Flyspeck Disease Management: Comparison of Flint versus Captan in Every-row versus Perimeter-row Sprays

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In 2001, we began a 4-year study to evaluate new pesticides (in this case, the environmentally benign fungicide, Flint, for flyspeck disease) for apple pests and a pesticide-reduction strategy (spraying only the two rows of apple trees on the perimeter of the block). Flyspeck (FS) disease, like apple maggot fly and plum curculio, survives the winter on or in plant material in the wooded or hedgerow borders and often infests an orchard block with a significant disease gradient which decreases with distance into the block (Cooley, 1996). The 2001 insect pest management results of the study were reported in *Fruit Notes* 66:14-18.

This study seeks to determine if the strategy of spraying only the two perimeter-rows in blocks of apple trees during the summer months is adequate to manage the disease at six orchards in Massachusetts. If proven efficacious, this strategy could help offset high costs of new materials and help reduce the pesticide load on the environment.

Materials & Methods

The experiment took place in blocks of apple trees at orchards in six Massachusetts towns: Harvard, Ber-

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XXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
XXXXXXXXXXXXX	XXXXX	XXXXXXXXXXXXX	XXXXXXXXXXXXX
Border area	Border area	Border area	Border area
Flint (2.0 oz./acre)	Captan 80 (2.5 lb./acre)	Flint (2.0 oz./acre)	Captan 80 (2.5 lb./acre)
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Key: + = sprayed tree, -- = unsprayed tree, X = trees, shrubs, and vines

Figure 1. An example of a perimeter-row spray block with fungicide rates in six Massachusetts apple orchards, 2001.

Key: Each block below represents a block of apple trees 7 rows deep by approx. 35 trees wide. Cardinal directions are noted with a capital letter. Principal border is shown at top of block. Host density ratings ranged from 1 (none to very few scattered) to 4 (continous deep patches of host plants). Flyspeck (FS) density ratings range from 0 (none) to 3 (high).

