Germplasm Enhancement in Groundnut

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Introduction

Groundnut is a major oilseed and food crop worldwide; 23 million t were produced from 20 million ha in 1992. Groundnut production systems, though diverse, can be broadly classified into four groups.

- Rainfed areas, where short- and medium-duration cultivars are grown for oil, food, and fodder;
- Areas with supplemental irrigation, where mostly medium-duration cultivars are grown for oil and confectionery use;
- High-input systems, in which medium- and long-duration cultivars are grown for oil and confectionery use;
- Residual-moisture systems, in which short-duration cultivars can be grown for oil and food.

Production constraints. Several biotic and abiotic stresses limit groundnut production to varying extents in different regions. The important biotic stresses include early and late leaf spots and rust among foliar fungal diseases; peanut bud necrosis virus, peanut stripe virus, rosette, and peanut mottle virus among virus diseases; and jassids, thrips, termites, leaf miner, *Spodoptera*, and white grubs among insect pests. Rosette is restricted to the African continent and surrounding islands. Bacterial wilt is widespread in East and Southeast Asia. The abiotic stresses include drought, iron chlorosis, soil acidity, low soil fertility, and low temperatures. These constraints often occur in combinations.

Research Objectives

Past/current objectives. Groundnut breeding research at ICRISAT has been conducted with the following objectives: high yield potential and wide adaptation, development of confectionery varieties, resistances to foliar diseases, *Aspergillus flavus*, viruses, and insect pests, and drought tolerance. Most of these objectives continue to receive our attention. Significant progress has been made in several areas, e.g., increasing yield potential and resistance to thrips and jassids. In these cases there has been a corresponding decrease in further research inputs, efforts being directed at other problems.

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Future objectives. Improved high-yielding groundnut varieties have been released in India and several other countries. The recent releases in India have resulted in a genetic pod yield gain of 1.3-3.2% per year. These productivity gains need to be sustained by incorporating resistance/tolerance to the prevailing biotic and abiotic stresses. To increase production further, cultivars suited to specific production systems are required. To sustain groundnut production, diversified products and uses must be developed; work on value-added products and specific traits relating to consumer acceptability will therefore need to be intensified. Future breeding objectives should thus include biotic and abiotic stress alleviation, specific adaptation, and improvement of specific characters required for various end uses.

Germplasm enhancement at ICRISAT

Groundnut breeding research at ICRISAT began in 1976 at ICRISAT Asia Center. From 1979 till date (where records are available) we have made 7920 crosses for different breeding objectives, using 532 germplasm lines, 718 advanced breeding lines, and 161 interspecific derivatives. We have also successfully exploited natural hybrids to develop high-yielding cultivars.

Over the years, the breeding research focus at ICRISAT has shifted from finished products to the development of genetically enhanced, advanced breeding lines/populations, from which our national collaborators select material best suited to local conditions. Breeding materials developed at ICRISAT—elite germplasm, segregating populations, and advanced breeding lines—are supplied to national programs on request, as are international varietal trials.

Table 1. ICRISAT-developed groundnut cultivars released in India.

Variety	Pedigree	Research initiated	Product identified	Product released
ICGS 11 (ICGV 87123)	Natural hybrid derivative from Kadiri 3	1977	1980/81	1986
ICGS 44 (ICGV 87128)	-do-	1977	1982/83	1988
ICGS 76 (ICGV 87141)	TMV 10 x Chico	1977/78	1985	1989
ICGS 37 (ICGV 87187)	Natural hybrid derivative from Kadiri 3	1977/78	1980/81	1990
ICGS 1 (ICGV 87119)	-do-	1977/78	1981	1990
ICG (FDRS) 10 (ICGV 87160)	Ah 65 x NC Ac 17090	1978	1983	1990
ICGV 86590	X 14-4-B-19-B x PI 259747	1979	1988	1991
ICGV 86325	ICGS 20 x G 201	1980	1989	1994

Released cultivars

Tables 1 and 2 list groundnut cultivars developed by ICRISAT and released through the national programs in India and elsewhere. Among the Indian releases for postrainy season cultivation, ICGS 11 and ICGS 44 are suitable for Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, and Madhya Pradesh and ICGS 37 for Gujarat. ICGS 76, ICG (FDRS) 10, and ICGV 86590 are suitable for rainy-season cultivation in peninsular India; the last two are resistant to rust and tolerant of late leaf spot, both of which can cause substantial yield losses in that region. ICGS 1 is suitable for both spring and rainy-season cultivation in northern India.

Table 2. ICRISAT-developed groundnut varieties released outside India.

