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ECONOMIC ANALYSIS OF USING A BORDER TREATMENT FOR REDUCING ORGANOPHOSPHATE USE IN SEED POTATO PRODUCTION

by
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UNIVERSITY OF MINNESOTA

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Economic analysis of using a border treatment for reducing organophosphate use in seed potato production

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ABSTRACT

Recent research shows initial colonization of potato fields by winged green peach aphid is concentrated at field edges. This suggests that insecticides applied only to field margins during initial colonization would largely eliminate a colonizing aphid population, conserve natural enemies in the field center, and reduce insecticide use. To better understand the costs and benefits of reducing organophosphate use, the six participating growers were interviewed to ascertain their reason for participating and their satisfaction with the border only treatment method as well as their estimated net economic benefits. Five of the farms ranked cost reduction as the most important reason for participating. The sixth farm ranked reducing virus spread as the most important reason with cost reduction as their second most important reason. The average cost savings over all 28 participating fields of using the border treatment is estimated to be $23.85 per acre for the entire field—a 93% savings. Almost all the farmers found the border treatment method to be successful at aphid control. None of the farmers observed any impact on the physical yield of seed potato. All the fields were certified during the summer except for one of Farmer F's fields that was lost because of off type. In conclusion, the border treatment method seems likely to be adopted by many farmers since the potential cost saving is large and farmers dislike Monitor. However, some farmers may resist the method due to scouting requirements and costs. Also, farmers with fields that do not meet the uniformity requirements of the border treatment will not be successful in their use of the border method.

Economic analysis of using a border treatment for reducing organophosphate use in seed potato production[1]

Kent Olson, Thaddee Badibanga, Edward Radcliffe,
Matthew Carroll, Ian MacRae, David Ragsdale[2]

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Introduction

Potato production has an on-farm value in excess of $300 million in the Northern Great Plains. Survival of this industry is dependent upon availability of virus-free seed. The important virus diseases of potato, *Potato leafroll virus* (PLRV) and *Potato virus Y* (PVY) are aphid-transmitted. PLRV is transmitted almost exclusively by green peach aphid. PVY is transmitted by a number of aphids, but by far most important are green peach aphid and bird cherry-oat aphid.

When aphid flight activity or aphid infestation of their fields is detected, growers spray insecticide, usually methamidophos, a restricted-use organophosphate insecticide. The usual practice is to spray the whole field with methamidophos, which has the brand name of Monitor. Recent research by Robert Suranyi and Matthew Carroll from 2000 to 2002 shows initial colonization of potato fields by winged green peach aphid occurs in mid-summer and is concentrated at field edges. They found that for the first 10 days following initial detection, more than 90% of the aphids were within 20 meters of field margins. This suggests that insecticides applied only to field margins during initial colonization would largely eliminate a colonizing aphid population, conserve natural enemies in the field center, and reduce insecticide use on at least first application by 70-80%.

The larger entomological phase of the project included border treatment at participating farms, monitored aphid flight activity and infestations, and documented populations before and after treatment of the borders only in the project fields. The purpose of the study was to better understand the costs and benefits of reducing organophosphate use (specifically, Monitor) in seed potato production. This manuscript reports the economic analysis of the border treatment versus full field treatment and the participating growers satisfaction with the border treatment method and the likelihood they will adopt this approach to aphid pest management in their future operations.

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[1] This manuscript and analysis is part of a larger project, "Reducing organophosphate use in potato production" funded through the Food Quality Protection Act (FQPA, U.S. EPA) and administered by the American Farmland Trust.
[2] Olson and Badibanga are in the Department of Applied Economics; Radcliffe, Carroll, MacRae, and Ragsdale are in the Department of Entomology; University of Minnesota, St. Paul, Minnesota

Procedures

Seed potato farmers were invited to participate in the research project through announcements at farmer meetings and in appropriate publications. Through the summer of 2003, aphid flight activity was monitored as part of the *Aphid Alert* weekly advisory program. As soon as the trapping network detected a spike in green peach aphid activity, each field was sampled to confirm whether green peach colonization has occurred and how it is distributed within the field. The participating farmers were notified when colonization occurred, and Monitor was applied aerially to field margins adjoining fallow ground. The project paid for the aerial application, the Monitor, and associated costs. Following application, the fields were again sampled to determine treatment effectiveness and aphid distribution within the field. Subsequent pest management decisions and treatments were then left to the individual growers for the duration of the growing season.

