Effect of planting time on growth and productivity of garlic

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Abstract: A research trial was conducted to check the effect of planting time on growth and yield of garlic at Vegetable Research Area, Institute of Horticultural Sciences, University of Agriculture, and Faisalabad. Experiments were laid out according to randomized complete block design and replicated thrice. Data regarding growth and yield was recorded and was subjected to analysis of variance technique and means were compared using LSD test. The data were collected on morphological and biochemical parameters like biological yield (kg), leaf area (cm^2), bulb weight (g), clove weight (g), neck diameter (mm), bulb diameter (mm), clove maximum length (mm), clove minimum length (mm), number of cloves per bulb, clove volume (mL), fresh weight (g), dry weight (g) and total phenolic contents (mg GAE/100g). In this experiment where three different sowing times were compared, biological yield (kg), leaf area (cm^2), bulb weight (g), clove weight (g), neck diameter (mm), bulb diameter (mm), clove maximum length (mm), clove minimum length (mm), number of clove per bulb, clove volume (ml), fresh weight (g), dry weight (g) and total phenolic contents (mg GAE/100g) were highest when garlic was sown on October 30, 2017, while lowest value of all these parameters were recorded for December 01, 2017 plantation because of non-availability of suitable environment.

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Key words: Garlic, sowing time, growth, yield

1. Introduction

Garlic (*Allium sativum* L.) is a member of *Alliaecae* family and after onion its ranking in bulbous crops is second (Dayi, 2008). Garlic is cultivated worldwide. It was firstly grown in Egypt in 2780 B.C. (Yamaguchi, 1983). Its center of origin was Central Asia and later on it was found in China and the Mediterranean (Etoh and Simon, 2002). Garlic consists of mostly single bulb that contains small bulbs known as bulblets. Leaves are flat. Garlic cloves contains 63% water, 7% protein, 0.2% fat, 28% carbohydrates, 0.8% fiber with huge amount of sulfur that is responsible for pungency and taste of garlic (Rabinowitch and Currah, 2002). Garlic requires a warm temperature of 30 ^{0}C for its best growth and bulb maturation while, at its initial stage of growth cool environment promotes vegetative growth. High humidity and rainfall affect both vegetative as well as bulb growth of garlic. The best soil for garlic is sandy or silt loam soil with good capacity to hold water (Sovovo and Sova, 2004).

Temperature and the length of the day both have effect on the initiation of the bulb and its formation (Rahman *et al.,* 2004). While, the movement of the photosynthetic substrates that take place from leaves toward bulb affect development of the bulb and that movement is increased at warm temperature (Kamenetsky *et al.,* 2004). Apart from its high economic and medicinal value and production on large scale its, productivity in most part of the world is less due to some genetic and environmental factors (Nonnecke, 1989). Sowing time generally affects the growth pattern and output of the garlic crop, which is mostly planted in the beginning of the winter. The growth of garlic starts mostly during cool weather but when it is sown in late season it faces high temperature and more rainfall which are unfavorable conditions for garlic growth. Early sown crops have the benefits of getting more favorable conditions in term of cool season. Long days and warm temperature are good for the development of the bulb (Subrata *et al*., 2010). In Bangladesh, farmer sow garlic in December and January after uprooting the nursery of Aman rice, at that late planting time there is exposure of high temperature just before the initiation of the bulb, during growth and developmental stage of the garlic in the month of the February to April. That results in the reduction in yield of bulb and some time there is no initiation of the bulb at all (Rahim *et al*., 1984). Late planting after October 30, in India resulted

in lower yield (Swati *et al.*, 2013). Rahman and Talukdar (1986) concluded that short day length with cool environmental temperature at planting time resulted in maximum yield and showed that bulb weight and its yield was increased with early sowing.

Therefore, this study was designed to evaluate the effect of planting time on growth and yield of garlic.

2. Materials and Methods

This experiment was planned in the scenario of increasing temperature of early winter (autumn) month, and to estimate delayed of planting time on garlic yield.

Treatments

T_1 = October 30, 2017
T_2 = November 15, 2017
T_3 = December 01, 2017

Data were recorded on the following parameters during course study:

1. Biological yield (kg)
2. Leaf area (cm^2)
3. Bulb weight (g)
4. Clove weight (g)
5. Neck diameter (mm)
6. Bulb diameter (mm)
7. Clove maximum length (mm)
8. Clove minimum length (mm)
9. Number of clove per bulb
10. Clove volume (ml)
11. Fresh weight (g)
12. Dry weight (g)
13. Phenolic content (mg/100g)

3. Results and discussion

This experiment was planned in the scenario of increasing temperature of early winter (autumn) moth, and to estimate delayed of planting time on garlic yield.

Table 3.2.1: Effect of planting time on different traits of garlic.

