

Fungicide and Nematicide Update

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Fungicide Testing for Early and Late Blight Control in Potatoes

Fungicide testing in potatoes (*Solanum tuberosum* L.) has been aimed primarily at two foliar diseases, late blight (*Phytophthora infestans* (Mont.) de Bary) and early blight (*Alternaria solani* (Ell. & G. Martin) Sor.). Of the two, late blight is much more sporadic. Since *P. infestans* is an obligate parasite, inoculum can survive only in colonized tubers that overwinter in cull piles or in soil below the frost line. The pathogen may also be reintroduced into an area on infested seed stock. If inoculum is present, disease outbreaks depend on windblown rain to disperse the sporangia and on cool, moist conditions for infection. Early blight, despite its name, is a disease of mature foliage. *A. solani* is almost universal where potatoes are grown because it survives saprophytically on colonized debris in or on soil. Sporulation and infection require a moist environment but occur over a much wider range of temperatures than does *P. infestans*.

In the last 8 years, a number of fungicides with specific activity against pythiaceous fungi have become available for testing, and late blight control has been a major area of interest. Metalaxyl (Ridomil, Ciba-Geigy Corp.) has been the most widely tested and is now registered as Ridomil MZ-58 (10% metalaxyl and 48% mancozeb) for foliar application. This formulation has been tested in a protectant schedule (usually at 14-day intervals) and as a postinfection eradicator or curative treatment. Tests in Maine in 1982 and 1983, under moderate to heavy disease pressure, showed complete disease control with biweekly applications of metalaxyl. When applied as an eradicator where late blight had already resulted in 10–15% defoliation, further sporulation was eliminated. Similar results have been reported from Michigan, North Carolina, Ohio, and Wisconsin during the last 3 years.

Because metalaxyl has no efficacy against early blight and Ridomil MZ-58 is formulated with only 48% mancozeb, most tests in the last few years have included additional mancozeb in the tank mix. A distinct improvement in early blight control using such mixtures has been shown in Maine and Wisconsin tests in 1982 and 1983. Other experimental fungicides with activity similar to metalaxyl have been widely tested during the last 3 years and may eventually become products similar to Ridomil.

Two problems exist for this group of fungicides on potatoes. First, because they lack efficacy against *A. solani*, they

must be formulated or tank-mixed with another fungicide. Second, in some parts of the world *P. infestans* has developed resistance to metalaxyl. Although not yet seen in North America, this is a significant concern. Formulation with broad-spectrum fungicides may help prevent both problems. It is imperative that a sufficient amount of these be included to control *A. solani*. Formulations of metalaxyl with mancozeb and with chlorothalonil are currently being tested.

Four broad-spectrum fungicides have been widely used for many years to control both late blight and early blight, the two most commonly used being mancozeb and chlorothalonil (Bravo 500, SDS Biotech Corp.). Others are the triphenyltin hydroxide formulations and captafol (Difolatan, Chevron Chemical Co.). During the past three seasons, most of these fungicides have been tested at various rates, intervals, and combinations in over 20 field trials in six states. Results indicate that all four, when applied weekly at labeled rates, have good activity against both *P. infestans* and *A. solani*. Mancozeb and chlorothalonil were the products most commonly tested for late blight control and usually performed excellently in all tests. For early blight control, the triphenyltin hydroxides provided the best results. Although results varied among tests, there was an overall trend among the other three fungicides of good control with the mancozeb materials and slightly inferior results with captafol and chlorothalonil. A number of trials included combinations of mancozeb with a triphenyltin hydroxide, usually resulting in excellent control.

A major limitation in the use of the tin fungicides, however, is associated with phytotoxicity. In Wisconsin tests, mild flecking of the undersides of treated potato leaves was observed in 1982 and 1983. Symptoms were reduced if mancozeb was tank-mixed with a slightly lower rate of triphenyltin hydroxide. In 1981, tin fungicides produced a light green foliage on treated plants in Wisconsin that was accompanied by small necrotic lesions on the undersides and significantly reduced yields. Ohio tests in 1981 and 1982 showed severe necrotic flecking with use of these fungicides, along with reduced plant growth and significant yield reductions. It appears that use of tin fungicides tank-mixed with mancozeb gives a broader spectrum of control than either used individually and provides greater safety with respect to phytotoxicity.

A number of studies have dealt with fungicide application timing. Although

weekly applications of all these fungicides provide good control, growers may prefer to spray less often. Ridomil MZ-58 applied at 14-day intervals provided excellent control of late blight in 1982 Maine tests but poor control of early blight in Ohio and Wisconsin tests. Tests in 1983 in Maine and Ohio showed significantly reduced control of late and early blight, respectively, with biweekly applications of mancozeb, compared with weekly applications. In 1981, similar results were seen in New York on late blight with mancozeb and in Maine and Ohio on early blight with mancozeb, captafol, and chlorothalonil. These data indicate that under severe disease pressure, control of early blight requires weekly applications of available protectant fungicides.

Various formulations of these standard fungicides have been available for testing in recent years. Flowables (F) eliminate the mess and dust problems of wettable powders (WP) during mixing but have the disadvantages of chemical separation in the container and high shipping weight. A recent innovation being tested is the dispersible granule (DG), a pelletized dry formulation that is dustless, pours easily and cleanly from the container, and dissolves rapidly in the spray tank. Tests in 1982 and 1983 in Michigan, Ohio, and Wisconsin comparing WP, F, and DG formulations of mancozeb and maneb plus zinc (Dithane M-45, Rohm and Haas Co.) showed equal control of early blight with all three. Difolatan F and DG formulations were compared for early blight control in Ohio in 1983 and in Wisconsin in 1982 and found to be equally effective. Dithane WP and DG formulations worked equally well for late blight control in a 1983 Maine test. In 1981, New York and Ohio tests compared Dithane WP and F formulations and found equal efficacy. A 1981 North Carolina test of Difolatan F and DG formulations also showed equal late blight control. These tests indicate that the new formulations retain the efficacy of the wettable powders while providing increased convenience and safety to the user. Dispersible granule formulations may well be the way of the future.

Dr. Rowe is editor of the vegetable 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.