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FORMING A NEW MAIZE SYNTHETIC VARIETY AND INPROVEMENT BY USING S_1 LINE *PER SE* SELECTION.

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ABSTRACT

This investigation was conducted at Sakha Research Station from 1997 through 2002 growing seasons. White synthetic variety Sakha-6, as a new maize variety, was used in this study to utilize its genetic variability in improving yielding potentiality via S_1 lines *per se*. A total of 200 S_1 families from Sakha-6 were tested during the 2001 season in two separate experiments under low and high N doses (i.e., 70 and 120 Kg N/faddan, respectively).

Differences between the two nitrogen levels were not significant for all traits except grain yield and ear diameter. However, the means were higher under the high nitrogen level for all traits except resistance to late wilt disease and silking date.

Genetic variance was significant for all traits at each of the two nitrogen levels and from both levels, while, the interaction between genetic variance and variance due to nitrogen levels was not significant for all traits except resistance to late wilt disease.

Phenotypic and genotypic variances were increased under the high nitrogen level for grain yield, resistance to late wilt disease and ear height. But, they were increased under low nitrogen level for number of ears / plant ,ear length ,ear diameter and silking date.

Heritability was higher under the high nitrogen level for all traits except number of ears/plant and silking date.The higher values over the two nitrogen levels were obtained for silking date (89.20%) and grain yield (85.10%).

The expected gain from selection was higher under low nitrogen level for all traits except resistance to late wilt disease and plant and ear height.

The expected gain from selection showed that S_1 families selection would be effective for increasing the grain yield (28.10%) in cycle-1 for the new synthetic variety Sakha-6 .

Correlation coefficients between all studied traits with grain yield were significant, indicating that the indirect selection for linked traits with yield would be useful and effective for improving grain yield.

INTRODUCTION

The new synthetic variety of maize Sakha-6 was formed during 1997 to 2000 season .The successes of any breeding program depend on the amount and type of genetic variability in the germoplasm pool and choosing the better selection method for obtaining the suitable utilization of this genetic variability. Jenkins (1940) was the first to suggest a breeding procedure for development of superior synthetic varieties of maize . Carangal *et al.* (1971) reported that the expected genetic advance in the derived synthetic was greater for selection based upon S_1 progeny evaluation. Morever, Choo and Kanneberg (1979) studied the relative efficiencies of mass, ear-to row and S_1 selection. They found that S_1 selection was the most effective in early cycles in all cases. El-Rouby *et al.*(1979) concluded that use of S_1 lines selection was recommended to select among base population to start improvement in most promising ones. Also, Aboul-Soad (1984) found that variability for all characters extended over a wider range in the S_1 progenies than in half-sib ones. Meanwhile the coefficient of variability for various traits and heritability from S_1 lines selection had slightly greater expected and actual gains than the half-sib family selection. Shehata *et al.* (1987) found that S_1 lines *per se* selection method was the most efficient method followed by full-sib family selection and lastly half-sib family selection .Significant genotypic variance was detected among S_1 progenies for all studied traits over locations.Walter *et al.*(1991) found significant change for agronomic traits and for genetic variances among S_1 lines, significant correlations between agronomic traits and grain yield .Burgess and West (1993) reported that the response to S_1 selection was 44% yield increase after four cycles and Galal *et al.*(1996)found that the broad-sense hertiability were 57.99 ,44.67, 35.84, 57.39 and 84.14 for modified ear-to-row cycle 0,cycle-1,cycle-2 families, half sibs and S_1 lines *per se* , respectively. Moreover, heritability values and expected gain from selection obtained from S_1 lines *per se* was higher than thus of other traits.

This study was conducted to gain information on : estimation of phenotypic and genotypic variances, heritability and expected genetic gain from selection at low and high nitrogen level rates on a new the synthetic variety Sakha-6 to improve the yielding potential by using S_1 lines *per se* in a selection method.

MATERIALS AND METHODS

The new synthetic variety of maize Sakha-6 which used in this study was formed originally at Sakha Research Station during 1997 through 2000 season.

In 1997 season , four inbred lines were selected. They had high combining ability and high yielding with respect to crosses between them .These lines were : Sids-7 (original population American early dent variety); Sids- 63 (original population Tepalcingo # 5 variety);Sakha-132 (original population Composite Sakha-1) and Sakha-8238 (original population Cairo-1 variety). These inbred lines were the origin components of the synthetic variety (Syn-0).

