Pesticides

V.C. Mimeo 287
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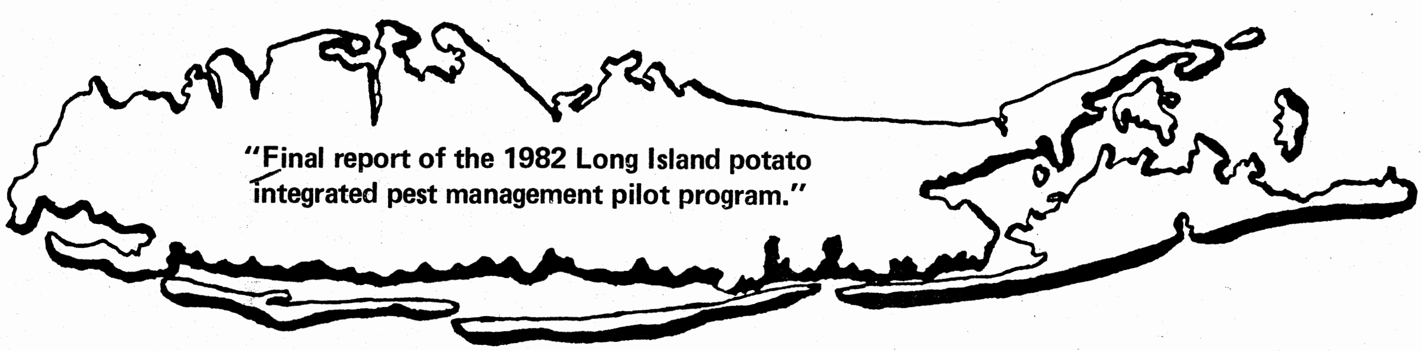
[Cornell University]

Dept. of Vegetable Crops
L.I. Horticultural Research Lab
Riverhead, New York 11901

"Final report of the 1982 Long Island potato integrated pest management pilot program."



R.J. Wright, R. Loria, J.B. Sieczka and D.D. Moyer

"Final report of the 1982 Long Island potato integrated pest management pilot program."

Long Island Horticultural Research Laboratory
Cornell University

R. J. Wright	Dept. of Entomology
R. Loria	Dept. of Plant Pathology
J. B. Sieczka	Dept. of Vegetable Crops
D. D. Moyer	Suffolk County Cooperative Extension

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I. INTRODUCTION

A pilot potato IPM program was initiated in Suffolk County with funds provided by the Cornell University Pest Management Steering Committee in June 1981. The major emphasis of the 1981 program was to obtain information on monitoring and management of the Colorado potato beetle (CPB), which is currently the major limiting factor in potato production in Suffolk County. Because of the great difference in growing conditions and pest problems, the Long Island program could not adopt many of the procedures of the Upstate potato IPM program without major modifications. Unfortunately, there is not yet an adequate research data base on the CPB and other pests under Long Island conditions for development of a total management program. Therefore, the L. I. potato IPM program is seeking to develop and refine procedures, while at the same time provide cooperating growers with the best available knowledge on potato pest management.

The results of the 1981 program provided useful information that allowed us to further focus and improve the 1982 program. For example, CPB sampling was greatly streamlined without sacrificing accuracy and tentative CPB action thresholds, based on 1981 IPM data, were provided to growers. Aphid sampling techniques and action thresholds were adopted from the Upstate potato IPM program and used in 1982. *Pratylenchus penetrans*, the root lesion nematode (RLN), was identified as an important pest in commercial fields, especially those on the South Fork of Long Island, during the 1981 program.

The 1982 program was funded by the Cornell University Office of Research. With these funds two pest management scouts, both Cornell University undergraduates, were hired and transporation for their travel provided. The two scouts sampled 12 fields on a weekly basis for pests and crop development. Cooperating growers were on both the North and South Forks of Long Island.

In addition to the weekly monitoring of pests, further information was collected on the effect of crop rotation with rye on two potato pests, CPB and the root lesion nematode. Four comparisons were made between rotated and non-rotated potato fields to quantify the effects on these pests.

Weed populations were monitored in a study to evaluate post-emergence applications of Lexone/Sencor for weed control under standard and reduced cultivation practices. Four growers participated in this demonstration.

