

Single and double combinations of nematicides against *Rotylenchulus reniformis* and *Tylenchulus semipenetrans* infecting cowpea and citrus

Taysir BADRA ⁽¹⁾ and Dawood M. ELGINDI

Nematology Research Centre, Faculty of Agriculture, Cairo University, Giza, Egypt.

SUMMARY

Application of aldicarb, oxamyl and fensulfothion nematicides gave an increase in growth of cowpea and citrus and a reduction in the populations of *Rotylenchulus reniformis* and *Tylenchulus semipenetrans*. Growth of plants grown in soil treated with DBCP and miral was not increased even though the nematode populations were reduced. Plant growth was unthrifty in the ethoprop and phenamiphos applications and nematode control was intermediate. Of the nematicide combinations tested, oxamyl + DBCP combination was the best effective mixture for host growth followed by miral + DBCP and fensulfothion + DBCP. All combinations produced maximum nematode kill.

RÉSUMÉ

Effets des nématicides, seuls ou en combinaisons par deux, contre Rotylenchulus reniformis et Tylenchulus semipenetrans, parasites de Vigna sinensis et des citrus

Sept nématicides, fumigants, de contact et systémiques, ont été testés, en pots, aux doses de 24 et 36 kg/ha contre *Rotylenchulus reniformis* et *Tylenchulus semipenetrans* parasitant respectivement *Vigna sinensis* et les citrus. Ils comprenaient deux carbamates : l'aldicarb et l'oxamyl, quatre organophosphorés : l'éthoprop, le fensulfothion, le miral et le phenamiphos et un fumigant : le DBCP. Dans une autre expérience, des pots contenant des pieds de *Vigna* ou de citrus ont été traités avec des combinaisons de deux nématicides à la dose totale de 36 kg/ha. Les résultats ont montré que l'aldicarb, l'oxamyl et le fensulfothion provoquaient une réponse hautement significative de la plante allant de pair avec un remarquable contrôle des deux parasites. Avec le miral et le DBCP l'augmentation de croissance de la plante était moindre bien que leur action nématicide sur *R. reniformis* et *T. semipenetrans* fût très forte. A l'inverse, l'éthotrop et le phenamiphos n'ont eu que peu d'action sur la croissance des plantes et n'ont que modérément éliminé les nématicides. Parmi les combinaisons de deux produits, l'oxamyl associé au DBCP a été la plus active pour stimuler la croissance des plantes, suivie de près par le fensulfothion associé au DBCP, la moins active étant le miral associé au DBCP. Les trois combinaisons ont réduit sérieusement les populations de *R. reniformis* et *T. semipenetrans* permettant la propagation du plus faible nombre de nématicides sur les plantes traitées.

The application of fumigant, non fumigant and systemic nematicides can be a successful management tool in controlling nematode pests. Fumigants have proved to be effective in eradi-

cation of *Belonolaimus*, *Heterodera*, *Meloidogyne*, *Paratylenchus*, *Pratylenchus*, *Radopholus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchulus* and *Xiphinema* (Baines, 1964 ; Figueroa, 1975 ; Guérout, 1972 ; Maggenti & Hart, 1975 ; Miller, Edgington & Hawkins 1967 ; Raskin, 1964 ;

& O'Bannon, 1974; Van Gundy *et al.*, 1960; Weingartner & Dickson, 1970 and Whitehead *et al.*, 1972). Also, oximacarbamate and organophosphate nematicides have been efficient against plant parasite nematodes infecting crops, e.g., deciduous fruits, potatoes, citrus, cotton, carnations, banana, tomatoes and beets (Abawi & Mai, 1971; Abdel-Rahman *et al.*, 1974; Baines & Small, 1969, 1974 & 1976; Birchfield, 1971; Cuany *et al.*, 1974; Gowen, 1977; Jones & Overman, 1976; Scotto La Massese & Roussel, 1975; Moss, Crump & Whitehead, 1976; Oteifa, Elgindi & Eleraqi, 1971; Radewald *et al.*, 1973 and Steudel, 1976). This study was intended to evaluate the nematicidal efficacy and degree of host response due to single and double combinations of some nematicides.

sulfinyl) phenyl] phosphorothioate = fensulfothion 10% G (Terracur P®); ethyl 4-(methylthio)-*m*-tolylisopropylphosphoramidate = phenamiphos 5% G (Nemacur®) and 1,2 dibromo-3-chloropropane = DBCP (Fumazone® 75% EC). Single nematicides were applied at two rates: 24 and 36 kg/ha (2.4 and 3.6 kg a.i./ha) while combinations of nematicides were applied at 36 kg/ha composed of 18 kg of each nematicide. There were three replications per treatment. Plants were left untreated to serve as controls. Experiments were conducted in a greenhouse at 30 ± 5 °C for 60 days and then terminated. At harvest, plants were removed and plant growth was recorded as shoot and root weights. Soil nematodes were extracted by means of Oostenbrink's technique (1960) on replicated 250 g samples, while nematodes populations in roots were determined on 3 g representative root sample/treatment using the blending technique of Fallis (1943) as modified by Taylor and

