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PERFORMANCE OF A NEW SYNTHETIC SUNFLOWER STOCK DEVELOPED FROM LOCAL AND INTRODUCED GERMPLASM AND FURTHER IMPROVEMENT VIA POPULATION IMPROVEMENT METHOD

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SUMMARY

From virtual self-sufficiency in edible oil supply in 1960, Egypt lapsed back to depedence on imports because of sharp population increase, increased oil consumption and a reduction in the acreage under cotton, the main oil crop in the country. Attempts to improve the edible oil production in Egyot made it evident that synthetic sunflower varieties are a more viable option than sunflower hybrids.

Having defined a model cultivar for Egypt in 1982, the author established and tested a collection of land varieties from Middle and Upper Egypt. The accessions showed good yielding ability, vigorous growth and adaptability on one side and tall steam, late maturity and low oil content on the other. Based on the experiments and combining ability results, three land varieties and two cultivars were selected for female parents of a base synthetic population intended to be made.Regarding the male parent, VN-03, VN-04 and VN-05 were selected for earliness and short steam, Citosol, Drysol and ISEA for high oil content and large head.The materials gathered were selfed for two years, srossed by hand, and the obtained seeds sown in two diverse locations in 1986, for selection for smaller height, larger head, absence of natural disease symptoms, bird resistance, high seed yield and high oil content. The two groups were differentiated to early high oil and medium late high oil genotypes. The seeds in each group were mixed to form Synthetic-1 for group I and Synthetic -1 for group II. The former synthetic was futher tested at Suez Canal University, the latter by the author of this paper.

Dominance of tall plants and transgressive segregation for achene yield per plant and oil percentage were the problems which confronted the author. He started a program of recurrent selection to increase gene frequencies for the desired characters. After one cycle of recurrent selection, the synthetic was divided in six sub-populations according to achene yield, oil content or oil yield and seed color. These sub-populations are presently in a cycle of population improvement.

INTODUCTION

The gap between production and consumption of edible oils, in Egypt as well as in many African countries, is increasing day after day and from one year to another. The failure in ceasing the gap increments, in my country, has many reasons.

The population in Egypt has increased from about 10 milion at the beginning of the 20th century to 28 million in 1960.Nowdays,it exceeded 55 million and is expanding at a rate of about 3% every year. Surprisingly, not only the population increased at a high rate, but the consumtion of edible oil per person alse increased in the last decade from 9 to 12 kg. Besides, the area under cotton, which was and still is the mail oil crop in Egypt, decreased from 1.9 million feddan contibuting 888000 metric tons of seed in 1960 to 1.05

million contibuting 552000 metric tons of seed in 1986. For all these reasons, self-sufficiency decreased from 95.4% in 1960 to 34% in 1980. Now, domestic production accounts only for approximately one fifth of the consumtion. Thus, more attention and investments are given to oil crops including sunflower.

International experience with sunflower revealed that crossing among a limited number of chosen selfed lines to develop synthetic cultivars would be a better way for sunflower improvements in most countries. Moreover, synthetic varieties of open pollinated crops are more acceptable in many third world countries due to the price policy and the prevailing market purchasing conditions. Hybrid seed of sunflower can be produced in Egypt only under some sort of governmental support through the distribution of subsidized seeds to farmers.

