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AN ANALYSIS OF THE ACCEPTANCE OF IPM TECHNIQUES IN PROCESSED SWEET CORN

Joanne Waldorph
Gerald B. White

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York 14853

ABSTRACT

Previous studies of IPM techniques in New York State enlisted that processed sweet corn showed reduced number of sprays when fields were randomly sampled and sprayed only when necessary. Sweet corn processors have incorporated IPM techniques into their pest management programs because of the potential to reduce sprays; however, they have altered these techniques to insure effective control and to lower costs. Alteration of IPM techniques has resulted in increased costs for spray materials. Processors feel they can benefit more from ensured control than reduced sprays.

In the near future, pest management costs have the potential to double. Chemical costs may double, present equipment used in applications may be banned or restricted, and processors will have to contend with prior notification regulations. If costs do rise substantially, processors will have to look for other alternatives which are more cost effective. Acceptance of IPM techniques may become more popular as processors realize the benefits of reducing sprays.

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Introduction

Integrated Pest Management (IPM) techniques have been a part of pest management in processed sweet corn since the 1980's. In 1981, the IPM pilot program for sweet corn in New York State began to promote reduced pesticide usage in the environment and to lower costs without adversely affecting yields. The IPM techniques processors began using were economic thresholds, sampling of fields, keeping field records, and analyzing pest behavior.

According to the literature, IPM techniques of sampling and determining economic thresholds have reduced the number of sprays applied (Carlson, Shelton, White and Thompson). These reduced sprays were accomplished by sampling each field individually and only spraying when pest levels exceed economic thresholds. Sampling fields individually is not the type of sampling methods used by processors of sweet corn.

IPM techniques are not always used because processors are not convinced that benefits will outweigh time and money requirements. Sweet corn fields are sprayed by custom aerial applicators; therefore, processors need to schedule sprays ahead of time. Processors feel that timely sprays of fields would not be possible if processors wait to spray every area only when necessary. Fields are sprayed by area because spraying every field individually is impossible when pesticides are applied by air.

Fields are not sampled individually because processors feel that the labor cost is too high. Instead, sweet corn processors designate only one field in an area as the field from which they will take samples; this field is called the key field. Sampling pests by key fields are an effort by processors to lower yearly costs. Processors are not convinced that the benefits of sampling fields, as dictated in Shelton's article, will outweigh the costs. Processors feel that identification of key fields can ensure low costs while benefiting from sampling fields. The purpose of this analysis is to determine how effective processors have been in implementing IPM in sweet corn.

Methodology

The data for the analysis was collected from surveys sent to sweet corn processors in New York State (Appendix). Of the five sweet corn processors in New York State, three were selected by their willingness to participate. The analysis was designed to compare cost data from years previous to 1981, years when IPM was not used, to years following 1981 when IPM was being used. Unfortunately, the only data available were for years 1985-1987; therefore, results are compared to previous analyses which theorizes that proper IPM techniques would lower sprays per field and reduce pesticide costs (Shelton, White and Thompson). The information was analyzed by: (1) total pesticide

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[1]Research Support Specialist and Associate Professor, respectively; Department of Agricultural Economics, Cornell University, Ithaca, New York 14853-7801.
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costs, (2) average sprays per field, and (3) break-even analysis of the potential savings of sprays from sampling fields individually to the cost of each scout.

Pesticide cost information was summarized for each year from 1985-1987. The cost information collected was total pesticide costs, application costs, and scouting costs. Application costs were not always available so costs were estimated by average sprays per acre, total acreage, and an application cost of \$3.75 per acre[2]. These calculated costs were checked by comparing costs to those reported in the survey. The break-even analysis was included to examine how accurate processors are in assuming that potential benefits of sampling fields individually is outweighed by the costs.

<u>Intensive Scouting</u>

The break-even analysis was performed by estimating the potential savings for sampling fields individually and the cost of each scout. According to a three year study by Shelton, processors should be able to reduce sprays up to 30 percent if they sample fields individually and spray pests only when necessary.

