CROP PROTECTION THROUGH A NEW DEER REPELLENT SPRAY

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Maine's deer herd has steadily increased not only in the wilder areas but also in areas adjacent to farm lands and in the agricultural sections themselves. The result is that crop damage has increased and damage claims against the State have mounted.

In 1935 damage claims in Maine amounted to $5000 paid out on 211 complaints. Since 1935 the figures have risen until in 1947, the last year with complete figures available, a total of about $60,000 was paid out on 952 complaints. This is money actually paid out of department funds. It does not represent the full value of crop damage nor include cost of investigation, time and mileage, and repellents. This past year, on the basis of incomplete figures, it seems likely that the total cost to the State arising from deer damage, including the above activities, will be about $200,000.

The types of crops destroyed or damaged by deer include beans, cucumbers, strawberries and grain. In the past few years there has been an alarming amount of damage done to young fruit trees, until it has become next to impossible to establish an orchard in some parts of the State. As each year passes, new types of crops, hitherto untouched, are being added to an already long list.

As we see it, there are four methods of handling this problem. They are as follows:
(1) **PAYING DAMAGE CLAIMS:** This is the path of least resistance. Most farmers regard it as swapping an old dollar for a new one without profit or production. For the orchardist, who is operating on a long-term investment and must first grow trees in order to produce apples, it means abandoning his project.

(2) **ERADICATION:** This method is not so easy as it seems. We legally killed 35,364 deer in Maine during the 1948 season, a large proportion of these in agricultural sections. Yet I venture to say that our crop claims will continue to mount unless more effective steps are taken. Moreover, the method of eradication requires constant vigil, and then the farmer who successfully employs it soon finds himself branded as a "poacher" and "game hog" and the local game clubs are soon up in arms against him.

(3) **FENCING:** This method can be successful or nearly so, but deer-proof fences are expensive, both in money and in time, for constant maintenance is necessary. Electric fences of many types have been tested; some will reduce the number of deer that enter a field but will not keep them all out. These fences are not dependable, are difficult to maintain, and of course are not effective during the winter when there is snow on the ground. At such times the orchardist is particularly vulnerable.

(4) **REPELLENTS:** This is the method with which we are concerned. An agricultural spray to prevent crop damage by deer is as important to many farmers today as are insecticides and weed killers, and it is the modern approach to this problem.
Many state and other agencies have experimented with deterrents. Work was begun in California as far back as 1926; New Hampshire was working on it in 1930; Vermont, New York, Michigan and almost every other state where deer are present on agricultural land has in some way at some time attacked the problem. The Fish and Wildlife Service, through its Research Laboratory in Denver, Colorado, has contributed much.

In Maine, research in deer repellents has been carried on since the late 1930's. Work by Walter Kittams of the Maine Cooperative Wildlife Research Unit at the University of Maine, and by Joel Marsh, Merwin A. Marston and Nathan W. Fellows, Jr., of the Department of Inland Fisheries and Game has laid the groundwork for testing techniques and has eliminated many worthless "cures" from consideration. Of the over 100 compounds tested not one seemed to be wholly satisfactory, although several indicated we were on the right track. All work, done by the Department of Inland Fisheries and Game, has been undertaken with Federal Aid to Wildlife Restoration funds under Pittman-Robertson Project Number 8-R.

Compounds closely related to the repellent now in use were tested on Swan Island in 1947. Through the help of Dr. Luther L. Baumgartner and the courtesy of the B. F. Goodrich Chemical Company, the formulation of Goodrite z.a.c. combined with Goodrite p.e.p.s., an adhesive, was worked out in the spring of 1948. The practical application of this compound in different concentrations was carried out in controlled experiments on garden plots on Swan Island and on
the mainland during the following summer. In most cases a substantial amount of damage by deer had occurred in the areas treated, and various deterrents such as stock dip, string, anise, bloodmeal, etc. had been used without worthwhile results.

**CONTROLLED TESTS**

The general procedure in the four controlled tests was to spray the rows with various dispersions of the repellents, ranging from one to five per cent by weight, leaving untreated check rows. The repellent was applied by the use of a hand-operated compressed air type sprayer. Browse counts were made each day and all plants that had been nipped were counted and removed from the area.

