

## APHID MANAGEMENT IN CPB- AND PLRV-RESISTANT NEWLEAF PLUS RUSSET BURBANK POTATOES

by  
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### Introduction

Over 80% of insecticides in the Columbia Basin are targeted at two pests: green peach aphids, due to their ability to vector potato leafroll virus (PLRV), and Colorado potato beetles (CPB). Through the techniques of plant biotechnology, NatureMark has developed a Russet Burbank potato that is protected from both CPB and PLRV. These potatoes are expected to be available to the commercial potato industry in 1998, pending full federal approval.

Host-plant resistance to both CPB and PLRV can fundamentally change the management of potato insects, replacing most or all insecticides currently used in this crop. PLRV transmission is not a concern in NewLeaf Plus, since plants are protected from infection by the production of viral replicase. The nature of this resistance, coupled with a careful consideration of aphid biology, will allow growers and pest managers to alter aphid scouting and treatment programs significantly.

### PLRV resistance in NewLeaf Plus

NewLeaf Plus lines were selected for their ability to withstand challenge with viruliferous green peach aphids in repeated trials. Although these plants are not 100% immune, they are very highly resistant to the virus and demonstrate excellent protection under both artificial and natural inoculation.

In 1995, NewLeaf Plus and standard Russet Burbank potatoes were grown in Hermiston, OR in 55X55 ft blocks, replicated six times, and treated with various commercial insecticide regimes. At harvest, 100 tubers were collected from each plot and held in storage. Tubers were planted in the greenhouse in March. Visual PLRV symptoms were evaluated and confirmed with ELISA for each plot (Table 1).

Insecticide treatment	% Infection
Permethrin	63b
Temik	50b
Phorate	45b
Admire	24 ab
NewLeaf Plus, no insecticide	2 a

(Data from Gary Reed, Hermiston, OR, 1996)

This Presentation is part of the 1998 Proceedings of the Washington State Potato Conference and Trade Show.

All of the insecticide treatments provided good aphid control throughout the season, but none adequately protected the plants from infection with PLRV. However, NewLeaf Plus potatoes with no insecticide contained only 2% infection, representing superior control of this disease.

### **Aphid biology**

Green peach aphids overwinter on peach or apricot trees. After completing one cycle from egg to winged adult in early spring, they fly to alternate hosts, including potatoes. Here, they reproduce in a wingless form within the crop. These wingless aphids move readily from plant to plant, and are responsible for most of the PLRV spread within the field. Wingless aphids typically reach a population peak in late July, and subsequently disappear due to natural causes. In fall, remaining aphids develop wings in response to changing day length and declining food sources. Winged aphids then leave potatoes and fly back to overwintering hosts.

The certified seed program in North America ensures a reliable and clean supply of seed potatoes. However, most standard Russet Burbank seed lots contain at least a small amount of PLRV infected plants. For example, a seed lot with 0.1% PLRV will contain approximately 18 infected plants per acre, or 2,160 infected plants in a 120 acre pivot. These plants serve as the major source of inoculum within a field. As winged adults colonize infected plants, their wingless offspring readily acquire the virus and pass it along to adjacent plants.

