Slowing Spread of Lettuce Infectious Yellows Virus With Stylet Oil

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ABSTRACT

Infection by lettuce infectious yellows virus was reduced in lettuce treated with stylet oil. There was a difference in the final infection level between treated and untreated blocks and reduced infection in early readings. Yields were slightly better in the treated blocks. It has not been determined if and under what conditions it would be feasible to use this treatment on a practical scale.

BACKGROUND

Damage to lettuce from the infectious yellows virus (LIYV) occurs only when young plants are infected. A delay in the time of infection may result in higher weight for the individual heads and therefore greater overall yield. This virus problem is serious because of the large number of widely scattered virus source plants which are active when the young lettuce plants emerge. The virus is introduced to the field by abundant insect vectors in the area and spread within the field.

The goal of this research program is to find ways of reducing or slowing early introduction and spread of LIYV in lettuce fields. Because of the characteristics of the disease there seems to be no single or simple way of doing this. The ideal way of controlling virus diseases, is to have virus-resistant varieties. While some resistance has been observed in wild lettuce to LIYV, there seems to be little hope that it will provide an early solution. There also does not appear to be any weak link in the disease cycle, as with seed transmission in lettuce mosaic, that could lead to a successful single-action management approach.

The two targets for any successful management scheme for lettuce infectious yellows would be to reduce or avoid the whitefly vector populations and/or the weed and crop plants that serve as the alternate hosts of the virus. Actions to do this are sometimes successful but always hard to measure and, as a consequence, often difficult to recommend successfully for implementation.

OBJECTIVE

Test the feasibility of stylet oil as a means of slowing spread of lettuce infectious yellows virus.

PROCEDURES

In cases where stylet oil has been successfully demonstrated to reduce or slow virus spread, large areas have been sprayed (several acres) because the anticipated effect is additive (3). The research this year was an expansion and modification of the experiment that showed promise in 1988 (2). The stylet oil experiment has been enlarged considerably and a new system used for analyses.

The experimental area was a 10-acre field of lettuce planted on September 15, 1989, on The University of Arizona Yuma Agricultural center. A high pressure sprayer was purchased and modified as required for application of the stylet oil (420 psi). The field consisted of 860 rows on 430 beds. The field was divided into four treatment blocks each approximately 2.5 acres and initially consisting of 200 rows. The oil was applied twice weekly to two of the four blocks (Figure 1). Because of this application schedule, the required irrigation frequency interfered with the spray schedule so alternate 10-row segments in each block were disked clean and left dry. The remaining ten, 10-row segments in each experimental block contained lettuce. Thus spraying and irrigation could occur simultaneously and all spray schedules maintained. Spraying commenced immediately after thinning. Treatments were applied on Monday and Thursday through the end of November. In all, 16 oil applications were made.

The four data plots were located on two of the four beds in each of the ten 10-row segments in each treatment block, two on the east end and two on the west end. Plots consisted of 40 plants located on adjacent rows on a bed in each area. Thus, there were 160 plots altogether with a total of 6,400 plants from which disease data were taken. Figure 1 represents the diagrammatic representation of the experiment and the construction of the individual data plot. Figure 2 shows the data plot and how different sections are exposed to external vector flights.

Data were acquired periodically (Table 1) on symptoms by visually scoring the plants. Early in the experiment a series of lettuce plants were checked with our improved ELISA system to confirm that our visual reading system was accurate (1). Only one plant failed to react positively with LIYV antiserum that was judged visually to be infected with LIYV. At the end of the experiment, yield data were taken by collecting 24 consecutive heads of lettuce from each plot and weighing them. In 80 of the 160 data plots, the heads harvested to be weighed were also scored for marketability based on size, firmness, and appearance. Large treatment blocks (2.5 acres) were used to maximize the opportunity for the stylet oil to be effective. This meant only two replications were possible.

RESULTS

Several conclusions can be drawn from the data. First, although the stylet oil may delay the onset of symptoms, it does not eliminate virus symptom expression (72% of the sprayed plants showed symptoms; Table 1). Second, consistent with last year's results, we observed fewer plants with symptoms in sprayed plots (Table 1) and a higher percentage of marketable heads in sprayed plots (Table 2). Third, counting marketable and unmarketable heads together, there was very little difference in average head weight (Table 2).

We will run an additional experiment using stylet oil during the summer of 1990 to see if the spread of leaf crumple, a whitefly transmitted virus disease of cotton can be slowed with this technique. Leaf crumple offers an additional opportunity to investigate the potential of stylet oil in a host that presents some attractive field research possibilities that are difficult to duplicate with lettuce. The outcome would be used to redesign an additional lettuce experiment in the fall of 1990 if results with cotton leaf crumple warrant it.

In summary, our research with stylet oil to date continues to suggest potential. At this moment we are still not in a position to recommend it as a sole treatment for control of lettuce infectious yellows virus.

