

Effect of Planting Date and some Pre-Planting Treatments on Growth and Yield of Garlic

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ABSTRACT

Two successful field trials were carried out during 2016/2017 and 2017/2018 seasons at Kaha Vegetable Research Farm, Kaliobia Governorate. This work aimed to study the effect of planting date (D1:1st September, D2: 15th September, D3:1st October, D4:15th October) and six pre-planting treatments on plant growth, yield and its components and chemical compounds of bulbs. The six pre planting treatments were T1: the control, T2: soaking garlic cloves (SGC) in water for 24 hour, T3: SGC in 5 ppm GA₃ for 24 hour, T4: SGC in water for 24 h and then placing in moist peat-moss for one day, T5: SGC in water for 24 h and then placing in moist peat-moss for two days and T6: SGC in water for 24 h and then placing in moist peat-moss until root initiation (after three days). The results showed that D2 produced markedly the highest values of plant length, number of leaves per plant, neck diameter, bulbing ratio as well as dry weight of leaves, bulb and plant. In addition, such planting date resulted in highest values of total yield at harvest time, bulb diameter, bulb weight and number of cloves per bulb in the yield sample after curing. The last planting date (D4) scored the highest values of total carbohydrates. While, D1 exhibited the highest level of nitrogen and crude protein in dry matter of garlic bulbs. T6 exhibited the highest germination percentage, plant length as well as dry weight of leaves, bulb and plant. Furthermore, such treatment (T6) produced the highest values of total yield, bulb diameter, bulb weight and total carbohydrates in bulb. Also, the highest level of nitrogen and crude protein were more achieved via T5.

Keywords: Garlic, planting dates, soaking cloves, water, GA₃, peat-moss, total yield, bulb quality.

INTRODUCTION

Garlic (*Allium sativum*, L.) is one of the most important vegetable bulb crops and the next to onion in importance in Egypt. Balady and Sids 40 are the main garlic cultivars grown in Egypt. Garlic planting date has a great effect on vegetative growth, yield and its components. Early planting enhances germination and produce adequate vegetative growth resulted in high yield with good quality (Maksoud *et al.*, 1983; El-Shabasi, 1988; Rahman *et al.*, 2004; El-Zohiri and Farag, 2014; Youssef and Tony, 2014; Hassan *et al.*, 2016).

Plant growth regulators enhance sprouting of garlic (Moon and lee, 1980; Rahim and Fordhan, 1988). Soaking of seed bulbs (cloves) in GA₃ solution stimulate sprouting and bulbing and its development (Moon and Lee, 1980). Rahman *et al.* (2006) noted that application of GA₃ has the capability to break dormancy and accelerates garlic sprouting. Ahmed and Hemada (2012) indicated that soaking garlic cloves in water or GA₃ at 5 ppm for 24 hours improved vegetative growth, bulb fresh weight, total fresh yield and cured yield. Samy *et al.* (2014) on potato concluded that dipping the tubers in GA₃ caused increasing vegetative growth characters and total tuber yield.

Ibrahim (2010) compared between different media (clay, sand, vermiculate, compost and peat moss) for sunflower sprout production for fresh human consumption after soaking in water. In this respect, Wet peat moss layers are used by Abd El-Latif *et al.* (2015) for accelerating germination of globe artichoke stumps in vernalization process.

The objective of this investigation was to elucidate the effect of planting date and some pre-planting treatments in order to enhance the growth and yield of garlic plant.

MATERIALS AND METHODS

The current trial was carried out during 2016/2017 and 2017/2018 seasons at Kaha Vegetable Research Farm, Kaliobia Governorate. The soil was clay loam in texture with pH 7.49, EC 1.94 (ds/m). The study aimed to find out the effect of planting date and some pre-planting treatments on garlic plants.

Sids-40 cultivar was used in this experiment. A split plot design with three replicates was adopted. The planting dates (1st September, 15th September, 1st October and 15th

October) represented the main plots. The sub-plots were six pre-planting treatments *i.e.*, the soaking garlic cloves (SGC) in water for 24 hour, SGC in 5 ppm GA₃ for 24 hour, SGC in water for 24 h and then placing in moist peat-moss for one day, SGC in water for 24 h and then placing in moist peat-moss for two days, SGC in water for 24 h and then placing in moist peat-moss until appearance of roots (after three days) and the control treatment (cloves direct planted in the soil). The experimental sub-plot area was 10.50 m² which contained 3 rows, with 5 m length and 0.70 m width. Garlic cloves were planted on both sides of the rows at 10 cm apart. All agriculture practices for cultivation were performed as recommended by Ministry of Agriculture.