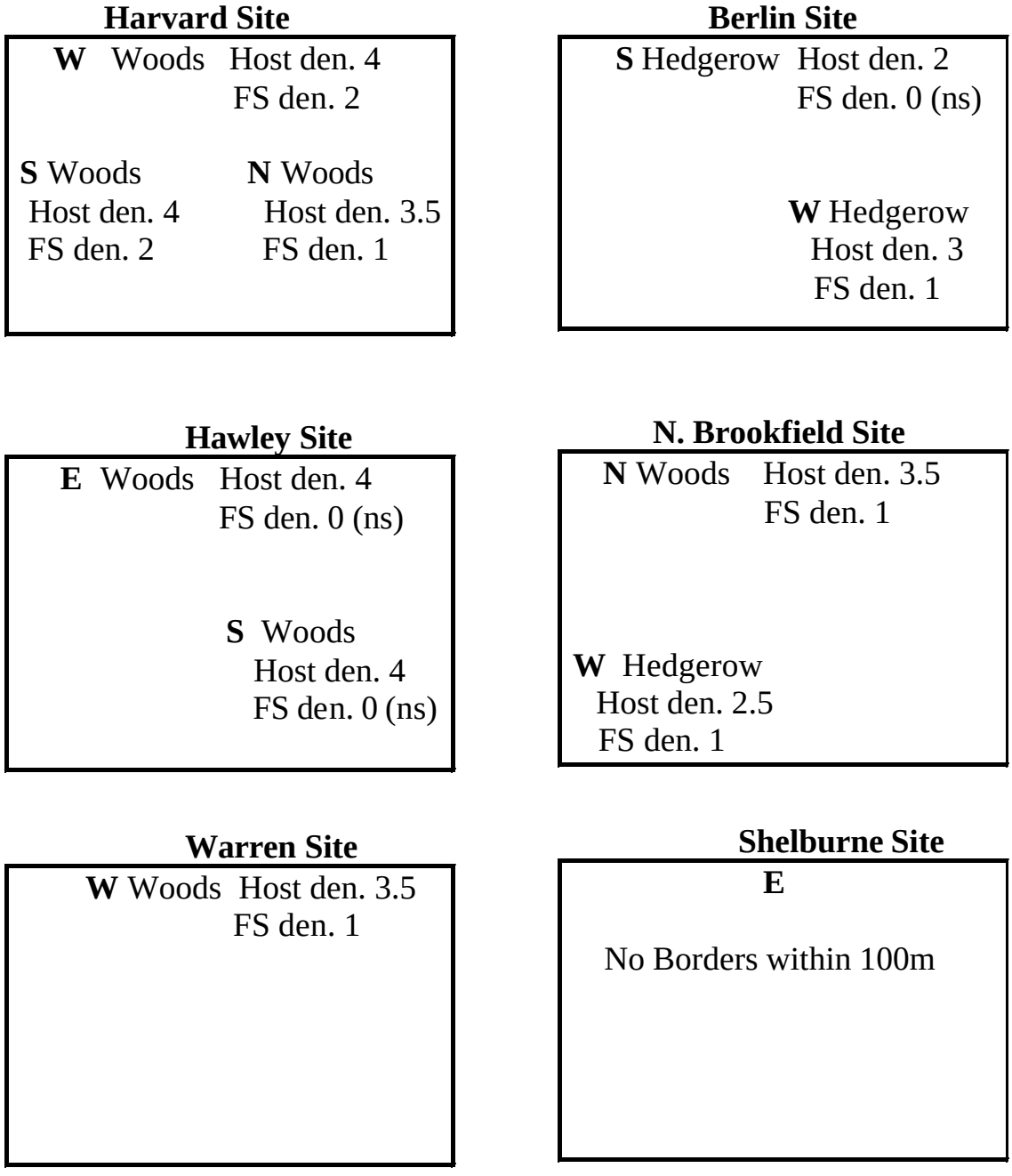


Figure 2. Evaluation of alternate host density and flyspeck (FS) density in border area habitats at six apple orchards in Massachusetts, 2001.

Table 1. Fungicide application schedule for 6 orchards in Massachusetts, 2001.

Site					
Harvard	**23-May**	**31-May**		18-Jul	08-Aug
Berlin	**23-May**	**31-May**	**13-Jun**	18-Jul	08-Aug
Warren	**25-May**	**02-Jun**	**16-Jun**	19-Jul	10-Aug
N. Brookfield	**25-May**	**02-Jun**	**24-Jun**	19-Jul	10-Aug
Shelburne	**24-May**	**01-Jun**		18-Jul	09-Aug
Hawley		**10-Jun**		18-Jul	09-Aug

* Bold-face font indicates full cover spray; otherwise 2 row vs. 7 row spray applied.

lin, Warren, North Brookfield, Shelburne, and Hawley. Cultivars within the blocks were primarily mid-to-late season, with planting densities ranging from 100 to 1000 trees per acre. The minimum block size was seven rows deep by 28 trees long (Figure 1). Rows of trees were divided into four sections, by colored flagging, to correspond with the four separate post-petal-fall pesticide treatments. There were two treatments using new, environmentally friendly materials (the fungicide, Flint, and the insecticide, Avaunt) and two treatments using conventional materials (the fungicide, captan, and the insecticide, Guthion). For each of these treatments, there was a two-row perimeter-spray plot and a full seven-row spray plot.

During the early season (up through petal-fall) the growers applied fungicides of their choice. Petal-fall occurred in mid-May at five of the six sites, with the exception being Hawley, which reached petal-fall on May 31. After petal-fall, the sites were sprayed according to the experimental protocol with the University's air-blast sprayer.

In early June, border areas within 100m of the experimental blocks were surveyed for alternate FS-host density and density of FS on such hosts. Host density was estimated on a four-point scale, and FS density was estimated on a three-point scale after examining known host plants throughout the border for fifteen minutes (Figure 2). If any FS was found, a more precise measure was taken by examining 25 stems on alternate hosts every 10m along the border.