Sowing Time	Leaf area (cm^2)	Neck diameter (mm)	Bulb weight (g)	Bulb diameter (mm)	Number of clove per bulb	Clove weight (g)	Clove maximum length (mm)
October 30, 2017	13.017 a	7.5133 a	16.233 a	33.642 a	19.667 a	17.050 a	28.122 a
November 15, 2017	9.422 b	6.4750 b	10.408 b	28.147 b	14.583 b	9.983 b	21.158 b
December 01, 2017	7.142 c	3.8450 c	5.550 c	21.562 c	12.167 c	4.958 c	20.235 b
LSD (P<0.05)	0.9755	0.6318	1.3488	2.1954	1.6327	2.2575	1.6288

Means sharing similar letters are statistically non-significant at 5% probability level.

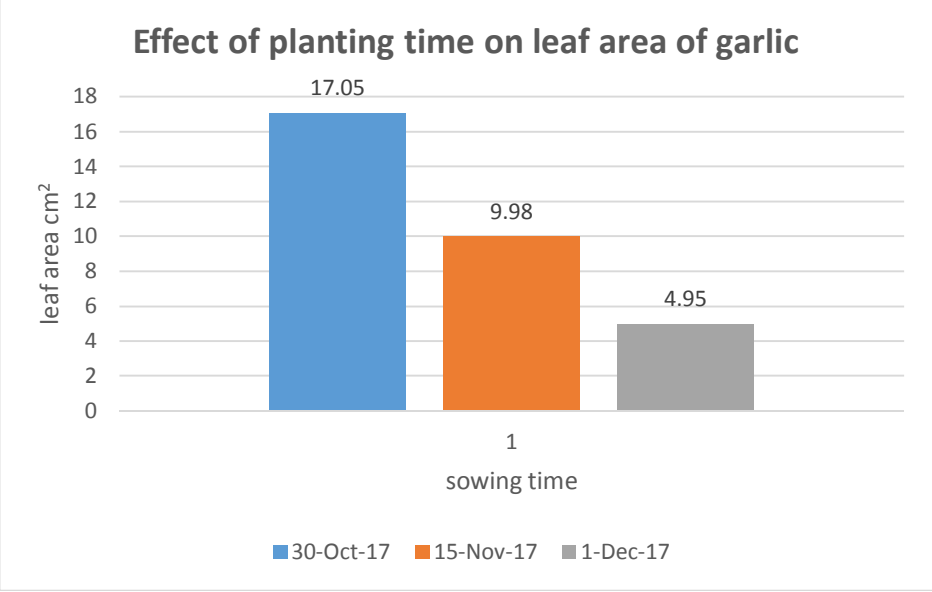

Figure 3.2.1: Effect of planting time on leaf area of garlic.

3.2.1: Leaf area (cm^2)

Statistical analysis of the data regarding leaf area revealed significant difference due to different treatments (Table 3.2.1). Means were compared by LSD test which showed leaf area (13.01 cm^2) being maximum for the crop which was planted on October

30, 2017 followed by sowing on November 15, 2017 where leaf area was 9.42 cm^2. Leaf area was minimum (7.14 cm^2) when garlic was sown on December 01, 2017. Our findings were supported by Mollah *et al.* (2015) who obtained maximum leaf area of onion with early planting.

Table 3.2.2: Effect of planting time on different traits of garlic.

Sowing Time	Clove minimum length (mm)	Clove volume (ml)	Fresh weight (g)	Dry weight (g)	Biological yield (kg)	Phenolic content (mg GAE/100g)
October 30, 2017	15.062 a	14.833 a	2.9629 a	1.044 a	202.97 a	40.676 a
November 15, 2017	12.373 b	7.750 b	1.93 b	0.74 b	144.80 b	35.656 b
December 01, 2017	11.883 b	4.667 c	1.17	0.35 c	73.74 c	32.079 c
LSD (P<0.05)	1.6263	1.7143	0.6262	0.3108	2.8540	1.7528

Means sharing similar letters are statistically non-significant at 5% probability level.

3.2.2: Neck diameter (mm)

Data for neck diameter were subjected to statistical analysis using analysis of variance technique that revealed significant results for the treatments. Mean values of treatments were arranged in Table 3.2.1 for comparison.

It is obvious from results that neck diameter was maximum (7.51 mm) when planting was done on October 30, 2017 followed by sowing on November 15, 2017 where neck diameter was 6.47 mm. Neck diameter was minimum (3.84 mm) for garlic sown on December 01, 2017. Our findings were supported by Bosekeng *et al.* (2015) who observed maximum neck diameter of onion in early planting as compared to late planting.