CHOICE OF PARENTS

For the judious choice of parents, I made an approach by defining the model cultivar needded in Egypt (Shabana, 1982) by testing 120 accessions, representing local and introduced germplasm, in several experiments which covered the environmental conditions orevailing in Egypt. I continued the work in co-operation with the Agronomy Department in Suez Canal University at Ismalia through joint university programs by making a collection from farmers in Middle and Upper Egypt who used to grow their own seed for many years. These land varieties, althought with mixed seed colour (mainly white and striped seeds) which would affect their acceptance and lower their price, were known to have a good yielding ability (2.4 - 3.6 tons/ha) when grown by small holders. They also showed vigourous growth and adaptability. However, they had some disadvantages such as tall stem, late maturity and low oil content (30%or less). We aimed to combine high oil content, earliness and short stems from foreign material with high yield potential and adaptability of our land varieties. Thus, we tested all the available accessions in Giza and Ismalia. The evaluated accessions included a varietal cross I made in the previous season between the two widely distibuted cultivars in Egypt, Giza 1 and Maiak, and some selections from previous works (Shabana and Abe-Khadrah, 1983). In Giza location, I used the polycross method to test the combining ability of the accessions that showed superiority in their characteristics and fit our need. Based on the evaluation experiments and the combining ability results, three land varieties were chosen as female parents together with the two widely distributed cultivars. As male parents, VN-03, VN-04, and VN-05, were selected as sources for earliness as well as short stem;Citosol, Drysol, and ISEA were alse chosen as sources for high oil content. Characteristics of the male and the female parents against the F_1 of the varietal cross Giza 1 x Maiak are presented in Table 1.

FORMATION OF BASE SYNTHETIC POPULATION

More than 100 healthy plants per parent were chosen for selfing by inducing the plants to form two branches as described by Škorić (1968). Selfing was continued for two seasons (fall and summer seasons). Visual selection was conducted in the field. After harvest, heads that were higher in seed yield and oil content in each parent were kept.

Table 1. Mean characteristics of parents used to form the synthetic population.

Parents	Days to flowering	Plant hight cm	Head diameter cm	1000 seed weight gm	Seed yield* kg/fed	seed oil content %
Giza (1)	85.5	383.2	20.9	96.45	1287	29.59
Maiak	75.5	362.3	15.5	67.50	633	38.20
Varietal cross	83.0	432.6	19.0	85.55	991	33.50
ISEA	75.0	304.5	19.5	85.00	1095	42.89
VN-03	58.0	168.5	18.4	62.10	476	41.23
VN-04	60.0	193.0	18.0	77.5	871	42.24
VN-05	49.5	92.0	7.0	56.60	261	33.11
Citosol	68.5	216.0	17.5	85.00	801	42.18
Land cv.	82.5	453.2	21.9	91.80	1819	23.54
Land cv.	81.0	453.8	23.0	91.25	1452	22.73
Land cv.	83.0	410.0	23.5	98.75	1637	25.05
Range for all accesions	49.5 to 86.5	72.4 to 495.0	8.4 to 22.0	47.50 to 108.80	550 to 1819	21.10 to 44.00

* to convert from kg/fed to ton/ha, multiply by 0.00238

The S_2 of the female parents were sown 15 days earlier than the male parents and treated by GA_3 as a gametocide when heads were 1cm in diameter. Male and female plants were crossed by hand. Half the seed of each cross was evaluated in 2 diverse locations (Giza and Ismalia) in the summer season in 1986. Crosses that showed lower plant height, larger heads, absence of natural disease symtoms and bird resistance and morphological characteristics such as: drooping heads, lightness of seeds, more concave heads and bracts that were extanding over the head, were selected in the field. Based on the harmony in flowering date, crosses with high seed yield or oil content were grouped to two groups.

Group I : included the earlier crosses with high oil yield

Group II : included medium maturing crosses with high oil yield

Equal quantities of seeds from the crosses selected in each group (Synthetic o) were mixed, irrespective of seed coulour, to form Synthetic -1. Syn-1 from group 1 was assigned to the Agronomy Department in Suez Canal University for further improvement, while that from group II was my responsibility for further improvement. I will restrict myself in the rest of my presentation to the improvements made with respect to group II.

The data in Table 2 show the ranges among the crosses from which we selected the ones that composed syn-1.

