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

THE EFFECT OF NITROGEN FERTILIZERS ON THE GROWTH OF OLIVE AND IN RELATION TO INFESTATIONS OF *ROTYLENCHULUS RENIFORMIS*

by

T. BADRA [1] and M. M. KHATTAB

The application of mineral nitrogenous fertilizers has been reported by workers to influence nematode damage to crops. In some instances nematode populations were suppressed, e.g. *Helicotylenchus, Pratylenchus, Heterodera* and *Tylenchulus* (Castaner, 1966; Kurten and Kemper, 1974; Schorok-Fischer and Schwabe, 1973; Scotto La Massese *et al.*, 1973), while in others populations were either unaffected or increased following fertilizer treatments (Balbaeva *et al.*, 1972; Barry *et al.*, 1974; Chawla and Prasad, 1974; McEwen *et al.*, 1973). The experiments described here compared the efficacy of soil and foliar treatments of different forms of mineral nitrogen on the growth of olive and on the numbers of *Rotylenchulus reniformis* Linford *et* Oliveira, on this host. Phenolics were also assayed and correlated with nematode susceptibility/resistance.

MATERIALS AND METHODS

Six-month old seedlings of olive, *Olea europaea* L., were potted singly in 15-cm clay pots containing 1 kg autoclaved clay loam and then inoculated with the reniform nematode, *R. reniformis*, at 3,000 nematode/pot. After 15 days, treatments consisting of 350 and 700

[1] Present address: International Institute of Tropical Agriculture, Ibadan, Nigeria.

ppm nitrogen in the form of ammoniacal (ammonium sulphate 20.5% N), ammonium+nitrate (ammonium nitrate, 33.5% N) or synthetic organic N (urea, 46% N) were applied. Each dose was either incorporated into the soil in one group of pots or sprayed onto the foliage in the other group using 25 ml of water plus 0.5% Tensofix as a sticker-spreader. Each treatment was replicated four times. The pots were kept in a screenhouse from late Auguste to October and then discontinued in late November. Fresh shoot and root weights were recorded and soil nematode populations assayed in three replicated 250-g soil samples per treatment using an Oostenbrink elutriator (1960). For each treatment a 4 g root sample was processed by the blending techniques (Fallis, 1943; Taylor and Logering, 1953) to determine nematode densities in the roots. Another 3-g fresh root samples were used for assessment of phenols in tissues (Snell and Snell, 1953).

RESULTS AND DISCUSSION

The three types of nitrogen fertilizer significantly affected shoot and total plant weights but root growth was almost unaffected (Tab. I). Incorporation into the soil of 350 ppm ammoniacal N had the greatest effect on the total growth weight of olive seedlings ($P=0.01$). Both foliar application of synthetic organic N gave better results than the comparable soil treatment. Almost all N treatments significantly increased plant height except the foliage spray of ammonium nitrate and urea at 700 ppm which slightly depressed elongation. The higher dosage of N as soil treatment increased height with respect to plants receiving the lower dosage. Most treatments significantly increased branching although the higher dosages were less effective in this respect. Plants sprayed with 350 ppm synthetic organic N showed the best height and branching response.

The population density of *R. reniformis* in soil was decreased only with the soil treatment of 350 and 700 ppm synthetic organic N and 350 ppm ammoniacal N by 31.3, 31.4 and 18.2%, respectively (Tab. II). All other treatments resulted in increased numbers of nematodes, both in the soil and in the roots, except for the higher dosage of urea in which treatment the nematode density in the roots was less than in the controls. The reduction of nematode populations following the soil treatment of nitrogen and the lack of effect with

Table I - *Influence of soil and foliar treatments of three nitrogen forms on* R. reniformis *infested olive seedlings.*