In another article in this report, there is a description of techniques we are attempting to develop to analyze and display data to evaluate multiple-action management schemes to reduce the impact of the virus. Stylet oil sprays can be evaluated further for possible subtle positive effects as part of this work.

The virus disease data were subjected to statistical analysis to see if significant differences in levels of infection occurred and to determine the kind of disease spread that took place in sprayed vs. unsprayed plots. Figures

4-6 display disease data by treatment block on the three reading dates. Significant differences at the .05 level are indicated by different letters associated with each treatment. Runs analyses are conducted on the data from each plot. Disease data were recorded on a grid so that the date specific plants became infected is recorded. This is necessary for runs analysis. Runs analyses shows how disease was spread in the field (defined in Figure 3) and provides additional information on the effects of the oil treatment on virus spread.

The data (Table 3) suggest that virus infected plants are not uniformly distributed throughout the blocks early in the epidemic (10/19/89), but, the distribution becomes random as the epidemic develops. Plan-to-plant spread (Figure 3) is not significant until late in the epidemic and then only in the center two blocks. It may be possible that the end blocks continue to have virus introduced in a random manner from outside the field that breaks up the in-field runs of healthy plants (more runs). The center blocks, on the other hand, may not have as much random introduction from outside and the runs of healthy and diseased plants are therefore longer. Under this scenario, the source of virus in the center blocks might come predominantly from within the field spreading from plant-to-plant. The stylet oil did not have an impact upon the distribution of the infected plants in the field as compared to the nontreated checks, however, the oil did significantly reduce the number of infected plants.

REFERENCES

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3. Simons, J.N. 1982. Use of oil sprays and reflective surfaces for control of insect-transmitted plant viruses. Pages 71-93. In: Pathogen, Vectors, and Plant Diseases. Academic Press, N.Y. K. Harris and K. Maramorosch (eds.).

Table 1. **Number of lettuce plants showing symptoms of lettuce infectious yellows observed in sections of the field with and without repeated application of stylet oil spray.**

Date of observation	Sprayed[a]	Unsprayed[b]
October 19	48 (1.5%)	140 (4%)
November 3	260 (8%)	348 (11%)
November 15	2,300 (72.1%)	2,656 (83%)

Table 2. **Percentage of lettuce heads scored as marketable and average weight of all heads harvested from plots located in sprayed or unsprayed parts of the field.**

	Sprayed[a]	Unsprayed[b]
Percentage of heads marketable[a]	40%	32%
Average weight per head[b]	1.2 lb	1.1 lb

[a]Each percentage is based on 960 heads scored from 10 plots in each of two sections of the field.

[b]Averages include weights of both marketable and unmarketable heads; each value is the mean of 1920 head weights from 20 plots in each of two sections of the field.

Table 3. Analysis of the pattern of plants with symptoms of LIYV at 3 dates and the mean number of plants per plot showing symptoms.

10/19/89	variance/ mean	Patchiness	K	Z-score	mean
Block-1 oil	clumped	clumped	clumped	no plant-plant	0.7 a
Block-2 check	clumped	clumped	clumped	no plant-plant	1.4 bc
Block-3 check	clumped	clumped	clumped	no plant-plant	0.5 ab
Block-3 check	clumped	clumped	clumped	no plant-plant	2.1 c
11/15/89					
Block-1 oil	random	random	random	no plant-plant	3.7 b
Block-2 check	random	random	random	no plant-plant	2.9 ab
Block-3 check	random	random	random	no plant-plant	2.8 a
Block-4 check	random	random	random	no plant-plant	5.8 c
11/03/89					
Block-1 oil	random	random	random	no plant-plant	29.7 a
Block-2 check	random	random	random	plant-plant	31.7 b
Block-3 oil	random	random	random	plant-plant	28.5 a
Block-4 check	random	random	random	no plant-plant	34.7 c

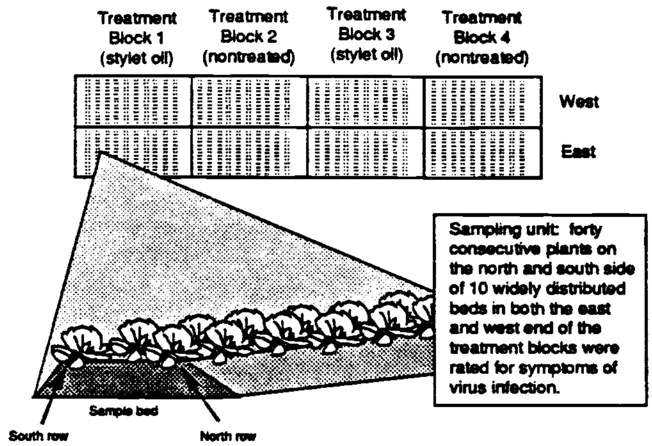

Figure 1. Field plot orientation and sampling unit description.

