INFLUENCE OF DIFFERENT WEED MANAGEMENT PRACTICES ON YIELD OF GARLIC CROP

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ABSTRACT

Field trials were conducted to compare different weed management practices in garlic (Allium sativum L.) at Government Seed Farm, Ratta Kulachi, Dera Ismail Khan (Pakistan) during winter 2007-08 and repeated during winter 2008-09. Randomized complete block design, with five replications was used in the experiment. The treatments were; 1) weeds free (manual weeding throughout season), 2) twice manual weeding (30 and 60 days after germination), 3) Pendimethaline (2.5 L ha^{-1}), 4) Dual Gold (2.5 L ha^{-1}), 5) Buctril Super (1.25 L ha^{-1}), and 6) control. The major weeds were Avena fatua, Chenopodium album, Chenopodium murale, Convolvulus arvensis, Coronopus didymus, Euphorbia helioscopia, Medicago denticulata, Phalaris minor, Rumex dextatus, and Melilotus indica. Weed management practices significantly affected weeds incidence in garlic crop as compared to weedy check (control). Garlic yield in all weed controlled treatments was significantly improved than control. For controlling weeds, Pendimethaline was found to be the best herbicide as compared to control and other herbicides. The maximum bulb yield was found in weed free treatment, followed by Pendimethaline, whereas, minimum bulb yield was recorded in control. Therefore, manual weeding throughout season or the use of Pendimethaline @ 2.5 L ha^{-1} is recommended for getting higher garlic yield.

Key Words: **Garlic, Allium sativum, weed management, herbicides, manual weeding**.

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INTRODUCTION

Garlic (*Allium sativum* L.) belongs to family "Alliaceae". It has a compound bulb, containing 10-16 cloves enclosed by a thin membranous sheath. It 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 the level of cholesterol in the blood. It also contains a considerable amount of calcium, phosphorus and vitamin C (Baloch, 1994).

Garlic is grown throughout Pakistan. In 2004-05, it was cultivated over an area of 6600 hectares with a production of 55900 tones (PARC, 2011). The average yield of garlic in Pakistan is very low as compared to other leading countries due to many factors. One of the main limiting factors is weed infestation. Weeds compete with garlic for nutrients, soil moisture, space, and light and 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 compete with crop plants at very early growth stages. 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.

Manual weeding is an important cultural practice to control weeds for marketable bulb. Usually farmers do not do weeding early enough to prevent crop from major damages caused by weeds. Further, manual weeding is a very tedious and expensive laborious method of weed control, even often damages the crop well. Weeds can also be controlled biologically and chemically. 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 Khan *et al*., (2010) also reported that different weed control methods had a substantial effect on crop yield. However, No such work has been done in southern districts of Khyber Pakhtunkhwa province of Pakistan. Therefore, the present study was conducted to compare the effectiveness of different weeds control methods in garlic crop grown in field demonstration plot to transfer weed control technology to the farming community of the area.

MATERIALS AND METHODS

A field trial was conducted on the comparison of weeds management practices in Garlic (*Allium sativum* L.) at Government Seed Farm, Ratta Kulachi, Dera Ismail Khan, Pakistan during winter 2007-08 and repeated during winter 2008-09. The experiment was laid out in Randomized Complete Block Design (RCBD). Plot size was 2×3 m^2. The trial comprised of the following six treatments, each replicated five times:

T1: Weeds Free (Manual weeding throughout season).

T2: Manual weeding (30 and 60 days after germination).

T3: Pendimethaline 33% (Stomp) @ 2.5 L ha^{-1}.

T4: Dual Gold (S-Metolachlor) @ 2.5 L ha^{-1}.

T5: Buctril Super (Bromoxinil + MCPA) @ 1.25 L ha^{-1}.

T6: Control (Weedy check).

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. 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 15th November, 2007 (year 1) and 20th November, 2008 (year 2). Row to row and plant to plant distances were kept 25 cm and 10 cm respectively. Pendimethaline and Dual Gold were sprayed with the help of a Knapsack sprayer before emergence of garlic crop on 18th November, 2007 (year 1) and 23rd November, 2008 (year 2) in "tar wattar" condition, whereas, Buctril Super was sprayed after emergence of weeds. The weeds free plots were hoed manually throughout the season and no weeds were allowed to grow. The hand weeding was done twice during the crop season i.e. First manual weeding was done 30 days after germination, while the second one was done 60 days after germination. No weeding was done in the weed control plots.

