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Recurrent Selection and Half-Sib Selection for Improvement oil contained in Maize (*Zea mays* L.) Variety TALAR

Hussain.A.Sadalla * and Sakar.A.Kakarash * and Nyaz.R.Mustafa **

*Dept. of Field crops. Collage of Agriculture. Salahaddin Univ. Erbil
** Dept. of Field crops. Technical institutes. Erbil

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Correspondence: H.A. Sadalla
Dept. of Field crops. Collage of Agriculture. Salahaddin Univ. Erbil

ABSTRACT

Recurrent selection (R.S.) and Half-Sib (H.S.) selection were conducted to increase oil % in Maize variety (TALAR). Each method consisted of two cycle, each cycle consisted of two growing season. In first season of recurrent selection, full reciprocal diallel cross among ten high oil ears selected from original variety, while in half-sib selection, equal number from each selected high oil ears, bulked and planted, pollen grain were collected from several plants and pollinated other plants. In second season in both method self pollination were performed, and sample of kernels used to oil % determination. The ten high oil content ears will selected to second cycle. Results showed an increasing in oil % from (7.22 to 8.3%) after two cycle of R.S. while in H.S. there were increasing only in first cycle from (7.22 to 7.41) and decreased after second cycle. This result confirmed that recurrent selection performance was superior to half-sib selection. Both selection methods had significant effect on plant and ear height and decrease in ear length and 1000 kernel weight. As well as decreased in heritability in both methods were recorded.

الانتخاب التكراري المتبادل وانصاف الاشقاء لتحسين المحتوى العالي للزيت في الذرة الصفراء صنف تالار

حسين أحمد سعد الله* و ساكار أسعد كاكةرةش* و نياز رشيد مصطفى**

* قسم المحاصيل الحقلية – كلية الزراعة – جامعة صلاح الدين – اربيل

** قسم المحاصيل الحقلية – المعهد الفني – مؤسسة المعاهد الفنية – اربيل

الخلاصة

نفذ طريقتي الانتخاب التكراري Recurrent selection وانتخاب انصاف الاشقاء half-sib selection لزيادة نسبة الزيت في الذرة الصفراء صنف " تالار" وكل طريقة نفذت بدورتين كل دورة تتكون من موسمين زراعيين. الموسم الاول في الانتخاب التكراري تم استخدام التهجينات المتبادلة الكاملة بين عشرة عرانيص عالية الزيت التي تم انتخابها من الصنف الاصلي. وفي طريقة انتخاب انصاف الاشقاء اخذ عدد متساوي من بذور كل عرنوص من العرانيص العشرة الاعلى في نسبة الزيت، ثم خلطها وزراعتها وجمع حبوب لقاح من عدة نباتات لتلقيح نباتات اخرى. وفي الموسم الثاني وفي كلا الطريقتين اجري التلقيح الذاتي للنباتات، واخذ نموذج من كل عرنوص لتقدير نسبة الزيت فيها وتم انتخاب عشرة علرانيص عالية الزيت الى الدورة القادمة. أظهرت النتائج زيادة معنوية في نسبة الزيت بطريقة الانتخاب التكراري من (7.22 الى 8.3 %) بعد دورتين من الانتخاب، اما طريقة الانتخاب انصاف الاشقاء فكان هناك زيادة معنوية بعد الدورة الاولى من (7.22 الى 7.41 %) . وانخفضت نسبتها بعد الدورة الثانية. كان لطريقتي الانتخاب تأثيرا معنويا موجبا ادى الى زيادة ارتفاع النبات والعرنوص وانخفاض في طول العرنوص ووزن 1000 حبة، كما ادى الى انخفاض نسبة التوارث في الطريقتين.

