DO COLORADO POTATO BEETLES LIKE ALL POTATO PLANTS?

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Abstract

Adult beetles were marked and released on several potato varieties, including Nooksack, Russet Burbank, and Norkotah. Identities of adult beetles, and numbers of egg masses and larvae found on each row, were counted and recorded. The variety Nooksack seemed to be about four times more attractive to marked adult beetles than was Norkotah. More total egg masses were laid on Russet Burbank leaves than were laid on the other two varieties, but many more egg masses per adult beetle were laid on Norkotah. The hatch rates of egg masses varied from about 11 larvae each on Nooksack to less than 5 on Norkotah. This resulted in an overall effect of larval feeding that produced considerably less spuds on Nooksack and Russet Burbank than on Norkotah.

Text

I hope you all know that potato leaves are poisonous to humans, and quite a few other critters. The leaves contain chemical compounds, such as citrinoids, and few insects other than the Colorado potato beetle have adapted to feed on them. Plants utilize chemicals in a number of ways to survive feeding by herbivores. One way is to decrease the insect's feeding by killing them with poison. We entomologists call this "antibiosis". Another way is to taste so bad that the feeding is limited to short episodes, after which the insects move on to try a different plant. Entomologists refer to this as "antixenosis". Generally the insects don't lay many eggs on plants they don't like to eat, either, so antixenosis is reflected in what humans would call a lack of preference for the plant.

There are several responses that an insect can use to mitigate the effects of plant chemical compounds. For antibiotic chemicals, the insect may eat so fast that the chemical is flushed through the gut before it has a chance to poison the insect. Some sequester the chemicals in droplets or packets which prevent them from circulating throughout the body. And some insects detoxify the chemicals by attacking them with chemicals of their own. Detoxification is often an elective response, that is, the insect may not produce its own protective chemicals until challenged by the plant's defensive chemicals.

This Presentation is part of the Proceedings of the 1993 Washington State Potato Conference & Trade Fair.

Although potato beetles can feed on potato leaves, the amount of feeding done may be influenced by the amounts and kinds of chemicals in them. Yesterday, Dr. Mark Martin showed you a positive correlation between concentration of one of these compounds and feeding by the beetles. Some other common food crops with poisonous leaves are tomatoes and eggplant. Colorado potato beetles feed on these, too.

When we first began marking and tracking Colorado potato beetles, we found that most beetles don't move very far during their lifetime. Half of the beetles we recaptured in commercial stands of potato never moved more than 4 meters from where they were marked, and ninety percent stayed within 30 meters of where they were marked.

This behavior, coupled with the cooperation of Dr. Thornton and the physical layout of his seedlot trials, enabled us to begin study of beetle preferences for different potato varieties under controlled conditions in the field. We marked adult beetles so that each individual could be identified later, and released them on adjacent rows of various potato varieties. Each week, we recorded the identities of adult beetles found on each row, and counted egg masses and larvae as well. At the end of the trial we measured the weight of harvestable spuds in a fixed length of row to compare with beetle feeding pressure. We expected that adult beetles would move to the next row of potatoes if, for some reason, they didn't like the variety we released them on. We also expected they would lay their eggs on leaves of potato varieties that would be most suitable for development of their offspring. Finally, we expected that potato varieties that were most attractive to adult beetles would be fed on most heavily, reducing yields. Here's what we found.

If beetles tended to move onto a variety, then more beetles were found on that variety, and our "immigration index" (Fig. 1 CPB Immigration) was positive. If beetles tended to leave a variety, then our index was negative. In this trial, the variety Nooksack seemed to be about four times more attractive to marked adult beetles than was Norchip or Norkotah. To illustrate some of our ideas about measuring the interactions among beetles and potato varieties, we compare for you an attractive-to-beetles Nooksack, a not-so-attractive Norkotah, with an intermediate, the Russet Burbank.

First, note that more egg masses were laid on Russet Burbank (Fig. 2 CPB Fecundity) leaves than were laid on the other two varieties, but many more egg masses per adult beetle were laid on Norkotah. So although beetles seemed to be attracted to Nooksack, they didn't lay as many egg masses. The number of eggs per egg mass can vary, but the important thing to us is the number of hungry larvae that hatch from them. The relatively few egg masses laid on Nooksack produced about 11 larvae each (Fig. 3 CPB Hatch) compared to less than 5 on Norkotah. Again, Russet Burbank was intermediate in "hatchability".

These are average figures observed over several weeks' time. When total larval densities are shown (Fig. 4 CPB Larvae) during the trial, we see distinctly different patterns of feeding pressure developing on each variety.