Data recorded:

Random samples of three plants from each experimental sub-plot were uprooted after 150 days from planting to determine plant length (cm.), number of leaves per-plant, neck and bulb diameter (cm.), bulbing ratio, and dry weight of leaves, bulb and plant (gm.). Germination percentage was determined after 45 days from planting, the germinated cloves were counted and germination percentage was estimated using the following formula: Germination% = Number of germinated cloves per plot / Total number of planted cloves per plot X 100. Total yield was determined for each experimental sub-plot at harvest. The plants were placed for 15 days in an aerated area for curing. After curing five bulbs were randomly taken from each experimental sub-plot to determine the averages of bulb diameter (cm.), bulb weight (gm.), cloves number per bulb and clove weight (gm.). Total carbohydrates were determined colorimetrically in dry matter of the bulbs according to James (1995). Total nitrogen and phosphorus were determined in dry matter of bulbs according to A.O.A.C. (1990), and crude protein was calculated as nitrogen content x 6.25.

Statistical analysis:

The data were statistically analyzed using the procedure outlined by Snedecor and Cochran (1980). Also, data were tested for least significant differences (L.S.D.) to compare the averages of the determined parameters.

RESULTS AND DISCUSSION

1-Vegetative growth measurements

It is obvious from Tables 1 that there were significant differences between planting dates in germination

percentage, plant length, number of leaves / plants, nick and bulb diameter, bulbing ratio and dry weight of leaves, bulb and plant. Whereas, the highest germination percentage was obtained from D3. In this respect, D2 exhibited the highest values of plant length, number of leaves/ plants, nick diameter, bulbing ratio and dry weight of leaves and plant in the both seasons of trial. However, D1 resulted in the lowest germination percentage (in the two seasons), plant length, dry weight of leaves and plant (in the first season). Also, D4 gave the lowest values of number of leaves (in the two seasons), nick diameter, bulbing ratio, dry weight of bulb (in the first season), and dry weight of plant (in the second season). D3 gave the lowest values of plant length, nick diameter, dry weight of leaves in the second season. The obtained results could be due to that earliest plantation encourage meristematic elongation and cell division which encourage the vegetative growth of the plants that received low temperature and short-day length. These results are in

agreement with those obtained by Maksoud *et al.* (1983), El-Shabasi (1988), Rahman *et al.* (2004), El-Zohiri and Farag (2014), Youssef and Tony (2014) and Hassan *et al.* (2016).

With respect to the effect of pre-planting treatments in Table 2 results indicate that germination percentage, plant length, number of leaves/ plants, nick and bulb diameter and dry weight of leaves, bulb and plant were significantly affected as a result of treatments comparing with the control. In this respect, T6 exhibited the highest values of germination percentage, plant length, dry weight of leaves, bulb and plant, also, nick and bulb diameter (in the second season only). Moreover, T5 exhibited the highest values of number of leaves in the two seasons. However, the lowest values of germination percentage, plant length, number of leaves/ plants, nick and bulb diameter, as well as dry weight of leaves, bulb and plant was noticed by the control. Similar results were reported by Rahman *et al.* (2006), Ahmed and Hemada (2012) as well as, Samy *et al.* (2014) on potato.

Table 1. Effect of planting date on germination%, plant length, leaf number, neck and bulb diameter, bulbing ratio and dry weigh of garlic plant in 2016/2017 and 2017/2018 seasons.

Treatments	Germination %	Plant length (cm.)	Leaf number /plant	Neck diameter (cm.)	Bulb diameter (cm.)	Bulbing ratio	Leaves D.W (gm.)	Bulb D.W (gm.)	Plant D.W (gm.)
2016/2017 season									
D1	81.89	68.61	11.26	1.41	4.58	0.32	10.78	12.23	23.01
D2	92.78	76.92	11.89	1.76	4.42	0.40	15.16	15.18	30.33
D3	95.25	71.39	10.28	1.65	4.78	0.34	14.15	12.82	26.97
D4	95.00	68.61	9.56	1.33	4.42	0.30	11.66	11.92	23.58
L.S.D. 5%	2.03	1.27	0.73	0.13	N.S.	0.05	0.97	0.63	1.36
2017/2018 season									
D1	76.96	70.42	11.25	1.54	5.36	0.29	12.11	14.96	27.07
D2	79.93	72.89	12.11	1.56	5.27	0.30	12.39	15.98	28.36
D3	95.82	61.72	10.75	1.25	5.41	0.23	10.57	15.97	26.54
D4	90.74	65.50	10.44	1.28	5.53	0.23	11.16	15.36	26.52
L.S.D. 5%	1.98	2.92	0.57	0.06	N.S.	0.02	0.74	N.S.	1.25

D1:1st Sep., D2: 15th Sep., D3: 1st Oct., D4: 15th Oct.

Table 2. Effect of some pre-planting treatments on germination%, plant length, leaf number, neck and bulb diameter, bulbing ratio and dry weigh of garlic plant in 2016/2017 and 2017/2018 seasons.

