

Efficacy of New Fungicides as Potential Management Tools for Phytophthora Crown and Root Rot on Pepper Plants

Michael E. Matheron and Martin Porchas

Abstract

Phytophthora blight of peppers (Capsicum annuum) is caused by the oomycete pathogen Phytophthora capsici. In Arizona, the root and crown rot phase of the disease initially can appear on plants early in the growing season in areas of the field where soil remains saturated with water after an irrigation or rainfall event. Disease severity can increase dramatically due to summer rains during July and August in the southeastern Arizona production area. Fungicides are an important component of a Phytophthora disease management system, when used in combination with other management practices such as crop rotation, raised beds, and water management. The efficacy of the systemic fungicide mefenoxam (Ridomil Gold) for control of Phytophthora blight on pepper has been documented; however, in many pepper production regions, populations of the pathogen insensitive to this fungicide have developed. Other chemistries, including dimethomorph (Acrobat) as well as some new fungicides in development, have activity on some species of Phytophthora and associated diseases on crops other than pepper. The objective of the following study was to evaluate these additional chemistries for efficacy in suppressing development of root and crown rot on pepper plants grown in soil naturally infested with Phytophthora capsici in a greenhouse environment. The mean duration of survival for Aristotle bell pepper plants in untreated soil infested with P. capsici was 29 days. On the other hand, a significant increase in pepper plant survival was achieved when soil was treated with Reason (fenamidone) + Previcur Flex (propamocarb), SA-110201, Ranman (cyazofamid), Omega (fluazinam), Ridomil Gold (mefenoxam), V-10161 (fluopicolide), Forum (dimethomorph), NOA-446510 (mandipropamid), IR-6141 (kiralaxyl), and Maestro (captan). The data from this study suggest that several fungicides currently not registered for use on peppers may be effective components of a management program for Phytophthora crown and root rot. The data is promising; however, additional studies in field soil naturally infested with P. capsici are needed to confirm these preliminary findings as well as to determine the optimal application rate and timing for each new chemistry.

Introduction

The oomycete pathogen, *Phytophthora capsici*, can cause extensive losses in pepper plantings. The first symptoms usually include a crown (stem) and root rot, which can be followed by an aerial blight of leaves, fruit, and stems in regions with frequent rainfall events. *Phytophthora capsici* was first described as a pathogen on pepper plants by Leon Leonian at the New Mexico Agricultural Research station in Las Cruces in 1922. In later years, the pathogen has been shown to cause disease not only on pepper plants, but also on such diverse crops as melons, squash, eggplant, tomato, snap bean and lima bean. As with all species of *Phytophthora*, water is a crucial factor in

pathogen reproduction and subsequent disease development. Excessive soil moisture, either from irrigation or rainfall, stimulates production of sporangia and release of zoospores, the infective propagule of the pathogen. *Phytophthora* goes where water flows and can be carried by surface irrigation water or dispersed aerially by rainfall. If both mating types of the pathogen are present, the oospores that can form in plants as they are dying may produce progeny that could be more virulent or less susceptible to a fungicide than their parents. These oospores will remain in the soil after the host plant decays, lying dormant until another crop of peppers or other susceptible host is planted.

Fungicides are an important component of a *Phytophthora* disease management system, when used in combination with other management practices such as crop rotation, raised beds, and water management. The number of available fungicides are limited. Populations of *P. capsici* in many growing areas have become resistant to Ridomil Gold (mefenoxam). Another fungicide, Acrobat (dimethomorph), has been shown to be an effective compound against this pathogen. There is a definite need for more fungicides to incorporate into an integrated disease management plan.

Several new fungicides are being developed with known activity against oomycete pathogens closely related to *P. capsici*. The objective of the following trial was to evaluate these new chemistries for their efficacy in suppressing development of crown and root rot on pepper plants grown in soil naturally infested with *Phytophthora capsici*. To accomplish this objective, trials were established in the greenhouse with soil naturally infested with *P. capsici*.

Materials and Methods

This study was conducted to assess the ability of some fungicides in development, with known activity against other oomycete plant pathogens, to control the development of *Phytophthora* crown and root rot on bell peppers caused by *P. capsici* when applied to soil. Naturally infested soil was collected from around diseased chile pepper plants within a field planting in southeastern Arizona on September 18, 2006 and transported to The University of Arizona, Yuma Mesa Agricultural Center for establishing a trial in the greenhouse. Five parts of naturally infested soil was thoroughly mixed with two parts sand in a large container, then dispensed into a series of 1-pint capacity plastic pots. A bell pepper seedling (cultivar 'Aristotle', approximately 3 inches tall) was transplanted into the soil within each pot, after which one of the various chemical treatments was applied by drenching the soil within each container with 200 ml of a solution of each chemistry to be evaluated. Each treatment was evaluated on 10 replicate plants. Control plants were grown in untreated field soil. Treatments were applied again at 3 and 6 weeks after transplanting. Plants were watered daily for the duration of the trial. On October 13, each pot containing a pepper plant was placed in a container (4 inches in diameter x 1.5 inches deep), which was filled with water daily to maintain wet soil conditions that favor development of *Phytophthora* crown and root rot on pepper. Plants were maintained in the greenhouse for the duration of the trial. The experiment was terminated after about two months on November 27. The following data were collected either during or at the end of the experiment: i) time in days from initiation of the experiment until a plant permanently wilted (duration of plant survival), ii) fresh weight of plant shoots and roots, and iii) number of dead plants. The recorded range and mean of soil temperature (°F) at the 4-inch depth during the course of the trial was as follows: range 52 to 104, mean 76.