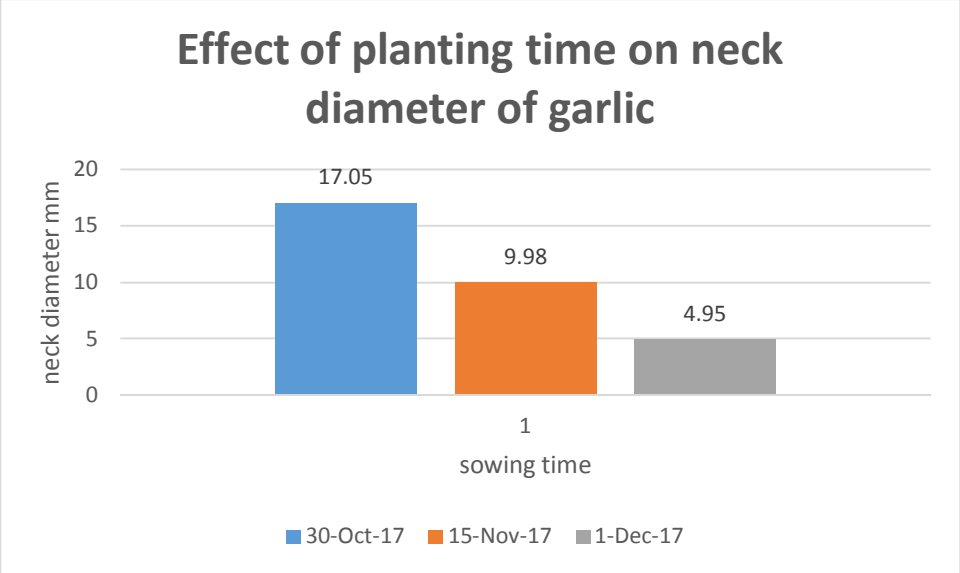

Figure 3.2.2: Effect of planting time on neck diameter of garlic.

3.2.3: Bulb weight (g)

Data pertaining bulb weight were analyzed statistically using analysis of variance technique that showed significant results for the treatments. Comparison of treatments Table (3.2.1) showed that all treatments differed significantly for bulb weight, being maximum (16.23 g) for crop sown on October 30, 2017 followed by sowing on November 15, 2017 where bulb weight was 10.40 g. Bulb weight was minimum (5.55 g) when garlic was sown on December 01, 2017.

Our findings were supported by Rahman and Talukda (1986) who recorded maximum bulb weight of garlic by early sowing while bulb weight was reduced with delay in sowing time.

3.2.4: Bulb diameter (mm)

Data regarding bulb diameter were subjected to statistical analysis that exhibited significant difference among treatments. Mean values of treatments were arranged in Table 3.2.1 for comparison. It is evident from results that maximum bulb diameter (33.64 mm) was recorded when garlic was sown on October 30, 2017 followed by sowing on November 15, 2017 where bulb diameter was 28.14 mm. Bulb diameter was minimum (21.56 mm) when garlic was sown on December 01, 2017. Our findings were supported by

Caruso and Anna (1995) who reported that bulb diameter of garlic was decreased with delay in planting time and reported that maximum bulb diameter (5.93 cm) was obtained by early planting.

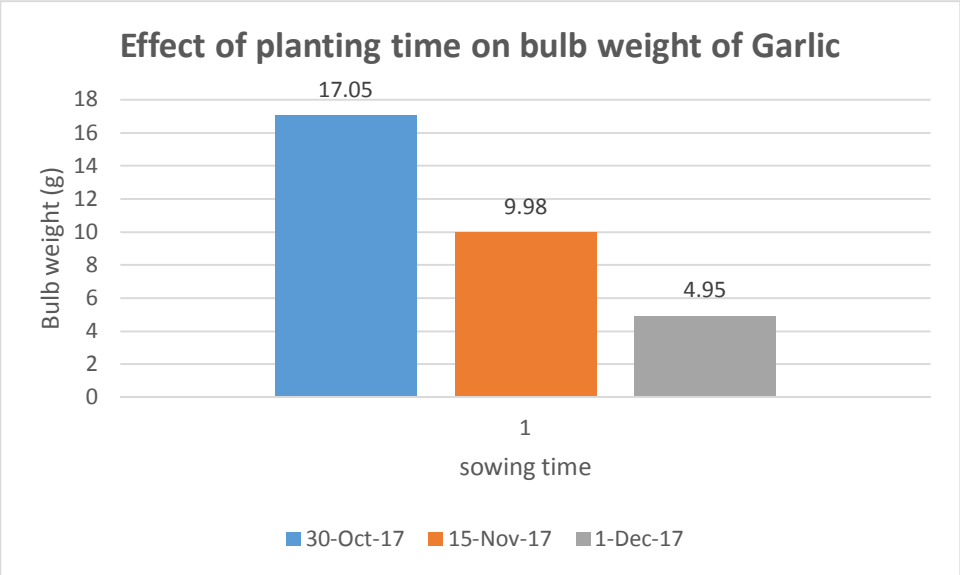

Figure 3.2.3: Effect of planting time on bulb weight of Garlic.

