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Influence of Planting Dates and Some NK-Rates on Productivity and Storability of Garlic

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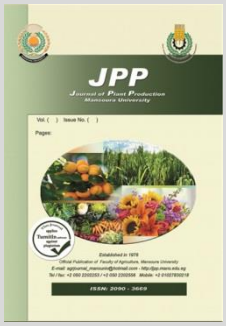

ABSTRACT

Two field experiments were carried out of the vegetable private farm at Kafr Meet Faris, Dakahlia Governorate, during 2017/2018 and 2018/2019 seasons to study the influence of planting dates (20 September, 5 October, 20 October and 5 November) either single and/or in combination with some NK-rates (100%, 110% and 120% from recommended rate) on plant growth, yield and its components, as well as chemical constituents and storability of bulbs on garlic Sids-40 cultivar. Results showed that, the Germination percentage and vegetative growth characteristics (plant height, number of leaves, plant dry weight and bulbing ratio) were better with the second planting date (5 October) followed by the third planting date (20 October) in both seasons. Moreover, total yield, bulb weight and diameter and average clove weight were increased with these planting dates. Whereas, the late planting date (5 November) gave the lowest values in both seasons. On the other hand, application of 120% NK-rate resulted in significant increases in most parameters compared with other treatments. Moreover, concentration N, P, K, TSS and volatile oils in cloves were significantly increased with this treatment. Also, this treatment was significantly reduced the weight loss percentages. The positive interactions between planting dates and NK-rates were often observed. The best results were obtained by the second planting date followed by the third planting date without significant differences between them in most cases combined with 120% NK-rate. Therefore, this treatment could be recommended for improving productivity, quality and storability of garlic under similar conditions to this work.

Keywords: garlic**,** Sids-40 cultivar, planting dates**,** NK-rates, productivity, storability.

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important bulb vegetable crops and is next to onion in importance. It is used as a spice or in the medicinal purposes. It was cultivated for both local consumption and export. Therefore, the essential aims for farmers and consumers was increasing garlic productivity and enhancing bulb quality.

Planting dates plays an important role on the growth and yield of garlic (Shuvra *et al*., 2017). The short day and cool temperature is favorable for vegetative growth of garlic plants, meanwhile, long day and high temperatures are better environment conditions for bulb development (Subrata *et al*., 2010).

Inasmuch the climate changes and the temperature degrees rising in start of autumn, and because the garlic need a period of dormancy before resuming growth, and break dormancy of garlic bulbs have needed to low temperature to accelerate sprouting (Arifin *et al*., 1999; Rosa, *et al*., 2009 and Desta *et al*., 2017), it has been essential to reconsider about the recent planting dates of garlic.

In this respect, Ali and El-Sayed (1999), Rahim *et al.* (1984) and Abdalla *et al.* (2011) found that plant height, number of cloves/bulb, bulb diameter, bulb clove weight, yield were increased by early planting date for the white garlic genotype. El–Zohiri and Farag (2014) under El-Kalubia Governorate conditions, found that planting on 10th October gave higher yield components than late planting. Therefore, they concluded that the colored cultivars (Sids-40 and Egaseed 1) could be planted on the mid of October. Moreover, Youssef and Tony (2014) found that growth, yield and its component of colored cultivar (Sids-40) affected by planting date, 10 October date gave the higher values. The lowest yield was scored at the late of planting date (1 November). Similar results were obtained by Hassan *et al.* (2016) and El-Shabasi *et al*. (2018). Besides, Ismail *et al.* (2018) in south sinai obtained the interaction between planting dates on 15th Oct. or 1st Nov. and fertilizing plants with 100% of the recommended rate of N gave the highest values of each of dry weight of bulbs, leaves, and total dry weight/plant.

Productivity and quality of garlic are affecting by nitrogen and potassium nutrition. Gardener *et al*., 1985 reported that nitrogen is a main constituent of many organic compounds in plants, such as proteins, enzymes, pigments, hormones and vitamins. Besides, potassium plays a role in enhances N uptake, promotes protein synthesis and carbohydrate synthesis and translocation (Marschner, 1995). Moreover, Application of potassium along with nitrogen may have beneficial effect on yield and influences quality parameters of garlic (Das *et al.* 1985).