This figure was utilized in an equation to determine the potential savings they may receive if they scout fields randomly instead of by key fields. The savings processors could receive were calculated by multiplying the number of fields by the average number of sprays to get total number of sprays. Total sprays are multiplied by 30 percent to get the number of sprays that should be reduced if producers sample fields randomly. The number of sprays reduced is multiplied by the cost per spray to equal the amount of money saved. The equation is:

$$(A*B)=C$$
$$(C*.30*D)=E$$

A=average sprays per field
B=number of fields
C=Total yearly sprays
D=Number of sprays avoided
E=Total Dollar Savings in Sprays

The value for E estimated above was compared by break-even analysis to the cost per scout. The equation is:

$$\frac{\text{Total Dollar Savings}}{\text{Total Dollar Cost of One Scout}} = \text{number of scouts}$$

Estimated scouting costs were based on a previous estimate by Shelton and the average per hour rates paid by processors. Scouting costs were calculated assuming that scouts would be paid \$5 per hour. Scouts day length was estimated as 10 hours per day with a length of employment of 60 days. It was assumed that scouts would be employed sixty days or 12 weeks excluding weekends. When multiplied together, each scout's salary cost the processor \$3000 a year. Transportation, equipment and other fringe benefits were assumed to cost \$1000 for a 12 week period. A range of scouting costs were included in the break-even analysis to compensate for underestimations of the cost of employing a scout and to look at the sensitivity of the break-even analysis to rising scouting costs.

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[2]The per acre cost of \$3.75 was obtained from personal communications with the processors.

The number of scouts calculated in the break-even analysis were compared to number of scouts processors would need in order to sample fields individually. It was assumed that a scout could cover 12 fields (approximately 200 acres) in one day or 60 fields in one week. Inexperienced scouts would probably not cover as many fields. In an effort to compensate for this, it was assumed that every field must be examined every week. This is not the case in an actual field situation; therefore, assuming all scouts will cover 60 fields in a week was considered a reasonable estimation.

Results and Discussion

The analysis indicated a trend towards higher pesticide costs. Increased costs is a direct result of; (1) increased pesticide costs, and/or (2) increased sprays per field. This result, which is contrary to what would be expected, occurred due to a change in product and a movement away from IPM techniques.

Increased Pesticide Costs

The total input cost for pesticides usage has increased since 1985. When data was summed by year, per acre costs for chemicals and applications increased by two to four dollars per acre (Table 1). The cause of this increase can be contributed almost exclusively to an increase in sprays per field (Table 2).

Comparing costs by per spray per acre resulted in application and chemical costs remaining the same (Table 3). Separating this calculation by processor gave similar results. The one exception was an increase of chemical costs between 1986 and 1987 for processor I when chemical costs increased $3 per acre. The increase in chemical cost is an indication of the type of pesticides used.

This change in 1987 pesticide costs indicated an increased usage of permethrin. The usage of permethrin has increased because it is one of the few insecticides available for European Corn Borer control. This insect is a chronic problem in processed sweet corn; therefore, most pesticide applications are for control of this pest. Pesticides recommended for use in European Corn Borer control are methyl parathion (Penncap-M), EPN, and permethrin (Pounce or Ambush). Processors are avoiding the use of methyl parathion because it is believed to be responsible for a large amount of bee kills in New York State (Nowodrodzki and Morse), and its use is prohibited when weeds, flowers, and sweet corn are in bloom or when sweet corn is tasseling and when bees are foraging heavily (Cornell).

Permethrin is a compound from the family of chemicals called pyrethroids. These compounds typically are less toxic and do not remain in the soil as long as EPN or methyl parathion; however, they are twice as expensive as EPN. Processors use pyrethroids since they are one of the few compounds approved for use on sweet corn.

EPN is the major pesticide used because of its low cost. Unfortunately, this compound will not be re-registered for use on sweet corn. With EPN unavailable, permethrin will be the major pesticide used in European Corn Borer control. In terms of costs, EPN costs $1-$2 per acre while permethrin costs $4-$9 per acre. The percentage of pesticide costs that will be affected from this increase cannot be estimated from the information available; however, permethrin costs over twice what EPN costs so the difference is a definite concern.

Table 1. Total Dollar Costs Broken Down Into Application and Chemical Costs

Year	Processor	Acres	Total	Application Total	Application Per Acre	Chemical Total	Chemical Per Acre	Total Per Acre
1985	I	2,800	$ 59,000	$ 28,000	$10	$ 31,000	$11	$21
	II	14,815	265,731	125,645	8	140,086	9	17
	III	6,000	97,000	60,000	10	37,000	6	16
	TOTAL	23,615	$421,731	$213,645	$ 9	$208,086	$ 9	$18
1986	I	3,000	$ 69,000	$ 29,000	$10	$ 40,000	$13	$23
	II	14,939	231,385	147,358	10	84,027	6	16
	III	6,000	159,000	77,000	13	82,000	14	27
	TOTAL	23,939	$459,385	$253,358	$11	$206,027	$ 9	$20
1987	I	3,500	$ 89,000	$ 30,000	$ 9	$ 59,000	$17	$26
	II	14,369	350,958	158,128	11	192,830	13	24
	III	6,000	114,000	62,000	10	52,000	9	19
	TOTAL	23,869	$553,958	$250,128	$12	$303,830	$13	$25