Data Collection and Analysis

During the course of the study, data were recorded on parameters such as, weed density (number of weeds per m² area), fresh weeds biomass (fresh weight of weeds collected from one m² area; g m^{-2}), dry weeds biomass (dry weight of weeds collected from one m² area; g m^{-2}), bulb weight (average single bulb weight; g), bulb diameter (cm), number of bulbs per plot, bulb yield per plot (kg) and bulb yield per ha^{-1} (tons). The bulb yield of garlic was recorded (in kg) in each plot and 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. The data recorded were statistically analyzed using statistical software MSTATC (Michigan State University, USA). 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

Weed Density (m^{-2})

Statistical analysis of the data showed that different treatments significantly ($P \leq 0.001$) affected the weed density m^{-2} in garlic crop. It was noted that maximum weed density was recorded in Control (weedy check) as shown in Fig 1 (c). The weed density in plots sprayed with Buctril Super @ 1.25 l ha^{-1} (post emergence) was at par with manual weeding twice during the crop season. Similarly weed density in Dual Gold @ 2.5 l ha^{-1} and Pendimethaline 33% @ 2.5 l ha^{-1} was also statistically at par. These results depicted that herbicides Dual Gold and Pendimethaline 33% effectively controlled weeds. Broad leaf weeds like *Convolvulus arvensis, Chenopodium album, Chenopodium murale, Melilotus indica, Rumex dentatus, Anagallis arvensis* and *Euphorbia helioscopia*, sedges like *Cyperus rotundus* and grasses like *Cynodon dactylon* and *Sorghum halepense* were found in garlic crop during the course of study. Buctril Super controlled broad leaf weeds but did not control sedges and grasses. Pendimethaline has been reported as effective herbicide in garlic crop (Vora and Mehta, 1998 and 1999; Mahmood *et al*., 2002) and in onion (Zhidkov and Krivtsov, 2003; Ghaffoor, 2004; Manisha *et al.*, 2005; Marwat *et al.*, 2005; Zubair *et al*., 2009). The present study showed that although manual weeding throughout the season controlled weeds but it is too much laborious and time consuming as well as more expensive process.

