Niger Agric. J. 33 (2002): 76-82

EVALUATION OF SESAME (*Sesamum indicum* L) GENOTYPES FOR YIELD STABILITY AND SELECTION IN NIGERIA

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ABSTRACT

After years of preliminary and advanced yield trials, seven advanced beniseed genotypes were selected for on-station evaluation at NCRI, Badeggi in 1996 and 1997. Four genotypes identified as promising lines were selected with the farmers' variety (Yandev-55) for multi-locational on-farm evaluation in six states. The states included Benue, Nasarawa, Jigawa, Kano, Kaduna and Taraba. The result obtained showed that two genotypes 530-6-1 and E-8 gave the highest yield across the locations. Also the linear responses of the genotypes indicated E-8 to have average response to environments with b value greater than unity. This shows that E-8 has the potential to grow well under favourable condition. Other genotypes 530-6-1, Type 4 (1), Goza-25 and the check (Yandev 55) have b values less than Unity, which was an indication of better performance under poor environmental condition. For the stability parameters, the mean deviation from regression coefficient also proved the four genotypes to have average stability and general adaptability. The yield rank-sum over locations indicated no consistency among the genotypes, which suggested lack of specific adaptation to a particular environment among the tested genotypes.

INTRODUCTION

Sesame (*Sesamum indicum* L.) also commonly known as beniseed in Nigeria is an important and very ancient oilseed crop, cultivated extensively in Asian countries and drier parts of Africa (Joshi, 1966). It is a minor crop in Nigeria, cultivated for its leaves and seeds used as condiment in the making of local vegetable soup (Uzo, et al 1985). The seeds contain about 50% oil, 25% protein and 11% carbohydrate (Ochse, *et al* 1961). Besides, industries in developing countries use beniseed oil to improve the shelf life of canned products (fish, meat etc.) because of the stability of its oil. (Anon. 1971). In Nigeria, beniseed is grown in the northern and central zones of the country as an export crop. The major producing state are Adamawa, Benue, Borno, Gombe, FCT-Abuja, Kogi, Jigawa, Kano, Nasarawa, Niger, Katsina, Kaduna, Yobe, Zamfara, Taraba, Kebbi and Sokoto (Iwo, *et al.* 1998). Prior to now, beniseed has attracted little research efforts. Therefore, yields still remain generally low and vary from one area to another due to lack of improved seeds. The average yield of the crop has been put at

about 300kg/ha, which is three times lower than the average yield of what is obtainable, for example, in Indonesia and Sudan (Anon. 1999) The high economic potentials, both as a source of raw material and foreign exchange earner for the country makes it imperative that concerted efforts have to be made to provide high yielding varieties to the farmers in order to boost beniseed production. Crop varieties differ genetically for their stability across different environments. An ideal variety is the one that combines high yield with stability over environments (Finlay & Wilkinson, 1963). The superiority of the new variety should be reliable over a wide range of environments in which it will be grown. In other words the variation of a genotype across locations is a measure of its adaptability. The purpose of the study is to evaluate some promising beniseed genotypes for yield stability, adaptation and selection through multi-locational on-farm trial.

MATERIALS

On-Station Evaluation:

After preliminary and advanced yield trials, seven (7) advanced beniseed genotypes were selected and further evaluated on-station at NCRI, Badeggi in 1996 and 1997. Farmers' variety, (Yandev-55) was used as the check. The design was a Randomized Complete Block Design (RCBD) with three replicates. Plot size was 5m x 2.6m- ($13m^2$) with a plant spacing of 65cm inter-row and 10cm intra-row. Cultural practices such as hoe weeding and fertilizer application (20N: 30P:30K) were carried out at two and three weeks after planting respectively. Data were collected on relevant agronomic traits such as days to 50% flowering, Days to 90% maturity, disease incidence, lodging rate, shattering rate and grain yield. The oil content was also determined by roasting 500g of each variety at a temperature of 150^0C for 10 minutes, after which the seeds are grinded to paste and the cake pressed to extract the oil using hydraulic hand press machine. Percentage oil content was calculated according to Anuonye *et al.* (1998) as

$$\% \text{ Oil content} = \frac{\text{vol. Oil}}{\text{Wt of seed}} \times \frac{100}{1}$$

