EFFECT OF MOTHER BULB SIZE, PLANTING SPACE AND NITROGEN LEVEL ON ONION SEED YIELD AND ITS QUALITY

By

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ABSTRACT

Two field experiments were carried out at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt. The experiments were carried out during 1999/2000 and 2000/2001 seasons to study the effect of three mother bulb sizes (<3, 3-5 and >5 cm in diameter), three planting spaces (15, 25 and 35 cm apart) and three nitrogen levels (60, 90 and 120 kg N/fed.) on seed production and its quality of onion cultivar Giza 20. The treatments were arranged in split-split plot design with four replications. The main findings could be summarized as follows:

The obtained resultes reveal that mother bulb size had a significant effect on number of sprouts and scapes/plant, dry weight of umbels/plant, seed yield per plant and per feddan, 1000-seed weight in both growing seasons as well as on diameter of main umbel in 2000/2001 season and on weight of seed/umbel in 1999/2000 season. The highest values of all these traits were obtained with sowing the largest mother bulb size. On the other hand, seed setting and seed germination percentages were not significantly affected by mother bulb size in the two seasons of study.

Increasing planting space from 15 to 35 cm apart caused a significant increase in diameter of main umbel, dry weight of umbels/plant, seed weight/umbel, seed yield/plant and 1000-seed weight, but it significantly decreased seed yield/fed. Planting space had no significant effect on number of sprouts and scapes/plant as well as seed setting and seed germinations percent in both seasons.

Application the highest rate of nitrogen (120 kg N/fed.) resulted in the highest values of all studied traits in the two seasons. The obtained results reveal also that with each increment of applied nitrogen the number of sprouts and scapes/plant as well as seed yield per plant and per feddan were significantly increased in both seasons.

Finally, it can be concluded that planting large bulbs (>5 cm in diameter) at narrow spacing (15 cm between plants) and applying nitrogen

level at a rate of 120 kg N/fed. were recommended for onion growers at Kafr El-sheikh Governorate to produce the highest seed yield of Giza 20 with best quality.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important crops in Egypt for exportation as well as for local consumption. Nowadays, onion seed production is the most important and vital step in onion crop production. since the production of bulbs is directly dependent on the highly selected onion seed. Thus, maximizing the productivity of onion seed yield with excellent specific quality under the conditions of Kafr El- Sheikh Governorate could be achieved by improving cultural practices such as choosing the suitable mother bulb size, planting space as well as the optimum nitrogen level.

Several investigators stated that mother bulb size is one of the limiting factors affecting onion seed yield and its quality. In this connection, Mostafa (1992) investigated the effect of three mother bulb sizes (> 7, 5-7 and 3-5 cm in diameter) on onion seed production. He concluded that number of umbels/plant, number of capsules/umbel, seed setting percentage, weight of seeds/umbel, seed yield per plant and per feddan as well as 1000- seed weight were increased with increasing mother bulb size up to 7 cm or more. Whereas, number of seeds/capsule and seed germination percentage did not affected by different sizes of mother bulbs. Also, Brewster (1994); Gamie et al. (1996); Mostafa et al. (1996); Perez et al. (1996); Nawab et al. (1998); Singh and Sachan (1998 and 1999) reported that large mother bulbs produced the highest values of onion seed yield and its attributes with best quality.

With respect to the effect of planting space on onion seed yield, many researchers reported that the highest seed yield/fed. was obtained from the closer spacing between rows and within row, although the seed yield of individual plant was increased with wider spacing. They found also that the highest values of number of sprouts and scapes/plant, 1000- seed weight and seed germination percent were obtained with wider distance between plants (Dalject et al., 1990; Farghaly and Farag, 1990; Ibrahim et al., 1990; Mostafa, 1992; Singh et al., 1993; Abdel- Latif, 1995; Gamie et al; 1996; Nawab et al; 1998 and Singh and Sachan, 1999.

