Cankerworm Control in Shelterbelts

R.D. Frye, D.K. McBride,
D.R. Carey, T.L. Elichuk and R.L. Dregseth

Imidan, Pyrocide and Dipel were consistently among the most effective insecticides applied for cankerworm control in Siberian elm shelterbelts in 1973 through 1976. Sevin, Dylox, Lorsban, Thuricide and Biotrol performed well in some tests. Tested only in 1975, Sumithion was also promising.

Figure 1. Portion of a Siberian elm shelterbelt showing defoliation by cankerworms; the tree on the end of the belt is not defoliated; Walhalla, North Dakota, 1976.

Introduction

The spring cankerworm, *Paleacrita vernata* (Peck), and the fall cankerworm, *Alsophila pometaria* (Harris), are important as defoliators in shelterbelts in the northern Great Plains (Fig. 1). In recent years, *P. vernata* has been the dominant species. Because they seldom kill trees, cankerworms are not considered a major pest. However, severely defoliated belts do not protect adjacent crops from severe weather stresses, and are aesthetically unpleasing as well.

Several insecticides were tested from 1973 to 1976 near Walhalla in Pembina county, North Dakota. The entomogenous bacterium, *Bacillus thuringiensis* Berliner, was included in the investigations due to continuing concern over the use of conventional insecticides. Harper (1974) summarized work on the use of this bacterium for control of cankerworms, including results of efforts in North Dakota.

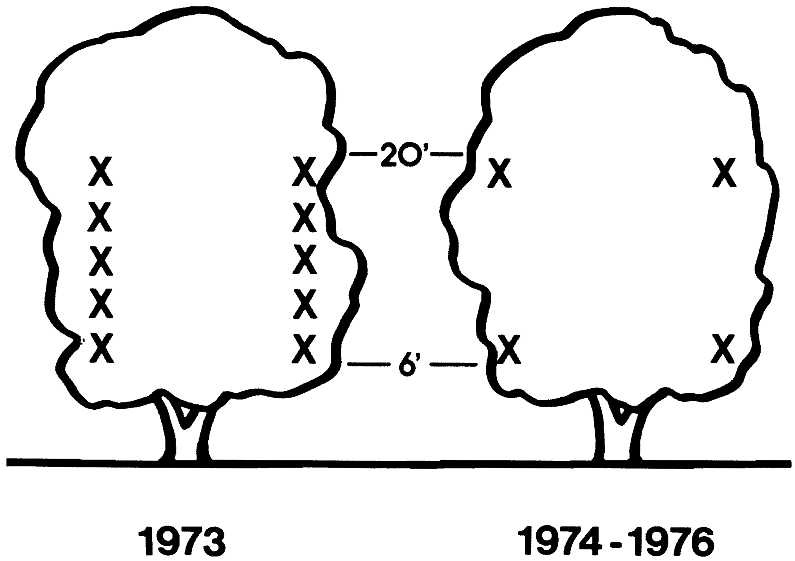

Figure 2. Sites in crowns of Siberian elm trees from which twig samples for cankerworm counts before and after insecticide applications were removed; Walhalla, North Dakota, 1973 through 1976.

Methods and Materials—

Single applications of insecticides were made from the air with 44 D-7 nozzles at an airspeed of 100-115 mph and 40 psi. The materials were applied in 3 gallons water/acre. Treatments were applied to single row Siberian elm *(Ulmus pumila* L.) shelterbelts, except in 1973. In 1973, Imidan[1], 70 WP and 50 WP were applied to single row American elm (*Ulmus americana* L.) belts (Table 1). In all years, the windspeed at the time of application was 5-10 mph; measurable and prolonged rainfall occurred within 24-48 hours after the treatments were applied. The belts were about ½ mi long, with about 100 yds between the belts, separated by cropland. Cankerworms were significantly more abundant on Siberian elm. Averages per two-foot twig in 1973 were 3.94 and 8.58 on American and Siberian elm respectively.

Data consisted of per cent reduction in cankerworms between pre- and post-application counts. Larval counts were made from two-foot twigs taken at eye level and up to 20 feet above ground level (Fig. 2). Larvae were in the 1st to the 3rd instars. No reduction in cankerworms was assumed when post-application counts were equal to or greater than pre-application counts. There was an interval of approximately one week between counts. In all years there were approximately two spring cankerworms to 1 fall cankerworm. The arcsin transformation was applied to the data. Treatments were compared with "t" tests in 1973 and 1976 and with analysis of variance and range tests (Duncan 1955) in 1974 and 1975.

