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# ICC 4958

## A Drought Resistant Chickpea

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- Drought-resistant donor
- High yielding in low-productivity, short-duration, terminal drought environments



*Figure 1. Genotypic differences between roots of ICC 4958, Annigeri, and a F<sub>4</sub> segregant derived from a cross between the two, grown in nutrient sand culture.*



**ICRISAT**

**Plant Material Description no. 33**

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## Purpose of Identification

ICC 4958 is a drought-resistant accession available from the ICRISAT germplasm collection. It is used as a drought-resistant donor parent that produces high yields in low-productivity, short-duration, terminal drought prone environments, e.g., those in peninsular India, and for spring sowings in West Asia, it wilts late when infected by *Fusarium oxysporum* f.sp. *ciceri*. Pod borer damage, caused by *Helicoverpa armigera* is similar to that of Annigeri, a control variety of comparable duration. The percentage of borer-damaged pods in one study was 22% in ICC 4958 compared to 40% in Annigeri.

## Origin and Development

ICC 4958 is a genetic stock. It was collected from Jabalpur, Madhya Pradesh, India in 1973, and it was among the over 1500 germplasm accessions screened for drought resistance at ICRISAT Center between 1978 and 1983.

## Plant Characters

ICC 4958 is a desi-type chickpea. Anthocyanin is present in its stems and foliage. Its growth habit is semi-erect, and it has more terminal branches than Annigeri. The plant height at flowering is around 40 cm. The root system (Fig. 1) and leaf size are relatively large. ICC 4958 flowers approximately 39 days after sowing under peninsular Indian conditions, and the crop matures in less than 90 days in rainfed environments (Table 1).

## Seed Characters

ICC 4958 has large seeds with brown seed coats and a 100-seed mass of  $30 \pm 0.3$  g compared to  $19 \pm 1.2$  g in Annigeri.

## Performance

Results of the 1983/84 replicated evaluation for drought resistance in ICC 4958 were first reported in 1987. A regression of yield of individual genotypes on the mean yield (of all the genotypes) in the environment was fitted. Genotypes with higher intercepts combined with lower slopes were considered drought-resistant. In the 1984/85 season, the drought resistance of ICC 4958 was validated in trials conducted across eight different environments experimentally created at ICRISAT Center (Fig. 2). ICC 4958 was also found to be the most drought-resistant entry when judged by these criteria in drought-screening trials at the International Center for Agricultural Research in the Dry Areas (ICARDA), Tel Hadya, Syria. These trials used a range of soil moisture environments created by line-source sprinkler irrigation. The drought resistance of ICC 4958 was also evaluated using the drought tolerance index (DTI), computed as the standardized residual in a multiple regression analysis with nonirrigated (stress) yield as the dependent variable and days to flowering (escape) and irrigated (potential) yield as the independent variables. A higher

value of DTI is indicative of a greater degree of drought resistance. Results obtained at ICRISAT Center and recently in the ICRISAT-Indian Council for Agricultural Research (ICAR) collaborative trials on drought tolerance in chickpea in peninsular India, are given in Table 2.

**Table 1. Morpho-phenological traits of ICC 4958 and Annigeri, measured at ICRISAT Center except for flowering, maturity, and seed size which are the means of six locations in Peninsular India.**

	ICC 4958		Annigeri	
	Mean	SE Mean	Mean	SE Mean
Plant height (cm)	39	± 6.6	37	± 8
Branch number plant <sup>-1</sup>	15	± 1.8	22	± 4.3
Node number plant <sup>-1</sup>	149	± 26	196	± 42
Pinnule number leaf <sup>-1</sup>	13.7	± 0.22	13.7	± 0.22
Leaf size (cm <sup>2</sup> )	6.4	± 0.12	3.3	± 0.12
Days to 50% flowering	39	± 2.1	43	± 2.3
Days to maturity (-)	88	± 4.5	89	± 4.6
Days to maturity (+)	103	± 3.9	104	± 3.9
100-seed mass (g)	30	± 0.30	19	± 1.2

