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NEMATODE CONTROL IN GINGER WITH NEMATOCIDES, SELECTION OF PLANTING MATERIAL AND SAWDUST MULCH

by R. C. COLBRAN, M.Agr.Sc., Ph.D.

SUMMARY

Severe root-knot developed in late-harvest ginger when rhizomes showing no external symptoms of infestation were planted in soil fumigated with ethylene dibromide at 50 litres/ha. Doubling the rate of ethylene dibromide improved control but was of no value when the planting material was heavily infested. Under these conditions, spraying the soil with 'Nemacur' (ethyl 4-(methylthio) m-tolyl isopropylphosphoramidate) at 4.9 kg a.i./ha immediately after fumigation with ethylene dibromide at 50 litres/ha gave good results.

Mulching with sawdust to a depth of 50-75 mm and/or treating the growing crop with Nemacur granules (three soil dressings) or oxamyl (four foliar sprays) reduced nematode development. Nemacur was more effective than oxamyl but less effective than sawdust. The highest level of control was achieved by sawdust mulching combined with postplant treatment with Nemacur.

Post-plant treatment with Nemacur or oxamyl reduced the incidence of fusarium yellows caused by *Fusarium oxysporum* f. sp. *zingiberi* which affected one trial.

I. INTRODUCTION

Previous studies of root-knot in ginger reported by Colbran (1962, 1968) and Colbran and Davis (1969) showed that the use of planting material infested with *Meloidogyne javanica* (Treub) and *M. incognita* (Kofoid and White) led to a marked reduction in yield. A programme for producing nematode-free 'seed' (pieces of rhizome used for planting) which involves site and seed selection, hot water treatment of seed and soil fumigation before planting has not provided an adequate answer to the problem.

In trials with granular formulations applied as surface dressings without mechanical soil incorporation, 'Nemacur' applied in mid-November and late January gave promising results whereas 'Temik', 'Mocap' and 'Vydate' (oxamyl) were of little value (Colbran, 1972).

The two trials reported in this paper were made in the 1972-73 season to ascertain the extent to which nematode infestation in ginger seed crops was influenced by four preplant soil treatments with EDB and/or Nemacur, level of infestation of planting material, sawdust mulch and postplant applications of Nemacur granules to the soil or oxamyl as a foliar spray. The object was to develop a practical programme for ensuring consistently low levels of root-knot in ginger seed crops.

II. MATERIALS AND METHODS

The nematocides used were—

EDB. Ethylene dibromide. As EDB15, a liquid formulation containing 15% v/v ethylene dibromide in power kerosene.

'Nemacur G.' A granular formulation containing 10% ethyl 4-(methylthio)-m-tolyl isopropylphosphoramidate.

'Nemacur P'. An emulsifiable concentrate containing 43.6% w/v ethyl 4-(methylthio)-m-tolyl isopropylphosphoramidate.

Oxamyl. Methyl N,N-dimethyl-N-(methylcarbamoyl) oxy-1-thiooxamimidate.

As 'Vydate L', a liquid formulation miscible with water containing 25.2% w/v oxamyl.

The two trials were set out as 4 x 6 randomized blocks with split plots.

The main treatments were—

1. EDB—50 litres/ha injected in rows 30 cm apart.
2. EDB—100 litres/ha injected in rows 30 cm apart.
3. EDB—50 litres/ha injected followed by Nemacur P 4.9 kg a.i./ha sprayed on the soil.
4. Nemacur P—9.8 kg a.i./ha sprayed on the soil and incorporated by discing.

Each main plot consisted of two beds 2 m wide and 36 m long. Three rows of ginger were planted in each bed.

In trial 1, one bed in each plot was planted with heavily infested seed and the other with lightly infested seed. In trial 2, one bed in each plot was covered with a layer of hardwood sawdust 10 cm deep and the other was left unmulched.

In both trials the subplots were further divided into three plots each 12 m long for the following postplant treatments—

1. Control.
2. Nemacur G. Three applications 6 weeks apart, each of 4.9 kg a.i./ha spread over the bed.
3. Oxamyl. Four foliar sprays of 1.1 kg/100 litres/ha 3 weeks apart.

The levels of nematode infestation in the seed planted in the trials were determined by peeling 20 randomly-selected pieces and counting the numbers of discrete discoloured infestation sites.

Root-knot ratings of 0, 1, 2, 3, 4, corresponding to increasing severity of infestation were converted to indices (0-100) after the method of Smith and Taylor (1947). Rhizomes with ratings of 0, 1, and 2 showed no external symptoms of nematode infestation whereas those with ratings of 3 and 4 had light-to-moderate and moderate-to-severe surface cracking respectively.

Trial 1 was on a sandy alluvial soil at Beerwah. The preplant treatments were applied on 11 August 1972, beds made on 8 September and planted on 19 September. Nemacur granules were applied on 1 November, 13 December and 25 January and oxamyl sprays on 22 November, 13 December, 3 January and 25 January. In autumn, the trial became badly affected with fusarium yellows caused by *Fusarium oxysporum* Schlecht. ex F. f. sp. *zingiberi* Trujillo and on 3 May, the incidence of the disease in each plot was recorded. The ratings used were 0, 1, 2, 3 and 4 corresponding to 0, 1-25, 26-50, 51-75 and 76-100% of the plants affected.

III. RESULTS

In trial 1, heavily infested seed averaged 9.9 infestation sites per seedpiece and lightly infested seed 1.1. In trial 2, the average was 0.4.

Data on nematode infestation and fusarium yellows in trial 1 and nematode infestation and yields in trial 2 are presented in Tables 1 to 6. The yield data from trial 1 were of no value because of the advanced rhizome rot.