Treatments	Germination %	Plant length (cm.)	Leaf number /plant	Neck diameter (cm.)	Bulb diameter (cm.)	Bulbing ratio	Leaves D.W (gm.)	Bulb D.W (gm.)	Plant D.W (gm.)
2016/2017 season									
T1	84.93	65.17	9.63	1.34	3.93	0.34	11.36	10.09	21.45
T2	91.79	70.83	10.67	1.53	4.36	0.36	13.50	12.15	25.64
T3	91.07	70.38	10.39	1.53	4.62	0.33	12.32	12.41	24.72
T4	90.99	74.25	11.58	1.64	4.94	0.33	13.62	13.46	27.09
T5	94.11	72.00	11.58	1.61	4.85	0.33	12.83	14.99	27.82
T6	94.49	75.67	10.63	1.58	4.61	0.34	14.01	15.12	29.12
L.S.D. 5%	1.53	1.62	0.80	0.15	0.31	N.S.	1.05	0.47	1.10
2017/2018 season									
T1	76.11	62.96	10.79	1.25	4.77	0.26	9.96	12.50	22.46
T2	85.75	65.67	11.33	1.40	5.43	0.26	11.63	14.74	26.37
T3	89.25	67.17	10.88	1.35	5.35	0.26	10.49	15.82	26.30
T4	87.00	67.29	11.13	1.40	5.54	0.25	11.78	16.38	28.16
T5	87.33	70.96	11.42	1.49	5.48	0.27	12.55	16.49	29.04
T6	89.72	71.75	11.29	1.58	5.78	0.27	12.92	17.48	30.41
L.S.D. 5%	1.77	2.07	0.39	0.14	0.28	N.S.	0.81	0.71	0.99

T1: the control, T2: soaking garlic cloves (SGC) in water for 24 hours, T3: SGC in 5 ppm GA₃ for 24 h, T4: SGC in water for 24 h and then placing in moist peat-moss for one day, T5: SGC in water for 24 h and then placing in moist peat-moss for two days and T6: SGC in water for 24 h and then placing in moist peat-moss until root initiation.

Data in Table 3 present the interaction between planting dates and pre-planting treatments showed significant effects on germination percentage, plant length, number of leaves per plant, neck diameter, bulbing ratio and dry weight of leaves, bulb and plant except number of leaves in the first season, nick diameter and bulbing ratio in the second season. However, bulb diameter in the two seasons recorded insignificant effect. D2 with T6 gave the highest dry weight of leaves, bulb and plant. Also, D2 with T4 and D2 with T2 recorded the highest values of plant length in the first and second seasons, respectively. Furthermore, D4 with T6 and D3 with T3 recorded the

highest values of germination percentage, in the first and second seasons, respectively. Conversely, D1 with T1 recorded the lowest germination percentage in the first season. Moreover, D2 with T5 resulted the highest values of number of leaves in the second season. While D1 with T1 (control) and D4 with T1 recorded the lowest values of dry weight of leaves, bulb and plant in the first and second seasons, respectively.

2- Yield and its components

Data in Tables 4 show significant differences between the planting dates in total yield, bulb diameter, bulb weight, cloves number/bulb and clove weight. In this

respect, the highest yield was resulted from D2 followed by D3 in the two seasons. While the lowest values of yield obtained from D1 in both seasons. The second planting date (D2) gave significant increases of total yield over the first planting date (D1) by 53.3% and 48.4% in the first and second seasons, respectively. In the same respect, D2 followed by D3 gave the highest values of bulb diameter, bulb weight, cloves number/ bulb in the first and second seasons. However, D1 result the highest values of clove weight in the two seasons. On the contrary, D4 gave the lowest significant values of bulb diameter as well as bulb

and clove weight in first season only. Also, D1 gave the lowest values of cloves number/ bulb in the two seasons and bulb weight (in second seasons). D2 gave the lowest values of clove weight (in second season only). These results may be due to that earlier planting, *i.e.*, Sep. 15th permitted adequate growth development of plant and thereby resulted in high yield with a better quality. The results of total yield is in agreement with those of Maksoud *et al.* (1983), El-Zohiri and Farag (2014), Youssef and Tony (2014) and Hassan *et al.* (2016). Additionally, Rahman *et al.* (2004) found that the yield decreased gradually with the late planting.

Table 3. Effect of interaction between planting dates and some pre-planting treatments on germination%, plant length, leaf number, neck and bulb diameter, bulbing ratio and dry weigh of garlic plant in 2016/2017 and 2017/2018 seasons.

