MAPPING YOUR ROUTE TO THE FUTURE

Great Lakes Fruit, Vegetable & Farm Market EXPO
DeVos Place Convention Center
Grand Rapids, MI
December 7-9, 2004

Potato

Tuesday afternoon 2:00 pm

Where: Gallery Overlook Room E-F (upper level)

Recertification credits: 1 (Private, 1A, 1B)

CCA Credits: IPM(0.5) CM(0.5)

Moderator: Fred Springborn, Montcalm Co. MSU Extension

2:00 p.m. Now is the Time to Manage Resistance in the Colorado Potato Beetle

- Edward Grafius, Entomology Dept., MSU

2:20 p.m. Integrated Late Blight Control and Management

- William Kirk, Plant Pathology Dept., MSU

2:40 p.m. Resistance Management : A Key Issue in Controlling Potato Diseases

- Walter R. Stevenson, Plant Pathology Dept., Univ. of

3:00 p.m. Potato Varieties for the Fresh Market and Table

- David Douches, Crop & Soil Sciences Dept., MSU

3:20 p.m. Enhancing Skin Color: The Case of Michigan Purple

- Sieglinde Snapp, Horticulture Dept., MSU
- Chris Long, Crop and Soil Sciences Dept., MSU

3:40 p.m. Marketing Michigan Table Potatoes (Speakers To be determined)

Now is the Time to Manage Resistance in the Colorado Potato Beetle

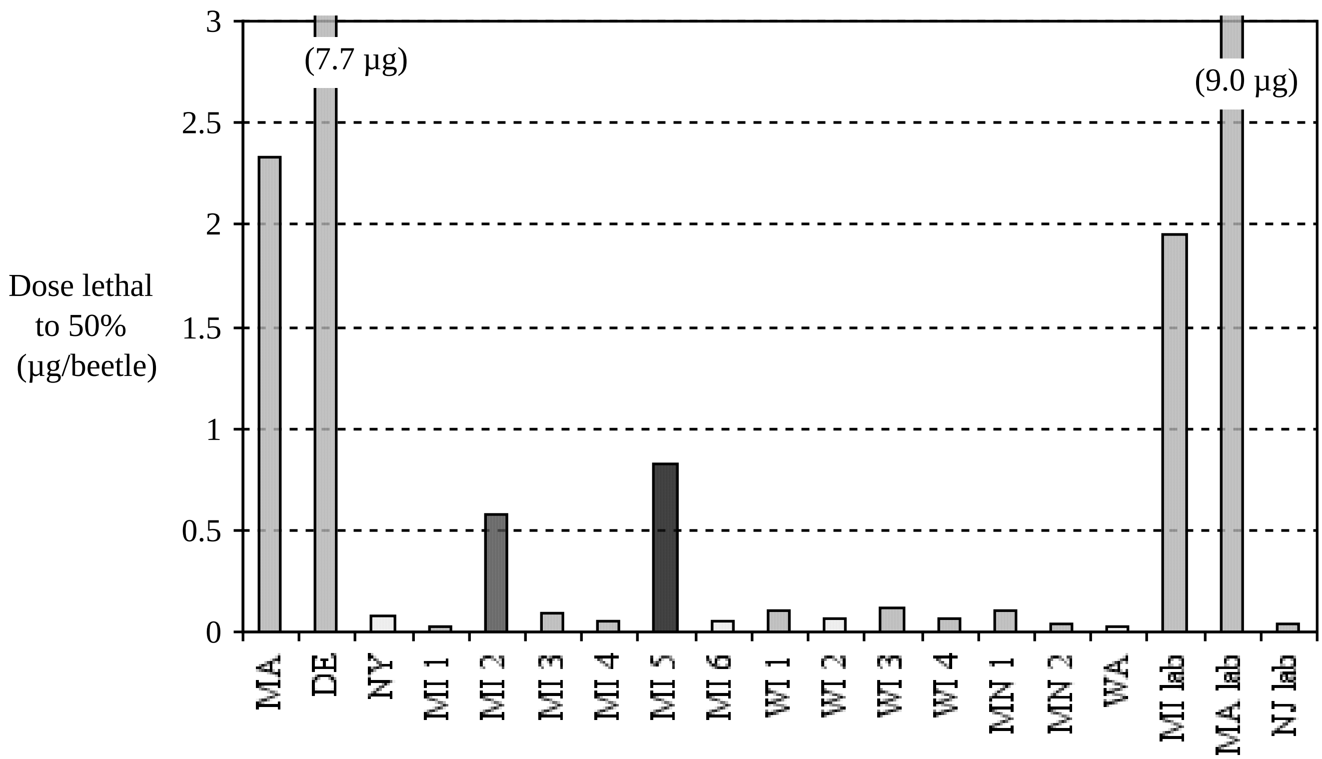
Edward J. Grafius
Department of Entomology
Michigan State University

