Influence of soil-applied pesticides on potatoes

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Many new pesticides have been registered for use in potatoes over the past few years. Despite the fact that interactions among systemic pesticides are well documented in crops such as soybean and corn (Hayes, et al. 1979, Waldrop and Banks, 1983), little effort has been made to evaluate these interactions in potatoes. Previous studies have shown that systemic insecticides such as Thimet® applied at planting can increase susceptibility of potatoes to damage by herbicides such as Sencor® (Cranshaw and Thornton, 1988). Temik® has been shown to reduce the populations of growth-promoting bacteria associated with potato roots (Sturz and Kimpinski, 1999), which in turn led to a reduction in plant growth and an increase in Rhizoctonia stem canker (Scholte, 1987, Sturz and Kimpinski, 1999). Insect control can also be compromised as Spartan® herbicide injury was shown to reduce the effectiveness of Admire® in controlling Colorado potato beetle (Zollinger and Fitterer, 2000).

The cause of these interactions among systemic pesticides is unknown. In an attempt to shed some light on this complicated issue studies were conducted at the University of Idaho Research and Extension Centers located in Parma and Aberdeen between 2004 and 2006 using Russet Burbank and Shepody potatoes.

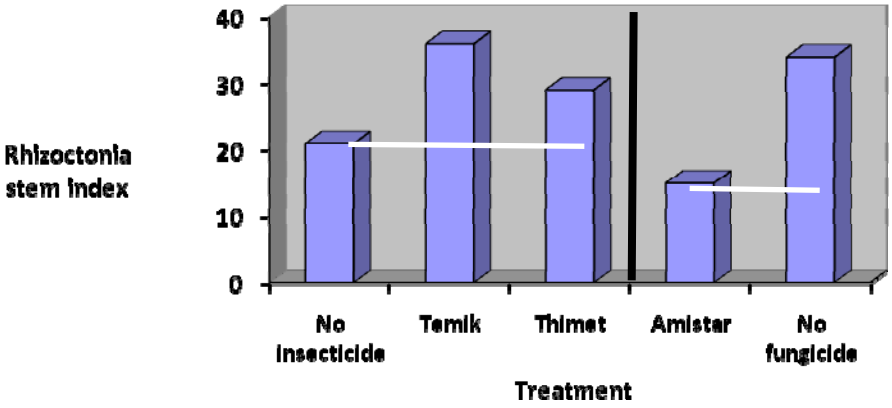
Impact of soil-applied insecticides and fungicides on disease

Commonly used insecticides/nematicides were applied at the following rates in-furrow at planting: Temik 15G® (20 lbs/acre), Vydate C-LV® (8.4 pts/acre), Admire 2F® (16 oz/acre), Platinum 2SC® (8 oz/acre), and Thimet 20G® (16.6 lbs/acre). The idea was to set up a "worst case scenario" by using maximum labeled rates and applying these products right onto or next to the fresh cut seed pieces. To evaluate the potential for an interaction between products, all insecticide treatments were applied with and without Amistar® fungicide in-furrow at planting at a rate of 3.63 oz/acre.

Both Temik and Vydate occasionally increased the level of seed decay compared to the non-treated control. However, final stands were not reduced and it appeared that the main impact was on how quickly the seed piece rotted after plants had emerged.

The most consistent impact of soil-applied insecticides was on Rhizoctonia stem canker. Averaged over the four site-years of this study, Temik increased Rhizoctonia by 69% compared to the no insecticide control, while Thimet increased Rhizoctonia by 37% (Figure 1). In contrast, Amistar fungicide applied in-furrow at planting reduced Rhizoctonia by 56% compared to the no fungicide control. These results emphasize the importance of using fungicides to control Rhizoctonia when carbamate or organophosphate insecticides are applied near the potato seed piece at planting. The neonicotinoid insecticides (Admire, Platinum) did not appear to influence Rhizoctonia severity.

Figure 1. Influence of soil-applied insecticides and fungicides on Rhizoctonia stem canker of Russet Burbank potatoes at two locations in Idaho during 2005 and 2006. Insecticide means are averaged over two fungicide treatments and fungicide means are averaged over 5 insecticide treatments.



Some of the non-target disease impacts of systemic pesticides were actually beneficial. For example, in-furrow application of Amistar reduced stem infection by the fungus *Verticillium dahlia*, one of the causes of early dying. The mechanism for the suppression of Verticillium by Amistar is not known, but has been previously reported in other regions.

Foliar early blight symptoms were also significantly reduced by in-furrow applications of Amistar. The reason for the reduction in early blight following in-furrow application of Amistar is not clear. Plants treated with Amistar had lower levels of stem infection by *Verticillium* (as reported above), and therefore may have had less senescent tissue that would be susceptible to infection by *Alternaria* spores. Conversely, Amistar may be more upwardly systemic than previously thought, and may be directly reducing infection.

None of the insecticides evaluated in this trial consistently impacted *Verticillium*, early blight, white mold or black dot. Amistar also had no impact on white mold or black dot incidence.

Impact of soil-applied insecticides and herbicides on plant injury and insect control

The same insecticide treatments outlined above were evaluated in combination with post-plant/pre-emergence applications of Spartan herbicide (4oz/acre). Dual Magnum® and Prowl® were applied to the entire trial area to keep all plots weed free.

Pre-emergence application of Spartan herbicide caused visual plant injury and stunting all locations. Spartan treated plants exhibited nine-fold higher plant injury ratings than plants treated with just Dual and Prowl (Figure 2). Plants treated with Vydate and Thimet also tended to exhibit more plant injury than the non-insecticide control. The insecticide/herbicide interaction was significant in one of the four site-years, indicating that in-furrow application of Thimet may cause plants to be more susceptible to Spartan injury. These results emphasize the role that carbamate and organophosphate insecticides can play in increasing plant susceptibility to herbicide injury. The neonicotinoid insecticides (Admire, Platinum) and Temik did not appear to influence herbicide injury (data not shown).

