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Flowering Delay in Flue-cured Tobacco Infected with *Meloidogyne* Species[1]

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Infection with *Meloidogyne* spp. caused a delay in flowering in flue-cured tobacco (*Nicotiana tabacum* L.) in microplot experiments in Florida and North Carolina. Similar observations were recorded in field nematicide tests in Florida. Some of the nematode population versus tobacco yield interaction data have been published (1–5). This report focuses on the relationship of relative nematode population density to a delay in flowering of tobacco.

Microplot tests with ranges of initial inoculum densities (P_i) of *M. incognita* (Mi) in six soil types were conducted in North Carolina (Table 1). Soil types included Fuquay sand (91% sand, 6% silt, 3% clay, 0.6% O.M.), Cecil sandy clay loam (53% sand, 18% silt, 29% clay, 1.4% O.M.), Norfolk sandy loam (84% sand, 12% silt, 4% clay, 1.4% O.M.), organic (58% sand, 33% silt, 9% clay, >30% O.M.), Portsmouth loamy sand (72% sand, 18% silt, 10% clay, 2.7%

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TABLE 1. Effects of three *Meloidogyne* species on flowering of flue-cured tobacco grown in microplots in North Carolina (cv. Coker 319) and Florida (cv. McNair 944).

Location and *Meloidogyne* species	P_i, eggs/ 100 cm^3 soil	% plants flowering
North Carolina*		
M. incognita	0	55.0 a†
	250	16.7 b
	1,000	8.3 bc
	4,000	0 c
Florida‡		
M. arenaria	4	92.9 a§
M. incognita	4	100.0 a
M. javanica	4	100.0 a
M. arenaria	16	85.7 ab
M. incognita	16	100.0 a
M. javanica	16	50.0 b
M. arenaria	64	100.0 a
M. incognita	64	71.4 a
M. javanica	64	18.2 b

* Six soil types were Fuquay, Norfolk, Organic, Portsmouth, Cecil clay loam, Cecil sandy clay; data taken 56 days after transplanting are means across these soils with five replicates per nematode level in each soil type.

† Means followed by a common letter are not significantly different according to Waller-Duncan's *K*-ratio *t*-test ($P \leq 0.05$).

‡ Average of eight replicates per nematode level in Lakeland fine sand; percent flowering recorded 13 June 1981, 55 days after transplanting.

§ Grouped means followed by a common letter are not significantly different according to Duncan's multiple-range test ($P \leq 0.05$).

TABLE 3. Coefficients of linear correlation between percent plant flowering and *Meloidogyne javanica* juvenile populations, root galling, and tobacco yield.†

	Correlation coefficient (*r*)		
	Soil populations	Gall index	Yield
Test 1	−0.49*	−0.62*	+0.62*
Test 2	−0.68*	−0.54*	+0.27
Test 3	−0.29*	−0.46*	+0.50*
Test 4	−0.21	−0.37*	+0.44*
Test 5	−0.34*	−0.51*	+0.47*
Test 6	−0.33*	−0.35*	+0.25

† Determined from field-nematicide evaluations, same tests as data in Table 2; nematode and root galling data taken at mid to late season.

* $P \leq 0.05$.

O.M.), and a Cecil sandy clay (48% sand, 13% silt, 39% clay, 0.9% O.M.). The highest P_i of Mi caused complete suppression of flowering regardless of soil type on 30 June 1981 (56 days after transplanting) in contrast to 55% flowering for no nematodes. Levels of Mi were inversely correlated ($r = -0.83$, $P \leq 0.01$) with flowering. Soil type had little influence on flowering, so data are presented as means across soil types. The lower P_i, however, enhanced tobacco growth in the Cecil sandy clay loam.

The impact of *Meloidogyne* infection on flowering of tobacco depended on the nematode species and initial inoculum level in a Florida microplot test with a Lakeland fine sand soil (93% sand, 4% silt, 3% clay). Visual observations indicated *M. arenaria*, *M. incognita*, and *M. javanica* each suppressed flowering at the P_i levels used, but only the effects of *M. javanica* (Mj) were significant among species at time of data collection (Table 1). The highest P_i of Mj caused the greatest suppression of tobacco flowering.

Nematicide test results collected over 4 years in Florida (1978–81) with Mj in a heavily infested Chipley fine sand soil (89% sand, 8% silt, 3% clay) were similar to those of the microplot tests. The more effective

TABLE 2. Flowering of tobacco plants as influenced by application of DD and ethoprop to soil naturally infested with *Meloidogyne javanica*.

Treatment*	Test 1 (68 days)†	Test 2 (75 days)	Test 3 (66 days)	Test 4 (67 days)	Test 5 (69 days)	Test 6 (69 days)
DD	51 a‡	83 a	—	34 a	29 a	28 a
Ethoprop	25 b	66 b	20 a	10 a	—	15 b
Control	10 b	59 b	2 b	22 a	13 a	13 b

* DD applied broadcast at 187 liters/ha in tests 1 and 2, and in-row at 93 liters/ha in tests 3–6; ethoprop was applied broadcast and incorporated at 9 kg a.i./ha in all tests.

† Days after transplanting.

‡ Column means followed by the same letter are not different ($P \leq 0.05$) according to Newman-Keuls test.

nematicide, D-D(1,2-dichloropropane-1,3-dichloropropene), resulted in the greatest flowering with the controls giving the lowest (Table 2). The less effective nematicide, ethoprop (O-ethyl S,S-dipropyl phosphorodithioate), had an intermediate effect on flowering. In these tests, flowering was positively correlated with yield and negatively related to soil nematode populations and root-gall indices (Table 3).

Infection by *Meloidogyne* species can have an important impact on the phenology of flue-cured tobacco. Flowering is delayed under moderate infection levels or completely suppressed by high nematode infection. The tobacco cyst nematode, *Globodera solanacearum,* also delays flowering of flue-cured tobacco in Virginia (John Riley and Dean Komm, pers. comm.).

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