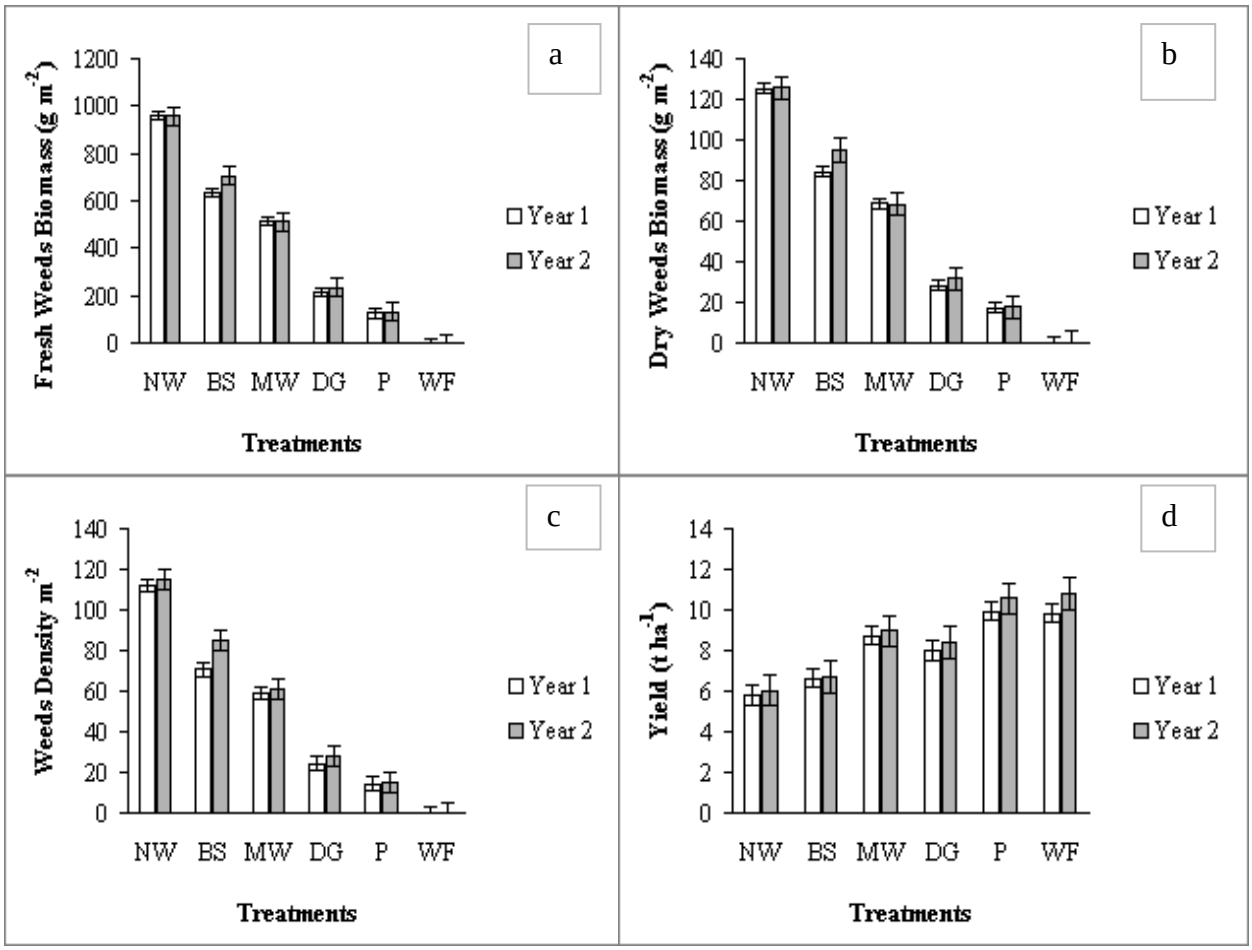

Fig 1. Fresh (a) and dry (b) weed biomass m-2, Weed density (c), and Garlic Bulb yield (d) per hectare (tons) as affected by No Weeding (NW), Buctril Super (BS), Twice Manual Weeding (MW), Dual Gold (DG), Pendimethaline (P) and Weeds Free (WF). Error bars show LSD value at P≤0.01.

Fresh Weed Biomass (g m^{-2})

Statistical analysis of the data indicated that fresh weed biomass (g m^{-2}) was significantly (P<0.0001) affected by different treatments of weed management practices. It was found in the study that manual weeding and application of herbicides reduced the fresh weed biomass Fig 1 (a). There were no weeds in the plots, where manual weeding was done throughout the crop season. Minimum fresh weed biomass was recorded in plots sprayed with Pendimethaline 33% (stomp), while maximum fresh weed biomass was noted in plots, where weeds were not controlled. Mahmood *et al*., 2002 also found Pendimethaline and oxadiazone as effective herbicides in garlic crop. Similar results were also reported by Zubair *et al*., 2009 in their study on onion that application of herbicides and hand weeding significantly reduced weed biomass m^{-2}.

Dry Weeds Biomass (g m^{-2})

Statistical analysis of the data showed that dry weed biomass (g m^{-2}) was significantly (P<0.0001) affected by different weed management practices. The results depicted that manual weeding and application of herbicides reduced the dry weed biomass Fig 1 (b). There were no weeds in the plots, where manual weeding was done throughout the crop season. It was noted that minimum dry weed biomass was recorded in plots sprayed with Pendimethaline 33% (stomp), while maximum dry weed biomass was noted in control, where weeds were not controlled. Mahmood *et al*. (2002) also found Pendimethaline and oxadiazone as effective herbicides in garlic crop to control weed biomass. The results are also in agreement with the findings of Saimbhi *et al.*, (2000). They found that application of herbicides and hand weeding reduced the dry weed biomass. Similar results were also noticed by Thakral *et al.* (2003), Manisha *et al.* (2005) and Qasem (2006). Their studies also showed that application of

herbicides and hand weeding resulted in the lowest dry weeds biomass. Similarly, Zubair *et al*. 2009 also found in their study on onion crop that application of herbicides and hand weeding significantly reduced weed biomass m^{-2}.