Sprays applied by the University (Table 1) prior to June 10 were full cover sprays, meaning all trees received fungicide. Captan 80 was applied at 1.75 pounds/acre and Rubigan at 4.0 ounces/acre. At three sites, scab persisted, so one additional unplanned cover spray was needed in mid-June. For such applications, Flint was applied at 2 ounces/acre.

Fungicides were applied twice in the summer, with one spray on July 18 or 19 and the other on August 8 or 9. The two Flint treatments were applied to trees at a rate of 2.0 ounces/acre, and Captan 80 was applied at 2.5 pounds/acre. All sprays were delivered with the equivalent of 150 gallons per acre.

FS counts began July 15. One hundred fruit were sampled in rows 1, 3, 5, and 7, in each of the four spray treatments. Four hundred fruit were counted per treatment, and 1600 fruit per block. Distance between rows ranged from 8m (Shelburne) to 3m (Hawley). The sample area was comprised of the bottom 6 feet of fruit, on all sides of the tree. The typical sample was 20 fruit, from five trees, within each row. Also, the first and last tree of each row, for each treatment, was not sampled, since such trees could have been affected by spray drift. Samples occurred weekly or semiweekly until early September, when they were conducted weekly. Counts continued until harvest, with the last count on October 1.

Table 2. Treatment and border area parameters, and percentage of apples infected with flyspeck at harvest in 6 commerical apple blocks in Massachusetts, 2001.

Site	Fungicide treatment	Perimeter or full block	Significant borders*	Distance to border(m)**	Flyspeck density in border***	Fruit infected at harvest (%) Whole Treatment	Fruit infected (%) Row 1	Fruit infected (%) Row 7
Harvard	Captan 80	perimeter	West	3.1	2	44%	100%	11%
			North	19.5	1			
		full	West	3.1	2	8%	8%	9%
			North	56.1	1			
	Flint	perimeter	West	3.1	2	4%	8%	1%
			South	53.4	2			
		full	West	3.1	2	3%	11%	0%
			South	9.8	2			
Berlin	Captan 80	perimeter	South	4.4	0	7%	0%	9%
		full	South	4.4	0	1%	1%	0%
	Flint	perimeter	South	4.4	0	8%	0%	6%
			West	44.2	1			
		full	South	4.4	0	2%	0%	4%
			West	3.9	1			
Warren	Captan 80	perimeter	West	7.3	1	1%	3%	0%
		full	West	7.3	1	5%	21%	0%
	Flint	perimeter	West	7.3	1	1%	0%	3%
		full	West	7.3	1	<1%	1%	0%
N. Brookfield	Captan 80	perimeter	North	7.9	1	<1%	0%	1%
			West	79.8	1			
		full	North	7.9	1	0%	0%	0%
			West	39.9	1			
	Flint	perimeter	North	7.9	1	<1%	1%	0%
			West	7.9	1			
		full	North	7.9	1	3%	0	4%
Shelburne	Captan 80	perimeter	None within 100m	N/A	N/A	2%	0%	0%
		full	None within 100m	N/A	N/A	0%	0%	0%
	Flint	perimeter	None within 100m	N/A	N/A	1%	0%	0%
		full	None within 100m	N/A	N/A	<1%	1%	0%
Hawley	Captan 80	perimeter	East	9.1	0	0%	0%	0%
		full	East	9.1	0	0%	0%	0%
			South	9.1				
	Flint	perimeter	East	9.1	0	0%	0%	0%
			South	53.0				
		Full	East	9.1	0	0%	0%	0%

* principal border listed first
** distance from edge of woods or hedgerow in principal border to first row of apple trees
*** 0=none, 1=low, 2=medium, 3=high

