Journal of Nematology 26(2):249–250. 1994.

Effects of Pesta-Pelletized *Steinernema carpocapsae* (All) on Western Corn Rootworms and Colorado Potato Beetles[1]

W. R. Nickle,[2] W. J. Connick, Jr.,[3] and W. W. Cantelo[2]

Abstract: Pesta-pelletized *Steinernema carpocapsae* (All) nematodes were used in soil treatments in the greenhouse against larvae of Western corn rootworm and prepupae of Colorado potato beetle. The pesta-pellets delivered 100,000 living nematodes/g. Infective-stage nematodes and their associated bacteria survived the pesta-pellet process, emerged from the pellets in large numbers in the soil, and reduced adult emergence of both pest insects by more than 90%.

Key words: biological control, *Diabrotica virgifera virgifera,* entomopathogenic nematode, formulation, *Leptinotarsa decemlineata,* nematode, pesta, *Steinernema carpocapsae.*

The need for practical delivery systems for steinernematid nematodes has stimulated research on granular and pelletized formulations for these biocontrol organisms. These formulations offer advantages over the currently used water suspension, including protection from desiccation and solar radiation, placement of the nematodes near the target insects beneath the soil surface, and modification to function as a bait (2,3). Calcium alginate capsules containing *Steinerema carpocapsae* and *Heterorhabditis heliothidis* have been described (7,8). A wheat flour-based pelletized formulation called "Pesta" was developed (4) as a mycoherbicide to encapsulate fungal weed pathogens. Recently, pesta was modified (5) to incorporate steinernematid nematodes.

Our objectives were to monitor the survival of infective-stage nematodes in the pesta production, nematode emergence from pesta pellets applied in the soil, and the ability of emerged nematodes to kill pest insects.

Materials and Methods

Cultures: The nematode tested was *Steinernema carpocapsae* All provided by Biosys (Palo Alto, CA). Second-instar larvae of Western corn rootworm (WCR), *Diabrotica virgifera virgifera,* were obtained from French Agricultural Research, Lamberton, Minnesota. Prepupae of Colorado potato beetles (CPB), *Leptinotarsa decemlineata,* came from the Vegetable Laboratory, Beltsville, Maryland, greenhouse colony.

Preparation of pesta granules: Ingredients included wheat flour semolina (Antoine's pasta flour, A. Zerega's Sons, Fair Lawn, NJ), kaolin (J. T. Baker, Inc., Phillipsburg, NJ), and Canadian peat ground and sieved through a 1 mm screen. Semolina (32 g), kaolin (6 g), and peat (2 g) were added to 35 ml water containing a suspension of 5×10^6 *S. carpocapsae* nematodes, rolled into 3-mm thick sheets and dried overnight; ca. 50 g pesta was made per batch (5). The sheets were broken manually and screened through screens with 2.36 and 0.85-mm openings. The pellets remaining on the sieve with finer openings were stored at 5 C for 2–4 weeks before being used.

Western corn rootworm: Caged 50 × 35 cm flats were planted with two rows of corn (*Zea mays* cv. Pioneer 3615) in greenhouse potting soil (30% peat, 26% perlite, and 44% loam); 200 second-instar WCR and the appropriate amount of pesta pellets (ca. 0.25 to 2.00 g) were added to deliver one of the three dosage rates of infective-stage *S. carpocapsae.* Control flats contained

Received for publication 14 April 1993.

[1] This paper reports the results of research only. Mention of a proprietary product does not constitute an endorsement or recommendation for its use by the U.S. Department of Agriculture.

[2] Nematology Laboratory and Vegetable Laboratory, USDA ARS, Beltsville, MD 20705.
[3] Southern Regional Research Center, USDA ARS, P.O. Box 19687, New Orleans, LA 70179.

We thank Ms. Marla McIntosh, ARS statistician and Antonette K. Malabey, Naeema Latif, and Bob Reise of the Nematology Laboratory and Bob Bennett of the Vegetable Laboratory for technical assistance. We thank Ramon Georgis, Biosys, for providing the nematodes used in this study.

2 g of nematode-free pellets. There were two replicates of each dosage.

