EFFECT OF SEED SIZE ON GERMINATION, YIELD AND JUICE QUALITY OF SOME SUGAR BEET VARIETIES (*BETA VULGARIS* L.) IN EGYPT

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Abstract

Two experiments were carried out, a laboratory experiment and a field one to study the effect of seed size, variety and their interaction on seed viability, germinability, yield and juice quality of some sugar beet varieties(*Beta vulgaris L.*). The effect of temperature, variety, seed size and their interaction on sugar beet seed germination was also investigated. The field experiment was conducted in Tameya district, El Fayoum governorate. Both experiments were carried out during the two successive seasons 2001/2002 and 2002/2003. Sugar beet seeds of the three tested varieties (Samba, Gazilla and Helious) were divided into three seed diameters (<5, 5-7 and >7 mm).The experimental design used was a randomized complete blocks with three replications. The obtained data revealed that Gazilla variety surpassed the other two varieties in weight of 1000 fruits (33.31 g), weight of 1000 true seeds (12.63 g), mean number of the true seeds/fruit (2.25), root yield (27.75 t/fed.) and sugar yield (4.46 t/fed.). Samba variety was superior in germination percentage (65.60%) and Helious variety gave the maximum value for monogermity percentage (31.43%). Larger seeds (>7mm) gave the highest value for weight of 1000 fruits (49.12 g), weight of 1000 true seeds (22.42 g), mean number of true seeds/ fruit (2.45), emergence percentage(68.89%), germination percentage (68.17%)and speed of germination at 25 C^0 (0.93). Smaller seeds (<5mm) were superior in monogermity percentage (48.79%). Germination percentage was maximum at 25 C^0 which gave (56.48%). Variety, seed size and their interaction did not affect sugar percentage, alfa amino nitrogen (ml.Equ.), sodium (ml. Equ.), potassium (ml.Equ.), purity%, sugar lost to molasses % , sugar extractable% nor extractability.

INTRODUCTION

Sugar beet (Beta vulgaris, L.*)* is a biennial crop. It is the second sugar crop of the two main crops responsible for sugar production, the other crop is sugar cane. Yield and quality of sugar beet are dependent on a number of important factors such as variety, weather, soil characters, plant population...etc. Sugar beet is an indeterminate plant, therefore, harvested seeds will have different seed sizes, the

earlier flowers emerge and give larger and mature seeds. This gives seed size an important role in determining the number of plants per area and affect germination, emergence and plantlet vigor, which could be reflected in the final yield. Blaesdale (1966) concluded that with most crops, early growth is related to seed size but final yield is seldom-affected. Tekrony and Hardin (1969) claimed that the major cause of variable and poor seedling emergence in sugar beet is the occurrence of seedless fruits and those containing undeveloped seeds, which might be less frequent in large seed grades. On the other hand, Bornscheuer (1972) reported that while field emergence invariably improved with increasing seed size within the same seed bulk, large seeds from one seed lot is not necessarily better than small seeds from another lot. Francois and Goodin (1972) tested germination of two multigerm varieties Us-H2 and Us-H6 and two monogerm one Us-H5 at 10, 15, 20, 25, 30, 35 and 45 C^0. They found that seed germination for all varieties was maximum at 25 C^0, near maximum at 10 to 15 C^0, markedly depressed when germinated over 25 C^0 to 35 C^0 range and nearly completely inhibited at temperatures greater than 40 C^0. They added that large-seeded multigerm variety Us-H2 germinated significantly better than the other three varieties at the lower temperatures of 10, 15 and 25 C^0. Farag (1978) found a strong positive relation between seed size and the weight of 1000 seeds. Large seeds produced large seedlings which consequently were able to emerge from greater soil depth and generally considered to be adaptive under harsh establishment. There has been some differences in the review concerning the optimum constant temperatures required for the germination of sugar beet. Chamberland (1974) reported that a range of 15-25 C^0 was the optimum temperature for sugar beet germination. Brown (1980) and Cuddy (1960) found that 20 C^0 was the optimum degree for sugar beet germination. This investigation aims to study the effect of seed size, variety and their interaction on seed quality, germinability, yield and juice quality of some sugar beet varieties. This study was carried out to investigate the effects of sugar beet variety, seed size and their interaction on seed viability, yield and yield components of *Beta vulgaris*, L.

MATERIALS AND METHODS

In this study seeds of the varieties Samba, Gazilla and Helious were used. The three varieties were introduced from Netherlands, Germany and Denmark, respectively. Two experiments were executed.

The first experiment was carried out in the laboratory using petri dishes to study germination parameters and performance of sugar beet seeds. The laboratory experiment was conducted to study the effect of seed size (<5, 5-7, and >7mm) of

the three sugar beet varieties (Samba, Gazilla, Helious) on seedling characters and quality under controlled conditions. Seeds were screened using screens with suitable mesh diameters.

The second experiment was conducted in the field during two successive seasons 2001-2002 and 2002-2003 in Tameya district – El-Fayoum Governorate to study the effect of variety and seed size on sugar beet yield and yield components. Physical and chemical properties of the experimental soil are shown in Table (1).

Laboratory experiment:

Germination temperatures used in this experiment were 5, 10, 15, 20, 25, and 30C. The germination was carried out in a germinator in glass petri – dishes, using Whattman No.1 papers moistened with 2 ml. distilled water. Three replications each of 25 seeds were used for each experimental temperature. The dishes were watered every two days or when needed. The seeds were considered germinated when essential structures i.e. the root tip and radical just protruded from the seed coat. The number of germinated seeds were counted every day for fourteen days since no more germination was observed when the seeds were left in the germinator for another week.

The experimental design was complete randomized with three replications and the following characters were recorded.

Table 1. Physical and chemical properties of the experimental soil.

