Cut Rose Production Increase With Nematode Control

These experiments show that with the use of a particular application technique, DBCP (1,2-dibromo-3-chloropropane) effectively reduces the nematode population around the roots of greenhouse rose plants. The reduction in population of these nematodes in the soil also resulted in increased flower production. At the end of the 26th week after the first treatment there were approximately 13,000 more blooms per acre in the Pink Sensation variety plots, and 19,000 more blooms per acre in the Golden Wave plants, as compared with the untreated check plots.

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SEVERAL NEMATODE GENERA have been reported to exist in association with roses. A preliminary study showed that *Meloidogyne hapla* could be controlled in container-grown roses by the flood application of 1,2-dibromo-3-chloropropane (DBCP). This report is concerned with both the control of nematodes in commercial rose plantings and the effect on rose production of reducing the nematode population.

The test plots were established in a heavily infested commercial rose planting. The most numerous species found were *Xiphinema americanum* and *Meloidogyne hapla*. Also present in lower numbers were *Pratylenchus, Tylenchorhynchus,* and *Paratylenchus* species. Two of the rose varieties, Tiara and Pink Sensation, were grown on Manetti rootstock. The variety Golden Wave was grown on Dr. Huey rootstock.

The experimental plots were raised beds 4 ft wide by 49 ft long. The soil in the beds was native to the area, but had been heavily amended with redwood shavings. A tile drain was positioned in the center of the bed at the bottom of the cultivated area. The plants were grown in approximately 8 inches of soil and each plant occupied about 1 sq ft of bed.

In the course of this investigation, four experiments were conducted. In the first test, single beds were subdivided into 16 plots, each 3 ft long. The test consisted of five treatments replicated three times. Single plots were used to test a higher application rate of two chemicals. Duplicate treatments were tested on two rose varieties, Pink Sensation and Tiara.

The test chemicals were 0,0-diethyl 0-(p-(methylsulfinyl)phenyl) phosphorothionate (Dasanit, BAY 25141); ethyl 4-(methylthio)-m-tolyliso-propylphosphoramidate (BAY 68138); and 1,2-dibromo-3-chloropropane (DBCP). BAY 68138 was used at the rate of 2.5 and 5 lbs per acre. Dasanit was tested at 5 lbs per acre, and DBCP was used at the rate of 1 gallon per acre. Single plots were

TABLE 1. AVERAGE NUMBER OF NEMATODES RECOVERED FROM 50 CC of SOIL

Treatment	X. americanum	M. hapla
	Av. No.	Av. No.
Check	111 ± 10	56 ± 30
DBCP–1 gal/A	92 ± 28	51 ± 22
DASANIT—5 lb/A	158 ± 36	56 ± 18
BAY 68138–2½ lb/A	99 ± 43	84 ± 42
BAY 68138–5 lb/A	164 ± 31	26 ± 12
BAY 68138–10 lb/A	147	3
DASANIT–10 lb/A	108	26

TABLE 2. THE RECOVERY OF DBCP AND M. HAPLA FROM SOIL TREATED IN POTS

Time	DBCP	M. hapla† 50 cc soil
No. weeks	(ppm)*†	Av. No.
0 (Treatment 1)	0.0	108
1 (Treatment 2)	3.3	137
2 (Treatment 3)	7.3	238
3	10.4	186
4	13.5	4
5	4.1	1
6	2.8	0
7	1.3	0
8	1.1	1

* μg DBCP/g oven dry soil
† Mean of 3 replicates

TABLE 3. AVERAGE NUMBER OF NEMATODES RECOVERED FROM 50 CC OF SOIL AND DBCP CONCENTRATIONS IN PLOTS FOLLOWING TRIPLE TREATMENT

Time	X. americanum†		M. hapla†		DBCP
	Treated	Check	Treated	Check	
No. weeks	Av. No.	Av. No.	Av. No.	Av. No.	Ppm*†
0	12	38	8	16	0
1	3	44	8	52	2.1
2	2	48	1	15	6.3
3	10	52	10	21	6.0
4	0	35	0	5	4.1
5	2	44	0	4	2.6
6	0	99	0	9	2.0
7					1.5
8					1.3

* Ppm DBCP (μg/g Soil)
† Mean of 3 replicates

TABLE 4. AVERAGE NUMBER OF XIPHINEMA AMERICANUM AND MELOIDOGYNE HAPLA RECOVERED FROM 50 CC OF SOIL AND THE CONCENTRATION OF DBCP IN THE TREATED BEDS.

Time	X. americanum†		M. hapla†		DBCP
	Treated	Check	Treated	Check	
No. days	Av. No.	Av. No.	Av. No.	Av. No.	Ppm*†
0	100 ± 20	85 ± 15	46 ± 14	53 ± 21	0
7	–	–	–	–	2.9 ± 0.5
14	–	–	–	–	4.5 ± 0.6
22	49 ± 11	150 ± 22	9 ± 3	143 ± 58	5.8 ± 0.8
29	59 ± 26	87 ± 11	11 ± 5	39 ± 8	5.0 ± 0.6
36	6 ± 3	183 ± 34	7 ± 5	94 ± 32	3.6 ± 0.4
50	4 ± 2	117 ± 24	4 ± 2	104 ± 30	1.8 ± 0.1
64	2 ± 1	122 ± 30	2 ± 1	19 ± 10	1.5 ± 0.2
85	<1	156 ± 43	2 ± 1	72 ± 19	0.6 ± 0.1
113	0	116 ± 11	<1	47 ± 25	0.2
154	<1	121 ± 42	1	29 ± 8	<0.1
190	0	93 ± 11	1 ± 1	29 ± 8	–

* Ppm DBCP (μg/g Soil)
† Mean and standard error—6 replicates

treated with 10 lbs per acre of BAY 68138 and Dasanit.