Several researchers reported that fertilization garlic plants by N and K improving growth, yield and its components and enhanced storability of garlic bulbs. In this regard, (Silva *et al*., 2000; Nadiu *et al*., 2000; El-Morsy and Shokr, 2005 and Farooqui *et al*., 2009) found that plant height, number of leaves, neck thickness, bulb size, number of cloves/bulb and total yield were increases with increasing N-fertilizer level. Furthermore, contents of N, P and K in leaf and bulbs of garlic and volatile oils in bulbs were much increased by increasing N-level (Naruka, 2002 and El-Morsy and Shokr, 2005). Likewise, several researchers reported that garlic plants growth and yield were improved by application

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of potassium (El Sayed and El Morsy, 2012; Arisha *et al*., 2017 and Jiku *et al*., 2020). Furthermore, Maupua and Rathoipe (2007), Shiferaw *et al*. (2015) and Khan *et al.* (2016) found that the garlic plant growth, yield and its quality were increased with increasing NP and/or NK rates.

The objectives of present investigation aims to study the influence of some planting dates and some NK-rates to improving productivity and quality as well as storability of garlic bulbs (Sids–40 cultivar) under the local conditions of Dakhlia Governorate.

MATERIALS AND METHODS

In the vegetable private Farm at Kafr Meet Faris, Dakahlia Governorate, during two growing seasons of 2017/ 2018 and 2018/2019, two field experiments were carried out to study the effects of planting dates (20 September, 5 October, 20 October and 5 November) either single and/or in combination with some NK-rates (100%, 110% and 120% from recommended rate) on growth, yield and yield components of garlic (Sids-40 cultivar) as well as chemical constituents in cloves and bulb storability.

The experimental were carried out in clay loam soil in texture with pH 7.9. Available N, P and K contents were 20.6 - 22.3, 2.5 - 2.8 and 295 - 315 ppm during the first and second seasons, respectively.

The treatments were laid out in split-plot design with three replicates. The tested planting dates were randomly arranged in the main plots, while, NK-rates were assigned to the sub-plots, each sub-plot area was 17.5 m^2 (5 ridges, each 70 cm width and 5 m long). Homogenate cloves were chosen, then soaked in running water for 12h prior to planting and planted at 10 cm apart on two sides of each ridge

Garlic cloves were planted in studied planting dates in both seasons. All the plants were fertilized with the NK-rates were studied, nitrogen as ammonium sulphate (20.5% N) and potassium as potassium sulphate (48% K_2O), which added in three equal doses 30, 60 and 90 days after planting. While, The phosphorus fertilizer was applied as calcium superphosphate (15.5 % P_2O_5), which added in two equal doses, the first applied during preparing the soil before planting and the second at 30 days after planting. According to the instructions laid down by the Ministry of Agriculture, Egypt, the other cultural practices for garlic commercial production were used. Data in Table (1) listed the average of maximum and minimum temperature during the growth seasons under Dakahlia Governorate conditions. The harvesting was done 180 days after planting in both seasons.

Table 1 .Monthly temperature (°C) at El-Dakahlia Governorate during 2017 and 2018 seasons.

Months	2017/2018			2018/2019		
	Temperature ^{0}C		Mean	Temperature ^{0}C		Mean
	Max	Min		Max	Min	
September	31	23	27	31	21	26
October	30	21	26	28	19	24
November.	24	16	20	22	13	18
December	18	11	14	20	13	16
January	20	11	15	21	12	16
February	22	11	16	22	13	17
March	24	12	17	25	12	18
April	29	13	19	28	14	21

Data recorded:

Germination Percentage:

Germination percentage was determined after 30 days from planting date according to the following formula:

$$\text{Germination \%} = \frac{\text{Number of germinated cloves per plot}}{\text{Total number of planted cloves per plot}} \times 100$$

Growth parameters:

Five plants was taken from each plot as a random sample after 120 days from planting to determine the vegetative growth parameters as plant height, number of leaves per plant, plant dry weight (without roots) and bulbing ratio.

Yield and its components:

The harvested plants of each plot were cured in an open space, 15 days after harvest, weighted in kg and converted to record as total yield (ton/fed). A random sample (10 bulbs) was taken from each treatment to estimated bulb weight, bulb diameter, number of cloves/bulb and average clove weight.

Chemical constituents:

Dried foliage of garlic were ground, wet digested as described by Hesse (1971), and determined N%, P% and K% according to the methods described by Pregl (1945), John (1970) and Brown and Lilleland (1946) respectively. Total soluble solids in garlic cloves (TSS %) determined according to A.O.A.C. (1970) and volatile oils (cm^3/kg cloves fresh weight) determined according to Guenther (1961).

