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Effect of planting time and bulb size on growth, bulbs and seeds yield in onion *var*. Texas Early Grano

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ABSTRACT:

An experiment was conducted to determine the effect of the bulb size and different planting dates on the growth and yield of bulbs and seeds in onion *var* Texas Grano in the Fallujah Amiriya (60 Km southwest of Baghdad) in the agricultural season 2016-2017. Three sizes of bulbs were used (15, 25and 20 g) and planted in three dates: 15 of December, 30 of December and 15 of January. The obtained results showed a significant effect of bulb size and planting date on the growth and yield of both bulbs and seeds. The planting date of 15 January with small bulb size (15 g) had the lowest rate of total vegetative characteristics, such as the number of tubular blades and the leaf area while the highest percentage of bulbs was 60.67%. The best results for the bulbs yield was 17.43 tons.ha $^{-1}$, while the large bulb size (25 g) and the early date of 15 January were the best growth rates, number of tubular blades and leaf area in addition, the lowest percentage of flowering plants reached (21.87%) and lowest yield reached (6.50 tons.ha^{-1}) while the highest flowering percentage was 78.10% and the lowest seed yield was 401.93 kg.ha^{-1}.

Keywords:

Onion, Planting dates, Bulb size, yield, Texas Grano.

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INTRODUCTION

Onion (*Allium cepa L*.) of the Alliaceae family is one of the most important strategic vegetable crops after tomato and potato. The importance of this crop due to its high nutritional value, economic feasibility and various medicinal benefits (Hazra and Som, 2006). The onion is grown in Iraq using the bulbs and transplants derived from planting seeds. The use of the plant in agriculture often leads to the direction of plants for early bloating and high loss of the bulb yield (Khokhar, 2009). The size of bulbs used in planting is one of the determinants of the bulbs yield where the larger the size of the sets, the lower bulbs yield and the higher seed yield due to the increase in the percentage of flowering plants, which cause a large loss of the bulbs yield in contrast to the use of the small sets Brewster (2008), as well as early cultivation leads to an increase in the proportion of flowering plants (Khokhar, 2014).

The local varieties of onions are considered as the best diffused varieties for their high nutritional value, high content of dry matter, while and long-term storage and shipment of large distances as well as adapting to the conditions of the country. Texas Early Grano is one of the main imported varieties with medium to large size of bulbs and high content of water in addition to it is one of the cold varieties that adapted to Iraqi's environmental conditions, which have been cultivated and spread over the past ten years (Alabday and Abed, 2015). This research was carried out with the aim of finding the best size of the sets and the best planting date to obtain the highest bulb yield and the lowest percentage of flowering in the central region of Iraq.

MATERIALS AND METHODS

This research was conducted in Amiriya Fallujah (60 Km southwest of Baghdad) in the agricultural season 2016-2017 in a field experiment using the small Texas Grano Onion (diameter less than 2.5 cm) and three weights, large 25 g, medium 20 g and the small 15 g. The three weights were planted at three dates, 15 of December, 30 of December and 15 of January, to obtain the best combination of sets size and planting time to achieve the highest bulb yield. The soil was prepared from tillage, softening and fertilization as recommended by Hasan (2000) and the land was divided into lines with distance of 75 cm between the lines as well as the sets was planted on both sides of the lines. The distance between the plants was 20 cm and the experimental unit contains four lines of two meters length and 40 plants with three square meters for each experimental unit. The experiment was designed according to random complete block design RCBD with three replicates. The study included 27 experimental units from three dates, three sizes and three replicates.

Vegetative growth traits

1. Number of tubular blades

It was calculated by counting all tubular blades and neglected the one with length less than 5 cm.

2. Leaf area

It was calculated according to Brewster (2008).

Yield components

3. Bulbing percentage (%)

It was be calculated from percentage of non-flowering plants of the total number of plants.

4. Plant yield (g/plant^{-1})

It was calculated by dividing the experimental unit yield to the number of plants in the experimental unit.

5. Total yield of the area (tons. hectare^{-1})

It was determined by calculating the total bulb yield of the experimental area in one hectare (10000 square meters).

Flowering and seeds traits

6. Percentage of flowering plants (%).

7 - Plant seeds yield (g.plant^{-1}).

8 - The seed yield per unit area (kg.ha^{-1}).