In 1998 season ,a diallel crosses was carried out among the four parental lines to obtain six crosses and equal number of seeds from each cross which were mixed to obtain the seeds of first synthetic generation (Syn-1).

In 1999 season, seeds of (Syn-1) were sown in an isolated plot under random mating to obtain seeds of (Syn-2).

In 2000 season, 200 plants were randomly chosen from the population (Syn-2) and selfed to obtain 200 ears from S_1 lines *per se* . Each ear divided into 5 envelopes ; 2 for each of the two nitrogen levels trials and one envelope was kept in the cold store room .

In 2001 season, 200 S_1 lines *per se*, were evaluated in two experiments under two nitrogen levels, 70 and 120 Kg nitrogen per faddan in a randomized complete block design with two replications .Plot size was one row, 6m long ,80 cm apart and 25 cm between hills. Observations were recorded on eight traits,viz : Grain yield (ard /fad) adjusted based on 15.5% grain moisture content, shelling percentage, number of ears per plant, ear length (cm), ear diameter(cm),percentage of resistance to late wilt disease, number of days from planting to 50 % silking date (days)and plant and ear height (cm). The analysis of variance for each experiment and their combined were computed according to Snedecor and Cochran (1967), before calculating the combined analysis, test of homogeneity of error mean squares for the two experiments was done .Estimates of heritability and expected gain from selection was done as outlined by Falconer (1960).

In 2002 season, selection of 10% superior families based on cross yield trials in 2001 season and equal number of seeds from selected S_1 families were bulked and planted in isolated plot under random mating, to obtain seeds of cycle-1 which will be used to produce the next cycle.

RESULTS AND DISCUSSION

Mean squares of S_1 families for eight traits at two nitrogen levels and their combined are given in Table (1). Differences between two nitrogen levels were not significant for all traits except grain yield and ear diameter, indicating that grain yield and ear diameter showed significant response to the increase in nitrogen level. Also, highly significant differences were detected between S_1 families for all traits at 70, 120 Kg N/fad and their combined, while the interaction between S_1 families x nitrogen levels was not significant for all traits except resistance to late wilt disease .On other word, the S_1 lines *per se* differed significantly from each other for all traits, while the rank of S_1 lines *per se* was constant in both nitrogen levels for all traits except resistance to late wilt disease. These results are in agreement with Shehata *et al.* (1987), Omar *et al.* (1990), Amer (1995) and Galal *et al.* (1996).

Means, environmental error (σ^2e) and coefficient of variability (C.V.%) for the eight studied traits are presented in Table (2). The high nitrogen level produced high means than the low nitrogen level for all studied traits except resistance to late wilt disease and silking date, while the reverse were obtained for environmental error (σ^2e) and coefficient of variability (C.V.%) which were decreased when nitrogen level increased for most traits, indicating that accuracy of experiment was higher at the high nitrogen level or non stress environment than at the low nitrogen level or stress environment. The high nitrogen level caused an increase than the low nitrogen level by 31.69% for grain yield, 6.4% for number of ears /plant, 9.53% for ear length , 3.6% for ear diameter, 0.27% for plant height, 1.38% for ear height .The reduction estimates in resistance to late wilt disease and silking date for high nitrogen compared with low nitrogen level was about 0.44% and 1.03% for the two traits, respectively. These results are in common agreement with Frey (1964) who defined that the stress environment as one in which mean performance for a certain attribute is low .Omar *et al.*(1990)found that the nitrogen level of 120 kg N/ fad increased grain yield and ear height compared with 90 kg N/fad. Mosa (2001) found that increased nitrogen level from 70 Kg N/fad to 140 Kg N/fad leading to decrement in resistance to late wilt disease and silking date .Amer (1995) stated that the C.V.% of S_1 families was increased under stress environment for grain yield.

