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RELATIONSHIP BETWEEN MANUAL WEEDS REMOVAL TIMINGS AND GARLIC (*Allium sativum* L.) PRODUCTION

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ABSTRACT

A field experiment was carried out to study the relationship between manual weeds removal timings and garlic production during winter 2007-08 at Government Seed Farm, Rakh Manghan, Dera Ismail Khan Pakistan. Randomized complete block design, having five replications, was used in the experiment. The treatments were; No weeding (weedy check), Two weedings (75 days interval), Three weedings (60 days interval), Four weedings (45 days interval), Six weedings (30 days interval), and Twelve weedings (15 days interval). Garlic yield (t ha^{-1}) and yield components (bulb diameter, height and weight) increased significantly (P≤0.001) with increase in manual weeds removal timings, whereas, weeds density, fresh and dry weeds biomass decreased significantly (P≤0.001) with increase in manual weeds removal timings. Negative linear relationship between bulb yield and weeds fresh and dry biomass (t ha^{-1}) and positive linear relationship between bulb fresh weight and bulb diameter were observed.

Key words: Garlic (*Allium sativum*), weeding, weeds removal

INTRODUCTION

Garlic (*Allium sativum* L.) is grown throughout Pakistan. During 2004-05, total area under cultivation was 8400 hectares with total production of 67200 tones (FBS, 2010). The average yield of garlic in our country is very low as compared to other leading countries due to many factors like high cost of inputs, no application of modern production technology and lack of hybrid and high yielding varieties. Weed infestation is the largest single limiting factor affecting the crop yield. Weeds compete with crop for nutrients, soil moisture, space, and light, which considerably reduce 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 well with weeds. Weeds competition with crop plants starts at very early growth stages. Weeds also harbor insect pests and disease-causing organisms. The losses

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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*. (2002) and Usman *et al*. (2010) also reported that different weed control methods had a substantial effect on crop yield. It is fact that chemical weed control is an easiest way to control weeds in vegetables but vegetable growing community in southern districts cannot afford the expenses of herbicides to control weeds in garlic well in time. Before the onset of chemical weed control, most of the work on the farm by farming community through out the year was hoeing (manual weeding practice). Manual weeding is an important cultural practice to control weeds for marketable bulb. It is also suggested by Zimdahl (1993) that more labour may be expended on weeding than on any other enterprise. Unfortunately, our farmers do not practice weeding early enough to prevent crop from major damages caused by weeds. Moreover, people in the world prefer to eat organic than in-organic fruits and vegetables. Therefore, keeping in view the above facts, it was considered desirable to conduct a field demonstration experiment under existing agro-ecological conditions in southern districts of Khyber Pakhtoonkhwa province and draw some conclusions of relationship between manual weeds removal timings and garlic bulb yield and its components, which may be beneficial for researchers and growers, as well as to transfer this weed management practice to the farming community to increase garlic production in the area.

MATERIALS AND METHODS

A field demonstration trial was conducted on the effect of manual weeds removal timings on Garlic (*Allium sativum* L.) production at Government Seed Farm, Rakh Manghan, Dera Ismail Khan, Pakistan during winter 2007-8. The experiment was laid out in Randomized Complete Block Design (RCBD). Plot size was 2m × 3m. The trial comprised of the following six treatments, each replicated five times;

T1: Control (Weedy check)
T2: Two weedings (75 days interval)
T3: Three weedings (60 days interval)
T4: Four weedings (45 days interval)
T5: Six weedings (30 days interval)
T6: Twelve weedings (15 days interval)

Land was prepared and recommended dose (20-25 tons ha^{-1}) of FYM was incorporated into the soil. NPK were applied @ 100-90-60 kg ha^{-1} using urea, single super phosphate (SSP) and sulphate of potash (SOP) respectively (Baloch, 1994). Full doses of phosphorus and potassium and half dose of nitrogen were applied before sowing, while remaining dose of N was added at six-leaf stage of the crop. A garlic cultivar "Faisalabad White" was sown on 20th November, 2007. Row to row and plant to plant distances were kept 25 cm and 10 cm, respectively. In control plots (weedy check), weeds were left free to grow. The experimental plots were irrigated with river and tube well water whenever required.

