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# Plant-parasitic nematodes associated with alfalfa and fluctuations of *Pratylenchus jordanensis* population in the Sultanate of Oman

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**Summary -** Surveys carried out in the Batinah, Dhahira, Dhofar Governorates, and the Interior and Sharqia regions of the Sultanate of Oman during 1991-1996 revealed the presence of thirteen genera of plant parasitic nematodes associated with alfalfa. *Pratylenchus* spp. were the most common nematodes and were found in 61% of samples, followed by *Meloidogyne* spp., *Tylenchorhynchus* spp., *Helicotylenchus* spp., and *Rotylenchulus reniformis*. The population fluctuations of *Pratylenchus jordanensis* were studied on alfalfa at two locations at Rumais in the Batinah region during 1994-1995 and 1995-1996, respectively. A positive correlation ($P \geq 0.01$) between nematode populations in roots and soil temperature was observed. The nematode population in roots was highest from July to November and lowest from December to June.

***Résumé - Nématodes phytoparasites associés à la luzerne et fluctuations des populations de* Pratylenchus jordanensis *dans le Sultanat d'Oman -*** Des enquêtes réalisées de 1991 à 1996 dans les gouvernorats de Batimah, de Dhahira et du Dhofar et dans les régions de l'Intérieur et de Shargia ont révélé la présence de treize genres de nématodes phytoparasites associés à la luzerne. Les *Pratylenchus* sont les nématodes les plus communs (61% des échantillons) suivis par *Meloidodgyne* spp., *Tylenchorhynchus* spp., *Helicotylenchus* spp. et *Rotylenchulus reniformis*. Les fluctuations de population de *Pratylenchus jordanensis* ont été suivies sur luzerne en deux sites à Rumais dans la région de Bathinah en 1994-1995 et 1995-1996, respectivement. Une corrélation positive ($P \geq 0{,}01$) a été observée entre les populations du nématode et la température. Les populations endoracinaires sont les plus élevées de juillet à novembre et les plus basses de décembre à juin.

**Key-words:** alfalfa, distribution, fluctuation, occurrence, plant nematodes, population, *Pratylenchus jordanensis*.

Alfalfa (*Medicago sativa* L.) is the most important forage legume grown in the Sultanate of Oman. It is grown on most of the farms under traditional farming systems either as a sole crop or as an intercrop among irrigated fruit trees. In recent years, it was observed that the crop started declining 3 to 4 years after sowing as compared with 8 to 10 years of healthy crops in the past. Results of a preliminary survey revealed that *Pratylenchus* spp. were associated with alfalfa in certain parts of Oman (Waller & Bridge, 1978). Other surveys carried out in parts of Oman revealed the occurrence of *P. jordanensis* and this nematode was considered to have a negative effect on the production of alfalfa (Anon., 1993; Mani, 1993, 1996). Therefore, it was considered necessary to identify the plant-parasitic nematodes associated with alfalfa in all regions and to study the population fluctuations of *P. jordanensis* to understand its behaviour. Surveys were carried out in all alfalfa growing regions of Oman and the fluctuations of *P. jordanensis* population at Rumais in the Batinah region were monitored during the present investigations.

## Materials and methods

### OCCURRENCE AND DISTRIBUTION OF PLANT-PARASITIC NEMATODES

Surveys were carried out for two consecutive cropping seasons during 1990-1992 in the Batinah Governorate, 1992-1994 in the Interior region and the Dhahira Governorate, and 1994-1996 in the Sharqia region in northern Oman, and for a single season (1995) in Dhofar Governorate (Salalah) in southern Oman. Twelve wilayats (divisions) in Batinah, twelve in Interior, six in Dhahira, six in Sharqia, and five in Dhofar were surveyed (Fig. 1). Five farms were randomly selected in each wilayat with the help of extension personnel. Three to five samples were collected from each farm using a trowel, then pooled together. Soil and root samples were collected from the rhizosphere region up to 20 cm from the base of alfalfa plants and at a depth down to 15 cm. One sample from each farm and a total of 169 soil samples were collected from five regions. A composite sample of 250 $cm^3$ of soil was processed by Cobb's sieving and

