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Review Article

Environmental Abiotic and Nematode Biotic Factors Affecting Virulence of Corn Cyst Nematode, Heterodera Zeae on Corn in Egypt

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Abstract

Soil texture as abiotic factor alongside three biotic factors respecting with nematode such as inoculation levels, inocula storage conditions and inocula source types affects the virulence of Heterodera zeae. Lighter soil textures such as sandy clay loam and sandy loam were found to be more conducive to nematode proliferation compared to other soil types. Previous studies have stated that the initial level of H. zeae increased, the final population also showed a corresponding increase, but a negative correlation existed between the initial level and rate of nematode build-up. Notably, highly final population were detected on inoculated corn plants with fresh stored cysts under greenhouse conditions compared to stored cysts in a refrigerator or under laboratory conditions. When the corn plants were inoculated with juveniles, the nematode attained the lowest rate of build-up while the maximum value was achieved when eggs were used as the inoculum. Additionally, corn growth was significantly reduced in cases where eggs were used for inoculation compared to juveniles or cysts.

Keywords: Hererodera zeae; Soil Textures; Inoculation Levels; Inocula storage Conditions; Types of Inocula; Virulence; Egypt

Introduction

In Egypt, the corn cyst nematode, Hetetodera zeae has been identified as a significant nematode affecting maize plants, as highlighted by Aboul-Eid and Ghorab (1981), Ismail (1985, 2009), Abadir (1986), Moussa., *et al.* (1988) and Ismail., *et al.* (1993) [1-6] Some methods are discussed as follows

An Environmental Abiotic Factor

Behavior of H. zeae as influenced with soil textures

Movement, development and distribution of the nematode were observed in the best soil textures. Upadhyay., *et al*. (1972) , Whitney and Doney (1973), Santo and Bolander (1979) , Anand and Weather (1985),Walia (1987) and Todd and Pearson (1988) [7-12] stated that the virulence of related nematode species, including Hetetodera rostochiensis , H. schachtii , H. cajani and H. glycines were more favourable in the light clay soil than in the heavy clay soil. Lighter soils were observed to be more favorable for H. zeae build-up and attributed to good aeration and porosity in these soil types [13]. Studies conducted by Egyptian researchers, showed that H. zeae vitality increased in light soil than heavy soil [2,4,14] which help free vitality the nematode infection. The same findings are consistent with earlier research by Wallace, 1963; Upadhyay et al.,1972; Taha and Kassab,1979 and Walia,1987 [7,11,15,16]. Specifically, lighter soils i.e. sandy clay loam and sandy loam have been identified as more conducive environments for corn plant damages by the nematode infection compared to other soil types. [10,14,17].

Nematode biotic factors

Heterodere zeae behavior as influenced with nematode inoculation levels and response of the corn growth

Biotic factors such as nematode inoculation levels are useful in evaluating the virulence potential of a nematode species [18]. The relationship between inoculation levels of other cyst nematode species and host plant growth, nematode build-up was deeply studied (Rao and Peachy, 1965 on H. rostochiensis, Gill and Swarup, 1973 on H. avenae, Sharma and Sethi, 1975 on H.cajani, Maas and Brinkman, 1977 on H. graminicola and Griffin, 1988 on H. schachtii) [19-23]. Specifically, 100 or 500 cysts of H. zeae/plant affected corn height; while levels of 100, 250, 500, or 1000 cysts/plant adversely decreased the fresh and dry weights [24]. Applying 100 juveniles of H. zeae/kg of soil for the Pusa isolate and 1000 juveniles per kilogram for other isolate significantly decreased corn growth in compared to check plants (Srivastava and Sethi,1984b) [25]. In 1985, Ismail [2] declared that rate of cyst increase for corn cyst nematode was achieved at 200 cysts/plant. Abadir (1986) [4] reported that Tanta isolate of H. zeae inoculated with 1000 eggs and juveniles/plant was most virulence producing the highest number of cysts but, at using of 2000 eggs and juveniles/plant it was surpassed by the Belbais isolate. Plant growth reduction caused by the nematode could be attributed to the modification of plant physiological function i.e. photosynthesis, transpiration and mineral uptake following infection as reported by Heald and Jenkins (1964), , Wallace (1963),Ismail (1985) and Ismail and Khair (2014b). [2,15,26,27].

Viability, infectivity and virulence of H. zeae as influenced with cysts storage conditions.

Inocula storage conditions are important as biotic factors influencing on the nematode's behavior. The potato cyst nematode, H. rostochiensis cysts and juveniles were viable after 5 years under dry storage conditions [28,29] in compared to H. schachti because the juveniles of the sugerbeet cyst nematode lose water more than H. rostochiensis juveniles, while these conditions are not fovorable to H. avenea cysts [30]. Active juveniles and cysts of H. glycines were extracted from soil balls which taken from soybean seed sources after 5-8 months from collecting time [31]. Soybean cyst nematode juveniles survived 7-19 months under irrigation conditions and up to 38 months in dry soil [32]. Low-temperature (5 or 10°C) was more favourable for the vitality of H. avenea juveniles [33]. Respecting to H. zeae, there is a scarcity of literature on this particular factor. Krusberg and Sardanelli (1989) [34] observed that eggs or active second stage juveniles inside cysts of H.zeae still vital under field conditions. Recovered after fifty one months from naturally infested field soil stored moist under laboratory conditions some good cysts were extracted but after over two hundred days of storage, active larvae emerged from the recovered cysts and many white females developed in bioassays of these cysts. Ismail and Khair (2014 c) [35] observed that H. zeae had higher reproduction rates on inoculated maize plants with fresh cysts followed by which stayed for twelve months under low temperature 5°C. Also, the lowest final population and build-up was found when using H. zeae cysts stored under laboratory conditions. Consequently, the reduction in plant growth was more significant when fresh cysts were used compared to other storage conditions. Cooling conditions was better for H. zeae cysts than drying state [34].

Influence of various inocula kinds on virulence of corn cyst nematode.

Also, vorious types of inocula have been studied by some researchers. In 1973, Gill and Swarup [20] observed that freshly hatched second-stage juveniles of H. avenae was very virulence than cysts done. H.rostochiensis populations were significantly increased in case the plants which inoculated with cysts than the eggs and this regarding to the variation in the cyst contents of eggs and juveniles [36]. Contrarily, Ismail and Khair (2014d) [37] found that the further development of H. zeae was high at using eggs as inocula compared with cysts or juveniles. This method was found to be more virulent on corn growth and this respecting to the presence of eggshell which protect the juveniles from the adverse external conditions during the inoculation process. On the other hand, using juveniles as the inoculum might expose them to harmful conditions during this process. When cysts were used as the inoculum, the variability in their content and delaying of juveniles' emergence may decrease their virulence [37].

Conclusions and Recommendations

Soil textures as an environmental abiotic factor along with certain nematode biotic factors i.e. inoculation levels, inoculum storage conditions and inoculum source types are directly affecting on virulence of corn cyst nematode. Some methods were discussed to manage the nematode.

New Statement

The work declare the important environmental abiotic and nematode biotic factors affecting the population behavior of corn cyst nematode.

Author Role

Ahmed El-Sayed Ismail: Adopt an idea, prepared all required references , wrote, reviewed the paper.

Conflict of Interest

No conflict of interest.

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