Late Blight

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Late Blight is a major threat to potato and tomato industries in California. It was also a major problem in spring potatoes in 1994 and 1995. It subsequently has spread to tomatoes in the same areas. Late blight has become a problem in the past few years for two reasons. A new strain of the fungus has entered Kern County, just as it has in other counties in California and other parts of the U.S. Also, the spring weather for the past two years has been very conducive for late blight to occur. The introduction of the new strain of *Phytophthora infestans* has made the control of late blight more complicated in several ways. There are now two new fungicides that are available for late blight management that have been approved for use in California by section 18 emergency exemption, but a complete IPM program is essential to minimize the threat of Late Blight.

The amount of late blight that develops in Kern County potato fields, in other counties, and on tomatoes is dependent on weather conditions, the strains of *P. infestans* in the field, and the diligence of growers in employing good management practices.

Late blight is caused by the water mold fungus *Phytophthora infestans*, which over-winters in infected tubers in the field, storage, or cull piles. Development and spread of the disease requires moisture from rainfall, sprinkler irrigation, or a relative humidity of 90% or greater. Average temperature must be less than 78 F. In the spring with favorable weather *P. infestans* will produce mycelium which is the vegetative body of the fungus. The mycelium will then produce asexual reproductive structures from which sporangiospores are produced and released. The sporangiospores are carried by wind or water to other plant locations to cause new infections. At the new infection sites the sporangiospores germinate and penetrate leaf or stem tissue, produce mycelium, and in 3-5 days produce more sporangiospores to again be spread by wind and water. Thus a large number of asexual generations are produced in a single growing season when environmental conditions are favorable for its development.

The new strain (A2) is the second mating type required for sexual reproduction to occur by the fungus *Phytophthora infestans*. Until recently, both mating types where not found outside of Mexico or South America. However, both mating types are now being reported to be found in many parts of the world. Since 1994, Mike Coffey from U.C. Riverside has been collecting *P. infestans* isolates from throughout California and has determined that both mating types are now found here. With sexual reproduction a spore called an oospore is produced. The oospore is a thick walled resilient spore that can survive in the soil without being inside a host's tissue to over-winter. The production of oospores could possibly mean that late blight inoculum would be present in a field even though there were no infected culls, volunteer potatoes, or alternate host for the pathogen to over-winter. Oospores have been detected in Europe and Mexico, but not in the United States at this time.

The old strain, A1, was originally satisfactorily controlled with the use of metalaxyl (Ridomil) in combination with other available fungicides. The presence of the newly introduced A2 strain has hampered control of late blight because it has shown resistance to metalaxyl. The presence of both mating types has also produced new genetic recombinations that are superior in their ability to cause disease. These new genotypes may have been imported on seed potatoes from the northwest U.S. or western Canada, or may have been produced in Kern County; in either case, their presence has been documented by Mike Coffey. The new genotypes found in Kern County potato fields are superior to the previous strains that growers had to deal with in their ability to over-winter, produce

many generations of asexual spores (sporangiospores), survive higher temperatures, and resistance to metalaxyl. Because of the increased virulence of the new strains, growers need to adopt new control strategies.

Two new fungicides have been approved for use in California for potatoes for the control of late blight. Tattoo C and Curzate M-8 have been used in Europe and in other parts of the United States with success in late blight control. Tattoo C is a combination of propamocarb and chlorothalonil while Curzate M-8 is a combination of cymoxanil and mancozeb. Tattoo C and Curzate M-8 are both systemic and can give some post-infection activity, but both of these chemicals should be used in a preventive spray program and not a curative program. Growers must follow the section 18 emergency exemption label for each of the new fungicides.

Metalaxyl was very effective on sensitive strains and was easily moved in the plant by its systemic activity. The entire plant could be protected with the fungicide even if the plant coverage was not totally adequate. The tubers were also protected from the pathogen because of the highly systemic activity of metalaxyl. The two new registered materials are also systemic but not to the degree of metalaxyl. Thorough coverage of the plant with the new materials is required for protection. This is also true with the other protective fungicides that are available such as chlorothalonil, mancozeb, maneb, and others. Metalaxyl covered up many application mistakes in the past, but now that it is ineffective against the new strains of late blight, growers need to make sure that the fungicides are getting down well into the canopy.

Ground applications of the fungicides may provide better coverage than aerial applications. The amount of water and the types of nozzles used should also be carefully considered when applying fungicides for late blight control. The higher recommended rates of water will generally give more coverage than the lower rates. Proper nozzle size and type should be selected to give the best possible coverage of the material on the plant.

The interval period between fungicide applications should be reconsidered because of the new strains and genotypes that are found in Kern County. The genotype that is found in the local potato fields is able to produce many generations of asexual spores in a shorter period of time than the older strains growers are used to. New leaves and shoots are not protected from the bombardment of spores being released by the fungus as the potato plants grows. Shorter spray intervals when plants are younger and producing new foliage would offer more protection from the increased spore production of the new strains. There are however limits to the total amount of fungicides that can be applied to a field in one year. Tattoo C and Curzate M-8 are both restricted to no more than five applications each. Also, Curzate M-8 contains mancozeb which is an EBDC which is restricted to 11.2 lb. active ingredients per acre for each growing season. The amount of mancozeb in Curzate M-8 must be included in the total amount of all mancozeb products used in the field. Tattoo C contains chlorothalonil which is also restricted to a total of 12 lb. active ingredients per year for potatoes. Alternating fungicides between registered preventative chemicals and the new fungicides should be less expensive and equally effective. In fungicide trials in Kern County this year (1996), equal control has been achieved with a 7-day spray interval of preventive fungicides as with the new chemicals. Incidence of late blight in Kern County in 1996 has been sporadic; the combination of fungicide applications and intermittent warm, dry weather has prevented major outbreaks; however, sporulating plants could still be found throughout Kern County in mid-April.

Sanitation is more important as a method of late blight control with the more virulent strains of *P. infestans*. Volunteer potatoes are an excellent source for the fungus to over-winter and begin early infections In the winter of 1995-96 many volunteer plants grew in fallow fields and in previous potato fields that were planted into carrot, onion and other crops. Numerous fields had potatoes the previous year and are again planted into potatoes this year. It is important to remove all possibilities of the pathogen over-wintering to the new growing season. Reducing the ability of the pathogen from over-wintering will keep the initial levels of the inoculum low, allowing better early season management. If the inoculum levels are high as the potatoes emerge from the soil, the disease could become established very early in the growing season.

In addition to good sanitation, the use of certified seed for planting should be practiced. Certification alone will not assure the absence of late blight infected tubers. Investigate the source to determine if late blight was found in the field, or in nearby fields, of origin of the seed. The absence of infected seed tubers will eliminate an early source of

infection. Eliminating these early sources of infection will make management of late blight easier and require less applications of fungicides.

To reduce the chance of infection of the tubers while in storage, the tops should be rolled and allowed to dry at least two weeks prior to harvest. The fungus is not able to survive in dead plant matter and any remaining sporangiospores would be killed from desiccation.

The varieties currently grown in California, and throughout the U.S., are all susceptible to late blight. Some new selections in the UC Potato Research Advisory Board showed some tolerance or resistance in 1995 trials. Good sources of resistance have been identified in a wild potato species, *S. bulbocastanum*. This resistance has been introduced through protoplast fusion. Selections from those somatic hybrids and other potential sources of resistance are being screened at the UC Research and Information Center in Kern County. No results are available yet; if late blight is established at this experimental site, a field day may be held in May 1996.