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A decade of sesame breeding in Uganda (1991-2000)

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Abstract

The paper describes the rationale and progress of sesame breeding work in Uganda from 1991 to 2000. The work done has been to: (a) increase genetic variability to improve on the yield in sesame by (i) intercrossing of a wide range of cultivars from various germplasm pools, (ii) purifying local adaptable cultivars through pure-line selection method; (b) test new introductions and select better lines out of them and; (c) evaluate promising introductions and local cultivars on-station and other agro-ecological zones for adaptability and yield performance. Two promising varieties EM-14 and EM-15-3-4 were released in year 2000 as Sesim 1 and Sesim 2, respectively. Better introduced cultivars have also been selected either for direct production or for crossing with the local cultivars and also within the exotics with diverse origin.

Key words: Sesame, breeding, adaptability, selection, crosses, yield, sesamum indicum, Uganda

Introduction

Sesame (*Sesamum indicum L.*), also locally known as simsim in East Africa, is an important crop and one of the major oil crops in Uganda. It is a crop mainly grown in the east and north of the country, usually grown by small holders in small plots. It is a source of good edible oil and protein and has been crowned the 'queen of the oilseed crops' because of the good quality of the oil it produces (Weiss, 1971).

Breeding of sesame in Uganda was started by Hirst when he made a number of selections in the 1950s (Tribe, 1967). The best of these selections were designated E, L and S. Tribe made some breeding in Serere by beginning hybridisation in 1962 between E, L and S and imported varieties like Rio, Dulce, Morada. In the 1970s, another breeder, continued with the work of Tribe until when two varieties 'S' and 'Serra' were released in 1974 and 1977, respectively. The breeding programme continued at a lower scale during the 1980s (Table 1) and almost collapsed during the 1987-1990 due to insurgency in Teso whereby most of the germplasms were lost.

Table 1: Seed yield (kg/ha) of elite sesame varieties grown at Serere Between 1981-1985

Variety	1981	1982	1983	1984	1985	Mean
S	322.76	383.60	496.01	255.15	341.40	360
EM-14	429.02	518.13	429.36	314.70	255.15	389
EM-15	370.24	460.86	570.96	267.27	298.18	393
U1	371.24	478.13	444.12	220.61	319.59	366
SERRA	329.62	559.34	428.14	324.56	362.12	400
1850	376.66	457.23	456.42	224.24	315.33	366
1858	338.42	470.56	432.99	229.70	321.48	358
2463	382.34	427.23	414.80	250.91	315.94	358
2478	332.74	439.65	542.97	330.91	355.48	400
Mean	**361.45**	**466.08**	**468.42**	**268.67**	**320.52**	
CV%	**16.3**	**13.6**	**19.7**	**40.0**	**22.8**	
LSD 5%	**77.9**	**81.9**	**119**	**139**	**96**	

Objectives

The main breeding objectives were:

i) To develop and select varieties/lines that are high yielding and stable across a wide range of environments.
ii) To improve on susceptible but high yielding varieties against major diseases and pests of economic importance.
iii) To improve on harvest index by incorporating desirable traits.

Sesame Breeding Research, 1991-2001

a) Sesame breeding at Namulonge Research Station, 1991-1993

Due to the insurgency at Serere in the late 1980s, the sesame breeding programme was temporarily moved to Namulonge. In order to revitalise the sesame breeding work, the following breeding approaches were undertaken at Namulonge:

(i) Germplasm collection locally.
(ii) Introduction of germplasm.
(iii) Pure line selection.
(iv) Evaluation of promising introduced and local purified cultivars.

(i) Germplasm Collection and Maintenance.

Sesame is rich in genetic variability. Many landraces exist but often grown in mixtures. Three FAO expert consultations recommended that sesame collection, evaluation and exchange should be enhanced.

In 1990, a small collection of sesame local lines was undertaken in two districts of Lira and Apac where much of sesame is grown. The following land cultivars were collected (Table 2).

ii) Introduction of germplasm

Introduction, sometimes accompanied by mass-or single –plant selection has proved successful among sesame breeders. Introduced line Renner 1-3 in our germplasm has been selected through single plant selection. Introduced lines were obtained from Dr. Abbas Omran (IDRC Network Technical Advisor) that was based in Addis Ababa, Ethiopia and Dr. R.D. Brigham (Texas a and M University), (Table 3).