Nitrogen fertilizer levels are of much importance to onion seed production, it is considered as an essential element for both growth and reproductive of all plants and onion crop. The beneficial effect of nitrogen

application on onion seed yield and its attributes was noted by Farag et al. (1989); Hanna- Alla et al. (1997); Rahim et al. (1997) and El-Saadany and Salman (2000).

The objective of the present investigation was to study the effect of mother bulbs size, planting space and nitrogen fertilizer level on yield and quality of onion seeds.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of Sakha Agricultural Research Station at Kafr El- Sheikh, Agricultural Research Center (ARC), Egypt during the two successive growing seasons of 1999/2000 and 2000/2001. The preceding crop was cotton in the two seasons. The experimental soil was clay in texture with pH of 8.1. 1.95% organic matter and containing 24, 11 and 450 ppm available N, P and K, respectively (average of the two seasons for the upper 30 cm of the soil surface). A split- split plot design with four replicates was used in this study. The main plots were designated to the three mother bulb sizes grades, i.e. < 3 cm in diameter (small size), 3-5 cm in diameter (medium size) and > 5 cm in diameter (large size). The sub plots were allocated to three planting spaces, i.e. 15 cm (narrow spacing), 25 cm (mid spacing) and 35 cm (wide spacing). Plant spacing treatments, number of plants/fed. as well as weight of bulbs required/fed. for each treatment are show in Table (1). The three nitrogen fertilizer levels, i.e. 60, 90 and 120 kg N/fed. were randomly distributed in sub- sub plots. The sub- sub plot consisted of 4 ridges, each 3.5 meter in length and 60 cm in width. Mother bulbs were planted on December 15th in the two seasons. Nitrogen levels in the form of ammonium nitrate (33.5% N) at the above mentioned levels, were applied in the two equal doses, the first was applied after thirty days from planting before the first irrigation and the second was given thirty days later. Calcium superphosphate (15.5% P_2O_5) was added during tillage operation at the rate of 300 kg/fed. Other cultural practices for growing onion seed have been carried out as recommended.

Table (1): Planting space treatments, number of plants/fed. and weight of bulbs required/fed.

Spacing between plants (cm)	No. of plants/fed.	Weight of bulbs required (t/fed.)		
		< 3 cm	3-5 cm	> 5 cm
15	46 666	1.222	2.450	3.724
25	28 000	0.734	1.470	2.134
35	20 000	0.524	1.050	1.596

Studied characters:

1. Ten plants were randomly labeled as a representative sample of each plot and the number of sprouts/ plant was measured.
2. At harvest. the following characters were determined on the chosen ten plants:

2.1. Number of scapes/ plant. 2.2. Diameter of main umbel (cm).
2.3. Dry weight of umbels/ plant (g). 2.4. Seed- setting percentage*.
2.5. Weight of seed/ umbel (g). 2.6. Seed yield/ plant (g).

* It was calculated according to the following formula:

$$\text{Seed setting percentage} = \frac{\text{number of capsules / umbel}}{\text{total number of flowers / umbel}} \times 100$$

3. Umbels in each plot were harvested and left two weeks until fully air-dried by sunshine. then onion seed yield as kg/fed. was calculated.
4. Seed quality: onion seed quality was determined as:

4.1. Weight of 1000-seed (g). 4.2. Seed germination percentage.

All data collected were subjected to statistical analysis as described by Snedecor and Cochran (1980). The mean values of treatments were compared according to Duncan's multiple range test (Duncan, 1955). All statistical analysis was performed using analysis of variance technique by means of "IRRISTAT" computer software package.

RESULTS AND DISCUSSION

Effect of mother bulb size:

The presented data in Tables (2 and 3) indicate that mother bulb size had a significant effect on number of sprouts and scapes/plant, dry weight of umbels/plant, seed yield per plat and per feddan, 1000-seed weight in both seasons as well as on diameter of main umbel in the second season and on seed weight/umbel in the first season. Whereas, seed setting and seed germination percentages were not significantly affected by mother bulb size in the two seasons. The highest values of all these traits were recorded with the largest mother bulb size. It is also clear from the presented data that each increment in mother bulb size resulted in a significant increase in seed yield per plant and per feddan in both seasons. From the previously mentioned results. it my be concluded that there was a strong association between number of sprouts as well as scapes and size of mother bulbs. The larger size of mother bulbs contained more growing points than smallest size. The increase in seed yield per plant as well as per feddan may be due to the fact.