Treatments	Germination %	Plant length (cm.)	Leaf number / plant	Neck diameter (cm.)	Bulb diameter (cm.)	Bulbing ratio	Leaves D.W (gm.)	Bulb D.W (gm.)	Plant D.W (gm.)
2016/2017 season									
D1	T1	74.17	67.67	11.00	1.63	3.93	0.43	9.44	19.11
	T2	87.50	67.33	10.67	1.40	4.50	0.31	11.40	22.67
	T3	76.67	63.33	10.23	1.27	4.30	0.31	9.66	22.13
	T4	78.33	70.67	12.67	1.37	5.03	0.27	10.76	24.48
	T5	87.50	69.00	12.67	1.37	5.03	0.27	11.44	25.49
	T6	87.17	73.67	10.33	1.43	4.70	0.30	11.99	24.17
D2	T1	88.89	69.67	10.67	1.65	3.94	0.42	13.11	22.94
	T2	90.00	81.00	12.33	1.75	3.91	0.46	14.45	30.05
	T3	94.45	71.20	11.00	1.54	4.30	0.36	14.09	26.42
	T4	94.45	86.00	12.67	2.00	4.80	0.42	16.09	32.27
	T5	94.45	75.67	13.00	1.84	4.79	0.38	16.14	33.61
	T6	94.44	78.00	11.67	1.77	4.77	0.37	17.06	36.69
D3	T1	90.00	62.67	8.83	1.16	3.95	0.29	12.39	22.87
	T2	94.67	72.00	11.00	1.71	4.72	0.36	16.93	28.06
	T3	95.83	74.33	10.00	2.03	5.46	0.37	14.28	27.03
	T4	95.83	72.67	10.67	1.69	5.07	0.33	14.24	25.80
	T5	97.50	70.67	11.00	1.69	4.89	0.35	12.84	27.44
	T6	97.67	76.00	10.17	1.59	4.59	0.35	14.25	30.62
D4	T1	86.67	60.67	8.00	0.90	3.90	0.23	10.50	20.87
	T2	95.00	63.00	8.67	1.27	4.30	0.30	11.20	21.79
	T3	97.33	72.67	10.33	1.27	4.43	0.29	11.23	23.30
	T4	95.33	67.67	10.33	1.50	4.83	0.31	13.40	25.79
	T5	97.00	72.67	9.67	1.53	4.70	0.32	10.92	24.74
	T6	98.67	75.00	10.33	1.53	4.37	0.36	12.72	25.01
L.S.D. 5%	3.44	3.22	N.S.	0.31	N.S.	0.08	2.14	1.07	2.42
2017/2018 season									
D1	T1	70.56	66.83	11.17	1.63	5.17	0.32	10.18	23.39
	T2	72.56	70.50	12.17	1.57	5.50	0.28	12.42	27.71
	T3	78.89	69.67	11.00	1.37	5.27	0.26	11.62	27.41
	T4	76.44	69.83	10.17	1.50	5.40	0.28	11.91	26.83
	T5	80.00	72.17	11.67	1.57	5.43	0.29	14.38	30.78
	T6	83.33	73.50	11.33	1.63	5.37	0.30	12.12	26.29
D2	T1	68.33	70.67	11.33	1.20	4.35	0.28	9.99	21.65
	T2	77.22	75.67	11.67	1.63	5.50	0.30	13.11	27.71
	T3	87.44	72.00	11.33	1.57	5.17	0.30	10.31	25.40
	T4	77.22	71.00	13.00	1.60	5.52	0.29	12.32	31.05
	T5	83.22	73.67	13.33	1.65	5.37	0.31	12.85	29.72
	T6	86.11	74.33	12.00	1.73	5.72	0.30	15.74	34.67
D3	T1	88.33	54.67	10.33	1.03	4.78	0.22	10.19	23.88
	T2	97.67	54.00	10.83	1.07	5.18	0.21	10.47	25.16
	T3	98.44	63.67	11.00	1.23	5.28	0.23	9.85	25.67
	T4	97.67	64.17	11.00	1.33	5.63	0.24	11.91	27.92
	T5	95.56	66.50	10.50	1.40	5.47	0.25	10.16	26.60
	T6	97.22	67.33	10.83	1.43	6.12	0.23	10.83	30.00
D4	T1	77.22	59.67	10.33	1.13	4.77	0.24	9.50	20.92
	T2	95.56	62.50	10.67	1.32	5.55	0.24	10.53	24.92
	T3	92.22	63.33	10.17	1.23	5.67	0.22	10.17	26.74
	T4	96.67	64.17	10.33	1.17	5.62	0.21	11.00	26.85
	T5	90.56	71.50	10.17	1.33	5.63	0.24	12.79	29.04
	T6	92.22	71.83	11.00	1.50	5.92	0.25	13.00	30.67
L.S.D. 5%	3.78	4.75	0.92	N.S.	N.S.	N.S.	1.65	1.55	2.19

D1: 1st Sep., D2: 15th Sep., D3: 1st Oct., D4: 15th Oct., T1: the control, T2: soaking garlic cloves (SGC) in water for 24 hours, T3: SGC in 5 ppm GA₃ for 24 h, T4: SGC in water for 24 h and then placing in moist peat-moss for one day, T5: SGC in water for 24 h and then placing in moist peat-moss for two days and T6: SGC in water for 24 h and then placing in moist peat-moss until root initiation.

