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UMBERTO MALOSSINI (*) - GIADA D'ERRICO (**) - MAURO VARNER (***)
FRANCESCO PAOLO D'ERRICO (#) - OTTAVIO SOPPELSA (##)

THE VERTICAL AND HORIZONTAL DISTRIBUTION OF *MESOCRICONEMA XENOPLAX* (RASKI, 1952) IN THE TRENTINO VINEYARDS (NORTHERN ITALY)

(*) *F.E.M. IASMA, Centro Trasferimento Tecnologico San Michele all'Adige, Via E. Mach, 1, 38010 San Michele all'Adige, Trento, Italy*; e-mail: umberto.malossini@iasma.it
(**) *Dipartimento di Scienze Animali, Vegetali e dell'Ambiente; Università degli Studi del Molise, via De Sanctis, 86100 Campobasso, Italy.*
(***) *Cantina Mezzacorona s.c.a., Trento, Italy.*
(#) *Dipartimento di Entomologia e Zoologia Agraria, Università degli Studi di Napoli "Federico II", via Università 100, 80055 Portici (NA), Italy.*
(##) *Dipartimento delle Scienze Biologiche, Università degli Studi di Napoli "Federico II", via Mezzocannone 8, 80134 Napoli, Italy.*

Malossini U., d'Errico G., Varner M., d'Errico F.P., Soppelsa O. – The vertical and horizontal distribution of *Mesocriconema xenoplax* (Raski, 1952) in Trentino vineyards (Northern Italy).

Spatial distribution of *Mesocriconema xenoplax* (Raski, 1952) was investigated in vineyards in the Trentino region (Northern Italy). Horizontal distribution showed characteristic aggregate pattern for nematodes, correlated to the symptomatology of the localized spots of infestations. The vertical distribution, in compact texture soils, revealed maximum population levels of the nematode in the top layers depending on the root occurrence that, in such conditions, is lower at the deeper levels. Higher nematode number was found at greater depths in loose soils, where roots easier penetrate.

The knowledge gained from the spatial distribution of this species is fundamental to investigate the effectiveness of different sampling patterns in order to improve efficacy of control strategies.

KEY WORDS: *Mesocriconema xenoplax,* spatial distribution, vineyards.

INTRODUCTION

Mesocriconema xenoplax (Raski, 1952) (Nematoda: Tylenchida) is a cosmopolite nematode highly harmful to several crops, such as the grapevine (KLINGER, 1975; PINOCHET and CISNEROS, 1986; WALKER, 1995). In some traditional growing vineyards areas it is recorded as the most abundant plant parasitic nematode (GÜNTZEL *et al.*, 1987; PINKERTON *et al.*, 1999). The species reproduces from 60 to 1,300 times in 4-5 months on *Vitis vinifera* and *V. labrusca*. The damage threshold is 10,000 individuals per plant on *V. vinifera* var. *Blauburgunder* (KLINGER, 1975) and *V. labrusca* var. *Concord* (SANTO and BOLANDER, 1977). The visible symptom of the attack is represented by reduced development and browning of roots, which lacking in absorbing, in a short time, go to decortication and destruction (KLINGER, 1975). *M. xenoplax* is often found associated to *Xiphinema* genus in virused vineyards and for this reason it is considered a probable vector of grapevine viruses (HEWITT *et al.*, 1958; JMENEZ, 1962; RAMSDELL and MYERS, 1974). *M. xenoplax* is widespread and in some Western Oregon zones is present up to 85% sampled soils (PINKERTON *et al.*, 2004). In old traditional grapevine areas of Germany and in Switzerland its presence is constant (WEISCHER, 1960*a*; 1960*b*; 1961*a*; 1961*b;* PINKERTON *et al.*, 2005). In Italy, it has been found in several regions, with high frequency (84%) and abundance (up to more than 1,000 individuals/500 cm^3 of soil) in Trentino (MALOSSINI *et al.*, 2008).