II. PROCEDURES

1. Field characteristics: Eight of the 12 fields were part of the crop rotation study. Four growers, two each on the North and South Forks, were cooperators. Two fields on each farm were chosen for the study. One had been in potatoes in 1981 and was planted to potatoes in 1982. The other was in rye grown to seed in 1981 and planted to potatoes in 1982. Pairs of fields to be compared were selected to minimize differences in soil conditions as much as possible. The two fields were various distances apart from each other or from nearby potato fields (from adjacent up to a mile apart). All eight fields were in Superiors in 1982.

Of the 4 other fields in the 1982 program, 3 were Katahdin, grown on the North Fork and the fourth was Superior grown on the South Fork. At the start of the program, additional information was collected from all fields on cultural practices (e.g. planting date, fertilization, seed spacing), herbicide usage, field size and cropping history.

2. Field scouting: An approximately 10 acre section of each of the 12 fields was monitored weekly by two scouts, working as a team. Scouts did not enter fields until 48 hours after insecticide applications. Fields were scouted most intensively for CPB but were also monitored for aphids, other insects, diseases and weeds.

10 x 12 120

80

CPB were sampled at 20 sites per field; at each site 4 vines were carefully examined and all above-ground CPB life stages were counted. Larvae were characterized as small (1st and 2nd instars) or large (3rd and 4th instars). Scouts followed a zig-zag pattern through the field and sample sites and vines were chosen randomly. Defoliation was rated at each site on a scale from 0-5 (see Appendix 1).

Beginning June 21, aphids were sampled using the procedures of the Upstate potato IPM program (aphids were counted on 40 leaves/field; 4 leaves were chosen at each of 10 sites).

Diseases observed while scouting were noted and their incidence was rated qualitatively (light, moderate, heavy). Samples of questionable disorders were brought back to LIHRL for identification. Root and soil samples were taken from each field at least once during the growing season and populations of the RLN were determined. Fields in the rotation study were sampled twice. Five samples of both roots and soil were collected from each field; each sample was a composite of 10 subsamples. Root samples were processed immediately after collection using the shaker technique and soil samples were stored at 5° C for up to 4 weeks before being analyzed using a modified Baerman funnel procedure.

Because of the risk of spreading the golden nematode from field to field during scouting, strict sanitary procedures were necessary. Scouts carried brushes and containers of water to clean nematode sampling equipment and shoes upon leaving fields. Disposable plastic boots were worn over shoes when fields were wet. The pest management car was kept off farm roads when possible and was cleaned frequently. All soil and root samples were placed in containers before leaving the field.

3. Environmental monitoring: Hygrothermographs and rain gauges were placed near two of the fields in the program (1 each on the North and South Forks) to obtain data for calculation of late blight infection periods. A Blitecaster[R] (environmental monitoring station and microprocessor) was placed near one additional field on the South Fork and another was set up at LIHRL. However, the widespread occurrence of blight in Long Island potato fields necessitated the maintenance of a 5-7 day spray schedule throughout most of the growing season.

4. Grower practices: Growers were asked to record the date and type of each pesticide application on forms kept in a location convenient for the grower. Information on tillage and irrigation practices was also requested. Scouts collected these forms as they were completed and provided new ones.

5. Information delivery: Standard forms (Fig. 1) were completed by the scouts after each sampling visit and left on a clipboard in a convenient location. These forms were in triplicate; one copy was left for the grower, one copy was forwarded to the county agent-potato specialist (Dale Moyer), and one copy was retained for our files. Infestations of CPB were classed as low, medium or high and recommendations of whether or not to spray insecticides were made. CPB action thresholds were based on densities of adults, small and large larvae, considered separately (see Appendix 1).

These levels were based mainly on data from the 1981 LI potato IPM program. The relationship between defoliation levels and CPB numbers was analyzed for CPB adults and larvae. The thresholds were chosen so that CPB would be controlled by insecticides before defoliation of 20% or greater occurred. Although sensitivity of potatoes to defoliation has been shown to vary with varieties and plant growth stage, in most cases defoliation below 20% causes minimal yield loss.

Thresholds were set up separately for different CPB life stages. Small larvae are easiest to control with insecticides and are subject to a variable amount of mortality in the field from weather and a few biotic causes. Fewer large larvae can be tolerated because over three-quarters of all foliage consumed by larvae occurs in the fourth instar and they are harder to control with insecticides. Adult thresholds are low as adults consume approximately as much foliage per day as a fourth instar larva and they produce the eggs for the next larval generation.

The grower report also contained information on defoliation levels, aphid densities and suggested action thresholds (from Upstate potato IPM program, see Appendix 1) and provided space for observations on other insects, diseases or weed problems noted.

