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# Fungicides Evaluated for Cereal and Forage Crop Disease Control

Recent trends in the development of new fungicides for control of diseases of small grains and forages have been toward systemic, sterol-inhibiting, triazole-based products with broad-spectrum activity against powdery mildews, rusts, and leaf spots. This trend essentially began with the testing of triadimefon (Bayleton) and propiconazol (Tilt). The goal of new fungicide development has been to formulate products that are effective against a wide range of plant pathogens when applied at low rates and, preferably, with only one application needed to accomplish the job.

Over 40 reports were published in the cereal and forage crops section of *Fungicide and Nematicide Tests*, volume 40. The majority of the 1984 reports (published in 1985) were on wheat, with emphasis on leaf rust (*Puccinia recondita*), stem rust (*P. graminis*), stripe rust (*P. striiformis*), powdery mildew (*Erysiphe graminis*), Septoria leaf blotch (*Septoria tritici*), and Septoria glume blotch (*S. nodorum*). As expected, foliar disease severity was variable except for that of wheat leaf rust. In most wheat-growing areas where fungicides were tested, leaf rust developed late, with only light to moderate severities reported on flag leaves.

**Wheat.** In the Northwest, several fungicides were tested for control of the rusts, Septoria leaf and glume blotch, and Pseudocercosporella foot rot. Triadimefon was used in Washington to obtain data on spring and winter wheat yield losses caused by rusts. Yield losses ranged from 2 to 13% on untreated hard red spring wheat cultivars and from 5 to 56% on soft white spring wheats. On these plots, triadimefon applied at flowering did not control late-developing stem rust. A similar pattern was reported for the winter wheat plots. In winter wheat, triadimefon controlled stripe and leaf rusts up to the milk stage but did not control later developing stem rust. Yield losses up to 35% were recorded on the untreated winter wheat plots.

In another Washington trial, application of propiconazol or triadimefon at jointing and again at heading effectively controlled stripe rust on a susceptible winter wheat cultivar, with no difference in efficacy between the 2- and the 4-oz a.i. per acre rates. All three rusts in Washington and stripe rust in Oregon were controlled with DPX H6573 and triadimefon. These products, along with propiconazol, RH-3866, HWG 1608, XE-779, BAS-421, and nuarimol (EL-228), reduced apparent infection rate and final rust severity. Another test in Oregon showed triadimefon combined with mancozeb or chlorothalonil or captafol combined with HWG 1608 reduced *S. tritici* and *S. nodorum* infection of upper leaves and heads. Septoria leaf and glume blotches were also controlled by chlorothalonil or propiconazol alone. Benomyl, thiophanate-methyl, propiconazol, and thiabendazole reduced stem lesions caused by *Pseudocercosporella herpotrichoides* in an Oregon study but were not effective against this disease in Idaho.

Tests in the central and southern Great Plains were limited in number but involved several experimental fungicides. Most of the new products evaluated in Nebraska, Missouri, Oklahoma, and Texas were experimental triazoles. Researchers were able to evaluate product performance against tan spot (*Pyrenophora trichostoma*), Septoria leaf and glume blotches, and powdery mildew. The only trials that effectively evaluated fungicide performance against leaf rust were those in Oklahoma and Texas.

*P. recondita* was moderately severe in Texas, moderate in Oklahoma, and light in Nebraska and Missouri. In both the Texas and Oklahoma tests, a single application of propiconazol at growth stage 8, 9, or 10 (Feekes scale) at 4 fl oz (formulation) per acre effectively controlled leaf rust. Also, triadimefon at 4 oz a.i. per acre applied at growth stage 8 was as effective against leaf rust as 2 oz a.i. per acre applied at growth stages 8 and 10.1. In Oklahoma, a single application of triadimefon at 4 oz a.i. per acre applied at growth stage 9 resulted in only moderate leaf rust control. DPX H6573 applied twice at growth stages 10.1 and 10.5 was the most effective tan spot treatment in the Nebraska trial. DPX H6573 was also the most effective leaf rust treatment in the Texas trial and showed good activity against Septoria leaf blotch in one of the two Missouri tests.

Several treatments in the Nebraska trial involved single applications at growth stage 5.5 (triadimenol, mancozeb, HWG 1608, and benomyl) or 7 (XE-779, XE-779 + captafol, mancozeb, and RH-3866). None of these early treatments adequately protected flag leaves from infection by *P. trichostoma*. A split application of benomyl at growth stage 5.5 and mancozeb at growth stage 10.1 also did not prevent severe blighting of flag leaves. In general, those plots treated at growth stage 10.1 and again at growth stage 10.5 showed the lowest tan spot severity on the flag leaf. Propiconazol, chlorothalonil, mancozeb, triadimefon + mancozeb, triadimefon + chlorothalonil, RH-3866 + mancozeb, and DPX H6573 + mancozeb were also effective against tan spot in the Nebraska and Oklahoma tests. The addition of a penetrant seemed to slightly improve fungicide efficacy, but differences were not significant.