Participating growers were interviewed (face-to-face) in early November, 2003, to ascertain their satisfaction with the border treatment method and the likelihood they will adopt this approach to aphid pest management in their future operations. The growers were asked a series of questions about their practices, expenses and yields related to the use of Monitor in traditional and alternative production methods, their perceptions of the efficacy of the alternative methods, and their farm. The interview form is attached at the end of this manuscript.

The participating farmers were interviewed again in March 2004 about their winter test results and their plans for using the border treatment method in 2004 and beyond.

Empirical Results

Six farms volunteered to participate in the border treatment project. These six farmers had considerable experience in both farming in general and in growing seed potatoes. They had been farming for an average of 32 years with a range from 9 to over 40 years. They had grown seed potatoes for an average of 17 years with a range from 4 years to over 40 years. Two of the farms currently grew potatoes commercially as well as producing seed potatoes; two had before but were not now; and two had never grown commercial potatoes.

All of the farms reported that seed potatoes were more than 50% of their total farm net income. Three of the farms has seed potatoes on 50% or less of their crop acres; three had more than half of their farm in seed potatoes. Other crops grown included wheat, barley, soybeans, sugar beets, and small grains. Only one farm reported having any livestock.

When asked why they were willing to participate in this project on border treatment of aphids, five of the farms ranked cost reduction as the most important reason. The sixth farm ranked reducing virus spread as the most important reason with cost reduction as their second most important reason. Extending the market life of Monitor

was tied with cost reduction for the most important reason for one farm and the second most important reason for another farm. Reducing the amount of active ingredient was ranked second by one farmer and third by two. The dislike of Monitor was ranked as the second most important reason for participating by two farms; third, by two farms and fourth by one farm.

Compared to other problems in seed potato production, the damage or potential damage from aphid infestations has been very important for five of the six farms and important for the sixth farm.

A total of 28 fields on the six farms were included in the final analysis of the project. These fields had an average size of 64 acres (Table 1). The border area averaged 3.4 acres per field or 5.3% of the whole field. All 28 fields had been scouted by University of Minnesota personnel and treated by local commercial applicators. The first treatment for aphids was on the field border using an application rate of 2 pints of Monitor per acre. At the time of application, the cost of Monitor was $83.64 per gallon. The cost of aerial application on field borders was negotiated for each farm based on acres in the border, number of fields treated, and distance from airfield. The resulting aerial application cost varied from $4.70 to an estimated $23.23 per border acre although these costs may be lower than commercially available due to favorable rates given a University research project. Using the Monitor cost and application rate and the aerial application costs for each farm, the resulting average cost of treating just the borders ranged from $1.29 to $2.87 per acre in the entire field (that is, not just the borders).

Table 1. Estimated cost savings due to using border treatment method in seed potato production

Farm	Average field size (acres)	Average border area per field (acres)	Average cost over entire field using border treatment ($/acre)	Estimated average cost of full field treatment ($/acre)	Estimated average cost savings ($/acre)
A	77.5	4.1	1.71	25.56	23.85
B	67.9	3.2	1.29	25.56	24.27
C	43.0	2.9	2.87	25.56	22.69
D	68.0	3.8	1.93	25.56	23.63
E	89.3	4.6	2.17	25.56	23.39
F	47.4	2.5	1.42	25.56	24.14
Average over all fields	64.4	3.4	1.71	25.56	23.85

To compare the costs of the border treatment method to a more conventional treatment method, the cost of the applying Monitor to the entire field was estimated using the same application rate of 2 pints of Monitor per acre, the same Monitor cost of $83.64

per gallon, and a commercial aerial application rate of $4.65 per acre. The resulting cost of treating for aphids with Monitor was $25.56 per acre over the entire field.

The average cost savings of using the border treatment is estimated to be $23.85 per acre for the entire field—average over all 28 fields. The range in cost savings for the farms range from $22.69 to $24.27 per acre for the entire field. The cost savings is calculated by subtracting the average cost per acre of the border treatment (averaged over the entire field) from the estimated cost per acre of treating the entire field.

Farmer Comments and Observations

After participating in the Border Treatment Project, farmers have commented on their experience with these new methods of controlling aphids. Their comments include the advantages and disadvantages of using the border treatment techniques as well as the obstacles in its application and its future. The following is the summary of their comments gathered in November 2003.