Storability:

After curing, random samples (5 kg of marketable yield from every plot) were taken, stored at the normal room conditions (Table 2) and total weight loss percentages were recorded monthly during five months of storage.

All data were subjected to statistical analysis of variance according to the procedure outlined by Gomez and Gomez, (1984), and means were compared using LSD at 5 % level.

Table 2. Average (maxi. + min.) of air temperature and relative humidity in store room during 2018 and 2019 seasons.

Months	2018		2019	
	Temp. C°	Humidity %	Temp. C°	Humidity %
May	16.9	63	17.5	65
June	19.7	65	20.3	67
July	22.1	67	22.9	69
August	23.3	72	23.7	71
September	22.6	67	23.1	68

RESULTS AND DISCUSSION

1- Germination percentage and vegetative growth:

Effect of planting date:

Data presented in Table (3) illustrated that germination percentage, plant height, number of leaves/plant, plant dry weight/plant and bulbing ratio were increased significantly at planting in 5 October followed by 20 October planting date in both seasons. These results may be related to the beneficial effect of environmental condition during this period which suitable to germination of garlic cloves and the vegetative growth of the plants that received low temperature and short day length was encourage (Subrata *et al*., 2010). These results are in line with those of El–Zohiri and Farag (2014) and Youssef and Tony (2014) they found that colored cultivar (Sids-40) growth, yield and yield component gave the higher values with 10 October planting date. The lowest yield was record at the late planting date (1 November). Similar results were obtained by Hassan *et al*. (2016) and El-Shabasi *et al*. (2018).

Effect of NK-rates:

The effect of NK-rates presented in Table (3) show that a significant increases on germination percentage and all

studied parameters of vegetative growth in both seasons. Plants received NK at the rate of 120% from recommended rate were generally stocky and healthy in appearance comparing with other treatments. These results could be attributed to the effective role of nitrogen in a constituent of many organic compounds in plants, such as pigments, enzymes, hormones, vitamins, and proteins (Gardener *et al*., 1985) and the important role of potassium in enhances N uptake, and promotes protein synthesis (Marschner, 1995). The obtained results are in agreement with those reported by (El-Morsy and Shokr, 2005; Farooqui *et al*., 2009; Maupua and Rathoipe, 2007; Shiferaw *et al*., 2015 and Khan *et al*., 2016) they found that plant height, number of leaves and bulbing ratio were increases with increasing N and K as a single or combined.

Effect of interaction between planting dates and NK-rates:

It is evident from data in Table (3) that germination percentage and all vegetative growth characteristics are affected by interaction in both seasons. In general, planting date of 5 October followed by 20 October with 120% NK-rate produced the highest values of plant growth characters in both seasons. Moreover, these results revealed that no significant differences between the two planting dates with the same rate of NK. While, the lowest values were obtained by the late planting date (5 November) followed by the early planting date (20 September) in both seasons.

Table 3. Germination percentage and vegetative growth characters of garlic plants as affected by painting date, NK-rates and their interactions during 2017/2018 (S1) and 2018/2019 (S2) seasons.