**Plot 1 (Swan Island)**

This garden contained 14 rows, approximately 200 feet long, of yellow eye beans. The deer began browsing these plants as soon as the leaves were big enough to be noticed and a considerable number of deer were using this area to feed in.

On July 7, 1948, 800 linear feet of beans on one side of the plot were sprayed with a 5 per cent dispersion of Goodrite z.a.c., using a 0.5 per cent solution of Goodrite p.e.p.s. as a sticker; 600 linear feet of beans were left untreated as a control. Of the linear remaining half of the garden, 1,000/feet of beans were treated with a 3 per cent dispersion of the repellent and 400 feet left as check rows. The entire plot was cultivated and all deer damaged plants removed. A browse count was made each day and all plants that
were damaged the night before were pulled out and carried off the area.

During the 24 day period covered by this experiment the Twice treated rows were sprayed with a 3 per cent dispersion of the deterrent in order to cover the new growth.

The 1,000 feet of untreated beans were completely destroyed. In the remaining 1,800 feet of treated rows, 95 individual bean plants were browsed.

Plot 2 (Swan Island)

This plot contained 990 linear feet of beans that had been protected with an outrigger type of electric fence from the time the beans were planted up to July 7, 1948, when 540 feet of these beans were treated with a 3 per cent dispersion of Goodrite z-a-c. plus a 0.5 per cent solution of Goodrite p-e-p-s. The remaining 450 feet of beans were left untreated as a control.

This garden was inspected daily and all browsed material counted and removed.

The treated rows in this area were resprayed on July 16th and July 24th with a 3 per cent dispersion of the repellent.

During the period of July 8th to July 24th the deer browsed the check area to the ground and ate a total of 108 plants in the treated area. The heavy browsing on the treated area was done during the three days prior to the second spraying and was confined entirely to the new growth with little damage being done to the old treated leaves and stalks.
Plot 3 (Swan Island)

This garden had 1,100 linear feet of beans available for spraying. These beans had been protected by an electric fence since planting, and had no damage in them.

Approximately 700 linear feet of these beans were sprayed with a 1 per cent dispersion of the repellent and the remaining 400 feet of garden were left unsprayed as a check area.

Daily inspections were carried out and all damaged plants removed and recorded.

On this plot all check rows and 103 treated plants were consumed by the eighth day at which time the remaining treated rows were sprayed with a 1 per cent dispersion of Goodrite z.a.c. using a 0.25 per cent solution of Goodrite p.e.p.s. as a sticker.

During the next 12 days very little damage occurred. However, on July 27th, nine deer were observed feeding in this plot at one time, doing considerable damage to the remaining plants. By the middle of August this plot was completely destroyed and it was concluded that a 1 per cent dispersion of this deterrent was not sufficient under the deer pressure present.

Plot 4 (Brown's Point, Bowdoinham)

The 9,800 linear feet of beans used in this experiment were part of a 15 acre field. The test plot was chosen because it extended down into the woods and consequently considerable deer damage occurred on it.

Initial damage counts were made by sampling 10 feet of each
50 feet of beans. An average of 1.2 plants had been browsed out of each foot of crop row. This damage had occurred during the three days before the spray was applied.

Dispersions of 3 per cent, 4 per cent and 5 per cent were applied to this plot July 9th, using four rows to a test. No control rows were left.

The plot was inspected each morning and all new browse recorded, damaged plants removed, and the plot cultivated to remove deer tracks.

The entire plot was resprayed on July 17th with a 3 per cent solution of the repellent so as to cover the new growth that had come up during the previous eight days.

From the time the spray was applied July 9, 1948, to July 31, 1948, the plot was visited 24 times by deer and 3 times by moose. It is believed that only four deer and one moose were involved.

During the 23 day period, 324 plants had been browsed out of 9,800 linear feet exposed as compared with 11,760 plants damaged in three days before the material was applied.

FIELD TESTS

The practical application of this material was undertaken on sixteen different plots of factory beans ranging in size from one-half acre to six acres. Dispersions of 3 per cent or less were employed in all cases. Both hand-operated and power-driven equipment were used in the application of the spray. In all cases the plots were sprayed with a combination of Goodrite z.a.c. and Goodrite p.e.p.s.
Plot 1 (Harold Perry Farm, Litchfield)

This plot consisted of one acre of dry beans from which approximately 30 per cent of the foliage had been browsed by deer. The beans were sprayed with a 3 per cent dispersion on July 20, 1948, using a hand-operated compressed air sprayer.