The participation in the border treatment of aphids has been a successful experience for almost all farmers. In fact, except for one of Farmer D's fields on which a full field Monitor was applied after a border treatment, all the farmers enjoyed a substantial cost reduction due to the border treatment techniques. None of the farmers observed any impact on the physical yield of seed potato. All the farmers said using these techniques did not change other practices for seed potatoes nor did they change the production practices for other crops. All the fields were certified during the summer except for one of Farmer F's fields that was lost because of off type.

The success of the border treatment techniques depended largely on the availability of information on aphid movements, weather factors, and the estimation of their arrival at the field. All the farmers used *Aphid Alert* and started scouting earlier than the estimated arrival of aphids at their fields.

Although the border treatment methods are effective in cost reduction, they were not applied on some fields due to some obstacles. However, all the farmers were aware of alternative methods for controlling aphids, the list of which includes Aphoil©, crop borders, and other insecticides such as Fulfill©, Platinum©, Baythroid©, Leverage©, and so on. They used these methods successfully or did not use them at all.

Farmers A, B, and E saw some mosaic infestations in their fields due to drown out acres on some of their fields. Additionally, Farmer B faced a requirement of perimeter spray treatment. To overcome these problems, Farmer A and E treated the drowned out areas as border crops, while Farmer B tried new sprayer technology. However, Farmer E lost one field due to off type.

Farmer D observed that some of his/her fields had irregular shapes, little hills, and drainage ditches. This farmer used the border treatment technique and found out later on that the ditches created many borders in one field for aphids to see. So aerial application

became complicated and the solution was to try an alternative application method, that is, a full field treatment of Monitor. Thus, this farmer incurred extra costs.

Farmer E faced other obstacles in addition to mosaic infestations. Fields were dispersed geographically so it was difficult to make a special mix for each field. To accommodate this problem, they strived to border spray all fields first and then go back and spray fungicide in a second application.

Despite the problems faced in using the border treatment methods, all the farmers are optimistic on the adoption of these methods by other farmers. They believe, in fact, that cost saving is large enough to encourage farmers to adopting these techniques; Farmer E believes all farmers will adopt this technique. Also, the dislike of Monitor may contribute to the adoption of these methods. The only thing to do according to the farmers is popularize these methods.

However, they think that some other farmer may not use these methods due to the increase in scouting requirements (time spent in a field, expertise, timing, and equipment) and costs. In addition to the scouting requirements, Farmer B believes that some farmers will not adopt these methods since they have never dealt with aphid problems before. For Farmer C who conditions the use of the border treatment methods to the winter test results, some farmers whose test fields fail winter test will not adopt these methods since they will become costly. For Farmer D, some small growers with irregular fields that require additional investment and farms with small fields will not find the border treatment techniques beneficial to them. For Farmer F, commercial growers will not adopt these methods since they have so many acres to worry about scouting and aphids.

Winter Test Results and Future Plans

In March 2004, the participating farmers reported mixed test results. Farmers D and F said the tests were, in general, no better or worse than other years and other farmers. Farmer E said the results were better than usual for their farm. Farmer B said that none of their fields fared well in winter test results but then they had barely made summer readings either. Farmer C said that although some tests had very good results, they had poorer results overall compared to other years. Farmers C and B mentioned that the aphid pressure was so high in 2003, they weren't surprised by the mixed test results. In addition, Farmer C thought his decision to not treat with Monitor at the time of defoliation might have allowed aphid and thus, virus infestation to occur. Farmer F also commented that they should be more diligent in aphid control up to and including vine kill. (Farmer A did not run a winter test due to all their seed potatoes being used commercially.)

All the farmers planned to use the border treatment in the future with 2 qualifications. Farmers A, C, E and F do definitely plan to use the border treatment as they used it in 2003. Farmer A described it as “very successful.” Farmer C said he believes in the fundamentals of the idea. Farmer E said it “worked well.” Farmer B said they were still debating whether to grow seed potatoes in 2004, if they did, they would

use the border method but probably by ground application. Farmer D qualified their future use to whether they develop a separate boom for ground application in order to deal with non-rectangular fields and holes in their fields. Farmers B and F said they would use the border method early in the season but then be ready to treat the whole field as the season progressed.