Analysis	Season	
	2001/2002	2002/2003
Mechanical analysis		
Coarse sand%	1.35	1.82
Fine sand%	14.6	17.18
Silt%	21.3	18.0
Clay%	60.1	62.1
Texture	Clay	Clay
$Caco_3$	1.4	1.6
Chemical analysis		
Organic matter%	1.80	2.0

Available nitrogen ppm	16.25	17.3
Available phosphorus ppm	6.53	6.68
Available potassium ppm	290.36	274.35
Saturation water%	60	70
pH	8.3	8.2
EC ds/m	3.40	3.3
Cations & anions, meq/L		
Na+	6.6	6.88
K+	0.33	0.50
Ca++	2.20	2.70
Mg++	2.60	2.94
HCO_3^- meq/L	6.0	6.8
Cl-	5.6	6.00
SO_4^{--}	0.13	0.22

1- Weight of 1000 fruits (g.)

One hundred fruits of the tested varieties were weighted separately, then the weight of 1000 fruits was calculated by multiplying x 10 to obtain the weight of 1000 fruits.

2- Weight of 1000 true seeds(g.)

To calculate the weight of 1000 true seeds (g), the weight of 100 fruits was determined, then the true seeds were separated carefully, after separation of true seeds, the weight of the fruit coats of the hundred fruits were weighted. The weight of true seeds was calculated by subtracting the weight of 100 fruit coats from the weight of 100 fruits. The weight of 1000 true seed was calculated by multiplying the weight of 100 true seeds x 10.

3- Monogermity percentage.

Number of fruits that contains only one true seed was counted and monogermity percentage was calculated.

No. of monogerm seeds x 100/total seed No.

4- Mean number of true seeds per fruit.

Fruits were soaked in water for twelve hours and true seeds were separated by needle then mean number of true seeds per fruit was calculated.

5 - Speed of germination

Speed of germination was calculated from the following equation (ISTA, 996):

Speed of germination = a + (a+b) + (a+b+c)+(------)/n (a+b+c+-------) where:

a= number of germinated seeds at the first count

b= number of germinated seeds at the second count

c= number of germinated seeds at the third count

n= number of counts

Germination percentage

Germination was carried out at $25C^0$. Seeds were sown in the lass petri dishes (10.5 cm diameter), then covered with 2 cm. fine sand. The prepared dishes were moistened with distilled water to be just moist. The dishes were kept in complete darkness and watered every two days. The number of germinating seeds was counted every day. The seed is considered to be germinated when the essential structures i.e., root tip and radical are protruded and developed which are indicative for normal germination. Count was continued for 14 days. (ISTA 1996).

Effect of different temperatures, seed sizes, variety and their interactions on sugar beet germination

Effect of different constant temperatures (^oC) on seed germination:

Favorable temperature is a pre requisite to successful germination and seedling emergence before irrigation.

To test this factor experimentally, the seeds of the three studied sugar beet varieties were screened into three seed diameters (<5, 5-7, and >7 mm) by using screens with suitable mesh diameters to explain the effect of seed size on germination percentage and the lowest temperature below which germination ceases, the highest temperature above which germination ceases and the most suitable temperature for highest germination percentage.

Three replications were used for each experimented temperature, 25 seeds were sown in each dish. Observations were taken. Germination experiments were conducted under a wide range of constant temperatures of 5, 10, 15, 20, 25 and 30 C^0

in a seed germinator in complete darkness for 14 days. The number of germinated seeds were counted every day until no more germination was observed when the seeds were left in the incubator for another week.

Field experiment (yield characters)

Sugar beet seeds of the three varieties under investigation were screened into three seed diameters (i.e., <5, 5-7, >7mm). The experimental design was a randomized complete blocks with three replications. Each plot was 21 m^2 consisted of 6 ridges 7m long and 50 cm apart. Distance between hills was 20 cm. Planting date was on 4th of October in both seasons. All cultural practices were carried out following the recommendations of Ministry of Agriculture. Plants were harvested at the age of 180 days in both seasons and the following data were collected:

1-Root length (cm.) was calculated from 10 random roots

2- Root diameter (cm.) was calculated from 10 random roots. Root diameter was estimated at the upper third of the root.

3-Root yields (ton/fed.).

Root yield was calculated by inverting plot yield into fed. yield by multiplying plot yield x 200.

Quality traits

They were determined in the lab of Delta Sugar Company according the following:

4- Sugar percentage.

Sugar percentage was determined following the method of Le-Docte (1927)

5- Purity percentage

Purity % = B X 100\ Polarity (Devillers, 1988)

B = Sucrose % – (0.029-0.343)(k+Na)-0.0939(alfa amino-N)

6- Alfa amino nitrogen

Alfa amino nitrogen was determined using hydrogenation method according to Carruthers et al. (1962).

(Na & K) sodium and potassium were determined in the digested solution using flamephotometry- according method described by Brown and Lilliand (1964)

7- Sucrose loss to molasses (S.L.M%)

Sucrose loss to molasses (S.L.M) % =0.14 (Na + K) + 0.25(alfa amino nitrogen) + 0.5 (Devillers, 1988)

8- Sugar Extractable %(S.EX)

Sugar Extractable % = sucrose% – (0.029-0.343)(k+Na)-0.0939(alfa amino-N) (Reinefeld et al., 1974).

9- Extractability %(S.EX/Polarity)

Extractability % = sugar extraction/ sucrose %

10- Sugar yield.

Sugar yield was calculated from the following equation:

Sugar yield=root yield x extractability%

Statistical analysis

All data were exposed to statistical analysis. Since there was homogeneity between both seasons in laboratory traits, a combined analysis was performed. Least significant difference (LSD) values at 5% level of probability according to Steel and Torrie (1980) were used to compare treatment means.

