WHERE ARE WE WITH POTATO IPM?

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Potato IPM is here now. Washington potato growers have been using elements of IPM in potato production for some time. A 1992 survey of Washington potato grower practices showed that prior to planting, 53% tested their soil for nematodes, and 67% acknowledged site characteristics and the previous crop grown on the site to be important considerations in pest prevention. Furthermore 33% used resistant varieties for disease control, 30% used cover crops, but not for insect control. And 75% managed diseases by crop rotation, although only 50% thought it useful for controlling nematodes, weeds, or insects. Even just considering the pre-plant practices, IPM is apparently here now. Admittedly, interest among growers has increased noticeably since the withdrawal of aldicarb, and the discovery of strains of late blight which couldn't be controlled by available fungicides.

IPM is here to stay. Only IPM can reduce health and environmental risks, increase net yields, improve quality of produce, and help grower and processor meet increasingly stringent import and export criteria without increasing inputs of fertilizer, water, chemical pesticides, and that ultimate, non-renewable resource - land.

What do we mean by IPM? The concept of Integrated Pest Control was described during the 1950s, and urged the complementary use of all available methods of pest control. These include climate, host plant resistance, water and fertility management, chemical pesticides, mechanical controls and biological controls. How can all these be used in a coordinated way? It requires that the pest manager have a great deal of knowledge. Knowledge of pest biology and the biologies of beneficial organisms such as predators and parasites is essential. An understanding of the plant 's response to injury is useful: the same degree or type of injury has different effects on yield and quality at different growth stages of the crop plant. These kinds of knowledge can be gained from reading, attending workshops, and other activities during seasons when the crop is not in the field. The successful pest manager also needs real-time knowledge which is acquired through monitoring crop and pest development, and ecological conditions such as temperature and humidity. These bits of knowledge can be used to develop an economic injury level: the amount of injury which justifies the costs of materials and application to prevent it. Economic injury levels depend on crop stage and pest development, and thus predictions and warnings are generated to alert the manager, who is then able to use selective materials rather than broad spectrum biocides.

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Integrated Pest Management, then is a coordinated approach to managing a complex of pests using a great deal of knowledge about the local conditions and situation.

What IPM tools are available to potato growers now?

For management of weeds crop rotation and mechanical control (dragging off) are well known. Cover crops, including green manures are effective and gaining in popularity. Anything that increases stand vigor, and does so rapidly, makes the potato plant more competitive compared to the weeds.

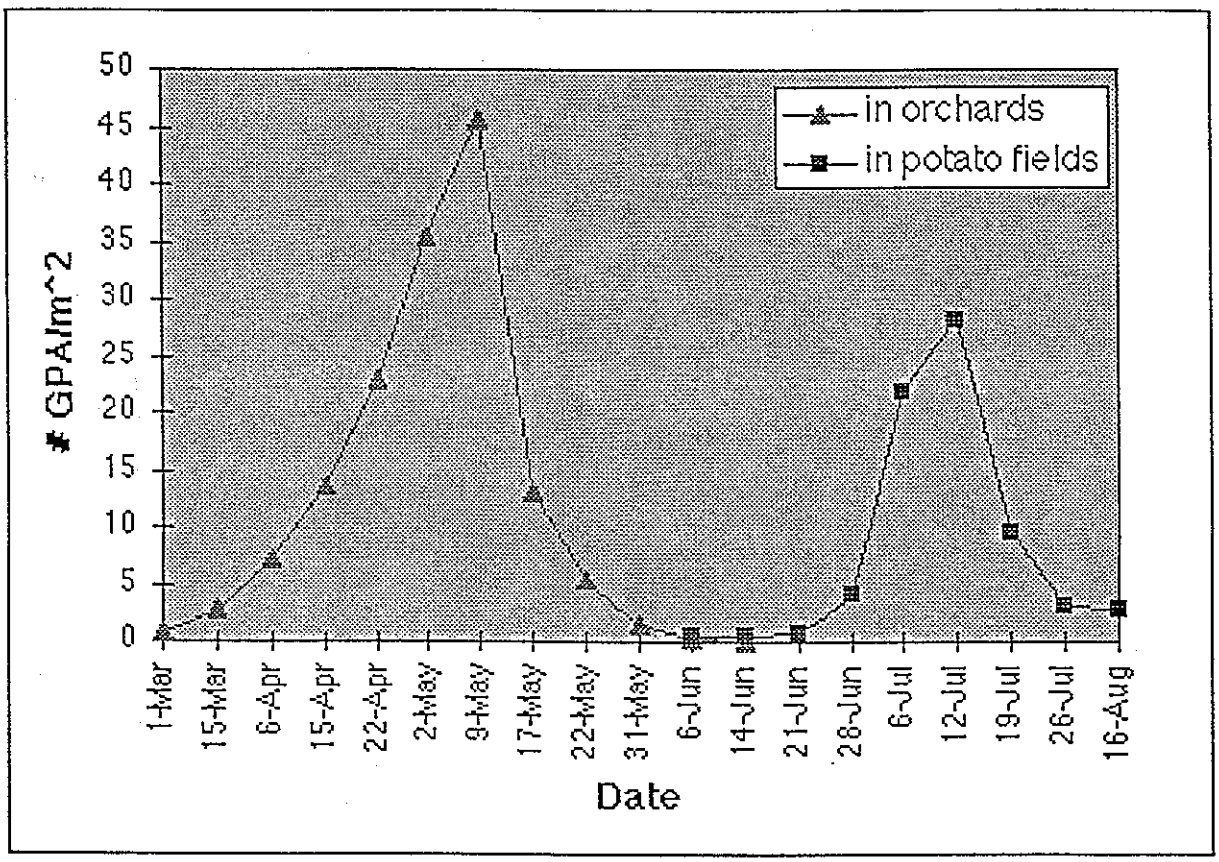
For **nematodes**, monitoring by soil testing is indispensible: if you have a problem, you'd better know about it! And if you don't have a problem, you may save hundreds of dollars per acre in unnecessary applications of nematicides. Crop rotation can be effective, and use of green manures.