TABLE 1

TRIAL 1. EFFECT OF PREPLANT TREATMENT ON ROOT-KNOT AND FUSARIUM YELLOWS

Nematocide	a.i./ha	Root-knot Index		Yellows Rating
		HN Seed*	LN Seed†	
EDB	50 l	28.75 (0.566)‡	16.70 (0.421)	1.07
EDB	100 l	31.04 (0.591)	4.07 (0.203)	0.89
EDB + Nemacur P	50 l + 4.9 kg	15.21 (0.401)	9.34 (0.311)	1.15
Nemacur P	9.8 kg	19.70 (0.460)	18.85 (0.449)	1.27
Necessary differences for significance		(0.141)	(0.141)	N.S.§
		5%	(0.194)	
		1%	(0.194)	

* Heavily infested seed.

† Lightly infested seed.

‡ Inverse sine transformation.

§ F not significant at 5% level.

TABLE 2

TRIAL 1. EFFECT OF SEED INFESTATION ON ROOT-KNOT AND FUSARIUM YELLOWS

Seed Infestation	Root-knot Index	Yellows Rating
Heavy	23.35 (0.504)*	1.14
Light	11.50 (0.346)	1.04
Necessary differences for significance	{ 5% (0.072) 1% (0.100)	N.S.†

* Inverse sine transformation.

† F not significant at 5% level.

TABLE 3

TRIAL 1. EFFECT OF POSTPLANT TREATMENT ON ROOT-KNOT AND FUSARIUM YELLOWS

Treatment	Root-knot Index	Yellows Rating
Control	28.81 (0.567)*	1.51 (1.418)†
Oxamyl	19.39 (0.456)	0.91 (1.189)
Nemacur G	6.26 (0.253)	0.88 (1.175)
Necessary differences for significance	{ 5% (0.069) 1% (0.091)	(0.123) (0.163)

* Inverse sine transformation.

† $\sqrt{x + \frac{1}{x}}$ transformation.

The spread of the disease made it necessary to harvest the trial on 4, 5 and 6 June rather than in late July as originally intended. A 6 m length of the middle row in each plot was dug and 20 pieces of healthy rhizomes each weighing between 120 and 140 g were rated for nematode infestation.

Trial 2 was on a krasnozem at Imbil. The preplant soil treatments were applied on 15 August, beds made on 6 September and planted on 11 September. The sawdust mulch was spread on 12 September. Nema-cur granules were applied on 1 November, 14 December, and 26 January and oxamyl sprays on 23 November, 14 December, 5 January and 26 January. On 30 and 31 July, a 6 m length of the middle row of each plot was harvested and 20 pieces of rhizome from each plot were rated for nematode infestation.

TABLE 4

TRIAL 2. EFFECT OF PREPLANT TREATMENTS ON ROOT-KNOT AND YIELD

Nematocide	a.i./ha	Root-knot Index	Yield (t/ha)
EDB	50 l	38.50	78.01
EDB	100 l	23.49	77.14
EDB + Nema-cur P	50 l + 4.9 kg	34.42	77.30
Nema-cur P	9.8 kg	37.84	75.66
		N.S.*	N.S.*

* F not significant at 5% level.

TABLE 5

TRIAL 2. EFFECT OF SAWDUST MULCH ON ROOT-KNOT AND YIELD

Treatment	Root-knot Index	Yield (t/ha)
Sawdust mulch	14.09 (0.385)*	76.10
No mulch	56.21 (0.848)	77.95
Necessary differences for significance .. { 5% / 1%	(0.100) / (0.135)	N.S.†

* Inverse sine transformation.

† F not significant at 5% level.

TABLE 6

TRIAL 2. EFFECT OF POSTPLANT TREATMENT ON ROOT-KNOT AND YIELD

Treatment	Root-knot Index		Yield (t/ha)
	Sawdust	Unmulched	
Control	14.74 (0.394)*	73.71 (1.032)	75.15
Oxamyl	26.37 (0.539)	52.69 (0.812)	77.52
Nema-cur G	4.80 (0.221)	41.33 (0.698)	78.41
Necessary differences for significance .. { 5% / 1%	(0.125) / (0.165)	(0.125) / (0.165)	N.S.†

* Inverse sine transformation.

† F not significant at 5% level.

IV. DISCUSSION

The results of these trials show that sawdust mulching is very effective in controlling root-knot in ginger seed crops and still further improvement can be obtained by postplant treatment with Nemacur or oxamyl.

In the absence of sawdust, Nemacur gave a satisfactory level of control in trial 1 which was harvested in early June but the result in trial 2 harvested at the end of July was disappointing. The difference is attributed to continued nematode development in the rhizome after the top of the ginger plant has ceased growth.

Doubling the rate of EDB used for preplant soil treatment reduced root-knot appreciably when there was only a light nematode infestation in the seed. When heavily infested seed was planted, the addition of Nemacur was more effective probably due to its residual action.

Having regard to the results of earlier trials (Colbran, 1972) it appears that three applications of Nemacur at 4.9 kg a.i./ha are inferior to two applications of 11.2 kg a.i./ha. Application of Nemacur granules to the soil after mid January is not practicable because of the density of the crop and Nemacur sprays damage the foliage. Oxamyl sprays could be continued until the crop matured and the results with this material were sufficiently encouraging to warrant examination of an extended spray schedule.

In trial 1, where fusarium yellows occurred fortuitously, the disease was less severe in plots where root-knot had been reduced by postplant treatment with Nemacur or oxamyl. Other workers have shown that root-knot nematodes reduce the resistance of cotton, tobacco, tomato and some other crop to specialized forms of *Fusarium oxysporum*. These relationships are discussed by Powell (1971).

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The author is Assistant Director, Plant Pathology Branch, Queensland Department of Primary Industries, stationed at Indooroopilly.