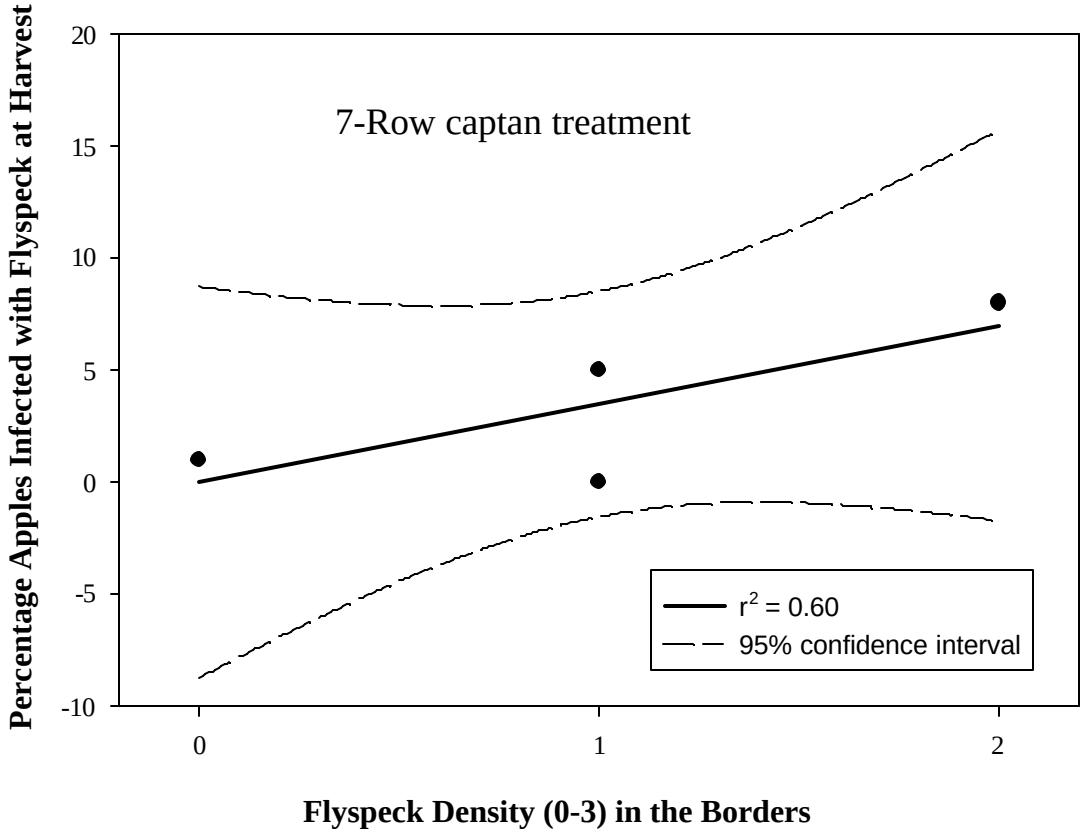


Figure 3. Flyspeck density observed on alternate host plants in the border area in June versus the percentage of apples infected with flyspeck at harvest in the seven-row captan treatment.

Results

In the June border survey, host density ranged from very high (4) at Harvard and Hawley, to moderate (2.2) at Berlin, to none at Shelburne (Figure 2). FS density on hosts ranged from moderate (2) at Harvard to low (1) at N. Brookfield to none (0) at Hawley. Twenty two percent of alternate host stems examined contained FS at Harvard, while 6-9% of stems inspected contained FS at Berlin, Warren, and N. Brookfield.

The Harvard block, with the highest rating for density of FS in the border, had the most FS in the apples at harvest (Table 2). When data for the four sites with the most FS at harvest were combined and tested, it was clear that the amount of FS observed in the borders in June had a major influence on the amount of infection in the apples at harvest. In the perimeter-rows and seven-rows captan treatments, 53% and 60%, respectively, of the variability in FS disease symptoms at harvest was explained by this relationship (Figure 3 shows the seven-row captan treatment). In the Flint treatments, the relationship was extant, but weaker (31% and 10% of the variability explained).

Distance to principal border ranged from 3.1m at Harvard, to 9.1m at Hawley (Table 2). Distance to perpendicular end borders ranged from 3.9m at Berlin to 53m at Hawley. At the Shelburne site, there were no significant borders within 100 meters of the block. The importance of the distance to a principal border on the level of infection in the apples was less than the importance of the amount of FS in the borders, but it is worth noting. As Figure 4 shows for the perimeter-rows captan treatment, 10% of the variability in fruit infection counts was explained by this relationship. Within the other three treatments, this relationship was weaker.