Table 1

Effectiveness of several fumigant, contact and systemic nematicides on growth of cowpea plants and associated *Rotylenchulus reniformis*

Treatment	Total plant weight (g)	Soil populations / 250 g soil				Root infection/ 3 g tissues
		Larvae	Males	Females	Total	
Aldicarb 10% G I	23.91 b	189	119	51	359 b	58
Aldicarb 10% G II	25.83 b	147	162	399	708 b	163
DBCP 75% EC I	18.00	232	182	57	471 b	71
DBCP 75% EC II	20.34 a	255	246	42	543 b	104
Ethoprop 10% G I	18.33	4788	526	1299	6613 a	332
Ethoprop 10% G II	20.58 a	3483	383	945	4811 b	378
Fensulfothion 10% G I	22.33 a	917	151	302	1370 b	67
Fensulfothion 10% G II	25.00 b	194	17	55	266 b	30
Miral 10% G I	20.59 a	1019	357	506	1882 b	84
Miral 10% G II	21.75 a	659	215	120	994 b	41
Oxamyl 10% G I	21.00 a	187	71	122	380 b	24
Oxamyl 10% G II	25.66 b	175	25	25	225 b	19
Phenamiphos 5% G I	18.59	5667	967	1100	7734	360
Phenamiphos 5% G II	21.00 a	467	160	162	789 b	92
Fensulfothion + DBCP	21.40 a	0	0	0	0	9
Miral + DBCP	16.24	0	0	0	0	7
Oxamyl + DBCP	21.50 a	0	0	0	0	15
Untreated	12.67	7712	848	2093	10,653	587

I and II = 2.4 and 3.6 kg a.i./ha. a & b statistically significant from control at 5 and 1 % probability, respectively using Duncan's multiple range test.

Table 2

Effectiveness of several fumigant, contact and systemic nematicides on growth of lime plants and associated *Tylenchulus semipenetrans*

Treatment	Total plant weight (g)	Soil populations/ 250 g soil	Root infection/ 3 g tissues
Aldicarb 10% G I	12.26 b	303 b	107
Aldicarb 10% G II	13.51 b	556 b	84
DBCP 75% EC I	9.27 a	129 b	41
DBCP 75% EC II	11.55 b	75 b	13
Ethoprop 10% G I	10.72 b	1810 b	114
Ethoprop 10% G II	11.38 b	1317 b	62
Fensulfothion 10% G I	11.68 b	719 b	170
Fensulfothion 10% G II	13.71 b	470 b	45
Miral 10% G I	9.57 a	369 b	37
Miral 10% G II	10.88 b	195 b	9
Oxamyl 10% G I	11.45 b	122 b	72
Oxamyl 10% G II	12.60 b	200 b	18
Phenamiphos 5% G I	7.69	803 b	194
Phenamiphos 5% G II	8.19	930 b	211
Fensulfothion + DBCP	12.27 b	161 b	23
Miral + DBCP	9.53 a	53 b	0
Oxamyl + DBCP	13.35 b	25 b	0
Untreated	6.39	2658	413

I and II = 2.4 and 3.6 kg a.i./ha. a & b statistically significant from control at 5 and 1 % probability, respectively using Duncan's multiple range test.

the treatments. Aldicarb induced highly significant growth increases in both hosts, while the other nematicides gave variable effects (Tabl. 1 and 2).

Data on nematicide combinations are summarized in Tables 1 and 2. No soil populations of *R. reniformis* were recovered from any combination treatments and similarly *T. semipenetrans* failed to appear in citrus tissues after the incorporation of miral or oxamyl with DBCP.

As regards growth of treated cowpea and citrus, it was revealed that best response to these combinations was reported by fensulfothion or oxamyl plus DBCP, while plants receiving miral+DBCP were relatively unthrifty (Tabl. 1 and 2).

Discussion

Some nematicides controlled nematodes and increased the growth of cowpea and citrus. The results obtained with aldicarb, oxamyl and fensulfothion were always statistically significant. Another group of materials were highly effective against nematodes but gave intermediate increases in growth of treated hosts. These materials were DBCP, miral and ethoprop. Phenamiphos gave the least satisfactory growth of

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