Effect of Irrigation Interval on Growth and Yield of Garlic (*Allium sativum* L.) in Sokoto, Nigeria

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Abstract: Field Experiments were carried out at the Usmanu Danfodiyo University Teaching and Research Fadama Farm, Kwalkwalawa about 5km from Sokoto Town (latitude 13° 01"N and longitude 05°15"E, 300m above sea level.) to investigate the performance of garlic (*Alliui sativum* L) to varying levels of irrigation interval. The treatments consisted of four irrigation intervals in days (3, 5, 7 and 9days). Treatments were laid out in a randomized complete block design with three replications.The experiments were conducted in 2 seasons (2002/03 and 2003/04) The results obtained revealed that 3-day irrigation interval significantly affected number of leaves per plant, plant height at maturity, bulb yield bulb weight, number of cloves per bulb and clove weight throughout the period of investigation, while increase in the number of days between irrigation interval negatively affected both growth and yield performance of garlic. Generally, 3-day irrigation interval resulted in better growth and yield of garlic in both seasons.
Keywords: Garlic; Irrigation; Yield

INTRODUCTION

Garlic (*Allium sativum* L.) belongs to the family Alliaceae (Kocher, 1986; Hanelt, 1990). Garlic originated in central Asia and later spread to Mediterranian region (Simon, 2001). It is grown in both temperate and tropical climates (FAO, 2001). Garlic is one of the most promising vegetable crops cultivated in Nigeria during dry season under irrigation in the northern part of the country due to its commercial values. According to Chuman and Maurya (1986) efficient utilization of water is vital for economic production and both water deficiency and over irrigation reduce garlic growth and yield.

Irrigation is a pre-requisite to successful garlic production in Nigeria. Garlic crop has fibrous and shallow rooting system; therefore it needs adequate attention with regards to its water requirements. According to Buwalda (1987) and Choi *et al.* (1980), garlic requires adequate moisture from establishment through to maturity for better growth, yield performance and quality. They further reported that the crop did not withstand application of excess water and deficiency may cause substantial yield reduction. Since water is a pre-requisite for garlic production, there is therefore the need to determine the most appropriate irrigation schedule for garlic so that both its growth and yield potentials would be properly exploited. Therefore, this research was carried out with a view to determining the most optimum irrigation schedule for garlic production in Sokoto.

MATERIALS AND METHODS

Field Experiments were carried out at the Usmanu Danfodiyo University Teaching and Research Fadama Farm, Kwalkwalawa about 5km from Sokoto Town (latitude 13° 01"N and longitude 05°15"E, 300m above sea level.) to investigate the performance of garlic (Alluim sativum L) to varying levels of irrigation intervals. The site was a low lying River Sokoto/Rima river flood plain (Fadama). It is usually submerged by flood water from August/September to October/November. The area is characterized by a long dry season with cool air during harmattan (November- February), hot dry air during hot season from

March to May. The meteorological data for the period of the experiment are minimum temperature of about 20°C and maximum temperature of 35°C. Relative humidity ranged from 27 to 30 in the morning and 38 to 40 in the evenings. Soil of the experimental site was sandy loam with a pH range of 5.50 (in $CaCl_2$) to 5.70 (in H_2O); 7.70 to 8.80% organic carbon; 0.85 to 0.88%N; and available phosphorous 0.54 to 1.93ppm.

The treatments consisted of four irrigation intervals (3, 5, 7, and 9 days) laid out in a randomized complete block design with three replications. Individual plot size was 1.5m x 3m with 2.7m^2 as the net plot size. The spacing used was 15cm x10cm with a single clove per hill. Five pre-treatment irrigations were given initially for about two weeks to enable the stand to be well established. Irrigation schedule was altered to correspond to irrigation treatments. To obtain uniform maturity, irrigation was stopped two weeks before harvesting. NPK (15:15:15) fertilizer was applied at the rate of 80, 50, and 50 kg/ha. Nitrogen was split in to two doses of 40kg and applied at planting and the other half (40kg) was top dressed in form of urea (45-46%N) at 4 weeks after the first dose. All the P and K were applied at clove bed preparation. All the fertilizers were incorporated in to the soil in order to minimize losses. Bulbs were harvested when the leaves had turned green and started falling. Data were collected on number of leaves per plant, plant height at maturity, bulb yield, bulb weight, number of cloves per bulb and clove weight. Data were analyzed statistically and multiple comparisons of treatment means were carried out using Duncan's Multiple Range Test according to Little and Hills (1978).

RESULTS

The effects of irrigation intervals on growth and yield performance of garlic are presented in Tables 1 to 3. Number of leaves per plant and plant height at maturity were significantly affected by irrigation interval in both seasons (Table 1). Three-day irrigation interval produced significantly higher number of leaves per plant and taller plants than the rest of the irrigation intervals in 2003/2004 seasons. There was no statistically sigfnificant difference ($P<0.05$) between 3 dayirrigation interval, 5 and 7 days irrigation intervals in terms of leaf number during the 2002/2003 season (Table 1). In the same season, the height of garlic plant in 7 and 9 day irrigation intervals was statistically ($P>0.05$) similar. In the second season, 2003/2004, each wider delay in irrigation intervals has significantly ($P<0.05$) reduced plant height.

Table 1: Mean number of leaves per garlic plant and plant height as affected by irrigation interval during 2002/2003 and 2003/2004 dry season at Sokoto.