Insecticide resistance in the Colorado potato beetle continues to be a major concern. Most potato growers in Michigan rely on insecticides in the neonicotinoid group and non-neonicotinoid insecticides have limitations to their use (Table 1). Before registration of the neonicotinoids, severe control costs and losses were threatening the industry. When the first neonicotinoid (Admire) was registered in 1995, costs and crop losses to the Michigan potato industry were reduced by >$8 million/year and use of insecticides was reduced by >200,000 lb active ingredient.

Table 1. New insecticides registered and effective for Colorado potato beetle.

Product (Brand name)	Group	Limitations
Imidacloprid (Admire, Provado, Gaucho, Genesis, Leverage)	Neonicotinoid	Use any neonicotinoid on one generation only (resistance management guideline)
Thiamethoxam (Platinum, Actara, Cruiser)	Neonicotinoid	Use any neonicotinoid on one generation only (resistance management guideline)
Abamectin (Agri-Mek)	Avermectin	Maximum two applications (label restriction), high cost
Spinosad (SpinTor)	Spinosin	Maximum two applications, do not apply to successive generations (label restriction)
Novaluron (Rimon)	Benzoylphenyl urea	Small larvae only, maximum two applications (label restriction)

Monitoring for resistance to thiamethoxam and imidacloprid was conducted in 2004 with the help of cooperators from industry, universities, and private cooperators. Populations from Massachusetts to as far west as Washington State were tested, with most populations from the Northeast or Midwest. 15 field populations were bioassayed for resistance to thiamethoxam and imidacloprid; one additional population (the Washington State site) was assayed for resistance to imidacloprid only because of a limited number of beetles. Results generally indicated widespread resistance to imidacloprid in the Northeast and little or none in the Midwest and West. However, significant levels of resistance to imidacloprid appeared for the first time in the Midwest in 2004 (Figure 1). Beetles from two fields on the same farm (fields MI2 and MI5) required much higher amounts of imidacloprid to kill half the population than we had previously seen from Michigan or other Midwestern states.



Why is now the time to manage resistance?
Resistance is a problem that can't be managed after it becomes serious – growers learned this in the early 1990s when most available insecticides failed. Once the genes for resistance become firmly established in a group of beetles, control with that insecticide or related products becomes ineffective. Experience with other insecticides indicate that resistance will remain or decrease only slowly even if the insecticide is no longer used. For example, resistance to Furadan is very stable and it likely would still be ineffective, even though Furadan has not been used for 10 years (since 1994) in Michigan. Resistance to pyrethroids like Asana is somewhat less stable, but even after 10 years without use except for potato leafhopper or corn borer, a pyrethroid would likely give less than ideal control and resistance would rapidly increase again.

What should I do to manage resistance to neonicotinoids on my farm?
Chemical management strategies like alternating with insecticides from different groups will help. However neonicotinoids are likely to be a part of most programs to manage Colorado potato beetle because not too many other products are available.

The single most important way to manage resistance to any insecticide is to use as many non-chemical controls as possible. <u>For Colorado potato beetle, this means crop rotation</u>. Unfortunately, we don't have resistant potato varieties available for commercial use and natural enemies are much less effective for Colorado potato beetle than for other pests, such as aphids.

Colorado potato beetles overwinters as adults in fields and field borders. A side-by-side rotation will help, but moving potatoes at least 1/4 mile is needed for crop rotation to be most effective. This may require changes in long term farm management plants and even discussions with neighbors about where and when they plan to plant potatoes on land adjacent to yours. Although long term planning is difficult, it will pay off in reduced insecticide costs and reduced future resistance problems.