Scouts consulted with growers, if available, concerning interpretation of reports and observations made in the field. Scouts made no specific recommendations concerning pesticide application.

Summarized CPB population data, other pest occurrences and timely management suggestions were included in the weekly Suffolk County Cooperative Extension Newsletter that is distributed to commercial growers and the agri-business community.

6. Weed study: Weeds were sampled every other week in the demonstrations of post-emergence applications of Lexone/Sencor. Weed ratings began the last week of June. Eight plots (each 25 feet by 2 rows) were set up in each treatment. Grass and broadleaf weeds and nutsedge were rated separately on a 0-4 scale (see Appendix 1). Predominant grass and broadleaf species were identified on each sampling date. Final ratings were made after vine-kill (late Sept.) to determine the effect of the treatments on weed populations at harvest, when their presence would interfere with harvest efficiency.

III. RESULTS

1. Crop rotation study: Adult CPB were sampled by LIHRL Entomology personnel in mid-May (after a majority of CPB had emerged from the ground, but before growers applied foliar insecticides). In three of four comparisons, the non-rotated field had significantly greater numbers of CPB than the rotated field (Table 1). The farm with no significant differences between the 2 fields had a different field in the 1981 program. Based on this grower's 1981 spray practices, it is probable that these 2 fields had low CPB numbers all season long in 1981 due to routine weekly insecticide sprays. This would account for the low CPB density in the non-rotated field on that farm.

The effect of crop rotation was also apparent in the number of larvae produced by the overwintered adults (Table 2). On the 3 farms where crop rotation caused a significant reduction in adult numbers, there also was a significantly reduced population peak of first generation larvae, as well as reduced defoliation at that time. These differences in larval numbers occurred despite the fact that the 3 growers treated each of their 2 fields essentially the same with regard to insecticide sprays (i.e. materials used and numbers and timing of sprays). By the end of June, there were no observable differences in CPB numbers or damage between the rotated and non-rotated fields.

Based on the above data and a knowledge of CPB population dynamics, we estimate that if the fields had been sprayed only as needed for CPB control, ca. 2-4 insecticide sprays could be saved with the use of a crop rotation of 1 year out of potatoes.

2. CPB action thresholds: Action thresholds were utilized in making recommendations to growers for CPB control. Threshold levels were based on data from the 1981 L. I. potato IPM program and are presented in Appendix 1.

Modifications were made to the thresholds after July 15 for the following reasons:

a). Results up to that date suggested that somewhat higher CPB levels could be tolerated without increased damage.

b). All plants scouted were in post-tuber initiation growth phase and a large amount of research demonstrates decreased sensitivity of tuber yield to defoliation at this time.

Generally, there were positive comments from participating growers about the usefulness of the CPB action thresholds. Although growers generally did not follow recommendations for CPB control during the first CPB generation (May-June) (see "Crop rotation study", above), by July, during the second CPB generation, the thresholds were followed well by many growers. These thresholds are conservative and if followed more closely by growers would not lead to intolerable levels of damage.

Some potential changes for the thresholds based on 1982 experiences would be:

a). Revise thresholds to include additive effects of moderate levels of two or more stages, none of which exceeds the thresholds by themselves.

b). Based on observations made early in the season (before CPB egg hatch) a threshold level of 1-2 adults per plant appears to be a good guideline for early season insecticide sprays. Fields or any field portion reaching this level prior to CPB egg hatch would probably justify an insecticide spray. Fields with lower CPB levels should be sprayed when peak CPB egg hatch occurs.

3. Information delivery: The grower report form (Fig. 1) was straightforward and easily understood by growers. One problem noted in 1982 was that there was some confusion over what the "medium" CPB infestation level meant. In the future, the recommended action ("no spray needed this week") should be the same for low and medium CPB infestations. The medium category would serve to warn that CPB populations are increasing.

4. Insecticide usage: The combination of Pydrin[R] - piperonyl butoxide (PBO) was the most frequently used insecticide for CPB control in 1982 among cooperating growers (Table 3); 41.3% of all insecticide applications were Pydrin-PBO, another 6.7% were Pydrin-PBO in combination with either Vydate[R] or Thiodan[R]. This is in sharp contrast to 1981 when only 1.7% of all insecticide sprays were Pydrin and 8.3% were Pydrin in combination with either Vydate or Vydate-Thiodan sprays (Appendix 2). In 1982, Thiodan or Vydate-Thiodan applications were the other major treatments used for CPB control. Pydrin-PBO was used almost exclusively during May and June and provided good control of CPB. Growers switched to other less effective treatments (i.e. Thiodan and Vydate-Thiodan) in July and August due to the decreased activity of Pydrin at temperatures above 80 F.