Studies on vertical distribution are present in literature for *M. xenoplax*, but not for its horizontal distribution. The most of specimens were found in the 0 to 40 cm soil level (WEISCHER, 1960*a*; 1960*b*; 1961*b*; AMICI, 1965; BIRD and RAMSDELL, 1985), and sometimes more numerous at greater depths (MANCINI *et al.*, 1980). Very conflicting data with occurrences above 80% at the deeper levels (from 80 to 120 cm) are also reported (AMBROGIONI and D'ERRICO, 1980).

Both the horizontal and vertical distribution of root parasitic nematodes in soil depend on different soil characteristics, such as humidity, soil type, pH etc. However, it depends primarily to the pattern of distribution of the plant root system that provides nematode feeding sites (YEATES and BOAG, 2004). For instance, WALLACE (1961) showed, in one of his first reports, a close relationship between moisture and soil type, affecting the bionomics of the free living stages of plant parasitic and zooparasitic nematodes.

The purpose of this study was to examine spatial variation in population sizes of *M. xenoplax* and to provide a scientific base for managing healthy soil ecosystem.

MATERIALS AND METHODS

The spatial distribution of *M. xenoplax* was investigated in the soil of vineyards in two Trentino sites (Northern Italy) in 2009. The survey on the horizontal distribution

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was carried out in Pancher farm situated in the Rotaliana Plain (near to Mezzocorona town). The vertical distribution was studied by means of three stratigraphies (in above mentioned Pancher farm, in Nardin and Gottardi farm both situated in Cembra Valley).

To detect the horizontal distribution, a grid of 300 squares (4x4 m), each comprising three grapevines rows (spacing of 2 m) was drawn on the field. The size of the squares was set to have a uniform distribution of the mass of the roots, by locating the central row in each square centre. About ten subsamples, all at the same level, collected from each square with a little drill, were placed in polyethylene bags and transferred into the laboratory and stored in a refrigerator at a temperature of 6-7 °C.

After appropriate mixing of each soil sample, 100 cm^3 of soil were used for nematode extraction according Cobb sieves method (THORNE, 1961).

The vertical distribution was carried out by digging three large holes of 1 meter deep allowing soil sampling every 10 cm starting from the deepest level (100 cm) from each hole wall (fig. I). Parameters, such as soil texture, pH and organic matter content, determining the nematological population, were recorded for all soil samples.

RESULTS

Horizontal distribution was analyzed and represented in figure II.

The data collected from three stratigraphies, related to investigated farms, are reported in Tables 1, 2 and 3.

Fig. I – A typical hole for soil sampling (Pancher farm).

Vertical distribution of *M. xenoplax* was evaluated and showed that was closely depended on root systems and consequently to soil texture (fig. III, IV and V). Roots become deeper in loose soils, allowing high nematode population density down to 1 m depth (Table 2); while in more compact soil the phytoparasite was more numerous in the top layers (Table 3).

DISCUSSION AND CONCLUSIONS

A forerunning study in a grass-land reported differences in nematodes spatial distribution (DE MAESENEER, 1963) where for examples *Pratylenchus crenatus* Loof, 1960 was present with high density only in one samples and absent in the remaining two. Further observations showed relationship between vertical distribution and seasonal fluctuations (population density was greater in the fall than in spring), and sampling site (the number of nematodes was higher within plant rows than across rows) and sampling grid size (nematodes were more numerous among 1x1 m than 3x3 m squares) (NOE and CAMPBELL, 1985).

Horizontal aggregated distribution is considered, among spatial distribution pattern of the organisms (orderly, random and aggregated), characteristic for nematological population. Surveys based on great number of soil samples showed high differences in nematological comunity density (BARKER and NUSBAUM, 1969) or in a population (D'ERRICO and CANCELLARA, 1976) in neighbouring soil samples. These results are confirmed by the spatial distribution of *M. xenoplax* found in this survey.

Vertical distribution studies on different taxonomical groups reveal that nematode species tend to occupy distinct soil horizons. For instance, plant parasitic nematodes are generally most abundant in the top 15-20 cm even if the population densities of some species are found to increase at greater depths (BARKER and CAMPBELL, 1981; RICKARD and BARKER, 1982).

