USE OF THE PROPANE FLAMER TO CONTROL INSECT PESTS OF POTATOES

The idea of using propane flamers to control over-wintering Colorado Potato beetles early in the season in potato fields was first championed by Dale Moyer from the Cornell Cooperative Extension Service. I met Dale at an International Conference on Potato Pest Management in Jackson Hole, Wyoming, in the fall of 1991 and he accepted an invitation to speak on the subject at our Colorado Potato Beetle Conference on March 11, 1992, at the Potato Development Centre in Wicklow, NB.

At the time, we were having serious problems trying to control Colorado Potato Beetles, as they had become resistant to most chemicals. Mr. Moyer's presentation sparked the interest of several growers in the region. Following the conference, Harold Culberson of Jacksonville made arrangements to have a flamer built by Ross Perry of Hartland Machine Ltd., Hartland, New Brunswick, while Dwayne White of Woodstock had a different machine built by Wendell Smith of Rexo-Therm Canada Ltd. of Toronto, Ontario.

The first unit was an open-type flamer front-mounted on the tractor with hydraulic height adjustments while the latter (shown at the top) was pulled behind the tractor and used metal row covers to contain the flames and retain the heat near the plant. Both units were summarily tested in 1992 under adverse conditions in a non-replicated experiment on Dwayne White's farm. Although the plants were too large to be flamed properly, the level of mortality of adult beetles and egg masses after treatment with the flamer was very encouraging.

In view of these results, we obtained funds in 1993 to conduct a comprehensive large scale replicated experiment in a commercial potato field. The experiment was conducted on the farm of Harold Culberson of Jacksonville, using the propane flamer manufactured by Ross Perry of Hartland Machine Ltd. The unit consists of a ramp that is controlled hydraulically. Individual burners are attached to the ramp, 2 / row and arranged in such a way that they are directed forward and slightly towards the potato row, one for each side of the row to ensure that each side of the plant is covered. The unit shown here is designed to cover 4 rows at a time. It is critical that the burners stay at the proper height and distance right on top of the rows. Since the most popular planters plant only 4 rows at a time, the number of rows covered by the burner is normally 4 as well. The burners can also be manufactured to cover only 2 rows at a time.

There is a platform at the back of the unit that is designed to hold 2 tanks of propane. The system comes with the necessary regulators and delivers liquid propane to the burners, as it is important to obtain enough heat to kill the insects while traveling fast enough to be efficient and ensure the plants are not harmed more than absolutely necessary. Although this slide does not show it, users have also found it useful to place a protective piece of plexiglass on top of the tractor, in front of the driver to avoid gusts of heat that may be uncomfortable.

Our intent with the propane flamer was to control the Colorado Potato beetle, as it is generally considered to be the most destructive insect pest of potatoes in this area. We timed our first treatment to try to eliminate the most beetles possible. In practice, this should be the first warm and sunny day when the beetles can be found feeding on the plants in great numbers. You can

see from this slide, which was taken shortly after the treatment, that the effect of the burner appears to be immediate. Affected adults usually fall to the ground immediately, and although they may not die immediately, they stop feeding and soon perish. In this experiment, we tried to consider as many angles as possible. We looked at the effect of the flaming on the adults and tried to determine if egg masses and later larval counts were affected. We also looked at subsequent Flea Beetle populations on the plants and finally and most importantly, we wanted to know if plants would be harmed and if yields and tuber quality factors would be affected by flaming.

A large field of Norwis potatoes was selected for the trial. The field was planted from May 20-22. The experimental area consisted of a long narrow strip of approximately 11 acres at the edge of the field. There were 3 replications and 4 treatments were applied as follows:

0 - No flaming
1 - 1 flaming - June 25
2 - 2 flamings - June 25, July 2
3 - 3 flamings - June 25, July 2, July 6

The propane flamer was operated at a pressure of 30 psi and travelled at a speed of 5 mph with the bottom of the burner at 10" above ground. Fuel cost for the propane were estimated at the time to be from $5-6/acre. No insecticides were applied at planting. An insecticide was applied to all plots on July 16 and 23 to reduce larval populations. This was the normal practice at the time in commercial fields and it was requested by the grower.

Ten egg masses were collected from each plot immediately after flaming and held for 10 days in the laboratory. Hatches were recorded. All adults (up to 20) were collected from a section of row in all plots immediately after flaming and held in the laboratory for 4 days. Survival was recorded. Field data on Colorado Potato Beetle egg masses, adults and larvae were collected weekly from June 25 to August 17. Yield data were also collected weekly from July 21 to September 1. In addition, data were also collected on Flea Beetle damage, plant growth, hollow heart and sucrose levels.