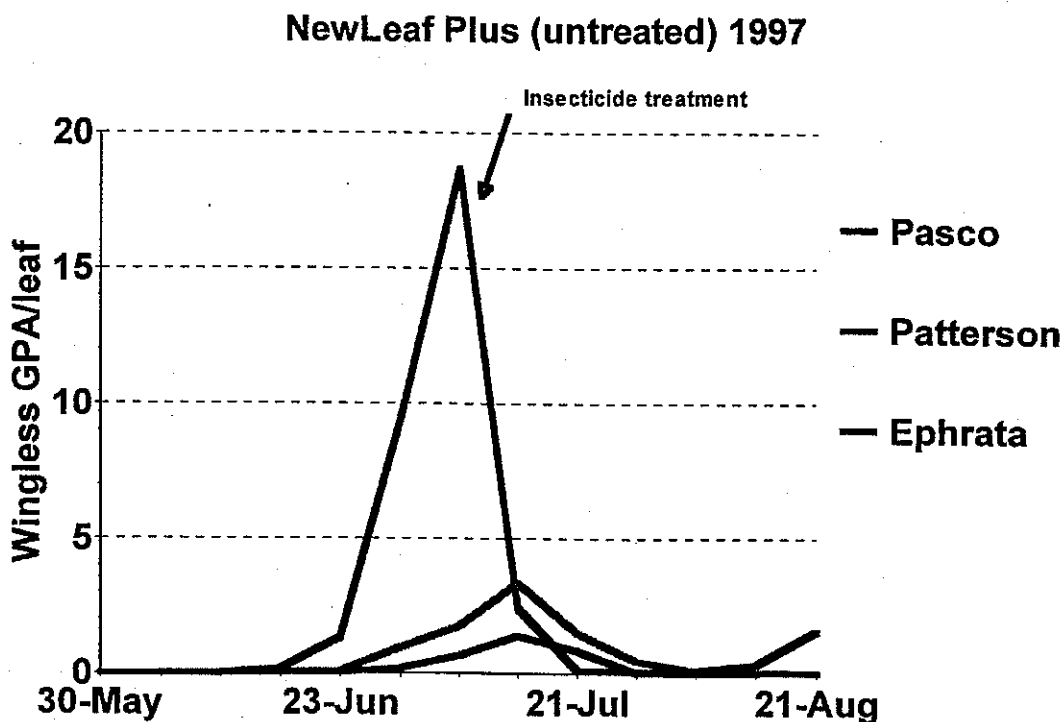
Because NewLeaf Plus potatoes are resistant to PLRV, they reach the commercial grower without the initial virus load that is typical of standard seed potatoes. In addition, if virus infected winged aphids enter the field and feed on NewLeaf Plus, the plants do not acquire or replicate the virus. Furthermore, since virus is not passed from adult to immature aphids, any aphids that are generated in NewLeaf Plus potatoes remain free of virus.

In the absence of PLRV, aphids pose a much reduced threat to potatoes, and insecticide programs can be modified. There are two primary considerations when managing aphids in NewLeaf Plus:

1. *Will aphids populations reach high enough levels to cause plant damage?* This is considered very unlikely in most cases. Potatoes can support substantial aphid populations without incurring damage or stress. When potatoes are not treated for insecticides, beneficial natural enemies are prevalent and may prevent aphids from reaching this level. In late July or early August in the Columbia Basin, aphids typically decline precipitously and remain low for the remainder of the year. Evidence that aphid populations may require treatment are signs of "honeydew" or sticky residue on the leaves. Further studies evaluating the effect of aphid populations on yield will be conducted in 1998.
2. *Will aphids move out of NewLeaf Plus and cause a threat to neighboring fields?* Aphids cannot move out of the field when they don't have wings. In most areas, aphids remain entirely in a wingless state in potato fields during the season, and movement is not a risk. However, the development of winged forms can result from excessive crowding which might occur under conditions of rapid population growth. Therefore, monitoring should focus on signs that aphids are increasing rapidly, and becoming crowded on the plants. Specifically, scout for the following changes:

- A. *Changes in aphid behavior.* Green peach aphids are most commonly found on the undersides of leaves, in the lower canopy. When they become crowded, aphids will begin to appear on the tops of leaves, and in the upper canopy. These aphids are easy to see, which simplifies scouting. Consider treating when aphids reach this point of crowding.
- B. *Development of wing pads.* Before aphids gain wings, the immatures develop triangular "wing pads" that appear like squared-off shoulders. If wing pads become evident, potatoes should be treated as soon as possible to prevent further development to winged forms.

Large research trials were conducted in 1997 commercial fields to address these issues in an effort to develop sound management recommendations. In 2 of 3 locations in WA, aphid populations never reached damaging populations and no insecticides were required. In one location, however, aphid population growth and subsequent crowding stimulated the development of winged forms, necessitating treatment with insecticides to prevent emigration to other fields (Figure 1). This was easily discerned from scouting, and all above cues made it evident that treatment was necessary.



**General Management Recommendations for NewLeaf Plus:**

1. *Do not apply systemic insecticides for beetle and aphid control.* Systemics lose efficacy by mid season when aphid populations are beginning to build. Since the plants are protected from Colorado potato beetles and virus infection, early season insect control is not necessary.

2. *Begin monitoring for aphid activity in late June.* Do not treat at the first sign of aphids, but monitor for signs of excessive population increase or behavioral changes, as discussed above.
3. *Treat only if behavioral or developmental cues indicate that control is necessary.* If treatment is warranted, apply an effective aphicide such as Monitor.
4. *Continue to monitor aphids throughout the season.* It is likely that aphid populations will decline naturally after mid-late July.
5. *Monitor for mites, loopers, and other occasional pests.* Mite outbreaks are often associated with previous insecticide usage. If you are not applying insecticides for aphids and beetles, the "natural enemies" in your crop will probably prevent mites from reaching damaging levels.