On-Farm Multilocational Evaluation:

The best four genotypes E.8, 530-6-1, Type 4 (1) and Goza-25 were selected on the basis of agronomic traits and oil content, from the on-station trials. Seeds of the four genotypes were multiplied at NCRI-stations and distributed to Nasarawa, Jigawa, Kano, Kaduna, Benue and Taraba ADPs in 1998 and 1999 for comparative on-farm evaluation. The plot size was in accordance with the ADPs on-farm size of 20 x $50m^2$. Data obtained were on grain yields. The varieties served as the treatments while the number of years served as replicates at various locations. Data analysis included analysis of variance and yield stability analysis using regression techniques as outlined by Eberhart and Russell (1966). Yield ranks of each genotype in all environments were also used as an indicator for the occurrence of specific adaptation to particular environment.

RESULTS AND DISCUSSION

The results of the on-station evaluation of the selected advanced beniseed genotypes at NCRI, Badeggi in 1996 and 1997 are presented in Table I. The average yields over two years for 530-6-1, E-8, Type 4(1) and Goza-25 were found to be between 600 and 781 kg/ha, which was higher than that of the farmers variety (Yandev 55). These four genotypes also had low shattering and low lodging percentages. Disease incidence was also low but the maturity period varied among the genotypes. The genotype E-8 was observed to be early maturing, 530-6-1 and Types 4(1) medium maturing while Goza-25 was late maturing.

The results of the 2 years multilocational on-farm trials of the selected sesame genotypes are presented in table 2. Seed yields of each genotype across the six environments revealed significant differences among the genotypes across locations. Combined analysis of yield data in two years over six environments indicted a large yield variation attributable to the effect of environment, genotypes and environment X genotype (G X E) interactions (Table 3). The observed high genotype x environment interaction shows that the performance of some genotypes was location specific. Three genotypes; 530-6-1, E-8, and Type 4(1) were high yielding with their mean yield across the locations greater or close to the population mean of 556.9 kg/ha. But at specific locations, Goza-25 being drought tolerant performed well in Jigawa, Kano, and Kaduna State in Northern guinea Savannah than in Benue, Nasarawa and Taraba in Southern guinea Savannah. The joint regression analysis also revealed that the component of genotype X environment interaction was highly significant for yield. The linear responses showed a range of b values (0.47741 – 1.95037) with two genotypes; (530-6-1 and Goza –25) having regression coefficients close to Unity (b =1) while E-8 indicated above average response with b value greater than Unity (Table 4). Since the b values measure the genotype response with variation in environmental conditions, the genotype E-8 that has the b value greater than unity indicated above average response and adaptation to better environments. The genotype has the potential to perform very well with good management condition or favourable environmental condition. On the other hand, four genotypes including the check variety (Yandev 55) with b values less than unity were considered to perform better even under poor environmental condition. For the stability parameters, the mean deviation from the regression coefficients and estimates for grain yield showed that all the genotypes have relatively high Sd^2 above the value of b except the variety E-8 with b value below $Sd^{2,\ which}$ indicated high response to environmental conditions. The E-8 may be recommended only for highly favourable environment while other genotype; 530-6-1, Type 4 (1), Goza-25 and the check variety (Yandev –55) showed average stability and general adaptation. According to Eberhart and Russel (1966), b was considered as parameter of response and Sd^2 as the parameter of stability. A relatively lower level of b against Sd^2 will mean less responsive to the environmental change and therefore more stable as in the case of 530-6-1, Type 4 (1), and Goza-25.

The use of ranking and rank-sum was also useful in determining the adaptability of the genotypes. The rank-sum as an indicator for performance of a genotype across locations showed that the genotype 530-6-1 and E-8 were consistently high yielding across many locations with rank-sum of 6 and 11 respectively while yield of Yandev 55 (check) was the least in ranking order compared to other genotypes (Table 5). However, yield ranks over the locations indicated no consistent rank for each genotype. The genotype 530-6-1 was ranked first in five locations except in Kano and E-8 was ranked second but ranked first in Kano. The inconsistency observed among all the genotypes was an indication of adaptation to specific environment.

Table 1: Yield and other Agronomic Traits of Selected Beniseed Genotypes Planted at NCRI, Badeggi (1996 and 1997 Cropping Seasons).