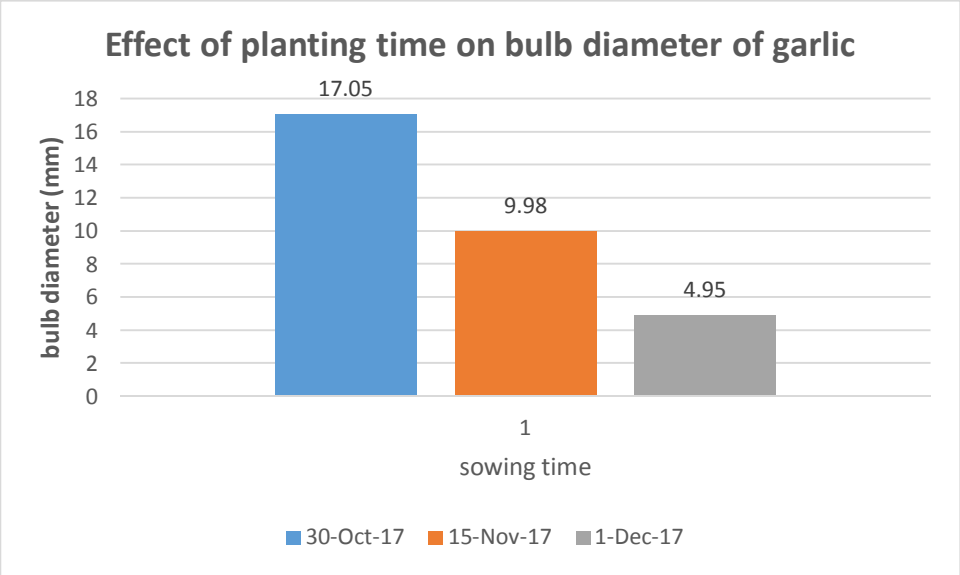

Figure 3.2.4: Effect of planting time on bulb diameter of garlic.

3.2.5: Number of cloves per bulb

Data pertaining numbers of cloves per bulb were analyzed statistically using analysis of variance technique that showed significant results for the treatments. It is obvious from results (Table 3.2.1) that numbers of cloves per bulb were maximum (19.66) when garlic was sown on October 30, 2017 followed by sowing on November 15, 2017 where, on an average, 14.58 cloves per bulbs were recorded. Number of cloves per bulb were minimum (12.16) for the crop which was sown on December 01, 2017.

Our findings were supported by Siddique and Rabbani (1985) who found that number of cloves per bulb decreased as sowing was delayed in the season.

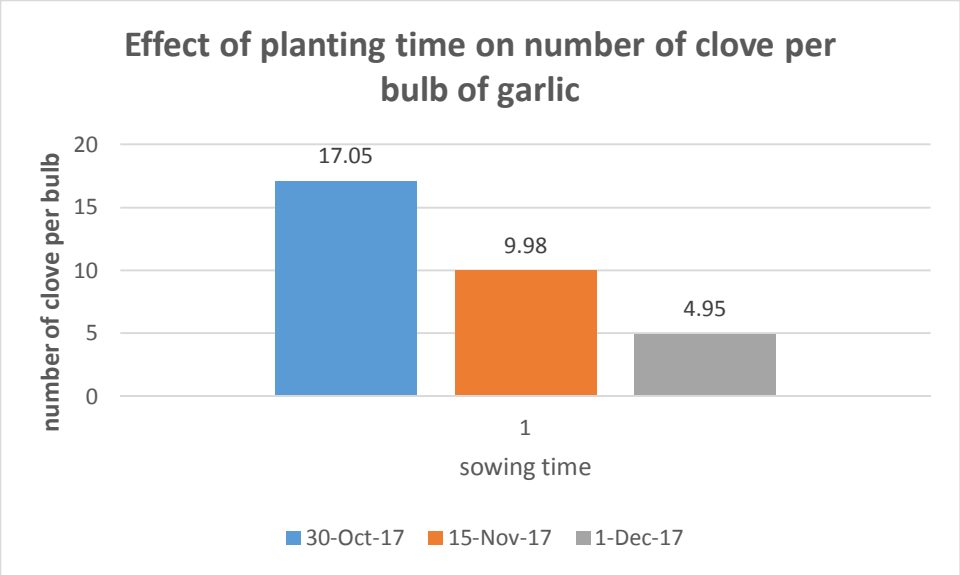

Figure 3.2.5: Effect of planting time on number of clove per bulb of garlic.

3.2.6: Clove weight (g)

Statistical analysis of data regarding clove weight revealed significant difference due to different treatments (Table 3.2.1). Means were compared by LSD test which showed maximum clove weight (17.05 g) when planting was done on October 30, 2017. Clove weight was half for November 15, 2014 (9.98) as compared to sowing on October 30, 2017. Clove weight was minimum (4.95 g) for sowing time of December 01, 2017.

Our findings were supported by Maksoud *et al.* 1984 who observed that clove weight was increased with early planting of garlic as compared to late planting.