In addition to crop rotation to manage insecticide resistance, growers should never use a foliar spray of a neonicotinoid insecticide if a neonicotinoid was used at planting. Do not even use a neonicotinoid for potato leafhoppers or aphids, if one was used at planting. Alternatively, if you do not use a neonicotinoid at planting, foliar neonicotinoid treatment should be used only one generation of Colorado potato beetle – often this will be for control of first generation larvae.

We have been very fortunate that Admire and other neonicotinoids have lasted for 10 years for Colorado potato beetle control without serious resistance problems. With careful planning, we will be able to retain these valuable resources for years into the future.

Potato late blight update for Michigan and fungicide-based control measures

Willie Kirk, Phill Wharton, Firas abu El-Samen, Ray Hammerschmidt and Dave Douches
Michigan State University, East Lansing, MI 48824

Late blight of potato, caused by the water mold *Phytophthora infestans*, has the potential to be a very destructive disease of potato in Michigan. The pathogen favors wet weather with moderate temperatures (60 – 80 °F), high humidity and frequent rainfall. Under such conditions, the disease can spread extremely rapidly and has the potential to completely defoliate fields within three weeks of the first visible infections if no control measures are taken. In addition to attacking foliage, *P. infestans* can infect tubers at any stage of development before or after harvest and soft rot of tubers often occurs in storage following tuber infections.

In 2004, LB first reported in SW MI early July but was not confirmed then appeared on July 14 in Saginaw. There then followed a steady appearance of fields with late blight through July into August. This was the worst outbreak since 1995. Factors contributing to the outbreak included the survival of volunteer plants, poor cull management in some areas and the possibility that some seed planted was already infected. Assuming the presence of inoculum the weather in mid to late spring and early summer was very conducive for potato late blight development. For example at the Muck Farm, Laingsburg, MI, maximum and minimum air temperature (^{o}F) were 88.2 and 67.2 (Jun), 87.5 and 67.7 (Jul), 88.1 and 67.7 (Aug) and 85.3 and 66.0 (Sep). Maximum and minimum soil temperature (^{o}F) were 74.5 and 69.8 (Jun), 77.0 and 71.9 (Jul), 78.0 and 71.4 (Aug) and 75.9 and 70.2 (Sep). Maximum and minimum soil moisture (% of field capacity) was 98.5 and 95.8 (Jun, severe flooding); 98.1 and 63.3 (Jul), 85.4 and 71.4 (Aug) and 76.8 and 79.8 (Sep). Precipitation was 4.04" (Jun), 3.68" (Jul), 1.83" (Aug) and 0.93" (Sep). The total number of late blight disease severity values (DSV) over the inoculation period was 116 and 44 (using 80% and 90% ambient %RH as bases for DSV accumulation), respectively (Figure 1).

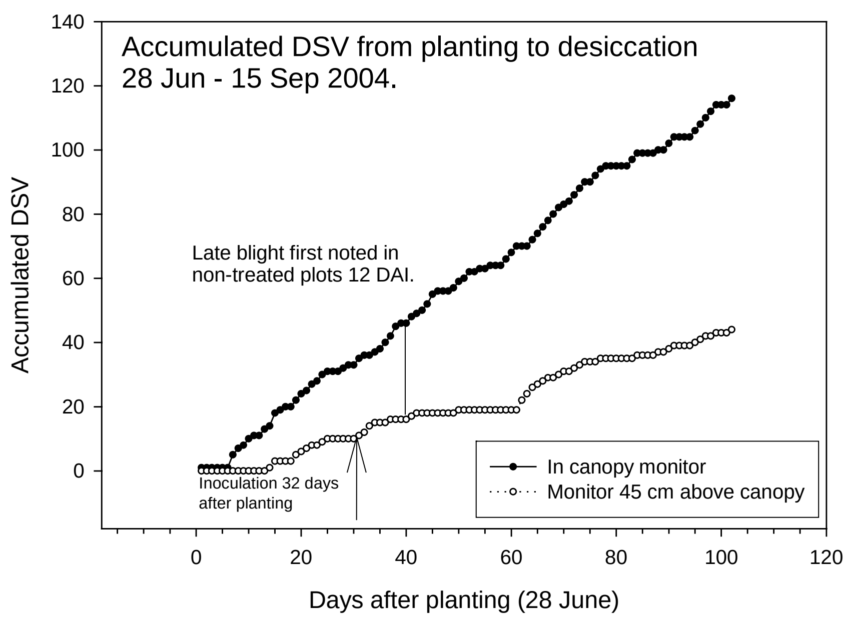


Figure 1. Accumualted late blight disease sevetiy values from planting to desiccation.

