Seed Treatment with Systemic Fungicides to Control *Cochliobolus sativus* on Barley

W. C. LUZ and J. C. VIEIRA, Research Plant Pathologists, Centro Nacional de Pesquisa de Trigo, Caixa Postal 569, 99100, Passo Fundo, RS, Brazil

ABSTRACT

Luz, W. C., and Vieira, J. C. 1982. Seed treatment with systemic fungicides to control *Cochliobolus sativus* on barley. Plant Disease 66:135-136.

Nuarimol and fenapanil were the most effective of six systemic fungicides tested as seed dressings to control infection of barley from seed and airborne *Cochliobolus sativus*. Imazalil and nuarimol improved germination; however, the latter and triadimefon were phytotoxic, causing delayed emergence, reduced growth of the plants, and dark green coloration of the leaves.

Additional key words: *Helminthosporium sativum*, seed infection, spot blotch

Cochliobolus sativus (Ito and Kurib.) Drechs. ex Dastur (*Helminthosporium sativum* Pam., King, & Bakke), the cause of common root rot, spot blotch and black point of barley, is a prevalent pathogen on barley seed in North America (1,4). In Brazil, it is prevalent in the states of Rio Grande do Sul (2) and Paraná (6). This pathogen is carried by soil, air, and seed.

Protectant chemicals used as seed dressings do not control airborne and seedborne fungal pathogens when the mycelial infections are located in the seed coat, in the internal parts of the pericarp, or deeply embedded in the embryo. Only systemic fungicides can control such infections. In Brazil, no systemic compound has been used on barley as a seed treatment for commercial plantings.

The present investigation was performed to determine the effectiveness of six systemic fungicides in controlling seedborne and airborne *C. sativus*.

MATERIALS AND METHODS

Seeds of the barley cultivars Antártica 04 and FM 404 were collected the previous growing season. The six systemic fungicides used were fenapanil 25 EC, imazalil 5.8 L, nuarimol 70 WP, triadimefon 25 WP, triadimenol 25 WP, and triforine 22 L. Liquid formulations were mixed with 500 g of seeds in a 1-L Erlenmeyer flask. The flask was held at a 45° angle, and the correct amount of fungicide was sprayed onto the internal flask surface. A portable atomizer, equipped with a compressed air motor and a pipette and calibrated to deliver the required amount of fungicide, was used to apply the liquids. Separate atomizers were used for each chemical.

The flask was hand shaken continuously for 3 min until the glass was clear and the kernels were uniformly coated. The flask was kept closed for 48 hr to permit vapor action, if any, on the seeds, which were stored for 5 days before sowing or plating in petri dishes. For powder formulations, the calculated quantity of powder was scattered over the top of the seeds and mixed as described above.

In compensation for the loss of fungicide that adhered to containers and sprayers, a seed lot was treated with the fungicide and discarded. The second seed lot treated in the same flask was used in the investigation. Untreated seeds were also shaken in an Erlenmeyer flask, stored, and used as a control to assay mechanical injury.

The mycoflora of treated and untreated kernels was determined by plating them on modified Jurema tomato juice. This medium consisted of 200 g of Jurema tomato juice, 3 g of calcium carbonate, 17 g of agar, and 800 ml of water. Five replicates of 20 kernels (10 kernels per

Accepted for publication 28 April 1981.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

0191-2917/82/02013502/$03.00/0

Table 1. Effect of systemic fungicides as seed dressings on seed infection of barley by *Cochliobolus sativus*

Fungicide	Dosage (a.i./ 100 kg of seed)	*C. sativus* isolated from seeds (%)[x]		Emergence (%)[y]	
		Antártica 04	FM 404	Antártica 04	FM 404
None		75 ab[z]	69 a	79.2 b	78.6 b
Triadimefon	50 g	72 ab	73 a	72.0 c	68.0 c
Triforine	66 ml	71 a	79 a	78.7 b	79.2 b
Triadimenol	50 g	38 c	44 b	78.9 b	79.1 b
Imazalil	8.7 ml	23 d	35 c	84.9 a	84.3 a
Nuarimol	21 g	1 e	0 d	86.6 a	85.8 a
Fenapanil	75 ml	0 e	0 d	79.3 b	79.0 b
CV (%)		4.6	7.7	7.3	7.4

[x] Percentage of infected seeds; average of five replicates.
[y] Average of four replicates.
[z] Means in a column followed by the same letter do not differ significantly (0.05 level) using Duncan's multiple range test.