	No. of leaves/plant		**Plant height (cm) at maturity**	
Treatment	2002/2003	2003/2004	2002/2003	2003/2004
Irrigation Interval (day) (I)				
3	21.8a	19.2a	61.0a	41.2a
5	20.7b	15.7b	59.3a	38.5b
7	18.2b	15.5b	56.6b	32.7c
9	17.1b	11.0c	54.0b	29.0d
SE+	0.80	0.56	1.2	).53
Significance	**	**	**	**

Means in a column followed by same letter within a treatment group are not significant at 5% level of significance using Duncan Multiple Range Test (DMRT)

Table 2: Mean bulb yield and individual cured weight as affected by irrigation interval during 2002/2003 and 2003/2004 dry seasons at Sokoto.

	Bulb yield (kg/ha)		**Individual cured bulb weight (g)**	
Treatment	2002/2003	2003/2004	2002/2003	2003/2004
Irrigation Interval (day) (I)				
3	3322.4a	3859.4a	12.8a	16.4a
5	2464.8b	2780.5b	10.5b	14.6a
7	2051.3b	2095.6c	8.4c	11.4b
9	2206.8	1804.0c	8.4c	8.7c
SE+	211.3	188.9	0.05	0.81
Significance	**	**	**	**

Means in a column followed by same letter within a treatment group are not significant at 5% level of significance using Duncan Multiple Range Test (DMRT)

Table 3: Number of clove per bulb and clove weight as affected by irrigation interval during 2002/2003, 2003/2004 dry seasons at Sokoto

Treatment	No. of cloves/bulb		Clove weight (g)	
Irrigation Iinterval (day) (I)				
	2002/2003	2003/2004	2002/2003	2003/2004
3	10.5a	17.3a	0.70a	0.81a
5	9.5b	16.0ab	0.58b	0.69a
7	8.7c	15.1b	0.58ab	0.68a
9	7.5d	10.3c	0.55b	0.44b
SE+	0.19	0.61	0.045	0.046
Significance	**	**	**	**

Means in a column followed by same letter within a treatment group are not significant at 5% level of significance using Duncan Multiple Range Test (DMRT)

Irrigation interval had significant ($P<0.05$) effect on cured bulb yield in both seasons (Table 2). Three-day irrigation interval produced significantly ($P<0.05$) higher cured bulb yield than the remaining irrigation intervals in both seasons (Table 2). In 2002/03, 5, and 7 day irrigation intervals produced similar cured bulb yield. Nine and 7 -day irrigation interval produced the lowest and statistically similar ($P<0.05$) cured bulb yield in 2003/2004 session. Bulb weight decreased as the irrigation interval increased in both seasons (Table 2). In 2003/2004, 3 day irrigation interval had statistically ($P<0.05$) similar bulb weight with 5 day irrigation interval while in 2002/2003 the difference in bulb weight between the two irrigation intervals was significant. There was significant difference ($P<0.05$) between 7 day and 9 day irrigation interval in 2003/2004 while the two irrigation intervals were at par in 2002/2003 in terms of bulb weight. Each increase in an irrigation interval from 3 to 7 days reduced the bulb weight (Table 2). Similar significant of bulb weight were recorded in 2003/2004.

Irrigation interval had significant effect on number of cloves per bulb (Table 3). Generally, in 2002/2003 season irrigation intervals differed significantly from one another. Three day irrigation interval had significantly higher number of cloves per bulb than the rest of the irrigation intervals. In 2003/2004, 3 day irrigation interval had

significantly higher number of cloves per bulb compared to both 7 day and 9 day irrigation interval but was at par with 5 day irrigation interval (Table 3). Five and 7 days irrigation intervals were at par in terms of clove number per bulb but differed significantly from 9 day irrigation interval. Generally, for all the treatments, higher clove numbers were recorded in 2003/2004 season.

In the two seasons, 3, 5, and 7 days irrigation intervals had statistically the highest clove weights which were at par with each other (Table 3). In 2002/2003 season, 3 day irrigation interval differed significantly in clove weight from 5 day irrigation interval while 7 day irrigation interval was at par with 5 and 9 day irrigation intervals. In 2003/2004 season, 9 day irrigation interval had significantly ($P<0.05$) the lowest clove weight than the other irrigation intervals

DISCUSSION

Adequate irrigation has been known to stimulate growth development and yield of most vegetable crops. In this study, significant increase in number of leaves per plant, plant height at maturity , bulb yield, bulb weight, number of cloves per bulb and clove weight as a result of irrigating the crop after every 3 days could be attributed to availability of water at the rooting zone. This phenomenon results in an increase in photosynthetic ability of the crop and is also very vital for both transpiration and tissue formation and this caused increased bulb size and quality. Similar results were reported by Scalopi *et al.* (1971), Lazari *et al.* (1978), Choi *et al.* (1980) and Carrijo *et al* (1982) who independently noted significant increased in number of leaves per plant, plant height, bulb yield, size and quality with adequate irrigation. In garlic the number of leaves per plant has been reported to have direct bearing on the number of cloves per bulb, which in turn affects both size and weight of the bulb. These growth and performance characteristics correlate with 3-day irrigation interval suggesting that giving water at every three days to be sufficient. This finding agreed with what was reported by Miko *et al.* (2000) on positive effect of adequate irrigation on yield attributes of garlic. He reported 5-day irrigation interval as being optimum, despite differences in soil type and climate. Garlic crop does not withstand application of excess water and water stress could decrease both growth and yield attributes of garlic by up to 60 percent (Buwalda, 1987).

CONCLUSION

Based on the two trials carried out in the two seasons, 3-day irrigation interval is the optimum irrigation schedulefor maximum growth and yield performance of garlic in sokoto

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