I have to apologize for the quality of my slides from this point on. The study is fairly old and the original data were not available to use with modern software. Many of the slides are originals which were taken at the time from a computer screen. Mortality data on adults collected from the field, indicate that 4 days after the first treatment, from 8.3 to 18.3% of the beetles were still alive in the flamed parcels compared to 96.6% for the untreated parcel.

The second flaming yielded similar results: from 8.3 to 10% of the beetles were still alive in the flamed parcels compared to 95% for the untreated parcel. Surprisingly survival was also lower in the parcel previously flamed only once a few days earlier. Obviously, adults were still dying. After the third flaming, survival was 0% in the parcel flamed 3 times and varied from 60 to 71.6% for the other plots. All differences were significant. Presumably, the reason for the diminished survival in untreated parcels is natural mortality. Most overwintering adults normally die by the first of August. Analysis of data on the # of larvae hatching from egg masses collected in the field after flaming, was inconclusive. Although there was a trend towards a diminished hatch in the flamed parcels, the experimental error was such that differences between

treatments were not always significant. This may be due to the fact that the # of eggs / egg mass varies quite widely in the field.

Note that the lines on this graph are interpolated between data points. The number of adults was essentially the same in all parcels just prior to flaming on June 25. Adult populations in the field during the summer were significantly lower in the flamed parcels than in the untreated checks. The differences between the treated and untreated parcels were significant and particularly pronounced in the spring and again in the fall when the large number of new adults in the untreated plots was indicative of the number of larvae which had survived in this treatment.

Differences in control between one, two and three flamings were not significant. The average number of adults in the flamed plots was only 9.1-20.3% of the number of adults in the untreated plot. Similarly, the number of egg masses laid during the season was significantly lower in the flamed parcel than in the untreated checks. The difference in abundance of egg masses between the parcels flamed once, twice or three times was not significant. The average number of egg masses in the flamed plots was only 9.2-18.2% of the number found in the untreated plot.

Again, the number of larvae on potato plants was significantly lower in the flamed parcels than in the untreated checks. Differences in the number of larvae between the flamed parcels was again non-significant. The average number of larvae counted in the flamed plots was only 5.2-16.9 % of the number counted in the untreated plot.

There was a significant reduction in the level of damage due to flea beetles in the flamed treatments when compared with the checks. Differences in damage levels between the flamed treatments were not significant. Average damage levels in the flamed plots were only 7.3-17.6% of those observed in the untreated plots.

It is undeniable that the plants suffer what seems to be substantial damage from the flaming. Our main goal with this experiment, was to try to quantify this damage. A few days after treatment the plants seem to have recovered quite well and one week after treatment, it would be difficult to guess that the plants had been flamed, were it not for an occasional leaf edge which would show some edge scorching.

The average weight of the foliage during the growing season was significantly greater for plants having been flamed only once than for plants having been flamed twice or three times or not having been flamed at all. It is likely that growth in untreated plants was reduced by the beetles while growth in plants treated more then once was diminished by the prolonged stress of successive flamings.

It appears that sucrose levels may have been somewhat more elevated in flamed parcels early on, particularly in those which were flamed more than once. Although a trend existed, differences between treatments were not large enough to be significant. The difference in sucrose levels was negligible at the end of the season when all samples were found to be within the acceptable range.

When the 10 largest tubers in each sample were examined, no hollow heart was found in tubers from untreated plants or plants having been flamed only once. There was a significant difference

however, in the amount of hollow heart found in the tubers from plants having been flamed twice or three times. Tuber size was significantly reduced in the parcels having been flamed more than once. There was not a significant size difference in tubers from untreated plants and plants flamed only once.

Tuber set seemed to be enhanced in the flamed parcels having been subjected to one or two flamings. The plants having been flamed three times had a lower set than other plants flamed less often and the set was not significantly different from that of plants left untreated. There was a significant difference in yields between all treatments. The average yield per plant over the whole season was best for the parcels having been flamed only once. Yields were diminished significantly for untreated parcels and again for parcels having been flamed twice and three times. Average yields per plant over the whole season, when compared to those of the untreated check, were diminished by 25.2% for 3 flamings and 11.4% for 2 flamings and were increased by 13.8% for the single flaming

Conclusions

- It appears that the use of a propane flamer in the spring, shortly after emergence, reduced the average number of adults , egg masses and larvae in the field over the whole season by approximately 80% for a single flaming. Flea beetle damage was also reduced by 80%.

- Tuber set was increased by 26% with a single flaming. Tuber size tended to diminish with each successive flaming, a probable consequence of increased stress.

- Plants flamed only once had the most foliage.

- Average yields over the whole season were 13.8% higher with a single flaming but were reduced with successive flamings.

- There was no hollow heart in the sections flamed once, however, successive flamings increased the incidence of hollow heart in the largest tubers. Maturity was not delayed significantly by flaming.