Estimates of phenotypic (σ^2ph), genotypic (σ^2G) and genotypic x nitrogen (σ^2GN) interaction are presented in Table (3). Genetic variance for all traits was significant at the two nitrogen levels and their combined .While the interaction between total genetic variance and nitrogen levels was not significant for all traits, except resistance to late wilt disease .However ,the phenotypic and genotypic variances were increased under high nitrogen level for grain yield, resistance to late wilt disease and ear height and σ^2G for plant height only. Also they increased under low nitrogen level for number of ears / plant ,ear length ,ear diameter , silking date and σ^2ph for plant height only. These results are in agreement with Frey (1964) and Frey and Maldonado (1967) they reported that under optimum environments the tested genotypes were fully expressed leading to an enlargement in genotypic variances while the stress conditions curtailed genetic differences among different genotypes .Omar *et al.* (1990) found that the genotypic variance was increased with the increasing nitrogen levels from 90 to 120 Kg N/fad for grain yield and disagreement with Amer (1995) who found that the phenotypic and genotypic variances were increased under stress condition (high plant density) for grain yield.

Regarding to Table (3) the phenotypic coefficients of variability (P.C.V) and genotypic coefficients of variability (G.C.V) were increased under low nitrogen level for grain yield, number of ears/plant, ear length ,ear diameter and (plant height for P.C.V only). While (P.C.V) and (G.C.V) were increased under high nitrogen level for resistance to late wilt disease, silking date, ear height and (plant height for G.C.V only). Amer (1995) stated that P.C.V and G.C.V were increased for grain yield and ear length under stress environment.

Heritability and expected gain from selection of S_1 families at the two nitrogen levels and their combined for eight trait are presented in Table (4). Hertiability (in the broad sense) were higher under high nitrogen levels for all traits except number of ears / plant and silking date. The highest values of hertiability over the two nitrogen levels were obtained for silking date (89.2%) and grain yield (85.1%). Coors (1988) found that broad sense hertiability estimate was 76% from S_1 families for grain yield and Gala *et al.* (1996) stated that the heritability of S_1 families was 84.14 for grain yield .On the other hand, these results disagree with Diab (1979) and Omar *et al.*(1990) who found that heritability estimate was high under the low nitrogen compared with high nitrogen level for grain yield.

The expected gain from selection was higher under the low nitrogen level for all traits except resistance to late wilt disease, plant and ear height, indicating that more gain from selection would be expected for these traits if selection is practiced under 70 Kg N/fad. Grain yield was the highest for expected gain from selection at the two nitrogen levels and their combined compared with other traits .In general, the expected gain from selection showed that S_1 families selection would be effective for increasing the grain yield by 28.10% for cycle-1. Omar *et al.* (1990) found that expected gain from selection was higher under the low nitrogen levels for grain yield and number of ears/100 plant.

Correlation coefficient between the eight traits for S_1 families are presented in Table (5).All possible correlations between the eight traits (28r) were positively and highly significant, meaning that the selection index for yield and desirable traits would be fruitful. In addition, the indirect selection for linked traits with yield would be useful and effective for improving grain yield.Walter *et al.*,(1991) found significant correlation coefficients between agronomic traits and grain yield.

Table (1): Mean squares of S_1 families for eight traits at two nitrogen levels and their combined in 2001 season .

S.V	Grain yield (ard/fad)	Number of ears/plant	Ear length (cm)	Ear diameter (cm)	Late wilt diseases resistance	Silking date (days)	Plant height (cm)	Ear height (cm)
70 kg N/ fad								
Rep.	5.719	0.161**	50.41**	0.043	28.323	2.250	4428.90**	361.00
S_1 Families(S_1f)	24.29**	0.046**	4.423**	0.087**	55.21**	9.615**	853.23**	327.3**
Error	7.71	0.022	2.868	0.045	34.973	1.868	375.948	115.01
120 kg N / fad								
Rep.	83.220**	0.013	92.93**	0.084	0.080	10.24*	14.44	20.703
S_1families(S_1f)	30.359**	0.042**	3.591**	0.077**	109.376**	9.536**	792.301**	3[illegible]7.1**
Error	8.573	0.021	2.097	0.037	21.91	1.898	174.716	111.441
Combined								
Nitrogen(N)	5072.31**	0.571	533.338	5.05*	35.494	105.125	90.451	735.361
Rep/N	44.47	0.087	71.67	0.064	14.202	6.245	2221.67	190.851
S_1Families(S_1f)	47.597**	0.070**	5.943**	0.199**	123.537**	17.28**	1397.15**	590.2**
S_1f x N	7.051	0.018	2.072	0.044	41.050**	1.864	248.378	104.314
Error	8.142	0.021	2.482	0.041	28.441	1.883	275.332	113.226

***,** significant at 0.05 and 0.01 levels of portability ,respectively.**

Table (2): Means, environmental error (σ^2) and coefficient of variability (C.V.%) for eight traits under two nitrogen levels and their combined.