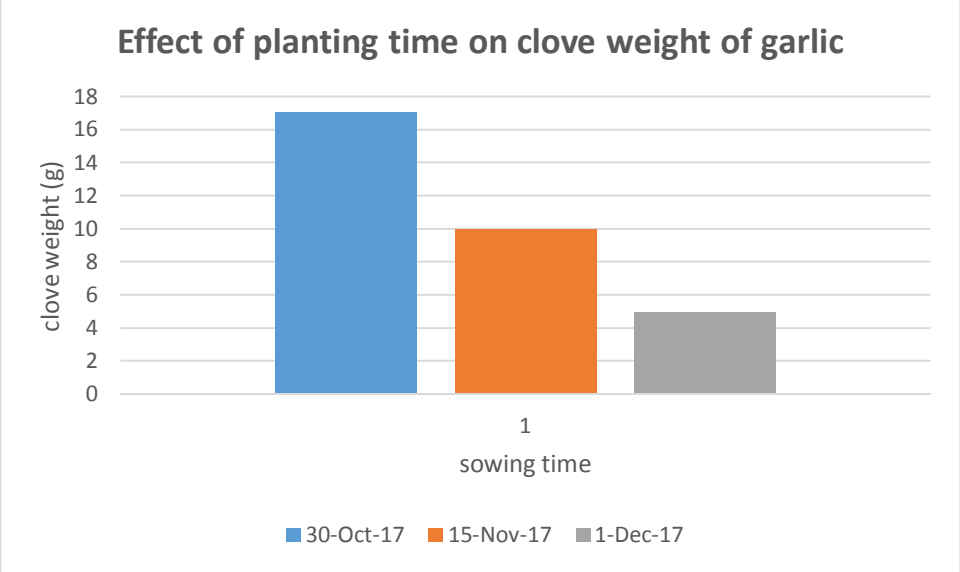

Figure 3.2.6: Effect of planting time on clove weight of garlic.

3.2.7: Clove maximum length (mm)

Cloves of maximum length were separated and their length was measured. Data pertaining clove maximum length were analyzed statistically using analysis of variance techniques that showed significant results for the treatments. Mean values of treatments were arranged in Table 3.2.1 for comparison. It is clear from results clove maximum length which was maximum (28.12 mm) when planting was done on October 30, 2017 followed by sowing time of November 15, 2017 where clove maximum length was 21.15 mm. Clove maximum length was lowest (20.23

mm) when garlic was sown on December 01, 2017. Our findings were supported by Singh and Phogat (1989) who reported that maximum garlic clove size was obtained by early planting as compared to late planting where cove size was minimum.

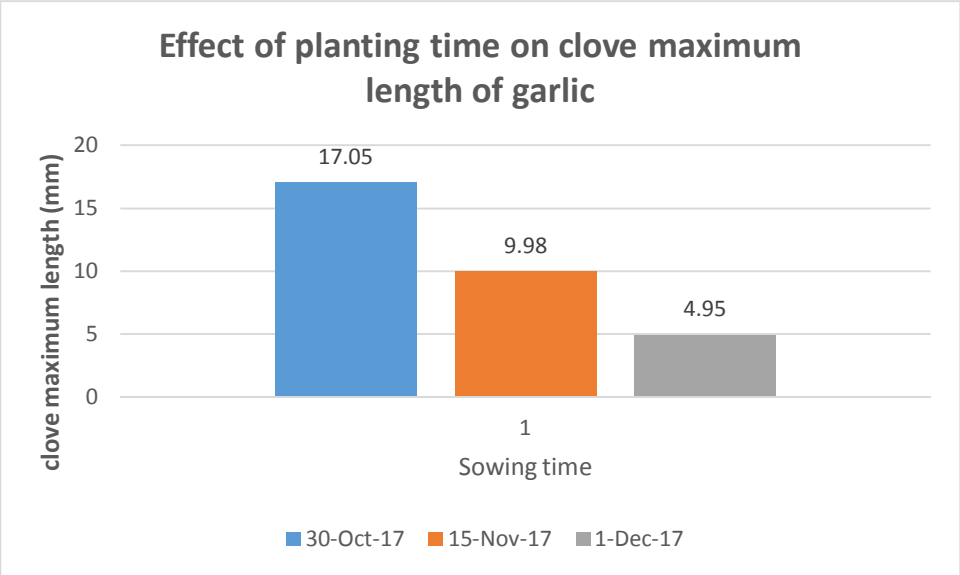

Figure 3.2.7: Effect of planting time on clove maximum length of garlic.

3.2.8: Clove minimum length (mm)

Cloves of minimum length were separated and their length was measured. Data pertaining clove minimum length were analyzed statistically using analysis of variance techniques that showed significant results for the treatments. Mean values of treatments were arranged in Table 3.2.2 for comparison. It is clear from results that clove minimum length which was highest (15.06 mm) when garlic was sown on October 30, 2017 followed by sowing on November 15, 2017 where clove minimum length was 12.37 mm. Clove minimum length was minimum (11.88 mm) for crop which was sown on December 01, 2017. Our findings were supported by Singh and Phogat (1989) who recorded minimum sized clove in late planting.

