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Effects of Clove Size And Defoliation Intensity on the Growth And Yield Of Garlic (Allium Sativum L.) In Sokoto, Nigeria.

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Abstract: Field trials were conducted during 2012/2013 and 2013/2014 dry seasons at the Teaching and Research Fadama Farm, Usmanu Danfodiyo University, Sokoto (latitude 13^0 0^1 N; longitude 5^0 15^1 E; altitude, 350m above sea level), to study the effect of clove size and defoliation intensity on the growth and yield parameters of garlic (Allium Sativum L.). Randomized complete block design was used with factorial combination of clove size and defoliation intensity. The treatment combinations were replicated three times. Results obtained revealed that clove size and defoliation intensity had significantly ($p<0.05$) affected growth and yield parameters such as plant height, number of leaves per plant, bulb weight and cured bulb yield in both seasons. It was concluded that large sized cloves of garlic out yielded small sized cloves and that the yield has appreciated to defoliation intensity between zero and 40% but continue to depreciate between 40% and 80% intensity**.**

Keywords: Defoliation intensity, Clove size; Garlic; Yield; Cloves.

I. INTRODUCTION

Garlic (Allium sativum L.) belongs to the family Alliaceae (Hanelt, 1990). Garlic originated in central Asia and later spread to Mediterranean region (Simon, 2001, Kilgori et al., 2005). It is grown in both temperate and tropical climates (FAO, 2001). Garlic is one of the most promising vegetable crops cultivated during dry season under irrigation in the Northern part of Nigeria because of its commercial values (Miko, 2000a). However, it is a well known fact that during off-season, same quantity of garlic is sold for twice or thrice the value of its onion counterpart (Kilgori, 2004). Despite these benefits obtained from its production, there has been little research effort geared towards increase production as regards to appropriate agronomic practices such as use of optimum defoliation stages and defoliation intensity for growth and yield of garlic. Production of vegetables is one of the major occupations of people in Sokoto and neighbouring States in Northwestern Nigeria, more especially during dry season when rainy season cultivation is over (Ahmed, 2006). This virtually stems the tide of rural-urban migration and is both an income generation and source of employment to a large population of otherwise redundant labour force (Ahmed, 2006).

In Garlic, cloves are used as planting material and they are the reproductive structure that consists of embryo, usually accompanied with a supply of food and is enclosed in a protective coat (Encyclopedia, 1994). Clove rate varies from 700 - 1000 $kgha^{-1}$ depending upon the weight of the individual cloves and spacing (Schumacher, 1997). However, since the planting materials are cloves, there is the need for grading of the cloves to be planted in order to obtain optimum economic yield and quality of the bulbs (Ahmed, 2006). It was theorized that larger cloves would produce larger plants at bulbing and consequently higher yields. This has been supported by Bravo and Duimovic (1978) and Wardjito and Abidin (1980) whom reported that garlic yield tend to be lower when smaller cloves were utilized. While, Bogatirenko (1977), D'Anna et al. (2000) and Zandstra and Squire (2000) they all noted that cloves from largest bulbs generally produced plants with larger bulbs, greater top dry weight and yield and observed that smaller cloves produced smaller plants with smaller bulbs and reduced to dry weights.

According to Wikipedia, (2012) Defoliation is the process of removal of leaves from a tree other than natural leaf fall. A defoliant is a chemical sprayed or dusted on plants to cause its leaves to fall off (Meyer 1998). Recently, studies in crop defoliation have been receiving more attention to determine the effect of removing leaves for livestock, industrial use and on the final yield for human consumption using various crops (Rahman et al., 2008). In Nigeria, Ogunlela and Ologunde (1985) compared varying defoliation intensity applied at different Defoliation Stages on sorghum. Yahya (2000) determined the effect of variety and defoliation on grain cowpea. Ibrahim (2001), worked on the effect of stages and intensity of defoliation on the growth and yield of grain cowpea. Silas (2008) also assessed on the effect of intensity of defoliation and spacing on cowpea. While Rahman et al. (2008) studied the effect of defoliation at different Defoliation Stages on yield and profitability of cowpea (Vigna unguiculata (L.) Walp.). Ibrahim et al. (2010) reported the effect of defoliation on the profitability of cowpea. Badi et al. (2012) worked on the response of vegetable cowpea (Vigna unguiculata) to intra-row spacing and defoliation. All these studies concluded that yield response depends on the extent of defoliation.

