A Rapid Method for Sampling Surface Soil

D. A. COOKE,[1] H. E. McKINNEY,[2] and I. J. THOMASON[2]

Economic thresholds have been established for relations between crop yields and cyst nematodes in different countries (2, 3, 4, 5, 6, 8). Nematode counts from soil samples taken before planting allow advice on whether to treat all or part of a field with nematicides or to plant a resistant variety or an alternative crop.

Although the collection of soil samples by standard methods is time-consuming and costly, many cores are needed to obtain a representative sample from which valid advice can be derived. Therefore, a rapid method was developed for sampling soil from many points situated on a relocatable pattern.

Surface sampler: The soil-sampling unit, mounted on the rear of a Honda (American Honda Motor Co.) All-Terrain cycle (ATC 90), consists of five cylindrical buckets (3.2 cm diam × 5 cm deep) bolted 12.7 cm apart to a chain around three sprockets (Fig. 1-A, B). A freely mounted rubber-tired land wheel drives the top sprocket via a V belt. As the buckets pass under the bottom sprocket, they collect some of the surface soil; this empties into a removable cylindrical container (10 cm diam × 30 cm deep) as the buckets pass over the top sprocket. The distance between sampling points is about 2.3 m. A foot-operated lever raises the whole unit 5 cm from the ground to discontinue sampling.

A platform at the rear of the vehicle stores samples and equipment, the upper part of the sampling unit is covered by a chain guard. An odometer, mounted on the handlebars, determines the length of field boundaries and enables sighting posts to be placed accurately. The all-terrain cycle can be carried between fields in a farm pickup truck.

Comparison with conventional sampling: A nematode-infested sugar-beet field at Brawley, California, was sampled with the Honda sampler and, for comparison, a Veihmeyer hammer tube (9). The soil, a Holtville clay, had been disced and planed. Its surface was dry and contained clods, but with moisture below 8 cm.

Sighting posts were placed at intervals of 30 m along opposite sides of the field.

Received for publication 21 February 1978.

[1] Broom's Barn Experimental Station, Higham, Bury St. Edmunds, Suffolk, England.

[2] Department of Nematology, University of California, Riverside, California 92521. This work was done while the senior author was on a one-year secondment to the Nematology Department, University of California, Riverside. The authors thank Mr. Ray Adams for suggestions and skillful practical assistance in construction of the sampling unit.

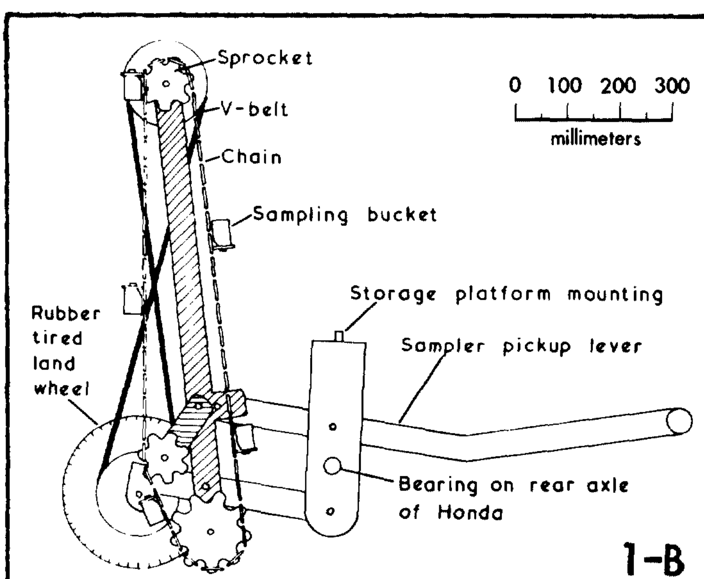

FIG. 1. A) Sampling unit and storage platform mounted on rear of All-Terrain cycle. B) Diagram of soil sampling unit.

Samples were taken along transects between opposing pairs of sighting posts. Plot size was 60 × 365 m. Each plot contained two transects. Four pairs of plots were sampled, one pair with the All-Terrain cycle, and the other with the Veihmeyer tube.