Treatment (ppm)		Height increase (cm)	No. of branches	Shoot wt. (g)	Root wt. (g)	Total plant wt. (g)
Soil treatment:						
Amm. nitrate	350	9.0 b	2.5 b	4.15	3.10	7.25
» »	700	12.5 b	2.0 a	5.18 a	2.80	7.98
Amm. sulphate	350	7.5 a	2.5 b	5.98 b	3.70 a	9.68 b
» »	700	9.0 b	1.5	4.73	3.05	7.78
Urea	350	6.0	1.0	4.80 a	3.30	8.10
»	700	7.0	1.5	4.53	2.30	6.83
Foliar treatment:						
Amm. nitrate	350	4.0	2 0 a	3.43	1.88	5.30
» »	700	4.0	1.0	3.63	2.00	5.63
Amm. sulphate	350	7.0	2.5 b	5.55 b	3.40	8.95 a
» »	700	9.0 b	1.5	5.25 b	3.35	8.60 a
Urea	350	10.0 b	3.0 b	5.83 b	3.40	9.23 b
»	700	4.0	1.5	5.05	3.38	8.43 a
Untraeted		4.5	1.0	3.43	2.33	5.77
LSD 0.05		2.7	0.8	1.33	1.35	2.47
LSD 0.01		3.6	1.1	1.78	1.81	3.31

a and b statistically significant with respect to control at 5 and 1% level, respectively.

foliar sprays suggests that the nematicidal action of the nitrogen fertilizer was by direct contact rather than indirectly by affecting the plant's physiology.

Phenol fractions in the root tissues of nitrogen-treated olive plants were significantly higher ($P=0.01$) than in untreated plants after most treatments (Tab. II). The lower dosages of foliar-applied nitrogen treatments induced greater amounts of phenols than did the higher dosages but the opposite tendency generally was found with soil treatments. There appeared different correlations between the quantitative and qualitative phenolic content and infestation of *R. reniformis* as compared in Table II. Quantitatively, higher amounts of total phenols were associated with higher nematode populations, especially with the soil and foliar treatments of ammoniacal N. How-

ever, phenols increased as nematodes declined when synthetic organic N was added to the soil and possibly this similarly occurred with foliar application of ammonium nitrate. Qualitatively, lower poly/monophenol ratios were always associated with higher nematode populations in the nitrogen treatments. This suggests that the accumulation of higher polyphenols in the roots of nitrogen-treated plants acts as an inhibitor of nematode infestations, while the reduction in the amount of polyphenols allows an increase of nematode numbers. This physiological balance may be involved as one of the factors affecting nematode development in roots.

Table II - *Effect of soil and foliar applications of three nitrogen forms on populations of* R. reniformis *infesting olive and on root phenolic content.*

Treatment		Soil population/250 g			Root population/4g tissues	Phenols in one g tissues		
		Males	Larvae + Females	Total		Mono	Poly	Total
	(ppm)	(No.)	(No.)	(No.)	(No.)	(µg)	(µg)	(µg)
Soil treatment:								
Amm. nitrate	350	245	1766	2011	227	1200 a	335	1533 a
» »	700	440 b	2610 b	3080 a	240	1500 b	333	1833 b
Amm. sulphate	350	644 b	3140 b	3784 b	289	1300 b	167 b	1467
» »	700	183	1023	1206	65	1033	300	1333
Urea	350	219	794	1013	83	1433 b	333	1766 b
»	700	232	778	1011	47	1467 b	467 b	1934 b
Foliar treatment:								
Amm. nitrate	350	1241 b	3114 b	4355 b	345	1433 b	400 b	1833 b
» »	700	1005 b	3516 b	4521 b	373	1433 b	333	1766 b
Amm. sulphate	350	525 b	4738 b	5263 b	441	1600 b	400 b	2000 b
» »	700	350	1497	1856	256	1200 a	467 b	1667 b
Urea	350	1000 b	3100 b	4100 b	318	1500 b	333	1833 b
»	700	477 b	1386	1863	125	1200 a	400 b	1600 b
Untreated		167	1307	1474	191	1033	300	1333
LSD 0.05		204	664	1426		148	38	153
LSD 0.01		273	887	1907		198	51	206

a and b statistically significant with respect to control at 5 and 1% level, respectively.

SUMMARY

Soil and foliar applications of three forms of nitrogen were compared in their effects on the growth of olive (*Olea europaea* L.) and on the infestations of *Rotylenchulus reniformis* Linford *et* Oliveira. Plant height and branching were significantly increased by most treatments, highest by foliar sprays of 350 ppm synthetic organic N. The foliar spray of ammonium nitrate N slightly suppressed growth. Soil incorporation of synthetic organic and ammoniacal N insignificantly reduced *R. reniformis* populations, while their foliar treatments supported significantly higher numbers of nematodes than controls. Soil treatment of ammonium nitrate was ineffective, and much greater numbers of *R. reniformis* were associated with the comparable foliar doses. Concentrations of root phenols increased in N treated plants; being higher in foliar treatments than in soil treatments. This is believed to be the first report of *R. reniformis* on olives.