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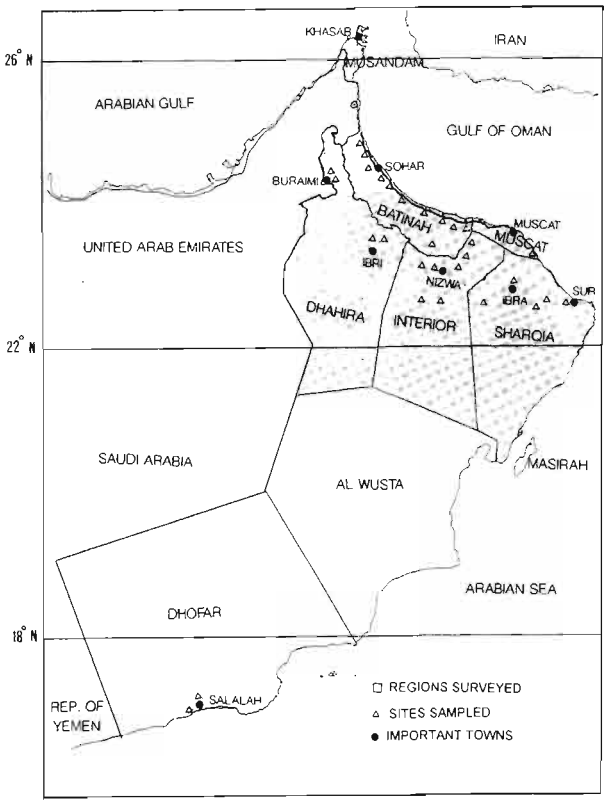


***Fig. 1.*** *Map of the Sultanate of Oman showing the regions surveyed and the sites sampled*

decanting technique and modified Baermann funnel method. Nematodes were identified by morphological and morphometric analysis of semi-permanent and permanent mounts of the specimens. *Meloidogyne* spp. were identified based on perineal patterns of adult females as well as characters of the second-stage juveniles (Jepson, 1987). Nematode populations were estimated from 1 ml aliquots under a binocular microscope.

### Fluctuations of *Pratylenchus jordanensis* populations

The study was carried out in 3-year old alfalfa fields, at two locations in the Batinah region from February 1994 to January 1995 and February, 1995 to January, 1996. The fields were flood-irrigated twice a week. Farmyard manure was applied at 2 t/ha once every 6 months. Soil and root samples were collected from ten randomly selected plots on the 14/15th of every month. The samples were collected from three plants in each plot, down to 15 cm depth around the plant. Soil temperature was recorded in the rhizosphere region at 5 and 15 cm depths using a Kane-May digital soil thermometer. The mean soil temperature recorded at 5 and 15 cm depth was calculated and used for statistical analysis and graphical representation. Nematodes were extracted from 250 $cm^3$ of soil. One gram of roots was washed free of soil, cut into pieces and macerated in a waring blender for 1 min. The root suspensions were incubated in modified Baermann funnels filled with water for 36-48 h. Nematode populations were counted in 1 ml aliquots using a stereo-binocular microscope. Moisture content of soil samples was estimated by an oven-dry method. Data on maximum and minimum temperatures and rainfall were recorded.