5. CPB sampling: Sampling methods for CPB were streamlined in 1982 and required much less time than in 1981, while sampling as many sites per field. Using 1982 sampling methods more growers and increased acreage could be sampled in 1983.

Data taken by the scouts is being analyzed to determine the optimum number of sites per field and number of vines per site to be sampled, to optimize sampling effort and precision. These data may also be used to construct a fixed sample size or sequential sampling plan for CPB.

6. Other insect pests: Aphids were the only other potato insect pests noted. The potato aphid was the predominant species seen. Although no fields

had levels of aphids requiring treatment (according to action thresholds), one grower applied Monitor[R] to two fields for aphid control.

7. Fungicide usage: The composition of fungicides sprayed for potato blight control in 1982 was very similar to those used in 1981 (Table 4 and Appendix 2). In 1982, Dithane M-45 accounted for 51.8% of all fungicide sprays. The average number of sprays applied per field was higher in 1982 than in 1981 (9.0 vs 7.3). This reflects greater concern by growers about late blight in 1982.

8. Root lesion nematode: During the 1981 program we found that populations of RLN were higher in South Fork potato fields than in those on the North Fork. Differences in rotational practices in these two potato production areas were thought to be responsible; frequent rotation of potatoes with rye is much more common on the South Fork than on the North Fork and rye is known to be an excellent host for RLN.

To test this hypothesis, pairs of rotated and non-rotated fields in both production areas were monitored for nematodes during 1982. The data, presented in Table 5, shows that field location had a greater effect on populations of RLN than did rotational history; much higher nematode populations were found in South Fork fields. Though rotation with rye did increase the populations in both production areas, the increases on the North Fork are not thought to be large enough to account for generally higher populations on the South Fork.

The data suggest that other edaphic factors may be responsible for the relatively high South Fork populations. Soil moisture, temperature, organic matter and pH could all be instrumental in influencing nematode populations on the North and South Forks.

Four other commercial potato fields (three Katahdin and one Superior) were sampled for nematodes as a part of the 1982 IPM program. All of the fields had been planted to potatoes during 1981. Nematodes in roots and soil from these fields were evaluted during June. The data (Table 6) show that nematode populations in the Katahdin fields on both the North and South Forks were below the detectable level at the time of sampling. The Superior field, located on the South Fork, had moderate populations, similar to those found in non-rotated Superior fields on the South Fork in the previous study (Table 5). It is likely that uniformly low populations in the late-planted Katahdin field were due to the unseasonable cool weather in spring, which resulted in little nematode development and reproduction before nematode samples were taken.

8. Weed study: Post-emergence applications of Lexone/Sencor at low rates were demonstrated to provide better control of weeds over the whole season than the standard grower practices. Reduced cultivation after Lexone/Sencor application was less effective than standard cultivation practices with Lexone/Sencor under 1982 weather conditions.

Table 1. Effect of crop rotation on early season CPB populations in commercial potato fields, Long Island, 1982.

Farm	Date	No. CPB adults/10 row-ft Field Type[1/] R	NR
A	5-19	0.15	3.1**[2/]
B	5-19	0.04	1.6**
C	5-18	0.28	0.32 (NS)
D	5-21	0.23	4.4**
E	5-20	-	3.3
F	5-20	-	8.1
G	5-20	-	11.5

1/ R = rotated one year out of potatoes.

NR = non-rotated potato field.

2/ Pair significantly different ($p < 0.01$) according to two-tailed "t" test.

Table 2. Effect of crop rotation on peak first generation larval CPB numbers and damage ratings in commercial potato fields, Long Island, 1982.

Farm	Field Type	Date	No. CPB larvae per 4 stems	Average damage rating
A1/	NR1/	6-17	11.05**2/	0.45 2/
	R	6-17	4.0	0.05
B	NR	6-16	13.6**	0.95
	R	6-25	2.6	0.20
D	NR	6-3	4.8*	0.80
	R	6-3	0.2	0.55

1/ Farm and field type abbreviations are as in Table 1.

2/ Pair significantly different according to two-tailed "t" test; ** = $p < 0.01$, * = $p < 0.05$, NS = $p > 0.05$.