A two acre piece of beans across the road was treated with stock dip, rags, and string by the local game warden the same day.

On August 2, 1948, the area was visited and no new damage could be found. The two acre piece across the road had a considerable amount of browsing in it at this time. Mr. Perry said he had seen only one deer in the treated plot and that animal had done no damage.

This area was rechecked on August 11, 1948, and no sign of browsing could be found. The unsprayed area across the road had been almost completely destroyed.

Plot 2 (Ivan Austin, Weeks Mills)

On July 23, 1948, two acres of dry beans were treated with a 3 per cent dispersion using hand sprayers to apply the material. This work had been done about 4 hours when it began to rain and continued to rain for the next 12 hours.

On July 26th, the area was checked. The sprayed material had not washed off and no deer damage was found. About 10 linear feet of beans had been eaten by a woodchuck on one end of the field.

The same plot was rechecked on August 11, 1948, and no damage could be found.
Application of common deterrent previous to July 7, 1948, had failed to stop the deer feeding in this field.

Mr. Austin said it kept the deer out of his beans but didn't think he should have to buy it although he was willing to put it on.

Plot 3 (Roy Ribedeauce, Weeks Mills)

On July 23, 1948, a 1 per cent dispersion was applied to a one-half acre plot of beans that had been completely defoliated by deer, leaving only naked stalks.

This plot was inspected on July 26, 1948, and no new browsing could be found. Between this date and August 8, 1948, when the plot was again inspected the plants had put on new leaves. These untreated leaves were browsed off by August 11, 1948.

Mr. Ribedeauce said the deer did not enter the plot for the first few nights and when they did come in they only browsed a small amount and left. He said he would like to purchase some of the material in order to apply it to the rest of the beans.

Plot 4 (Field 1, Bessey Brothers, Albion)

This 1 1/4 acre field of beans was treated with a 1 per cent dispersion using a 200 gallon power-driven, tractor drawn, boom type sprayer for application. Entire operations on this plot required only seven minutes, spraying six rows at a time.

There was no deer damage in this field at the time of the application although deer had done considerable browsing in this area the previous year. This area was checked August 11, 1948, and no damage could be found.
Plot 4, (Field 2, Bessey Brothers, Albion)

This 2 1/4 acre field was treated with a 1 per cent dispersion on July 23, 1948. Approximately 25 per cent of the top leaves had been browsed off and several deer were using the area to feed in every night.

On August 11, 1948, the owners claimed that little or no damage had occurred in their beans since the application of the spray, although deer had passed up and down the rows several times.

Plot 4 (Field 3, Bessey Brothers, Albion)

This area contained six acres with about 10 per cent damage and was sprayed July 28, 1948, with 275 gallons of a 1 per cent dispersion. No additional damage had been reported on August 24, 1948.

Plot 4 (Field 4, Bessey Brothers, Albion)

This field contained 2 1/2 acres of dry beans and had been completely browsed off the previous year. No damage had occurred as of July 28th of this year when the area was treated with a 1 per cent dispersion. On August 11, 1948, no damage had occurred in this field.

Plot 5 (Millard Sennett, Albion)

This 2 acre plot of dry beans was inspected on July 28, 1948, and found to be badly browsed.

Mr. Sennett was given a supply of the repellent which he agreed to apply as directed with his horse-drawn sprayer. However, on August 11, 1948, when this gentleman was contacted he claimed the material was no good and the deer had about cleaned up his beans.

Upon inspection it was found that the spray had been applied only to the outside rows on one side and that the deer had passed through
this area and were browsing the untreated area in the center of the garden. Very little new browse was found on plants where the spray could be seen. Many of the treated plants had very poor coverage.

**ORCHARD TESTS**

Our first attempt to use Goodrite z.a.c. and Goodrite p.e.p.s. in orchard treatment occurred on July 21, 1948, when 81 apple trees from 3 to 5 years old were sprayed with a 3 per cent dispersion of the material. These trees had been browsed on for the past two winters but this year was the first time that damage had been done during the growing season.

After spraying, the trees were pruned and damaged twigs removed in order to determine how much new browse occurred. The orchard was examined on August 3, 1948, and only 12 twigs had been nipped on seven different trees.