Characters		Germination%		Plant height(cm)		Number of leaves/plant		Plant dryweight (gm)		Bulbing ratio	
Treatments		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Planting date											
20 September		91.62	89.52	88.53	87.96	11.46	10.88	24.04	24.93	0.33	0.33
5 October		96.10	95.63	89.96	91.00	11.62	11.57	27.53	27.31	0.30	0.30
20 October		94.92	94.18	89.08	90.11	11.51	11.47	26.71	26.31	0.31	0.33
5 November		89.37	87.75	81.38	75.61	11.36	10.66	23.85	24.01	0.36	0.35
LSD at 5%		1.16	1.17	1.26	1.35	0.21	0.22	2.13	0.17	0.01	0.01
NK-rates:											
100% NK		92.55	91.15	84.94	85.50	11.35	10.90	23.76	24.00	0.34	0.34
110% NK		92.87	91.72	86.89	87.12	11.47	11.11	25.41	25.51	0.32	0.33
120% NK		93.58	92.45	89.86	85.88	11.65	11.44	27.43	27.41	0.31	0.32
LSD at 5%		0.90	0.89	0.70	0.90	0.27	0.19	1.11	1.38	0.01	0.02
Interactions:Planting date X NK-rates											
	100% NK	91.08	89.10	86.11	86.11	11.4	10.50	28.87	23.49	0.37	0.34
20 September	110% NK	91.44	89.57	88.11	88.11	11.5	10.86	28.23	25.11	0.36	0.33
	120% NK	92.33	89.89	89.66	89.66	11.5	11.30	28.10	26.19	0.34	0.32
	100% NK	95.73	95.00	89.11	89.11	11.5	11.50	27.36	25.44	0.33	0.31
5 October	110% NK	96.09	95.56	91.11	91.11	11.5	11.51	27.36	27.32	0.33	0.30
	120% NK	96.47	96.33	92.77	92.77	11.8	11.73	25.50	29.18	0.33	0.29
	100% NK	94.62	93.93	88.33	88.33	11.3	11.31	25.38	24.21	0.32	0.34
20 October	110% NK	94.66	94.11	90.00	90.00	11.5	11.51	24.67	26.10	0.31	0.34
	120% NK	95.48	94.51	92.00	92.00	11.7	11.63	23.20	28.63	0.31	0.32
	100% NK	88.77	86.58	78.44	78.44	11.2	10.30	22.96	22.87	0.30	0.36
5 November	110% NK	89.29	87.63	79.29	79.29	11.4	10.61	22.84	23.52	0.29	0.35
	120% NK	90.06	89.05	69.11	69.11	11.5	11.10	21.91	25.64	0.28	0.34
L.S.D. at 5%		1.86	2.60	1.43	1.53	0.31	0.14	1.91	0.45	3.76	1.52

2- Yield and its components:

Effect of planting dates:

Its obvious from data in Table (4) that the planting date of 5 October followed by 20 October, significantly increased total yield, bulb weight and diameter as well as number of cloves and average clove weight than the other dates in both seasons. The positive effect of these dates may be due to the stocky and healthy of vegetative growth in this dates which reflect to yield and its components (Table 3). The obtained results are in harmony with those of El–Zohiri and Farag (2014) and Youssef and Tony (2014) they found that planting on 10th October gave higher yield and yield components than the late planting date

Effect of NK-rates:

Data in Table (4) reveal that the total yield and its components were increased with increasing NK up to 120% NK-rate in both seasons. The highest values of total yield and its components were obtained with plants received NK at the rate of 120% from recommended rate compared with other treatments. These increases might be ascribed to the favorable roles of nitrogen in constituent of many organic compounds in plants and potassium in carbohydrate synthesis and translocation (Gardener *et al*., 1985 and Marschner, 1995). Similar results were reported by Nadiu *et al*. (2000), Silva *et al*. (2000), Maupua and Rathoipe (2007), Shiferaw *et al*. (2015) and Khan *et al*. (2016).

Effect of interaction between planting dates and NK-rates.

It is clear from data in Table (4) that total yield, bulb weight, bulb diameter, number of cloves/bulb and average clove weight were significantly affected by the interactions between planting dates and NK-rates in both seasons. In general, the highest yield and better yield components were obtained from the interaction between 5 October planting date followed by 20 October planting date with 120% NK-rate. These results coincide with those of Ismail *et al* (2018).

Table 4. Total yield and its components of garlic plants as affected by painting date, NK-rates and their interactions during 2017/2018 (S1) and 2018/2019 (S2) seasons.