Traits / Estimates	Grain yield (ard/fad)	Number of ears/ plant	Ear length (cm)	Ear diameter (cm)	Late wilt diseases resistance	Silking date (days)	Plant height (cm)	Ear height (cm)
70kgN/fad								
$\bar{x}$	15.87	0.94	17.208	4.353	95.39	71.08	251.06	138.85
σe^2	7.711	0.022	2.868	0.045	34.97	1.868	375.95	115.01
C.V%	17.5	15.68	9.84	4.89	6.2	1.92	7.72	7.72
120kgN/fad								
$\bar{x}$	20.90	1.001	18.84	4.51	94.97	70.35	251.74	140.77
σe^2	8.573	0.021	2.097	0.037	21.91	1.898	174.71	111.4
C.V%	14.01	14.41	7.69	4.29	4.93	1.96	5.25	7.50
Combined								
$\bar{x}$	18.38	0.97	18.02	4.432	95.18	70.71	251.40	139.81
σe^2	8.142	0.021	2.482	0.041	28.441	1.883	275.33	113.22
C.V%	15.52	15.03	2.482	4.59	5.60	1.94	6.60	7.61

Table (3): Estimates of phenotypic σ^2 ph , genotypic (σ^2G) and genotypic x nitrogen σ^2GN variances, phenotypic (P.C.V) genotypic (G.C.V) coefficients of variability of S_1 families at the two nitrogen levels and their combined for eight traits.

Traits / Estimates	Grain yield (ard/fad)	Number of ear/plant	Ear length (cm)	Ear diameter (cm)	Late wilt diseases resistance	Silking date (days)	Plant height (cm)	Ear height (cm)
70kgN/fad								
Σ^2ph	12.145	0.023	2.211	0.0435	27.605	4.807	426.615	163.697
σ^2G	8.289*	0.012*	0.777*	0.021*	10.118*	3.873*	238.64*	106.19*
P.C.V	21.959	16.133	8.64	4.791	5.507	3.084	8.226	9.214
G.C.V	18.14	11.653	5.12	3.329	3.334	2.768	6.153	7.421
120kgN/fad								
Σ^2ph	15.179	0.021	1.795	0.038	54.688	4.768	396.150	183.59
σ^2G	10.893*	0.01*	0.747*	0.02*	43.73*	3.819*	308.79*	127.86*
P.C.V	18.642	14.44	7.111	4.322	7.786	3.103	7.90	9.625
G.C.V	15.791	9.99	4.58	3.135	6.963	2.777	6.98	8.032
Combined								
σ^2ph	11.899	0.0175	1.485	0.029	30.884	4.321	349.288	147.565
σ^2G	10.136*	0.013*	0.967*	0.018*	20.62*	3.855*	287.19*	121.48*
σ^2.G.N	-0.545	-0.001	-0.205	0.002	6.304*	-0.009	-13.477	-4.456
P.C.V	18.767	13.637	6.764	3.842	5.838	2.940	7.434	8.868
G.C.V	17.321	11.75	5.459	3.027	4.771	2.776	6.740	7.883

* significant based on the respective stander error(± S.E.)

Table (4): Estimates of heritability (H_b%)and expected gain from selection (Δg%) of S_1 families at the two nitrogen levels and their combined for eight traits.

Traits / Estimates	Grain yield (ard/fad)	Number of ears/plant	Ear length (cm)	Ear diameter (cm)	Late wilt diseases resistance	Silking date (days)	Plant height (cm)	Ear height (cm)
70kgN/fad								
H_b%	68.2	52.17	35.142	48.27	36.652	80.57	55.938	64.871
Δg%	26.35	14.81	5.344	4.070	3.553	4.373	8.099	10.52
120kgN/fad								
H_b%	71.70	47.619	41.615	52.631	79.962	80.096	77.948	69.649
Δg%	23.53	12.128	5.208	4.003	10.934	3.078	10.845	11.798
Combined								
H_b%	85.10	74.28	65.117	62.068	66.765	89.20	82.222	82.327
Δg%	28.109	17.830	7.750	4.197	4.580	4.615	10.75	12.589

Table (5): Correlation coefficients between eight traits for S_1 families.

