
THE INHERITANCE AND ASSOCIATION OF RESISTANCE TO BEAN RUST
(UROMYCES PHASEOLI) AND COMMON BLIGHT (XANTHOMONAS CAMPESTRIS
PV. PHASEOLI) IN DRY BEANS (PHASEOLUS VULGARIS L.)

M. LUANN FINKE, D.P. COYNE, J.R. STEADMAN, AND A.K. VIDAVER
DEPT. HORTICULTURE AND DEPT. PLANT PATHOLOGY
UNIVERSITY OF NEBRASKA, LINCOLN, NEBRASKA, USA 68583

Bean rust (Uromyces phaseoli) (Up) and common blight (Xanthomonas campestris pv. phaseoli) (Xcp) are major disease problems affecting dry bean production worldwide. Information on the interaction of these pathogens and inheritance of resistance, would be useful in breeding programs.

A randomized complete block design (RCBD) with 5 replicates was used to determine if there was an antagonistic or synergistic interaction between strains of Up and Xcp. Leaves of 'Pompadour Checa' (PC) and 'Great Northern (GN) Tara' were inoculated in the following combinations on unifoliate and/or trifoliate leaves: Up alone, Xcp alone, Up and Xcp, and no treatment. Parents and F2 'Pompadour Checa' x 'GN Tara' were grown in the greenhouse and inoculated with 3 Up cultures (HG25, VC74f, NP104) followed with 2 Xcp strains (S.J-1, NE-1). A RCBD with 2 replicates was used. 'GN Tara' was resistant to common blight and PC to rust. F3 families derived from randomly selected F2 plants of the cross PC x 'GN Tara' were also tested. Plants were inoculated with rust using a cotton swab and 100,000 uredinia-spores/ml when the first trifoliate was 1/2 to 2/3 expanded. Ratings were made 14 days after inoculation utilizing the grading scale developed at the 1983 Bean Rust Workshop (Ann. Rept. Bean Improv. Coop., Vol. 26). Resistance was classified as hypersensitive flecking and small pustules with a diameter < 300 um. Plants with pustules >300 um were classified as susceptible. The multiple needle technique was utilized to inoculate plants with Xcp (10 Colony forming units/ml) when the second trifoliate was fully expanded. Common blight disease rating classes included: 1) hypersensitive, or no visible symptoms; 2) slight, small lesions on 1-5% of inoculated area; 3) lesions of moderate size on 6-25% of inoculated area; 4) lesions of varying size on greater than 25% of the inoculated area.

No interaction was detected between Up and Xcp, so this permitted the inheritance study of both reactions on the same plant. Inheritance of rust and common blight reactions can be studied simultaneously in the absence of an antagonistic or synergistic interaction. The F2 segregation of resistant and susceptible plants to 3 cultures of rust showed a good fit to 13:3 resistant: susceptible plants, respectively (Table 1). This suggested a hypothesis that 2 major genes determined the reaction, with a dominant gene for resistance exhibiting epistasis. Rust susceptibility was expressed only in the presence of the dominant allele for susceptibility and homozygous recessive alleles at the other locus. This hypothesis was confirmed based on the segregation of F3 families (Table 2). The

continuous distribution of the common blight reaction ratings indicated a quantitative inheritance pattern for this trait. No association was detected between the reactions of rust and common blight. Resistance to both pathogens can readily be recombined with either GN or PC seed type. Selection for resistance to rust can be achieved in early generations due to simple inheritance. The quantitative inheritance of resistance to common blight indicates that family selection should be made in replicated trials of later generations.

Table 1 Segregation of resistant and susceptible plants to 3 cultures of Uromyces phaseoli in F2 'Pompadour Checa' x 'GN Tara'.

| Generation | No. of Plants | | Expected | | |
|----------------------|---------------|-------|----------|----------------|---------|
| | Res. | Susc. | Ratio | X ² | P |
| P1 'Pompadour Checa' | all | | | | |
| P2 'GN Tara' | all | | | | |
| F2 P1 x P2 | | | | | |
| U. p. HG25 | 253:53 | | 13:3 | 0.35 | .70-.50 |
| U. p. VC74f | 253:48 | | 13:3 | 1.32 | .30-.05 |
| U. p. NP104 | 251:55 | | 13:3 | 0.10 | .95-.70 |

Table 2 Number of segregating and non-segregating F3 families for resistance and/or susceptibility to Uromyces phaseoli^z for the cross 'Pompadour Checa' x 'GN Tara'.

| F3 Segregation | No. of F3 lines | Expected No. |
|--|-----------------|--------------|
| All resistant | 17* | 17.5 |
| 13 res:3 susc. and 3 res:1 susc. | 19 | 15 |
| 1 res:3 susc. | 4 | 5 |
| All susceptible | 0 | 2.5 |

*X² = 1.77, 3 d.f., P = .70-.50

z = Families showed similar segregation to the 3 cultures of rust.