Characters / Treatments		Total yield (ton/fed)		Bulb Weight (gm)		Bulb diameter (cm)		No. of cloves /bulb		Average clove weight (gm)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Planting date:											
20 September		5.77	5.79	65.61	53.65	6.80	5.66	21.77	20.77	2.68	2.60
5 October		7.56	6.76	58.91	65.49	6.50	6.15	19.44	18.88	3.44	3.01
20 October		7.34	7.18	50.31	57.84	6.02	6.80	20.22	20.22	3.22	2.95
5 November		5.59	5.65	48.02	49.47	5.42	5.27	21.81	21.22	2.50	2.46
LSD at 5%		0.39	0.95	2.57	3.73	0.27	1.02	0.54	0.57	0.18	0.04
NK-rates:											
100% NK		5.97	5.92	60.63	52.4	5.74	5.12	20.02	20.41	2.73	2.55
110% NK		6.59	6.35	55.70	55.31	5.89	5.70	21.33	20.33	2.95	2.75
120% NK		7.13	6.78	50.82	51.40	6.18	6.03	21.33	20.08	3.20	2.97
LSD at 5%		0.27	0.89	2.02	4.54	0.11	1.25	0.78	0.99	0.14	0.15
Interactions:Planting date X NK-rates											
	100% NK	8.34	5.33	73.55	53.99	6.86	5.36	22.66	20.66	3.77	2.40
20 Sept.	110% NK	8.13	5.68	66.77	50.04	6.47	5.74	22.66	21.00	3.60	2.64
	120% NK	7.71	6.37	65.66	56.92	6.23	5.89	22.33	20.66	3.51	2.77
	100% NK	7.39	6.46	57.75	57.57	6.18	5.95	21.33	19.33	3.19	2.75
5 Oct.	110% NK	6.64	7.23	57.64	66.61	5.98	6.05	21.33	19.00	3.03	3.02
	120% NK	6.50	6.60	52.21	72.28	5.95	6.45	21.33	18.33	2.88	3.27
	100% NK	6.16	6.68	52.09	52.47	5.85	5.65	20.66	20.0	2.78	2.73
20 Oct.	110% NK	5.89	6.88	50.97	55.97	5.75	5.76	20.43	21.0	2.64	2.89
	120% NK	5.67	7.98	50.11	65.08	5.71	6.35	20.33	19.66	2.63	3.22
	100% NK	5.60	5.21	48.43	45.56	5.68	5.12	19.66	21.66	2.62	2.32
5 Nov.	110% NK	5.54	5.60	47.89	48.61	5.48	5.26	18.66	20.33	2.47	2.45
	120% NK	5.22	6.15	45.53	54.26	5.11	5.44	18.33	21.66	2.39	2.61
LSD at 5%		0.44	1.51	3.44	1.88	0.36	1.03	1.57	0.24	0.23	0.14

3- Chemical constituents:

Effect of planting dates:

It is evident from data in Table (5) that N, P, K, TSS and volatile oils in garlic cloves were significantly affected by planting dates. Planting in 5 October followed by 20 October significantly increased all concentrations in cloves in both seasons. While, these concentrations were reduced by the late planting date in 5 November followed by the early planting date in 20 September in both seasons. These results agreement with those of El-Shabasi *et al*, (2018).

Table 5. Chemical constituents in garlic bulbs as affected by painting date, NK-rates and their interactions during 2017/2018 (S1) and 2018/2019 (S2) seasons.

Characters / Treatments		Macronutrients N%		Macronutrients P%		Macronutrients K%		TSS %		Volatile oils (Mg/100g f.w)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Planting date:											
20 September		1.50	1.45	0.45	0.43	1.41	1.37	4.76	4.85	0.46	0.42
5 October		1.68	1.66	0.50	0.48	1.48	1.43	6.07	5.90	0.42	0.46
20 October		1.56	1.56	0.48	0.47	1.46	1.39	5.66	5.70	0.41	0.45
5 November		1.41	1.39	0.43	0.41	1.39	1.34	4.61	4.47	0.38	0.37
LSD at 5%		0.02	0.02	0.01	0.01	0.02	0.04	0.63	0.11	0.01	0.01
NK-rates:											
100% NK		1.48	1.45	0.44	0.43	1.41	1.36	4.75	4.85	0.44	0.39
110% NK		1.54	1.52	0.46	0.45	1.43	1.38	5.22	5.15	0.42	0.43
120% NK		1.59	1.57	0.49	0.47	1.46	1.42	5.86	5.68	0.39	0.45
LSD at 5%		0.01	0.01	0.01	0.01	0.01	0.03	0.60	0.12	0.01	0.01
Interactions:Planting date X NK-rates											
	100% NK	1.74	1.38	0.53	0.41	1.52	1.34	6.46	4.43	0.38	0.39
20 Sept.	110% NK	1.70	1.46	0.52	0.43	1.50	1.38	6.10	4.75	0.41	0.43
	120% NK	1.62	1.52	0.50	0.45	1.49	1.39	6.05	5.38	0.42	0.45
	100% NK	1.61	1.60	0.48	0.47	1.47	1.40	5.70	5.53	0.43	0.43
5 Oct.	110% NK	1.57	1.66	0.48	0.48	1.44	1.41	5.70	5.85	0.47	0.47
	120% NK	1.56	1.72	0.47	0.50	1.43	1.50	5.66	6.33	0.50	0.50
	100% NK	1.51	1.50	0.46	0.46	1.43	1.38	5.26	5.26	0.40	0.42
20 Oct.	110% NK	1.49	1.56	0.45	0.47	1.41	1.39	5.23	5.73	0.42	0.46
	120% NK	1.46	1.62	0.45	0.49	1.41	1.42	4.8	6.10	0.45	0.48
	100% NK	1.44	1.34	0.43	0.39	1.39	1.33	4.28	4.20	0.36	0.35
5 Nov.	110% NK	1.42	1.40	0.43	0.42	1.38	1.35	4.23	4.30	0.39	0.37
	120% NK	1.36	1.44	0.41	0.44	1.38	1.36	3.86	4.93	0.41	0.40
L.S.D. at 5%		0.03	0.03	0.02	0.02	0.01	0.11	0.96	0.09	0.97	0.04

