

Resistance to Bud Blight in Introductions from the Germ Plasm of Wild Soybean

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ABSTRACT

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Fourteen of 630 plant introductions of wild soybean, *Glycine soja*, differed in resistance to bud blight caused by tobacco ringspot virus. Introduction 378 693-B in maturity group VII, a type with pubescent leaves and large seeds, was rated slightly resistant; 342 434 and 407 287, both in group V and having very small seeds, were rated moderately resistant and resistant, respectively. The other introductions selected were slightly resistant and had very small seeds. The nodule leghemoglobin content of these resistant introductions was equal to or greater than that of *G. max* cultivars. All the other introductions tested were susceptible.

Bud blight caused by tobacco ringspot virus (TRSV) is a highly destructive disease of the cultivated soybean, *Glycine max* (L.) Merr. (1,7). TRSV affects the foliage and causes almost total seed loss due to flower abortion. The virus moves into the roots and root nodules and significantly impairs the symbiotic nitrogen fixation system (6-8). Bud blight occurs mostly in southern Canada and the midwestern United States; occasional serious outbreaks have occurred in Indiana and Iowa (1). It is one of the three most important diseases of soybean in China (10) and is considered very destructive in tropical and subtropical regions.

Glycine soja Sieb. & Zucc. (= *G. ussuriensis* Reg. & Maack) is an annual vine that grows wild in the Yangtze River valley in the northern and northwestern provinces of China, in adjacent areas in Siberia (USSR), and in Korea (4). *G. soja* and *G. max* have the same somatic chromosome number, $2n = 40$, and can be hybridized (2,4).

I undertook this investigation because the cultivated soybean, *G. max*, is not

known to have resistance to bud blight. *G. soja* is an excellent germ plasm for soybean breeding because of the high protein content of its seed (11), and it has not previously been evaluated for reaction to bud blight.

MATERIALS AND METHODS

The *G. soja* plant introduction (PI) collection evaluated for reaction to bud blight under greenhouse conditions consisted of 630 accessions from maturity groups (MG) OO to VII (3). The accessions, which were introduced from China, Taiwan, Korea, Japan, and the USSR, were supplied by R. L. Bernard, U.S. Regional Soybean Laboratory, U.S. Department of Agriculture, Urbana, IL.

The seeds were surface-disinfested with 75% ethyl alcohol for 30 sec, rinsed, air-dried, and scarified to enhance germination. They were placed about 5 mm deep in a mixture of pasteurized sandy loam soil and perlite. Before the seeds were covered, they were inoculated with 0.5 ml of a yeast-mannitol broth culture of the nodule-producing bacterium *Rhizobium japonicum* (strain USDA 311b-110).

Inoculation with TRSV. Individual introductions, growing in duplicate pots containing three plants each, were inoculated in the unifoliate stage with an extract from TRSV-infected leaves of *G. max* 'Tracy.' The extract, diluted (1:1) in 0.2 M of neutral phosphate buffer, was

applied to the leaves (8). Approximately the same number of uninoculated plants were used as controls. Disease reactions were recorded 15 days after inoculation with TRSV. The disease resistance scale described in Table 1 was the only criterion of resistance.

Introductions selected for resistance during tests in 1977 and 1978 were reinoculated with TRSV in 1979 while the plants were in the unifoliate and the trifoliate stages. The inoculated plants and the controls were maintained in a greenhouse with supplemental incandescent illumination to approximate 12-hr days at 34 ± 4 C during the fall and winter months. Although it might have been desirable, no attempt was made to test the field reaction of *G. soja* to TRSV.

The concept of disease resistance (as defined by Robinson [9]), rather than that of tolerance, was used to indicate the severity of symptoms of TRSV infection in the introductions tested.

Nodulation and leghemoglobin assay. The nodulating ability of the introductions in the *G. soja* germ plasm was estimated visually on washed roots at the time the plants were in bloom or early pod. The leghemoglobin content, as cyanmethemoglobin per gram of fresh nodule (12), was determined only for introductions that appeared to have resistance to bud blight and for *G. max* 'Bedford,' 'Beeson,' and 'Tracy.'

RESULTS AND DISCUSSION

Most of the *G. soja* introductions tested for reaction to bud blight were susceptible when inoculated with TRSV in either the unifoliate or trifoliate growth stage. Of this susceptible material, nearly 5% (31 introductions) was highly susceptible, being killed within a few days after inoculation. However, 14 introductions showed a difference in resistance depending on whether they were inoculated in the unifoliate or trifoliate stage (Table

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Table 1. Introductions of *Glycine soja* resistant to bud blight after inoculation with tobacco ringspot virus in the unifoliate or trifoliate growth stage

PI	MG ^a	Source	Leghemoglobin (mg/g of nodule)	Disease resistance scale ^b
342-434	V	Japan	8.26 ± 1.25	MR
378-684-A	VI	Japan	7.03 ± 0.13	SR
378 690	VII	Japan	6.40 ± 0.63	SR
378 693-B	VII	Japan	9.08 ± 1.09	SR
407 062	VI	Japan	7.72 ± 0.13	SR
407 068	VII	Japan	8.38 ± 0.11	SR
407-070	VII	Japan	6.86 ± 0.17	SR
407 072	VI	Japan	8.63 ± 0.47	SR
407 095	VII	Japan	8.27 ± 0.82	SR
407 207	V	Korea	8.13 ± 1.36	SR
407 259	V	Korea	5.94 ± 0.24	SR
407 287	V	Japan	9.63 ± 0.29	R
423 999-B	OO	USSR	... ^c	SR
424 005	IV	Korea	8.77 ± 0.12	SR

^a Maturity group.

^b S = susceptible (plants killed when inoculated in either the unifoliate or the trifoliate growth stage); SR = slightly resistant (plants killed when inoculated in the unifoliate stage but survived when inoculated in the trifoliate stage); MR = moderately resistant (plants recovered from either inoculation); R = resistant (only symptoms were very small, necrotic and chlorotic local lesions).

^c Lost sample.

1). *G. max* has been shown to have greater susceptibility to TRSV in the unifoliate than in the trifoliate stage (8).

Twelve of the 14 introductions, including PI 378 693-B (MG VII), which had pubescent leaves and large seeds, were rated slightly resistant; introductions 342 434 and 407 287 (both MG V), which had very small seeds, were rated moderately resistant and resistant, respectively. Profuse necrotic and chlorotic local lesions on the unifoliate leaves of PI 407 287 indicated that this introduction might be hypersensitive to the virus. Despite efforts to exclude viral contamination during the evaluation, mosaiclike symptoms that could have been caused by a seedborne virus were observed on some of the introductions.

Most introductions nodulated profusely in the absence of viral infection, but no attempt was made to record nodule weights for each introduction. The nodule leghemoglobin contents of the 14 introductions selected for resistance to bud blight were equal to or greater than those of *G. max* 'Bedford,' 'Beeson,' and 'Tracy' (6.50, 6.37, and 8.69 mg/g of fresh nodule, respectively) (Table 1). The leghemoglobin content of *G. max* is a better indicator of N₂-fixing potential than nodule fresh weight (5), and this may also be true for *G. soja*.

Genetic studies are needed to determine whether resistance to TRSV in soybean is quantitatively or qualitatively inherited and whether this resistance can be transferred from *G. soja* to *G. max*. This

is apparently the first report of resistance to bud blight in the annual wild soybean, *G. soja*.

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