Country	Variety	ICRISAT parent material	Year of release
South Korea	Jinpungtongkong	ICGS 35	1987
Pakistan	BARD 699	ICGS 44 + ICGS 37	1989
Ghana	Sinkarzei	ICGS 114	1989
Malawi	CG 7	ICGMS 42	1990
Zambia	MGV 4	ICGMS 42	1990
Republic of Guinea	VP 20	ICGV 86105	1992/93
Myanmar	Yezin 5	ICGV 87160	1993

NARS collaboration

The impact of ICRISAT's groundnut research can also be measured in terms of collaborative studies with NARS. Our cooperators in Asia and Africa have released a number of cultivars developed from advanced breeding lines, segregating populations, and germplasm accessions supplied by ICRISAT (Table 3). From the segregating materials, VRI 1, a short-duration variety with fresh seed dormancy and high shelling percentage; ALR 1 (a rust-resistant variety); and Girnar 1 (with multiple disease resistance) have been developed in India. Similarly, from ICRISAT's advanced breeding lines, Spring Groundnut '84 in Punjab, Konkan Gaurav in Maharashtra, and RG 141 in Rajasthan have been developed. ICRISAT-supplied germplasm accessions that have ben released as cultivars include Sinpadetha 2 and 3 in Myanmar, Johari in Tanzania, Cardi-Payne in Jamaica, ICG 7794 in Ethiopia, BARD 479 in Pakistan, and UPL Pn 10 in the Philippines.

A number of lines are in the testing and pre-release stages in various countries. In India, one short-duration variety (ICBS 86143), two confectionery varieties (ICHNG

Table 3. Groundnut varieties developed by NARS using ICRISAT parent material and released in India.

Variety	ICRISAT parent material	Bred/ selected by[1]	Year of release	Features of parent material
Spring Groundnut '84	ICGS 1	PAU, Punjab	1984	Matures in 112 days; tolerant of bud necrosis disease; high shelling percentage; good oil quality
Konkan Gaurav	ICGS 1	KKV, Maharashtra	1990	Matures in 112 days; tolerant of bud necrosis disease; high shelling percentage; good oil quality
VRI 1	TMV 7 x FSB 7-2	TNAU, Vriddhachalam	1986	High shelling percentage; fresh seed dormancy
ALR 1	FESR selection	TNAU, Aliyarnagar	1987	Resistant to rust and late leaf spot
Girnar 1	X14-4-B-19-B x NC Ac 17090	NRCG, Junagadh	1989	Short-duration, multiple resistance to foliar diseases, aflatoxin, jassids, and drought
RG 141	Kadiri 3 x NC Ac 2821	RAU, Rajasthan	1989	High-yielding

1. PAU, RAU, TNAU = Punjab, Rajasthan, Tamil Nadu Agricultural University, KKV = Konkan Krishi Vidyapeeth, NRCG = National Research Centre for Groundnut.

88438 and ICHNG 88398), and a drought-tolerant variety (ICDRG 87354) are in various stages of testing (Table 4). Similarly, several ICRISAT-bred varieties are in advanced stages of testing in other countries. These include ICGS(E) 56 in Pakistan and Bangladesh, ICGS(E) 52 in Gambia, ICGS(E) 11 in Bangladesh, ICGS 11 in

Table 4. Groundnut varieties developed jointly by ICRISAT and NARS, currently in testing and pre-release stages.

ICGV no.	AICORPO[1] no.	Year	Trial	Proposed by
ICGV 86143	ICBS 86143	1992/93	IVT	Bhavanisagar, Tamil Nadu
ICGV 88438	ICHNG 88438	1993/94	HPSVT	Hanumangarh, Rajasthan
ICGV 88398	ICHNG 88398	1993/94	HPSVT	Hanumangarh, Rajasthan
ICGV 87354	ICDRG 87354	1993/94	NDRVT	Durgapur, Rajasthan

1. AICORPO = All India Coordinated Research Project on Oilseeds.

Benin, ICGV 86553 in Cyprus, ICGV 87157 in Sierra Leone, and ICGV 87350 in the Philippines. In addition to these cultivars, several elite germplasm lines have also been developed for use by national programs as sources of resistance to multiple diseases and insect pests (Table 5).

Table 5. Elite groundnut germplasm developed at ICRISAT Asia Center.

Genotype	Attributes
ICGV 87157 [ICGV (FDRS) 4]	Resistant to rust, tolerant of late leaf spot, moderately resistant to bud necrosis disease
ICGV 86031	Multiple resistance/tolerance to *Spodoptera*, leaf miner, jassids, thrips
ICGV 86699	Multiple resistance/tolerance to rust, late leaf spot, bud necrosis, stem and pod rots, *Spodoptera*, jassids
ICGV 86564	Dual-purpose elite line suitable for direct consumption as seed and for oil

REIA workplan

The following varieties are suggested for impact analysis:

India

- ICGS 44 (Andhra Pradesh, Tamil Nadu)
- ICGS 11 (Maharashtra, Andhra Pradesh)
- ICGS 76 (Maharashtra)
- ICGS 21 (Maharashtra)
- ICGV 86590 (Andhra Pradesh, Karnataka, Tamil Nadu)

Other countries

- BARD 699 (Pakistan)
- ICGMS 42 (Zambia, Malawi)

For constraint analysis the following varieties are suggested:

- ICG (FDRS) 10 (Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu)
- ICGS 37 (Gujarat)
- ICGV 86564 (high-management areas in Maharashtra, Andhra Pradesh)

Although some of the above varieties have been released in India, they have not become popular. The reasons are not clear, but it appears that in some cases, e.g., ICG (FDRS) 10, the pods are not attractive and therefore not acceptable to farmers.