## Results and discussion

### Occurrence and distribution of plant-parasitic nematodes:

Thirteen genera of plant-parasitic nematodes were identified from the 169 soil samples collected (Table 1). *Pratylenchus* spp. were the most commonly occurring nematodes with a frequency of occurrence of 61%. *Meloidogyne* spp., *Tylenchorhynchus* spp., *Helicotylenchus* spp. and *Rotylenchulus* sp. occurred in 33.1, 32, 24.9, and 16% of the samples, respectively, and these five nematode genera were found widely distributed in all the regions. Among the various species of nematodes, *P. jordanensis* was the most frequently recorded, with a frequency of 38.5%, followed by *R. reniformis* and *M. javanica* with, 16 and 11.8%, respectively. *R. reniformis* was recorded with the maximum mean population of 522 nematodes per 250 $cm^3$ of soil, followed by *M. javanica, M. incognita* and *P. jordanensis* with means of 424, 335, and 155 nematodes, respectively. *Pratylenchus* spp. were recognized as the major plant-parasites of alfalfa in Australia (Georgaras *et al.*, 1992) and USA (Griffin, 1984). Thus, considering the widespread distribution, frequency of occurrence and population density, the present results suggested that *Pratylenchus* spp., and particularly *P. jordanensis,* were potentially important parasites in alfalfa-production systems in Oman. *R. reniformis* and *Meloidogyne* spp. were the other nematode parasites which might have an impact on crop health and longevity.

### Fluctuations of *Pratylenchus jordanensis* populations

Weather data recorded at the Agricultural Research Centre, Rumais during 1994-96 revealed that the monthly mean of the daily maximum air temperature increased from February and reached a peak of 41.2°C and 40.4°C in June of 1994 and 1995, respectively (Fig. 2 A). The temperature declined gradually from July on and reached a low of 26.2°C and 24.5°C in January of 1995 and 1996, respectively. The mois-

***Table 1.*** *Occurrence, population density and distribution of phytonematodes in association with alfalfa*

| Nematode species | Frequency of occurrence(%) (n=169) | Population* | Distribution** |
|---|---|---|---|
| *Aphelenchoides* sp. | 1.78 | 28 (20-40) | D, I, S |
| *Criconemella* sp. | 0.59 | 20 (20) | S |
| *Ditylenchus* sp. | 4.14 | 44 (20-70) | B, D, I |
| *Helicotylenchus multicinctus* | 2.96 | 66 (40-100) | B, D, I, S |
| *Helicotylenchus* spp. | 21.89 | 142 (15-960) | B, D, DG, I, S |
| *Hemicriconemoides* spp. | 2.37 | 37 (20-65) | B, D, I |
| *Hoplolaimus* sp. | 1.18 | 16 (12-20) | B, S |
| *Longidorus* spp. | 5.92 | 26 (10-60) | B, D, DG, I, S |
| *Meloidogyne incognita* | 7.1 | 335 (44-2080) | B, D, I |
| *M. javanica* | 11.83 | 424 (20-1320) | B, D, I, S |
| *Meloidogyne* spp. | 14.2 | 153 (20-550) | D, DG, I, S |
| *Pratylenchus brachyurus* | 4.14 | 111 (20-300) | B, D, S |
| *P. delattrei* | 8.88 | 109 (25-300) | B, I |
| *P. jordanensis* | 38.46 | 154 (20-1254) | B, D, DG, I, S |
| *P. neglectus* | 1.18 | 50 (40-60) | DG |
| *Pratylenchus* spp. | 8.28 | 32 (15-120) | B, DG, I, S |
| *Rotylenchulus reniformis* | 15.98 | 522 (20-4820) | B, D, DG, I, S |
| *Telotylenchus indicus* | 6.5 | 40 (30-110) | B, D, I |
| *Tylenchorhynchus* spp. (*T. annulatus, T. goffarti*) | 31.95 | 140 (15-500) | B, D, DG, I, S |
| *Xiphinema americanum* | 8.88 | 28 (15-80) | B, D, DG, I, S |

* Mean and range of number of nematodes in 250 $cm^3$ of soil.
** B=Batinah; D=Dhahira; DG=Dhofar Gov.; I=Interior; S=-Sharqia

ture content of soil samples ranged from 9.5 to 11%. The physical and chemical characteristics of the field soil and irrigation water are given in Table 2. The population of *P. jordanensis* in soil did not vary significantly and was high throughout the year (Fig. 2 B). However, the population was lowest in May and August at the first and second site, respectively. The correlation between nematode soil populations and

