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INHERITANCE OF RESISTANCE TO FUSARIUM WILT IN PIGEONPEA (*CAJANUS CAJAN* (L.) MILLSP.)

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ABSTRACT

The inheritance of resistance in pigeonpea (*Cajanus cajan* (L.) Millsp.) to fusarium wilt (*Fusarium udum* Butler) was studied in crosses between a resistant line ICP 8863 and two susceptible (ICP 2376 and LRG 30) pigeonpea lines. The parents, F_1, F_2 and backcross populations were screened for resistance to *F. udum* in a wilt-sick nursery at the ICRISAT Center. Resistance to fusarium wilt is controlled by a single recessive gene, which has been designated as pwr1.

Key words: Inheritance, fusarium wilt, resistance, pigeonpea.

Fusarium wilt caused by the fungus *Fusarium udum* Butler is a serious soil-borne disease of pigeonpea in India, Nepal, Tanzania, Kenya, Uganda and Malawi. Average wilt incidence of 36% in Malawi, 20% in Tanzania, 16% in Kenya and 7% from several Indian states surveyed between 1975 and 1980 has been reported [1].

Development of improved pigeonpea genotypes with resistance to fusarium wilt is a major breeding objective of the pigeonpea improvement research at ICRISAT. Adoption of certain management practices, such as, crop rotation and mixed cropping with sorghum are partially effective in minimising losses due to wilt. Similarly use of chemicals for soil treatment or soil solarization are not economical.

Although the search for sources of resistance to fusarium wilt in pigeonpea was initiated following the identification of the causal organism in India in 1908 [2], very few studies on the inheritance of wilt resistance have been undertaken. Earlier studies revealed that resistance to wilt was controlled by multiple factors [3], complementary genes [4], duplicate dominant genes [5], or a single dominant gene [6]. These results emphasized the need for further study to obtain information on the inheritance of wilt resistance. The present study reports results on inheritance of wilt resistance in the pigeonpea line ICP 8863 to the local isolate of *F. udum* at ICRISAT Center. This line showed resistance to wilt in multilocational

trials in India [7]. It is a medium-duration (155–175 days) line selected from a local landrace from the Maharashtra State. This line was tested for wilt resistance in the wilt-sick nursery at ICRISAT Center for more than 10 years and showed consistent resistance (less than 10% mortality).

MATERIALS AND METHODS

The resistant pigeonpea line ICP 8863 was crossed with susceptible lines ICP 2376 and LRG 30. In the following year, the two F_1s were backcrossed to both resistant and susceptible parents. The hybrid plants were also selfed by covering the plants with muslin cloth bags to produce F_2 seed. Parents, F_1, F_2 and backcross populations were grown in the pigeonpea wilt-sick nursery at ICRISAT Center during rainy season. The number of plants of the parents tested for wilt reaction ranged from 105 to 186. The F_1 plants tested in each cross ranged from 24 to 41. The population size of F_2 generation ranged from 441 to 483 plants. In backcross generation, plant population varied from 17 to 54. One of the wilt-susceptible parents, ICP 2376, was grown alternately after every two test rows to monitor the uniformity and level of wilt incidence in the nursery. Sowing was done on ridges 60 cm apart with the interplant spacing of 20 cm. Plants that wilted at maturity were classified as susceptible and those which did not wilt were recorded as resistant. The data were subjected to χ^2 test to determine the goodness of fit of the observed ratios.

RESULTS AND DISCUSSION

The susceptible parent ICP 2376 sown along with the test material showed 92 to 100% mortality, average 96%, by the time the crop reached maturity. Wilt incidence in the resistant parent ICP 8863 was 7% (Table 1). In both the susceptible lines, ICP 2376 and LRG 30, wilt incidence was more than 98% and the plants that did not wilt were found to be morphologically distinct from the susceptible parental types. This has been the trend in the reaction of these lines in the wilt nursery during the past 10 years either grown in few rows in a part of the nursery or on a large scale covering the entire nursery. In view of the consistent reaction of the lines in the nursery and the difficulty in raising large number of plants of pigeonpea which is a perennial bushy plant in pots using a pure culture of *F. udum*, evaluation was done in the wilt-sick nursery. Pigeonpea is an often cross-pollinated crop and the extent of outcrossing ranging from less than 1% in Hawaii, USA to 45.9% at Kabete in Kenya has been reported [8].

Both F_1s of the crosses between resistant and the two susceptible lines were susceptible (Table 1). Out of 24 to 41 plants tested, 3–4 plants did not show mortality. The surviving plants were examined for seed color, seed size, and maturity duration and were found to resemble the resistant parent ICP 8863. This may be due to chance selfing with resistant

Table 1. Reaction of parents, F_1, F_2 and backcross generations to fusarium wilt in a wilt-sick nursery at ICRISAT Center, Patancheru

Parent, cross and generation	Total plants	F_2 segregation		Expected ratio	χ^2	P
		res.	sus.			
Parents						
ICP 8863	186	173	13	—	—	—
ICP 2376	105	1	104	—	—	—
LRG 30	144	2	142	—	—	—
F_1 generation						
ICP 8863 x ICP 2376	24	4	20	Susc.	—	—
ICP 8863 x LRG 30	41	3	38	Susc.	—	—
F_2 generation						
ICP 8863 x ICP 2376	441	117	324	1:3	0.59	0.30–0.50
ICP 8863 x LRG 30	483	137	347	1:3	2.47	0.10–0.20
Backcross to resistant parent						
(ICP 8863 x ICP 2376) x ICP 8863	53	31	22	1:1	1.52	0.20–0.30
(ICP 8863 x LRG 30) x ICP 8863	17	10	7	1:1	0.52	0.30–0.50
Backcross to susceptible parents						
(ICP 8863 x ICP 2376) x ICP 2376	54	0	54	Susc.	—	—
(ICP 8863 x LRG 30) x LRG 30	37	0	37	Susc.	—	—

pollen while making emasculation and pollination. The resistant parent ICP 8863 produces brown seed and is of medium maturity. The susceptible parent LRG 30 has brown seed and is late maturing than ICP 8863 while ICP 2376 has white seed. The brown seed coat colour is dominant over white seed coat color and lateness is dominant over earliness [9, 10].

In the F_2 and backcross generations, the segregation for resistant and susceptible reactions were consistent with segregation of a single recessive allele conferring resistance. In the F_2 generation, the segregation was in the ratio of 1 resistant : 3 susceptible plants. The segregation in the backcross to the resistant parent was in the ratio of 1 resistant : 1 susceptible. As expected, backcrosses with susceptible parents produced only susceptible plants, providing further confirmation for the control of resistance by a single recessive gene (Table 1). The results of this study show that resistance to fusarium wilt in ICP 8863 is controlled by a single recessive gene. Earlier reports that resistance to fusarium wilt in pigeonpea is controlled by a dominant gene, complementary genes, or duplicate dominant genes could be due to the use of different resistant parents or isolates of *F. udum* in different studies.

The wilt resistant line has been released for commercial cultivation in the Karnataka State and is being used in the hybridization program at ICRISAT to incorporate wilt resistance into high yielding pigeonpea genotypes.

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