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ANALYSYS OF THE GEOGRAPHICAL DISTRIBUTION
OF *XIPHINEMA DIVERSICAUDATUM* AND *X. PACHTAICUM*
IN RELATION TO THE ENVIRONMENTAL FACTORS IN SPAIN

by

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Knowledge of the environmental factors affecting the distribution of soil inhabiting nematodes can indicate the areas in which species can or cannot spread and thus is helpful in establishing control measures for pathogenic species. Most field investigations concerned with pathogenic nematodes are conducted in the crops in which they are causing damage but many of these species also inhabit uncultivated areas and a study of these can be very informative with regard to nematode behaviour. This view gave rise to our studies of the behaviour and distribution of virus vector nematodes of the family *Longidoridae* in Spain.

The Atlas of *Longidoridae* in Spain (Arias, 1979), which is a contribution to the European Plant Parasitic Survey, was based on 5000 soil samples collected mainly from the cultivated soils at the bottom of valleys (Fig. 1). *Xiphinema* species were collected more frequently than *Longidorus* and therefore *Xiphinema* was chosen for an examination of ecological factors affecting the occurrence and distribution of individual species.

Materials and Methods

Two areas in the Central Region of Spain were chosen as having ecological and physiographic characteristics that are representative of atlantic, centraleuropean and mediterranean environments. The Alberche river basin (Fig. 1) has an atlantic environment in the upper part of the river basin, while the middle and lower regions are typically mediterranean.