Damage ratings are explained in Appendix 1.

Table 3. Insecticide usage on 12 Long Island commercial potato fields, 1982.

Insecticide	No. of Applications	% of all Applications
Pydrin - PBO	31	41.3
Thiodan	17	22.7
Vydate - Thiodan	8	10.6
Sevin	6	8.0
Pydrin - PBO - Thiodan	3	4.0
Thiodan - Parathion	3	4.0
Pydrin - PBO - Vydate	2	2.7
Vydate	2	2.7
Monitor*	2	2.7
Vydate-Thiodan-Parathion	1	1.3
	75	100.0

*applied for potato aphid control.

Table 4. Fungicide usage on 12 Long Island commercial potato fields, 1982.

Fungicide	No. of Applications	% of all Applications
Dithane M-45	56	51.8
Polyram	35	32.4
Bravo	9	8.3
Manex	6	5.6
Du-Ter	2	1.9
	108	100.0

Table 5. Populations of Pratylenchus penetrans in pairs of rotated and non-rotated commercial potato fields during 1982. All rotated fields were planted to a grain crop which was grown to maturity during 1981.

Grower & Field Type	Variety	Location	Sample	Nematode Populations Roots (1g) 6/82	Roots (1g) 7/82	Soil (100cc) 6/82	Soil (100cc) 7/82
A Rotated	Superior	North Fork	1	0.0	20.0	0.0	4.0
			2	2.4	8.0	0.0	8.0
			3	1.6	12.8	0.0	4.0
			4	0.0	24.0	0.0	0.0
			5	0.0	42.4	0.0	12.0
			$\overline{X}$	1.0	21.4	0.0	5.6
Non-rotated	Superior	North Fork	1	0.0	12.0	0.0	0.0
			2	0.0	2.4	0.0	0.0
			3	0.0	20.8	4.0	0.0
			4	0.8	8.0	0.0	0.0
			5	0.8	4.8	0.0	4.0
			$\overline{X}$	0.3	9.6	0.8	0.8
B Rotated	Superior	North Fork	1	20.8	0.0	0.0	0.0
			2	21.6	40.0	0.0	0.0
			3	23.2	4.8	0.0	0.0
			4	16.0	0.8	0.0	0.0
			5	0.0	0.0	0.0	4.0
			$\overline{X}$	16.3	9.1	0.0	0.8
Non-rotated	Superior	North Fork	1	0.8	133.6	0.0	0.0
			2	0.0	75.2	0.0	0.0
			3	0.8	28.8	0.0	0.0
			4	7.2	14.4	0.0	0.0
			5	0.0	6.4	0.0	0.0
			$\overline{X}$	1.8	51.7	0.0	0.0
C Rotated	Superior	South Fork	1	32.8	94.4	88.0	12.0
			2	54.4	122.4	196.0	20.0
			3	106.4	76.8	116.0	0.0
			4	76.0	63.2	36.0	0.0
			5	94.4	28.0	100.0	4.0
			$\overline{X}$	72.8	77.0	107.2	7.2

Table 5. (continued)

Grower & Field Type	Variety	Location	Sample	Nematode Populations			
				Roots (1g)		Soil (100cc)	
				6/82	7/82	6/82	7/82
C Nonrotated	Superior	South Fork	1	20.0	65.6	60.0	4.0
			2	16.8	36.8	52.0	8.0
			3	2.4	25.6	36.0	8.0
			4	12.0	90.4	60.0	0.0
			5	12.0	23.2	100.0	4.0
			$\overline{X}$	12.6	48.3	61.6	4.8
D Rotated	Superior	South Fork	1	40.8	120.8	16.0	4.0
			2	32.8	212.8	32.0	4.0
			3	43.2	309.6	28.0	32.0
			4	52.0	448.8	16.0	32.0
			5	24.8	228.8	32.0	4.0
			$\overline{X}$	38.7	264.2	24.8	15.2
Nonrotated	Superior	South Fork	1	53.6	262.4	64.0	12.0
			2	18.4	40.8	60.0	12.0
			3	20.0	44.8	12.0	4.0
			4	19.2	128.0	12.0	8.0
			5	28.8	67.2	8.0	20.0
			$\overline{X}$	28.0	108.6	31.2	11.2

Table 6. Pratylenchus penetrans populations in four commercial potato fields. Root and soil samples were taken during June 1982. All fields were planted to potatoes during 1981.