Data collection and analysis

During the course of the study, data were collected for weed density m^{-2}, fresh weed biomass (g m^{-2}), dry weed biomass (g m^{-2}), average bulb diameter (cm), average bulb height (cm), average bulb fresh weight (g), and bulb yield (kg $plot^{-1}$). The bulb yield of garlic was then converted to tons ha^{-1}. For taking dry weights, the fresh weeds were kept in electric oven (set at 70ºC) for three days and then the dry weight was recorded. Microsoft Office Excel 2007 was used for graphs and regression analysis (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Weed population (m^{-2})

Broad leaf weeds like *Convolvulus arvensis* L.*, Chenopodium* sp.*, Melilotus indica* L.*, Rumex dentatus* L.*, Anagallis arvensis* L. and *Euphorbia helioscopia* L., sedges like *Cyperus rotundus* L. and grasses like *Cynodon dactylon* L. and *Sorghum halepense* Pers. were found in garlic crop during the course of the study. In contrast to the garlic bulb yield, weed density, fresh and dry biomass decreased significantly ($P \leq 0.001$) with increasing manual weeds removal timings (Figure 1a and Table-1). Madan *et al*. (1994) found 100% weed control in garlic with hand weeding. Similarly other researchers also reported highest weed control with manual weedings through out 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). They also reported decrease in weed density, weed fresh and dry biomass with increase in number of manual weeding.

Effect on Garlic

Regression analysis of the data of garlic bulb yield (t ha^{-1}) and its components such as average bulb diameter, bulb height, and bulb fresh weight increased significantly ($P \leq 0.001$) with increase in manual weeds removal timings (Figure 1 and Table-1).

