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CALIFORNIA ICEBERG LETTUCE RESEARCH PROGRAM

Annual Report April 1, 1977 through March 31, 1978

PROJECT TITLE: Lettuce virus and virus-like diseases (1977-78)

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OBJECTIVES: Assessment of effect of methyl bromide and Vorlex on big vein of lettuce, test breeding lines of lettuce for resistance to Olpidium brassicae and lettuce big vein agent

PROCEDURES AND RESULTS:

Methyl bromide fumigation. The plot for the 1977 crop was treated in November 1976. The main treatment consisted of two replicates each of nontreated and of methyl bromide at 200 lb/A with plastic tarping. These ranged from 0.3 to 1.2 acres in size. One replicate each of methyl bromide at 400 lb/A for residue studies, and of methyl bromide gel (without tarp) at 100, 200, and 400 lb/A, were also included.

Soil samples were collected at planting time to determine the effectiveness of the fumigation. Three sample sites were located in each replicate and samples were taken at depths of: bed top, 6 inches, 1 ft and 2 ft. Plant parasitic nematode populations were low in the untreated soil; there were 1-3 sugar beet nematode larvae and 0-3 Tylenchorynchus sp. in 250 ml of soil collected at the 6" depth. There were none in similar samples from two replicate plots fumigated with methyl bromide (200 lb/A).

Pythium spp. were assayed quantitatively in soil samples collected at the 6" depth using a selective medium. The average number of propagules/gram of soil was reduced from 291 in the nontreated replicates to 166 in the methyl-bromide gel at 100 lb/A, to 2 in the methyl bromide 200 lb/A plots, and to 0 in the plots with methyl bromide gas at 400 lb/A or the methyl bromide gel at 200 or 400 lb/A.

In soil samples from nontreated plots, Olpidium brassicae, the vector of the big vein agent, was consistently recovered in all samples collected from the bed top down to the 2 ft depth. It was present in some, but not all, of the samples from the plot treated with methyl bromide gel at 100 lb/A. It was not detectable in any of the plots treated either with gas or gel at 200 or 400 lb/A except for a few samples from the 2-ft depth in the plot treated with 200 lb of methyl bromide gas.

During the first crop (planted 28 January 1977) and the second crop (planted 7 July 1977) data were collected from all the plots. Because only the main treatment of 200 lb/A of methyl bromide gas and the nontreated controls were replicated, the data from these plots are summarized in Table 1 with the

results of statistical analyses (t-tests). Unfortunately, harvest data from the second cutting of the first crop were not obtained. Fumigation reduced the incidence of big vein in both crops, increased the uniformity and rapidity of development so the first cutting yielded significantly more lettuce, and increased the bromide content of the lettuce. None of the samples exceeded the 60 ppm tolerance. The results from the methyl bromide gas at 400 lb/A were similar to those from the 200 lb/A rate; bromide residues were determined on three samples and these did not differ significantly from the 200 lb rate. Likewise the results from methyl bromide gels at 200 or 400 lb/A did not differ significantly from the results from the methyl bromide gas at 200 lb/A. The gel at 100 lb/A was inferior to the higher rates.

Table 1. Results from 1978 methyl bromide fumigation trial.

	Vigor[1] gm	% BV[2] at harvest	Yield (Ctn/A) 1st cut	2nd cut	Total	Nitrate[3] Br[3] ppm	N ppm	P[3] %	K[3] %
First Crop									
Nontreated	28.35	82	76.5	-	-	5.58	4250	0.57	4.23
MB 200 lb/A	35.12	0	656	-	-	25.68	4290	0.63	4.15
Significance[4]	N.S.	S.	S.			S.	N.S.	N.S.	N.S.
Second Crop									
Nontreated	-	40.5	230	246	476	8.03	-	-	-
MB 200 lb/A	-	25.0	495	169.5	664.5	17.3	-	-	-
Significance		S.	S.	N.S.	S.	S.			

[1]Vigor based on weight of duplicate samples, each of 5 randomly collected plants, in each replicate.

[2]Based on 4 sub plots each of 25 plants in each replicate.

[3]Based on three composite samples each consisting of four heads from each replicate.

[4]S = significant at 5% level; N.S. = not significant at 5% level.