RESULTS AND DISCUSSION

Laboratory experiment

1- Weight of 1000 fruits (g)

Data in Table (2) reveal that there were significant differences among varieties, fruit size and their interaction in 1000 fruit weight in both seasons (2001/02-2002/03) and their combined data. In both seasons and their combined data, Gazilla variety gave the highest 1000 fruit weight followed by Samba and Helious (32.38, 34.23 and 33.31 - 25.56, 31.25 and 28.41 - 23.16, 24.13 and 23.65 g, respectively). The 1000 seed weight significantly and gradually increased with increasing fruit size in both seasons and their combined data giving the highest values with fruits which are larger than 7 mm(45.69, 52.54 and 49.12 g). The interaction of variety x fruit size gave significantly different values in both seasons and their combined data. The biggest fruit size of Gazilla variety gave the highest fruit weight in both seasons and their combined data (60.27, 64.19 and 62.23, respectively). These results could be attributed to the fruit position on the inflorescence, since fruits produced in different parts of the same inflorescens may differ in weight.

2-Weight of 1000 true seed

Table (2) reveals the effect of variety, seed size and their interaction on 1000 true seed weight. There were significant differences among the three seed sizes (< 5 mm, 5-7 mm and > 7 mm), for the three varieties (Gazilla, Samba and Helious) and their interaction in both seasons and their combined data. Gazilla variety gave the highest 1000 true seed weight followed by Samba and Helious(11.84, 13.41 and 12.63 - 9.71, 10.73 and 10.22 - 5.54, 7.04 and 6.29 g in the 1 st and 2 nd seasons and their combined data, respectively). The largest seed size of Gazilla variety gave the highest seed weight in both seasons and their combined data (21.20, 23.64 and 22.42 g). The weight of 1000 true seed significantly increased with increasing seed size. Variety x seed size interaction was significant in both seasons and their combined data. The highest 1000 true seed weight resulted from Gazilla with 7 mm size. This result is in agreement with those obtained by Farag (1978) who reported that the weight of true seed is related to fruit weight and how seed size grading affect this relationship.

3-Monogermity percentage

Data in Table (3) indicate significant differences among varieties, different seed sizes and their interaction in monogermity in both seasons and their combined data. In both seasons and their combined data, Helious variety surpassed the other varieties in monogermity with an average of 31.24, 31.61 and 31.43% followed by Samba (26.90, 24.31 and 25.61%). Fruits which are larger than 7 mm had no monogerm seeds while those less than 5 mm seeds gave the highest values in both seasons and their combined data (47.50, 50.08 and 48.79, respectively). The interaction between variety and seed size was significant. Seeds less than 5 mm of Helious variety gave the highest percentage of monogermity (59.77, 58.03 and 58.90 %) in both seasons and their combined data, respectively.

4-Mean number of true seeds per fruit

Data in Table (3) reveal that there were significant differences among varieties and seed sizes in both seasons and their combined data, while, the interaction of variety x seed size was not significant in both seasons and their combined data. Gazilla variety significantly exceeded the other two varieties in both seasons and their combined data (2.17, 2.32 and 2.25 true seed/ fruit). Number of true seeds was significantly increased with increasing seed size in both seasons and their combined data (1.50, 1.44 and 1.48- 1.88, 2.07 and 1.98 - 2.18, 2.72 and 2.45 true seeds/fruit with <5, 5-7, and >7 mm diameter, respectively).

5- Germination percentage (25 C^0)

Samba variety significantly exceeded both varieties only in the first season (73.78) while Helious variety had the lowest values (52.89). In both seasons and their combined data, germination percentage was increased gradually with increasing seed size giving the highest values with seeds more than 7 mm (68.44, 69.33 and 68.89%, respectively). The interaction between varieties and seed size was significant only in the 1st season. The highest germination % (77.33, 76.00 and 76.67%) resulted from Samba with seeds of >7 mm in the first, second season and their combined data respectively.

6- Speed of germination

Data presented in Table (4) reveal that seed size significantly affected germination speed in the second season and combined data only while these differences were too small to reach the level of significance in the 1^{st} season. The highest speed of germination was resulted from >7 mm seed size (1.00 and 0.93) followed by 5-7 mm and <5 mm seeds (0.97, 0.91 and 0.87, 0.83 respectively) in a descending order in the second season and combined data. No significant effect of variety X seed size on speed of germination was detected in both seasons and their combined data.

Effect of temperature, variety, seed size and their interaction on sugar beet seed germination

Germination % gradually increased with temperature to a maximum at 25C^0. The increase in seedling emergence above 5 C^0 was 42.96, 44.00 and 43.48% in the first and second season and their combined data, respectively (Tables 5, 6 and 7). It is worth to mention that severe decrease in germination percentage occurred at 30 C^0, such depression was 25.04, 24.15 and 24.60% in the first and second season and their combined data, respectively. Samba variety gave the highest value of germination percentage (64.96, 66.22 and 65.60%). No significant difference between the last two varieties was revealed with respect to germination percentage in both seasons and their combined data. Data in Table (5, 6 and 7) reveal significant effect of seed size on seed germination in both seasons and their combined data. Seeds >7 mm in diameter gave the highest value of seed germination (66.93, 69.41 and 68.17%). This result shows that the more diameter of the seed, the more germination it has. This may be due to the bigger embryo and storage materials in the large seed or the more number of true seeds in the large fruits. The interaction of temperature x variety gave the highest value from seeds germinated at 25 ^{0}C of Samba variety (84.00 %). The interaction of temperature x seed size gave the highest value from

seeds larger than 7 mm at 25 ^{0}C in both seasons and their combined data (90.67, 92.44 and 91.56%, respectively). The interaction between seed size and variety gave the highest value of germination percentage in both seasons and their combined data from seeds >7 mm of Samba variety (78.44, 79.11 and 78.79%, respectively). The interaction among temperature, variety and seed size gave the highest value in both seasons and their combined data from seeds germinated at 25^0 C with diameter >7 mm of Samba variety (96.00, 96.00 and 96.00%).