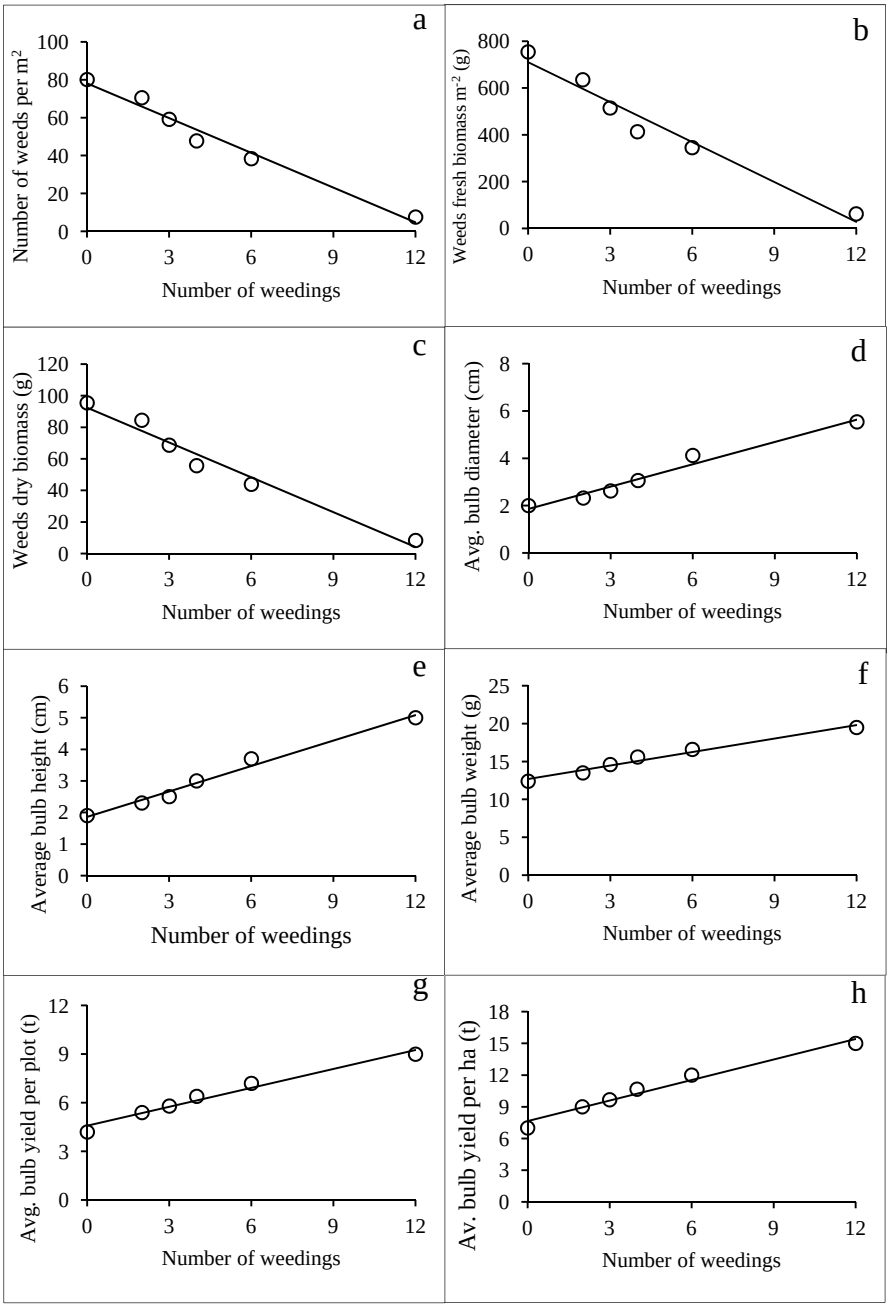

Figure 1. Effect of number of weedings on number of weeds per plot (a), weeds fresh biomass (b), weeds dry biomass (c), average bulb diameter (d), bulb height (e), bulb weight (f), bulb yield per plot (g) and bulb yield per ha (h).

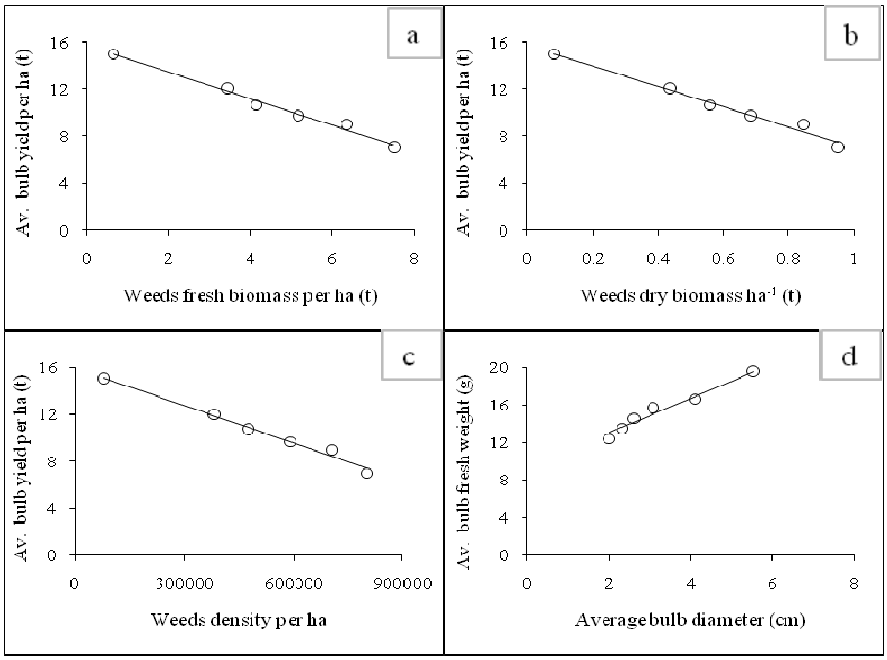

Figure 2. Relationship of average bulb yield per ha with weeds fresh biomass (a), weeds dry biomass (b), weeds density ha^{-1} (c) and relationship between average bulb fresh weight and bulb diameter (d).