Chemical control

Under high disease pressure situations programs incorporating Acrobat 50WP, Curzate 60DF or Previcur should be used. In Michigan, both Headline and Amistar have provided very effective late blight control but these products should be used in strict adherence with anti-resistance development strategies i.e. always mix with a protectant fungicide (e.g. EBDC or chlorothalonil-based products) and never apply consecutive treatments. Consult your local advisor for appropriate rates and additional combinations. New products of note include Tanos [Group 11, duPont, 25% cymoxanil (as in Curzate) + 25% famoxadone] which should be applied at 6.0 oz/A. Do not apply Tanos more than 6 times per year and mixing with Manzate or chlorothalonil is recommended. Do not mix or follow Tanos with a Group 11 fungicide (e.g. Amistar). Applied within a protectant program all of these products give excellent late blight control. In addition, trials over several years at MSU have shown that Amistar and Headline are still exceptionally good for early blight control. Gavel, a new product from Dow (released in 2003) is also best used as a protectant and has been reported to reduce tuber blight. The new product from Bayer, Reason 500SC has also given moderate late blight control in trials over several years.

In seasons when the weather conditions would not favor severe late blight development, programs based on chlorothalonil (e.g. Bravo WS 6SC, Echo 6SC, Equus 6SC) or EBDC containing products (e.g. Dithane 75DF, Manzate 75DF, Manex 4FL, Penncozeb 75DF, Polyram 80WP) will reduce the risk of disease establishment. The addition of Super Tin 8-WP or Agri Tin 80WP (TPTH 80WP) to any of the protectant programs will enhance disease control, particularly towards the end of the growing season. Note that TPTH 80WP has a seven-day pre-harvest interval, and the maximum use rate since 2002 is 11.25 oz per season. Fixed copper-based products such as Champ and Kocide can also be used in protectant programs. These products are best used early in programs or immediately post-harvest for killing inoculum which may have come from adjacent crops. They should always be applied at the full recommended rate of application. The observations of individuals responsible for implementing spray programs should determine when best to change from one product to another. Of major note, is that the Fungicide Resistance Action Committee (FRAC) has specific recommendations for mixing fungicides with high risk of resistance development. As of 2003, fungicides are now labeled with a Group number e.g. Headline, Tanos, Amistar, Gem are all Group 11; these fungicides should be not mixed or immediately alternated in a fungicide-based protectant program. The application of these fungicides as standalone products has never been recommended by MSU for late blight control. They should always be mixed with a protectant surface residual fungicide.

The appropriate placement of translaminar and other systemic products within programs is determined by the mode of action of the product in relation to host and disease development but all products are best used within a preventative protectant program. For example, Previcur, Acrobat, Amistar, Headline, Gem, Gavel or Curzate may be applied to protect new growth early in plant development. Curzate and Previcur may be applied while the canopy is expanding but before senescence and Acrobat is most effective as a post-senescence product and can be applied up to late crop senescence.

Recommended programs for late blight control are not straightforward. The product of choice may well depend on how and from where the disease has developed. Some possible scenarios are shown in Table 1 of the new potato late blight bulletin available at the MSU extension desk where a range of containment procedures are described for susceptible varieties and different levels of potato late blight in the field.

Full results of potato late blight fungicide trials will be available in the Michigan Potato Research Report, available after the Michigan Winter Potato Conference, Feb 2 – 3, Gaylord.

Resistance Management
A Key Issue in Controlling Potato Diseases

Walter R. Stevenson
University of Wisconsin, Department of Plant Pathology
Tel. No. 608-262-6291
Email: wrs@plantpath.wisc.edu

Resistance management is a persistent concern for potato growers as they attempt to control destructive pests and extend the life of both old and new effective products. While resistance to pesticides has concerned entomologists for decades, resistance management is fast becoming a threat to the management of plant pathogens and weeds affecting the potato crop. Potato growers faced the loss of fungicide efficacy in the early 80's due to pathogen resistance, when the US#8 genotype of the late blight pathogen became distributed throughout North America. This new highly aggressive pathogen genotype was also resistant to metalaxyl and growers soon observed that this extremely effective fungicide no longer controlled the late blight pathogen. Plant pathologists throughout the country soon recommended that growers should discontinue using metalaxyl and related chemistry for late blight control and within a few years, late blight was dropped from the product labels.