Bulb Weight (g)

Statistical analysis of the data depicted that average bulb weight (g) was significantly ($p \leq 0.001$) affected by different weed management practices. The results showed that maximum average bulb weight was found in plots, which were sprayed with Pendimethaline 33% Fig 2 (b). These bulbs were about 70% heavier than those of control plots, where weeds were allowed to grow freely causing decrease in average bulb weight. Mahmood *et al*. 2002 also found 46% increase in average bulb weight in plots, which were sprayed by Pendimethaline as compared to average bulb weight in control plots.

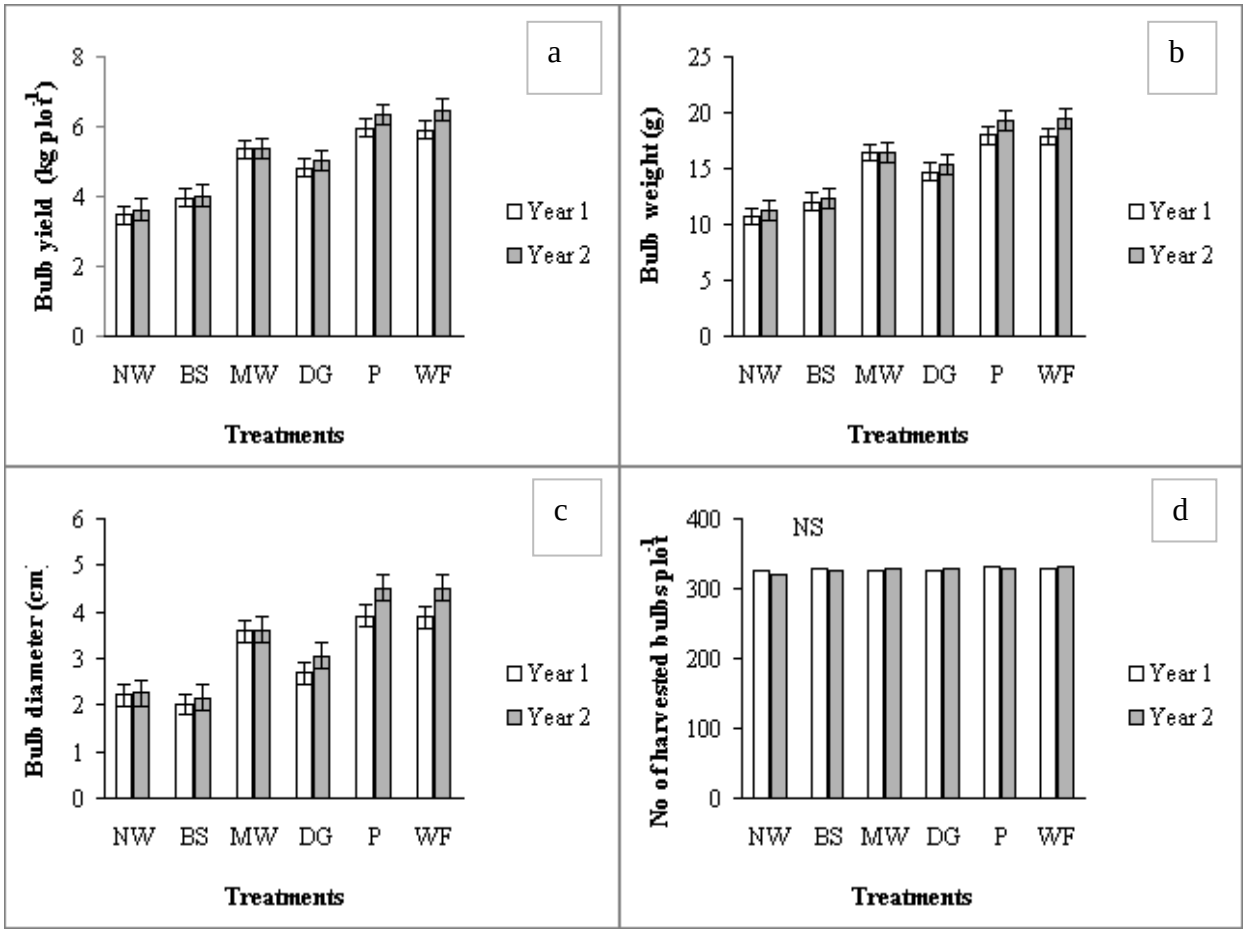

Fig 2. Bulb yield (a) Bulb Weight (b) Bulb Diameter, (c), No of Bulbs per plot (d) as affected by different treatments i.e No Weeding (NW), Buctril Super (BS), Twice Manual Weeding (MW), Dual Gold (DG), Pendimethaline (P) and Weeds Free (WF). Error bars show LSD value at P≤0.01.

Bulb Diameter (cm)

Significant differences in average bulb diameter were noted during both trials Fig 2 (c). Data revealed that the highest average bulb diameter was obtained in treatment, where Pendimethaline 33% was applied, followed by weeds free treatments. Both treatments were statistically at par. This increase in average bulb diameter was more than 76% as compared to the control treatment, where weeds were not controlled resulting increase in yield.

Number of Harvested Bulbs Plot^{-1}

No significant difference in number of harvested bulbs per plot among treatments was found during both trials Fig 2 (d). In contrast to our findings, Mahmood *et al*. (2002) reported significant effect of herbicides and manual weeding on number of harvested bulbs in their study on weed control in garlic crop.

Bulb Yield Plot^{-1} (kg)

Significant ($p \leq 0.001$) increase in bulb yield plot^{-1} during both experiments was observed in treatments, where weeds were controlled either manually or herbicides spray as compared to control treatment, where weeds were allowed to grow freely which resulting reduced garlic growth and development Fig 2 (a). Maximum bulb yield per plot was found in treatments, where weeds were controlled through either Pendimethaline spray or uprooted manually throughout crop season, whereas, minimum bulb yield plot^{-1} was noted in treatment, where weeds were not controlled throughout crop season. The findings are in accordance with the results of Mahmood *et al*. (2002).