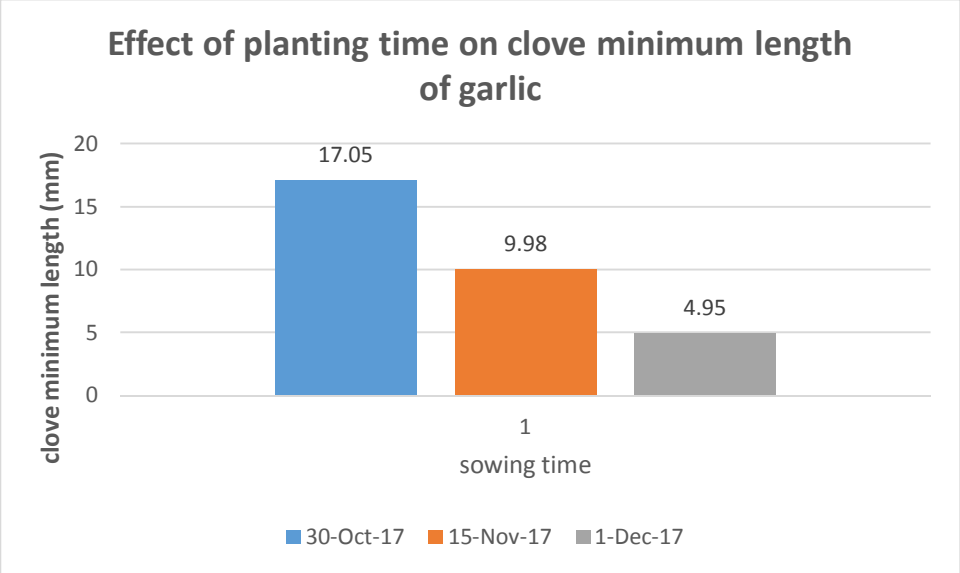

Figure 3.2.8: Effect of planting time on clove minimum length of garlic.

3.2.9: Clove volume (ml)

Data pertaining clove volume were analyzed statistically using analysis of variance techniques that showed significant results for the treatments. Mean values of treatments were arranged in Table 3.2.2 for comparison. It is clear from results that clove volume (14.83 ml) being maximum for the crop which was sown on October 30, 2017 followed by sowing on November 15, 2017 where clove volume was 7.75 ml. Clove volume was minimum (4.66 ml) for garlic sown on sown on December 01, 2017. Alam *et al.* (2010) reported that size of clove had effect on yield, different clove size (small, medium and large) was planted and maximum yield was obtained by larger cloves.

