.* (2004); Manisha *et al.* (2005); Marwat *et al.* (2005); Ghadage *et al.* (2006); Zubair *et al.* (2009) also found the highest onion bulb diameter, height, weight and yield in plots, where weeds were either controlled manually or chemically. In similar studies Mehmood *et al.*, (2007) obtained maximum bulb yield and weed control in herbicide treated plots.

Weed parameters

Statistical analysis of the data showed that different weeding intervals highly significantly ($P \leq 0.01$) affected the weed density m^{-2} in garlic crop. It was noted that maximum weed density was recorded in control ($80.2 m^{-2}$) where no weeding was done throughout the crop season, while minimum weed density was recorded in plots where weeding was done with 15 days interval (Table-2). Fresh weed biomass ($g m^{-2}$) was highly significantly ($P < 0.01$) affected by different weeding intervals. It was found in the present study that manual weeding with different intervals reduced the fresh weed biomass significantly (Table-2). Minimum fresh weed biomass (62.2) was recorded in plots where weeding with 15 days interval was performed, while maximum fresh weed biomass ($754.4 g m^{-2}$) was noted in plots where weeds were not controlled. Dry weed biomass ($g m^{-2}$) was also significantly ($P < 0.01$) affected by different weeding intervals. As dry weed biomass is an important indicator of crop yield estimation therefore decreasing dry weed biomass will have positive impact on the crop yield. Marwat and Khan (2007) reported that higher value of dry biomass significantly decreased the yield of the crops.

It was also found in the study that manual weeding with different intervals reduced the dry weed biomass (Table-2). Minimum dry weed biomass ($8.24 g m^{-2}$) was recorded in plots where weeding with 15 days interval was performed, while maximum dry weed biomass ($95.4 g m^{-2}$) was noted in plots, where weeds were not controlled. Several researchers also reported highest weed control with manual weeding throughout the crop season (Ghosh *et al.* 2004); Gorad *et al.* (2004); Manisha *et al.* (2005); Marwat *et al.* (2005); Ghadage *et al.* (2006); Zubair *et al.* (2009). The area under study is backward area of the province and labor is easily available and cheaper therefore hand weeding is the best option for the farmers having small land holdings.

Table-1. Mean squares (MS) for the parameters as affected by different manual weeding intervals in garlic.

Source	DF	Bulb diameter	Bulb height	Bulb weight	Bulb yield/plot	Bulb yield/ha	Weeds density	Weeds fresh biomass	Weeds dry biomass
Replications	4	0.040	0.031	0.157	0.111	0.314	11.533	878.617	13.395
Treatments	5	8.857**	6.413**	31.484**	13.573**	37.294**	3355.793**	293755.17**	4878.72**
Error	20	0.076	0.046	0.277	0.043	0.119	8.293	498.257	10.939
CV %		8.44	6.98	3.43	3.27	3.28	5.69	4.92	5.57

**= highly significant at 0.01 level of probability.

Table-2. Average bulb diameter, height, weight, yield (t ha⁻¹), weeds density, fresh and dry weed biomass as affected by different manual weeding intervals in garlic.

Treatments (Weeding intervals)	Bulb diameter (cm)	Bulb height (cm)	Bulb weight (g)	Bulb yield (t ha ⁻¹)	Weed density (m ⁻²)	Fresh weed biomass (g m ⁻²)	Dry weed biomass (g m ⁻²)
15 days	5.54 A	5.0 A	19.5 A	15.0 A	7.6 F	62.2 F	8.22 F
30 days	4.12 B	3.7 B	16.6 B	12.0 B	38.4 E	345.2E	43.8 E
45 days	3.06 C	3.0 C	15.6 C	10.7 C	47.8 D	413.2 D	55.6 D
60 days	2.62 CD	2.5 D	14.6 D	9.7 D	59.2 C	514.6 C	68.6 C
75 days	2.32 DE	2.3 D	13.5 E	9.0 E	70.6 B	635.2 B	84.4 B
Control (Weedy check)	2.00 E	1.9 E	12.4 F	7.0 F	80.2 A	754.4 A	95.4 A
LSD	0.4529	0.3523	0.8646	0.5667	4.731	36.67	5.433

Means not sharing common letters are significantly different at 0.01 level of probability.

Although the cost of labor will increase the cost of production but usually the whole families of the farmers are involved in farming therefore manual weeding in a small area is possible and economical as well. However, rainfall during the winter months may hamper the manual weeding due to which the farmers will have the only option of chemical weed control. Keeping in view the small area under garlic, weeding is possible for the farmers, economical and environment friendly in the area under study. Madan *et al.* (1994) found 100% weed control in garlic with hand weeding. While others (Mehmood *et al.*, 2007) reported that herbicide in combination with hoeing showed promising results by suppressing weeds and increasing yield of garlic.