With the widespread importance of late blight to the potato industry, the pesticide industry soon registered several new fungicides targeted at the late blight pathogen. Materials that included cymoxanil, dimethomorph and propamocarb hydroxide were formulated with either mancozeb or chlorothalonil as a precaution against selecting strains of the late blight pathogen with resistance to these newly introduced fungicides. Later when these active ingredients were decoupled from the broad spectrum protectants, labels began to carry directions that included information on resistance management and explicit directions that the late blight materials must be mixed with a protectant having a different mode of action. While there is still no evidence of resistance to these three materials after several years of intensive use, the industry remains cautious and continues to insist that products targeted at late blight such as Curzate, Acrobat and Previcur Flex must be mixed with a protectant each and every time they are applied.

During the past decade, we've observed that early blight continues to be a persistent problem affecting the health of potato foliage in many parts of the U.S. In Wisconsin, where much of the fresh market and processing acreage is planted on irrigated sandy soils, growers are treating their fields with fungicide as many as nine or more times per season. Although most standard protectants are modestly effective for early blight control, moderate levels of foliage loss often occur by the end of the growing season. Beginning in 1998, however, a new family of chemistry, the strobilurin fungicides, appeared on the market. The first entry, Quadris (azoxystrobin) provided exceptional control of early blight and essentially flattened the disease progress curve for this disease. By the second year of sales, this product was used in at least one spray application on over 80% of the Wisconsin acreage and the product was used heavily in many other states. As a result of greatly improved control of early blight, yields of long season russet potatoes increased by 10% or more. Our state production guidelines, based on years of field research, recommended that growers using Quadris should use the material early in the growing season to avoid curative use of the product, use up to three sprays of Quadris alternated with a protectant material and then use protectant materials for the remainder of the season. The label specified no more than 6 sprays per season and a seasonal use limit. Use pattern surveys indicate that the Wisconsin potato industry has and continues to use these recommendations and label directions.

The introduction of Quadris was soon followed by the release of several additional fungicides that fall into the strobilurin or strobilurin-like fungicide group. These materials include Amistar, Headline, Tanos, Gem and Reason. All of these materials are lumped into the Group 11 category of fungicides based on their mode of activity. As a added resistance management precaution, manufacturers are now recommending that when a Group 11 material is used to treat potato foliage for early blight control, the Group 11 fungicide should be tank mixed with another fungicide having a different mode of action. In spite of use precautions, however, the efficacy of azoxystrobin and other strobilurin chemistries has continued to decline. Statewide surveys conducted in 2001-2003 have shown populations of the early blight pathogen with significantly reduced strobilurin sensitivity compared with isolates collected in 1998 before the use of strobilurin fungicides.

The change in fungicide sensitivity of the early blight pathogen is a strong reminder of the potential for selecting pathogen strains with increased resistance to specific fungicides. New fungicide chemistries are by and large single site toxicants and more prone to resistance problems than the old standby materials such as maneb, mancozeb, metiram, chlorothalonil, triphenyltin hydroxide and fixed coppers. The fungicide industry is quickly adopting new and more visible resistance management recommendations. As new fungicides are developed and registered, the labels contain valuable information pertaining to resistance management including mixing recommendations, seasonal use limits and warnings that their products should not be used in a curative manner to treat established infections. You will also notice that the new product labels bear a Group # such as **Group 11 Fungicide** or **Group 9 Fungicide** somewhere near the top of the first page of the labels. The group numbers in bold print relate to the mode of activity for each fungicide and are designed to help growers choose mixing partners to assist them in their resistance management programs. The group numbering system for fungicides was developed by the Fungicide Resistance Action Committee (FRAC) and is being adopted by the EPA as a straightforward way to classify fungicides according to modes of action and risk for fungicide resistance. Similar approaches are being used for categorizing insecticides and herbicides. The next time you read a label of one of the newly registered pesticides, take a few minutes to locate the Group number and information on pest resistance. Using this information in an integrated pest management program will help to prolong product efficacy and help to avoid product failures. A summary table of fungicides currently available for disease control on potatoes (Table 1) is shown on the next page.

