

Registration of 'Serenut 5R' Groundnut

D. K. Okello, C. M. Deom,* N. Puppala, E. Monyo, and Boris Bravo-Ureta

Abstract

'Serenut 5R' (Reg. No. CV-129, PI 676092) is a new high-yielding, spanish-type groundnut (*Arachis hypogaea* L. subsp. *fastigiata* var. *vulgaris*) with two seeds per pod. Serenut 5R was released in 2010 by the National Semi-Arid Resources Research Institute, Soroti, Uganda. It was a selection from the ICRISAT advanced line ICGV-SM 93535. Serenut 5R originated from a cross made between ICGM 522 and 'RG 1'. ICGV-SM 93535 was developed by using repeated bulk selections for groundnut rosette disease resistance, using the infector row technique at the ICRISAT-Malawi research station. Performance tests in replicated trials were performed in Uganda in 2008 and 2009. Trials were performed in two seasons each year and averaged over 10 rainfed locations in Uganda. Serenut 5R matures in 100 to 110 d, similar to the widely grown control cultivar Serenut 3R. Serenut 5R resulted in significantly higher pod yields (16%) than Serenut 3R, and the shellout percentage for Serenut 5R was 4.8% higher than Serenut 3R. Seed testa is red, and the seeds are slightly larger than those of Serenut 3R. The sound mature kernel count for Serenut 5R was 38.7 g 100⁻¹ compared with 32.38 g 100⁻¹ for Serenut 3R, an increase of 19.51%. The dormancy period for Serenut 5R was significantly less than Serenut 3R.

'SERENUT 5R' (Reg. No. CV-129, PI 676092) is a high-yielding, early-maturing, red-seeded spanish-type groundnut (*Arachis hypogaea* L. subsp. *fastigiata* var. *vulgaris*) cultivar. It possesses resistance to groundnut rosette disease (GRD) and late leaf spot (LLS) [caused by *Cercosporidium personatum* (Berk. & M. A. Curtis) Deighton]. Groundnut varieties introduced into Uganda in 2003 from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)-Malawi groundnut program were evaluated in a screening program for resistance to GRD and LLS. In 2010, Serenut 5R, tested under the designation ICGV-SM 93535, was released by the National Semi-Arid Resources Research Institute (NaSARRI) in Uganda and is suitable for cultivation countrywide.

Groundnut rosette disease and LLS are the two most destructive diseases of groundnut in sub-Saharan Africa, including Uganda (Busolo-Bulafu, 2004; Okello et al., 2010). Groundnut rosette disease is caused by a complex of three agents (Naidu et al., 1999): *Groundnut rosette assistor virus* (Hull and Adams, 1968), *Groundnut rosette virus*, and a satellite RNA of *Groundnut rosette virus* (Murant and Kumar, 1990). Groundnut rosette disease can cause up to 100% loss in pod yield if the infection occurs before flowering (Naidu et al., 1999). It is estimated that GRD causes losses of more than US\$156 million yearly in sub-Saharan Africa (Naidu et al., 1999; Waliyar et al., 2007). Host plant resistance is the most economical way to minimize losses due to GRD and LLS.

Groundnut is grown by smallholder farmers primarily as a rainfed crop during the two rainy seasons in Uganda (Naidu et al., 1999; Okello et al., 2010). In 2013, groundnut was grown on 4.20 × 10⁵ ha in Uganda, producing approximately 2.95 × 10⁵ metric tons (Food and Agriculture Organization of the United Nations, 2013; Okello et al., 2015). Most of the traditionally

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Abbreviations: GRD, groundnut rosette disease; ICRISAT, International Crops Research Institute for the Semi-Arid Tropics; LLS, late leaf spot; NaSARRI, National Semi-Arid Resources Research Institute.

grown varieties of groundnuts are landraces, which are low-yielding and susceptible to GRD and LLS. Ugandan farmers need a variety that matures early (to avoid late-season drought), is resistant to GRD and LLS, and possesses red seed color, a trait highly valued by consumers. In addition, groundnut cultivars with short seed dormancy are needed as the popular cultivar Serenut 3R has a long seed dormancy (45 d) that cannot fit into the 1-month window between the first and second growing seasons. Moreover, Serenut 3R has weak pegs at physiological maturity, which leads to considerable yield losses at harvest.

Methods

Parental Lines and Pedigree Information

Serenut 5R is a selection from the ICRISAT advanced breeding line ICGV-SM 93535, derived from a cross between ICGM 522 and 'RG 1'. The Department of Agricultural Research and Technical Services in Malawi developed RG 1, a GRD-resistant cultivar belonging to subsp. *hypogaea* var. *hypogaea*. ICGM 522 belongs to subsp. *fastigiata* var. *vulgaris*, matures in 110 to 118 d, possesses high shelling turnover with tan color seed, and was used to increase yield potential (Kapewa et al., 2002).