This increase in bulb yield and its components might be attributed to reduction in garlic-weeds competition for nutrients. Low bulb yield in weedy control was due to the fact that weeds appeared immediately after sowing and competed with garlic crop till harvest. It was extremely difficult to locate and harvest bulbs. Bulb size and yield was affected in those plots, where weeds appeared in abundance due to less number of weeding and competed with crop at bulb formation stage. Regression analysis between different parameters depicts that average garlic bulb yield (t ha^{-1}) decreased significantly ($P \leq 0.001$) with increase in weed density, fresh and dry biomass, whereas, average bulb fresh weight increased significantly ($P \leq 0.001$) with increase in average bulb diameter (Figure 2 and Table-1). Vora and Mehta (1998 and 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) and Gorad *et al.* (2004),

Manisha *et al.,* (2005), Marwat *et al.,* (2005), Ghadage *et al.,* (2006), and Zubair *et al*. (2009) also found the highest onion bulb diameter, bulb height, bulb weight and bulb yield in plots, where weeds were either controlled manually or chemically.

Table-1. Regression coefficients for different parameters studied, where a, b, and r^2 are the intercept, the linear coefficient and coefficient of determination respectively and the values in parenthesis are the standard errors.

Parameters	a	b	r^2	Probability
Weeds density	78.17 (±2.79)	-6.12 (±0.47)	0.980	P≤0.001
Weeds fresh biomass	710.09 (±32.58)	-56.88 (±5.52)	0.964	P≤0.001
Weeds dry biomass	92.44 (±3.84)	-7.36 (±0.65)	0.970	P≤0.001
Bulb diameter	1.863 (±0.152)	0.314 (±0.024)	0.974	P≤0.001
Bulb height	1.858 (±0.101)	0.268 (±0.017)	0.984	P≤0.0001
Bulb fresh weight	12.699 (±0.274)	0.593 (±0.046)	0.976	P≤0.001
Bulb yield per plot	4.585 (±0.189)	0.388 (±0.032)	0.973	P≤0.001
Bulb yield per ha	7.641 (±0.316)	0.648 (±0.053)	0.973	P≤0.001
Bulb yield/ha vs. weeds fresh biomass	15.67 (±0.32)	-1.13 (±0.06)	0.987	P≤0.0001
Bulb yield/ha vs. weeds dry biomass	15.73 (±0.37)	-8.71 (±0.57)	0.983	P≤0.001
Bulb yield/ha vs. weeds density	15.88 (±0.36)	-0.00001 (±0.000)	0.985	P≤0.0001
Bulb fresh weight vs. bulb diameter	9.296 (±0.61)	1.85 (±0.17)	0.965	P≤0.001

CONCLUSIONS AND RECOMMENDATION

It is concluded from the study that weeds density, fresh and dry weeds biomass decreased significantly (P≤0.001) with increase in manual weeds removal timings, resulting to increase (P≤0.001) garlic yield (t ha^{-1}) due to significantly (P≤0.001) increase in attributing components (bulb diameter, height and weight). Negative linear relationship (P≤0.0001) was observed between average bulb yield (t ha^{-1}) and weeds density, fresh and dry biomass (t ha^{-1}). In contrast, positive linear relationship was observed between average bulb fresh

weight and average bulb diameter. Although manual weeding is a tedious, laborious and time consuming task, but studies suggest that regular manual weeding through out crop season can be successfully applied to boost up garlic production and get maximum profit for raising the economic status of the farmers.

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