In 1973, each treatment was applied along the length of one of eight belts. Cankerworms averaged 22.5 per twig on May 29. Treatments were applied May 30. Counts were made from five twigs from each side of five randomly spaced trees along the length of each belt (Fig. 2). Pre-treatment counts averaged 22.5 larvae/twig in 1973. In 1974 and 1975, logistics dictated complete block tests with systematically arranged treatments in which each insecticide was applied across six belts. Each plot consisted of two continuous 50 ft. swaths. The plots were separated in the belts by approximately 75 ft. of untreated trees. Treatments were applied June 13 in 1974 and July 3 in 1975. Larval counts were made from two randomly selected 2-foot twigs from each side of one tree in the center of each plot (Fig. 2). Pre-treatment larval counts averaged 10.3/twig in 1974 and 5.3 in 1975. In 1976, each insecticide was applied along the length of one of six belts on June 3. Pre-treatment counts were made from two randomly selected twigs on each side of six randomly spaced trees long the length of each belt on June 2 (Fig. 2). Larvae averaged 48.9/twig.

The effectiveness of the insecticides tested for cankerworm control in 1973 is shown in Table 1.

---

[1]*The use of trade names is for brevity and specificity, and does not imply endorsement by North Dakota State University to the exclusion of equivalent products.*

Dr. Frye is professor, McBride is Extension entomologist, Carey is a technician, Elichuk is a graduate research assistant, and Dregseth is a technician, Department of Entomology.

Acknowledgements: We thank Vernon Fitzsimonds, Leo Eppler, Dick Hardy, Dennis Gratton, Perry Anderson, Larry Kotchman and Mike Pederson for their assistance during these studies. Appreciation is extended to the following companies which supplied the insecticide formulations tested: Abbott Laboratories; Chemagro; Dow; McLaughlin, Gormley, King; Sandoz-Wander; Stauffer; Thompson-Hayward; Union Carbide.

Table 1. Effectiveness of insecticides tested for cankerworm control in shelterbelts; Walhalla, North Dakota, 1973.

Treatment		Ave % larval mortality [1,2]	
Insecticides	Rate/acre	Unadjusted	Adjusted[3]
Imidan 50W	¾ lb ai	95.0 a	92.5
Imidan 70W	¾ lb ai	93.7 a	90.5
Sevin 80S	1 lb ai	80.6 b	70.8
Thuricide 16B[4]	1 qt product	66.6 b c	49.7
Dipel W[4]	½ lb product	66.4 b c	49.4
Dipel W[4]—	½ lb product	37.6 c	0.6
cane molasses	3.6 oz/gal spray	—	—
Untreated	—	33.6 c	—
Imidan 1E	½ lb ai	7.2 c	−39.5

[1]*Based on 10 observations.*
[2]*Averages followed by the same letter do not differ significantly at P=0.05.*
[3]*Adjusted for the untreated check by Abbott's formula (Abbott 1925).*
[4]*A formulation of the bacterium Bacillus thuringiensis.*

Imidan 50W and 70W were most effective for cankerworm control. Sevin, Thuricide and Dipel also provided control. The amount of cane molasses used did not improve on control with Dipel. Mortality in trees treated with Imidan 1E was less than mortality in untreated trees.

Results of the cankerworm control test in 1974 are presented in Table 2. In 1974, Dipel and Pyrocide were the most effective compounds evaluated for cankerworm control. Lorsban, Dimilin, Sevin, Biotrol, Thuricide and Imidan also were effective. Larval mortality was markedly increased following application of Imidan 1E at ¾ ai/acre in 1974 when compared to that obtained from ½ lb rate evaluated in 1973. Imidan 1E was as effective as Imidan 70W in 1974.

Table 2. Effectiveness of insecticides tested for cankerworm control in shelterbelts; Walhalla, North Dakota, 1974.