Effect of NK-rates:

Data presented in Table (5) illustrated that concentrations of N, P and K as well as TSS % and volatile oils in cloves were significantly increased with increasing of NK-rate up to 120% from recommended rate. The highest values were obtained from application of 120% NK-rate comparing with the other rates. These results similarly with those of Naruka (2002) and El-Morsy and Shokr (2005).

Effect of interaction between planting dates and NK-rates:

From such data in Table (5) it is evident that the all chemical constituents in cloves significantly affected by interaction between planting dates and NK-rates in both seasons. Planting in 5 October date followed by 20 October date and application of NK at the rate 120% from recommended rate resulted in the highest values of N, P, K, TSS% and volatile oils. Similar results were obtained by Ismail *et al.* (2018).

4- Storability:

Effect of planting dates:

Data presented in Table (6) show that the planting dates had a significant effect on weight loss percentages of bulbs during and at the end of storage period in both seasons. However, it increased by increasing the storage period and reached its maximum values at the fifth month. Planting of 5 October date resulted in the lowest total weight loss percentage comparing with other planting dates. These results could be due to increase dry matter in plants (Table 3) and TSS in cloves (Table 5).

Table 6. Weight loss percentage of garlic plants as affected by painting date, NK-rates and their interactions during 2017/2018 (S1) and 2018/2019 (S2) seasons.

Characters / Treatments		Weight loss (%) during the storage period									
		30 days		60 days		90 days		120 days		150 days	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Planting date											
20 September		25.8	24.8	35.5	35.9	42.36	42.13	46.0	46.47	50.6	49.06
5 October		22.8	22.1	31.3	30.9	36.73	35.88	39.3	40.11	42.6	41.40
20 October		20.8	26.3	32.4	32.5	38.33	37.46	41.4	40.83	43.3	42.96
5 November		29.4	29.5	40.9	40.9	45.95	44.37	49.4	50.85	54.6	53.20
LSD at 5%		4.04	6.27	1.92	0.08	0.39	2.10	0.16	1.88	0.27	0.25
NK-rates											
100% NK		26.08	25.7	36.06	36.7	42.43	41.15	46.02	45.47	49.7	48.82
110% NK		23.65	27.4	35.22	35.2	40.97	40.09	43.92	44.50	47.5	46.55
120% NK		24.47	23.9	33.90	33.3	39.13	38.65	42.25	43.73	46.1	44.60
LSD at 5%		4.00	6.32	1.69	0.08	0.09	1.97	0.10	1.76	0.14	0.10
Interactions:Planting date X NK-rates											
20 Sept.	100% NK	30.5	25.6	42.8	37.1	47.73	43.8	44.0	47.20	43.9	52.3
	110% NK	29.2	24.8	41.3	35.8	46.30	41.9	41.9	44.93	43.7	48.7
	120% NK	28.5	24.2	38.7	35.0	44.00	40.7	41.2	47.30	53.0	46.2
5 Oct.	100% NK	26.3	23.1	36.6	32.7	43.83	36.9	38.3	40.10	44.1	42.2
	110% NK	25.9	22.1	36.0	31.0	41.90	35.8	36.7	39.50	52.8	41.7
	120% NK	25.4	21.0	34.0	29.2	41.20	34.9	35.2	40.93	53.2	40.3
20 Oct.	100% NK	23.8	23.4	34.0	34.2	39.70	40.0	39.7	42.30	49.0	44.3
	110% NK	23.7	33.6	33.4	32.7	39.00	37.1	39.0	41.70	49.8	43.0
	120% NK	23.1	22.0	32.2	30.6	38.30	35.3	36.3	38.50	48.7	41.6
5 Nov.	100% NK	22.3	30.8	31.0	42.9	36.70	43.86	47.7	52.31	49.9	56.5
	110% NK	21.7	29.3	30.8	41.3	36.30	45.56	46.3	52.06	49.3	52.8
	120% NK	16.4	28.5	29.9	38.5	35.20	43.70	43.8	48.20	49.7	50.3
L.S.D. at 5%		5.84	0.13	2.94	0.58	0.24	5.39	0.11	5.04	0.38	0.10

