Biological control of root-knot nematode on peach

Graham R. Stirling ■ Michael V. McKenry ■ Ron Mankau

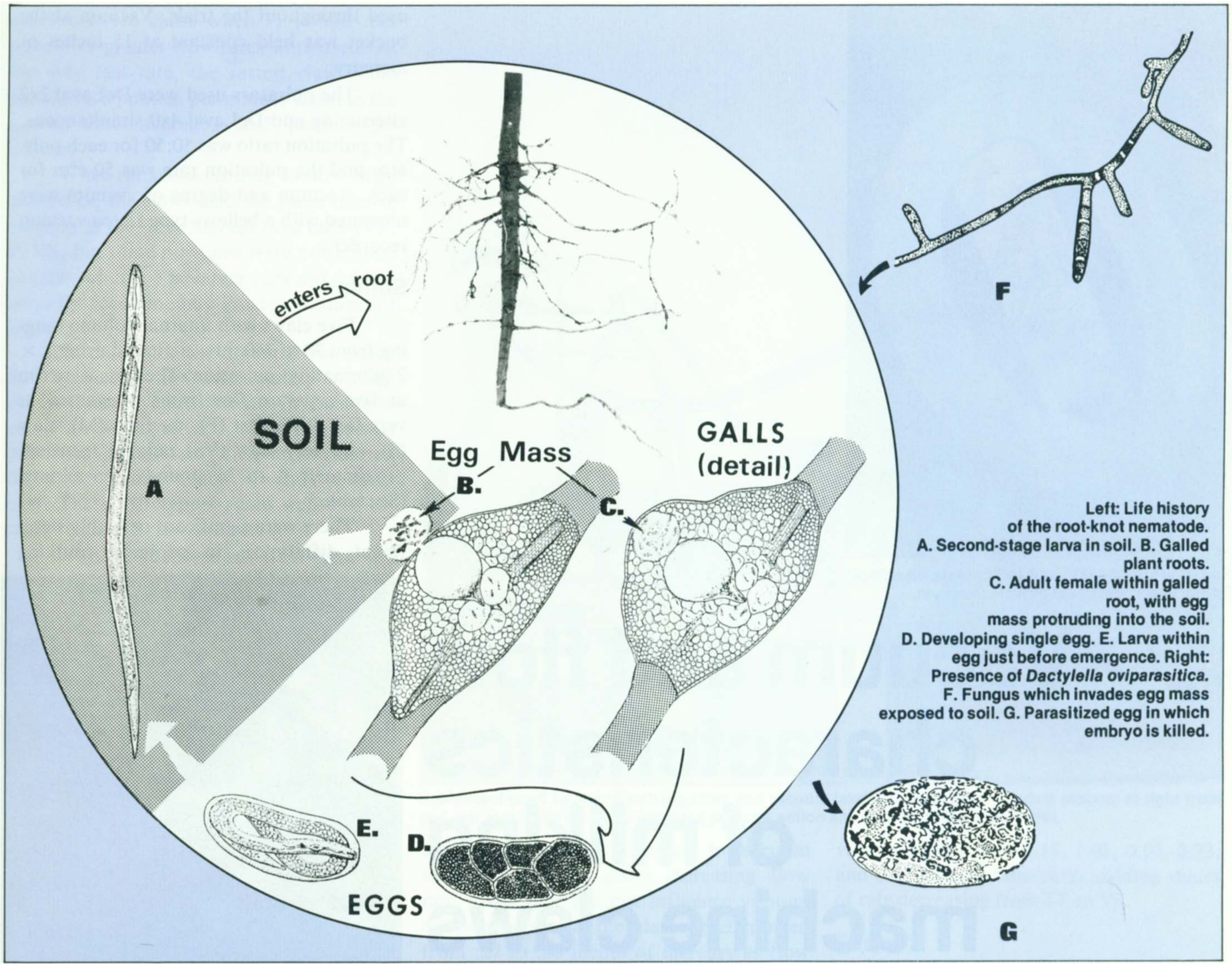
Control of root-knot nematodes in peach orchards on Lovell rootstock is one of the first examples of biological control of a plant-parasitic nematode in the field by a naturally occurring antagonist.