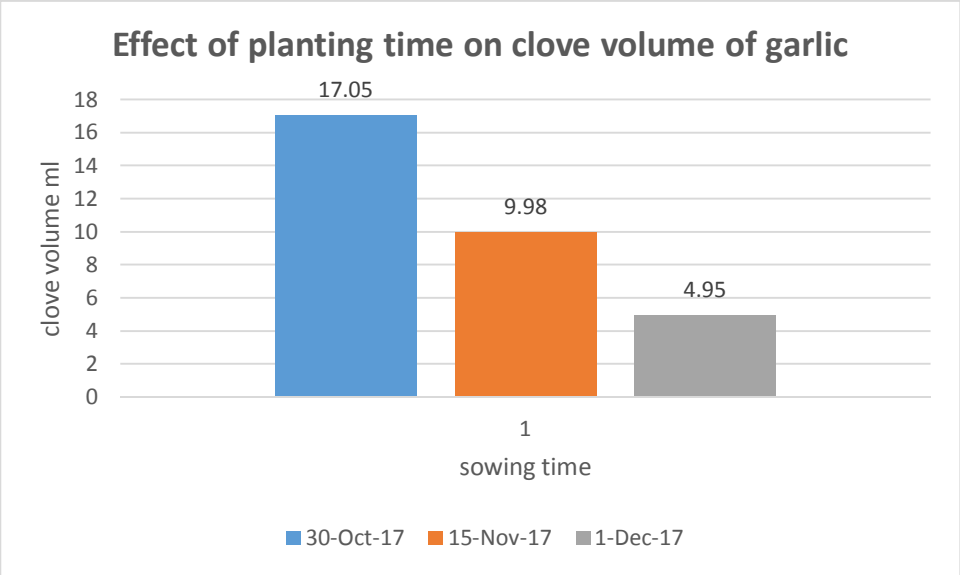

Figure 3.2.9: Effect of planting time on clove volume of garlic

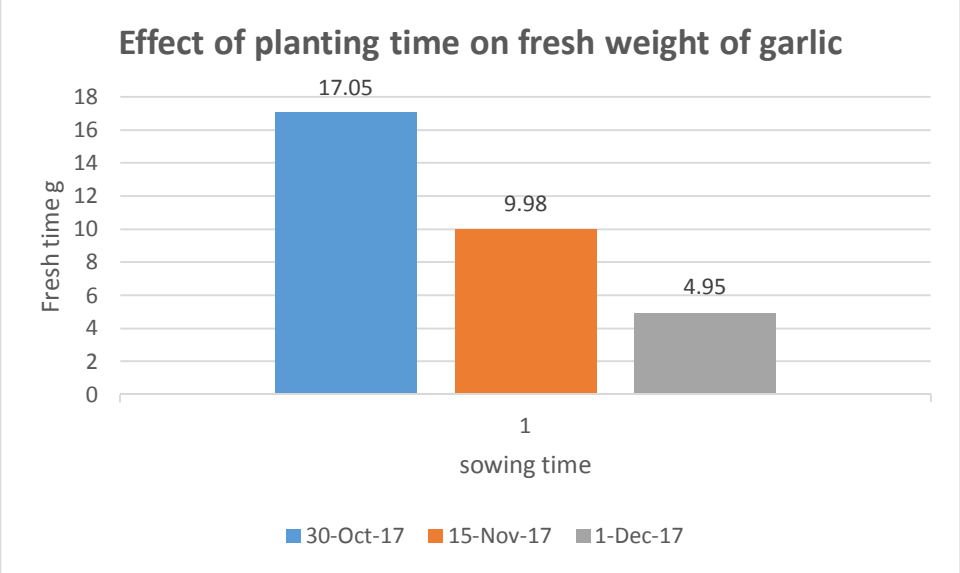

Figure 3.2.10: Effect of planting time on fresh weight of garlic.

3.2.10: Fresh weight (g)

Data pertaining fresh weight were analyzed statistically using analysis of variance techniques that showed significant results for the treatments. Mean values of treatments were arranged in Table 3.2.2 for comparison.

All treatments differed significantly for fresh weight which was maximum (2.96 g) when garlic was

sown on October 30, 2017, followed by sowing on November 15, 2017 where fresh weight was 1.93 g. Fresh weight was minimum (1.17 g) for the crop which was sown on December 01, 2017.

Our findings were supported by Rahim *et al.* (1984) who reported that maximum fresh weight of garlic cloves was obtained in early sowing as compared to late sowing where fresh weight of cloves was minimum.

3.2.11: Dry weight (g)

Statistical analysis of data regarding clove dry weight revealed significant difference due to different treatments (Table 4.2.2). Means were compared by LSD test which showed that dry weight which was maximum (1.04 g) for the crop which was sown on October 30, 2017, followed by sowing on November 15, 2017 where dry weight was 0.74 g. Dry weight was minimum (0.35 g) when garlic was planted on December 01, 2017.

Our findings were supported by Jones and Mann, (1963) who recorded that dry weight of garlic cloves was minimum as planting time was delayed and it was maximum in early planting time.