Table 2. Cultivars collected from Lira and Apac in 1990

Cultivars	Description of the cultivars
1. Olara	Seeds are medium size and very while
2. Ocara	Highly shatters
3. Abonyo	Purplish pigmented like a locust
4. Odong	A tall and late maturing
5. Arut	Twin capsules? (quadricarpellate)
6. Anyena	Purplish capsules but green stem

Table 3. Country of origin and the number of exotic lines.

Country of Origin	Number of cultivars
Uganda	**15**
USA	20
Ethiopia	19
Somalia	11
Philipines	16
Tanzania	9
Sudan	2
India	1
Srilanka	2
Total	**95**

Table 4. Seed yield (kg/ha) of some sesame lines grown at Namulonge in 1992 and 1993

Cultivars	Country of origin	NAARI 1992	NAARI 1993	Means
1.NAL. 79111.9	Tanzania	107(10)	402 (9)	255(8)
2. Adong	Uganda	442(5)	532 (7)	487 (7)
3. E	Ethiopia/ Uganda	50(11)	-	50 (11)
4. Kenaena 7	Sudan	31 (12)	-	31(12)
5. Nal 79.309.16	Tanzania	114(8)	356(10)	235(9)
6. Anyena	Uganda	343(7)	742(3)	543(4)
7. Arut	Uganda	473(4)	504(8)	489(6)
8. Abonyo	Uganda	391(6)	634(5)	513(5)
9. Otara	Uganda	486(3)	716(4)	601(3)
10. EM-14	Uganda	605(1)	880(2)	743(1)
11. S	Uganda	494(2)	943(1)	791(2)
12. Bora	Tanzania	110(9)	-	110(10)
Mean		**304**	**634**	

iii) Pure line selection

Sesame is a self pollinated crop and realising that individual plants in a self- pollinated crop are largely homozygous, a pure-line selection and mass selection methods were adopted. Promising individual plants were selected and planted head to row for progeny, testing.

iv Evaluation of promising introduced lines and local cultivars

Out of the 95 lines collected both locally and introduced only 12 were selected for yield evaluation in 1992 (Table 4). The best were high yielding lines from the local selected lines possibly due to their adaptability in the local environment. Most of the exotic lines were abandoned from 1993 and these included E., Kenana 7, and Bora. Two Tanzanian lines were maintained due to their long capsules and plant height which could be used in the future hybridisation programme. At Namulonge, EM-14, 'S' and Otara were the most promising lines in 1992 and 1993 (Table 4).

.b) Sesame breeding at Serere Research Institute, 1993-2001

The breeding work continued with the following approaches:

(i) Evaluation of promising introduced and local purified cultivars
(ii) Introduction of germplasm
(iii) Pure line selection and hybridisation

(i) Evaluation of promising introduced and local purified cultivars.

Under the National Agricultural Research Organisation (NARO), oil crops programme based at Namulonge was transferred to Serere in 1994 but in 1993 some evaluation had already been done at Serere (Table5). EM-14 continued to be the best variety in 1994 and 1995 with 527 kg/ha and 481 kg/ha. Compared to the yields of the promising varieties grown at Serere in the 1980s (Table 1), yields of the selected sesame lines from 1993 were quite higher.

Table 5. Seed yield (kg/ha) of some sesame varieties grown at Serere from 1993 – 1995

Cultivars	SAARI 1993	SAARI 1994	SAARI 1995	Mean
1. NAL. 79.111.9	465(9)	123(8)	355(8)	314(11)
2. Adong	559(4)	374(3)	383(5)	439(3)
3. Nal 79.309.16	540(7)	69(10)	389(4)	333(10)
4. Anyena	773(1)	304(4)	359(7)	479(2)
5. Arut	549(5)	294(7)	350910)	398(6)
6. Abonyo	538(8)	178(7)	380(6)	365(5)
7. Otara	392(10)	377(2)	436(2)	402(4)
8. EM-14	681(2)	527(1)	481(1)	563(1)
9. S	545(6)	107(9)	424(3)	359(7)
10. SERRA	570(3)	191(3)	317(11)	359(7)
11. T-85	-	-	351(9)	351(9)
Mean	**561**	**254**	**384**	

From 1997, more promising lines were selected and incorporated in the advanced yield trial (Table 6). Yield reduced in 1997 due to too much rain during the planting time which washed much of the seed and therefore reduced plant population. In 1998, cultivars like Adong, Arut, Otara and T-85 were removed from the advanced yield trial since their yields were lower than most of the other lines.