Therefore, this research was carried out with a view to determining the most suitable defoliation intensity of garlic and appropriate clove size for optimum yield of garlic in Nigeria.

II. MATERIALS AND METHODS

Field trials were carried out during 2012/13 and 2013/14 dry seasons at Usmanu Danfodiyo University, Fadama Teaching and Research Farm, Sokoto (latitude 13°01'N; longitude 5°15'E, 300 m above sea level) to investigate the effects of defoliation stages and defoliation intensity of garlic. The site is a low lying Sokoto and Rima river flood plain (Fadama). The land is submerged by flood water from August/September to October/November. The area is characterized by a long dry season with cool air (November-February), hot dry air during hot season from March to May (Kowel and Knabe, 1972). The meteorological data for the period of the experiment are minimum temperature of about 25.0 and 28.0°C and maximum temperatures of 30.0 and 36.5°C. Relative humidity ranged from 27 to 35% in the mornings and 38 to 45% in the evenings. Soil of the experimental site was sandy loam with a pH of 5.70 (in H_2O), 7.7 to 8.8% organic carbon; 0.85 to 0.88% N and available phosphorus of 0.54 to 1.93 ppm.

The treatments consisted of three defoliation intensity which was determined using meter rule and scissors to trim the leaves based on height (0% or no defoliation, 40% leaves defoliation and 80% defoliation) and two clove sizes (small (< 1cm) and large (> lcm) in diameter), which was determined by measuring their diameter using a Vanier caliper, arranged in all possible factorial combinations and laid out in a randomized complete block design with three replications. Individual plot size was 1.5x2 m with 2.08 m^2 as net plot size. The spacing used was 15x10 cm with a single clove per hill. To obtain uniform maturity, irrigation was stopped two weeks before harvesting. Fertilizers NPK (15: 15: 15) was applied at the rates of 80, 50 and 50 kg ha^{-1}, respectively. Nitrogen (45-46% N) was split applied at sowing and at 4 weeks after sowing. All of the P and K were applied at sowing. All the fertilizers were incorporated into the soil in order to minimize losses. Bulbs were harvested when the leaves had turned pale green and started falling. Data were collected on plant height, number of leaves per plant, bulb weight and cured bulb yield. Data were analyzed statistically and multiple comparisons of treatment means were carried out using Duncan's New Multiple Range Test (Little and Hills, 1978).

III. RESULTS

Table 1 show plant height and number of leaves per plant of garlic as affected by clove size and defoliation intensity at 10 WAS during 2012/2013 and 2013/2014 seasons. The results indicated that clove size had no significant ($p>0.05$) effect on plant height and number of leaves per plant at 10 WAS during 2012/2013 dry season but large sized cloves produced the tallest plants with the highest number of leaves per plant than those produced by the small sized cloves in 2013/2014 season.

Defoliation intensity had significantly affected plant height and number of leaves per plant of garlic at 10 WAS during both seasons. In both seasons, zero percent defoliation intensity produced significantly taller plants with more number of leaves per plant than the shorter plants with less number of leaves produced by 80 percent defoliation intensity. The interaction of the factors was not significant.

Table 2 show the results of bulb weight and cured bulb yield of garlic as affected by clove size and defoliation intensity during 2012/2013 and 2013/2014 seasons. The results indicated that clove size had no significant ($p>0.05$) effect on bulb weight and cured bulb yield during 2012/2013 dry season but large sized cloves produced heavier and more bulbs than those produced by the small sized cloves in 2013/2014 dry season.

Defoliation intensity had significantly affected bulb weight of garlic only in 2012/2013 season with zero percent defoliation intensity produced significantly higher bulb weight compared to the bulbs produced by 40 and 80 percent defoliation intensity that were at par. . The interaction of the factors was not significant.

IV. DISCUSSION

The significant effect of clove size on Bulb weight observed in this study can be attributed to the fact that large size cloves possessed more food reserve for the growth and development of young clovelings, enhanced soil nutrients uptake by the crop and mobilization of more growth and development. This was in conformity with what was reported by Wardjito and Abidin (1980) and Purseglove (1992), who reported that large-sized cloves produced plants that are taller, with larger bulbs and cloves than the small-sized cloves and availability of food coupled with cool temperature enhances crop energy formation and its transfer as well as cell division thereby enhances both roots and leaves growth and development.