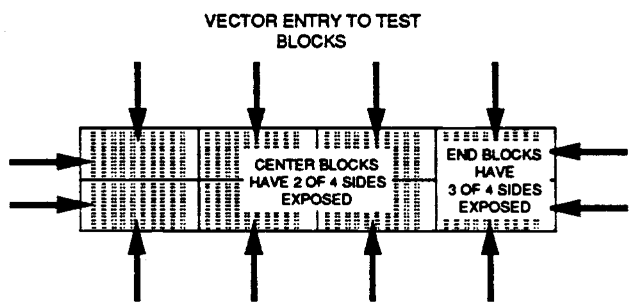

Figure 2. Possible directions from which the vector may enter the treatment blocks.

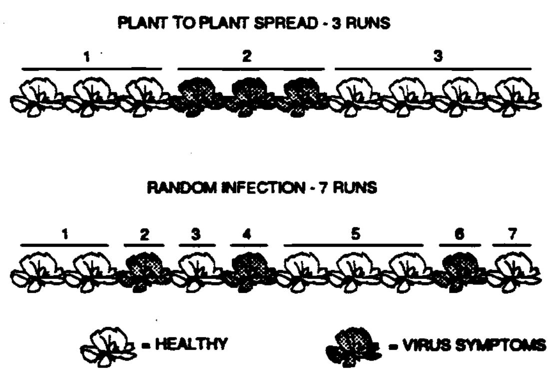

Figure 3. Ordinary runs analysis to indicate plant-to-plant spread of disease. Too few "runs" indicate that the disease is spreading from plant-to-plant. Plant-to-plant spread was only significant at the November 15th sampling date and then only for blocks 2 and 3.

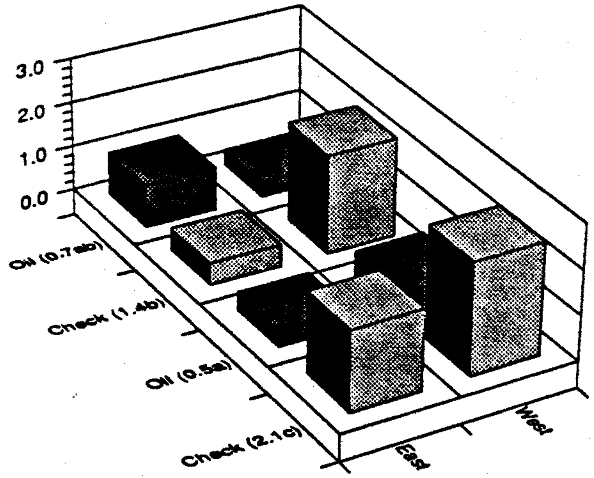

Figure 4. October 19. 1989 evaluation of disease prevalence. Each cube represents the average number of diseased plants in a 40 plant sample (10 rows of 40 plants per row). Refer to Figure 1 for a description of the field trial design. The mean of both the east and west sections for each treatment block is listed after the treatment [eg. Oil(0.7ab)]. Numbers followed by the same letter are not significantly different (LSD p=0.05).

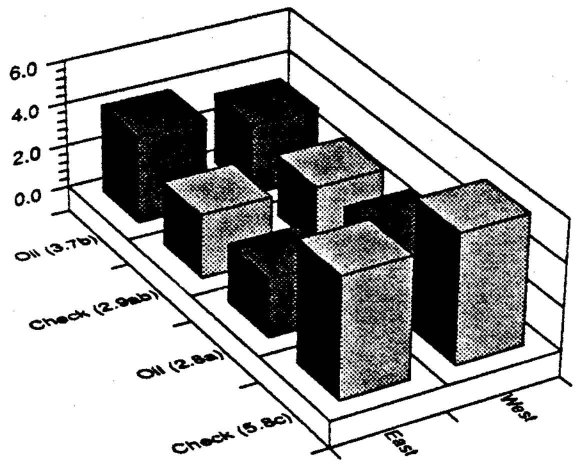

Figure 5. November 3, 1989 evaluation of disease prevalence. Refer to Figure 4 for a detailed description.

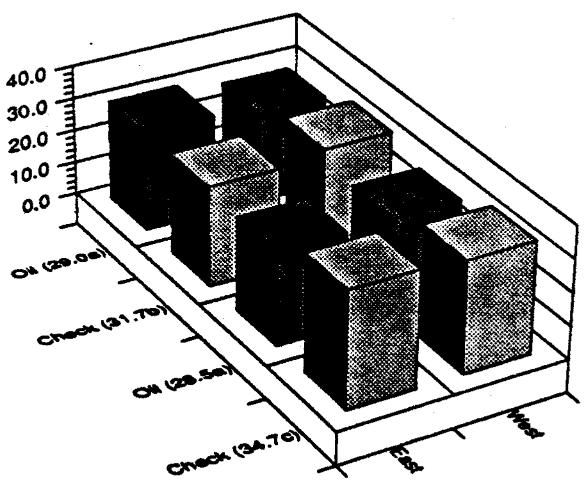

Figure 6. November 15, 1989 evaluation of disease prevalence. Refer to Figure 4 for a detailed description.