

# MULTIPLE TACTICS FOR COLORADO POTATO BEETLE MANAGEMENT

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Project Duration - 3 years, 1992-1994

## Objectives:

1. Develop application procedures for conventional and biological insecticides
2. Monitor status of CPB resistance to conventional insecticides in Wisconsin
3. Investigate cultural controls for off-crop CPB management
4. Integrate cultural, chemical, and biological controls into CPB management system
5. Determine appropriate use patterns for transgenic plants with CPB resistance to reduce potential for resistance and maximize effectiveness in existing IPM programs

## Results 1993

### Objective 1. Experimental Chemistry - applications for Wisconsin

- Continued evaluation of Furadan 4F application as an early season foliar/soil systemic treatment. Good efficacy was demonstrated as both banded and broadcast spray applied pre-hilling. Commercial use as an edge spray was effective.
- Continued evaluation of imidacloprid (Admire, Miles, Inc.) for CPB, aphid, and leafhopper control. Excellent efficacy was obtained from soil treatments (furrow and layby), but continued concerns over cost and resistance potential prompted examination of foliar sprays. Sprays were effective against all pests at a greatly reduced cost. Miles has agreed to add this option to the label for crops East of the Rockies. This will increase potential for Wisconsin use. Label anticipated in 1994. Wisconsin growers are in a good position to use Admire sparingly in a rotational program which will extend the time before resistance is encountered.

- Trigard, a biological growth regulator, was investigated to determine the most effective delivery system for Wisconsin. Early season applications were most effective and the material can be integrated well with conventional insecticides.
- Pyrolle (AC303630. American Cyanamid) represents a new insecticidal chemistry with excellent CPB activity. Timing and rates were investigated in 1993 and low rates (0.15 lb AI/A) were found to be effective when targeted against larvae. Adult efficacy was poor. Bioassays were conducted which showed that the material was equally effective against highly resistant beetle populations from other states. Pyrolle will fit well into the type of larval control programs commonly used in Wisconsin and increase grower options for rotation.

#### Objective 2. Resistance Status of CPB in Wisconsin

- The resistance study started in 1992 was expanded in 1993. 19 Wisconsin CPB populations were tested as well as 7 populations from other states. The susceptibility of all populations to Asana, Thiodan, Guthion, and Furadan was evaluated.
- In 1993, eight Wisconsin populations were significantly resistant to Asana. Low levels of Thiodan tolerance was also detected. None of the populations were significantly resistant to either Guthion or Furadan.
- Asana resistance was detected at a highest ratio of 12, which may be a level approaching that which will result in control failures. Resistance levels to Thiodan were much lower. Resistance levels remained stable from 1992-1993.
- Pyrethroid resistance in Wisconsin CPB populations appears to be geographically scattered and highly variable, but is approaching control failure levels in some populations. Growers are being urged to utilize alternatives to Pyrethroid foliar sprays when options exist.

#### Objective 3. Cultural Controls for CPB

- Trap crops in the spring, to aggregate beetles moving into fields, and in the fall, to aggregate beetles moving out of fields, were investigated with commercial growers. The trap crop technique is an effective means of concentrating beetles in an area where they can be controlled effectively using chemical or physical controls. Trap crops will not be 100% effective but will reduce beetle populations and make on-crop management more effective.
- Spring traps may require early planting of strips to be most attractive and a knowledge of the source of overwintering beetles to improve placement. Variety did not markedly affect attraction. Field edges might be used in the spring, but early germination improves effectiveness.

- Fall traps, created by not vine killing strips in the field, are effective and concentrate large numbers of beetles. Defoliation is rapid, however, and controls should be applied quickly to avoid beetle escape.
- Physical controls using a propane flamer were investigated in 1993 and this mechanism was very effective, particularly on small plants. Repeated use is necessary.

#### Objective 4. Integration of CPB Controls

- Four sites were established in 1993 which will employ fall traps in 1993 and spring traps in 1994 on adjacent fields in combination with conventional controls.
- In 1994, a field site will be selected to directly compare 5-acre blocks with trap crops with similar blocks managed conventionally. The impact of cultural vs. chemical management on ground water will be measured. This project, conducted with Dr. Sam Kung, which began with WPIB funding, will be funded federally.

