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Nematicide Seed Dressing for Cyst and Lesion Nematode Control in Wheat[1]

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Abstract: A trial was conducted in the northern Negev region of Israel in a field heavily infested with both cyst (*Heterodera avenae*) and lesion (*Pratylenchus mediterraneus*) nematodes. Wheat (*Triticum aestivum* cv. Bet Lehem) seeds were coated with either seed-dressing formulation of furathiocarb 10 g a.i./kg seed or emulsifiable concentrate formulations of carbofuran 10 g a.i./kg seed or oxamyl 3.6 g a.i./kg seed. Untreated seeds served as control. The trial was arranged in a randomized block design with six replicates. Two months after germination, the population density of *H. avenae* in three treatments was 10–20% of that of the control and that of *P. mediterraneus* was 20–35%. The height of the wheat plants in the treated plots was 150% of the control. Toward ripening, ear counts in the treatments were 20–31% higher than in the control. Grain yield of the treatments was 38–48% higher than that of the control.

Key words: carbofuran, cereal cyst nematode, furathiocarb, *Heterodera avenae*, lesion nematode, oxamyl, *Pratylenchus mediterraneus*, seed dressing, *Triticum aestivum*, wheat.

The northern Negev is a semi-arid region in Israel with an average annual rainfall of 200–300 mm, all occurring between November and April. Wheat is the main winter crop, covering a total area of ca. 50,000 ha. Most of the wheat is cultivated under dry farming conditions and thus renders modest yields. Because of a lack of economic alternatives, wheat is grown continuously, although the fields are fallowed from time to time. Under these conditions, buildup of the cereal cyst nematode (*Heterodera avenae* Woll.), probably mixed with *H. latipons* Franklin, and the lesion nematode (*Pratylenchus mediterraneus* Corbett) reaches damaging thresholds (1,2). Managing the nematodes by agrotechnical means, such as fallowing, or by nematicide application resulted in increases in the grain yield (2). A less expensive alternative method was needed, however, for a low-cash crop such as wheat in a semi-arid region. Following a small-scale field experiment in which wheat seeds coated with a seed-dressing formulation of furathiocarb gave promising results (3), a more extensive field study was conducted to develop a practical method to control plant-parasitic nematodes in wheat. The results are reported here.

MATERIALS AND METHODS

The experiment field, heavily infested with both the cyst nematode and the lesion nematode, was located in Kibbutz Sa'ad, in the northern Negev. Wheat (*Triticum aestivum* L. cv. Bet Lehem) seeds were coated with an emulsifiable concentrate formulation of carbofuran 10 g a.i./kg seed, a seed-dressing formulation of furathiocarb 10 g a.i./kg seed, and an emulsifiable concentrate formulation of oxamyl 3.6 g a.i./kg seed. Untreated seeds served as the control. Seed treatments were carried out 2–3 weeks before seeding. The experiment was arranged in a randomized block design, with four treatments in six replicates, each 4 × 50 m. Seeding at the rate of 125 kg/ha was carried out with a 4-m-wide drill in mid-December 1987. The experimental field was treated as in conventional practice. Seedling stand in a 3 × 1 m area in each plot was determined 2 weeks after germination. The height of 10 plants in each plot was measured six times during the season, and the number of ears per square meter was recorded close to wheat ripening in mid-April 1988. Nematode population levels were determined in root samples taken 60 days after germination.

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FIG. 1. A 4-week-old wheat plot grown from seeds coated with carbofuran (left) vs. untreated control (right).

Each sample consisted of 12 plants and 300 g soil taken from three locations in each plot. *Pratylenchus mediterraneus* was extracted by the mist chamber incubation method and a Baermann funnel. Young (white) cysts were collected by washing the wheat roots over a 120-μm-pore screen (ca. 325 mesh). At the end of May 1988 an area 34 m^2 in each plot was harvested with an experimental mechanical harvester and weighed. Subsamples were taken for 1,000-seed weight and volume weight.

RESULTS AND DISCUSSION

As early as 2 weeks after germination, the plots with seed treatments were superior visually in their deep green color and plant density, compared with chlorotic patches and sparse wheat plants in control plots (Fig. 1). No visual differences could be discerned among the three seed treatments. Seedling stand counts in the plots

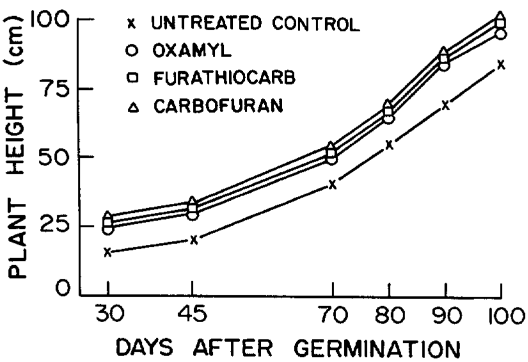

FIG. 2. Height of wheat plants taken six times during the growing season from plots that received various seed-dressing treatments.