Results and Discussion

The results of this greenhouse trial are presented in the following data table. The mean duration of survival for Aristotle bell pepper plants in untreated soil infested with *P. capsici* was 29 days. On the other hand, a significant increase in pepper plant survival was achieved when soil was treated with Reason (fenamidone) + Previcur Flex (propamocarb), SA-110201, Ranman (cyazofamid), Omega (fluazinam), Ridomil Gold (mefenoxam), V-10161 (fluopicolide), Forum (dimethomorph), NOA-446510 (mandipropamid), IR-6141 (kiralaxyl), and Maestro (captan). If we use the fresh weight of plant tops as a measure of fungicide efficacy, then significant increases compared to untreated plants were realized on plants treated with Reason + Previcur Flex, SA-110201, Ranman, and IR-6141 + Remedier (*Trichoderma* spp.). The plant growth data (fresh weight of shoots and roots) may not be

as important as plant survival for assessing fungicide efficacy in this greenhouse trial, since plant growth was restricted within the 1-pint containers for all treatments.

The data from this study suggest that several fungicides currently not registered for use on peppers may be effective components of a management program for *Phytophthora* crown and root rot. The data is promising; however, additional studies in field soil naturally infested with *P. capsici* are needed to confirm these preliminary findings as well as to determine the optimal application rate and timing for each new chemistry.

| 2006 bell pepper <i>Phytophthora</i> crown and root rot fungicide evaluation study ¹ | | | | | |
|---|-----------------------------|---|------------------|------------|---------------------------|
| Michael Matheron and Martin Porchas, The University of Arizona, Yuma Agricultural Center, Yuma, AZ | | | | | |
| Treatment ² | Rate of product per acre | Duration of plant survival ³ | Fresh weight (g) | | Percent dead plants |
| | | | Shoots | Roots | |
| Reason (fenamidone) + Previcur Flex (propamocarb) | 8.2 fl oz + 1.2 pt | 62 | 7.1 | 2.4 | 10 |
| SA-110201 | 32 fl oz | 60 | 5.6 | 2.9 | 20 |
| Ranman (cyazofamid) | 5.5 fl oz | 59 | 4.7 | 2.3 | 20 |
| Ranman (cyazofamid) | 2.75 fl oz | 57 | 5.3 | 2.1 | 30 |
| Omega (fluazinam) | 1.5 pt | 56 | 6.2 | 3.8 | 30 |
| Ranman (cyazofamid) | 11.0 fl oz | 56 | 4.6 | 3.4 | 40 |
| SA-110201 | 16 fl oz | 56 | 5.3 | 3.8 | 30 |
| Ridomil Gold (mefenoxam) | 16 fl oz | 56 | 4.3 | 1.7 | 30 |
| V-10161 (fluopicolide) | 8.0 fl oz | 53 | 3.4 | 2.1 | 40 |
| Forum (dimethomorph) | 6.1 fl oz | 52 | 4.6 | 2.2 | 50 |
| NOA 446510 (mandipropamid) | 8.0 fl oz | 51 | 4.0 | 2.1 | 30 |
| IR-6141(kiralaxyl) | 2.1 lb | 48 | 4.7 | 1.7 | 40 |
| NOA 446510 (mandipropamid) | 16 fl oz | 47 | 3.4 | 1.6 | 60 |
| V-10161 (fluopicolide) | 4.0 fl oz | 47 | 3.3 | 1.9 | 50 |
| Maestro (captan) | 6.0 lb | 47 | 2.0 | 0.7 | 50 |
| Folpan (captan) | 6.0 lb | 44 | 2.3 | 1.1 | 60 |
| Prophyt (phosphorous acid salt) | 5.3 gal | 44 | 2.0 | 1.0 | 60 |
| IR-6141(kiralaxyl) + Remedier (<i>Trichoderma</i> spp.) | 0.21 lb + 2.2 lb | 38 | 5.2 | 2.5 | 50 |
| Untreated control | ----- | 29 | 2.0 | 0.9 | 70 |
| LSD ($P=0.05$) ⁴ | | 17 | 3.0 | 1.4 | ----- |
| <ol style="list-style-type: none"> 1. This trial was initiated Sep 25 and terminated Nov 27, 2006. The recorded range and mean soil temperature values in °F at the 4-inch depth during the course of the trial was as follows: range 52 to 104, mean 76. 2. Plants were treated when transplanted into field soil naturally infested with <i>Phytophthora capsici</i> in the greenhouse (the beginning of the experiment), then again at 3 and 6 weeks after transplanting. 3. Each value represents the average elapsed time in days from initiation of the experiment to death of plants. Plants were considered dead when leaves wilted permanently. This trial was terminated after 63 days. 4. Each value is the mean from 10 replicate plants. Values in each column differing by more than the LSD (Least Significant Difference) value are significantly different (at $P = 0.05$). | | | | | |