#### Objective 5. Transgenic Plants

- Transgenic plants with CPB resistance are expected to have a significant impact on the potato industry. Registration is anticipated in 1996.
- Our research (WPIB and Industry Funded) has been concentrated on determining the impact of transgenic resistance on IPM in Wisconsin and on reducing the potential for resistance to transgenic Btt. Eight lines of transgenic Russet burbank potatoes were grown commercially using standard Wisconsin IPM practices. Yields and quality were comparable to non-transgenic controls.
- On the Hancock station, studies were continued to investigate the potential for increased biological control of aphids in plots where CPB control was achieved by transgenic resistance. Aphid parasites and predators were significantly increased in 1993 in transgenic plots, but aphid numbers were not sufficiently high to demonstrate biocontrol potential. PLRV transmission will be determined following dormancy. Plant mixtures using both transgenic and non-transgenic plants in random seed mixes or blocks were investigated to determine beetle movement and survival. Mixtures increased survival, which is desirable for resistance management, but interplant movement in random seed mixtures may continue to select for resistance. These studies will continue in 1994.

Table 1. Resistance ratios for populations of Colorado potato beetle tested against four conventional insecticides (1992 / 1993).

Field #	Asana	Thiodan	Guthion	Furadan
1 (Arlington)	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
2	0.6* / --	-- / --	0.6* / --	-- / --
3	0.7 / --	0.9 / --	-- / --	-- / --
4	0.8 / --	1.0 / --	1.0 / --	-- / --
5	0.9 / --	1.7* / --	2.8 / --	0.6 / --
6	1.1 / 1.7	1.6* / --	1.0 / --	0.6 / --
7	1.2 / --	0.7* / --	1.7 / --	-- / --
8	1.2 / --	-- / --	-- / --	-- / --
9	1.3 / 1.5	1.4 / --	0.7* / --	2.2 / --
10	1.3 / --	-- / --	-- / --	-- / --
11	1.4 / --	2.1* / --	1.1 / --	-- / --
12	1.4 / --	3.8* / --	1.2 / --	-- / --
13	1.4 / --	1.3 / --	1.0 / --	-- / --
14	2.0 / 1.5	-- / --	0.8 / --	1.2 / --
15	2.4* / --	0.9 / --	1.0 / --	0.5 / --
16 (Hancock)	2.4 / 1.5	1.2 / --	0.9 / --	0.6 / --
17	2.4* / --	-- / --	-- / --	-- / --
18	2.8* / 2.6*	1.5 / --	1.8 / --	-- / --
19	3.5* / --	2.3* / --	0.7* / --	0.6 / --
20	5.7* / --	1.2 / --	-- / --	-- / --
21	9.4* / --	1.3 / --	1.0 / --	-- / --
22	12.0* / --	0.6* / 0.2*	0.7* / 0.5*	0.3* / --
23 (Michigan)	20.5* / 13.0*	309.6* / --	14.7* / --	-- / --
24	-- / --	4.5* / --	-- / --	0.5 / --
25 (Idaho)	-- / 1.1	-- / 0.3*	-- / 0.6	-- / --
26	-- / --	-- / 1.0	-- / --	-- / --
27	-- / 1.4	-- / 0.6	-- / 0.3*	-- / 0.4
28	-- / 1.9	-- / --	-- / --	-- / --
29	-- / 1.9	-- / --	-- / 0.3*	-- / --
30	-- / 2.1	-- / 1.0	-- / 0.4*	-- / --
31	-- / 2.1	-- / --	-- / --	-- / --
32	-- / 2.3*	-- / --	-- / --	-- / --
33	-- / 2.3*	-- / 1.3	-- / --	-- / --
34	-- / 2.5*	-- / --	-- / --	-- / --
35	-- / 2.7*	-- / --	-- / --	-- / --
36	-- / 3.2*	-- / 0.6	-- / --	-- / --
37	-- / 5.9*	-- / 1.0	-- / 1.3	-- / --
38	-- / 6.4*	-- / --	-- / 0.5	-- / --
39 (No. Dakota)	-- / 9.6*	-- / --	-- / --	-- / --
40 (Minnesota 1)	-- / 17.3*	-- / 1.6	-- / 0.8	-- / 1.5
41 (Maine)	-- / 104.2*	-- / 2.2*	-- / --	-- / --
42 (New York)	-- / 137.0*	-- / 1.6	-- / --	-- / 7.2*
43 (Minnesota 2)	-- / 469.5*	-- / 8.3*	-- / 2.0	-- / --

\*Statistically different at the 5% level of significance.

## More About Pinkeye<sup>2</sup>

Doug Rouse<sup>1</sup>

Pinkeye is a disease of potato tubers that can effect most varieties including round white, red and russet cultivars. In Wisconsin it is of particular concern on Russet Burbank used for processing. However, it can effect quality and grade of other potato varieties and can lead to soft rot in storage. This disease should be of general concern to growers because incidence of pinkeye is correlated with poor storage potential of the crop.