Treatment		Ave % larval mortality [1,2]	
Insecticides	Rate/acre	Unadjusted	Adjusted[3]
Dipel LC[4]	1 qt product	98.5 a	98.1
Pyrocide[5]	1 qt product	98.4 a	98.0
Lorsban 2E	1 lb ai	90.4 a b	88.1
Dimilin 25W[6]	¼ lb ai	90.0 a b	87.6
Sevin 80S	1 lb ai	84.7 a b	81.3
Biotrol 25W[4]	1 lb product	81.7 a b	77.6
Imidan 1E	¾ lb ai	77.9 a b	72.6
Thuricide 16B[4]	1 qt product	72.4 a b	65.8
Imidan 70W	¾ lb ai	72.3 a b	65.7
Dylox 80W	1 lb ai	58.6 b	48.7
Untreated	—	19.3 c	—

[1]*Based on six replicates.*
[2]*Averages followed by the same letter do not differ significantly at P=0.05.*
[3]*Adjusted for the untreated check by Abbott's formula (Abbott 1925).*
[4]*A formulation of the bacterium Bacillus thuringiensis.*
[5]*Synergized pyrenthrum.*
[6]*An insect growth regulator.*

Performances of insecticides tested in 1975 are shown in Table 3. Cankerworm mortality was greatest in plots treated with Sumithion, Imidan, Dylox, Pyrocide, Dipel LC and Thuricide in 1975. Lorsban caused less mortality than in 1974. A greater per cent of cankerworms were killed with Dipel LC than with Dipel SC. Higher rates of Dipel SC, Pyrocide, Dylox and Sumithion were the most effective. One and one-half pounds of actual Imidan per acre did not improve on control with one pound.

Table 3. Effectiveness of insecticides tested for cankerworm control in shelterbelts; Walhalla, North Dakota, 1975.

Treatment		Ave % larval mortality[1 2]	
Insecticides	Rate/acre	Unadjusted	Adjusted[3]
Sumithion 8E	½ lb ai	100 a	100
Imidan 70W	1 lb ai	97 a	96
Dylox 4 E	1 lb ai	93 a	91
Pyrocide[5]	1 qt product	92 a	89
Dipel LC[4]	1 qt product	92 a	89
Thuricide 16B[4]	1 qt product	88 a b	84
Dylox 4E	¾ lb ai	85 a b	80
Imidan 70W	1½ lb ai	81 a b	75
Dipel SC[4]	1 qt product	80 a b	73
Sumithion 8E	¼ lb ai	74 a b	67
Dipel SC[1]	1 pt product	71 a b c	61
Lorsban 2E	1 lb ai	61 a b c	48
Pyrocide[5]	1 pt product	61 a b c	48
Lorsban 2E	½ lb ai	49 b c	32
Untreated	—	25 c	—

[1]*Based on six replicates.*
[2]*Averages followed by the same letter do not differ significantly at P = 0.05.*
[3]*Adjusted for the untreated check by Abbott's formula (Abbott 1925).*
[4]*A formulation of the bacterium Bacillus thuringiensis.*
[5]*Synergized pyrethrum.*

Cankerworm control in 1976 is described in Table 4. Cankerworm reduction in all treated belts was significantly greater than in the untreated belt. Dylox 4E and 80S caused the greatest mortality. Dipel, Sevin and Thuricide also provided significant control.

Table 4. Effectiveness of insecticides tested for cankerworm control in shelterbelts; Walhalla, North Dakota, 1976.

Treatment		Ave % larval mortality[1 2]	
Insecticide	Rate/acre	Unadjusted	Adjusted
Dylox 4EC	1 lb ai	99.5 a	99.1
Dylox 80S	1 lb ai	98.7 a	97.7
Dipel LC[4]	1 qt product	91.0 b	84.3
Sevin 80S	1 lb ai	85.7 b	75.0
Thuricide 16B[4]	1 qt product	84.0 b	72.1
Untreated	—	42.7 c	—

[1]*Based on 12 observations.*
[2]*Averages followed by the same letter do not differ significantly at P=0.05.*
[3]*Adjusted for the untreated check by Abbott's formula (Abbott 1925).*
[4]*A formulation of the bacterium Bacillus thuringiensis.*

Reductions in cankerworm numbers in the untreated checks were greater than expected in most years. We speculate that much of these decreases may have been due to pupation of the larvae; the insects fall to the ground to pupate after reaching the last larval instar. Such forms would have been alive, but were not counted when twig samples were taken. This cannot be fully explained because of lack of information on the incidence of pupation at sampling time. The weather in most years warmed (especially in 1976) after treatments were applied, and could have caused accelerated development of the cankerworms. There was considerable variation in the cankerworm infestation from year to year (22.5, 10.3, 5.3 and 48.9 larvae per 2-foot twig in 1973, 1974, 1975 and 1976 respectively). However, the numbers were adequate for tests in all years.