Table 2. Average Per Acre Cost For Applying Pesticides From Three Sweet Corn Processors

Year	Average Number of Sprays	Chemical	Application	Total Cost
		Dollars Per Acre		
1985	2.7	9	9	18
1986	3.0	9	11	20
1985	3.5	13	10	23

Table 3. Chemical and Application Costs by Per Spray/Acre

Year	Processor	Chemical Cost Per Spray/Acre	Application Cost Per Spray/Acre
1985	I	$3	$3
	II	3	4
	III	2	2
	Average	$3	$3
1986	I	$3	$4
	II	3	2
	III	4	4
	Average	$3	$3
1987	I	$3	$6
	II	4	3
	III	4	3
	Average	$3	$4

Increased Sprays

According to IPM principles, average number of spray applications should be decreased when fields are scouted individually (Shelton and White and Thompson). If these articles are true, why have applications increased? This occurrence could be explained by several reasons: (1) increased insect resistance, (2) imprecision of low economic thresholds (3) sampling of key fields and spraying by schedule, and (4) changes in the product marketed from cut corn to cob corn.

Although all of the reasons above may have had an affect on the results, the most likely explanation for increased sprays are (3) and (4). Pest resistance is always a concern because various pests have developed resistance to their specific pesticides (Dreistadt and Leahey). In terms of sweet corn, the major pest problem is European Corn Borer. Presently, this insect does not appear to display any type of resistance to pesticides; therefore, it is a reasonable assumption to eliminate this category. Imprecision of economic thresholds may be contributing to increased sprays. Fohner, White, and Schwager found that economic thresholds are valuable when pest densities are well above or well below the threshold. Nyrop et. al. supports this when he suggests that sampling and the usage of economic thresholds are not always the optimum alternative. Their is no evidence in sweet corn production to support claims of imprecision of economic thresholds but there is evidence to dispute it (Shelton).

Research by Shelton and others support the benefits of only spraying fields when necessary and sampling fields on an individual basis (Osteen et. al., Hall et. al., Carlson, and White and Thompson). Since processors sometimes spray on a scheduled basis and they sample areas by designating a key field, it would be a likely conclusion to assume that increased sprays are a direct relationship to the alteration of IPM techniques. This is most likely the reason average sprays per field increased between 1985 and 1986 (Table 2). Variability between years would be one explanation; however, increased sprays in 1987 suggests that processors are moving towards a lower commitment to IPM techniques. This implies that processors feel IPM is a more risk alternative.

The change in sprays per field between 1986 and 1987 can be attributed to a product change from cut corn to cob corn. Cob corn requires the ear to be almost damage free in comparison to cut corn. Cob corn is managed by sampling key fields for pest damage and then spraying fields on a schedule basis. This management method contributed to the $3 per acre average increase in pesticide costs from 1986 which did not appear as high.

Scouting

Processors hire a limited amount of scouts to sample fields. As stated in the introduction, processors feel they can reap higher profits by sampling key fields and minimizing the number of scouts hired than hiring a larger number of scouts and sampling fields on an individual basis. The break-even analysis explores this issue by comparing the expense of a spray to the expense of a scout.

Processors employ from 1 to 4 scouts per growing season (Table 4). These scouts have not maintained or lowered sprays for any of the processors over the last three years; instead sprays have increased. How many more scouts would processors have to hire in order to scout fields individually? Processors would have to hire between 2-12 more scouts depending on the amount of acreage contracted (Table 5). When averaged by processor, they could hire from 7-8 scouts.

Table 4. Potential Savings Per Acre And The Number of Scouts Required To Sample Every Field

Year	Processor	Scouts Employed	Scouts Required	Potential Savings Per Acre	Scout Cost Per Acre
1985	I	2	3	$6	$3.0
	II	3	15	5	0.8
	III	4	6	5	3.0
	Average	3	8	$5	$1.5*
1986	I	1	3	$7	$1.0
	II	3	15	5	0.8
	III	4	6	8	3.0
	Average	3	8	$6	$1.5
1987	I	0	3	$8	$0.0
	II	3	14	7	0.8
	III	4	6	6	3.0
	Average	3	8	$7	$1.5

*Average scout cost per acre was figured by average number of scouts multiplied by $4000 divided by average acreage.