Table 1. Classification of fungicides used in the production of potatoes according to the target site of activity.

FRAC Code	Target Site	Chemical Group	Common Name	Trade Names	Risk of Resistance
1	mitosis - β-tubuline assembly	benzimidazoles thiophanates	thiabendazole thiophanate thiophanate-methyl	Mertect Tops Topsin M	High
2	NADH cytochrome c reductase in lipid peroxidation (proposed)	dicarboximides	iprodione	Rovral	Medium to high
4	RNA polymerase I	acylalanines	metalaxyl mefenoxam	Ridomil Ridomil Gold	High
7	Complex II of fungal respiration	carboxamides	boscalid flutolanil	Endura Moncut Moncoat	Medium
9	Methionine biosynthesis (proposed)	anilino-pyrimidines	pyrimethanil	Scala	Medium
11	Complex III of fungal respiration; Q_o site	strobilurins methoxy acrylate methoxy carbamate oximino acetate ozazolidine dione imidazolinone	 azoxystrobin pyraclostrobin trifloxystrobin famoxadone fenamidone	 Quadris, Amistar, Quadris Opti Headline, Cabrio Gem Tanos (contains cymoxanil) Reason	High
12	MAP protein kinase in osmotic signal transduction	phenylpyrroles	fludioxonil	Maxim	Low to Medium
14	Lipid peroxidation (proposed)	aromatic hydrocarbons	quintozene (PCNB)	Blocker	Low to Medium
15	Cell wall synthesis	cinnamic acids	dimethomorph	Acrobat	Low to Medium
22	Mitosis β-tubulin assembly	benzamides	zoxamide	Gavel (also contains mancozeb)	Low to Medium
27	Unknown	cyanoacetamide oximes	cymoxanil	Curzate	Low to Medium
28	Cell membrane permeability, fatty acids (proposed)	carbamates	propamocarb hydrochloride	Previcur Flex	Low to Medium
29	Uncoupler of oxidative phosphorylation	2,6-dinitro-anilines	fluazinam	Omega	Low
30	Inhibitors of oxidative phosphorylation	organo tin compounds	triphenyltin hydroxide	Super Tin	Low to Medium
M	Multi-site contact activity	M1 – copper	copper hydroxide	Kocide Champ	Low
M		M3–ethylenebis Dithiocarbamates (EBDC's)	mancozeb maneb metiram	Dithane, Manzate, Penncozeb Maneb Polyram	Low
M		M4 – phthalimides	captan	Captan	Low
M		M5 – phthalonitriles	chlorothalonil	Bravo,Echo, Equus	Low

Source: FRAC (Fungicide Resistance Action Committee) web site (http://www.frac.info/)

Enhancing skin color, tuber set and skin set in Michigan Purple with the application of 2,4-D.

Chris Long and Dr. Sieg Snapp
Department of Crop and Soil Sciences
Michigan State University, East Lansing, MI.

The marketing of color skinned varieties continues to grow in the United States. Colored skinned varieties are an attractive alternative to the russet skinned and round white potatoes and provided superior cooking quality, in many applications, to that of the russet potato. A critical aspect of markting colored skinned varieties is a strong attractive appearance, primarily a vibrant skin color. It become common knowledge that with application of the Ester of 2,4-Dichlorophenoxyacetic Acid (2,4-D), a grower could enhance the skin color of a red skinned potato variety. In addition, reduce the overall size profile and increase tuber skin set. Small uniform sized potatoes are highly desirable in a "Farm Market" setting. We wanted to see the effect of this produce on a newly released purple skinned variety from Michigan State University. This new variety also has a nice white flesh. The variety Michigan Purple was released from the Potato Breeding Program at Michigan State University in 2003. All the data in this report is observational, but seems to suggest that 2,4-D does in fact reduce the size profile of this variety compared to the check. The result is more marketable potatoes. Tuber skin pigmentation, when 2,4-D is applied, appears to be more pronounced and more evenly distributed across the tuber making the overall all appearance more attractive. In addition the skin set occurs sooner and as a result the tuber is less vulnerable to skinning at harvest. 2,4-D L.V.4 Ester is not currently labeled as a skin color enhancing produce. The research conducted here is experimental and is not a recommendation to potato growers.