Table 2. Ranges among the crosses, mode and percentages of frequencies below or above the mode class

Character	Range	Mode	Percentage of frequencies	
			below mode class	above mode class
Number of leaves/pl*	19-59	34.39	50.79	37.30
Plant height, cm	127-375	257.21	32.59	35.56
Head diameter, cm	12-27	19.46	42.31	41.02
Achene yield, gr/pl	77-307	143.36	51.13	34.47
Oil percentage	13.3-48,5	30.00	27.47	56.04

* Range for number of leaves among male parents was 7-39 and among female parents it was 17-46

It is obvious that taller plants dominated the crosses. Thus, one of my objectives was to increase gene frequencies for shortness. However, it seemed as a difficult task from the experience with my synthetic populations so far. Table 2 also shows transgressive segregations for achene yield per plant and oil percentage.

To increase gene frequencies for the desired sharacters, I began a recurrent selection program. Mwala et al. (1988) conducted a recurrent selection program in Zambia using a composite and were able to increase the potential yield from 1.5 to 2.5 mt./ha. and oil content from 28-32% to 35-44% on a country-wide basis. Their data show the advantages of local breeding programs.

In my recurrent selection program, I tested the general combining ability using a weak tester for the characters in question (i.e., $p < 0.5$) Thus, to screen the population for high achene yield, I used Maiak as a tester. By contrast, to screen for oil content in the population, I used Giza I (oil content about 30% only) as a taster. Selection pressure for performance in the field and achene yield was 10% but about 1% was retained after oil analysis.

After one cycle of recurrent selection, the synthetic population was divided in six sub-populations based on achene yield, oil content or oil yield and according to seed colour (black, white or striped). Performance of the six sub-populations (mean of five replications) in the summer season this year is presented in Table 3.

Table 3. Field performance of six sub-populations after one cycle of recurrent selection in synthetic-1 in the summer season in 1989.

Sub-population	Plant height cm	Head diameter cm	Achene yield q/feddan
A	342.17	17.09	26.18
B	314.03	17.60	24.38
C	290.10	18.06	28.11
D	342.20	18.78	29.06
E	328.53	17.43	25.51
F	343.70	17.09	25.19

I hope to continue developing these populations via population improvement. Frey (1983) mentioned that with this procedure, populations of plants are dynamic gene pools to which new sources of germplasm are added when feasible, in which the frequecies of desired alleles are progressively increased through recurrent selection, in which genetic recombination is enhanced by massive hybridization amng selected genotypes, and from which cultivars, inbred or parental lines can be extracted at any stage. Indeed, Eberhart et al. (1967) suggested that a breeder who wants to start a population breeding program should spend three to five years evaluating and selecting plant materials from locally adapred and exotic sources for inclusion in the population. Their suggestions are in consistence with my present breeding work.

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PERFORMANCES D'UNE NOUVELLE VARIETE SYNTHETIQUE DE TOURNESOL ISSUE DE GERMPLASMES LOCAUX ET INTRODUITS, AMELIORATIONS OBTENUES GRACE A LA METHODE D' AMELIORATION DES POPULATIONS

R. Shabana

A partir d'une auto-suffissance en huile de consommation atteinte en 1960, l'Egypte redevint tributaire d'importations du fait de la forte augmentation de sa population, de l'augmentation de la consommation d'huile et de la réduction des surface consacrées au coton, principale culture olèagineuse de ce pays. La nécessité d'ameliorer la production d'huile de consommation en Egypte a mise en évidence la supériorité des variétés synthétiques de tournesol par rapport aux hybrides.