The All-Terrain cycle was driven between opposing pairs of sighting posts. The average weight of a dry bulk sample obtained from each plot by this method was 2,050 g, collected from about 300 sampling points.

With the Veihmeyer hammer tube an average bulk sample weight of 1,920 g was collected from about 20 sampling points in each plot. Three replicate samples were taken by the two methods from each of the four plots.

Dried soil samples were crushed and mixed thoroughly; 600-g subsamples were soaked for two days in a 20% Calgon solution to disperse the clay particles before cysts were extracted in a flotation can. After redrying, cysts were refloated in a 9:1 ethanol-glycerine mixture to separate them from other organic material (1,7) and were counted. Eggs were released from cysts by blending in a homogenizer for 30 sec, and were then suspended in 100 ml of water, and a 1-ml aliquot was counted. In plot 1, which contained fewer eggs, a 10-ml aliquot was counted.

It took 15 min to position the 16 sighting posts with the All-Terrain cycle. Average sampling times per plot were 15 min with the All-Terrain cycle and 45 min with the tube. There were no significant differences between the two methods in the numbers of cysts and eggs recovered (Table 1).

The All-Terrain cycle enables relocatable transects across fields to be established quickly, and samples of surface soil to be collected rapidly from close spacings along these transects. The cycle and the adaptation to sampling are costly. The machine does not operate satisfactorily in bedded fields. It is suitable for use only in fields that have been plowed or cultivated to mix the cysts throughout the soil profile. Because surface soil dries more quickly, and fluctuates more in temperature than deeper soil, the method is suitable for cyst nematodes but does not lend itself well for collecting species that are greatly affected by variations in soil temperature and moisture.

TABLE 1. Sampling for *Heterodera schachtii* by All-Terrain cycle and hammer tube.

Plot	All-Terrain cycle		Hammer tube	Mean
A) Cysts/600 g soil[a]				
1	1.33		0.94	1.14
2	2.49		2.54	2.52
3	2.18		2.19	2.19
4	2.03		2.07	2.05
Mean	2.01		1.94	
LSD	p = 0.05	p = 0.01		
Plot means	0.43	0.59		
Method means	0.13	0.17		
B) Eggs/6 g soil[a]				
1	1.32		0.74	1.03
2	2.41		2.54	2.48
3	2.29		2.27	2.28
4	2.00		2.25	2.13
Mean	2.01		1.95	
LSD	p = 0.05	p = 0.01		
Plot means	0.81	1.10		
Method means	0.23	0.32		

[a]Mean number of *H. schachtii* cysts and eggs per three replications transformed to $\log_{10}$ (N + 1).

LITERATURE CITED

1. ANDERSSON, STIG. 1970. A method for the separation of Heterodera cysts from organic debris. Nematologica 16:222-226.
2. BROWN, E. B. 1961. Assessing the damage caused by Heterodera rostochiensis Woll. Nature. London. 191:937-938.
3. COOKE, D. A., and I. J. THOMASON. 1979. The relationship between population density of Heterodera schachtii, soil temperature, and sugarbeet yields. J. Nematol. 11:124-128.
4. GOFFART, H. 1954. Bodengesundheitsdienst und Nematodenforschung. Mitt Dtsch Landw Ges. 69:34-35.
5. HEIJBROEK, W. 1973. Forecasting incidence of and issuing warnings about nematodes, especially Heterodera schachtii and Ditylenchus dipsaci. J. I.I.R.B. 6:76-86.
6. JONES, F. G. W. 1956. Soil populations of beet eelworm (Heterodera schachtii Schm.) in relation to cropping. II. Microplot and field plot results. Ann. Appl. Biol. 44:25-56.
7. SENHORST, J. W. 1970. Separation of Heterodera cysts from organic debris in ethanol 96%. Nematologica 16:330.
8. SIMON, M. 1953. Sugarbeet nematode in Belgium. Rapp. int. Rech. Bettaravieres XVI Assembl. Bruxelles. p. 55-62.
9. VEIHMEYER, F. J. 1929. An improved soil-sampling tube. Soil Science 27:147-152.