With respect to the effect of pre-planting treatments in Table 5, results indicate that, total yield, bulb diameter, bulb weight and cloves number/ bulb were significantly affected as

a result of treatments comparing with the control. The highest values of total yield, bulb diameter and bulb weight in the both seasons were obtained from T6. Also, T5 and T3 scored the

highest cloves number/ bulb in the first and second seasons, respectively. On the contrary, the lowest values of total yield, bulb diameter, bulb weight, cloves number/ bulb (in the first season only) and clove weight (in the second season only) were obtained from T1 (control). Soaking garlic cloves in water for 24 h. and then placing in moist peat-moss until root initiation (T6) gave significant increases of total yield over the control by 18% and 32.1% in the first and second seasons, respectively. The increases occurred on yield and its components might be attributed to the increase in vegetative growth parameters. These results agree with Ahmed and Hemada (2012) on garlic and Samy et al. (2014) on potato.

Table 4. Effect of planting date on total yield and its components of garlic plant in 2016/2017 and 2017/2018 seasons.

Treatments	Total yield at harvest (ton/fed.)	Bulb diameter (cm.)	Bulb weight (gm.)	No. of cloves/ bulb	Clove weight (gm.)
2016/2017 season					
D1	5.041	5.40	43.96	11.00	4.04
D2	7.725	5.52	56.88	15.44	3.76
D3	6.811	5.45	52.15	15.14	3.50
D4	5.317	4.63	41.04	14.06	2.97
L.S.D. 5%	0.363	0.27	2.18	0.88	0.41
2017/2018 season					
D1	5.042	5.46	49.74	10.91	4.63
D2	7.481	5.77	59.49	17.61	3.39
D3	7.137	5.52	56.27	15.52	3.64
D4	6.730	5.41	53.72	14.83	3.77
L.S.D. 5%	0.350	0.18	3.37	0.98	0.35

D1:1st Sep., D2: 15th Sep., D3: 1st Oct., D4: 15th Oct.

Table 5. Effect of some pre-planting treatments on total yield and its components of garlic plant in 2016/2017 and 2017/2018 seasons.

Treatments	Total yield at harvest (ton/fed.)	Bulb diameter (cm)	Bulb weight (gm.)	No. of cloves/ bulb	Clove weight (gm.)
2016/2017 season					
T1	5.721	4.96	42.46	12.33	3.50
T2	6.069	5.13	47.26	12.79	3.84
T3	6.422	5.23	51.33	14.42	3.63
T4	6.103	5.37	48.63	14.17	3.46
T5	6.275	5.34	49.43	14.92	3.46
T6	6.750	5.47	51.93	14.83	3.52
L.S.D. 5%	0.444	0.23	2.20	1.20	N.S.
2017/2018 season					
T1	6.061	5.05	43.45	14.86	2.98
T2	6.699	5.51	51.21	14.61	3.65
T3	6.252	5.57	56.32	16.07	3.55
T4	6.479	5.62	58.08	14.80	4.03
T5	6.084	5.61	56.78	14.64	3.94
T6	8.012	5.88	62.99	13.32	4.99
L.S.D. 5%	0.367	0.17	2.59	0.93	0.38

T1: the control, T2: soaking garlic cloves (SGC) in water for 24 hours, T3: SGC in 5 ppm GA₃ for 24 h, T4: SGC in water for 24 h and then placing in moist peat-moss for one day, T5: SGC in water for 24 h and then placing in moist peat-moss for two days and T6: SGC in water for 24 h and then placing in moist peat-moss until root initiation.

Table (6) present the effect of the interaction between planting dates and pre-planting treatments showed significant effects on total yield, bulb diameter, bulb weight, cloves number per bulb and clove weight. Results indicate that, D2 with T3 and D2 with T4 gave the heights values of total yield in the first and second seasons, respectively. Also, D2 with T6 gave the heights values of bulb diameter and bulb weight (in the second season) and D2 with T3 gave the heights bulb weight (in the first season). D2 with T5 and D2 with T3 gave the heights cloves number/ bulb in the first and second seasons, respectively. Conversely, the lowest values of total yield were obtained from D1 with T4 and D1 with T3 in the first and second seasons, respectively. Also, the

lower values of bulb diameter were obtained from D4 with T2 and from T1 with all four planting dates in the first and second seasons, respectively. However, the lowest values of bulb weight were obtained from D4 with T1 or T2 and from T1 with any of the first three planting date in the first and second seasons, respectively. Furthermore, the lower values of cloves number per bulb were obtained from D1 with all six pre-planting treatments in both seasons. The lowest values of clove weight were obtained from D4 with T2 and D2 with T1 in the first and the second seasons, respectively.