Summary and Conclusions

Investigations to determine the effectiveness of insecticides for cankerworm control in shelterbelts were conducted in 1973 through 1976 near Walhalla, North Dakota. The insecticides were applied from the air. Imidan 50WP and 70WP, Dipel LC, and

Pyrocide consistently caused high cankerworm mortality. Sevin 80S, Dylox 80S and 4E, Lorsban 2E, Thuricide 16B and Biotrol 25WP performed well in some tests. Sumithion 8E was also promising although tested only in 1975.

Insecticides currently recommended for cankerworm control include malathion, methoxychlor, the bacterium, *Bacillus thuringiensis* (in Dipel, Thuricide, Biotrol), Imidan and Sevin.

Cankerworm infestations were greater on Siberian elm than on American elm. The spring cankerworm was more abundant than the fall cankerworm (two spring to one fall).

References

Abbott, W.S. 1925. **A method for computing the effectiveness of an insecticide.** J. Econ. Entomol. 18:265-267.

Duncan, D.B. 1955. **Multiple range and multiple F tests.** Biometrics 11:1-42.

Harper, J.D. 1974. **Forest insect control with *Bacillus thuringiensis*, survey of current knowledge.** Auburn University Press, Auburn, Alabama. 63 p.

Guest Column continued from Page 2.

The development of these three basic laboratories in our department tended to outline the role of the cereal chemists in the work of the North Dakota Experiment Station. The first and foremost would be to maintain the milling and baking quality of hard red spring wheat followed by the milling and processing properties of durum wheat and the malting and potential brewing properties of malting barley.

A second role can be identified as the development of suitable testing methods to provide the most accurate means of maintaining high cereal grain quality.

A third important role of the cereal chemist is associated with an original objective of the department's work which is the training of students in the biochemical and technological aspects of cereals and cereal processing. Teaching did not become an important part of our activity until the early 1960's when a Ph.D. program was initiated in the department. Students graduating with an M.S. or Ph.D. degree in Cereal Chemistry are highly sought after for government or industrial positions.

Closely associated with our teaching program is the work that we do in basic research. This phase of our work is vital to better understand why wheat and barley varieties react differently to various quality tests. Both cereals are very complex biological materials made up of many constituents. A characterization of these constituents which includes the various carbohydrates, proteins, lipids and enzymes is important in developing new quality tests and to assist the plant breeder to know how these constituents affect quality.

Since 1960, several new roles have developed for the department and the cereal chemist. Although we do not have an extension person assigned to the department, there is a need to do considerable public relations work with crop improvement groups, visiting scientists, industrial users of wheat and barley, farm oriented youth and adult groups and foreign wheat trade teams. People are interested in the work we are doing so it is necessary for the staff of the department to tell their story to the public by various means.

The importance of the department was enhanced by the addition of the USDA-ARS Hard Red Spring and Durum Wheat Quality Laboratory in 1961. This laboratory was originally located in Beltsville, MD. By this move it put the department on the "map" as a regional spring wheat laboratory location. Our role in developing hard red and durum spring wheats was expanded to cover a nine-state region.

Recently, another role has emerged which is in the area of marketing of durum and hard red spring wheat. North Dakota's high quality wheat has always had a prominent place on the industrial user's shelf. The wheat, because of its exceptionally good quality, is utilized to increase the quality characteristics of lower quality domestic and foreign wheats. Occasionally we find that over-production and reduced needs for these premium wheats will cause a severe depression of their market value. Therefore, our staff has become quite involved in providing technical assistance to foreign buyers of spring grown hard wheats. This technical assistance involves providing information on the quality characteristics of the crop, how to cope with various forms of damage or non-wheat contaminants and new uses for these wheats. The improvement of the quality of other world market wheats and the competition of Canadian-grown spring wheats dictates the importance of retaining traditional customers and adding new ones.

Other crops that are grown by North Dakota farmers also are receiving attention in our work. Utilization of row crops such as sunflowers and navy and pinto beans in food products is being investigated. The high protein of such crops and the desirable amino acid balance of their proteins makes them a source of potentially high grade food protein. I have every reason to believe that this developing role may become a major role in our departmental work.

There is no doubt in my mind that the role of the cereal chemist and his work in the department will continue to expand. The improved quality of wheats in the hard winter wheat growing regions of the U.S., improvement in the quality of foreign grown wheats and improved utilization technology are factors that will undoubtedly direct the kind of work we do as cereal chemists and how we can offer maximum service to North Dakota's Agriculture.