The stratigraphy of *M. xenoplax* is well known and it appears to depend on soil texture (MANCINI *et al.*, 1980; AMBROGIONI and D'ERRICO, 1980). This information is confirmed by our observations, where in the loose soils the roots (providing nematode feeding sites) and the gravitational water easier penetrate in the deeper layers, allowing optimal conditions for nematode development. This is showed for the Nardin and the Gottardi farms, where greater *M. xenoplax* density was assessed between 90 and 100 cm depths. On the other hand, because of the compact texture soil, in the Pancher farm the nematode was found within the top 30 cm of the soil profile.

The pH and organic matter don't seem to influence the spatial distribution, probably it is due to light variations (especially in pH) recorded in each stratigraphies.

M. xenoplax spatial distribution evaluated is fundamental to investigate the different sampling patterns to improve future control strategies.

RIASSUNTO

DISTRIBUZIONE ORIZZONTALE E VERTICALE DI MESOCRICONEMA XENOPLAX (*RASKI, 1952*) *IN VIGNETI DEL TRENTINO*

La conoscenza della distribuzione spaziale (verticale ed orizzontale) delle popolazioni dei nematodi nel suolo è

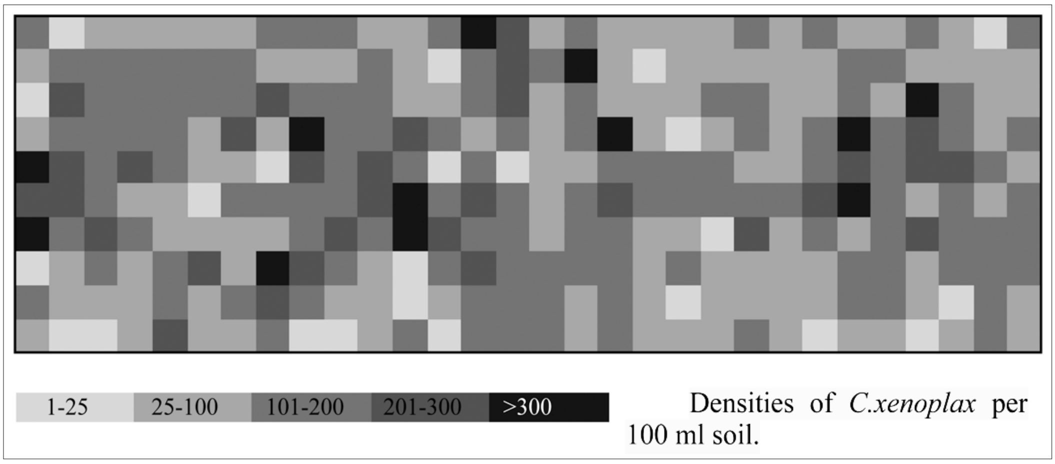

Fig. II – Horizontal distribution of *Mesocriconema xenoplax* in Rotaliana Plain, Pancher farm. Each square is 4x4 m. - Densities of *M. xenoplax* per 100 ml soil.

Table 1- Vertical distribution *Mesocriconema xenoplax* in Cembra Valley Nardin farm.

Depth (cm)	Soil texture	pH	Organic matter (%)	Individuals (n)	%
0 - 10	loam	8.26	1.6	64	7.3
10 - 20	loam	8.30	1.4	52	5.9
20 - 30	loam	8.31	1.2	47	5.3
30 - 40	loam	8.32	1.2	46	5.2
40 - 50	sandy-loam	8.49	0.8	221	25.1
50 - 60	sandy-loam	8.57	0.7	222	25.3
60 - 70	sandy-loam	8.62	0.5	68	7.7
70 - 80	sandy-loam	8.62	0.2	73	8.3
80 - 90	sandy-loam	8.65	0.2	71	8.1
90-100	sandy-loam	8.67	0.1	15	1.7

Table 2 - Vertical distribution of *Mesocriconema xenoplax* in Cembra Valley Gottardi farm.