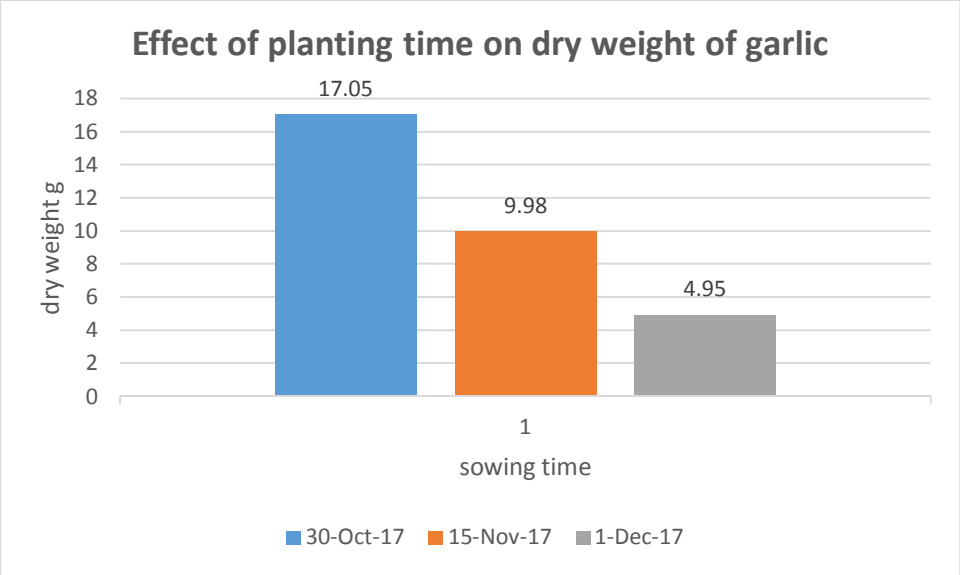

Figure 3.2.11: **Effect of planting time on dry weight of garlic.**

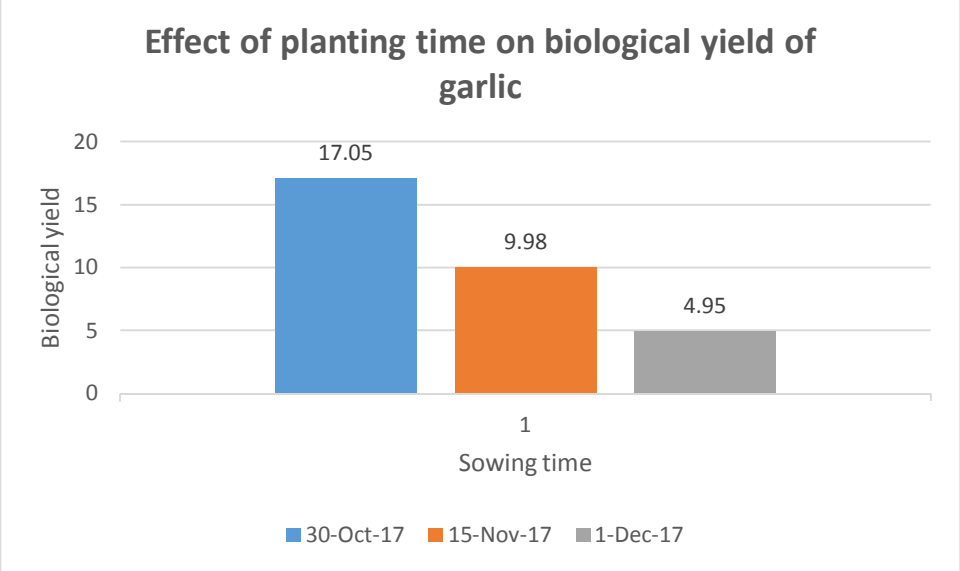

Figure 3.2.12: Effect of planting time on biological yield of garlic.

3.2.12: Biological Yield (g)

Data pertaining biological yield were analyzed statistically using analysis of variance techniques that showed significant results for the treatments. Mean values of treatments were arranged in Table 3.2.4 for comparison.

All treatments differed significantly for biological yield which was maximum (202.97 g/ft^2) when garlic was sown on October 30, 2017, followed by sowing on November 15, 2017 where biological yield was 144.80 g/ft^2. The biological yield was minimum (73.74 g/ft^2) for the crop which was sown on December 01, 2017. Our findings were supported by Oparanadi and Lal, (1987) who obtained maximum biological yield of garlic in early planting.

3.2.13: Phenolic content (mg/100g)

Data regarding total phenolic contents were subjected to statistical analysis that exhibited significant differences among treatments. Comparison of mean values of treatments (Table 3.2.2) showed significantly results for phenolic contents which were maximum (40.67 mg/100 g) by sowing on October 30, 2017, followed by sowing on November 15, 2017 where phenolic contents were 35.65 mg/100 g. Phenolic contents were minimum (32.07 mg/100 g) in sowing on December 01, 2017.

Chekki *et al*. (2014) reported 43.6 mg GAE/100 g total phenolic contents which support our results.

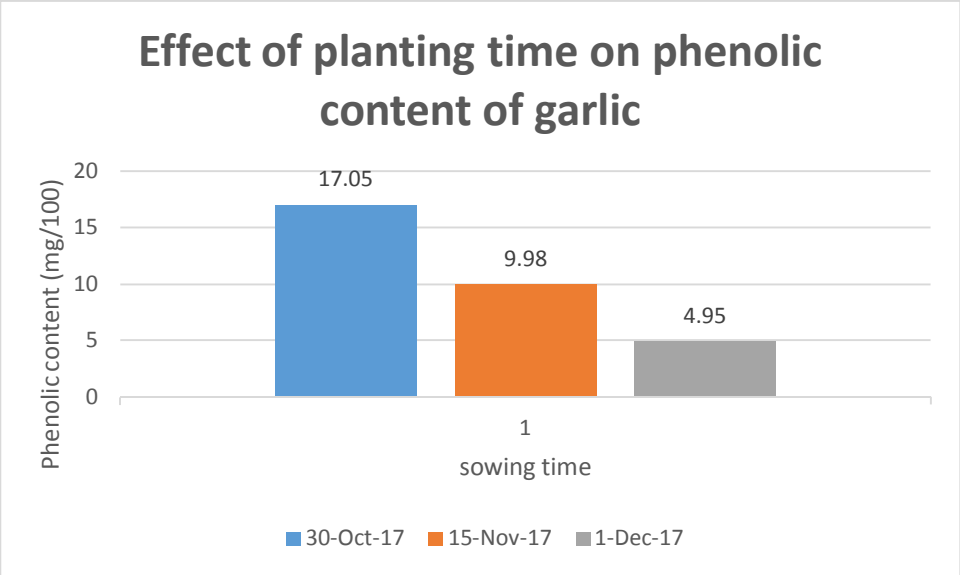

Figure 3.2.13: Effect of planting time on phenolic content of garlic.

4. Conclusion

It is concluded that the best sowing time to obtain maximum yield of garlic is 30-October because of suitable environmental conditions.

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