

Effect of Seed Color on Tolerance of Flax to Seedling Blight Caused by *Rhizoctonia solani*

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Yellow-seeded cultivars of flax (*Linum usitatissimum* L.), often desired because of their higher oil content and iodine number (1), are known to be more susceptible to seedling blight caused by *Rhizoctonia solani* Kühn (*Thanatephorus cucumeris* [Frank] Donk) than are brown-seeded varieties (2). The purpose of this work was to study the difference in susceptibility of brown- and yellow-seeded near-isogenic lines of flax to seedling blight.

Yellow seed coat in flax is conditioned by the homozygous recessive state at one of three independent loci, B_1 , G , or D . Near-isogenic pairs of yellow- and brown-seeded flax lines have been developed at the University of Minnesota Department of Agronomy which differ mainly at the locus conditioning seed coat color. Fifteen paired brown- and yellow-seeded lines, five differing at locus B_1 , five at locus G , and five at locus D , respectively, were exposed to two isolates of *R. solani*. Single-basidiospore isolate 60-12 and an artificially synthesized heterokaryon, No. 449, were chosen because of their moderate virulence on the brown-seeded flax lines. The single-basidiospore isolate and the single-basidiospore lines which were used to synthesize the heterokaryon originated from field isolates pathogenic to flax.

Discs 3 mm in diam of the two *R. solani* isolates were placed individually in petri dishes containing 20 ml of 1.5% water agar. The plates were incubated at 30 C for 3 days, at which time the fungus had completely covered the agar surface. Flax seed was in-

spected under a dissecting microscope, and sound seeds were surface-treated in 1.25% NaOCl for 1 min, followed by two rinses with sterile distilled water. Twenty-five seeds were placed in each petri plate, which was then incubated at 20-24 C. The number of healthy seedlings were recorded at 3 (Fig. 1) and 5 days after plating. Three replicate plates were prepared for each line of the 15 pairs of yellow- and brown-seeded flax lines exposed to the two isolates of *R. solani*.

After 3 days in contact with the fungus, survival of the yellow-seeded b_1b_1 and gg lines was significantly less than their corresponding brown-seeded near-isogenic members when exposed to both isolates of the fungus (Table 1). No significant difference was noted between members of pairs differing only at the D locus when exposed to both isolates of *R. solani*. For all three loci, germination percentages of the yellow-seeded lines were less than those of brown-seeded lines in the non-inoculated checks. These differences in germination percentages were not significant, and were probably due to the fact that defects in yellow seed are more difficult to detect.

After 5 days, differences in survival between B_1B_1 and b_1b_1 and between GG and gg lines were significant (Table 2). As compared to the 3-day readings, seedling survival after 5 days was reduced in all cases. Nearly all the seedlings of b_1b_1 and gg yellow-seeded lines had been killed while seedlings of dd yellow-seeded lines showed 51% and 62% survival when tested against the heterokaryon and single spore isolate of *R. solani*, respectively.

To determine if the yellow- and brown-seeded members of the three populations differed in their rate of germination, seeds from a representative isogenic pair from each population were placed on moist filter paper in petri dishes at 20 C and observed for germination rate. Seeds of the dd and DD genotype germinated and developed at approximately the same rate. Seeds of the gg line showed a marked retardation of germination and development as compared to the brown-seeded GG line. The radicles from the gg yellow seed emerged from 10 to 72 hr later than did the radicles from the GG brown seed. The rate of germination of



Fig. 1. Seedling development 3 days after placing the brown flax seed (GG), right, and yellow seed (gg), left, members of an "isogenic" pair of flax lines, in contact with isolate 449 of *Rhizoctonia solani*.

TABLE 1. Survival of paired brown- and yellow-seeded near-isogenic lines of flax subjected to *Rhizoctonia solani* for 3 days

Seed coat color		<i>Rhizoctonia</i> isolate		
		Heterokaryon 449	Basidiospore 60-12	Check
Genotype ^a	Phenotype	%	%	%
B_1B_1	Brown	75 ^b	82	92
b_1b_1	Yellow	11	18	88
GG	Brown	87	88	96
gg	Yellow	9	13	88
DD	Brown	83	90	92
dd	Yellow	78	84	90

^a Average of five separate near-isogenic lines.

^b Based on three replications of 25 seeds each.

TABLE 2. Seedling survival of paired brown- and yellow-seeded near-isogenic lines of flax subjected to *Rhizoctonia solani* for 5 days

Seed coat color		<i>Rhizoctonia</i> isolate		
Genotype ^a	Phenotype	Hetero- karyon 449	Basidio- spore 60-12	Check
		%	%	%
B_1B_1	Brown	53	60	92
b_1b_1	Yellow	0	3	88
GG	Brown	68	74	97
gg	Yellow	8	1	92
DD	Brown	67	85	93
dd	Yellow	51	62	91

^a Average of five separate near-isogenic lines.

^b Based on three replications of 25 seeds each.

GG brown seed was uniform, whereas that of gg yellow seed was not.

Radicle development of b_1b_1 yellow seed was slower than that of the B_1B_1 brown seed. Three days after the onset of germination, the radicles of b_1b_1 yellow seed were only three-fourths as long and less vigorous than were those produced by B_1B_1 brown seed.

From these data, we conclude that there are some

factors associated with seed color which have a significant effect upon the reaction of flax to seedling blight caused by *Rhizoctonia solani*. Yellow-seeded flax is more susceptible to infection than is brown-seeded flax; however, the three classes of yellow-seeded flax (b_1b_1 , dd , and gg genotypes) differed in their sensitivity to two isolates of this fungus. Yellow-seeded lines that possess the dd gene showed over 50% survival after 5 days' exposure to the fungus, whereas the b_1b_1 and gg lines showed less than 10% survival. Part of the reason for the low survival percentages may be that yellow seeds of the b_1b_1 and gg genotypes develop more slowly than their brown, near-isogenic counterparts, while dd -conditioned yellow seeds do not. When choosing a yellow-seeded flax cultivar for production in an area that is plagued with seedling blight, it seems imperative that the cultivar be of the dd genotype rather than either b_1b_1 or gg .

LITERATURE CITED

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