Statistical analysis

The data were analyzed using the least signifi-

Table 1. Effect of size and planting time in the number of leaves per plant in onion

S. No	TS	T_1 (11\15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	20.40	16.47	11.77	16.21
2	Medium size S_2	18.97	14.27	10.87	14.70±
3	Small size S_3	17.07	13.70	10.33	13.70±
4	Average of planting date	18.81	14.81	10.99	-
5	L.S.D	S	T	S×T	-
		0.613	0.613	1.062	

Table 2. Effect of size and planting time in the leaf area (cm^2) in onion

S. No	TS	T_1 (11\15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	50.03	46.23	44.77	47.01
2	Medium size S_2	59.90	43.40	37.40	46.90
3	Small size S_3	49.53	42.90	33.73	42.06
4	Average of planting date	53.15	44.18	38.63	-
5	L.S.D	S	T	S×T	-
		4.33	4.33	7.50	

cant difference of LSD at the probability level 0.05, according to the Al-Rawi *et al*. (2000) using Genstat statistical program.

RESULTS AND DISCUSSION

Characteristics of vegetative growth

The results of Tables 1 and 2 showed that the size of S_1 was significantly higher in vegetative growth characteristics, with the highest number of tubular blades and the highest leaf area of 16.21 blade/plant and 47.01 dcm^2/plant respectively compared to the lowest tuber blades and leaf area of the small size S_3 which recorded 13.70 blade/plant and less leaf area amounted to 42.06 dcm^2/plant sequentially. The first date was significantly higher in the number of tubular blades and the highest leaf area with 18.81 blade/plant and 53.15 dcm^2/plant respectively, compared with the lowest number of tubular blades and the leaf area given by the plants of the last date T_3 which reached 10.99 blade.$plant^{-1}$ and leaf area of 38.63 dcm^2.$plant^{-1}$respectively. The interaction between the two factors achieved a significant increase in the vegetative growth characteristics.

The large size plants cultivated with the first date gave the highest number of blades and the largest leaf area compared with the small size plants cultivated at the last date. These results clearly indicated that the use of large size gives larger plants that are more responsive to the floral stimulation (vernalization). This may be due to the arrival of plants to the physiological puberty and beyond the modernity stage, which leads to flowering, causing a significant loss in the bulbs yield (AL-Marsoumi and Khalifa, 1999; Mohammed and Sul-

Table 3. Effect of the size and planting time on the bulbing ratio (%) in tonion

S. No	TS	T_1 (11 \15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	21.87	37.63	57.63	38.04
2	Medium size S_2	25.07	40.67	57.33	41.02
3	Small size S_3	25.23	41.37	60.67	42.42
4	Average of planting date	24.06	39.89	58.54	-
5	L.S.D	S	T	S×T	
		0.521	0.521	0.902	-

Table 4. Effect of the size and planting time on the total bulb yield (g/plant^{-1}) in onion

S. No	TS	T_1 (11 \15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	39.23	45.67	52.53	45.81
2	Medium size S_2	41.73	48.60	55.20	48.51
3	Small size S_3	42.87	49.53	57.77	50.06
4	Average of planting date	41.28	47.93	55.17	-
5	L.S.D	S 0.642	T 0.642	S×T 1.112	-

Table 5. Effect of size planting time on onion yield per unit area (ton.ha^{-1}) in onion

S. No	TS	T_1 (11\15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	5.60	10.76	13.00	9.78
2	Medium size S_2	7.50	11.53	14.76	11.26
3	Small size S_3	9.53	14.33	17.43	13.76
4	Average of planting date	7.54	12.21	15.06	-
5	L.S.D	S 0.354	T 0.354	S×T 0.613	-

tan, 1983). The early date of agriculture gives a greater chance of the plant to increase the vegetative growth and give plants exceeded the critical size, increasing its response to low temperatures because the plants have passed the stage of juvenility, which increases the proportion of flowering plants, which reflects negatively on the yield of the bulbs (Alabday and Abed, 2015). This clearly indicated that the large size and the early date of planting are used when the aim of planting is to produce bulbs. These results were agreed with Al-Marsoumi and Khalifa (1999) and Al-Azzawi and Mahoush (2012).

Yield components

Tables 3, 4 and 5 showed that a significant superiority of the third date plants was noted in the traits of the yield where the highest percentage of bulbs, the highest yield of the plant and the highest yield of the area with means of, 58.54%, 55.17 and 15.06, tons.ha^{-1} respectively compared to the first date plants which indicated the lowest percentage of bulbs, less plant yield and the lowest yield of the area with means of 24.06%, 41.28 kg.plants^{-1} and 7.54 tons.ha^{-1} respectively. Also, Table 3, 4 and 5 showed a significant superiority of the plants with small sets size in the characteristics of the plant yield given the highest percentage of bulbs, the highest plant and the highest yield of the area with means of 42.42%, 50.06 g.plant and 13.76 tons.ha^{-1} respectively compared with large set plants which gave the lowest yield qualities of 38.04%, 45.81 g.plant^{-1} and 9.78 tons.ha^{-1} respectively.