Table 5. Analysis of Fixed Scouting Cost Compared to Cost of Yearly Spray For Three Processors

Year	Processor	Number of Scouts	Yearly Cost	Average Sprays	Number of Fields	Cost Per Spray Per Field
1985	I	2	$ 59,000	3.0	175	$112
	II	3	265,731	2.5	692	154
	III	4	97,000	3.0*	400	81
	Average	3	$140,577	2.7	422	$123
1986	I	2	$ 69,000	3.1	187	$119
	II	3	231,385	2.9	668	119
	III	4	159,000	3.1	400	128
	Average	3	$153,128	3.0	418	$122
1987	I	1	$ 89,000	2.9	217	$141
	II	3	350,958	3.9	568	158
	III	4	114,000	3.2	400	89
	Average	3	$184,653	3.5	395	$133

*Average sprays were estimated since this year's data were unavailable.

Comparing this to the results of the break-even analysis, processors could employ 13 scouts or, when broken down by processor, 3-24 scouts (Table 6). When cost per scout increases, the break-even number of scouts is still above scouts required to sample fields individually until cost per scout equals $6000. If cost per scout equals $6000 then processor I is close to having the correct number of scouts; however, the average number is still 4-6 scouts higher than the average number of scouts employed. This shows that the potential for savings per spray is high enough that variations in the cost per scout will not be higher than its benefits. When potential savings per acre is compared to the per acre cost of scouts hired, the potential savings is twice the per acre scout cost (Table 5).

Table 6. The Maximum Number of Scouts A Processor Could Hire At Various Costs Per Scout

Year	Processor	Cost Per Scout $4,000	Cost Per Scout $5,000	Cost Per Scout $6,000
		Number of Scouts		
1985	I	4	4	3
	II	19	16	13
	III	7	6	5
	Average	10	8	7
1986	I	5	4	3
	II	16	14	11
	III	11	10	10
	Average	11	9	8
1987	I	6	5	4
	II	24	21	17
	III	8	7	7
	Average	14	11	9

This per acre costs and the results of the break-even analysis suggest that number of scouts could be increased in an effort to lower number of applications. The fact that scouts employed averaged three and the break-even averaged 12 suggested that processors were not convinced that increased scouts would lower their inputs enough to have some impact on their costs.

Since sprays are more expensive than scouts, it seems logical that processors should consider spending the money to hire more scouts to reduce sprays than the reverse. When scouts employed are too few to cover all acres then acreage can not be effectively sampled. According to Shelton's analysis of sweet corn, sampling of key fields had higher sprays per acre than fields which were sampled individually. Processors may contain their costs by keeping number of scouts low; however, from this break-even analysis it appears that processors would have saved more money if they hired more scouts.

Future Conditions

Beside increased costs, increased sprays per acre, and limited usage of scouts, processors will have to deal with increased pressures of regulation. With recent findings of ground water contamination, the legislature is becoming more and more stringent on the use of pesticides (Barles and Kotas). Contamination of ground water has also sparked public concern about pesticide exposure which could greatly affect aerial sprays since they typically drift more than alternative methods (Allen). This is a growing concern for sweet corn processors since a large majority of sweet corn fields are close to residential areas where pesticide drift is an important concern.

These concerns may limit or even result in the banning of aerial applications permanently for fields near residential areas. This means processors will either have to buy equipment and apply pesticides themselves or use custom applicators. Pest resistance is a constant concern for pesticide usage. This is a strong argument in favor of fewer applications and lower rates (Leahey). Increased usage of sprays will compound the rising opposition to pesticide usage. This would in turn lead to more regulation and ultimately higher costs for the processor.

Processors are also facing higher pesticide costs. Since EPN is no longer available for use in sweet corn, processors will have to rely on permethrin. The increased usage of permethrin will raise pesticide costs higher than what was reported in 1985 to 1987. Increased pesticide costs will make the problem of increasing sprays per acre a costly one.

Summary

Even though processors have, to a certain extent, adopted IPM techniques, their spray costs per acre are increasing. Costs are increasing due to increased sprays per acre. Increased sprays seem to occur due to the sampling of key fields and spraying fields on a scheduled basis and the production of cob corn instead of cut corn. Both of these situations result in pest control decisions being made on a very limited amount of information.