Table 6. Effect of interaction between planting dates and some pre-planting treatments on total yield and its components of garlic plant in 2016/2017 and 2017/2018 seasons.

Treatments	Total yield at harvest (ton/fed.)	Bulb diameter (cm.)	Bulb weight (gm.)	No. of cloves/ bulb	Clove weight (gm.)	
2016/2017 season						
D1	T1	4.965	5.22	43.82	10.33	4.25
	T2	4.568	5.18	46.63	10.33	4.55
	T3	4.271	5.28	48.00	11.33	4.26
	T4	4.200	5.30	39.88	11.67	3.43
	T5	4.640	5.43	42.19	10.33	4.16
	T6	7.600	6.00	43.24	12.00	3.62
D2	T1	6.598	5.02	43.50	14.33	3.06
	T2	7.832	5.53	56.00	11.33	4.96
	T3	8.559	5.72	65.92	17.33	3.80
	T4	8.064	5.70	62.17	15.67	3.97
	T5	7.296	5.78	51.33	18.33	2.80
	T6	8.000	5.37	62.33	15.67	3.98
D3	T1	5.072	5.00	47.50	13.83	3.46
	T2	5.909	5.60	51.00	15.33	3.33
	T3	7.967	5.40	50.33	13.00	3.90
	T4	7.724	5.73	48.92	16.50	3.01
	T5	7.720	5.53	55.67	14.50	3.91
	T6	6.473	5.43	59.48	17.67	3.38
D4	T1	6.250	4.60	35.00	10.83	3.23
	T2	5.965	4.20	35.41	14.17	2.52
	T3	4.891	4.53	41.08	16.00	2.57
	T4	4.424	4.75	43.57	12.83	3.41
	T5	5.445	4.60	48.53	16.50	2.97
	T6	4.925	5.08	42.67	14.00	3.09
L.S.D. 5%	0.86	0.50	4.56	2.35	0.70	
2017/2018 season						
D1	T1	5.879	5.03	38.70	11.33	3.44
	T2	4.415	5.43	48.14	9.89	4.90
	T3	3.698	5.45	49.12	12.00	4.10
	T4	4.434	5.63	52.37	11.22	4.69
	T5	4.517	5.59	52.02	11.41	4.59
	T6	7.307	5.62	58.08	9.63	6.03
D2	T1	6.807	4.89	43.60	17.41	2.51
	T2	7.763	5.93	59.12	18.04	3.29
	T3	6.692	5.70	63.02	18.15	3.47
	T4	8.709	5.86	63.76	17.30	3.69
	T5	6.532	5.87	60.84	16.59	3.67
	T6	8.384	6.39	66.57	18.15	3.67
D3	T1	6.320	5.24	43.63	15.07	2.90
	T2	7.265	5.13	44.88	14.22	3.17
	T3	6.715	5.57	58.02	16.89	3.44
	T4	6.957	5.57	63.78	17.19	3.74
	T5	7.314	5.67	61.64	15.44	4.01
	T6	8.253	5.91	65.64	14.30	4.60
D4	T1	5.236	5.03	47.85	15.63	3.06
	T2	7.352	5.56	52.71	16.29	3.24
	T3	7.902	5.58	55.11	17.26	3.19
	T4	5.815	5.41	52.39	13.48	3.99
	T5	5.973	5.30	52.60	15.11	3.50
	T6	8.103	5.61	61.68	11.22	5.63
L.S.D. 5%	0.755	0.35	5.78	1.96	0.78	

D1:1st Sep., D2: 15th Sep., D3: 1st Oct., D4: 15th Oct., T1: the control, T2: soaking garlic cloves (SGC) in water for 24 hours, T3: SGC in 5 ppm GA₃ for 24 h, T4: SGC in water for 24 h and then placing in moist peat-moss for one day, T5: SGC in water for 24 h and then placing in moist peat-moss for two days and T6: SGC in water for 24 h and then placing in moist peat-moss until root initiation.

3- Chemical content of garlic bulbs

Data in Table 7 showed significant differences between planting dates in total carbohydrates, nitrogen and protein in dry matter of the bulbs, while planting dates had no significant effect on phosphorus percentage. D4 scored the highest values of total carbohydrates in both seasons. However, the lowest values of total carbohydrates were noticed by D2 in both seasons. The first planting date (D1) gave highest level of nitrogen and crude protein in dry matter of garlic bulbs in both seasons of the trial.

Table 7. Effect of planting date on chemical content of garlic bulbs in 2016/2017 and 2017/2018 seasons.