Effect of NK-rates:

Data in table (6) illustrate that storability of garlic bulbs was better with increasing of NK-rate. Moreover, plants received 120% NK-rate gave the lowest total weight loss percentage comparing with other treatments. These results may be due to increase TSS% and K-elements in cloves (Table 5). Similar results were obtained by El-Morsy *et al.* (2010) who found that the total weight loss percentage was reduced with increasing PK rate.

Effect of interaction between planting dates and NK-rates:

The presented data in Table (6) evident that the positive interactions between planting dates and NK-rates often observed on storability of bulbs. Planting in 5 October date with NK at 120% NK- rate followed planting in 20 October date with the same rate of NK gave the lowest total weight loss percentage during and at the end of storage period.

From the results of this investigation, it could be concluded that, planting garlic in 5 October and/or in 20 October with application NK at the rate of 120% from recommended rate are the recommended treatments for increasing garlic yield, improving bulb quality and storability of garlic under similar conditions to this work.

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تأثير مواعيد الزراعة وبعض معدلات النتروجين والبوتاسيوم على النمو والمحصول والقدرة التخزينية للثوم

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فى مزرعة خضر خاصة بقرية كفر ميت فارس -محافظة الدقهلية خلال موسمى الزراعة ٢٠١٧/٢٠١٨ و ٢٠١٨ / ٢٠١٩ م أُجريت تجربتان حقليتان على محصول الثوم (صنف سدس-٤٠) لدراسة تأثير مواعيد الزراعة (٢٠ سبتمبر، ٥ أكتوبر، ٢٠ أكتوبر و ٥ نوفمبر) كلٌ منها منفرداً أو مع بعض معدلات النتروجين والفوسفور والبوتاسيوم (١٠٠% ، ١١٠% و ١٢٠% من المعدل الموصى به) على النمو ومحصول الأبصال ومكوناته وكذلك أيضاً المحتويات الكيماوية فى الفصوص ونسبة الفقد فى وزن الأبصال خلال فترة التخزين. بصفة عامة كل الصفات المدروسة (نسبة الإنبات ، ارتفاع النبات، عدد الأوراق لكل نبات، الوزن الجاف للنبات ونسبة التبصيل، وأيضاً المحصول الكلى، متوسط وزن وقطر البصلة ، عدد الفصوص للبصلة ومتوسط وزن الفصل كانت أفضل مع ميعاد الزراعة الثانى (٥ أكتوبر) متبوعاً بموعد الزراعة الثالث (٢٠ أكتوبر) فى كلا الموسمين. بينما ميعاد الزراعة المتأخر (٥ نوفمبر) فقد أعطى أقل تسجيلات.ومن ناحية أخرى، إضافة النتروجين والبوتاسيوم بمعدل ١٢٠% أدت إلى حدوث زيادات معنوية فى معظم الصفات مقارنة بالمعدلات الأخرى. علاوة على ذلك، هذه المعاملة زادت معنوياً من تركيزات المواد الصلبة الكلية والزيوت الطيارة والنتروجين والفوسفور والبوتاسيوم فى الفصوص. بينما قللت معنوياً من نسب الفقد فى وزن الأبصال خلال فترة التخزين. وقد لوحظت التفاعلات الإيجابية بين مواعيد الزراعة ومعدلات النتروجين والبوتاسيوم. وقد تم الحصول على أفضل النتائج بزراعة الثوم فى ٥ أكتوبر يليه ٢٠ أكتوبر بدون فروق معنوية بينهما مع إضافة النتروجين والبوتاسيوم بمعدل ١٢٠% من الموصى به.ولذلك، يمكن التوصية باستخدام هذه المعاملة لرفع إنتاجية وتحسين جودة أبصال الثوم وقابليتها للتخزين تحت الظروف المشابهة لظروف هذا البحث.