**Table 2. Drought tolerance indices for ICC 4958 and Annigeri at ICRISAT Center (1983/84 to 1985/86) and in experiments conducted by the All India Coordinated Pulses Improvement Program, Directorate of Pulses Research, Kanpur, 1990/91.**

ICRISAT Center							
Genotype	1983/84		1984/85		1985/86		Mean
	Alfisol	Vertisol	Alfisol	Vertisol	Alfisol	Vertisol	
ICC 4958	1.21	0.99	0.05	1.17	0.76	1.37	1.03
Annigeri	0.69	-0.61	1.93	0.26	-0.10	-0.39	0.45

ICRISAT-ICAR collaborative trials			
Genotype	Locations		
	ICRISAT Center	Nandyal	Bellary
ICC 4958	1.81	1.35	1.48
Annigeri	-1.26	0.76	0.83

## Physiological Basis of Drought Resistance

The drought resistance of ICC 4958 is associated with its root system, that is both larger length and volume than that of Annigeri. The accumulation of seed mass after flowering starts is faster in ICC 4958 than in Annigeri. This trait permits ICC 4958 to accumulate a large seed mass before the soil moisture recedes and drought becomes increasingly severe.

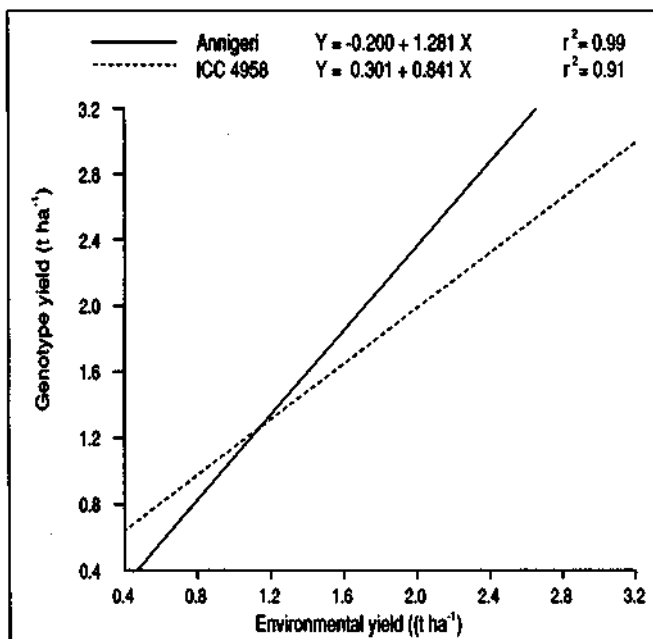


Figure 2. Genotypic differences between yields of ICC 4958 and Annigeri in 8 different experimental environments with mean yields ranging from 0.5 to 2.8 t ha<sup>-1</sup>.

## Plant Material Descriptions from ICRISAT

Leaflets in this series provide brief descriptions of crop genotypes identified or developed by ICRISAT, including:

- germplasm accessions with important agronomic or resistance attributes;
- breeding materials, both segregating and stabilized, with unique character combinations; and
- cultivars that have been released for cultivation.

These descriptions announce the availability of plant material, primarily for the benefit of the Institute's cooperators. Their purpose is to facilitate the identification of cultivars and lines and promote their wide utilization. Requests should be addressed to the Director General, ICRISAT, or to appropriate seed suppliers. Stocks for research use issued by ICRISAT are sent to cooperators and other users free of charge.

ICRISAT is a nonprofit, scientific, research and training institute receiving support from donors through the Consultative Group on International Agricultural Research. Its major mandate is to serve as a world center for the improvement of grain yield and quality of sorghum, millet, chickpea, pigeonpea, and groundnut, and to act as a world repository for the genetic resources of these crops. The plant materials announced in these leaflets are end-products of this work, which is aimed at enhancing the agricultural productivity of resource-poor farmers throughout the semi-arid tropics.