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Distribution of *Ditylenchus dipsaci* in Daffodil Bulbs

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Complete elimination of the stem nematode *Ditylenchus dipsaci* (Kühn, Filipjev) in bulbs in the Netherlands is the aim of the Plant Protection Service. Elimination of stem nematode in daffodil bulbs is achieved by hot-water treatment (HWT). This procedure, however, did not always result in adequate nematode control (5). Slootweg (6) states that survival of stem nematodes after HWT of daffodils is not always from inefficient treatment; timing of HWT and the temperature at which bulbs are stored are also important (7). During storage of the bulbs stem nematodes may desiccate and are therefore less sensitive to HWT. Temperature and humidity during bulb storage may influence the efficacy of HWT (2,7). The number of infecting stem nematodes per bulb may also affect efficiency of HWT (7), and nematode densities may vary greatly among bulbs (1). My objective was to investigate the variation in nematode population densities in bulbs from several lots.

Nematodes were isolated by leaving bulbs

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TABLE 1. Percentages of bulbs of eight lots of daffodil bulbs I–VIII classified according to the numbers of *Ditylenchus dipsaci* found in the bulbs.

Class	I	II	III	IV	V	VI	VII	VIII
1								
2								
3						0.9		
4								0.6
5		1.5				0.9		1.1
6		1.5		0.6				1.1
7	1.0	4.0	0.5	0.6			2.0	1.1
8	0.5	0.5		3.1		0.9	2.0	0.6
9	1.5	1.5	0.9	1.8		0.9	5.0	1.1
10	2.5	4.0	1.4	3.1	0.5	2.8	4.0	0.6
11	6.1	3.5	1.9	8.0	1.8	2.8	3.5	1.1
12	7.1	3.0	3.8	6.1	2.7	8.3	6.1	5.0
13	14.2	6.5	9.5	4.9	10.0	7.4	6.6	3.4
14	17.3	10.1	11.4	7.4	7.2	10.3	3.5	6.1
15	24.4	8.0	13.3	13.5	20.8	10.3	7.6	12.3
16	17.8	9.6	23.7	12.3	33.0	19.4	9.1	13.9
17	6.6	19.1	7.6	3.7	17.2	15.7	8.6	21.8
18	1.0	14.6	10.4	18.4	5.0	13.9	16.7	17.9
19		12.1	10.9	9.8	1.8	4.6	16.2	8.9
20		1.5	3.8	4.9		0.9	6.6	3.4
21			0.9	1.2			2.5	
22				0.6				
23								

in a mistifier for 2 days (3), and the nematodes extracted were then counted. Eight lots of daffodil bulbs with characteristic symptoms of stem nematode infection were examined. Infected bulbs are recognized by light to dark brown longitudinal bulb cuts of tissue on some scales. Infected scales are also soft and deteriorate during bulb storage. Bottoms of heavily infected bulbs become partly detached (4). Eight frequency distributions, indicated by I–VIII in Tables 1 and 2, were determined in July–October of 1975–79 with 197, 199, 211, 163, 221, 108, 198, and 179 Carlton daffodil bulbs. The distributions presented in Table 1 are composed of numbers of frequencies of bulbs on classes of nematode population densities on a logarithmic scale with base 2. Consequently, 0–1, 1–2, 2–4, 4–8, 8–16, etc., are indicated in the tables by 0, 1, 2, 3, 4, etc., respectively. In Table 2 the data of bulb examination, the number of bulbs per distribution, and the characterizations of the distributions I–VIII are mentioned.

Distributions I and II on one side and III and IV on the other side are samples from the same lots. Obviously the nematodes reproduced during the time lapse between August and October as can be ab-

TABLE 2. Date of bulb examination, number of bulbs per distribution, and characteristics of the distributions I–VIII.

		Mean	Min.	Max.	Modus	Std. err.	Std. dev.	Std. dev./ mean	Kurtosis	Skewness
I	08-08-1975, 197	13.076	5.000	17.000	14.000	0.149	2.095	0.16	5.20	−6.20
II	17-10-1975, 199	14.176	4.000	19.000	16.000	0.243	3.434	0.24	1.22	−6.01
III	10-08-1976, 211	12.725	4.000	18.000	13.000	0.171	2.480	0.12	0.76	−2.24
IV	28-10-1976, 163	14.245	5.000	21.000	17.000	0.264	3.376	0.24	−1.16	−2.64
V	22-07-1977, 221	9.448	4.000	13.000	10.000	0.110	1.639	0.17	1.56	−3.94
VI	17-09-1979, 108	15.083	3.000	20.000	16.000	0.280	2.907	0.19	6.05	−5.65
VII	10-08-1975, 198	10.591	2.000	16.000	13.000	0.259	3.648	0.34	−1.80	−3.88
VIII	02-10-1978, 179	15.816	4.000	20.000	17.000	0.228	3.055	0.19	8.98	−9.14

stracted from the shifts of the mean (Table 2) to classes of higher nematode numbers, and it is noteworthy that skewnesses are more or less the same: −6.20, −6.01 and −2.24, −2.64. Skewnesses of the four mentioned distributions and the other four (Table 2) are all negative and significant (> 1.96). Apparently the distribution of *Ditylenchus dipsaci* in daffodil is pseudo-normal and skews toward the lower classes of nematode numbers.

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