(ii) Introduction of germplasm

Through the support of FAO/IAEA by scientific visits, more germplasm was obtained from eight participating countries that are improving sesame cultivars by mutation induction. The countries of origin and the number of cultivars obtained are shown in Table 10.

(iii) Pure line selection and hybridization

The programme continued with pure line selections within both the local cultivars and some introductions. *Hybridization was also started by 1997 and 84 crosses were made.*

Promising progenies that have combined both the desirable traits from the introductions and adaptability for tolerance from the local cultivars were selected. This

Table 6. Seed yield (kg/ha of some sesame lines grown at Serere from 1997 – 1998

Cultivars	1997A	1998A
1. Adong	188(16)	-
2. Arut	223(13)	-
3. Otara	258(6)	-
4. EM-14	239(10)	475(10)
5. S	200(15)	519(5)
6. Serra	223(14)	494(8)
7. T-85	175(17)	-
8. Local stripe	232(11)	436(12)
9. U1-1	304(4)	509(6)
10. U1-2-1	134(18)	249(13)
11. U1-7	320(3)	421(13)
12. EM-15-1-5	257(8)	489(9)
13. EM-15-3-2	333(2)	523(4)
14. EM-15-3-4	285(5)	509(6)
15. 1858-3-4	253(7)	558(1)
16. Adong 4-4	376(1)	529(3)
17. ad-1-1-1	243(9)	557(2)
18. 2478-5-2	230(12)	443(11)
Mean	249	479

Table 7. Seed yield (kg/ha) of some sesame lines grown at Serere in 1999

Cultivars	Yield kg/ha
1. EM-14	487 (11)
2. EM-15-3-4	556(4)
3. UI-7	547(5)
4. EM-15-3-2	428(14)
5. UI-1	516(9)
6. Adong 4-4	435(13)
7. EM-15-1-5	390(15)
8. Local 158	371 (16)
9. Serra	572 (3)
10. S	367(17)
11. UI-2-1	533(7)
12. 1858-3-4	506(10)
13. Ad-1-1-1	535(6)
14. 2478-5-2	464(12)
15. Ajmo A 1-5	733 (1)
16. Ajimo A1-6	578(2)
17. Ajimo A1-8	518(8)
18. NAL 79.309.16	307(18)
Mean	491

Table 8. On-farm yields (kg/ha)of three sesame promi-sing varieties.

Variety	Serere (2000)	Orungo	Dokolo
EM-15-3-4 (SESIM 2)	613	259	751
EM-14 (SESIM 1)	429	340	-
U1-7	598	346	-

Table 9. Oil analysis of some sesame varieties at Serere

Variety	Oil content %
Adongo 4-4	**46.36**
SESIM 1 (EM-14)	**44.47**
UI-7	**34.04**
SESIM 2 (EM-15-3-4)	**41.63**
Ajimo A1-5	**48.35**
Ajimo A 1-6	**42.47**
Ajimo A1-8	**45.97**
Arut	**43.9**

Table 10. country of origin and number of exotic lines

Country of Origin	Number of cultivars
Egypt	**6**
India	**11**
Israel	**15**
Pakistan	**4**
Bangladesh	**4**
Srilanka	**13**
China	**3**
Korea	**2**
Turkey	**4**
Thailand	**28**
Total	90

is in line with the suggestions made by other scientists (Ashri, 1985; Rajan, 1981) that since selection within the local materials has been on-going for a long time, often in low input conditions, the genetic variability for yield within regions has been exhausted and a breakthrough in productivity will have to come from controlled crosses designed to create new and increased variability.

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Conclusion

A decade of sesame breeding in Uganda (1991 – 2000) had seen two promising varieties EM-14 and EM- 15-3-4 released for commercial production with the names Sesim 1 and Sesim 2, respectively. Better-introduced cultivars have also been selected either for direct production or for crossing with the local cultivars and also within the exotics with diverse origin. This will improve the production of sesame per unit area and therefore will enhance the livlihood of the rural poor resource farmers.

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