Bulb yield per hectare were found to be higher in large sized cloves. This could be due to the more available food reserved for the developing organs that have effect on photosynthates produced and dry matter accumulated. This agrees with Purseglove (1992), Brewster (1994) and Miko (2000b), who reported that highest yield and quality of garlic bulbs were obtained when large sized cloves were utilized. Other workers who

reported positive effect of large sized cloves on bulb yield of garlic include D'Anna et al. (2000) and Zandstra and Squire (2000).

Defoliation intensity had significantly affected growth and yield characters such as plant height, number of leaves per plant, bulb weight per plant and cured bulb yield in 2012/2013 and 2013/2014 dry seasons. Defoliation intensity of 80% produced significantly shorter plants with fewer leaves at maturity. This may be due to the intensity of leaves removal which is in conformity with Muro et al. (2001) who reported that the effect of defoliation intensity depends on the foliar surface area eliminated and on the growth at which it takes placed. Moreover, Rahman et al. (2008) and Badi et al. (2012) all worked on cowpea and reported that reduction in yield with increasing defoliation intensity could be due to lesser leaf area unable to supply available assimilates to the sink.

The yield loss could be because there was an increase in the defoliation intensity as found by Muro et al. (2001) studies of sunflower showed that crop yield loss increased with increasing level of defoliation. Rahman et al., (2008) also reported that Regression functions for the relationship between yield loss and defoliation level at the three growth stages of cowpea were positive and that there was an increase in yield loss as the intensity of defoliation increased but this influence was only significant in the vegetative stage.

V. CONCLUSION

It was concluded that large sized cloves of garlic out yielded small sized cloves and that the yield has appreciated to defoliation intensity between zero and 40% but continue to depreciate between 40% and 80% intensity.

Table 1. Plant height and number of leaves per plant of garlic as affected by defoliation stages and defoliation intensity at 10 WAS during 2012/2013 and 2013/2014 seasons at UDU, Teaching and Research Fadama Farm, Sokoto.

	Plant height (cm)		**Number of leaves per plant**	
Treatments	2012/2013	2013/2014	2012/2013	2013/2014
Clove size (CS)				
Small	31.37	38.46^{b}	8.24	9.31^{b}
Large	33.44	42.13^{a}	8.49	10.18^{a}
SE ±	0.857	0.681	0.249	0.248
Significance	NS	**	NS	*
Defoliation intensity (%)				
0	36.47^{a}	41.47^{a}	9.36^{a}	10.83^{a}
40	34.11^{ab}	40.39^{a}	8.38^{b}	9.52^{b}
80	32.04^{b}	35.03^{b}	7.36^{c}	8.93^{b}
SE ±	1.401	0.834	0.305	0.303
Significance	*	*	**	*
Interaction				
CS x DI	NS	NS	NS	NS

Within a treatment group, means in a column followed by same letter(s) are not significantly different at 5% level using Duncan New Multiple Range Test (DNMRT). NS = Not significant, * = Significant at 5% and ** = Significant at 1% levels probability. WAS = Weeks after sowing, CS = Clove Size and DI = Defoliation intensity.

Table 2. Bulb weight and cured bulb yield of garlic as affected by clove size and defoliation intensity during 2012/2013 and 2013/2014 seasons at UDU, Teaching and Research Fadama Farm, Sokoto.

	Bulb weight per plant (g)		**Cured bulb yield (kgha^{-1})**	
Treatments	2012/2013	2013/2014	2012/2013	2013/2014
Clove size (CS)				
Small	0.96	4.66^{b}	184.00	490.82^{b}
Large	1.04	5.70^{a}	185.19	696.69^{a}
SE ±	0.064	0.178	5.139	32.915
Significance	NS	**	NS	**
Defoliation intensity (%)				
0	1.34^{a}	5.24	189.26	629.40
40	1.04^{b}	5.22	185.94	608.70
80	1.00^{b}	5.19	178.58	543.10
SE ±	0.079	0.218	6.294	30.312
Significance	*	NS	NS	NS
Interaction				
CS x DI	NS	NS	NS	NS

Within a treatment group, means in a column followed by same letter(s) are not significantly different at 5% level using Duncan New Multiple Range Test (DNMRT). NS = Not significant, * = Significant at 5% and ** = Significant at 1% levels probability. CS = Clove Size and DI = Defoliation intensity.

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