

EVALUATION AND IDENTIFICATION OF ROOT ROT RESISTANCE TO *FUSARIUM SOLANI* F.SP. *PHASEOLI* IN COMMON BEAN

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Fusarium root rot caused by *Fusarium solani* f.sp. *phaseoli* (FSP) is particularly devastating in Andean seed types especially snap and dark red kidneys. Resistance, however, has been mainly observed in seed types from the Middle American gene pool. Populations developed to study the inheritance of this resistance involve crosses between 'Seafarer'/N203 and 'Montcalm'/FR266 and were designed to include genotypes within the same gene pool. PI203958 or N203, a photoperiod sensitive, weedy, small black bean is a common source of resistance originating from *P. vulgare*. Seafarer is an early maturing, photoperiod insensitive, determinate navy bean variety popular in Michigan. FR266 is a snap bean breeding line developed by Silbernagel (1987) which combines the resistance from N203 with improved root architecture in an Andean seed type. Montcalm is the most popular dark red kidney variety in the Michigan and MinDak production regions and is highly susceptible to root rot.

Crosses between these parents were made in 1996. F₁ progeny were advanced in the greenhouse in the spring of 1996. Approximately 105 F₂ from each cross were advanced to the F₃ generation in the greenhouse. F₃ seed from each F₂ plant was bulked to create two F_{2:3} recombinant inbred line (RIL) populations. Lines of the Seafarer/N203 population were advanced to the F_{2:4} generation in the greenhouse. Inadequate seed yield from Montcalm/FR266 lines forced us to advance this population by single seed descent in the greenhouse (F_{3:4}) and in the field (Montcalm County, MI F_{4:5}, 1997). In 1997, seed from each F_{2:4} line of the Seafarer/N203 population was planted in two locations (Presque Isle County, MI and Perham, MN), 10 plants per plot, and 3 to 4 replications for evaluation in the field. An additional two plants from each line were planted at the Saginaw Valley Bean and Beet Farm to create F_{4:5} RILs following the same F₂ lineage.

Field evaluations were conducted in fusarium infested fields in Presque Isle County, MI and Perham, MN. Five plants from each plot were uprooted using a spade. Roots were wiped free of soil and rated from 1 to 7. This is done twice during the growing season (growth stages R2 and R7). The following rating scale is used both in the greenhouse and field:

- 1) Healthy root system with no discoloration of root or hypocotyl tissue and no reduction in root mass;
- 2) Localized reddening at base of hypocotyl with normal root mass, size and appearance;
- 3) Increase in intensity and size of localized root/hypocotyl lesion and some discoloration but no reduction in root mass;
- 4) Increasing intensity of discoloration on hypocotyl with lesions becoming extended, some reduction in root mass;
- 5) Increasingly discolored and extended hypocotyl lesions. Roots are brown and have reduced root mass;
- 6) Hypocotyl lesions encircle stem, root mass is severely reduced and highly discolored; and
- 7) Pithy or hollow hypocotyl with very extended lesions. Root abundance is limited and functionally dead.

The data from this experiment will be used to determine heritabilities of resistance to fusarium root rot. Confirmation of field work will be performed using data from F₄-derived RILs in the greenhouse. Although no genetic variation was identified in the Seafarer/N203 population, root rot symptoms were observed in the dark red kidney checks at both locations. Thus, lack of disease cannot explain the absence of observed variability. Mean root rot values for N203 and Seafarer

appear at opposite ends of the population distribution but the difference between mean scores is only 1.3. Seafarer may possess more resistance or tolerance to root rot than previously thought since it scored at the resistance end of the rating scale (3.0). Greenhouse trials using Seafarer/N203 population will, hopefully, eliminate enough environmental error to help characterize the genetic variation in this population. The Montcalm/FR266 population should be a more informative population since Montcalm is highly susceptible in both field and greenhouse trials. Lack of seed prevented us from conducting field trials in 1997 but field and greenhouse evaluation are planned for 1998.

Greenhouse studies are also being developed to identify resistant individuals in early generations and to facilitate selection of genotypes to be evaluated in field trials. The most highly correlated greenhouse procedure to field studies ($r = 80^{**}$) utilizes Perlite and seedling flats. Ninety-six well seedling flats are filled with Perlite and saturated with half strength Hoagland's

Table 1. Seed type and root rot ratings for the 1996 and 1997 variety trials conducted in Presque Isle County, MI.

Cultivar	Seed Type [†]	1996 Rating [‡]	1997 Rating [¶]
PI203958*	Black	1.2	1.7
FR266*	Snap Bean	1.3	2.7
A300*	Navy	1.7	3.5
Huron	Navy	1.8	3.3
T39	Black	1.8	2.4
UI-114*	Pinto	2.0	-
Viva*	Pink	2.2	-
NW63	Small Red	2.3	-
Seafarer	Navy	2.4	3.0
NW590*	Pinto	2.4	-
Roza*	Pink	2.6	-
Wis. RRR36*	Snap	-	2.6
Newport	Navy	2.8	2.4
Mackinac	Navy	2.8	2.6
Chinook	LRK	3.6	4.5
Montcalm	DRK	3.9	5.1
Isles	DRK	5.1	6.4
Red Hawk	DRK	5.2	4.4
Mean		2.8	3.5
LSD (0.05)		1.0	0.8
CV (%)		20	15

*Cultivars previously reported as resistant to fusarium root rot.

†LRK, DRK, Light Red and Dark Red Kidney seed types

‡Cultivars are ranked according to increasing susceptibility based on 1996 scores.

¶Cultivars without a rating were not grown in 1997.

solution. A single plant is germinated in each well, with 3 to 6 seedlings per variety per replication. Fourteen days after planting 10 ml of 10^5 spore suspension of FSP is applied over base of hypocotyl using a syringe. Two weeks after inoculation, seedlings are removed from flats, cleaned of excess Perlite and rated on a scale from 1 to 7. For a non-destructive assay, seedlings can be dipped in Benlate and transplanted to normal potting soil.

Two variety trials were conducted using previously reported resistant genotypes (1996) and commonly grown MI varieties and advanced breeding lines (1997; Table 1). Field evaluations demonstrated that dark red kidney seed types were the most susceptible class and that FR266 and N203 possess superior resistance. Significant genetic variation was observed in both trials.

References

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