Field experiment (yield characteristics):

1-Root length

Differences among varieties, seed size and their interaction did not significantly affect root length in the first season, as was in the second season, Gazilla variety produced the longest roots with significant differences of Helious variety (table 8). Differences between Samba and Helious or Gazilla and Samba in root length did not reach the level of significance.

2-Root diameter

Table (8) represents the effect of variety, seed size and their interaction on root diameter in both seasons. In the first season, no significant differences were detected among varieties, seed size and their interaction. In the second season neither varieties nor their interaction with seed size had a significant effect on root diameter. While differences among seed sizes in root diameter were significant. Seeds less than 5 mm were significantly lower in root diameter (13.19 cm) than those of 5-7 mm and those more than 7 mm (14.40 and 14.49 cm, respectively). However there were no significant differences between the last two sizes. These data are in the same trend of those of Black (1959) and Bleasdale (1966).

3-Root yield

In both experimental seasons, there were significant differences among varieties. Gazilla variety gave the highest root yield values (28.46 and 27.04 t/fed., respectively) Table (9). Seed size exhibited significant effect on root yield only in the second season. Increasing seed size from <5 mm up to >7 mm substantially increased root yield from 14.19 to 26.09 to/fed. The increase in root yield accompanying higher seed size might have been due to the increase in emergence percentage, speed of germination as well as to the increase in root size in terms of length and diameter. The interaction between varieties and seed size had no significant effect on root yield/fed in both seasons (Table 9).

Quality traits

4- Sugar percentage.

In both seasons no significant effect was detected from variety, seed size and their interaction on sucrose percentage (table 9). This result is logical since the sucrose percentage is mostly affected by meteorological factors than other environmental factors. The same result was obtained by Farag (1978) who did not find any effect of seed grading on sugar beet sucrose percentage.

5- Impurities (Na, K, and alfa amino nitrogen)

In both seasons, no significant differences were detected among varieties, seed size and their interactions (Tables 10 and 11). The non significant effect of the experimental treatments on impurities have a great importance because it means that one can use any seed size of any variety without increasing percentage of impurities which is considered a great problem in sugar factories.

6- Purity, sugar loss to molasses, sugar extractable % and extractability (Slm – SEX and SEX/Pol)

There was no effect of variety, seed size and their interaction on purity SLM-SEX or SEX/POL in both seasons. This result has a great value since we may use different seed sizes within the treatment range without having any effect on juice technological characters (Tables 11, 12 and 13).

10-Sugar yield \fed

In both seasons, varieties differed significantly in sugar yield, where Gazilla variety surpassed the other varieties giving 4.59 and 4.32 ton\fed followed by Samba variety 4.16 and 4.01 ton\fed and Helious variety 3.85 and 3.63 ton\fed in the first and second seasons, respectively). The superiority of Gazilla in sugar production may be attributed to its large size roots and higher root yield per fed as well as higher percentage of extracted sugar.

The effect of seed size on sugar yield was significant only in the second season. In the second season, seeds >7 mm in diameter significantly gave the highest sugar yield\fed (4.16 ton\fed). The highest sugar yield accompanying seeds >7 mm might have been resulted from high root yield as well as lower percentage of impurities in terms of Na, K and amino N.

No significant effect of the interaction between variety and seed size on sugar yield could be detected in both seasons (Table 13).

CONCLUSION

From the obtained results, we can conclude that seed size has a significant effect on the germination and plantlet traits but not yield and its components. So, under good environmental conditions, we may introduce small seeds (which is economically cheaper) but under hazard conditions, it would be better to import larger seeds to avoid the decrease in plant number/area unit which may affect yield and quality.

Table 2. Effect of variety, seed size and their interaction on weight of 1000 fruits and true seeds in 2001/2002 and 2002/2003, seasons and their combined data.

Variety	Seed size	Weight of 1000 fruits (g.)			Weight of 1000 true seeds (g.)		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	12.37	13.43	12.90	4.13	5.31	4.72
	5-7	24.50	25.08	24.79	10.20	11.27	10.74
	> 7	60.27	64.19	62.23	21.20	23.64	22.42
Mean		32.38	34.23	33.31	11.84	13.41	12.63
Samba	< 5	11.83	13.54	12.69	4.63	4.83	4.73
	5-7	19.77	22.62	21.20	6.30	8.05	7.18
	> 7	45.07	57.60	51.34	18.20	19.32	18.76
Mean		25.56	31.25	28.41	9.71	10.73	10.22
Helious	< 5	11.43	11.91	11.67	1.47	3.90	2.69
	5-7	26.30	24.67	25.49	6.43	7.22	6.83
	> 7	31.73	35.82	33.78	8.73	10.00	9.37
Mean		23.16	24.13	23.65	5.54	7.04	6.29
Mean of seed size	< 5	11.88	12.96	12.42	3.41	4.68	4.05
	5-7	23.52	24.12	23.82	7.64	8.85	8.25
	> 7	45.69	52.54	49.12	16.04	17.65	16.85
L.S.D value at 5%							
Variety		1.56	2.00	1.09	1.22	0.79	0.63
Seed size		1.56	2.00	1.09	1.22	0.79	0.63
Variety x seed size		2.71	3.5	1.89	2.12	1.36	1.09

Table 3. Effect of variety, seed size and their interaction on monogermity% (Arcsin converted data) and mean number of true seeds/fruit in 2001/2002 and 2002/2003, seasons and their combined data.