Table (2): Effect of mother bulb size, planting space, nitrogen level and their interaction on onion seed yield of "cv. Giza 20" and its attributes as well as seed quality in 1999/2000 season.

Treatment	No. of sprouts /plant	No. of scapes /plant	Dimmeter of main umbel (cm)	Dry weight of umbels/ plant (g)	Seed setting percentage	Seed weight /umbel (g)	Seed yield (g/ plant)	Seed yield (kg/fed.)	1000-seed weight (g)	Seed germination percentage
Mother bulb size (cm) (A):										
< 3	4.02 b	3.77 c	6.57	24.36 b	55.49	3.99 b	13.57 c	276.39 c	3.22 b	83.32
3-5	4.08 b	4.12 b	6.84	28.96 b	56.61	4.53 a	18.98 b	406.67 b	3.67 a	86.34
> 5	4.88 a	5.34 a	6.91	42.62 a	56.63	4.71 a	22.35 a	511.81 a	4.63 a	87.71
F. test	*	**	N.S	*	N.S	*	**	**	*	N.S
Planting space (cm) (B):										
15	4.04	4.38	6.38 c	29.56 b	54.78	3.93 b	12.80 c	449.16 a	3.60 b	84.97
25	4.84	4.42	6.84 b	31.43 ab	55.53	4.22 b	17.89 b	395.97 b	3.77 b	84.04
35	4.10	4.43	7.09 a	34.95 a	58.43	5.10 a	24.21 a	349.72 c	4.15 a	88.35
F. test	N.S	N.S	*	**	N.S	**	**	**	*	N.S
N- level (kg N/fed.) (C):										
60	4.08 c	3.92 c	6.55 c	29.23 b	52.91 b	4.10 b	14.44 c	320.28 c	3.68 b	83.85 b
90	4.33 b	4.37 b	6.78 b	31.55 ab	56.79 ab	4.34 b	18.23 b	400.83 b	3.80 ab	86.36 ab
120	4.57 a	4.93 a	6.99 a	35.16 a	59.04 a	4.82 a	22.23 a	473.75 a	4.04 a	87.15 a
F. test	**	*	*	*	*	*	**	**	*	*
Interaction :										
A × B	N.S	N.S	N.S	N.S	N.S	*	*	N.S	N.S	N.S
A × C	**	*	N.S	N.S	N.S	N.S	*	**	N.S	N.S
B × C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
A × B × C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

*, ** and N.S indicate P<0.05, P< 0.01 and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level, using Duncan's multiple range test.

Table (3): Effect of mother bulb size, planting space, nitrogen level and their interaction on onion seed yield of "cv. Giza 20" and its attributes as well as seed quality in 2000/2001 season.