الكلمات المفتاحية : الانتخاب التكراري ، انصاف الاشقاء ، الزيت ، الذرة الصفراء ، تالار
للمراسلة :
حسين احمد سعدالله
قسم المحاصيل الحقلية – كلية الزراعة – جامعة صلاح الدين – اربيل

Introduction

Recurrent selection is population improvement that increase the frequency of favorable alleles while maintenance genetic variation (Doerksen, 2003). Those populations then can serve as a potential source of superior inbred lines for future hybrid improvement (Duvick, 1992; Kannenberg and Falk, 1995). Lambert et al (1997) evaluated for oil increase in Ask synthetic for 20 cycles of single kernel recurrent selection, found a significant increase in oil concentration about (41 g kg^{-1}) per cycle. Twenty four cycles of recurrent selection for high oil concentration. Misevic and Alexander (1989) found that total oil concentration increased by (118, 51 and 57 g kg^{-1}) of dry matter per cycles. The high- intensity within half-sib family selection for oil% in corn after seven cycles had increase in oil % from (40 to 91 g kg^{-1}) were recorded by (Miller et al, 1981). Sadalla et al (1990) used two cycle of recurrent selection in Maize, results showed an increasing in oil % from (4.62 to 6.27%). Dudley and Lambert, (1992) they reported that the reached grain oil content in the Illinois high oil population was (22%). Milorad et al, (2002) reported after nine cycles of mass selection for oil increasing in two Maize synthetic led to significant increasing in oil content and significant decreasing for grain yield. Our objective in this experiment was to determine which selection for high oil content was effective and if selection reduced the variation for oil content and if selection was effected on other characters.

Material and Methods

Field experiments were conducted at the Grdarash Research station / collage of Agriculture – Sallahadin Unive-Erbil during 2008-2010. the high oil content variety of Maize designated (TALAR) was used in this study to increase oil content in Fall season 2008, 17 ear were selected and self pollinated. Samples of seeds from middle of these plants were subjected individually to chemical analysis, using "Soxhlet" method. The remaining seeds of the 10 ears with the highest oil content were selected and used as parental materials for the following growing seasons. Then two method of selection were used, recurrent selection and half-sib selection. Two cycles of each were applied, each cycle consisted of the spring and fall growing season. First cycle of recurrent selection; in the spring season of 2009, the 10 selected ears were planted in ear-to-row, and reciprocal diallel crosses (all possible crosses) were mad among them, first cycle of half-sib selection: in the spring season of 2009 equal numbers of seed from the 10 selected ears were bulked and planted together in a plot (5 x 5 m). Bulk pollen from some plants was used to pollinate the other plants, In the fall season 2009 five kernels from each successful cross from diallel cross and half-sib, were bulked and planted separately. Plant and ear height measured for 10 randomly selected plants. Sixteen vigorous plants were selected and forced to self pollination by hand. Ear length, row/ear and 1000 kernel weight were recorded from previously selected plants. Samples of seed from each ear were subjected to chemical analysis. The top 10 ears for high oil content were selected to repeat the same procedures in the second cycle. t-calculated were performed according to (Sendecor and Cochran, 1967). Variance and standard deviation for oil content in population and 10 selected ears in both cycles were estimated. The heritability in narrow sense was estimated according to (Simonds 1984, Pamin et al 1986) as follow.

$$h^2_{NS} = \bar{x}_o - \bar{x}_p / \bar{x}_s - \bar{x}_p$$

$\bar{x}_o$ = means of produced offspring
$\bar{x}_p$ = means of original population
$\bar{x}_s$ = means of selected plants

Results and Discussions

Effect of selection on oil content:

From chemical analysis for the basic selection ears (fall season 2009) (Table 1) showed that there were high variations among the ears within the studied variety in oil content. The oil percentage ranged from (5.60 to 8.98) percent. The means of the basic selected ears was (7.22 %) with the variance (2.73) while the ten selected ears was (7.65%) with the variance 0.82.This variation in oil content was also reported by smith,(1974)

Table (1) The oil % of 17 ears and the tenth highest oil selected ears from Talar variety in Fall season 2008.