The conclusions from this plot and our previous plots are consistent. 1) Proper fumigation with methyl bromide can effectively reduce the population of Olpidium brassicae in the soil to a very low level. Olpidium, however, is not totally eradicated. In this 1977 trial it was recovered from 11 of 12 samples collected at the 1 ft depth when the second crop was harvested. 2) The reduction in Olpidium is directly related to a reduction in the incidence of big vein in the first two lettuce crops after fumigation. 3) Fumigation results in a more uniform and, especially in the first spring crop of lettuce, an earlier maturity. This is shown by the yields at the first cutting. The reasons for this are not clear. Control of big vein does not seem to be the critical factor. As shown in previous trials, plants with big vein in chloropicrin plots were comparable in size, early maturity, and uniformity to those without big vein in the methyl bromide plots. A similar response from fumigation has been seen in many crops and has been attributed to at least two factors. One is control of "minor" or "root-nibbling" pathogens. We found that Pythium populations in the soil were reduced to zero in this plot. Likewise, root infections when the crop was 6 weeks old were reduced from 14 per 100 root segments (each 3/4 inch long) to zero. We have attempted a growth chamber

trial to test the effects of Pythium. Fumigated soil was used with treatments consisting of a) Pythium added, b) Olpidium added, c) both Pythium and Olpidium added or d) no pathogens added and incubation at 54 or 64°F. Pythium caused no reduction in plant weight at either temperature. The second factor that has been suggested to account for growth stimulation is nutritional. This occurs because fumigation upsets the nitrogen cycle in the soil. We did not collect data on soil nitrogen as the crop was growing. Tissue analysis at maturity showed no significant difference between plants from fumigated or nonfumigated soil (Table 1). These data do not prove or disprove the nutritional hypothesis. Additional research would be needed to fully explain the growth response of lettuce to fumigation.

Vorlex soil treatment. As a result of a trial in 1976 in which lettuce showed a marked response to Vorlex, two plots were treated in December 1976 and the following crop was observed. Each plot had four replications of Vorlex at broadcast rates of 25 and 50 gal/A and a control; the Vorlex was injected into pre-listed beds 6-8" deep through three shanks. Each replication was four beds wide and the length was 200 ft in trial 1 and about 560 ft in trial 2. Soil samples were collected at the 8-inch depth at planting time for assays of nematodes, Pythium spp., and Olpidium brassicae. Vorlex at either rate reduced the small population of larvae of sugar beet cyst nematode and Tylenchorynchus sp. below the threshold of detection; reduced the Pythium sp. from 281 propagules/gm to 0 in plot 1 and from 485 propagules/gm to 22 in plot 2; had no detectable effect on Olpidium populations. The treatments had no effect on plant vigor in samples collected at 5-7 weeks after planting, or on incidence of big vein at harvest, or on yield. In the larger plot (#2) at harvest time the plants on treated soils were slightly larger and had firmer heads. Although this difference was readily detected by the harvest crews, it was not reflected in the vigor data or the yield data.

Although Vorlex had no demonstrable effect on Olpidium field fumigation plots, it can kill Olpidium in containers. We treated some of the same soil in a closed container at 60-68°F for 7 days with Vorlex at the equivalent of 35 gal/A. Olpidium was killed by this treatment. The fungicidal activity of Vorlex in closed containers is not achieved in open field soils.

Testing for Olpidium and big vein resistance. Breeding lines selected by Dr. Ryder were tested in greenhouse or growth chambers. The resistance to Olpidium was tested in 5 trials. In each trial two replicates each with 25 seedlings (4-day-old) were inoculated with a known number of zoospores and incubated 4 days. Then the number of zoospores that had been produced during a single generation was determined. It is assumed that the number of zoospores produced reflects the suitability as a host. In two trials 10 seedlings from each of the two replicates were then transplanted and kept in a cool chamber for expression of big vein symptoms. Olpidium reproduced adequately in all selections (Table 2). There was a gradation in reproduction. The selections most susceptible to big vein were the most suitable for Olpidium, however, even the selections that were most resistant to big vein were suitable hosts for Olpidium.

Table 2. Results of tests of Olpidium reproduction in big-vein resistance of selections from Dr. Ryder

Cultivar or breeding line	Olpidium reproduction in 5 trials[a]	Big-vein symptoms in 10 wk[b]	
		Trial 1	Trial 2
Climax[c]	146.7	20	20
72-119-M-1	103.7	20	19
76-160M-1	68.0	11	7
Merit[c]	51.3	14	6
70-612 M	46.0	7	2
71-31-1	46.6	5	4
73-34-MSA[c]	47.1	10	4
72-144M-1	27.7	8	3
72-136M-1	28.5	7	4
72-142M-1	25.3	6	6

[a]Number of zoospores X 10^{-5} released from two replicates of 25 plants of each selection, average from 5 trials. An average of 263 X 10^{5} zoospores was used as inoculum in these trials.

[b]Number of plants with big vein out of 20 plants (2 replicates of 10 plants) in each trial.

[c]These varieties were included as controls; Climax was the susceptible control and the others were resistant (73-34-MSA is a big-vein-resistant selection from J. W. Welch).