On August 10, 1948, the area was again checked and the new growth on 12 trees had been eaten. The trees had added some 2 inches of twig growth during this period.

A final check was made on this orchard August 25, 1948. Fifteen trees had been damaged in the area sprayed. On practically every tree in the unsprayed part of the orchard deer had browsed most of the new wood within reach.

Further orchard spraying was undertaken during October, when 1,300 apple trees, 1 to 10 years old, were treated. The orchard was
divided into three blocks, each block being sprayed with a different dispersion of the repellent ranging from 1 per cent to 3 per cent by weight. Deer were in the orchard at the time of application and a considerable amount of damage to spring grafts and August budding operations had resulted. Actual cost of material for this orchard amounted to about five cents a tree.

This area was checked on November 9, 1948, and little or no damage could be found. The orchard owner said he had not seen a deer around the place for the last 12 days, and wanted to know where he could get a half-ton of the stuff.

We again checked this orchard on December 16, 1948, and found that the block treated with a 1 per cent dispersion of 0.75 per cent active Goodrite z.a.c. had been browsed. Little or no repellent film could be seen on the tree limbs and two reasons for this can be given, namely, a wetting agent had been added to the repellent applied to this block of trees and unseasonably heavy fall rains cut down the Goodrite z.a.c. deposit with each storm. However, the remainder of the orchard, about 1,000 trees, showed no signs of damage and a deterrent film was present on the limbs. No wetting agent was added to the spray in this section of the area. The orchard owner was much impressed with the fact that the material had kept the deer from eating for five weeks. He said that if the snows had come around Thanksgiving, as they had in the past, no doubt he would have suffered no damage because the deer in this section move back into the black growth (coniferous) around the middle of November.
No doubt a respraying of the orchard at the first sign of new damage would have eliminated the deer trouble for the winter, but lack of the spray material at that time prevented it.

Three other orchards amounting to about 2,500 trees were sprayed this fall and to date the results have been satisfactory.

Several tests this winter on Swan Island showed that wild trapped Varying Hares did not gnaw green apple tree wood which was painted with this material. Whether this is going to hold true for rats and mice, I do not know.

This repellent has been used with almost 100 per cent success in preventing deer damage on beans, strawberries, cabbage, cucumber vines, beet and carrot tops, and apple trees. It is a white powder, wettable, has a low solubility, is micronized and essentially 100 per cent active. It is exceptionally safe for use on plants and has not injured the foliage of beans, squash, cucumbers, strawberries and raspberries. Repeated applications of dosages far in excess of those required have not been injurious to the plants to which it has been applied.

From tests carried out by the B. F. Goodrich Chemical Company, this material has shown promise of control of early and late blights of potato, tomato anthracnose, various mildews, apple scab and various rust diseases. Its control of other fruit and vegetable diseases has not been investigated. Goodrite z.a.c. and Goodrite p.e.p.s. in dispersions ranging from 1 per cent to 5 per cent by weight when applied as a spray to beans, will prevent deer from doing any appreciable amount
of browsing. The spraying of crops with this material must be so spaced as to keep in step with the growth of the plant where a heavy deer population is evident; otherwise one application is often sufficient.

The spraying of crops with a low concentration of the repellent before any deer had browsed the area seemed to protect the crops from damage during the season. We have no evidence that deer would have damaged the areas thus treated if they had not been sprayed other than the fact that in previous years substantial damage had been done in these fields, and that considerable browsing was done in adjacent fields this season.

The use of Goodrite p.e.p.s. as a spray adhesive has made Goodrite z.a.c. highly resistant to rainfall, thus affording better and longer protection. This material in itself is also fungicidal. In tests during the summer of 1947 Goodrite p.e.p.s. alone showed little or no deterrent value for deer.

The adhesive agent will interfere with the proper operation of spray machinery if allowed to dry and the pump should be flushed out several times with clear water at the end of each day. All tests seem to show that the repellent, when applied as a spray to various crops, made them objectionable to deer and turned the animals to other food.

Dispersions of not less than 1 per cent or more than 5 per cent by weight proved to be effective, depending upon the amount of original deer damage and deer pressure present, but I doubt very much if anything will keep a starving deer from browsing if it has nothing else to turn to.
This material may not be the complete answer to deer
damage but most certainly it is a step in the direction of raising
crops successfully under normal deer pressure in agricultural areas.