All Ears				Selected Ears	
No. of ears	**Oil%**	**No. of ears**	**Oil%**	**No. of ears**	**Oil%**
1	7.12	11	8.00	1	7.12
2	7.93	12	5.69	2	7.93
3	5.66	13	5.87	4	6.90
4	6.90	14	8.92	5	6.96
5	6.96	15	6.09	7	7.68
6	5.86	16	7.99	9	8.98
7	7.68	17	5.80	11	8.00
8	5.60			14	8.92
9	8.98			15	6.09
10	11.85			16	7.99
		Means	7.22	**Means**	7.65
		σ^2	2.73	**σ^2**	0.82
		S.D	1.65	**S.D**	0.90

Recurrent selection (R.S): after one cycle of R.S (fall season 2009) the oil percentage increased in the population from (7.22 to 7.57)% whereas the average of the selected 10 ears was (8.2 %) (Table 2).

The variation was decreased in the population to (1.29 %) and for selected 10 ears 0.37. These means that the population and selected ears led to homozygosity for this character. After second cycle of R.S (fall season 2010) the oil percentage increases to (8.3 %) for the population mean. The average of the selected 10 ears was (9.7) as well as the variation were (1.7 and 0.15) for population and selected 10 ears respectively (Table 3) this might be due to the effect of homozygosity among ears within the variety which was caused by selection and consequently by accumulation of desirable genes in the population. This showed that the average of increasing in the oil content of population after one cycle was (0.35 %) and after second cycle (0.73 %). Half-sib selection (H.S.): after one cycle of H.S. (fall season 2009).

Table (2) Oil % of 16 ears and the tenth highest oil selected ears after one cycle of "Recurrent selection" in Fall season 2009.

All Ears				Selected Ears	
No. of ears	Oil%	No. of ears	Oil%	No. of ears	Oil%
1	8.6	11	7.5	1	8.6
2	8.3	12	9.1	2	8.3
3	7.3	13	9.0	4	8.0
4	8.0	14	8.2	5	8.6
5	8.6	15	7.6	12	9.1
6	6.3	16	6.7	13	9.0
7	5.3	17		14	8.2
8	7.6	18		15	7.6
9	7.3	19		8	7.6
10	5.9	20		9	7.3
		Means	7.57	**Means**	8.2
		σ^2	1.29	**σ^2**	0.37
		S.D	1.13	**S.D**	0.61

Table (3) Oil % of 30 ears and the tenth highest oil selected ears after one cycle of "Recurrent selection" in Fall season 2010.

All Ears						Selected Ears	
No. of ears	Oil%	No. of ears	Oil%	No. of ears	Oil%	No. of ears	Oil%
1	8.0	11	9.3	21	5.6	2	9.6
2	9.6	12	8.3	22	9.0	4	10.0
3	8.3	13	10.3	23	8.0	5	10.0
4	10.0	14	9.6	24	9.3	8	9.3
5	10.0	15	6.3	25	10.3	11	9.3
6	6.0	16	7.3	26	8.6	13	10.3
7	7.0	17	8.6	27	9.3	14	9.6
8	9.3	18	8.0	28	6.6	24	9.3
9	7.6	19	7.0	29	9.0	25	10.3
10	6.6	20	7.6	30	8.6	27	9.3
				Means	8.3	**Means**	9.7
				σ^2	1.70	**σ^2**	0.50
				S.D	1.30	**S.D**	0.38

Table (4) presented the oil percentage increased in the population from (7.22 to 7.41 %) whereas the average of the selected 10 ears was (8.24 %). The variations were decreased in population and for selected 10 ears were 0.89 and 0.04 respectively.

Table (4) Oil % of 24 ears and the tenth highest oil selected ears after one cycle of " half-sib selection " in Fall season 2009.