Grower	Variety	Location	Sample No.	Nematodes Roots (1g)	Nematodes Soil (100cc)
E	Katahdin	North Fork	1	0.0	0.0
			2	0.0	0.0
			3	0.0	0.0
			4	0.0	0.0
			5	0.0	0.0
			$\overline{X}$	0.0	0.0
F	Katahdin	South Fork	1	0.0	0.0
			2	0.0	0.0
			3	0.0	0.0
			4	0.0	0.0
			5	0.0	0.0
			$\overline{X}$	0.0	0.0
G	Katahdin	North Fork	1	0.0	0.0
			2	0.0	0.0
			3	0.0	0.0
			4	0.0	0.0
			5	0.0	1.6
			$\overline{X}$	0.0	0.3
H	Superior	South Fork	1	9.6	36.0
			2	12.0	28.0
			3	12.8	40.0
			4	24.8	32.0
			5	21.6	16.0
			$\overline{X}$	16.2	30.4

CORNELL UNIVERSITY

L. I. I.P.M. PROGRAM

GROWERS REPORT

GROWER ______________________ DATE ______________________

FIELD ______________________

COLORADO POTATO BEETLE

Potential for Damage	Treatment Needed		#Colorado Potato Beetles/40 Stems	
High	Spray now		Adults ________	Egg Masses ________
Medium	May need a spray within 7 days		Small Larvae ________	Large Larvae ________
Low	No spray needed this week		Defoliation Rating[a]/ ________________	

APHIDS

Treatment Needed

Spray [ ] No Spray Needed [ ] ______ Aphids/leaf

Other Pests ______________________________

a/ Defoliation ratings:

Low	=	<10% defoliation
Moderate	=	10-25% defoliation
Severe	=	26-50% defoliation
Very Severe	=	>50% defoliation

Fig. 1. Grower Report Form - 1982

Appendix 1. Ratings and action thresholds used in 1982 LI Potato IPM Program.

Defoliation Rating

0 = No damage

1 = <10% defoliation

2 = 10-25% defoliation

3 = 26-50% defoliation

4 = 51-90% defoliation

5 = >90% defoliation

Weed Evaluation Scale

0 = None

1 = Scattered; few weeds

2 = Slight; 1 weed/6 row-ft

3 = Moderate; 1 weed/3 row-ft

4 = Severe; more than 1 weed/3 row-ft

Aphid Thresholds

Spray when # aphids/leaf are greater than;

0.5 - prior to tuber iniation

2.0 - during tuberization and 3 weeks after

4.0 - within 3 week of vine-kill

Plant Growth Stage

Foliar	Tuber	Bloom
1. Green row	1. None	1. None
2. Prior to filled row	2. Initiation	2. Buds
3. Filled row	3. Post-Initiation	3. Open Bloom
4. Touching across rows		4. Bloom end
5. Closed between rows		5. Post-bloom
6. Vines collapsing		

Appendix 1 (continued)

CPB Thresholds - 1982

	No. CPB/40 stems		
	High	Medium	Low
Up to July 15			
Adults	20	10-20	10
Small larvae	100	25-100	25
Large larvae	30	10-30	10
After July 15			
Adults	50	25-50	25
Small larvae	100	50-100	50
Large larvae	50	25-50	25

Proposed 1983 Thresholds

	No. CPB/40 stems		
	High	Medium 1/	Low
Adults	20	10-20	10
Small larvae	150	50-150	50
Large larvae	50	25-50	25

1/ If two or more CPB life stages are at medium levels, this would be equivalent to a high ranking. Insecticide treatments are recommended only when population is rated high.

Appendix 2. Insecticide and fungicide usage on 8 Long Island commercial potato fields, 1981.

Insecticide	No. of Applications	% of all Applications
Vydate - Thiodan	22	36.7
Thiodan - Parathion	12	20.0
Thiodan	8	13.3
Vydate - Thiodan - Parathion	4	6.6
Vydate - Thiodan - Monitor	3	5.0
Thiodan - Monitor	3	5.0
Pydrin - Thiodan	2	3.3
Vydate	2	3.3
Pydrin	1	1.7
Thiodan - Pydrin	1	1.7
Vydate - Pydrin	1	1.7
Vydate - Thiodan - Pydrin	1	1.7
	60	100.0

Fungicide	No. of Applications	% of all Applications
Dithane M-45	29	49.1
Polyram 80WP	20	32.2
Bravo 500	8	13.6
Manex	3	5.1
Total	60	100.0