Treatment	No. of sprouts /plant	No. of scapes /plant	Dimmeter of main umbel (cm)	Dry weight of umbels/ plant (g)	Seed setting percentage	Seed weight /umbel (g)	Seed yield (g/ plant)	Seed yield (kg/fed.)	1000-seed weight (g)	Seed germination percentage
Mother bulb size (cm) (A):										
< 3	3.50 c	3.72 b	6.79 b	33.14 b	65.57	4.27	15.26 c	310.56 c	4.27 b	84.81
3-5	4.10 b	4.29 b	7.20 ab	42.08 b	68.18	4.56	18.53 b	449.28 b	4.52 a	89.46
> 5	5.39 a	6.24 a	8.23 a	65.75 a	69.40	4.99	29.38 a	516.69 a	4.62 a	93.06
F. test	**	**	**	*	N.S	N.S	**	**	*	N.S
Plant spacing (cm) (B):										
15	4.29	4.50	7.07 b	36.49 c	65.21	3.80 c	16.91 c	515.11 a	4.13 b	88.47
25	4.31	4.60	7.51 ab	45.26 b	68.68	4.54 b	20.62 b	396.67 b	4.32 b	88.91
35	4.39	5.11	7.64 a	58.55 a	69.26	5.48 a	25.65 a	364.70 c	4.96 a	89.94
F. test	N.S	N.S	*	**	N.S	**	**	**	*	N.S
N- level (kg N/fed.) (C):										
60	3.98 c	4.13 c	7.08 b	48.32 ab	65.10 b	4.03 b	16.09 c	325.44 c	4.24 b	84.85 c
90	4.25 b	4.73 b	7.26 b	48.32 b	68.45 a	4.46 b	20.78 b	415.70 b	4.60 a	90.49 b
120	4.76 a	5.31 a	7.88 a	57.64 a	69.60 a	5.32 a	26.32 a	535.36 a	4.56 a	91.99 a
F. test	**	*	*	*	*	*	**	**	*	*
Interaction:										
A × B	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
A × C	N.S	N.S	N.S	N.S	N.S	N.S	**	**	N.S	N.S
B × C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
A × B × C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	**	N.S	N.S

*, ** and N.S indicate $P<0.05$, $P<0.01$ and not significant, respectively. Means of each factor designated by the same latter are not significantly different at 5% level, using Duncan's multiple range test.

that using large mother bulbs produced higher number of umbels/plant and this associated with increasing in seed yield/plant. The present results are in accordance with those reported by Mostafa, 1992; Brewster, 1994; Mostafa et al. 1996; Nawab et al., 1998 and Singh and Sachan, 1998 and 1999.

Effect of planting space:

As shown in Tables (2 and 3), planting spaces (15, 25 and 35 cm apart) significantly affected diameter of main umbel, dry weight of umbels/plant, seed weight/umbel, seed yield per plant and per feddan as well as 1000-seed weight. Increasing planting space caused a significant increase in these traits, except seed yield /fed., which significantly decreased with increasing planting space. Seed yield/plant was significantly increased, but seed yield/fed. was significantly decreased with each increment in planting space. While, planting space had no significant effect on number of sprouts and scapes/plant as well as seed setting and seed germination percentages in both seasons. Increasing planting space positively affects weight and diameter of umbel/plant, which reflected in seed yield/plant. Such result are realistic logic, where wide spaces between plants permit more suitable conditions for higher productivity of individual plant, while in case of narrow space, higher seed yield/fed. is due to the intensive number of plants/unit area. These results were supported by the findings of Mostafa, 1992; Singh et al., 1993; Abdel-Latif, 1995; Gamie et al., 1996; Nawab et al., 1998 and Singh and Sachan, 1999.

Effect of nitrogen level :

The analysis of variance indicate that all studied traits were significantly increased with increasing nitrogen level (Tables, 2 and 3). This fact was true in both seasons. The obtained results reveal that with each increment of applied nitrogen the number of sprouts and scapes/plant as well as seed yield per plant and per feddan were significantly increased in both seasons. Nitrogen fertilizer is of much importance to onion seed product, it is considered as essential element for both growth and reproductive all plants and onion crop. In general, application of nitrogen fertilizer improvement plant growth and photosynthetic capacity, which reflected in turn on increases different yield components as well as seed yield per plant and per feddan. These results are in harmony with those obtained by Farag et al., 1989; Hanna-Alla et al., 1997; Rahim et al., 1997 and El-Saadany and Salman, 2000.

Effect of interaction:

Data presented in Tables (2 and 3) show that the interactions among three factors under study failed to exert any significant effect on studied traits. except that the interaction between mother bulb size and nitrogen level on number of sprouts and scapes /plant only in the first season as well as on seed yield per plant and per feddan in both seasons. The interaction between mother bulb size and planting space was also significant on seed weight/umbel and seed yield/plant in the first season. The interaction among three factors affected significantly seed yield/fed. only in the second season.