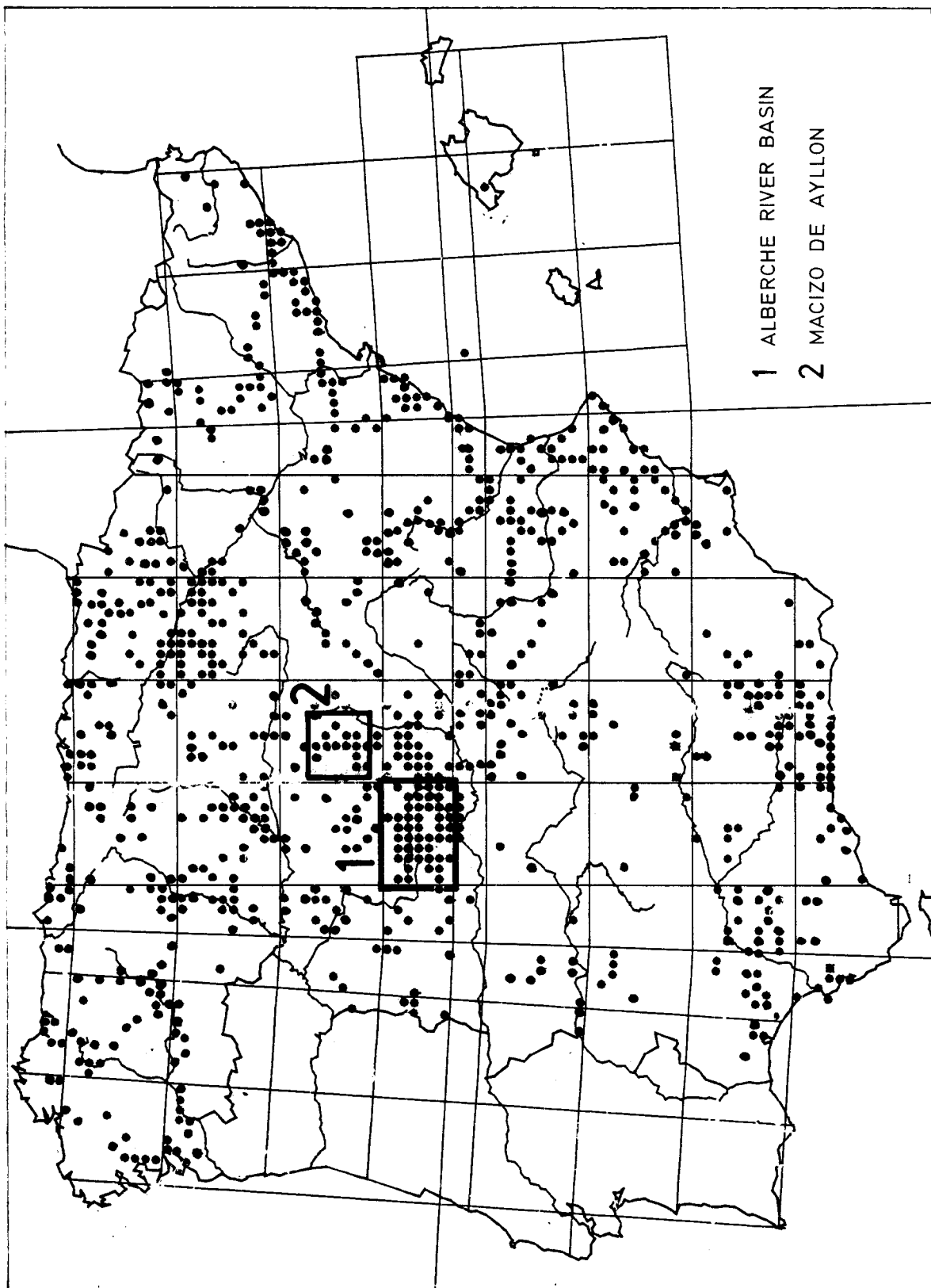


Fig. 1 - Distribution of samples on the Peninsular Spain and location of areas of study.

The second area, the Macizo de Ayllón, is a mountain system at an altitude in excess of 2.000 m in which vegetation characteristics of Iberian Peninsula is represented within 20 Km² area. Soils are mainly acid siliceous (gneiss, quartzite and slate) with some calcareous zones in the south and east; variation in topography gives rise to local differences in climate characteristics.

Information on the environmental factors influencing nematode occurrence in the lower Alberche river basin is derived from the ecological studies of Navas *et al.* (1981), Navas and Lacasta (1981) and Navas and Arias (1982). This area has a wide range of climate and vegetative environment to compare with the upper Alberche and with the Ayllón. Data on nematode distribution were related to vegetation, climate, soil type and edaphic characteristics as well as the influence of man's activities (crops and degraded zones). The data were subjected to χ^2 analysis, variance analysis and Student's t-test; Duncan's test as modified by Kramer was used as a uniformity test in the variance analysis.

Results and Discussion

Table I summarizes the association of *Xiphinema diversicaudatum* (Micoletzky) Thorne and *X. pachtaicum* (Tulaganov) Kirjanova with environmental factors and the influence of these on their abundance.

Xiphinema diversicaudatum was positively associated with natural vegetation and soils with 60 to 70% sand; the number of individuals present decreased with per cent increase of clay. Organic matter did not greatly influence occurrence, but populations were larger in soils rich in organic matter. *X. diversicaudatum* seems to be intolerant to pH, it occurred in a narrow range with an apparent preference for slightly acid soils. Soil type had no influence on this species but moisture did; and the negative association with the warm continental climate, perhaps indicates an intolerance of dry conditions.

Xiphinema pachtaicum was associated with crops (vineyards and fruit trees). It was little affected by climate and was widespread throughout the whole zone. Occurrence was unrelated to percentage of sand or pH, but organic matter appeared to be a limiting factor, although *X. pachtaicum* seems to tolerate dry conditions.

Table I - Influence of environmental factors on presence and abundance of *Xiphinema diversicaudatum* and *X. pachtaicum*.