A detached leaf assay was used to evaluate the interaction between systemic insecticides and herbicides on survival of Colorado potato beetle (CPB) larvae and adults. Platinum and Admire tended to provide better control of CPB larvae compared to the other treatments. There was no evidence that herbicides influenced the level of insect control for early or late stage larvae. However, there was a significant insecticide by herbicide interaction for CPB adult mortality due to the fact that mortality was significantly increased for Admire, Platinum and Vydate when Spartan herbicide was applied compared to when no Spartan was applied (Figure 3).

Figure 2. Influence of soil-applied insecticides and herbicides on visual injury ratings of Russet Burbank potatoes at two locations in Idaho during 2005 and 2006. Insecticide means are averaged over two herbicide treatments and herbicide means are averaged over 5 insecticide treatments.

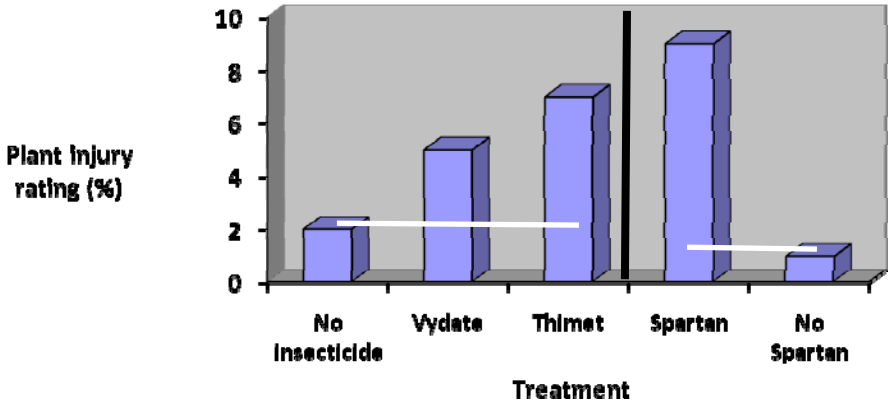
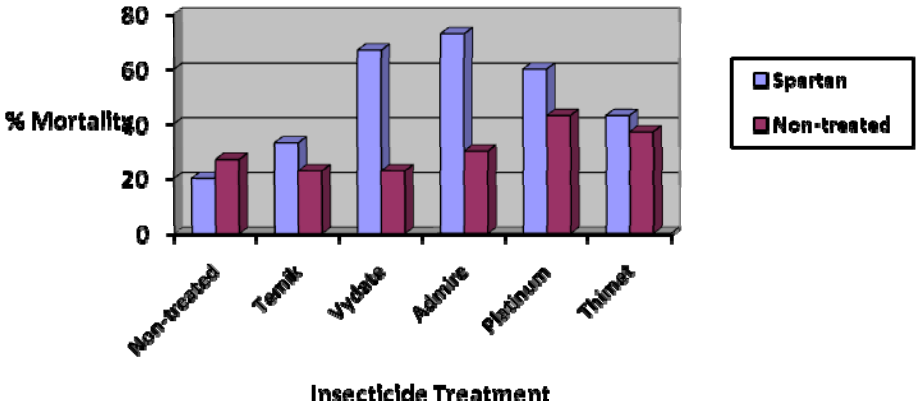


Figure 3. Interaction of insecticide with soil-applied herbicide on mortality of adult Colorado potato beetle feeding on detached leaves of Russet Burbank potatoes at Aberdeen, Idaho during 2006.



Impact of soil-applied pesticides on yield and grade

Even though systemic pesticides significantly influenced disease development and crop injury, there were relatively few differences in total tuber yield or grade (Table 1). It appeared that in most cases the benefits provided by nematode and/or insect control outweighed the impacts on disease development.

Vydate consistently decreased the percentage of US No.1 potatoes compared to the non-treated control. The rate of Vydate applied in this trial (8.4 pints/acre) is much higher than the rate most growers use for nematode control, so the grade impact may never be seen under field conditions.

Amistar significantly increased the percentage of US No.1 potatoes compared to the no-fungicide control in two of the four site-years. Rhizoctonia is known to impact tuber shape more than total yield, and this response was probably due to the effectiveness of Amistar in controlling this disease.

Despite the fact that Spartan significantly increased plant injury in all trials, it had only a slight impact on total yield (<4% compared to the non-treated control) and no impact on tuber grade. Potato plants appear to have the ability to tolerate plant injury due to herbicides, especially early in the season when plants are rapidly growing.

Table 1. Influence of in-furrow insecticides, fungicides and pre-emergence herbicides on total and marketable potato yield at two locations in Idaho during 2005 and 2006.

Treatment	Total Yield (cwt/acre)	US # 1 (%)[w]
Insecticide means [x]		
Non-treated	530	73 a
Temik	532	68 ab
Vydate	518	64 b
Admire	533	69 ab
Platinum	538	70 ab
Thimet	532	69 ab
Fungicide means [y]		
Amistar	565	73 a
Non-treated	552	67 b
Herbicide means[z]		
Spartan	495	69
Non-Spartan control	514	68

[w] Percentage by weight of tubers over 4 oz that meet US #1 grade standard.
[x] Insecticide means are averages of two fungicide treatments or two herbicide treatments over 8 trials.
[y] Fungicide means are averages of 5 insecticide treatments over 4 trials.
[z] Herbicide means are averages of 5 insecticide treatments over 4 trials.
Means followed by different letters are significantly different (P>0.05) using Fischer's protected LSD.