Prognosis models are rapidly becoming tools to manage bacterial pathogens through irrigation management. A year ago, the only way to manage late blight was to keep it out of the field. Recently we've heard that some varieties are differentially resistant, and that there are both single genes, and combinations of genes that show promise in conferring resistance. Perhaps as exciting is the discovery of selective chemistry that prevents the formation of zoospores, the form of late blight that disperses to the tubers. This may allow some late blight to exist in the potato foliage, while preventing its economic destruction of the tubers.

Some insects, especially green peach aphids (GPA), are vectors of viruses such as potato leafroll virus, the causative agent for net necrosis. Viruses can be managed somewhat through plant resistance, and densities of their vectors can be depressed by biological controls. But the best IPM tactics for virus management is through proper timing of insecticide applications, and use of selective materials that affect the vector without significantly impacting other, non-target organisms.

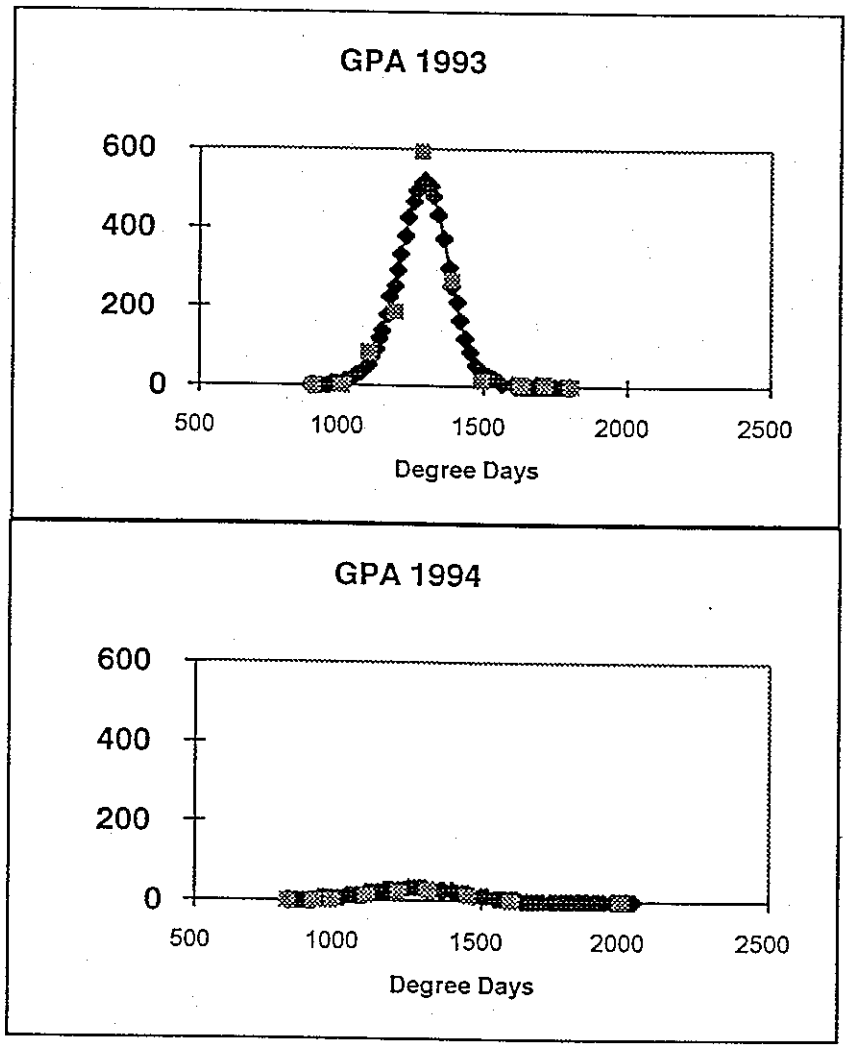
For example we know that GPA overwinter on peach trees, and can build large populations before emigrating from the peach tree (first peak in Fig. 1). These aphids do not carry virus, and move to many plant hosts during the early summer. Generally in July, there is a massive immigration to potato (second peak in Fig. 1). These aphids may carry virus, especially late in the immigration flight.