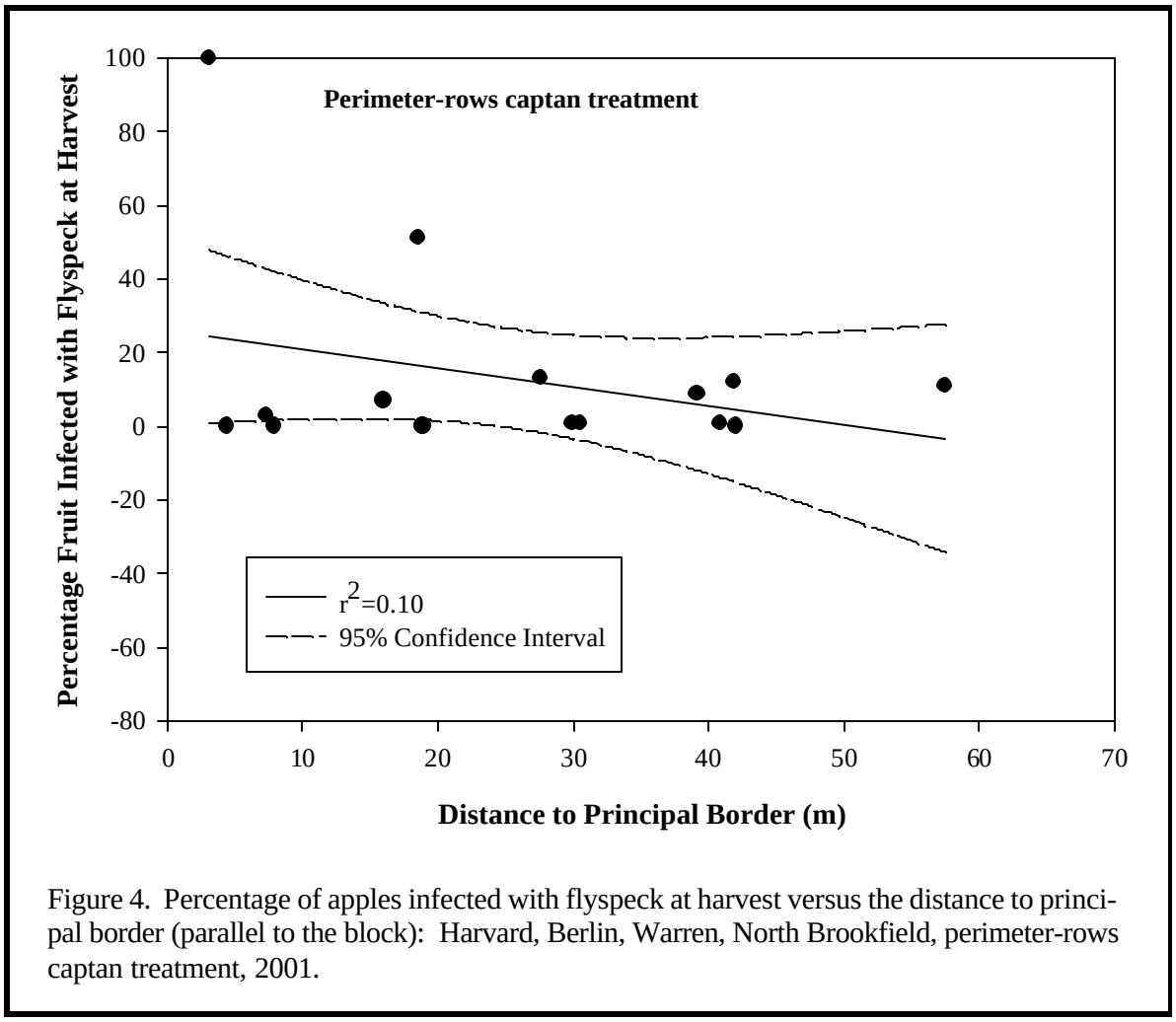
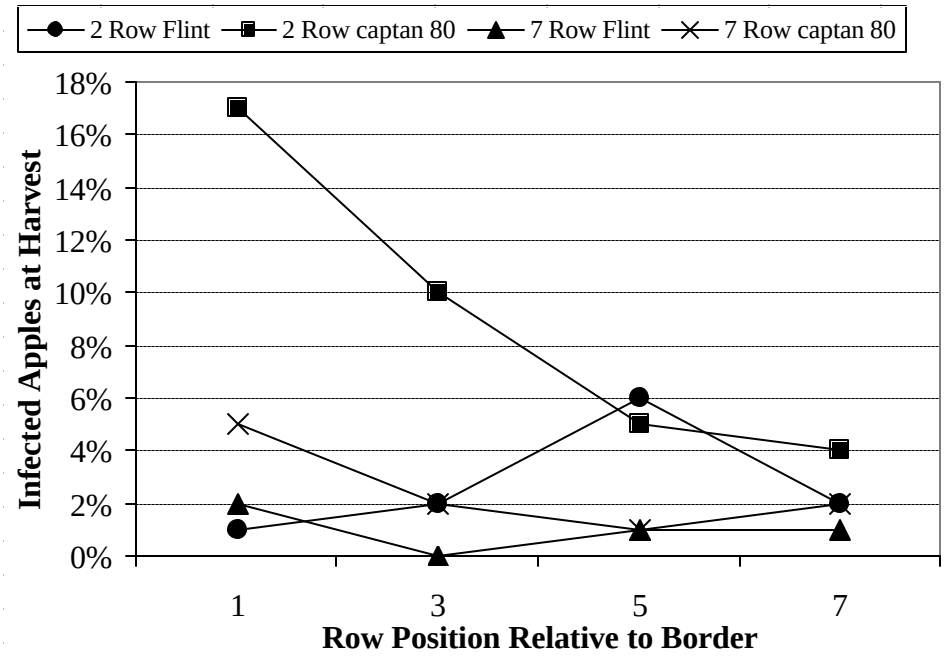