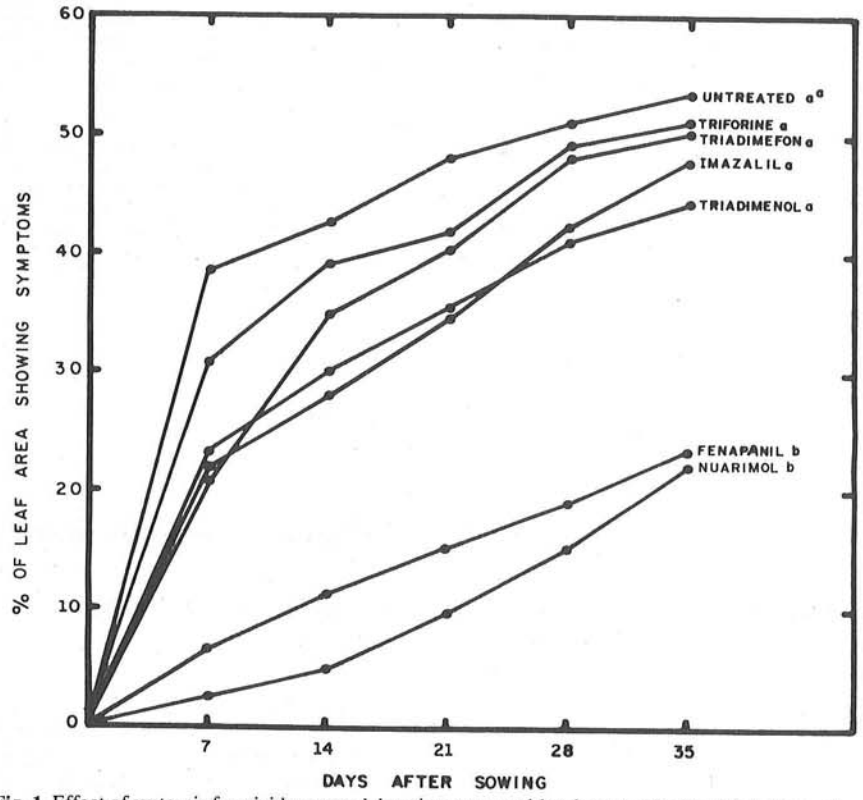

Fig. 1. Effect of systemic fungicides as seed dressings on spot blotch caused by *Cochliobolus sativus* on FM 404 barley. Treatments followed by the same letter do not differ significantly (0.05 level) according to Duncan's multiple range test. Average of four replicates. CV (%) = 8.5.

plate) were incubated under an ultraviolet light for a photoperiod of 12 hr at 21 ± 3 C. The light was suspended 25 cm above the petri plates. The presence and prevalence of the organisms from kernels were recorded 5 days later.

An emergence test was carried out in the greenhouse using four replicates of 100 seeds sown 2 cm deep in sterilized soil mixture of two parts clay loam and one part sand. The results were recorded 21 days after sowing.

For a greenhouse spot blotch trial, 30 isolates of *C. sativus* were cultured on autoclaved sorghum seeds (5) for 15 days. These experiments consisted of four replicates of each treatment in a completely randomized design with each plot consisting of one pot with 10 plants of FM 404 barley. Seven days after sowing, the primary leaves were spray inoculated with a suspension of a mixture of the isolates containing 10^5 conidia per milliliter. Three drops of Iharaguen as a spreader-sticker (Polioxithilene Nonilphenol ether 40%, Iharabras S.A., Brazil) was added to 1 L of inoculum. The plants were kept in a mist chamber at 98–100% relative humidity at 24 C for 48 hr. All pots were inoculated weekly to determine the duration of control provided by the fungicides. The spot blotch severity was rated as a percentage of leaf area showing symptoms 7 days after each inoculation.