Data in Tables (4 and 5) reveal that the combination between the largest mother bulb size (>5 cm in diameter) and the highest nitrogen level (120 kg N/fed.) recorded the highest values of number of sprouts and scapes/plant as well as seed yield per plant and per feddan. Whereas the smallest mother bulb size (<3 cm in diameter) gave the lowest values of mentioned traits when it fertilized with 60 kg N/fed.

Data presented in Table (6) show clearly that the highest weight of seed/umbel was obtained from medium bulb sizes and wide planting space. while the highest value of seed yield/plant was obtained from large bulbs and wide planting space. Small bulbs and narrow planting space recorded the lowest values of both traits. That was true in the two growing seasons.

According to the data in Table (7). it is clear that the highest seed yield/fed. was obtained by sowing the largest mother bulb size (>5 cm in diameter) at the narrow planting space (15 cm apart) and fertilized onion plants with the highest nitrogen level (120 kg N/fed.). while the smallest mother bulb size (<3 cm in diameter) gave the lowest seed yield/fed. when it planted at the wide planting space (35 cm apart) and its plants were fertilized with the lowest nitrogen level (60 kg N/fed.).

Table (4): Number of sprouts and scapes/plant of onion cv. Giza 20 as influenced by the interaction between mother bulb size and nitrogen level in 1999/2000 season

Nitrogen level (kg/fed.)	Mother bulb size (cm)		
	< 3	3-5	> 5
	Number of sprouts/plant		
60	4.01e	3.77f	4.46c
90	4.09de	4.01e	4.89b
120	4.15de	4.26cd	5.30a
	Number of scapes/plant		
60	3.44g	3.64fg	4.69c
90	3.74ef	3.97de	5.41b
120	4.13d	4.75c	5.92a

Means designated by the same latter are not significantly different at 5% level, using Duncan's multiple range test.

Table (5): Seed yield per plant and per feddan of onion cv. Giza 20 as influenced by the interaction between mother bulb size and nitrogen level in 1999/2000 and 2000/2001 seasons.

Nitrogen level (kg/fed.)	Mother bulb size (cm)					
	< 3	3-5	> 5	< 3	3-5	> 5
	Seed yield (g/plant)					
	1999/2000 season			2000/2001 season		
60	12.39f	13.22ef	17.72cd	13.13f	13.29f	21.84cd
90	12.98ef	19.10c	22.64b	15.10ef	18.43de	28.84b
120	15.85de	24.35ab	26.68a	17.57e	23.89c	37.49a
	Seed yield (kg/fed.)					
	1999/2000 season			2000/2001 season		
60	243.75g	350.42e	366.67de	248.75f	311.25e	416.33cd
90	259.17fg	430.83cd	519.50b	320.42e	465.00c	461.75c
120	326.25ef	438.75c	656.25a	362.50de	571.58b	672.00a

Means designated by the same latter are not significantly different at 5% level, using Duncan's multiple range test.

Table (6): Seed weight/umbel and seed yield/plant of onion cv. Giza 20 as influenced by the interaction between mother bulb size and planting space in 1999/2000 season.

Planting space (cm)	Mother bulb size (cm)		
	< 3	3-5	> 5
	Seed weight/umbel		
15	3.27e	3.75d	4.58bc
25	3.83de	4.18cd	4.63bc
35	4.87b	5.47a	4.92ab
	Seed yield (g/plant)		
15	10.12g	13.21fg	15.10ef
25	13.14fg	19.55cd	20.97bc
35	17.46de	24.18b	30.98a

Means designated by the same latter are not significantly different at 5% level, using Duncan's multiple range test.

Table (7): Seed yield/fed. Of onion cv. Giza 20 as influenced by the interaction between mother bulb size, planting space and nitrogen level during 2000/2001 season.