Entries	Days to 50% Flowering		Days to 90% Maturity		Disease incidence (1-9)		Lodging rate (1-5)		Shattering Rate (1-5)		Grain yield (kg/ha)		Oil Content %
	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	
530-6-1	36	37	104	105	1	1	1	1	2	1	850	712	45
73A-97	35	35	102	103	3	4	2	2	3	3	400	380	46
73A-11	34	34	102	102	3	4	2	2	3	3	360	460	45
E-8	30	31	87	90	2	1	1	1	2	1	800	600	50
Pbtil (No1)	38	38	102	102	4	1	1	1	3	2	500	480	50
Type 4(1)	34	32	102	101	1	1	1	1	2	2	780	531	50
Goza-25	39	41	113	115	1	1	1	1	1	1	700	5000	45
Yandev 55(Check)	37	39	107	107	3	1	1	1	3	3	600	500	35
Mean	35.4	35.88	102.4	103.1							626.3	520.4	
SE	0.93	1.15	2.42	2.30							61.2	32.8	
CV%	7.5	9.1	6.7	6.31							27.6	17.8	
LSD(P=0.05)	1.48	2.21	3.19	3.12							16.08	11.8	

Key: (a) Scale for Lodging (1-5)

1=0 - 20%
2 = 21 -35%
3.= 36-75%
4 = 56 – 75%
5 = 76 – 100%

(b) Scale for sha ring (1-5)

1 = 0 - 20
2 = 21 -35%
3 = 36 – 55%
4= 36- 75%
5 = 76 – 100%

:)Scale for leaf spot disease
ıcident (1-9)
- 2 = Highly Resistant
-4 = Moderately Resistant
-6= Moderately Susceptible
'-9 = Highly Susceptible

Table 2: Seed Yields of Selected beniseed genotypes in multi-locational on-farm trials (1998 and 1999 Cropping seasons).

Genotype	Benue	Nasarawa	Jigawa	Kano	Kaduna	Taraba	Mean Across Locations
530-6-1	700	627	711	629	587	583	639.5
E-8	609	555	702	693	579	535	612.2
Type 4	572	522	527	613	549	522	554.1
Goza –25	456	507	582	493	562	431	504
Yandev- 55 (Check)	530	449	511	493	396	470	475
Mean	573.4	532	611	599.2	535	508.2	556.9
SE	36.31	26.5	36.5	29.8	31.6	23.6	27.8
CV%	14.2	11.02	13.34	11.10	13.2	10.4	11.18

Table 3: Analysis of Variance of pooled Data

Source	Df	S.S	M.S
Varieties	4	174134.2	43533.5
Environment	5	115484	23096.8
Genotype X Environment	20	135137	6756.9
Error	30	34380	1146
Total	59	459135.2	

Table 4: Yield (kg/ha) Stability Parameters of Five Sesame Genotypes Across Six Locations in 1998/1999, base on Regression of yields on the Environment

Genotypes	Benue	Nasarawa	Jigawa	Kano	Kaduna	Taraba	Linear Response (b^1value)	Stability Parameter Sd^2
530-6-1	700	627	711	629	587	583	0.91308	5.970
E-8	609	555	702	693	579	535	1.95037	0.646
Type 4	572	522	547	613	549	522	0.47741	0.646
Gaza-25	456	507	582	568	562	431	0.91731	0.953
Yandev-55 (Check)	530	449	511	493	396	470	0.74183	2.123
Mean	573.4	532	611	599.2	535	508.2	1.00000	

Table 5 Yield (kg/ha) Ranking and Rank-sum of 5 Sesame Genotypes Over 6 Locations

Genotypes	Benue		Nasarawa		Jigawa		Kano		Kaduna		Taraba		Rank Sum
	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	
530-6-1	700	1	627	1	711	1	629	2	587	1	583	1	6
E-8	609	2	555	2	702	2	693	1	579	2	535	2	11
Type 4	572	3	522	3	547	4	613	3	549	4	522	3	20
Goza-25	456	5	507	4	582	3	568	4	562	3	431	5	24
Yandev-55 (check)	530	4	449	5	511	5	493	5	396	5	470	4	
Mean	573.4		532		611		599.2		536		508.2		28

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