Colorado potato beetle: Ten prepupae each were added to plastic trays (22.5 × 13.5 × 7.5 cm deep) containing 1 liter of potting soil (1). The pesta pellets were weighed and appropriate amounts were incorporated into the soil to obtain the desired nematode numbers (25,000–100,000). Control trays contained 2 g of nematode-free pellets. There were 12 replicates of each of the four nematode pellet dosage rates.

Evaluation: Adult insects that emerged were recorded daily. Analysis of variance ($P \leq 0.05$) was conducted to determine significant differences among means of log-transformed data.

Results and Discussion

Significant reduction in adult WCR emergence occurred when nematodes were delivered by pesta pellets into the soil. The mean numbers of WCR adults that emerged from soil treated with 0, 50,000, 100,000, and 200,000 pelletized nematodes were 90.8, 28.5, 9.8, and 5.5. Only the latter two numbers were not different ($P \leq 0.05$) by Fisher's least significant difference test.

Nematodes emerged successfully from the pellets and killed the CPB prepupae. Only 0.25 g of pesta (25,000 nematodes), killed 94% of the prepupae. The mean numbers of CPB adults that emerged from soil treated with 0, 25,000, 50,000, and 100,000 pelletized nematodes were 65.8, 5.8, 0.8, and 0.0. Only the latter two numbers were not different ($P \leq 0.05$) by Fisher's least significant difference test. The level of control achieved with 25,000 pelletized nematodes in this study was the same as a 50,000-nematode drench in a previous study (1). Therefore, only half as many pelletized nematodes may be needed to effect the same control as achieved by a drench. Solar radiation and temperature are also important environmental parameters when nematodes are sprayed onto the soil surface.

Pesta works well for *S. carpocapsae* (All). Our present formulation can deliver between 100,000 and 600,000 nematodes/g of pellets. Thus, 9–14 kg/hectare row treatment would deliver the equivalent of 2.5 billion nematodes/hectare. In addition, the pesta used in this experiment was stored as dry free-flowing pellets at 5 C for 2–4 weeks before use. It is anticipated that these pellets may find use against soil insects. For WCR, optimal application would be as a side dressing with fertilizer during cultivation 6 weeks after planting, when the insect larvae are present in the soil. For other crops, pesta pellets could be applied in the furrow when the seeds are planted.

Literature Cited

1. Cantelo, W. W., and W. R. Nickle. 1992. Susceptibility of prepupae of the Colorado potato beetle (Coleoptera: Chrysomelidae) to entomopathogenic nematodes (Rhabditida: Steinernematidae, Heterorhabditidae). Journal of Entomological Science 27: 37–43.

2. Capinera, J. L., and B. E. Hibbard. 1987. Bait formulations of chemical and microbial insecticides for suppression of crop-feeding grasshoppers. Journal of Agricultural Entomology 4:337–344.

3. Capinera, J. L., D. Pelissier, G. S. Menout, and N. D. Epsky. 1988. Control of black cutworm, *Agrotis ipsilon* (Lepidoptera: Noctuidae), with entomogenous nematodes (Nematoda: Steinernematidae, Heterorhabditidae). Journal of Invertebrate Pathology 52: 427–435.

4. Connick, W. J., Jr., C. D. Boyette, and J. R. McAlpine. 1991. Formulation of mycoherbicides using a pasta-like process. Biological Control 1:281–287.

5. Connick, W. J., Jr., W. R. Nickle, and B. T. Vinyard. 1993. "Pesta": New granular formulations for *Steinernema carpocapsae*. Journal of Nematology 25: 198–203.

6. Jackson, J. J., and M. A. Brooks. 1989. Susceptibility and immune response of western corn rootworm larvae (Coleoptera: Chrysomelidae) to the entomogenous nematode, *Steinernema feltiae* (Rhabditida: Steinernematidae). Journal of Economic Entomology 82:1073–1077.

7. Kaya, H. K., C. M. Mannion, T. M. Burlando, and C. E. Nelsen. 1987. Escape of *Steinernema feltiae* from alginate capsules containing tomato seeds. Journal of Nematology 19:287–291.

8. Kaya, H. K., and C. E. Nelsen. 1985. Encapsulation of steinernematid and heterorhabditid nematodes with calcium alginate: A new approach for insect control and other applications. Environmental Entomology 14:572–574.