Traits	Grain yield (rd/fad)	Number of ears/plant	Ear length (cm)	Ear diameter (cm)	Late wilt diseases resistance	Silking date (days)	Plant height (cm)	Ear height (cm)
Grain yield	-----	0.63**	0.38**	0.33**	0.33**	0.22**	0.37**	0.41**
No of ear/plant		-----	0.27**	0.33**	0.29**	0.37**	0.42**	0.48**
Ear length			-----	0.62**	0.55**	0.65**	0.52**	0.47**
Ear diameter				-----	0.67**	0.790**	0.55**	0.45**
Late wilt resistance					-----	0.79**	0.61**	0.52**
Silking date						-----	0.73**	0.67**
Plant height							-----	0.87**
Ear height								-----

** significant at 0.01 level of portability.

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تكوين صنف تركيبى جديد من الذرة الشامية وتحسينه بطريقة انتخاب سلالات الجيل الذاتى الأول

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كون صنف تركيبي جديد (سخا-٦) خلال المدة من ١٩٩٧ إلى ٢٠٠٠م فى محطة بحوث سخا واستخدمت طريقة الانتخاب المتكرر باستخدام سلالات الجيل الذاتى الأول لدراسة التغيرات الوراثية فى هذا الصنف ولتحسين القدرة المحصولية له حيث تم التلقيح الذاتي لـ٢٠٠ نبات من الصنف التركيبى اخذت بطريقة عشوائية وذلك خلا ل موسم ٢٠٠٠ . قيمت سلالات الجيل الأول الذاتي فى تجربتين منفصلتين تحت مستوين من التسميد النيتروجيني (٧٠ و ١٢٠ وحدة ازوت للفدان) خلال موسم ٢٠٠١ .أهم النتائج ما يلى:

- الاختلافات بين المستوين من التسميد النيتروجيني غير معنوية لكل الصفات المدروسة ما عدا صفة محصول الحبوب وقطر الكوز. التسميد العالي ١٢٠ وحدة ازوت للفدان أدى إلى زيادة جميع متوسطات الصفات ما عدا صفة المقاومة لمرض الذبول المتأخر وتاريخ تزهير ٥٠.% من الحريرات.
- كان التباين الوراثي معنويا لجميع الصفات المدروسة تحت المعدل العالي والمنخفض من التسميد . ولكن التفاعل بين التباين الوراثي والتسميد النيتروجيني لم يكن معنويا في جميع الصفات المدروسة ماعدا المقاومة لمرض الذبول المتأخر
- التباين المظهري والوراثي يزداد تحت مستوى التسميد النتروجينى العالي لصفة محصول الحبوب والمقاومة لمرض الذبول المتأخر وارتفاع الكوز. بينما يزدادوا تحت مستوى التسميد المنخفض لصفة عدد الكيزان للنبات، طول وقطر الكوز وتاريخ تزهير ٥٠% من الحريرات.
- تم الحصول على قيم عالية لتقديرات الكفاءة الوراثية تحت ظروف التسميد النيتروجيني العالي لجميع الصفات المدروسة ما عدا عدد الكيزان للنبات وتاريخ تزهير ٥٠.% من الحريرات . اعلى درجة توريث كانت لصفة المحصول(٨٥,١%) وتاريخ تزهير ٥٠.% من الحريرات(٨٩,٢%).
- كان التحسين الوراثي المتوقع عاليا تحت ظروف التسميد النتروجينى المنخفض فى كل الصفات المدروسة ما عدا المقاومة لمرض الذبول المتأخر وارتفاع النبات والكوز. اعلى نسبة تحسين وراثي كانت لصفة المحصول(٢٨,١%) للدوره الأولى.
- كان الارتباط بين صفة محصول الحبوب وجميع الصفات المدروسة موجب المعنوية وبالتالي فان الانتخاب لاى من الصفات المرغوبة منها سوف يكون موثر فى زيادة المحصول.