Depth (cm)	Soil texture	pH	Organic matter (%)	Individuals (n)	%
0 - 10	loamy-sand	7.90	1.3	26	4.8
10 - 20	loamy-sand	8.37	0.7	32	5.9
20 - 30	loamy-sand	8.54	0.5	75	13.9
30 - 40	loamy-sand	8.62	0.4	16	3.0
40 - 50	loamy-sand	8.60	0.5	26	4.8
50 - 60	loamy-sand	8.67	0.4	45	8.4
60 - 70	loamy-sand	8.71	0.4	98	18.2
70 - 80	loamy-sand	8.72	0.3	24	4.5
80 - 90	loamy-sand	8.75	0.3	65	12.1
90-100	sand	8.80	0.2	131	24.3

Table 3 – Vertical distribution of *Mesocriconema xenoplax* in Rotaliana Plain Pancher farm.

Depth (cm)	Soil texture	pH	Organic matter (%)	Individuals (n)	%
0 - 10	loamy-sand	7.90	1.3	26	4.8
10 - 20	loamy-sand	8.37	0.7	32	5.9
20 - 30	loamy-sand	8.54	0.5	75	13.9
30 - 40	loamy-sand	8.62	0.4	16	3.0
40 - 50	loamy-sand	8.60	0.5	26	4.8
50 - 60	loamy-sand	8.67	0.4	45	8.4
60 - 70	loamy-sand	8.71	0.4	98	18.2
70 - 80	loamy-sand	8.72	0.3	24	4.5
80 - 90	loamy-sand	8.75	0.3	65	12.1
90-100	sand	8.80	0.2	131	24.3

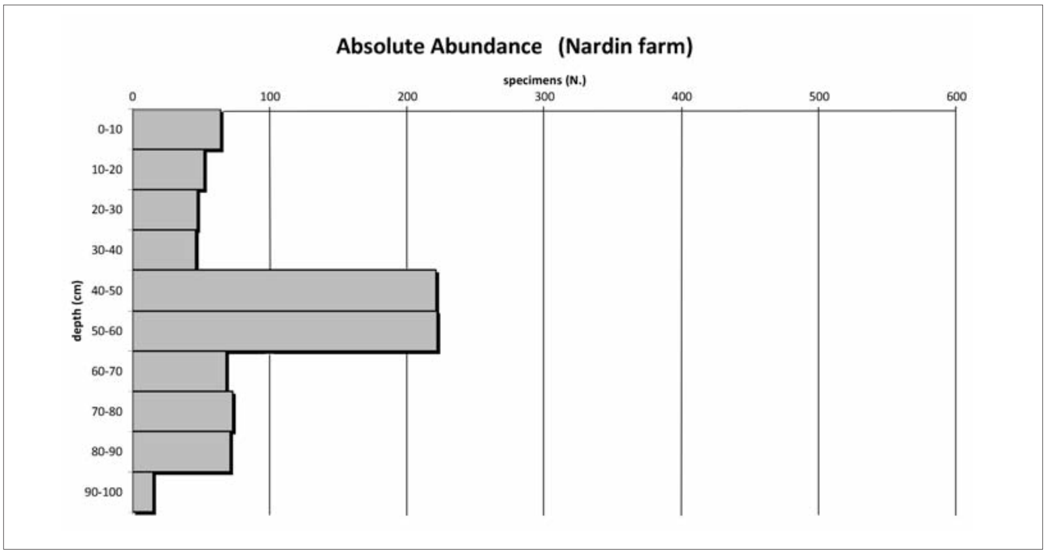

Fig. III – Vertical distribution of *Mesocriconema xenoplax* in Cembra Valley Nardin farm.