Variety	Seed size	Monogermity %			Mean number of true seeds/fruit		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	33.70	47.63	40.67	1.79	1.55	1.67
	5-7	11.50	20.10	15.80	2.20	2.37	2.29
	> 7	0.00	0.00	0.00	2.53	3.03	2.78
Mean		15.07	22.58	18.83	2.17	2.32	2.25
Samba	< 5	49.03	44.57	46.80	1.47	1.54	1.51
	5-7	31.67	28.37	30.02	1.77	2.10	1.94
	> 7	0.00	0.00	0.00	2.07	2.77	2.42
Mean		26.90	24.31	25.61	1.77	2.14	1.96
Helious	< 5	59.77	58.03	58.90	1.27	1.22	1.25
	5-7	33.97	36.80	35.39	1.68	1.72	1.70
	> 7	0.00	0.00	0.00	1.93	2.36	2.15
Mean		31.24	31.61	31.43	1.63	1.77	1.70
Mean of seed size	< 5	47.50	50.08	48.79	1.51	1.44	1.48
	5-7	25.71	28.42	27.07	1.88	2.07	1.98
	> 7	0.00	0.00	0.00	2.18	2.72	2.45
L.S.D value at 5%							
Variety		6.49	1.98	3.23	0.29	0.41	0.22
Seed size		6.49	1.98	3.23	0.29	0.41	0.22
Variety x seed size		11.23	3.43	5.60	N.S	N.S	N.S

Table 4. Effect of variety, seed size and their interaction on germination percentage % (sand test) and speed of germination % at 25 oC in 2001/2002 and 2002/2003 seasons and their combined data.

Variety	Seed size	Emergence percentage (sand test) at 25 °C			Speed of germination at 25 °C		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	52.00	56.00	54.00	0.85	0.85	0.85
	5-7	65.33	64.00	64.67	0.90	0.99	0.95
	> 7	69.33	73.33	71.33	0.92	1.00	0.96
Mean		62.22	64.44	63.33	0.89	0.95	0.92
Samba	< 5	69.33	64.00	66.67	0.79	0.86	0.83
	5-7	74.67	70.67	72.67	0.82	0.95	0.89
	> 7	77.33	76.00	76.67	0.85	1.00	0.93
Mean		73.78	70.22	72.00	0.82	0.94	0.88
Helious	< 5	49.33	46.67	48.00	0.74	0.90	0.82
	5-7	50.67	54.67	52.67	0.82	0.98	0.90
	> 7	58.67	58.67	58.67	0.81	1.00	0.91
Mean		52.89	53.33	53.11	0.79	0.96	0.88
Mean of seed size	< 5	56.89	55.56	56.23	0.79	0.87	0.83
	5-7	63.56	63.11	63.34	0.85	0.97	0.91
	> 7	68.44	69.33	68.89	0.86	1.00	0.93
L.S.D value at 5%							
Variety		6.62	N.S	2.49	N.S	N.S	N.S
Seed size		6.62	7.39	2.49	N.S	0.05	0.04
Variety x seed size		11.46	N.S	N.S	N.S	N.S	N.S

Table 5. Effect of temperature, variety, seed size and their interactions on sugar beet seed germination (2001/2002 season).

Variety	Seed size	Temperature						
		5	10	15	20	25	30	Mean
Gazilla	<5	13.33	25.33	30.67	40.00	49.33	20.00	29.78
	5-7	32.00	45.33	54.67	70.66	84.00	56.00	57.11
	>7	42.67	52.00	61.33	76.00	90.67	64.00	64.44
Mean		29.33	40.89	48.89	62.22	74.67	46.67	50.44
Samba	<5	40.00	48.00	53.33	61.33	66.67	38.66	51.33
	5-7	49.33	56.00	64.00	66.66	89.33	65.33	65.11
	>7	65.33	73.33	80.00	84.00	96.00	72.00	78.44
Mean		51.56	59.11	65.78	70.67	84.00	58.67	64.96
Helious	<5	20.00	32.00	40.00	56.00	68.00	49.33	44.22
	5-7	25.33	38.66	53.33	64.00	74.67	52.00	51.33
	>7	29.33	44.00	56.00	72.00	85.33	61.33	57.89
Mean		24.89	38.00	49.78	64.00	76.00	54.22	51.15
Mean of temperature		35.26	46.00	54.82	65.63	78.22	53.18	55.52
Mean of seed size	<5	24.44	35.11	41.33	52.44	61.33	36.00	41.78
	5-7	35.56	46.67	57.33	67.11	82.67	57.78	57.85
	>7	45.78	56.22	65.78	77.33	90.67	65.78	66.93
L.S.D value at 5%								
Temperature								2.47
Variety								1.73
TxV								4.23
Seed size								1.73
T x S								4.23
S x v								3.00
T x s x v								7.33

Table 6. Effect of temperature, variety, seed size and their interactions on sugar beet seed germination (2002/2003 season).

Variety	Seed size	Temperature						
		5	10	15	20	25	30	Mean
Gazilla	<5	13.34	22.66	32.00	41.33	53.33	28.00	31.78
	5-7	33.33	45.33	60.00	72.00	88.00	64.00	60.44
	>7	44.00	52.00	66.67	80.00	92.00	69.33	67.33
Mean		30.22	40.00	52.89	64.44	78.11	53.78	53.19
Samba	<5	38.67	42.66	53.33	60.00	64.00	41.33	50.00
	5-7	48.00	53.33	72.00	84.00	92.00	68.00	69.56
	>7	65.33	72.00	81.33	86.66	96.00	63.33	79.11
Mean		50.67	56.00	68.89	76.89	84.00	60.89	66.22
Helious	<5	20.00	33.33	40.00	56.00	61.33	36.00	41.11
	5-7	28.00	41.33	56.00	70.66	82.67	56.00	55.78
	>7	32.00	48.00	60.00	76.00	89.33	65.33	61.78
Mean		26.67	40.89	52.00	67.56	77.78	52.44	52.89
Mean of temperature		35.85	45.63	57.92	69.63	79.85	55.70	57.43
Mean of seed size	<5	24.00	32.89	41.78	52.44	59.56	35.11	40.96
	5-7	36.44	46.67	62.67	75.56	87.89	62.67	61.93
	>7	47.11	57.33	69.33	80.89	92.44	69.33	69.41
L.S.D value at 5%								
Temperature								2.39
Variety								1.69
TxV								4.15
Seed size								1.69
T x S								4.15
S x v								2.39
T x s x v								7.18

Table7. Effect of temperature, variety, seed size and their interactions on sugar beet seed germination (combined data of 2001/2002 and 2002/2003 seasons).