Figure 1. Densities of green peach aphids. The left peak occurs during spring when aphids are flying out of peach orchards. The right peak occurs during summer when aphids are flying into potato.



In the Washington Columbia Basin, weather patterns vary from year to year so that during mild summers, the total number of aphids that immigrate to potato is relatively low, but occurs over a longer period of time (bottom panel in Fig. 2) and the peak occurs slightly earlier in the season. During those years when a hot summer develops rapidly after a cold spring, many more aphids will fly, but the flight occurs as a short, intense peak of activity, later in the season (upper panel in Fig. 2). Sometimes, potatoes need protection from GPA for only a short time. During other years, aphids may keep flying into the fields for 3 or more weeks. Proper selection of materials, along with precise timing of application and excellent coverage are required to properly protect the potatoes from virus infection.

Figure 2. Variation in green peach aphid numbers between years. Aphids fly over longer periods of time, achieve lower overall densities, and peak earlier in some years, while in others overall densities are very high, with a sharply defined, later peak. Developmental Degree Days is a good predictor of when aphid flights will occur.



Insects other than vectors (beetles, wireworms, etc) can also be effectively managed by properly timing insecticide application timing and use of selective chemistry. However, because these organisms cause damage through their own feeding, and not through the transmission of a disease, plant resistance and biocontrols are more effective than they are for vectors.

However, remember that IPM deals with the entire pest complex, not just insects or weeds, and there are important interactions: pesticides kill biocontrol agents; weeds harbor plant pathogens; and insects carry disease.

The Pacific Northwest Potato IPM Program was initiated to advance the integration of pest control for all pest classes. The goals of the Potato IPM Program are to:

Maximize gains and minimize risks
Provide information and technology for making IPM decisions

Growers and processors have identified needs to meet these goals:

1) To know what IPM tools are available, and how to use them
2) To know what's limiting the maximization of economic yields now
3) On farm, integrated research and demonstration of IPM
4) Educated suppliers of pest control and crop management information

Fifty-seven tactics which advance IPM were identified by these and representatives of other, related industries, such as chemical sales and applicators. For example, among Preplant IPM Practices:

1. Crop rotation
2. Soil tests for nutrients, pH, etc
3. Soil tests for nematodes
4. Soil tests for other soilborne pests
5. Soil tests for herbicide or other chemicals
6. Grid sampling for precision applications
7. Plan fertilizer rates according to soil tests
8. Select herbicide based on expected weed pressure
9. Match irrigation system to soil type

were identifed (along with 48 additional elements of IPM throughout the production cycle).

This coming season an IPM Team consisting of Area Extension Agents, Growers, Banker, Chemical supplier, Crop consultant, Entomologist, Fertilizer/nutritionist, Horticulturist, Irrigation engineer, Nematologist, Plant pathologist, Processor, and Weed scientist will attempt to plan and implement an advanced IPM program on commercial potato acreage.

This effort, and the results obtained will be carefully documented and cost/benefit relationships analyzed. This is a major new step: large scale IPM demonstration on Washington potatoes.

Progress on this and other IPM Program Information, as well as pest alerts can be found on the Washington State University IPM Internet Site at http://IPM.wsu.edu