All Ears						Selected Ears	
No. of ears	Oil%	No. of ears	Oil%	No. of ears	Oil%	No. of ears	Oil%
1	6.6	11	7.3	21	7.6	2	8.3
2	8.3	12	4.6	22	7.0	3	8.3
3	8.3	13	8.6	23	6.3	4	8.6
4	8.6	14	7.0	24	6.6	8	8.0
5	7.0	15	8.0			13	8.6
6	6.0	16	8.0			15	8.0
7	7.3	17	8.0			16	8.0
8	8.0	18	8.3			17	8.0
9	7.6	19	8.3			18	8.3
10	7.6	20	7.0			19	8.3
				Means	7.41	**Means**	8.24
				σ^2	0.89	**σ^2**	0.04
				S.D	0.94	**S.D**	o.22

After second cycle of H.S. (fall season 2010) (Table 5) the oil % slightly decreased from (7.41) after first cycle to (7.0 %) after second cycle as well as the mean of 10 selected ears also decreased from (8.24) after first cycle to 8.1 after second cycle. This may be its due to increasing in variation of population and selected 10 ears to (1.47 and 0.52), from these two method after two cycle of selection. It's evident that the performance of recurrent selection was superior to the half-sib selection.

Table (5) Oil % of 24 ears and the tenth highest oil selected ears after one cycle of " half-sib selection" in Fall season 2010.

AllEars						Selected Ears	
No. of ears	Oil%	No. of ears	Oil%	No. of ears	Oil%	No. of ears	Oil%
1	5.3	11	7.3	21	7.0	3	9.3
2	7.3	12	6.6	22	5.6	4	8.3
3	9.3	13	6.0	23	6.6	5	8.3
4	8.3	14	7.6	24	6.6	6	7.3
5	8.3	15	8.0			8	8.0
6	7.3	16	5.0			11	7.3
7	4.6	17	7.6			14	7.6
8	8.0	18	9.3			15	8.0
9	7.0	19	7.0			17	7.6
10	6.3	20	6.3			18	9.3
				Means	7.0	**Means**	8.1
				σ^2	1.47	**σ^2**	0.52
				S.D	1.21	**S.D**	0.72

Effect of selection on other characters:

Were summarized in (Table 6 and 7) in both methods there were increase significantly in plant and ear height. After two cycle of half-sib-selection the plant and ear height increase from (150.5 to 182.5 cm) and (53.9 to 98.4 cm). While in recurrent selection the increase was from (150.5 to 171.4 cm) for plant height, and for ear height the increased was from (53.9 to 89.9 cm). This result was not agree with results reported by (Milorad et al, 2002) who noticed an decrease in ear height and not agreed with (Dudly et al, 1992) who reported that high oil % was associated with shorter plants. This result is in agreement with the result found by (Sadalla, 1990) who observed significant increasing in methods plant and ear height. Significant reduction found in ear length and weight of 1000 kernels after two of selection. This result in agreement with the result of (Madej and lambert, 2007) .

Heritability with narrow-sense was decreased for oil content in both selection methods in recurrent selection the reduction was from (81 %) after first cycle to (48 %) after second cycle, while in half-sib the heritability after first cycle was (84%) but due to decreasing in oil content. The heritability consider zero after second cycle.

Table (6) Effect of Recurrent Selection on some studied characters.

Years	Plant height (cm)	Ear height (cm)	Ear length (cm)	Row / ear	1000 kernel weight (gm)	Oil % in population	Oil % in 10 select ear	Heritability
2008	150.5	53.9	19.6	18.8	307.6	7.22	7.65	81%
2009	174.5	89.0	24.3	17.2	292.7	7.57	8.2	
2010	171.4	89.9	16.25	18	245.31	8.31	9.7	48%
t.cal.	0.48	5.29	1.04	2.13	0.72	0.71	0.85	
	0.09	0.17	4.35	0.94	3.86	1.61	4.28	

Table (7) Effect of half-sib Selection on some studied characters.

Years	Plant height (cm)	Ear height (cm)	Ear length (cm)	Row / ear	1000 kernel weight (gm)	Oil % in population	Oil % in 10 select ear	Heritability
2008	150.5	53.9	19.6	18.8	307.6	7.22	7.65	84%
2009	176.8	92.8	22.2	16.6	292.5	7.43	8.24	
2010	182.5	98.4	16.43	15.8	260.71	7.0	8.1	0.0
t.cal.	3.62	5.34	2.03	2.70	0.68	0.33	1.73	
	0.81	0.69	1.71	0.93	1.84	0.82	0.46	

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