Variety	Seed size	Temperature						
		5	10	15	20	25	30	Mean
Gazilla	<5	13.33	24.00	31.33	40.67	51.33	24.00	30.78
	5-7	32.67	45.33	57.33	71.33	86.00	60.00	58.78
	>7	43.33	52.00	64.00	78.00	91.33	66.67	65.89
Mean		29.78	40.44	50.89	63.33	76.22	50.22	51.81
Samba	<5	39.33	45.33	53.33	60.67	65.33	40.00	50.67
	5-7	48.67	54.67	68.00	75.33	90.67	66.67	67.34
	>7	65.33	72.67	80.67	85.33	96.00	72.67	78.79
Mean		51.11	57.56	67.33	73.78	84.00	59.78	65.60
Helious	<5	20.00	32.67	40.00	56.00	64.67	42.67	42.69
	5-7	26.67	40.00	54.67	67.33	78.67	54.00	53.56
	>7	30.67	45.67	58.00	74.00	87.33	63.33	59.83
Mean		25.78	39.44	50.89	65.78	76.89	53.33	52.02
Mean of temperature		35.56	45.82	56.37	67.63	79.04	54.44	56.48
Mean of seed size	<5	24.22	34.00	41.56	52.44	60.44	35.56	41.37
	5-7	36.00	46.67	60.00	71.33	85.11	60.22	59.89
	>7	46.44	56.78	67.56	79.11	91.56	67.56	68.17
L.S.D value at 5%								
Temperature								1.69
Variety								1.20
TxV								2.93
Seed size								1.18
T x S								2.93
S x v								2.07
T x s x v								5.22

Table 8. Effect of variety, seed size and their interaction on sugar beet root length and diameter in 2001/2002 and 2002/2003 seasons.

Variety	Seed size	Root length (cm.)			Root diameter (cm.)		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	28.00	28.20	28.10	13.00	13.20	13.10
	5-7	27.83	29.83	28.83	13.20	14.83	14.02
	> 7	28.50	30.30	29.40	13.33	14.77	14.05
Mean		28.11	29.44	28.78	13.17	14.27	13.72
Samba	< 5	28.67	28.43	28.55	12.67	13.23	12.95
	5-7	28.50	27.67	28.09	12.20	14.83	13.52
	> 7	30.67	29.47	30.07	13.33	14.63	13.98
Mean		29.28	28.52	28.90	12.72	14.23	13.48
Helious	< 5	29.67	27.17	28.42	13.50	13.13	13.32
	5-7	28.67	27.07	27.87	13.20	13.53	13.37
	> 7	27.67	27.37	27.52	12.83	14.07	13.45
Mean		28.67	27.20	27.94	13.17	13.58	13.38
Mean of seed size	< 5	28.78	27.93	28.36	13.06	13.19	13.13
	5-7	28.33	28.19	28.26	12.83	14.40	13.62
	> 7	28.94	29.04	28.99	13.17	14.49	13.83
L.S.D value at 5%							
Variety		N.S	1.96		N.S	N.S	
Seed size		N.S	N.S		N.S	0.95	
Variety x seed size		N.S	N.S		N.S	N.S	

Table 9. Effect of variety, seed size and their interaction on sugar beet root yield and sucrose % in 2001/2002 and 2002/2003 seasons.

Variety	Seed	Root yield (t/fed.)			Sucrose %		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	27.67	26.53	27.10	18.77	18.62	18.70
	5-7	29.20	26.67	27.94	18.55	18.43	18.49
	> 7	28.50	27.93	28.22	18.38	18.77	18.58
Mean		28.46	27.04	27.75	18.56	18.73	18.59
Samba	< 5	27.20	23.67	25.44	18.71	18.55	18.65
	5-7	25.67	25.33	25.50	18.62	18.39	18.63
	> 7	25.93	26.87	26.40	18.50	18.33	18.51
Mean		26.26	25.29	25.78	18.61	18.61	18.59
Helious	< 5	23.97	22.37	23.17	18.48	18.50	18.42
	5-7	25.00	22.86	23.93	18.78	18.73	18.61
	> 7	23.90	23.47	23.69	18.82	18.57	18.49
Mean		24.29	22.90	23.60	18.60	18.69	18.51
Mean of seed size	< 5	26.27	24.19	25.23	18.65	18.55	18.76
	5-7	26.62	24.95	25.79	18.65	18.52	18.70
	> 7	26.11	26.09	26.10	18.56	18.56	18.65
L.S.D value at 5%							
Variety		1.45	1.28		N.S	N.S	
Seed size		N.S	1.28		N.S	N.S	
Variety x seed size		N.S	N.S		N.S	N.S	

Table10. Effect of variety, seed size and their interaction on sugar beet alfa amino nitrogen % and sodium % in 2001/2002 and 2002/2003 seasons.