Treatments	Carbohydrates (gm./100 gm. d.w.)	N (%)	P (%)	Crude protein (%)
2016/2017 season				
D1	24.86	2.32	0.070	14.49
D2	19.49	2.23	0.070	13.91
D3	25.92	2.16	0.070	13.52
D4	33.15	2.09	0.070	13.09
L.S.D. 5%	1.55	0.06	N.S.	0.37
2017/2018 season				
D1	24.47	2.35	0.070	14.70
D2	20.62	2.16	0.070	13.52
D3	25.56	2.13	0.070	13.29
D4	32.08	2.11	0.070	13.22
L.S.D. 5%	0.88	0.06	N.S.	0.39

DI: 1st Sep., D2: 15th Sep., D3: 1st Oct., D4: 15th Oct.

Regarding the effect of pre-planting treatments in Table 8, results indicate that, it was found all treatments especially T6 increased total carbohydrates in bulb, as well as, T5 increased nitrogen and crude protein in bulb. However, the lowest values of total carbohydrates were resulted from T1. Also, the lowest level of nitrogen and crude protein were resulted from T1 in the first season and from T6 in second season. On the other hand, phosphorus content was not significantly affected by pre-planting treatments. In this respect, El-Shabasi *et al.* (2007) stated that GA₃ increased total carbohydrates percentage in foliage of strawberry plants while GA₃ did not affect nitrogen and phosphorus and potassium content.

Table 8. Effect of some pre-planting treatments on chemical content of garlic bulbs in 2016/2017 and 2017/2018 seasons.

Treatments	Carbohydrates (gm./100 gm. d.w.)	N (%)	P (%)	Crude protein (%)
2016/2017 season				
T1	21.65	2.05	0.070	12.80
T2	26.40	2.11	0.070	13.19
T3	21.95	2.28	0.070	14.23
T4	24.39	2.27	0.070	14.17
T5	28.98	2.29	0.070	14.33
T6	31.76	2.21	0.070	13.80
L.S.D. 5%	1.52	0.06	N.S.	0.34
2017/2018 season				
T1	22.80	2.14	0.070	13.38
T2	27.54	2.19	0.070	13.68
T3	24.26	2.20	0.070	13.74
T4	25.82	2.26	0.070	14.14
T5	25.36	2.28	0.070	14.25
T6	28.31	2.07	0.070	12.90
L.S.D. 5%	1.29	0.05	N.S.	0.30

T1: the control, T2: soaking garlic cloves (SGC) in water for 24 hours, T3: SGC in 5 ppm GA₃ for 24 h, T4: SGC in water for 24 h and then placing in moist peat-moss for one day, T5: SGC in water for 24 h and then placing in moist peat-moss for two days and T6: SGC in water for 24 h and then placing in moist peat-moss until root initiation.

The interaction between planting dates and pre-planting treatments in Table (9) showed the highest values of total carbohydrates in bulb were resulted from D3 with

T6 and D4 with T6 in the first and second seasons, respectively. The higher level of nitrogen % and crude protein in bulb were resulted from D1 with T4 and D1 with T5 in the first and second seasons, respectively. Contrary, the lower values of total carbohydrates in bulb were resulted from D1 with T1 and D3 with T1 in the first and second seasons, respectively. Also, the lower level of nitrogen % and crude protein were resulted from D4 with T4 and D3 with T6 in the first and second seasons, respectively. On the other hand, phosphorus percentage was not significantly affected by the interaction.

Table 9. Effect of interaction between planting dates and some pre-planting treatments on chemical content of garlic bulbs in 2016/2017 and 2017/2018 seasons.

Treatments	Carbohydrates (gm./100 gm. d.w.)	N (%)	P (%)	Crude protein (%)	
2016/2017 season					
D1	T1	16.81	2.15	0.070	13.44
	T2	28.62	2.02	0.070	12.64
	T3	19.63	2.43	0.070	15.21
	T4	20.55	2.50	0.070	15.60
	T5	31.64	2.41	0.070	15.03
	T6	31.91	2.41	0.070	15.03
D2	T1	18.38	1.92	0.069	11.97
	T2	19.49	2.22	0.069	13.89
	T3	18.65	2.35	0.069	14.69
	T4	20.09	2.44	0.070	15.23
	T5	19.43	2.35	0.070	14.69
	T6	20.88	2.08	0.070	13.00
D3	T1	18.58	2.11	0.070	13.20
	T2	22.98	2.15	0.070	13.42
	T3	19.57	2.16	0.069	13.52
	T4	24.82	2.26	0.070	14.13
	T5	32.04	2.07	0.069	12.92
	T6	37.55	2.23	0.069	13.91
D4	T1	32.82	2.02	0.070	12.60
	T2	34.53	2.05	0.070	12.80
	T3	29.94	2.16	0.070	13.48
	T4	32.10	1.87	0.070	11.71
	T5	32.82	2.35	0.070	14.69
	T6	36.70	2.12	0.070	13.26
L.S.D. 5%	3.17	0.12	N.S.	0.72	
2017/2018 season					
D1	T1	20.29	2.23	0.070	13.95
	T2	27.11	2.41	0.070	15.07
	T3	21.14	2.22	0.070	13.85
	T4	22.45	2.38	0.070	14.87
	T5	25.60	2.52	0.070	15.74
	T6	30.20	2.35	0.070	14.71
D2	T1	20.75	2.29	0.069	14.31
	T2	20.62	2.10	0.070	13.14
	T3	19.63	2.14	0.070	13.36
	T4	26.13	2.15	0.070	13.42
	T5	17.93	2.22	0.069	13.85
	T6	18.65	2.09	0.070	13.06
D3	T1	17.47	1.93	0.070	12.08
	T2	29.28	2.05	0.070	12.84
	T3	28.03	2.25	0.070	14.07
	T4	21.67	2.51	0.069	15.70
	T5	27.11	2.21	0.070	13.81
	T6	29.80	1.80	0.070	11.23
D4	T1	32.69	2.11	0.070	13.20
	T2	33.15	2.19	0.070	13.66
	T3	28.23	2.19	0.070	13.66
	T4	33.02	2.01	0.069	12.56
	T5	30.79	2.18	0.070	13.60
	T6	34.60	2.02	0.070	12.60
L.S.D. 5%	2.51	0.11	N.S.	0.67	