RIASSUNTO

Effetto di fertilizzanti azotati sulla crescita di piantine di olivo in presenza di infestazioni di Rotylenchulus reniformis.

È stato studiato l'effetto di somministrazioni fogliari di tre forme di azoto sulla crescita di piantine di Olivo (*Olea europaea* L.) e sulle infestazioni di *Rotylenchulus reniformis* Linford *et* Oliveira. Altezza e ramificazione delle piante sono state significativamente aumentate da quasi tutti i trattamenti, con effetto maggiore da parte di irrorazioni fogliari, alla concentrazione di 350 ppm, di azoto organico sintetico. Le somministrazioni fogliari di nitrato di ammonio hanno leggermente ridotto la crescita delle piante. L'incorporazione al terreno degli stessi prodotti non ha ridotto in maniera significativa le popolazioni del nematode, mentre i trattamenti fogliari hanno aumentato i livelli di infestazione. La concentrazione dei fenoli era maggiore nelle radici di piante trattate e le somministrazioni fogliari sembrano aver avuto un maggior effetto di quelle al terreno. *Rotylenchulus reniformis* è segnalato per la prima volta su Olivo.

LITERATURE CITED

BALBAEVA Z. A., BEISOVA T. K., KUANSHALIEVA E. N. and NUGMANOVA K. N., 1972 - The effect of fertilizers on the numbers of parasitic nematodes on vegetables and potatoes in southeastern Kazakhstan. *Trudy Inst. Zool. Akad. Nauk Kazakhskoi, SSR, 33*: 151-163.

BARRY E. R., BROWN R. H. and ELLIDTT B. R., 1974 - Cereal cyst nematode (*Heterodera avenae*) in Victoria: Influence of cultural practices on grain yields and nematode populations. *Aust. J. Exper. Agric. & Animal Husb., 14*: 566-571.

CASTANER D., 1966 - The relationship of numbers of *Helicotylenchus microlobus* to nitrogen soil amendments. *Iowa St. J. Sci., 41*: 125-135.

CHAWLA M. L. and PRASAD S. K., 1974 - Multiple cropping and nematodes. I. Effect of fertility management and intensive rotations on nematode populations and crop yield. *Indian J. Nematol., 3*: 34-49.

FALLIS A. M., 1943 - Use of the Waring blendor to separate small parasites from tissues. *Can. J. Publ. Hlth., 34*: 44.

KURTEN P. W. and KEMPER A., 1974 - Effect of annual fertilization with calcium ammonium nitrate and ammonia in a crop rotation on the yield and nema-

tode infection of the soil (1964-1971). *Nachrich. Deutsch. Pflanzensch., 26*: 39-42.

McEwen J., Salt G. A. and Hornby D., 1973 - The effects of dazomet and fertilizer nitrogen on field beans (*Vicia faba* L.). *J. Agric. Sci., 80*: 105-110.

Oostenbrink M., 1960 - Estimating nematode populations by some selected methods. *In* « Nematology » eds. J. N. Sasser and W. R. Jenkins. Univ. N. Carolina Press, Chapel Hill, 85-102.

Schonrok-Fischer R. and Shwable L., 1973 - Investigations on the possibility of reducing yield losses due to nematodes in intensive cereal growing. *In*: Vortrage der 12. Tagung uber probleme der Landwirtshaftswissenschafter der DDR., 55-69.

Scotto La Massese C., Vassy R. and Zaouchi H., 1973 - *Tylenchulus semipenetrans* eradication by nitrogen fertilization in a clementine orchard. *Nematol. medit., 1*: 15-21.

Snell F. D. and Snell C. T., 1953 - *Colorimetric methods of analysis including some turbimetric and nephalometric methods*. D. Van Nostrand Inc., Princeton, N.J., Toronto, N.Y., London, vol. III, 606 pp.

Taylor A. L. and Loegering W. Q., 1953 - Nematodes associated with lesions in in Abaca. *Turrialba, 31*: 8-13.

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