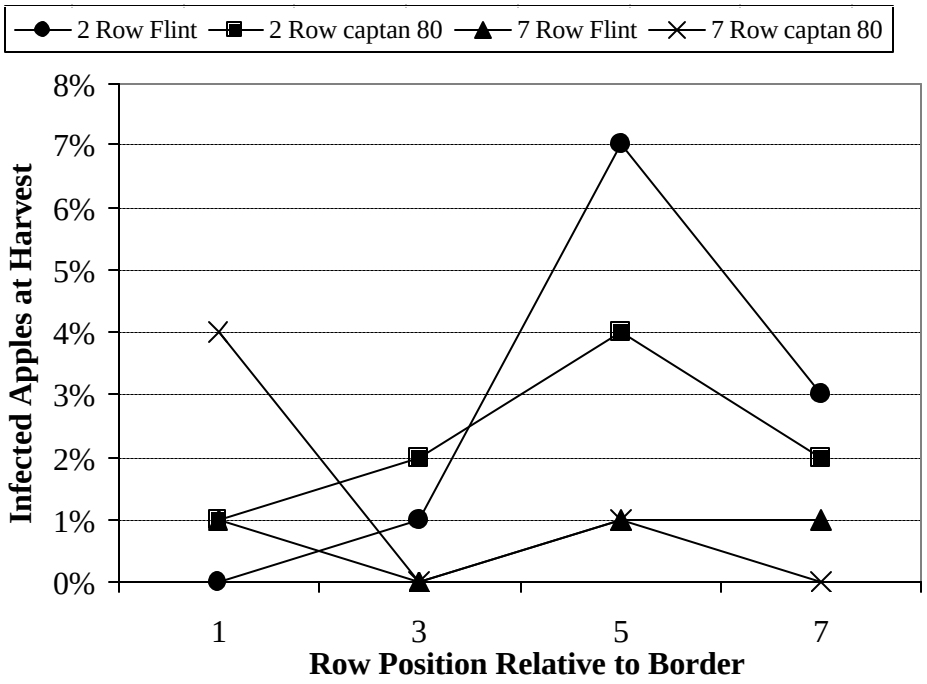
Figure 4. Percentage of apples infected with flyspeck at harvest versus the distance to principal border (parallel to the block): Harvard, Berlin, Warren, North Brookfield, perimeter-rows captan treatment, 2001.