Bulb Yield Hectare^{-1} (tons)

Analysis of variance indicated that bulb yield (tons ha^{-1}) was significantly ($p \leq 0.001$) affected by different weed management practices. The results displayed that the highest yield was recorded in plots, where weeds were uprooted manually throughout the crop season Fig 1 (d). This bulb yield was 79 % higher than that of control plots, where weeds were allowed to grow freely, which affected the garlic growth and development resulting reduced bulb yield. Similar results were observed by Mahmood *et al*. (2002) in their study on weed control in garlic crop. They recorded highest bulb yield in weed free treatment, which was significantly higher than rest of the treatments where herbicides were sprayed. Bulb yield in plots sprayed with Pendimethaline 33% (stomp) was statistically at par with weed free plots, showing 75 % increase over the bulb yield of weedy check. Lowest bulb yield was obtained in plots with no weed control, which was statistically at par with the yield obtained from plots sprayed with Buctril Super. Similarly Dual Gold and manual weeding (twice during season) treatments were also found statistically similar. These results are similar with the findings of Mishra and Tyotishi (2002) who obtained the highest average onion bulb yield in plots, which were sprayed with Pendimethaline 33% (stomp), where bulb yield was 63 % higher than the un-weeded treatment. Similar results were also demonstrated by Jilani *et al.* (2003), Ghaffoor (2004) and Manisha *et al.* (2005). They showed that the highest bulb yield was obtained in plots sparyed with Pendimethaline 33% (stomp).

CONCLUSION AND RECOMMENDATION

It is concluded from the study that different weed management practices significantly reduced the weed density and increased garlic bulb yield with either manual weeding or the application of different herbicides. Overall herbicides applied, Pendimethaline 33% (stomp) proved to be the best weed control method. Results revealed that manual weeding throughout growing season had controlled all weeds, which resulted in the highest garlic bulb yield, but it is the most laborious and un-economical method to control weeds as compared to the application of herbicides. Therefore, the use of Pendimethaline 33% (stomp) as pre-emergence herbicide is recommended for the farming community of the area to achieve maximum garlic bulb yield ha^{-1}.

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