Planting space (cm)	N- level (kg/fed.)	Mother bulb size (cm)		
		< 3	3-5	> 5
15	60	362.5 i-m	376.25 h-l	419.75 d-j
	90	400.00 d-j	533.75 cde	515.75 c-g
	120	467.50 d-i	645.00 b	675.50 a
25	60	226.25 no	283.75 lmn	416.00 e-j
	90	271.25 lmn	791.25 d-h	406.00 g-k
	120	327.50 j-n	537.25 cd	610.75 bc
35	60	157.50 o	273.75 lmn	413.25 f-d
	90	250.00 mno	370.00 i-l	463.50 d-i
	120	292.50 k-n	532.50 c-f	529.75 c-f

Means designated by the same latter are not significantly different at 5% level, using Duncan's multiple range test.

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الملخص العربى

تأثير حجم الأبصال ومسافات الزراعة ومعدلات التسميد النيتروجينى على إنتاج وجودة بذرة البصل

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** معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية

أجريت تجربتان حقليتان بالمزرعة البحثية لمحطة البحوث الزراعية بسخا- كفرالشيخ- مصر خلال موسمى ١٩٩٩/٢٠٠٠، ٢٠٠٠/٢٠٠١م لدراسة تأثير ثلاث أحجام من الأبصال بأقطار <٣، ٣-٥، >٥ سم وثلاث مسافات للزراعة وهى ١٥، ٢٥، ٣٥ سم بين الأبصال وثلاث مستويات من التسميد النيتروجينى وهى ٦٠، ٩٠، ١٢٠ كجم أزوت/فدان على إنتاجية وجودة بذور البصل صنف جيزة ٢٠. أستخدم تصميم القطع المنشقة مرتين فى أربع مكررات فى هذه الدراسة. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

أوضحت النتائج المتحصل عليها أن لحجم الأبصال تأثير معنوى على كل من عدد الأفرخ الخضرية وحوامل النورات والوزن الجاف للنورات للنبات، محصول البذور للنبات والفدان، وزن الـ ١٠٠٠ بذرة فى كلا موسمى النمو

بالإضـــافة الى تأثيرها على قطر النورة الرئيسية فى موسم ٢٠٠٠/٢٠٠١م، وزن الـــبذور/نورة فى موسم ١٩٩٩/٢٠٠٠م. ولقد أدت زراعة الحجم الكبير للأبصال الـــى الحصول على أعلى القيم من كل هذه الصفات. ومن ناحية أخرى فإن صفتى نســـبة العقد ونسبة إنبات البذور الناتجة لم تتأثر معنويا باختلاف حجم الأبصال فى كلا موسمى الدراسة.

أدت زيـــادة مســـافة الزراعة بين الأبصال من ١٥ الى ٣٥ سم الى زيادة معـــنوية فى قطر النورة الرئيسية/نبات، الوزن الجاف لنورات النبات، وزن البذرة لكل نورة، محصول البذرة لكل نبات، وزن الـــ ١٠٠٠ بذرة بينما أدت الى نقص معـــنوى فـــى محصول البذور للفدان. ولم يكن لمسافات الزراعة بين الأبصال أى تأثيـــر معنوى على عدد الأفرخ الخضرية والحوامل النورية للنبات بالإضافة الى نسبة العقد ونسبة الإنبات فى كلا الموسمين.

نـــتج عن إضافة المستوى العالى من النيتروجين (١٢٠ كجم أزوت/فدان) أعلـــى القيم من كل الصفات المدروسة بكلا الموسمين. كما تشير النتائج أيضا الى أن كـــل زيادة فى مستوى النيتروجين المضاف أدت الى زيادة معنوية فى كل من عـــدد الأفـــرخ الخضـــرية وحوامل النورات للنبات بالإضافة الى محصول البذرة للنبات والفدان فى كلا الموسمين.

وعمـــوما يمكن توصية مزارعى البصل بمحافظة كفرالشيخ للحصول على أعلى محصول من البذور ذات الجودة العالية بزراعة الأبصال كبيرة الحجم (> ٥ ســـم فى القطر) على مسافات (١٥ سم بين الأبصال) وتسميدها بمعدل ١٢٠ كجم أزوت للفدان.