On Russet Burbank populations developed to high levels early in the trial. On Nooksack, populations developed to high levels only late in the trial, while on Norkotah, larval population never reached high levels. The overall effect of larval feeding can be seen by adding up the numbers of larvae on a variety each day during the trial and comparing it to the number of pounds of harvestable potatoes at the end of the trial (Fig. 5 CPB Yield). Norkotah produced considerably more spuds than did Nooksack or Russet Burbank, probably because there was relatively little feeding by beetle larvae. Future work in potato IPM must include plant resistance to insects, especially tolerance to foliage feeding.

Figure 1. CPB Immigation Among Varieties '92

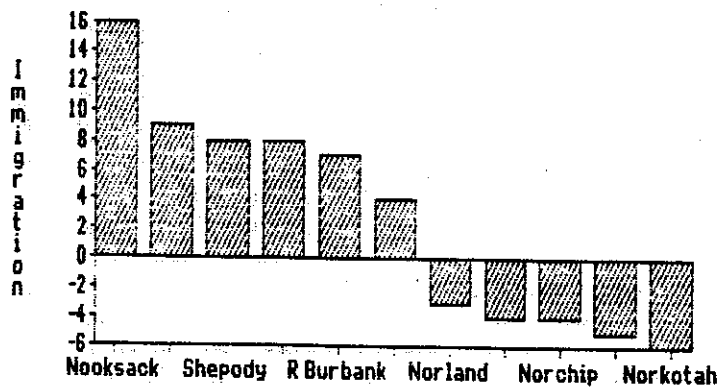

Figure 2. CPB Fecundity Among Varieties '92

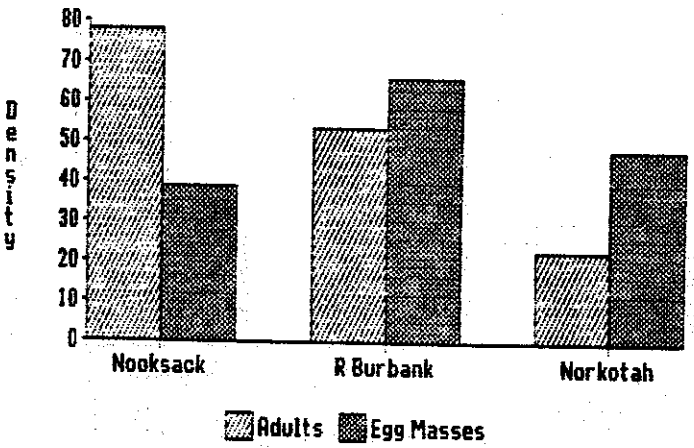

Figure 3. CPB Hatch Among Varieties '92

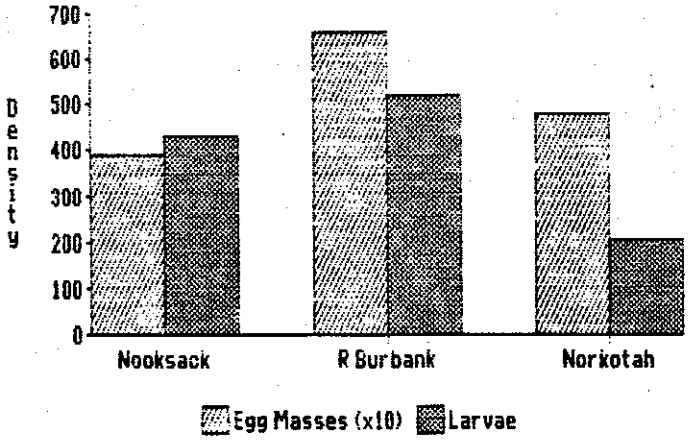

Figure 4. CPB Larvae Among Varieties '92

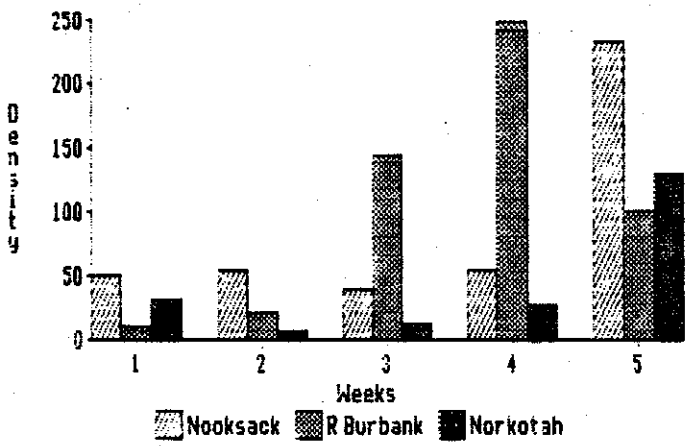

Figure 5. CPB Yield Among Varieties '92