Breeding, Selection, and Evaluation

The ICRISAT-Malawi groundnut program developed ICGV-SM 93535, following repeated bulk selections for GRD resistance using the infector row technique (Bock 1987; Bock and Nigam 1988), for agronomic traits such as maturity and acceptable pod and seed characteristics. Therefore, ICGV-SM 93535 is an advanced groundnut variety obtained for evaluation in Uganda. Initially, ICGV-93535 was grown for three seasons on station at NaSARRI before being evaluated at eight national performance trial sites for countrywide adaptability. It was introduced to replace the popular cultivar Serenut 3R, which has a long fresh seed dormancy of approximately 45 d. Serenut 3R also has weak pegs, which leads to considerable yield loss at harvest as most pods remain in the soil. Farmers in northern and eastern Uganda (where groundnut is primarily grown) grow two crops annually. Selection was performed for pod yield, maturity using the hull scape test (Williams and Drexler, 1981), seed color, and high percentage of two-seeded pods.

Performance Test

Replicated tests for yield and grade characteristics were performed for two seasons (2008 and 2009) at nine on-farm locations (Abi, Bulindi, Ikilki TVC, Kuju, Kumi, Mukono, Nakabango, Ngetta, and Serere) under rainfed conditions in Uganda. The design was a randomized complete block design with four replicates. The locations experience a bimodal rainfall distribution and are within the Kyoga Plains agro-ecological

zone of Uganda. All experiments were planted with the onset of rains. Experiment 1 (2008A) was planted on 18 to 22 Apr. 2008 at four locations (Ikilki, Mukono, Kumi, and Serere); Experiment 2 (2008B) was planted on 30 Sept. 2008 at three locations (Ngetta, Nakabango, and Ikilki-TVC); Experiment 3 (2009A) was planted on 22 Apr. 2009 at six locations (Ikilki, Mukono, Serere, Ngetta, Nakabango, and Abi); and Experiment 4 (2009B) was planted on 15 Sept. 2009 at eight locations (Serere, Ikilki, Mukono, Nakabango, Kuju, Abi, Kumi, and Bulindi). No fertilizer or fungicides were applied at any of the locations. Plot size consisted of eight rows 5.0-m long spaced 30 cm between rows and 10 cm between plants within row. Serenut 3R was used as a control in all trials. Plants were harvested when 80% of the pods showed dark brown discoloration inside the pods.

Observations on plot yield (g), 100-seed weight (g), and shelling outturn were recorded. One hundred randomly selected pods were shelled to measure shelling outturn. Likewise, sound mature kernels were used to record 100-seed weight. Both blanching and flavor scores were conducted by J. Leek and Associates (Brownfield, TX). Five hundred grams of seeds were used to determine the flavor score by a trained flavor panel and the blanching results.

Statistical Analysis

Data for each variable were analyzed using PROC MIXED model in SAS 9.3 (SAS Inst.). A LSD *t* test was used for mean separation involving entries (Steele and Torrie, 1989).

Characteristics

Plant Characteristics

Serenut 5R is a spanish market-type cultivar with a red seed color, which matures in 100 to 110 d, similar to the control cultivar Serenut 3R. Serenut 5R has a bunch growth habit with alternate branching. The leaves are dark green with flowers on the main stem. It has a shorter period of seed dormancy, 30 d, compared with 45 d in Serenut 3R. This allows farmers to grow Serenut 5R in both rainy seasons. More important, Serenut 5R has much stronger pegs compared with Serenut 3R, which significantly minimizes loss of pods during digging, resulting in higher yields.

Yield and Grade Characteristics

Averaged across four seasons, Serenut 5R produced a significant increase in pod yield (1240 kg ha⁻¹) that was 16% greater than Serenut 3R (1068 kg ha⁻¹) (Table 1). In addition, Serenut 5R had a 4.8% higher shelling outturn than Serenut 3R (Table 2). Serenut 5R gives a 100-seed weight of 37 g, 8.8% greater than Serenut 3R (Table 3). The net profit for growing Serenut

Table 1. Two-year (21 tests) average for pod yield of Serenut 5R and Serenut 3R.

Cultivar	2008A	2008B	2009A	2009B	Mean
	kg ha ⁻¹				
Serenut 5R	915 a†	949 a	1571 a	1262 a	1240 a
Serenut 3R	558 b	676 b	1478 b	1164 b	1068 b
Mean	737	813	1525	1213	1154
CV (%)	42.1	46.3	32.9	45.5	47.9

† Means within columns followed by the same letter are not different at *p* = 0.05 according to Fisher's Protected LSD.