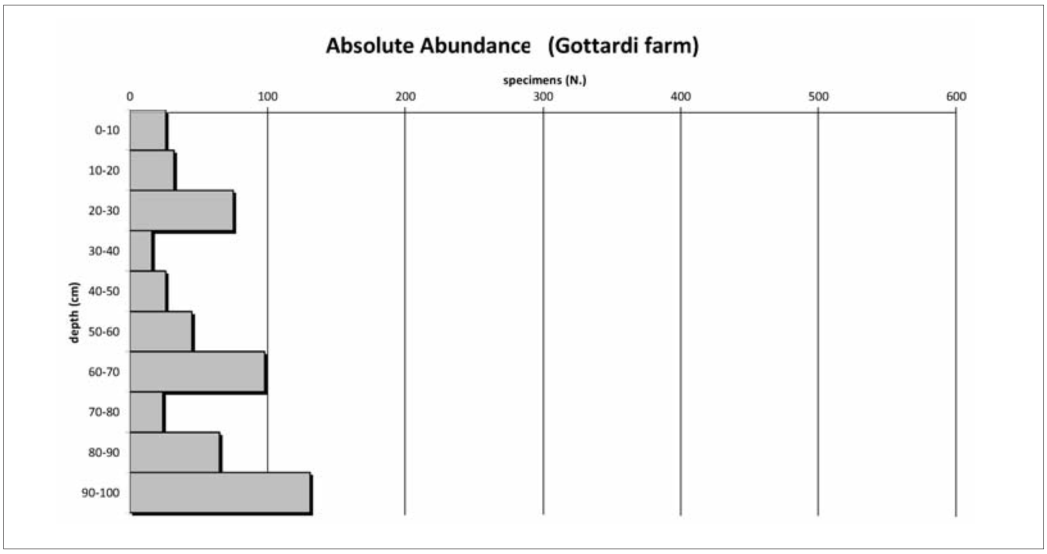

Fig. IV - Vertical distribution of *Mesocriconema xenoplax* in Cembra Valley Gottardi farm.

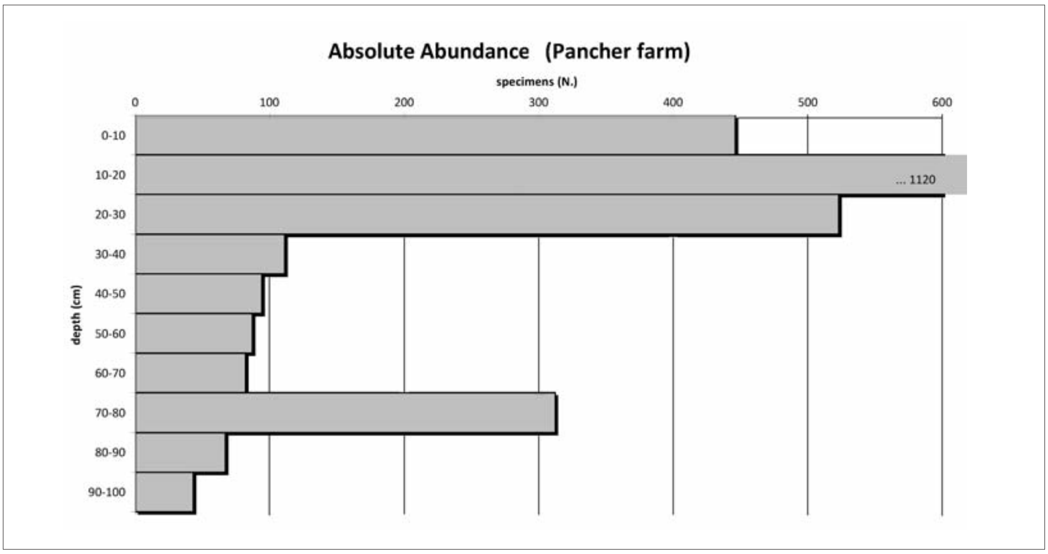

Fig. V – Vertical distribution of *Mesocriconema xenoplax* in Rotaliana Plain Pancher farm.

fondamentale per mettere a punto un metodo di campionamento rappresentativo e descrittivo del sito in esame contribuendo a rendere più efficaci le strategie di controllo. Con questo scopo è stata studiata la distribuzione orizzontale e verticale di *Mesocriconema xenoplax* (Raski, 1952) in alcuni vigneti del Trentino. La distribuzione orizzontale osservata è quella caratteristica per i nematodi, quindi di tipo aggregato che corrisponde a una sintomatologia delle infestazioni a macchie. La distribuzione verticale, nei terreni più compatti, ha mostrato una densità maggiore negli strati più superficiali, in relazione alla maggiore presenza degli apparati radicali che in tali condizioni scendono poco in profondità. Nei terreni più incoerenti, dove gli apparati radicali trovano minori ostacoli alla loro penetrazione, la distribuzione tende a localizzarsi anche negli strati più profondi dove le densità raggiungono livelli più elevati.

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