FS was discovered in row 1 at the Harvard site on July 16, in both the Flint (9%) and captan (13%) perimeter-rows spray treatments. At the Berlin site, FS was found initially on August 27, in rows 3, 5, and 7, of all but the seven-row Flint treatment. FS was first discovered at the Warren site on August 29, in row 5 of the perimeter-row captan treatment. At the North Brookfield site, FS was found on August 15, in both the perimeter-rows Flint and captan treatments. The Shelburne site first had apples infected with FS on August 16, in the unsprayed rows of the perimeter-row spray treatments of Flint and captan. FS was not found at the Hawley site, despite counts continuing into early October. It was not surprising, given the absence of FS on alternate host plants within the surrounding border in June.

When harvest counts (September 6 to 13) from all treatments and all rows of all sites were compared (Figure 5, upper graph), Flint treatments had as little or less FS than captan treatments in rows 1, 3, and 7. The perimeter-rows Flint count (6% infected fruit) was slightly higher than the perimeter-rows captan treatment (5%), but overall, Flint compared favorably to captan. The lowest average FS incidence was found in the seven-row Flint treatment. The perimeter-row captan treatment had the most FS, with 17% of fruit infected in row one. This high average number was greatly influenced by the 100% incidence in this treatment and row at the Harvard site. When the Harvard data were omitted (Figure 5, lower graph), FS incidence in this row and treatment was reduced to 1%. Row 5 of the perimeter-row Flint treatment had the next highest FS incidence, with 7% of fruit infected. With Harvard omitted, FS incidence in row 5 of all treatments was greater or equal to the FS incidence in rows 3 and 7 of the respective treatment.



All 6 Sites 9/6-9/13



5 Sites (Harvard Omitted)

Figure 5. Percentage of apples infected with flyspeck at harvest in rows one (next to border) through row seven (from border) in Massachusetts apple orchards with four fungicide treatments, 2001.

Conclusions

The new environmentally benign fungicide, Flint, performed as well or better than the older broad spectrum fungicide, captan. This finding was supported by similar results in our twelve-block "Orchard Architecture" experiment in which a Flint-captan-Flint three-spray summer program was as effective as a first-Level IPM program. Other work of ours in small plot trials in MA and RI and work reported by Dave Rosenberger in New York indicate Flint and the other new strobilurin fungicide, Sovran, are quite effective against FS and scab. A task for 2002 is to determine the minimum amount strobilurin necessary to control different levels of FS infection.

At two of the sites, the perimeter-rows spray treatment worked as well as the seven-row spray treatment. These were sites with relatively low levels of FS in the borders adjacent to the blocks. At the other four sites, there was more FS in the apples in rows 3, 5, and 7 of the perimeter-rows spray treatment blocks than in the corresponding rows of the seven-row spray treatment blocks. Among unsprayed rows, row 5 had the most FS, while row 3 had less (presumably due to spray drift from rows 1 and 2), and row 7 had even less than row 3. FS showed-up earliest in the site which had the highest amount of FS in the border in June (Harvard).

For adequate management of FS, blocks with relatively high FS levels in the border areas will either require spraying further into a block than row 2 or removal or treatment of FS in the borders. We will test these findings further in the second year of the study. We will also attempt to control for spores that might be entering the research blocks from border areas to the sides and rear of the blocks.

References

Cooley, D.R. et al. 1996. Orchard site factors related to incidence of FS in apples. *Fruit Notes* 61(2): 1-4.

Acknowledgements

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