Table 2. Two-year (21 tests) average for shelling outturn of Serenut 5R and Serenut 3R.

Cultivar	2008A	2008B	2009A	2009B	Mean
	%				
Serenut 5R	65.19 a†	58.50 a	62.71 a	57.97 a	60.77 a
Serenut 3R	59.50 b	54.75 b	60.42 b	56.63 b	57.99 b
Mean	62.34	56.63	61.56	57.30	59.38
CV (%)	8.76	14.03	7.41	15.74	12.44

† Means within columns followed by the same letter are not different at $P = 0.05$ according to Fisher's Protected LSD.

Table 3. Two-year (21 tests) average for 100 seed weight of Serenut 5R and Serenut 3R.

Cultivar	2008A	2008B	2009A	2009B	Mean
	g				
Serenut 5R	36.56 a†	33.33 a	35.42 a	35.16 a	35.24 a
Serenut 3R	31.88 b	30.83 b	32.71 b	32.97 b	32.38 b
Mean	34.22	32.08	34.06	34.06	33.81
CV (%)	19.85	20.69	20.13	17.91	18.71

† Means within columns followed by the same letter are not different at $p = 0.05$ according to Fisher's Protected LSD.

5R is US\$683 ha⁻¹ compared with US\$497 ha⁻¹ for Serenut 3R (Okello et al., 2015), which represents a 37% increase in additional income for Serenut 5R. Based on 2015 market prices, growers in Uganda can benefit from growing Serenut 5R due to higher pod yields and relatively superior grade characteristics.

Disease Resistance

Serenut 5R and Serenut 3R have similar disease (GRD and LLS) scores (Tables 4 and 5), indicating that Serenut 5R has resistance to GRD and LLS at the same levels as those found in Serenut 3R. However, Serenut 5R was less affected by soil-borne

fungi than Serenut 3R. Mold incidence caused by *Aspergillus* spp. is higher in Serenut 3R compared with Serenut 5R (Okello, unpublished data).

Quality Analysis

The mean roasted peanut flavor intensity of Serenut 5R was significantly higher than Serenut 3R (Table 6). Serenut 5R compared with Serenut 3R recorded 11% greater oil and protein and 20% greater sugar content (Table 7). Consumers prefer Serenut 5R over Serenut 3R because of its sweet taste and red-colored seeds (Okello, unpublished data).

Table 4. Two-year (21 tests) average for groundnut rosette disease of Serenut 5R and Serenut 3R.

Cultivar	2008A	2008B	2009A	2009B	Mean
Serenut 5R	3.13	1.42	1.92	2.69	2.33
Serenut 3R	2.94	1.58	2.13	3.25	2.67
Mean	3.03	1.50	2.02	2.97	2.50
LSD	NS†	NS	NS	NS	NS
CV (%)	35.26	50.34	49.81	34.62	45.44

† NS, not significantly different at the $p = 0.05$ level of probability.

Table 5. Two-year (21 tests) average for LLS of Serenut 5R and Serenut 3R.

Cultivar	2008A	2008B	2009A	2009B	Mean
Serenut 5R	4.13	4.08	3.33	3.66	3.63
Serenut 3R	4.19	3.50	3.71	3.78	3.88
Mean	4.16	3.79	3.52	3.72	3.76
LSD	NS†	NS	NS	NS	NS
CV (%)	23.88	24.29	24.33	18.97	22.81

† NS, not significantly different at the $p = 0.05$ level of probability.

Table 6. Flavor components of Serenut 5R and Serenut 3R. Data are mean values from selected locations harvested in 2014 in Clovis, NM.

Genotype	Roasted	Sweet	Aromatic	Bitter
Serenut 5R	6.3 a†	2.3 a	1.3 a	2.7 a
Serenut 3R	2.6 b	0.0b	0.0b	0.6b

† Means within columns followed by the same letter are not different at $p = 0.05$ according to Fisher's Protected LSD.

Table 7. Two-year average protein, sugar, oil, and moisture content of Serenut 5R and Serenut 3R at Clovis, NM. Data are mean values from selected locations harvested in 2014 in Clovis, NM.

Genotype	Protein	Sugar	Oil	Moisture
Serenut 5R	25.5	4.2	44.8	3.6
Serenut 3R	23.0	3.5	40.5	3.0

Seed Availability

Seed of Serenut 5R has been deposited with the USDA-ARS National Center for Genetic Resources Preservation, where it is freely available for research purposes. The Nucleus seed will be maintained at NaSARRI, P.O. Box Private Bag, Soroti, Uganda. The cultivar must be sold as a class of certified seed, by cultivar name only. Small samples of seed for research purposes may be obtained from the corresponding author.

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