Variety	Seed size	Alfa amino nitrogen ml. Equ			Sodium ml. Equ		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	1.54	1.27	1.41	1.23	0.99	1.11
	5-7	1.37	1.48	1.43	1.53	1.38	1.46
	> 7	1.45	1.49	1.47	1.1	1.08	1.09
Mean		1.45	1.42	1.44	1.29	1.15	1.22
Samba	< 5	1.61	1.64	1.63	1.01	1.21	1.11
	5-7	1.61	1.59	1.60	1.18	1.20	1.19
	> 7	1.58	1.45	1.52	1.22	1.38	1.30
Mean		1.60	1.56	1.58	1.14	1.25	1.20
Helious	< 5	1.38	1.43	1.41	0.96	1.30	1.13
	5-7	1.78	1.27	1.53	1.79	1.57	1.68
	> 7	1.58	0.92	1.25	1.65	1.14	1.40
Mean		1.58	1.21	1.40	1.47	1.33	1.40
Mean of seed size	< 5	1.51	1.45	1.48	1.07	1.17	1.12
	5-7	1.58	1.45	1.52	1.50	1.38	1.44
	> 7	1.53	1.29	1.41	1.32	1.18	1.25
L.S.D value at 5%							
Variety		N.S	N.S		N.S	N.S	
Seed size		N.S	N.S		N.S	N.S	
Variety x seed size		N.S	N.S		N.S	N.S	

Table 11. Effect of variety, seed size and their interaction on sugar beet potassium % and purity % in 2001/2002 and 2002/2003 seasons.

Variety	Seed size	Potassium ml. Equ			Purity %		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	5.27	5.13	5.20	85.10	84.10	84.60
	5-7	5.04	5.64	5.34	85.00	83.90	84.85
	> 7	6.40	5.52	5.96	84.00	84.20	84.10
Mean		5.57	5.43	5.50	84.70	84.07	84.38
Samba	< 5	4.86	5.50	5.18	84.90	84.10	84.50
	5-7	4.89	5.46	5.18	85.20	83.90	84.55
	> 7	5.49	5.58	5.54	84.80	83.80	84.30
Mean		5.08	5.51	5.30	84.97	83.93	84.45
Helious	< 5	5.19	5.59	5.39	85.20	84.00	84.60
	5-7	6.25	5.79	6.02	85.30	83.80	84.55
	> 7	5.82	5.40	5.61	84.90	83.90	84.40
Mean		5.75	5.60	5.68	85.13	83.90	84.52
Mean of seed size	< 5	5.11	5.41	5.26	85.07	84.07	84.57
	5-7	5.40	5.63	5.52	85.17	83.87	84.52
	> 7	5.90	5.50	5.70	84.57	83.97	84.27
L.S.D value at 5%							
Variety		N.S	N.S		N.S	N.S	
Seed size		N.S	N.S		N.S	N.S	
Variety x seed size		N.S	N.S		N.S	N.S	

Table 12. Effect of variety, seed size and their interaction on sucrose lost to molasses % and sugar extractability in 2001/2002 and 2002/2003 seasons.

Variety	Seed size	Sucrose lost to molasses %			Sugar extractable %		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	1.80	1.68	1.74	16.10	16.11	16.11
	5-7	1.76	1.85	1.81	16.26	15.81	16.04
	> 7	1.91	1.80	1.86	15.95	15.71	15.83
Mean		1.82	1.78	1.80	16.11	15.88	16.00
Samba	< 5	1.72	1.85	1.79	15.88	15.59	15.74
	5-7	1.75	1.83	1.79	16.09	16.13	16.11
	> 7	1.83	1.83	1.83	15.57	15.80	15.69
Mean		1.77	1.84	1.81	15.85	15.84	15.85
Helious	< 5	1.71	1.82	1.77	15.89	16.08	15.99
	5-7	2.07	1.85	1.96	15.76	15.53	15.65
	> 7	1.94	1.65	1.80	15.82	15.95	15.89
Mean		1.91	1.77	1.84	15.82	15.85	15.84
Mean of seed size	< 5	1.74	1.78	1.76	15.95	15.93	15.94
	5-7	1.86	1.85	1.86	16.04	15.83	15.94
	> 7	1.89	1.76	1.83	15.78	15.82	15.80
L.S.D value at 5%							
Variety		N.S	N.S		N.S	N.S	
Seed size		N.S	N.S		N.S	N.S	
Variety x seed size		N.S	N.S		N.S	N.S	

Table 13. Effect of variety, seed size and their interaction on sugar beet extractable/polarity(Extractability) and sugar yield in 2001/2002 and 2002/2003 seasons.

Variety	Seed size	S.EX /Pol(Extractability)			Sugar yield		
		2001/2002	2002/2003	Mean	2001/2002	2002/2003	Mean
Gazilla	< 5	87.24	87.77	87.51	4.46	4.28	4.37
	5-7	87.26	86.69	86.98	4.75	4.21	4.48
	> 7	86.70	87.24	86.97	4.55	4.49	4.52
Mean		87.07	87.23	87.15	4.59	4.33	4.46
Samba	< 5	87.58	86.80	87.19	4.31	3.69	4.00
	5-7	87.36	87.16	87.26	4.14	4.09	4.12
	> 7	86.83	86.74	86.79	4.03	4.24	4.14
Mean		87.26	86.90	87.08	4.16	4.01	4.09
Helious	< 5	87.52	86.91	87.22	3.81	3.59	3.70
	5-7	85.77	86.93	86.35	3.94	3.55	3.75
	> 7	86.50	87.90	87.20	3.78	3.75	3.77
Mean		86.60	87.25	86.93	3.85	3.63	3.74
Mean of seed size	< 5	87.44	87.16	87.30	4.19	3.86	4.03
	5-7	86.80	86.93	86.87	4.28	3.95	4.12
	> 7	86.68	87.29	86.99	4.12	4.16	4.14
L.S.D value at 5%							
Variety		N.S	N.S		0.23	0.18	
Seed size		N.S	N.S		N.S	0.18	
Variety x seed size		N.S	N.S		N.S	N.S	

