GROWER CONDUCTED SURVEYS FOR FIELD DIAGNOSIS AND SAMPLING FOR ROOT-KNOT NEMATODE BASED ON ROOT GALL INDICES

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Various species of the root-knot nematode (Meloidogyne) are some of the most economically important nematode pests of field grown vegetables in Florida. With methyl bromide soil fumigation, specific grower decisions regarding nematode monitoring or management were never essential because of the broad spectrum efficacy of the fumigant. However, today with new formulations and reduced use rates, even methyl bromide no longer provides season-long protection from root-knot nematode in many cases. The new fumigant alternatives under development are also generally less effective or consistent as methyl bromide for nematode control. Cropping system problems involving root-knot nematode are expected to increase after the methyl bromide phase out, particularly in double cropping systems where two crops are grown sequentially.

In order to determine whether nematodes such as root-knot are the cause for poor crop performance or to determine the need for nematode management, some form of pest monitoring or sampling is required. Historically, laboratory assays of soil samples have been the principal method of detection and quantification of nematode density. Due to the field patchiness and low abundance of nematodes (a microscopic organism) in tilled, fallowed soil prior to planting, there is often no assurance of obtaining accurate estimates of field populations even with detailed soil sampling schemes, especially when large fields are involved. Recognizing that the root-knot nematode causes the formation of large swollen areas or galls on the root systems of susceptible crops, relative population levels and field distribution of this nematode can be estimated by simple examination of the crop root system for root gall severity. Root gall severity is a simple measure of the proportion of the root system which is galled. Immediately after final harvest, a sufficient number of plants can be carefully removed from soil and examined to characterize the nature and extent of the problem within the field. In general, soil population levels increase in an exponential fashion with root gall severity. This form of sampling can provide immediate confirmation of a nematode problem and permit mapping of current field infestation. Currently, the detection of any level of root galling usually suggests a nematode problem for planting a susceptible crop, particularly within the immediate areas from which the galled plant(s) were recovered. The purpose of this study is therefore to explore the use of root gall assessment, rather than soil sampling, as a means of monitoring nematode populations in cropped fields.

Procedure: Eight fields in which crop production problems involving root-knot nematode (*Meloidogyne* spp.) were identified in the vegetable producing areas of west central and southwest Florida. In each of these fields, root-knot nematode infestation levels and patterns of field distribution were characterized by removing infested plants acquired systematically from across each field, after final harvest of the primary crop. At two sites, some of the excavated plants were individually weighed and root gall severity ratings recorded. The study area at each site consist of a 3-7 acre subsection of infested field. The basic sampling unit within each field consisted of blocks of 6 plant rows (spray rows). In each 3-4 acre subsection, upwards of 500 crop plants were removed from soil after final harvest. Plant removal followed a regular / systematic pattern of 50-foot increments within each plant row (**Fig. 1**). The actual number of plant samples removed was defined by row length and the number of rows within the 3-4 acre field site. Once uprooted, the specific field location (block, row, section) and root gall severity index value were recorded. The root galling index used consisted of a scale of 0 to 10, reflecting the proportion of root system galled. Grower field personnel who participated in these studies were trained and continually coached for all plant and root system rating evaluations.