The emulsifiable concentrates were diluted with water and applied through a hose with an aspirator for mixing. Each plot was treated with approximately 2 inches of water emulsion. The plots were sampled five weeks after treatment and the nematodes were extracted under mist.

Greenhouse test

In a greenhouse test, roses infested with *M. hapla* growing in 1-gallon containers were treated with DBCP. The treatment consisted of drenching the soil with the equivalent of 1 acre-inch of water (0.62 gallon per sq ft) containing 100 ppm (w) DBCP (37.1 ml 50 per cent E.C. per 100 gallons) at weekly intervals. The plants were not watered between treatments. Samples were taken weekly to evaluate the effect of the treatment on the nematode population and to study the behavior of the DBCP. The nematodes were extracted under mist and DBCP was recovered from the soil and analyzed.

The next test was conducted in the commercial planting in 3 × 4 ft plots. In this test the E.C. formulation of DBCP was mixed with water in a container and poured on the plots. Soil samples were taken at weekly intervals to check numbers of nematodes and DBCP content. The treatment and check were replicated three times.

In the final test, entire beds of two varieties were treated. The E.C.-DBCP was mixed in a galvanized container and pumped to the beds. The emulsion was distributed over the beds manually by moving a hose slowly down the length of the 49-ft bed. All beds were sampled weekly for nematodes and DBCP for five weeks and thereafter less frequently. Collection of production data was initiated seven weeks after application of the first treatment.

Results

The first experiment with BAY 68138, Dasanit, and DBCP (table 1) shows that none of the materials reduced the nematode populations after five weeks. The pot test (table 2) shows an abrupt decrease in the numbers of *M. hapla* recovered between the fourth and fifth weeks. The DBCP data show a steady increase in concentration of this chemical in the soil until the fifth week, at which time the concentration begins to decrease. Table 3 gives the results of the small plot triple treatment with DBCP. The nematode density in all plots was low. The treated plots had the same nematode density-time trend as those in the pot test. The DBCP recovered from these plots shows the same concentration-time pattern observed in the pot test.

Table 4 gives the results of the final experiment with the large planting beds. The pattern of nematode population reduction and the quantity of DBCP recovered from the soil is the same as in the two preceding tests. The decrease in the number of nematodes recovered from the treated plots occurs between the 29th and 36th day (in weeks 4 and 5) after the start of the experiment.

The collection of production data began seven weeks after the first application of the treatment. By this time a reduction in the nematode populations could be measured. The cumulative total number of blooms produced per bed was higher in the treated than in the untreated beds. At the end of the 26th week after the first treatment there was an average of 61 more blooms per bed in the treated Pink Sensation plots and 87 more blooms in the Golden Wave plots than in the untreated plots.

These experiments show that when the proper application technique is used, DBCP effectively reduces nematode populations around the roots of living plants. Past studies have shown that effective control of *M. javanica* with DBCP requires a 21-day exposure to a concentration between 20 and 25 ppm. DBCP can disappear from the soil by vaporization and leaching. Applications of DBCP should be repeated over a relatively short time interval to help maintain a lethal concentration for the required period of time. This study indicates that the same conditions that control *M. javanica* also control *M. hapla* and *X. americanum*.

These experiments show that the reduction in the population of these nematodes in the soil resulted in increased flower production. With a continuous harvesting of roses, yields show a cyclical pattern. It will be necessary to have yield records for an extended period of time to evaluate the efficacy of treatment and to determine the rate of increase in nematode populations.

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Control of

with

Verticillium wilt caused by Verticillium albo-atrum and sclerotinia white rot caused by Sclerotinia sclerotiorum are two diseases of commercial chrysanthemums in San Diego County. Previously, the only control of verticillium wilt was soil treatment with chloropicrin or steam prior to planting. In young plants sclerotinia can be prevented by these same soil treatments but tests reported here also show control possibilities by pre-plant application of fungicides on the soil surface. Sclerotinia control may be variable in a maturing cut-flower crop under moist greenhouse conditions where the fungus attacks high on the stems.

THREE EXPERIMENTS were conducted in commercial greenhouses to test new systemic fungicides and organic amendments for control of verticillium wilt. The third experiment coincidentally yielded results on sclerotinia control.

Experiment 1

Benlate 50W—formerly DuPont 1991—[methyl 1-(butylcarbamoyl)-2-benzimidazole-carbamate] was applied at rates of 1 lb and ½ lb per 1000 square ft of chrysanthemum bed. The fungicide in suspension was drenched over established four-week-old plants, White Iceberg variety, with a garden sprinkler can on October 11, 1967. Two gallons of solution were used per 80 sq ft treatment (180 plants). Each treatment was replicated three times.

No injury could be observed to the chrysanthemums. When the flowers reached harvest stage on January 8, 1968, a distinct difference in treatments was plainly visible. The untreated plots had yellow and necrotic foliage, typical