REFERENCES

1. Black, J. N. 1959. Seed size in herbage legumes. Herbage Abstracts 29:235-241.
2. Blaesdale K. A. 1966. Plant growth and crops yield .Ann.of Appl.Biology .57:173-182.
3. Bornscheuer E. 1972. Influence of different production regimes on sugar beet seed .35th winter congress of the International Institute of Sugar beet Research .Report No.2:1-8.
4. Brown S. J. 1980. Variation in germination and seedling emergence of sugar beet at sub-optimal temperatures. Annals of Applied Biology, 95: 143-150.
5. Borwn J. D. and O. Lilliand. 1964. Rapid determination of potassium and sodium in plant material and soil in extracts by Flame photometry. Pro. Amer. Soc. Hort. Sci; 48: 341-346.
6. Carruthers A., J. F. T. Oldfield and H. J. Teague. 1962. Assessment of beet quality. Paper Presented to the 15th Annual Technical Conference, British Sugar Corporation LTD. P 36. (C.F. Cooke D.A and Scott R.K (1993) The Sugar Beet Crop. 1st ed. Chapman and Hall (World crop series), London, UK.
7. Chamberland E. 1974. Germination tests of sweet sorghum and sugar beet cultivars. Candian journal of plant science, 54: 855-857.
8. Cuddy T. F. 1960. Studies on the germination of sugar beet seed. Proceedings of the Association of Official Seed Analysts, 49: 98-102.
9. Devillers P. 1988. Prevision du sucre melasse. Scurries francases 129, 190-200. (C. F. The Sugar Beet Crop Cooke D.A and Scott R.K, 19931st ed. Chapman and Hall (World crop series), London, UK.
10. Farag M. A. 1978. Breeding methods and seed treatments for improving seed characteristics ,root yield and sugar production in polyploid monogerm sugar beet , Ph Thesis ,The Hungarian Academy of Science
11. Francois L.E and J.R Goodin. 1972. Interaction of temperature and salinity on sugar beet germination, Agronomy journal., 64; 272-273.
12. ISTA. (1996) International rules for seed testing Association. Seed Science and Technology. 24: 155 – 202.
13. Le-Docte, A. 1927. Commercial determination of sugar in beet root. Le-Docte process. Int. Sug. J. 29: 488-492.

14. Reinfeld, E. A., G. Emmerrich,. C. W. Baumgarten and U. Beiss. 1974. Zurvaraussage des malassezyu chers aus Robenanailysen. Zuker, 27:2-25. (C. F. The sugar beet crop, Cooke, D.A and R.K. Scott.1 st ed. 1993. Chapman and Hall (World crop series), London, UK.)

15. Steel, R.G. and H.H. Torrie. 1980. Principles and procedures of statistics. 2 nd Ed. Mcgraw Hill. New York.

16. Tekrony D. M. and E.E. Hardin. 1969. The problem of under developed seeds occurring in monogerm sugar beets. J. Amer. Soc. Sugar Beet Technol.15(7):625-639.

تأثير حجم البذرة على الإنبات والمحصول وصفات العصير في بعض أصناف بنجر السكر في مصر

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تم إجراء تجربتين التجربة الأولي معملية والأخري حقلية لدراسة تأثير كل من الصنف وحجم البذرة والتفاعل بينهما علي جودة البذور والإنبات والمحصول وأيضاً جودة العصير في بعض أصناف بنجر السكر. وكذلك تأثير الحرارة والصنف وحجم البذرة والتفاعل بينهم علي الإنبات. أجريت التجربة الحقلية في منطقة طامية بمحافظة الفيوم بحيث نفذت كل من التجربتين في خلال موسمين متتاليين ٢٠٠١/٢٠٠٢ – ٢٠٠٢/٢٠٠٣ . تم تقسيم بذور ثلاثة أصناف من بنجر السكر (Gazilla, Samba, Helious) إلي ثلاثة أحجام (<٥, ٥–٧, >٧ مم). حقق الصنف Gazilla تفوقاً معنوياً في وزن ١٠٠٠ ثمرة (٣٣,٣١ جم)، وزن ١٠٠٠ بذرة حقيقية (١٢,٦٣ جم)، متوسط عدد البذور لكل ثمرة (٢,٢٥)، محصول الجذور (٢٧,٧٥ طن/فدان)، وأيضاً محصول السكر (٤,٤٦ طن/فدان) في حين أظهر الصنف Samba تفوقاً معنوياً في نسب الإنبات (٦٥,٦٠%) وأعطي الصنف Helious أعلي قيمة بالنسبة لنسبة البذور وحيدة الأجنة (٣١,٤٣%). حصلت البذور كبيرة الحجم علي أعلي قيمة لوزن ١٠٠٠ ثمرة (٤٩,١٢جم)، وزن ١٠٠٠ بذرة حقيقية (٢٢,٤٢جم)، متوسط عدد الأجنة لكل ثمرة (٢,٤٥)، النسبة المئوية لظهور البادرات (الإنبات في الرمل) علي درجة حرارة ٢٥ مْ (٦٨,٨٩%)، نسبة الإنبات (٦٨,١٧%) وكذلك سرعة الإنبات علي درجة حرارة ٢٥مْ (٠,٩٣) بينما حصلت البذور الأصغر حجماً علي أعلي قيمة بالنسبة لنسبة البذور وحيدة الأجنة (٤٨,٧٩%) . زادت نسبة الإنبات زيادة معنوية وتدريجية بارتفاع درجة الحرارة حتى وصلت إلي أعلي قيمة لها عند ٢٥مْ (٥٦,٤٨%). لم يكن لأي من الصنف أو حجم البذرة ولا التفاعل بينهما أيضاً تأثيراً معنوياً علي كل من النسبة المئوية للسكر ، ألفا أمينو نيتروجين ، الصوديوم ، البوتاسيوم ، النقاوة ، السكر المفقود في المولاس ، النسبة المئوية للسكر المستخلص وكذلك نسبة الاستخلاص.