DI: 1st Sep., D2: 15th Sep., D3: 1st Oct., D4: 15th Oct., T1: the control, T2: soaking garlic cloves (SGC) in water for 24 hours, T3: SGC in 5 ppm GA₃ for 24 h, T4: SGC in water for 24 h and then placing in moist peat-moss for one day, T5: SGC in water for 24 h and then placing in moist peat-moss for two days and T6: SGC in water for 24 h and then placing in moist peat-moss until root initiation.

Finally, from the forgoing results and discussion, it could be concluded that planting date 15th September and soaking garlic cloves in water for 24 h and then placing in moist peat-moss until root initiation improved vegetative growth, increasing total produce and bulb quality.

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تأثير ميعاد الزراعة وبعض معاملات ما قبل الزراعة على النمو والمحصول في الثوم

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أجريت هذه التجربة الحالية في الموسمين الزراعيين 2017/2016 و 2018/2017 بمزرعة بحوث الخضر بقها بمحافظة القليوبية. يهدف هذا البحث إلى دراسة تأثير مواعيد الزراعة (1- سبتمبر، 15 - سبتمبر، 1- أكتوبر، 15- أكتوبر) وستة معاملات ما قبل الزراعة (نقع فصوص الثوم في الماء لمدة 24 ساعة، نقع الفصوص في GA₃ بتركيز 5 جزء في المليون لمدة 24 ساعة، نقع فصوص الثوم في الماء لمدة 24 ساعة ثم الوضع في البيت موس الرطب لمدة 24 ساعة ثم الوضع في البيت موس الرطب لمدة يوم واحد، نقع فصوص الثوم في الماء لمدة 24 ساعة ثم الوضع في البيت موس الرطب لمدة يومين، نقع فصوص الثوم في الماء لمدة 24 ساعة ثم الوضع في البيت موس الرطب لحين ظهور مبادئ الجنور والكتنرول بدون نقع في الماء) على النمو والمحصول ومكوناته والمركبات الكيميائية في الإنبال. أظهرت النتائج أن الزراعة في 15 - سبتمبر أنتجت أعلى قيماً لصفات طول النبات، وعدد الأوراق / النبات، وقطر العنق، ونسبة التنصيل وأيضاً الوزن الجاف للأوراق، والبصلة والنبات. كذلك أنتج ميعاد الزراعة هذا أعلى محصول كلي عند الحصاد وأعلى قيم لقطر ووزن البصلة وعدد الفصوص في البصلة في عينة المحصول بعد العلاج التجفيفي. وسجل ميعاد الزراعة الأخير أعلى قيم للكربوهيدرات الكلية. بينما أظهر ميعاد الزراعة الأول (أول سبتمبر) أعلى مستوى للنتروجين والبروتين في المادة الجافة للإنبال. أظهرت معاملة نقع فصوص الثوم في الماء لمدة 24 ساعة ثم الوضع في البيت موس الرطب لحين ظهور مبادئ الجنور أعلى قيم للنسبة المئوية للإنبات، طول النبات وأيضاً الوزن الجاف للأوراق، والبصلة والنبات. أيضاً أنتجت هذه المعاملة أعلى القيم للمحصول الكلي، قطر البصلة، وزن البصلة والكربوهيدرات الكلية في البصلة. وتجمل النتائج إلى أن الزراعة في 15- سبتمبر ونقع فصوص الثوم في الماء لمدة 24 ساعة ثم الوضع في البيت موس الرطب لحين ظهور مبادئ الجنور يحسن النمو الخضري مما يزيد من المحصول وجودة الإنبال.