Concluding Comments

The potentially devastative effects of aphid infestation on the productivity and profitability of the seed potato industry have motivated growers to use the appropriate methods for controlling the pest. Among alternative methods, Monitor (methamidophos) has been the most widely used insecticide. Usually it is applied to the whole field as soon as aphid flight or aphid infestation of fields is detected. However, recent studies have shown that more than 90% of aphids are within 20 meters of field margins in the 10 days after their initial detection and that spraying insecticides to the field margins would eliminate the colonizing aphid population while reducing insecticide use by 70-80% and conserving natural enemies in the field center. These methods of controlling aphid have been called border treatment.

To determine the effectiveness of these new methods, six farmers participated in the University of Minnesota's Border Treatment Project in Summer 2003 and then interviewed in November of the same year on their experience with the project and the likelihood of the adoption of the methods by other farmers. In a follow-up interview in March 2004, the farmers were asked about their winter test results and their plans for using the border treatment method in the future.

Empirical results show substantial cost reduction for each farmer. In fact, the average cost savings ranges from $22.69 to $24.27 per acre for the entire field. Using border treatment did not change other production practices of seed potato or those of other crops.

However, some problems were encountered in using the border treatment. These methods were not applied successfully on some fields due to drowned out spots, fields with irregular shapes, and geographically dispersed fields. One farmer did incur additional costs since Monitor or other alternative methods needed to be applied after the failure of the border treatment. But this was an isolated case.

In conclusion, the border treatment method seems likely to be adopted by many farmers since the potential cost saving is large and farmers dislike Monitor. However, some farmers may resist the method due to scouting requirements and costs. Also, farmers with fields that do not meet the uniformity requirements of the border treatment will not be successful in their use of the border method.

Farmer Survey
AFT Potato Aphid Control Project

How many years have you been farming? _____

How many years have you been growing seed potatoes? _____

Have you or do you grow potatoes commercially? __ no ____ yes
If yes, how many years did you or have you been growing potatoes commercially? _____

How important are seed potatoes to your farm?
As a percent of total crop acres:

a. 1-9%	b. 10 - 25%	c. 26 – 50%
d. 51 – 75%	e. 76 – 99%	f. 100%

As a percent of total farm net income:

a. 1-9%	b. 10 - 25%	c. 26 – 50%
d. 51 – 75%	e. 76 – 99%	f. 100%

Besides potatoes, what other crops do you grow?

Do you have a livestock enterprise on your farm?
___ no
___ yes If yes, what species? _____

What created your interest in participating in this border treatment project?
Please rank as many of the following as you considered in your decision. Use 1 as the most important reason, 2 as the second, etc. (Rank only those you used in your decision.)
___ cost reduction
___ reduction in active ingredient used
___ extend market life of Monitor
___ dislike of using Monitor
___ other, please specify: _____

Compared to other problems in seed potato production, how damaging or potentially damaging have aphid infestations been on your farm?

a. Very important
b. Important
c. Equal to other problems
d. Somewhat important
e. Not important

Please answer the following questions for each field receiving the border treatment method.

Field:	1	2	3	4	5	6
Total acres in field						
Acres in border						
Monitor application rate on border (lb. a.i./acre)						
Other border treatments?						
Number of other, full field Monitor treatments						
Monitor application rate for the full field (lb. a.i./acre)						
What was the yield of seed potatoes?						

Field:	Other comments on each field, if any:
1	
2	
3	
4	
5	
6	

Overall comments on the fields:

Did using the border treatment method change other production practices in these fields for seed potatoes? ___ no ___ yes If yes, how did they change?

Describe how the fields receiving the border treatment compared to your fields that did not receive the border treatment?

Production practices:

Number of treatments and application rate of Monitor:

Yield:

Overall:

Did using the border treatment method for seed potatoes change your production practices for **other** crops? ___ no ____ yes

If yes, how did they change?

Describe what you think are obstacles to using the border treatment method on your farm?

Do you think other farmers **will adopt** this method? ___ no ___ yes If yes, why?

Do you think other farmers **will not adopt** this method? ___ no ___ yes If yes, why not?

Do you know of alternative products or methods to control aphids on seed potatoes?
__ no __ yes If yes, please describe them.

Did you use the information in *Aphid Alert* or other early scouting information?
__ no __ yes If yes, please describe how you used that information.

Other comments?

Thank you for your time and wisdom.