	<i>X. diversicaudatum</i>		<i>X. pachtaicum</i>	
	PRESENCE	ABUNDANCE	PRESENCE	ABUNDANCE
HOST	Fruit trees (-)*** Evergreen Oaks (+)***	Natural > Arable*	Fruit trees (+)*** River side vegetation (-)*** Evergreen Oaks (-)**	Fruit trees > E. Oaks* Pasture > Cereal*
TEXTURE	Loamy sand (+)** Sandy clay loam (-)*	Loamy-sand > Sandy-clay loam	N S	N S
SAND (%)	60 - 70 (+)**	N S	N S	N S
pH	6.07 (+)** (slightly acid)	slightly acid > (6-6.5) acid > neutral	N S	N S
ORGANIC MATTER	N S	Rich content > deficient very deficient normal	1.12% (+)* (deficient content)	N S
SOIL TYPE	N S	N S	NS	N S
CLIMATE	Warm continental (-)*	N S	N S	N S

association
(+) positive
(-) negative

signification level
N S not significant
* P (< 0.05)
** P (< 0.01)
*** P (< 0.001)

In the lowest part of the Alberche basin, *X. diversicaudatum* appeared only on the north side of the river without differentiation between the two types of climate (warm semicontinental and temperate continental). A thermopluviometric study (Navas and Lacasta, 1981) showed that there are two climatic areas in the lower zone of the river i.e. dry subhumid on the north side and semiarid on the south side. Thus it seems that *X. diversicaudatum* has its distribution limit in dry subhumid climate, as it occurred more frequently in the upper part of the basin which has dry subhumid, subhumid and humid climates, as well as soils richer in organic matter and with a high percentage of sand.

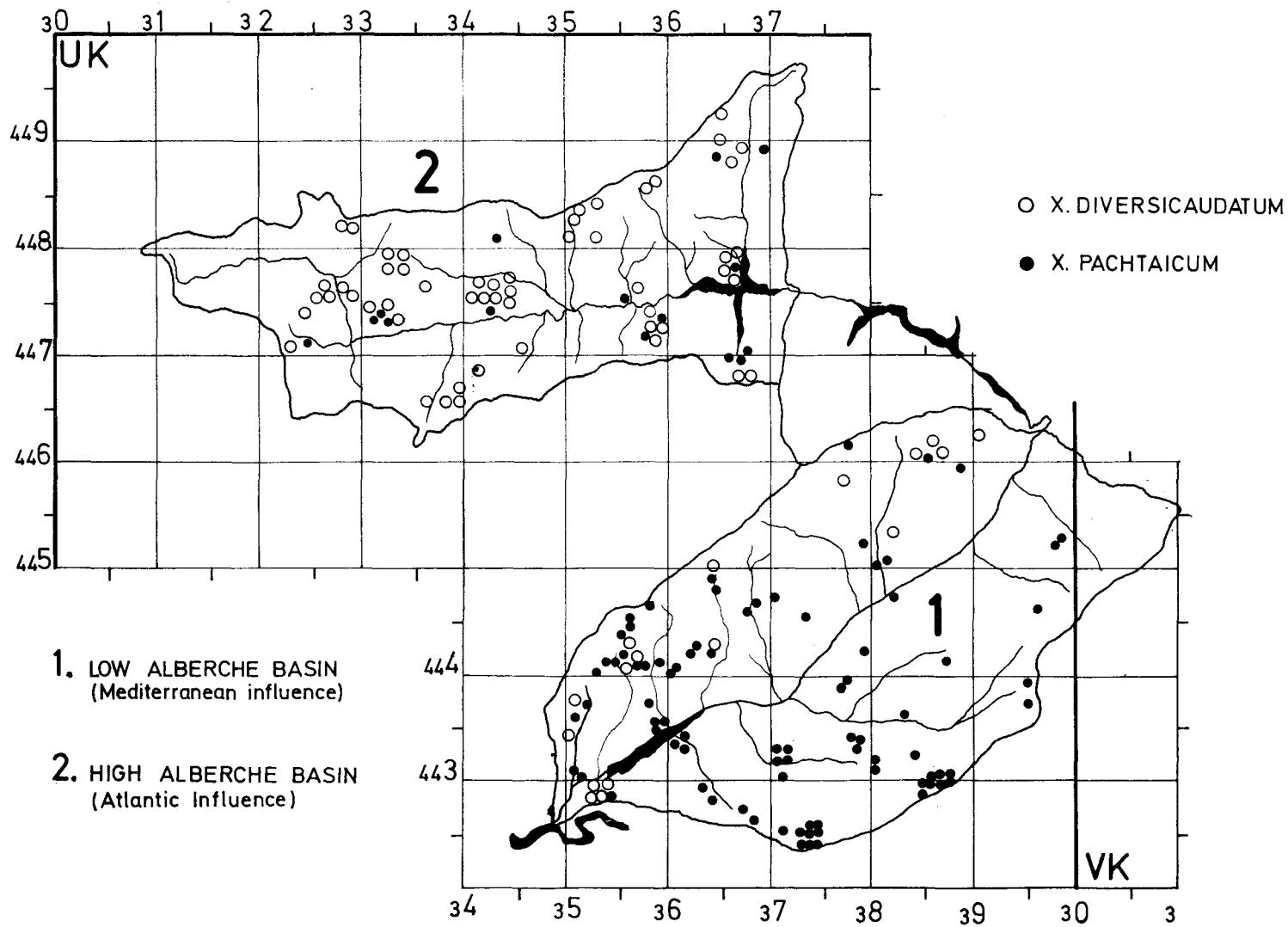
Xiphinema pachtaicum was very widespread in the lower part of the river basin and appeared in isolated spots in the upper part, generally associated with particular crops or in places where evapotranspiration was high resulting in arid conditions.