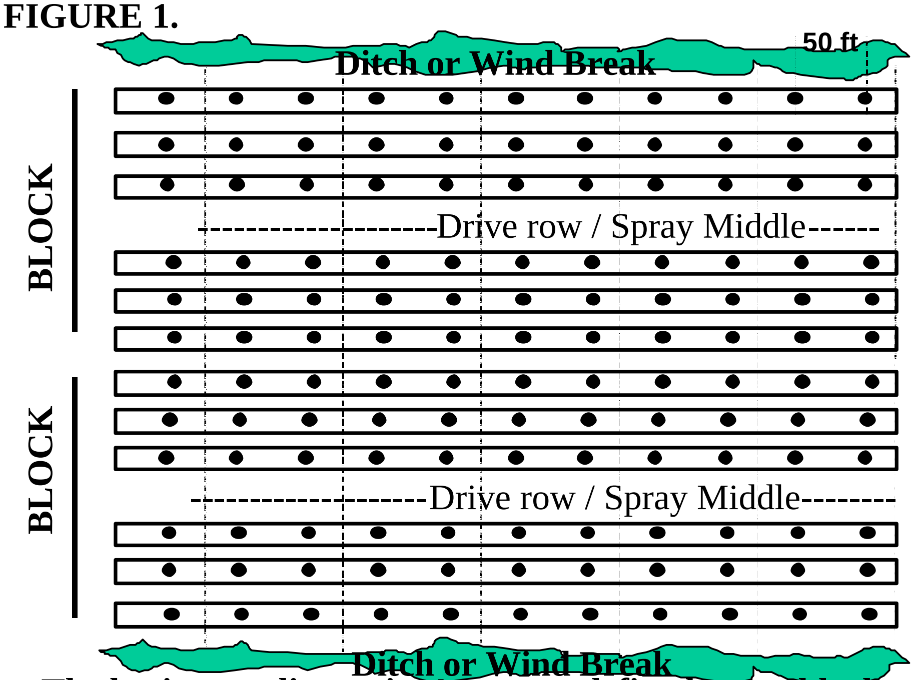
The data were entered in spreadsheet format for statistical, simulation, and graphical analysis. Probabilities of detecting root-knot nematode infested plants for a range of sample sizes was computed for each 6-row block within each nematode infested field surveyed. Sample sizes were also computed and correlated with the range of field infestation level within blocks and fields. The objective was to determine the smallest number of plant samples that maintain sampling error within acceptable limits. To minimize sampling requirements, frequency distributions were also calculated and analyzed for specific sample site locations to identify any propensity for root-knot nematode infestation to specifically occur within certain areas of the field. This analysis was conducted to determine whether it might prove useful for instructing growers where to sample, i.e., within certain rows, blocks, or subsections.

Results: Analysis of patterns of field distribution of root-knot nematode indicates a nonrandom, aggregated pattern in most of the fields surveyed. These same analyses also suggest that the crowned areas of the field or field center is oftentimes the site which recolonize first with root-knot nematode after soil fumigation. This early recolonization by root-knot nematode may occur because these crowned areas are possibly the hottest and driest areas of field at the time of soil fumigation, and the more rapid escape of the fumigant may afford nematodes greater survival. At other experimental sites, root-knot nematode recolonization appears to occur within rows rather than between rows. Interestingly, sampling precision was generally less variable, and often required fewer samples when plants were randomly obtained exclusively from the crowned areas or field middles rather than from plants acquired randomly from throughout the entire field.

Preliminary analysis of these data also indicate that as overall root gall severity increases in the field, the numbers of plants which must be uprooted and examined for root galling for a given level of sampling precision decreases. For a given sample size, sampling precision increased significantly when overall root gall severity was greater than 5 (scale 0-10) in any given field. This was fortunate because the visual acuity of growers to detect the presence of galling on roots also appears to be at or near a root gall severity index of 5. At this overall level of root galling, growers must inspect a minimum of 4 to 6 plants per 6 row field block to achieve acceptable precision. When the nematode problem in the field is less severe and overall root gall severity less than 5, as many as 2 to10 more plants must be inspected to accurately assess nematode problems within the field with the same level of sampling precision.

In summary, these field results and analyses suggest that use of crop plants as bioindicators of nematode problems can be a meaningful, informative, and grower-acceptable means of nematode sampling. Rather than soil sampling, the results of these studies suggests that use of root galling indices of crop plants acquired systematically from grower fields after final harvest of the crop can be used to accurately characterize root-knot nematode infestation level and for revealing patterns of field distribution. Work continues to correlate whether root gall severity and foliar symptoms of plant health could also prove useful for determining which plants to select for root-knot nematode sampling. Nonrandom sampling strategies directed at specific field locations and at plants showing decline symptoms are practical considerations which could improve detection of field distribution and quantification of nematode density with least grower cost to the grower.

FIGURE 1.



The basic sampling unit: A grower defined spray block or land

● **Sites for removal and gall indexing of a crop plant based on 50 ft increments of plant row.**