Twenty-five years ago Lovell peach was widely used as a rootstock for peach in California, but its susceptibility to root-knot nematodes (*Meloidogyne* spp.) led to its replacement by Nemaguard rootstock in most areas. A recent survey showed that several old San Joaquin Valley orchards on Lovell rootstock had unexpectedly low root-knot nematode populations. It was suspected that the nematode was under natural biological control in these orchards, and further investigation revealed root-knot nematode eggs parasitized by a fungus.

The fungus penetrated eggs from appressoria, which formed on the surface of the egg, and then proliferated through the embryo and eventually destroyed it. Because root-knot nematode eggs are clumped together in masses on the root surface, often all the eggs produced by a female were destroyed. Occasionally, the fungus grew into the root-knot nematode females and caused egg production to cease prematurely.

The fungus was isolated from parasitized eggs, cultured on artificial media in the laboratory, and found to be a new species, *Dactylella oviparasitica.* Root-knot nematode eggs were shown to be an important, but not an exclusive, source of nutrition for the fungus. *D. oviparasitica* also grew sapro-

Parasitism of root-knot nematode eggs by *Dactylella oviparasitica.* Left and middle: Early stages of parasitism, showing fungal hyphae in eggs. Right: Late stage of parasitism following destruction of eggs by the fungus.



Left: Life history of the root-knot nematode. A. Second-stage larva in soil. B. Galled plant roots. C. Adult female within galled root, with egg mass protruding into the soil. D. Developing single egg. E. Larva within egg just before emergence. Right: Presence of *Dactylella oviparasitica*. F. Fungus which invades egg mass exposed to soil. G. Parasitized egg in which embryo is killed.

phytically on dead roots and was capable of parasitizing the eggs of several other free-living and plant-parasitic nematode species.

Techniques developed to determine the presence and activity of *D. oviparasitica* in soil showed that it was widespread in San Joaquin Valley peach orchards and that it parasitized more than half the root-knot nematode eggs produced in some of these orchards. The proportion of parasitized eggs was highest in autumn and winter and lowest in summer, probably because soil temperature affected parasitism. The optimum temperature for growth of *D. oviparasitica* was 24° to 27° C, but the fungus parasitized eggs at 12° to 27° C. It was slightly more efficient as a parasite as temperatures decreased from 27° C, because fungal growth continued at temperatures that slowed the development and hatch of root-knot nematode eggs.

Experiments

Experiments in which *D. oviparasitica* was cultured in the laboratory on artificial media and then incorporated into soil in pots showed that parasitism by the fungus reduced root-knot nematode populations on peach.

In the field, *D. oviparasitica* parasitized root-knot nematode eggs on Lovell peach and Thompson seedless grape, but only on peach were nematode populations lower than expected. Greenhouse experiments showed that root-knot nematodes laid eggs over a period of about 20 days on Lovell peach and produced relatively small egg masses containing 250 to 400 eggs. When *D. oviparasitica* invaded these masses, it parasitized most of the eggs. On hosts such as grape, egg production continued longer, and egg masses contained about 1,500 eggs. *D. oviparasitica* rarely parasitized more than 50 percent of the eggs in these masses, and so large numbers of viable eggs remained.

We hypothesize that on hosts such as Lovell peach, where root-knot nematodes produce relatively small egg masses, parasitism by *D. oviparasitica* can substantially reduce nematode populations. On hosts such as grape, parasitism is generally insufficient to reduce root-knot nematode populations unless environmental conditions favor the parasite or are unsuitable for the nematode.

The apparent biological control of root-knot nematodes in several peach orchards on Lovell rootstock is one of the first documented examples of biological control of a plant-parasitic nematode in the field by a naturally occurring antagonist. Further studies of factors affecting the parasitic activity of *Dactylella oviparasitica* are in progress, and we hope that eventually it will be possible to optimize the effectiveness of the fungus in the field by orchard management.

Graham R. Stirling is Graduate Student, Michael V. McKenry is Assistant Nematologist, and Ron Mankau is Professor of Nematology and Nematologist, Department of Nematology, University of California, Riverside.

The senior author received financial assistance from a CSIRO (Australia) postgraduate studentship. The financial support of the California Tree Fruit Agreement is also gratefully acknowledged.