All data were subjected to analysis of variance, and the means were compared by Duncan's multiple range test.

RESULTS AND DISCUSSION

Control of seedborne inoculum. Incidence of *C. sativus* in each cultivar of barley as determined in the laboratory by plating the seeds on Jurema medium was considerably higher in the untreated than in the treated seeds (Table 1). Other pathogens found on seeds were *Alternaria tenuis* Nees, *Fusarium* spp., and *Pyrenophora teres* (Died.) Drechs. Saprophytic organisms also occurred. The high incidence of *C. sativus* in barley seed indicated that this organism was the most prevalent pathogen, as has been reported previously (1,2,4,6). The most effective fungicides in suppressing *C. sativus* were nuarimol and fenapanil, which practically eliminated the fungus on both cultivars. The biocidal activity of fenapanil on *C. sativus* agreed with the observation of Edgington et al (3). Imazalil and triadimenol showed only moderate inhibition of *C. sativus*. Treatment with triadimefon and triforine produced no decrease in *C. sativus* when compared with untreated seeds in the laboratory test.

Emergence test. Emergence from seeds treated with fenapanil, triforine, or triadimenol was not significantly different from that of the untreated check. Triadimefon caused a significant reduction in emergence recorded 21 days after sowing. Imazalil and nuarimol improved emergence, but phytotoxic effects were observed on plants from seeds treated with nuarimol. These effects included delayed emergence, dark green coloration of the leaves, and initial growth reduction. Triadimefon caused the same abnormal symptoms.

Control of airborne infection. The first symptoms of spot blotch appeared within 2 days after inoculation. The effectiveness of different systemic fungicides is shown in Figure 1. Only fenapanil and nuarimol were effective against this phase of the disease. The data presented in Figure 1 were taken up to 35 days after sowing. The persistence of fenapanil and nuarimol had broken down 35 days after sowing, by which time the spot blotch severity was higher than 20%. The effectiveness of some of the seed treatments against *C. sativus* for 35 days suggests that the active ingredients are taken up by the plant continuously during this period.

These results indicate that it is possible to protect barley from both seedborne and airborne *C. sativus* by seed treatment with fenapanil or nuarimol. However, the efficacy of these chemicals in the control of *C. sativus* should be tested under field conditions. They would also be expected to control *C. sativus* effectively in field trials, where disease severity is usually lower than under controlled conditions.

The control of spot blotch for 35 days after sowing is important in regions where *C. sativus* occurs in the early stages of plant growth. In areas where the disease also occurs in late stages, good control of spot blotch can be obtained by spraying the plants with fenapanil, fenarimol, or nuarimol (W. C. Luz and J. C. Vieira, *unpublished*). Seed treatment combined with application of these fungicides to the foliage may give complete protection against *C. sativus* during the entire growing season.

LITERATURE CITED

1. Christensen, J. J. 1963. Variability of the microflora in barley kernels. Plant Dis. Rep. 47:635-638.
2. Costa Neto, J. P. 1973. Fungi found in barley seeds. Fitopatologia 8:15.
3. Edgington, L. V., Martin, R. A., Bruin, G. C., and Parsons, I. M. 1980. Systemic fungicides: A perspective after 10 years. Plant Dis. 64:19-23.
4. Greaney, F. J., and Machacek, J. E. 1943. Prevalence of *Helminthosporium sativum* in wheat and barley seed in Canada. (Abstr.) Phytopathology 33:4.
5. Joshi, L. M., Goel, L. B., and Renfro, B. L. 1969. Multiplication of inoculum of *Helminthosporium turcicum* on sorghum seeds. Indian Phytopathol. 22:146-148.
6. Luz, W. C. 1980. Ocorrência de *Pyrenophora teres* (Died.) Drech. em sementes de cevada (*Hordeum vulgare* L.) no Brasil. Fitopatol. Brasileira. 5:273-276.