Researchers in Ohio, Indiana, Illinois, and Kentucky evaluated fungicides against powdery mildew, scab (*Fusarium* spp.), and the *Septoria* diseases. A split plot design involving triadimenol (Baytan) seed treatment and single or dual foliar application of propiconazol significantly reduced infection of flag leaves by *E. graminis* in an Ohio trial. In a second Ohio trial, triadimenol, triadimenol + HWG 1608, and triadimefon provided excellent control of powdery mildew. In Indiana, good powdery mildew control was obtained by these same treatments and also by XE-779, triadimefon + mancozeb, triadimefon + thiabendazole, and XE-779 + captafol. Illinois researchers obtained good control of scab with triadimefon, DPX H6573, DPX 965, HWG 1608, RH-3866, XE-779, and XE-1019 applied at growth stages 8.5 and/or 10.1. A study in Kentucky found many of the previously discussed fungicides effective against *S. tritici*, but the only treatment resulting in significantly higher yields was a mid-season application (growth stage 10.5) of triadimenol + HWG 1608.

Mississippi workers found that a single application of propiconazol or dual applications of benomyl + mancozeb or triadimefon + mancozeb gave better Septoria leaf blotch control on susceptible cultivars than did a dual application of mancozeb alone. In Louisiana, an early application of propiconazol followed by an application of chlorothalonil or two applications of a triadimefon + mancozeb tank mix gave the best overall control of leaf rust, Septoria leaf blotch, and scab. The most effective treatments for scab were mancozeb, chlorothalonil, benomyl, propiconazol + chlorothalonil, and mancozeb + triadimefon.

Warm, dry weather limited foliar disease development in Virginia, Tennessee, and Alabama. In an Alabama trial, propiconazol and triadimefon effectively reduced severity of powdery mildew, leaf rust, and Septoria glume blotch on seed heads. Propiconazol was the most effective treatment against *S. nodorum* infection of leaves. The activity of

propiconazol was not enhanced by the addition of mancozeb, but the efficacy of triadimefon against the three foliar diseases was improved by tank-mixing it with mancozeb. Two applications of chlorothalonil, a single application of propiconazol, or a split application of chlorothalonil followed by propiconazol effectively suppressed Septoria leaf blotch.

Propiconazol and a split application of propiconazol at growth stage 8 and chlorothalonil at growth stage 10.5 were the most effective treatments against powdery mildew, leaf rust, and the Septoria diseases in Pennsylvania. Triadimenol and HWG 1608 were more effective than triadimefon against Septoria leaf blotch. XE-779 + captafol gave the best suppression of leaf rust and Septoria glume blotch, and triadimenol was the most effective treatment against powdery mildew.

In Australia, a single application of triadimefon or propiconazol effectively suppressed stripe rust for 3–4 weeks after application. A second application of either fungicide 4 weeks after the first restricted rust development an additional 5 weeks.

**Barley.** Net blotch (*Pyrenophora teres*) development on upper leaves was effectively arrested by application of propiconazol or treatment with a triadimefon + captafol tank mix followed by propiconazol + captafol in studies in Pennsylvania and Maine.

**Rice.** In Texas, propiconazol, DPX H6573, or SN-84364 applied at booting and then again at heading controlled sheath blight (*Rhizoctonia solani*) and narrow brown leaf spot and brown blotch (*Cercospora oryzae*).

**Alfalfa.** Application of mancozeb or chlorothalonil at both 25 and 10 days before harvesting suppressed spring black stem (*Phoma medicaginis*) development on leaves and stems and reduced leaf spotting by *Stemphylium botryosum*. Defoliation and forage yields were not correlated with foliar disease severity or with disease suppression by fungicides. In an Illinois study, increasing the number of fungicide treatments from two to three between cuttings reduced defoliation but did not significantly increase forage yields.

**Subterranean clover.** A study in Victoria, Australia, found that two applications of benomyl reduced the severity of clover scorch (*Kabatiella caulivora*).

*Dr. Watkins is editor of the cereal and forage crops section of* Fungicide and Nematicide Tests, *David F. Ritchie, Editor, published annually by the New Fungicide and Nematicide Data Committee of The American Phytopathological Society. Copies of current and past volumes may be obtained from Richard E. Stuckey, Business Manager F & N Tests, Plant Pathology Department, University of Kentucky, Lexington 40546.*