The interaction between the two factors gave the same response as the plants of the third date with small size significantly exceeded the traits of the plants of the

Table 6. Effect of size and planting time on flowering plants ratio (%) in onion

S. No	TS	T_1 (11\15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	78.10	62.50	42.30	61.00
2	Medium size S_2	74.90	59.30	42.70	59.00
3	Small size S_3	57.40	58.60	39.30	51.80
4	Average of planting date	70.13	60.13	41.43	-
5	L.S.D	S 3.22	T 3.22	S×T 5.58	-

Table 7. Effect of size and planting time on seed yield (g/plant^{-1}) in onion

S. No	TS	T_1 (11 \15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	3.63	2.63	1.26	2.51
2	Medium size S_2	3.40	1.80	1.26	2.15
3	Small size S_3	3.36	1.46	1.16	2.00
4	Average of planting date	3.46	1.96	1.23	-
5	L.S.D	S 0.209	T 0.209	S×T 0.362	-

first date and the large size. The above results can be attributed to the large size of the plant produces a larger size than the plants of critical size, as well as the early date of planting gives a great opportunity for the growth of plants and increase their size, which increases the intensity of their response to the catalyst and increase the proportion of flowering plants which increases the proportion of flowering and reduce the proportion of bulbs which reflected negatively on the bulbs yield. On the contrary delay the date of cultivation and using small size of sets has caused smaller plants production and did not reach the critical size in the period of low temperatures, causing the tendency of plants towards increasing the bulb production. The obtained results were in agreement with Al-Azzawi and Mahoush (2012) and disagreed with Ud-Deen (2008).

Seed qualities

The results of tables 6, 7 and 8 indicated a significant superiority in the seed yield characteristics of the first date plants, giving 70.13%, 3.46 g.plant^{-1} and 400.19 kg.h^{-1} respectively, for the percentage of flowering plants, seed yield and seed yield for total area compared with last date plants which gave the means of 41.43%, 1.23 g.plant^{-1} and 351.62 kg.ha^{-1} respectively. The results of Table 6 showed that the large size plants significantly increased the proportion of flowering plants (61.00%) compared to the lowest percentage of flowering given by the small size plants (51.80%). Regarding the seed yield, the plants with large size (2.51 g.plant^{-1}) significantly exceeded the seed yield given by plants of small size (2.00 g.plant^{-1}) while the size did not have an effect on the plant yield of the area unit.

The interaction between the size and date factors was significant, as the cultivated plants of the first date obtained from a large sets exceeded the highest percentage of flowering plants (78.10%) compared with the lowest percentage of the last date plants obtained from a small sets (39.3%) (Table 6). Plant yield of the seeds, which surpassed the same plants giving 3.63 g.plant^{-1} and significantly exceeded the plants of the last date (1.23 g.plant^{-1}) Table 7. The plants produced by the large size and cultivated at the first date by giving the highest yield of seeds in the unit area was 401.93 kg.ha^{-1} compared to the lowest seed (348.50 kg.ha^{-1}) for plants grown in the third season resulting from a medium-sized

Table 8. Effect of size and planting time on seed yield (kg/ha^{-1}) in onion

S. No	TS	T_1 (11\15)	T_2 (11\30)	T_3 (12/15)	Average of sets size
1	Large size S_1	401.93	395.50	354.73	384.06
2	Medium size S_2	400.43	395.17	348.50	381.37
3	Small size S_3	398.20	387.27	351.63	379.03
4	Average of planting date	400.19	392.64	351.62	-
5	L.S.D	N.S	T 16.00	S×T 18.02	-

sets (Table 8).

It can be attributed that early planting will push plants to reach critical size (5-7) leaves per plant, increasing their responsiveness to the vernalization and increase flowering and seed yield. On the contrary, late date planting will result in relatively small plants in the period of low temperature which associated with the above-mentioned critical volume, resulted in a decrease in their response to the catalyst of vernalization and reduces flowering and seed production which in agreement with the finding of Khokhar (2014) and it is recommended to plant in the last date to produce the bulbs. The superiority of the plants resulting from the large sets in the qualities of the seed yield was due to their tend to duplicate and give more than one branch, especially as these plants have reached the critical size which stimulate the flowering and seed production. These results agreed with finding of Khokhar (2009) and Al -Azzawi and Mahoush (2012).

CONCLUSION

In conclusion, the obtained results demonstrated the adoption of the last date 15.12.2016 and the small set sizes 15 g in the production of the bulbs which results in plants below the critical size in the period of low temperatures, causing continuous vegetative growth. The opposite if the purpose of planting is to produce seeds, where the early date of planting was 15.01.2017 and the large sets sizes 25 g that lead to the orientation of the resulting plants to early flowering and seed production instead of bulbs yield. The results obtained showed a significant effect of bulb size and planting date on the growth and yield of both bulbs and seeds.

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