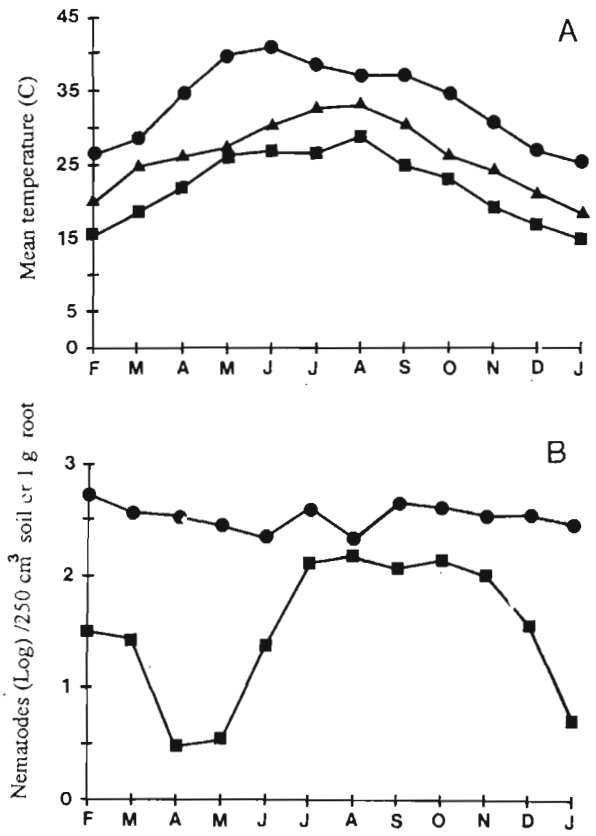


***Fig. 2.*** *A: Monthly mean of the daily maximum and minimum air temperature and mean soil temperature recorded during 1994-96; mean of two years data (●: Maximum temperature; ■: Minimum temperature; ▲: Mean soil temperature); B: Population fluctuations of* Pratylenchus jordanensis *in rhizosphere soil and roots of alfalfa during 1994-96 (mean of two years data; (●: Soil population; ■: Root population).*

soil temperature was not significant ($P \geq 0.05$). In contrast with the soil population, nematode populations in roots fluctuated greatly with a distinct high from July to November at both locations, which coincided with higher soil temperatures. In spite of the presence of a high nematode population in the soil, the population in roots was very low from December to June, coinciding with lower soil temperatures. These findings were confirmed by the positive correlations between the populations in roots and the soil temperature ($r$ = 0.433 and 0.324; $P \geq 0.01$), represented by the linear regression equations, $Y=78.45+29.43x$ and $Y=76.11+3.38x$. The high nematode population in roots from July to November suggested that the penetration and/or reproduction of *P. jordanensis* into roots was favoured by high soil temperature. Similar observations have been made with those species of *Pratylenchus* which are usually present in warmer regions. *P. brachyurus* was found to reproduce on soyabean in large numbers at 29°C when compared with low temperature levels (Lindsey & Cairns, 1971). Similarly, *P. neglectus*, observed on many field crops in Interior region of Oman (Anon., 1993), also penetrated maize roots in high numbers at 30°C (Townshend, 1972) and the rate of reproduction was higher at 38°C than at other temperatures (Mountain, 1954). Besides soil temperature, the phenology of the crop also might have played a major role in determining the population fluctuations of the nematode as suggested by Ferris and McKenry (1976). The significantly high populations of *P. jordanensis* in roots indicates that this nematode needs to be controlled to improve the health of the crop.

***Table 2.*** *Physical and chemical characteristics of field soil and irrigation water at two experimental sites in the Batinah region of Oman*

| Parameters | Site 1 | Site 2 |
|---|---|---|
| *Soil* | | |
| Coarse sand (%) | 16.2 | 9.8 |
| Fine sand (%) | 68.2 | 70.9 |
| Silt (%) | 11.9 | 11.6 |
| Clay (%) | 3.7 | 7.7 |
| $CaCO_3$ (%) | 26.8 | 24.0 |
| pH | 8.2 | 8.1 |
| Electrical conductivity (μΩ/cm-1.5) | 600 | 460 |
| *Irrigation water* | | |
| pH | 7.5 | 7.2 |
| Electrical conductivity (μΩ/cm-1.5) | 4600 | 5200 |

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