A limited amount of information would seem logical since processors hire a limited number of scouts. This low number of scouts employed by processors would not cover the acreage contracted which reduces the processors ability to spray fields as needed. From the break-even analysis it would seem that processors would benefit more from reducing sprays than limiting the number of scouts. This suggests that processors are not convinced that IPM techniques will reduce sprays per acre.

Processors may feel that their methods are cost effective; however, the potential of reducing sprays would suggest otherwise. The cost of a spray is much greater than the reduction of a few scouts. From the data it appears that increasing sprays should be a concern; however, cost control and insurance against damage was the issue for the processors instead of profits. Processors should be aware that this approach will undoubtedly prove costly in the future.

Processors realize that conditions are worsening for pest control in sweet corn. Prior notification, increasing chemical costs, and potential elimination of aerial applicators in certain areas could double the present cost of pest control. With an environment conducive to increased spray costs and stable labor costs; processors will most likely shift their concentration from low labor costs and insured control to reducing sprays per acre. Processors so far have not completely accepted IPM techniques, but the future supports processors looking for alternative methods. Since IPM has the potential to reduce sprays per acre, processors should look towards these techniques as a method to deal with increasing costs.

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APPENDIX

QUESTIONNAIRE

This questionnaire is designed to obtain information about content and availability of sweet corn producer's data concerning pesticide usage and the effects IPM principles have had on those practices. This information is only for analysis purposes and will be kept strictly confidential. Results will be expressed on a per acre basis so that individual firms cannot be identified.

Name of Business ______________________________

Address ______________________________

____

A. Years of Data

Please check the years for which your company has records of total dollar cost of pesticide used and spray programs.

___1981 ___1982 ___1983 ___1984 ___1985 ___1986

B. IPM Methods

Do you use any IPM practices on your fields?

___yes ___no

If yes, what year did you start using these practices? 19____

Please check the IPM methods listed below that your company uses on your contracted sweet corn fields.

____ scouting

If yes, check at what level or levels do you scout by?

____ field-by-field

____ grower

____ area (several growers)

____ thresholds

____ Other (specify) ______________________________

If you checked scouting above, please answer the following questions.

1. How many scouts does your company employ? __________

2. Who trains these scouts? ______________________________

3. Please check the highest educational level completed by most scouts hired by your company.

    ____ high school
    ____ college
        ____ freshman
        ____ sophomore
        ____ junior
        ____ senior
    ____ masters

What type of insect problems do you generally have on your sweet corn fields?

____

____

What type of weed problems do you generally have on your sweet corn fields?

____

____

What type of disease problems do you generally have on your sweet corn fields?

____

____

For the insects listed above, please list the threshold levels you follow when deciding to spray a field? (Answer this question only if you spray by threshold levels.)

____

____

____

Please check all of the impacts listed below that you feel your company has experienced using IPM practices:

____ reduced sprays
____ increased yields
____ increased crop quality
____ more detailed records
____ better distribution of sprays (spray fields only as needed)
____ increased public understanding of pesticide usage
____ other (specify)____

C. Type of Data

Does your company keep records on a field-by-field basis or on a grower basis?

____ field-by-field
____ grower

Please check all of the items listed below that your company has on record?

____ total amount of applications per field or per grower (circle either one)

____ rates of pesticide applied

____ type of pesticides applied

____ yields for each field or each grower (circle either one)

____ crop quality rating (trying to place a figure on improvement in crop quality)

D. Contents of Data

What is the total overall acreage contracted for sweet corn for each year starting with year checked in question A?

__________1981 __________1982 __________1983 __________1984

__________1985 __________1986 __________1987

How many fields were contracted for each acreage total listed above?

__________1981 __________1982 __________1983 __________1984

__________1985 __________1986 __________1987

How many producers contracted for sweet corn for each year starting with year checked in questions A?

__________1981 __________1982 __________1983 __________1984

__________1985 __________1986 __________1987

What is the total dollar amount spent on pesticides purchased for use in each year beginning with year checked in question A?

$__________1981 $__________1982 $__________1983 $__________1984

$__________1985 $__________1986 $__________1987

E. Comments

1. How do you think IPM has been beneficial to your company?

____

____

____

____

2. What types of problems have you encountered using IPM?

____

____

____

____

3. If IPM has improved crop quality do you have any type of rating or measure that could be used in order to quantify improvements in yield?

____yes ____no

If yes, please explain type and how measured.

____

____

____

Please write any other comments you would like to add below.

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