CONCLUSIONS AND RECOMMENDATIONS

It is concluded from the study that weeds density, fresh and dry weed biomass decreased significantly with an increase in manual weeding intervals, resulting in increased garlic yield ($t\ ha^{-1}$) because of significant increase in the attributing components (bulb diameter, height and weight). In spite of the fact that manual weeding is a tedious, laborious and time consuming job; maximum crop yield can be achieved with frequent manual weeding intervals through out the crop season. As the labour is cheaper and easily available during the crop season therefore, maximum profit could be obtained due to low cost of production to raise the economic status of the farmers in the area under study.

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REFERENCES CITED

- Anonymous. 2011. PARC, Garlic (<http://www.parc.gov.pk/1SubDivisions/NARCCSI/Horticul/Garlic.html>), accessed on March 8, 2011.
- Baloch, A.F. 1994. Vegetable Crops. In "Horticulture". Edited by Elena Bashir and Robeyn Bantel. National Book Foundation, Islamabad Pakistan., pp. 502-3.
- Ghadage, H.L., J.V, Kathepuri, V.Y. Sankpal and S.M. Jawale. 2006. Integrated weed management in winter onion (*Allium cepa* L.) under irrigated conditions. Res. Crops, 7(1): 275-278.
- Ghosh, R.K., S. Sankar, G. Pritam and S.K. Ghosh. 2004. Integrated weed management in onion (*Allium cepa* L.) under entisol of West Bengal. Ind. Agriculturist, 48(3-4): 233-236.

- Gorad, M.K., P.B. Ghode, D.T. Deshmukh and D. Megha. 2004. Effect of pre-emergence herbicides on weed control and yield of onion. *Annals Plant Physiol.*, 18(2): 146-148.
- Hussain, F. 1983. Biochemical Inhibition (allelopathy) a less understood ecological factor in agroecosystems. *Progr. Farming*, 3: 33-37.
- Khan, M.A., G. Hassan, W.A. Shah and M.Z. Afridi. 2002a. Duration effect of weed competition on the yield and yield components of wheat. *Sarhad J. Agric.*, 18(3): 335-337.
- Khan, M.A., K.B. Marwat, G. Hassan and W.A. Shah. 2002b. Effect of different weed free periods on the growth and yield of wheat. *Pak. J. Agri., Agril. Eng. Vet. Sci.*, 18(1-2):30-33.
- Madan, S.P., S. Jassal and M.S. Saimbhi. 1994. Herbicidal control of weeds in garlic. *Punjab Vegetable Growers*, 29: 1-2.
- Mahmood, T., S. I. Hussain, K. M. Khokhar, G. Jeelani, and Hidayatullah. 2002. Weed control in garlic drop in relation to weedicides. *Asian J. Plant Sciences*, 1(4): 412-13.
- Manisha, K., P. Shubhi and K. Shailendra. (2005). Integrated weeds management in Kharif onion (*Allium cepa* L.). *Farm Sci. J.*, 14 (2): 89-90.
- Marwat, K.B., B. Gul, M. Saeed and Z. Hussain. 2005. Efficacy of different herbicides for controlling weeds in onion in higher altitudes. *Pak. J. Weed. Sci. Res.*, 11(1/2): 61-68.
- Marwat, K.B. and M. A. Khan. 2007. Climatic variation and growth of Holy Thistle (*Silybum marianum* Gaertn.). *Pak. J. Bot.*, 39 (2): 319-327.
- Mehmood, T., K. M. Khokhar and M. Shakeel. 2007. Integrated weed management practices in garlic crop in Pakistan. *Crop Protec.*, 26: 1031-1035.
- Sandhu, K. S., D. Singh and J. Singh. 1997. Weed management in garlic (*Allium sativum* L.). *Vegetable Sci.*, 24: 7-9.
- Steel, R.G.D. and J.H. Torrie. 1984. Principles and Procedure of Statistics. Mc-Graw Hill Book Co. Inc. New York.
- Tewari, A.N., K.S. Rathi and B. Singh. 1998. Integrated weed management in garlic (*Allium sativum* L.). *Indian. J. Agric. Sci.*, 68: 281-83.
- Usman, K., S.K. Khalil and M.A. Khan. 2010. Impact of tillage and herbicides on weed density and some physiological traits of wheat under rice-wheat cropping system. *Sarhad J. Agric.*, 26(2): 475-488.
- Vora, V. D. and D. R. Mehta. 1998. Integrated weed management in winter garlic. *Agric. Sci. Digest Karnal*, 18: 237-39.

- Vora, V.D. and D.R. Mehta. 1999. Studies on growth, yield and yield attributes of garlic as influenced by herbicides and weeds. *Agric. Sci. Digest Karnal*, 19: 129-33.
- Zubair, M., H.U. Rahman and M.S. Jilani. 2009. Comparison of different weed management practices in onion (*Allium cepa* L.) under agro-climatic conditions of Dera Ismail Khan. *Pak J. Weed Sci. Res.*, 15(1): 45-51.