

## Registration of Six Fusarium Wilt-Resistant Chickpea Germplasm Lines

Six chickpea (*Cicer arietinum* L.) germplasm lines, ILC 9784 (Reg. no. GP-159, PI 592394), ILC 9785 (Reg. no. GP-160, PI 592395), ILC 9786 (Reg. no. GP-161, PI 592396), FLIP 86-93C (Reg. no. GP-162, PI 587043), FLIP 87-33C (Reg. no. GP-163, PI 587044), and FLIP 87-38C (Reg. no. GP-164, PI 587045), were jointly released by the International Center for Agricultural Research in the Dry Areas (ICARDA), Syria, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India, and the Universidad de Córdoba, Spain, in 1994. ILC 9784 is resistant to Races 0, 1, and 5 of *Fusarium oxysporum* Schlecht.:Fr. f. sp. *ciceris* (Padwick) Matuo & K. Sato (hereafter referred to as *F.o.c.*). The remaining five lines, ILC 9785, ILC 9786, FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C, are resistant to Races 0 and 1 of *F.o.c.* Of these, FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C are also cold tolerant. All six lines are of the kabuli type (characterized by large rams-head-shaped beige seeds). These lines were released for use in breeding program because of their resistance to two or three races of *F.o.c.*, their large kabuli-type seeds, and their cold tolerance.

ILC 9784 is an introduction from Iran, ILC 9785 from Afghanistan, and ILC 9786 from Turkey. (The original accession numbers were ILC 267, ILC 1278, and ILC 1300, respectively.) These three lines were mixtures, purified by mass selection. The resistant plants from each line were selected and bulk-harvested in the first year. The bulked seeds were sown in the wilt-sick plot in the second year, and the resistant plants were again selected and bulk-harvested.

FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C were developed from the crosses ILC 195/FLIP 82-78C, FLIP 82-72C/FLIP 82-93C, and FLIP 81-56W/FLIP 82-78C, respectively. These crosses were made in 1983 at the main research station of ICARDA at Tel Hadya, Syria. The  $F_1$ 's were grown in the off-season nursery at the ICARDA high-altitude substation at Terbol, Lebanon. The resulting  $F_2$  bulks were grown in the winter nursery (November to June) at Tel Hadya. In the absence of facilities to screen for resistance to fusarium wilt, selections were made mainly for cold tolerance, early maturity, and seed size. Plants with such attributes were bulk-harvested. The  $F_3$  bulks of three crosses were grown in the off-season at Terbol, and early maturing plants from each cross were bulk-harvested. The  $F_4$  bulks were grown in the winter nursery at Tel Hadya, and plants with cold tolerance, early maturity, and large seeds were individually harvested. The  $F_5$  progenies were grown in the winter nursery at Tel Hadya. Selection was primarily for cold tolerance, large seed size, and productivity. Uniform and high-yielding progenies were bulked and grown in the off-season nursery at Terbol for seed increase and purification. The lines were tested in the  $F_7$  for seed yield in both winter and spring seasons at three locations (two in Syria and one in Lebanon). These lines produced high seed yields and were assigned the accession numbers FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C.

Between 1987 and 1993, 3019 germplasm lines were evaluated by the Universidad de Córdoba in a local farmer's field, following the method described by Jiménez-Díaz et al. (1). The field was naturally infested with Races 0, 1, and 5 of *F.o.c.*, and 47 lines were identified as resistant to fusarium wilt. These 47 lines were evaluated by means of artificial inoculation by the pot culture method (2) in the greenhouse against *F.o.c.* Races 0, 1, and 5 (3). All 47 lines were resistant to Race 0 of the wilt pathogen, but ILC 9784 was also resistant to Races 1 and 5.

ILC 9785, ILC 9786, FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C were tested in the greenhouse at Córdoba for resistance to *F.o.c.* and were found resistant to Race 1. In addition, FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C were cold tolerant under Tel Hadya conditions during 1991–1992, when minimum temperatures reached  $-8.8^\circ\text{C}$  and freezing temperatures occurred for 57 d.

The 100-seed weight of ILC 9784, ILC 9785, ILC 9786, FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C was 20, 33, 40, 54, 33, and 24 g, respectively. ILC 9784, ILC 9785, ILC 9786, FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C matured in 179, 182, 185, 192, 193, and 187 d, respectively, when winter-sown at Tel Hadya. ILC 9784 (35 cm) was short; FLIP 86-93C (58 cm), FLIP 87-33C (54 cm), and FLIP 87-38C (57 cm) were midtall; and ILC 9785 (61 cm) and ILC 9786 (66 cm) were tall. The protein content in seed of ILC 9784, ILC 9785, ILC 9786, FLIP 86-93C, FLIP 87-33C, and FLIP 87-38C was 19.3, 23.3, 23.4, 21.0, 22.4, and 22.9%, respectively. These six fusarium wilt-resistant lines therefore differ in cold tolerance, seed size, maturity, plant height, and seed protein, and will provide breeders a choice of fusarium wilt-resistant lines for use in their breeding programs.

Seed of these lines is being maintained by the Germplasm Program of ICARDA, and small quantities can be obtained upon request for use in breeding programs.

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### References and Notes

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2. Jiménez-Díaz, R.M., P. Crinó, H. Halila, C. Mosconi, and A. Trapero-Casas. 1993. Screening for resistance to fusarium wilt and ascochyta blight in chickpea. p. 77–95. In K.B. Singh and M.C. Saxena (ed.) *Breeding for stress tolerance in cool-season food legumes*. John Wiley & Sons, Chichester, UK.
3. Jiménez-Díaz, R.M., A. Trapero-Casas, and J. Cabrera de La Colina. 1989. Races of *Fusarium oxysporum* f. sp. *ciceri* infecting chickpeas in southern Spain. p. 515–520. In E.C. Tjamos and C.H. Beckman (ed.) *Vascular wilt diseases of plants*. Vol. 428. Springer-Verlag, Berlin.
4. K.B. Singh, ICRISAT/ICARDA Chickpea Project, ICARDA, P.O. Box 5466, Aleppo, Syria; R.M. Jiménez-Díaz, Cátedra de Patología Vegetal, Dep. de Agronomía, Univ. de Córdoba, and Inst. de Agric. Sostenible, Consejo Superior de Investigaciones Científicas, Apartado 3048, 14080 Córdoba, Spain. Joint contribution of ICARDA, ICRISAT (Patancheru PO, AP 502 324, India), and Univ. de Córdoba. Registration by CSSA. Accepted 31 Dec. 1995. \*Corresponding author.