A partir d'un modéle type du cultivar adapté à l'Egypte, l'auteur a créé et testé une collection de variétés de pays provenant de la Moyenne Egypte et de la Haute Egypte. Les assecions montrent d'un coté, une bonne abilité au rendement, une bonne vigueur de croissance, une bonne adaptabilité, et d'un autre coté, une tige haute, une maturité tardive, et une faible teneur en huile. A partir des résultats experimentaux et en tenant compte de leur abilité à la combinaison, trois variétés de pays et deu cultivars ont été sélectionnés comme parents femelles pour les populations en cours de création. Concernant les parents mâles, VN-03, VN-04, et VN-05 ont été sélectionnés pour leurs précocités et leurs tiges courtes, Citosol, Drysol et ISEA ont été retenus pour leur teneur en huile. Tout le materiel rassemblé a été autoféconde pendant deux ans, les croisements étant effectués manuellement, et les graines récoltées ont été semées dans deux localités en 1986 afin d'améliorer les caractéres suivants: taille plus courte, capitule plus large, abscence de symptomes dus aux maladies, résistance aux oiseaux, haut rendement et haute teneur en huile. Deux groupes ont été différenciés: un génotype précoce à haute teneur en huile, et un génotype plus tardif également à haute teneur en huile. Les semences de chacun de ces deux groupes ont été mélangées pour créer une variété Synthétique-1 a pàrtir du groupe 1 et une variétè synthétique-2 a partir du deuxième groupe. Ces variétés ont été testées à l'Université du Canal de Suez, par la suite par le même auteur.

Nous avons été confronté au problème de la hauteur des plantes et à celui de la ségrégation transgressive pour le rendement en graine par plante. Un programme de sélection récurrente a été commencé afin d'augmenter la fréquence des génes des caractéres concernés. Aprés un cycle de sélection récurrente, la variété synthétique a été scindée en 6 sous-populations selon les caractéres suivants: rendement en grain, teneur en huile ou rendement en huile, et couleur des graines. Ces sous-populations subissent actuellement un programme d'amélioration des populations.

COMPORTAMIENTO DE UNA POBLACION SINTETICA DESARROLLADO A PARTIR DE GERMOPLASMA LOCAL Y DE INTRODUCCIONES Y POSTERIOR MEJORA A PARTES DE ESQUEMAS DE POBLACIONES.

R. Shabana

De una virtual autosuficiencia en aceite comestible en 1960, Egipto pasó a la dependencia de importaciones debido a un importate aumento de la población, incremento del consumo y reducción de la superficie dedicada a algodón, la principal oleaginosa en el pais. Los intentos para incrementar la producción de aceite comestible en Egipto pusieron de manifiesto que las variedades sintéticas contituyen una opción mas viable que los hìbridos en girasol.

Después de establecer un modelo de cultivar en Egipto en 1982 el autor estableció y ensayó una colección de variedades locales procedentes del Medio Oeste y el Alto Egipto. Las accesiones mostraron una buena aptitud para el rendimiento, crecimiento rigoroso y adaptabilidad por un lado y tuvieron demasiada altura, longitud de ciclo y contenido de aceite por otro. En base a experimentos y resultados de aptitud combinatoria tres variedades locales y dos cultivares fueron seleccionadas como parentales femeninos a partir de una población sintética base. En relación con parentales masculinos fueron seleccionadas en base a precocidad y corta estatura VN-03, VN-04 y VN-05 y Citosol, Drysol y ISEA, para alto contenido en aceite. Los materiales recogidos se autofecundaron dos años, y se se cruzaron siendo seleccionados para menor altura, capítulos mayores, carencia de sintomas de enfermedades, resistencia al ataque de pájaros y alto rendimiento de semilla y aceite. Dos grupos fueron deferenciados, genotipos precoces y alto aceite y de medio a largo ciclo y alto aceite. Las semillas en cada grupo fueron mexcladas para formar el Sintetico 1 para el Grupo I y Sintético 1 para el Grupo II. El primer sintético fué testado otra vez en la Universidad Canal Suez y el segundo por el autor de esta publicación.

La dominancia de plantas altas y segregación transgenica para rendimiento de aquenios por planta porcentaje de aceite fueron los problemas confrontados por el autor. Se inició un programa de selección recurente para incrementar las frecuencias de genes de los caracteres deseados. Después de un ciclo de selección recurrente el sintético fué dividido en seis subpoblaciones de acuerdo con el rendimiento de aquenios, contenido o rendimiento de aceite y color de la semilla. Estas subpoblaciones tienen actualmente un ciclo de selección.