In Ayllón we sampled beech woods in the North West, where climatic conditions are severe, and for some months in the year soils are covered by snow; in the North East we sampled the juniper woods of Cantalojas and in the South East the juniper and evergreen woods of Tamajón. No *Xiphinema* species were found in the first two areas. *X. pachtaicum* occurred only in Tamajón, the zone where the mediterranean influence is most accentuated; *X. diversicaudatum* was not found here.

Our whole results indicate that climate influences the distribution of *X. diversicaudatum* and *X. pachtaicum* (Weischer, 1975) and, as found by Cohn (1969) and Jones *et al.* (1969), their occurrence can also be related to soil structure. The relationship of both species with organic matter can be explained by the fact that *X. diversicaudatum* is associated with natural environments and high content of organic matter, while *X. pachtaicum* is, on the contrary, associated with soils deficient in organic matter and arable land. This is in agreement with the european distribution of both species (Lamberti, 1981, and Brown and Taylor, 1977), bearing in mind that mediterranean soils have a low content in organic matter. The only previous reports associating occurrence with pH are those of Brown (1975) and Klingler (1984) which agree with our results. Since pH is a manifestation of chemical and biological activity, mainly of organic matter and clay, it is of great importance.

This ecological study has been centered in a limited area of contact between two environments (mediterranean and atlantic) in which the soils are typically siliceous. The studies should be extended to other areas that represent the calcareous soils of Spain.

Fig. 2 - Geographic distribution of species on Alberche river basin.



SUMMARY

To establish the environmental factors of importance in soil nematode distribution and their potential influence on the control of pathogenic species, an analysis of the geographical distribution of *Xiphinema diversicaudatum* and *X. pachtaicum* in Spain has been made. These species were chosen because they are the most representative ones of the Atlantic and Mediterranean areas, respectively, among the Spanish species of *Xiphinema*. The ecological behaviour of these species on two areas of the Central Region were studied as a basis for the analysis of their geographical distribution in relation to environmental factors in the Iberian Peninsula. The two studied areas were representative of either Atlantic or Mediterranean ecosystems in their natural vegetation. Finally, factors of vegetation climate, soil and the human influence affecting the distribution of these species were determined.

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