Pinkeye is characterized by a pink or brownish coloration around at least some of the eyes of the tuber, often at the bud end where most of the eyes are concentrated. This pink discoloration may be superficial and even disappear shortly after digging the tubers. Alternatively, the pink/brownish coloration may extend below the surface of the tuber. Tubers are scored positive for pinkeye during inspection if pink or brownish discoloration of the flesh is evident after peeling the skin around the eyes. These areas of discoloration may dry out producing a corky appearance on the skin. This is sometimes referred to as "bullhide" and is a problem for the processor since it will not easily peel. Alternatively, the discolored areas may begin to decay leading to soft rot.

Pinkeye has been reported to occur in most of the production areas in North America including Maine, Florida, the Red River Valley, Idaho and Wisconsin. It was first reported in Maine and studied during the 1950's. From the beginning the disease was associated with *Verticillium* wilt or potato early dying. A particular type of bacterium was isolated from 50-70% of tubers with pinkeye symptoms. This bacterium, known as *Pseudomonas fluorescens*, is a common soil inhabiting bacterium. Researchers were able to reproduce symptoms of pinkeye in the greenhouse by drenching the soil in pots in which potatoes were growing with the bacterium.

How could a common saprophytic (grows on nonliving substrates => ordinarily not a pathogen) soil bacterium found in all soils cause this disease? This question is significant because other researchers were able to isolate this bacterium from the surfaces of healthy tubers. In the field the disease is somewhat mysterious due to its sporadic occurrence. In some years the disease is much worse than other years and it seems much more likely to occur in some places than others. This is true despite the fact this bacterium is always present in the soil.

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<sup>2</sup>This report is taken in part from an article written for the Common Tater

There are several possible explanations. One possibility is that Pseudomonas flourescens does not cause this disease. Since it is found on healthy tubers and is fast growing it may simply be the easiest organism to isolate. The real causal agent may not be isolated because of interference by P. flourescens. It may be that only certain strains of the bacterium are capable of causing disease. It is also possible that disease is only expressed under certain specific conditions. This seems to be likely regardless of the role of the bacterium since many observations indicate pinkeye incidence may be related to soil conditions, especially water stress.

The two most consistent observations about pinkeye are its apparent correlation with Verticillium wilt and water stress. We made our own observations in the central sands by conducting a survey in 1991 and 1992. In several cases where parts of fields were fumigated pinkeye was found to be much greater in the nonfumigated then fumigated portions of the field. Pinkeye was also associated with wet areas of fields, for example, low areas or along rows used by spray equipment. Pinkeye typically occurred beginning the first of August. We were able to isolate several kinds of bacteria from tubers with pinkeye. Pseudomonas florescens was the most frequently isolated bacterium.

It may be that potato early dying and excess soil moisture function in the same way to increase the likelihood of pinkeye. Potato early dying results in reduced transpiration. This means the soil will have a higher moisture content where the disease occurs. Another observation reported to us was that herbicide stress increased pinkeye incidence. Again reduced transpiration associated with that stress might explain the incidence of pinkeye.

Pinkeye is highly correlated with other tuber quality factors. Several of these including hollow heart and internal browning and necrosis are known to be associated with stress during tuber bulking in the field. The highest and most consistent factor correlated with pinkeye was soft rot. Soil moisture stress has been associated with all of these disorders in one way or another. This constitutes another observation suggesting a role for soil moisture in pinkeye incidence.

To test these observations we conducted an experiment at Hancock. The frequency and amount of irrigation were varied to establish potato plots with different levels of soil moisture. Although we selected locations for the experiment at Hancock where pinkeye had been observed previously the 1991 and 1992 growing seasons were not conducive to a high incidence of pinkeye. Nevertheless we observed slightly higher pinkeye in plots that received excess irrigation.

In 1992 we also added bacteria to the soil in the plots. We observed considerably higher pinkeye with some of the bacterial treatments although the highest pinkeye was in a plot receiving a bacterium that was not Pseudomonas florescens. We are repeating

these experiments one last time at Hancock this summer. With the high rainfall levels we have had it may be a bad year for pinkeye. At least we will have a chance to determine the effect of our treatments under wet conditions.

In the mean time, it is clear that careful management of the crop to avoid excessive water can only help reduce disease problems. It is also clear that controlling potato early dying will also significantly reduce pinkeye.