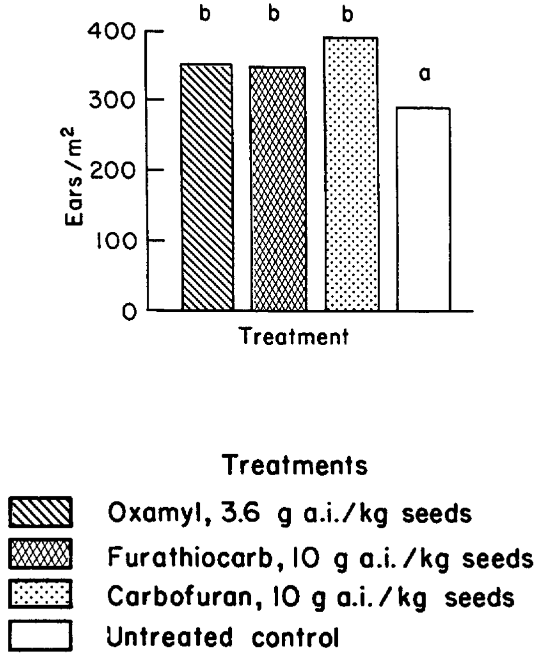

FIG. 3. Wheat ears from plants grown in plots receiving various seed-dressing treatments. Means followed by the same letter are not significantly different according to Duncan's multiple-range test ($P = 0.05$).

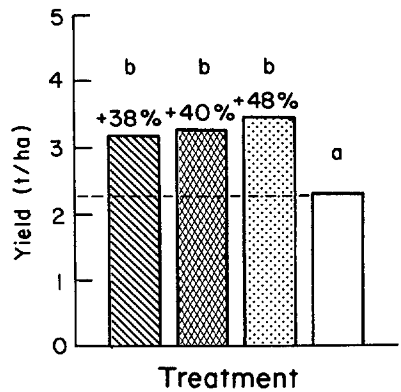

FIG. 4. Grain yield from plants grown in plots receiving various seed-dressing treatments. Percentages indicate grain yield increase over the untreated control. Means followed by the same letter are not significantly different according to Duncan's multiple-range test ($P = 0.01$). See Figure 3 for treatment key.

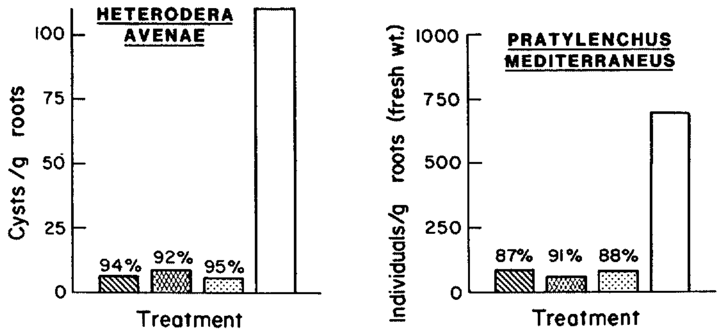

FIG. 5. Cyst (*Heterodera avenae*) and lesion (*Pratylenchus mediterraneus*) nematode levels in plots receiving various seed-dressing treatments, 8 weeks after germination. Percentages indicate nematode control over the untreated control. See Figure 3 for treatment key.

treated with carbofuran and the furathiocarb did not differ from the control (170–175 seedlings/m^2), whereas the seedling stand in the oxamyl-treated plots was 14.5% higher than that of the control. Differences in plant height between the treatments and the control continued throughout the growing season, thus indicating that growth of the control plants was hampered by the nematode during the early growth period (Fig. 2). All the seed-dressing treatments resulted in a tillering increase, as indicated by the ear counts per square meter (Fig. 3). The three seed-dressing treatments brought about a remarkable 38–48% yield increase over the untreated control, with carbofuran superior to the two other nematicides (Fig. 4). No differences in 1,000-seed weight (36.3–38.4 g) and in volume weight (79.9–80.9 kg/hl) were found among the treatments. Nematode population levels within the wheat roots of the various seed-dressing treatments 2 months after germination were 87–95% of the untreated control (Fig. 5).

These results indicate that seed dressing with nonvolatile nematicides at dosages of 475–1,250 g a.i./ha will control nematodes. Reducing nematode population levels enabled the young wheat roots to develop undisturbed and to function efficiently, resulting in a vigorous growth rate. Perhaps even more important, the treated wheat plants also were able to form more ears, contributing to high grain yield.

The nematicide seed-dressing application method also has environmental and economic advantages. Only a minimal amount of pesticide per unit area is applied, and this is degraded during the 6-month season, as indicated by residue levels below detection levels in preliminary tests of the grains and straw. From an economic point of view, seed dressing is a relatively inexpensive pesticide application method. The method is economically attractive to low-cash crops grown in marginal production areas.

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