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INFLUENCE OF ROOT LEACHATES AND TEMPERATURES ON EGG HATCH OF *MELOIDOGYNE* SPECIES

by
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Tomato (*Lycopersicon esculentum* Mill.) root leachates enhance the egg hatching of *M. hapla* Chitwood, *M. incognita* (Kofoid *et* White) Chitwood and *M. javanica* (Treub) Chitwood (Lownsbery and Viglierchio, 1958, 1960; Viglierchio and Lownsbery, 1960). The effect of temperature on egg hatch has also received attention. Bird and Wallace (1965) reported that *M. hapla* and *M. javanica* have a thermal optimum of 25 and 30° C, respectively, while Watson and Lownsbery (1970), reported a thermal optimum at 21° C for *M. hapla.* These authors also observed that 50 and 70% of *M. hapla* egg hatched after 8 weeks at 6 and 9° C. Inserra *et al.* (1983) reported that egg hatch of *M. chitwoodi* Golden *et al.* and *M. hapla* was not affected by root leachates of tomato and wheat, but was greatly affected by temperature. In order to extend the information on the influence of temperature and root leachates on the egg hatch of *Meloidogyne* spp. we investigated, under laboratory conditions, the effect of six temperatures and three root leachates on the egg hatch of *M. arenaria* (Neal) Chitwood, *M. hapla, M. incognita* and *M. javanica.*

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Materials and Methods

Italian populations of *M. arenaria* from peach (*Prunus persica* Stokes), *M. hapla* from sugarbeet (*Beta vulgaris* L.), *M. incognita* from tomato and *M. javanica* from bean (*Phaseolus vulgaris* L.) were reared on tomato cv. Rutgers in a greenhouse. Fifty egg masses (about 50.000 eggs) of each nematode species from tomato roots were placed on each of seventy two microsieves (75 μm aperture 20 mm diam.) and enclosed in petri dishes partially filled with distilled water or root leachates of « Roma VF » susceptible, « IAS-1 » resistant tomato or wheat (*Triticum durum* Desf.) cv. Creso, sufficient to cover the egg masses (Greco *et al.* 1982). The dishes with egg masses were maintained at 5, 10, 15, 20, 25 or 30° C (± 2) in growth chambers with 4 replicates of each treatment. Root leachates were obtained by drenching the soil of one month old container grown plants with 3 litres of distilled water and collecting the leachates during a 48 hour period. The leachates were centrifuged at 1500 × g for 30 minutes and stored at 3-4° C. Fresh changes of distilled water and root leachates and counts of emerged juveniles were made weekly for 8 weeks. At the end of the experiment the egg masses were placed in 50 ml glass tubes and treated with NaOCl to dissolve the gelatinous matrix (Hussey and Barker, 1973) and the unhatched eggs were counted. Egg hatch was expressed as percent of total initial population and analyzed by a split-plot in time analysis of variance.

Results

Hatch of *M. arenaria* eggs at 5 and 10° C was less ($P = 0.01$) than at the other temperatures in all leachates and at all time intervals (Fig. 1 A-D). At 15° C the egg hatch was similar to that at 20° C in all media after 8 weeks, but was less up to 4 weeks. The maximum egg hatch of 85-87% of the initial egg number was achieved at 6 weeks at 15° C in all leachates which was longer than that at the other temperatures (Fig. 1 A-D). The egg hatch at 25 and 30° C was less than at 15 and 20° C ($P = 0.05$) in susceptible tomato root leachate and in distilled water, but was similar to that at 25° C in resistant tomato root leachate after 8 weeks. At 30° C egg hatch was less ($P = 0.01$) than that at 15, 20 and 25° C in all root leachates, but was similar to that at 25° C in distilled water after 8 weeks. At each

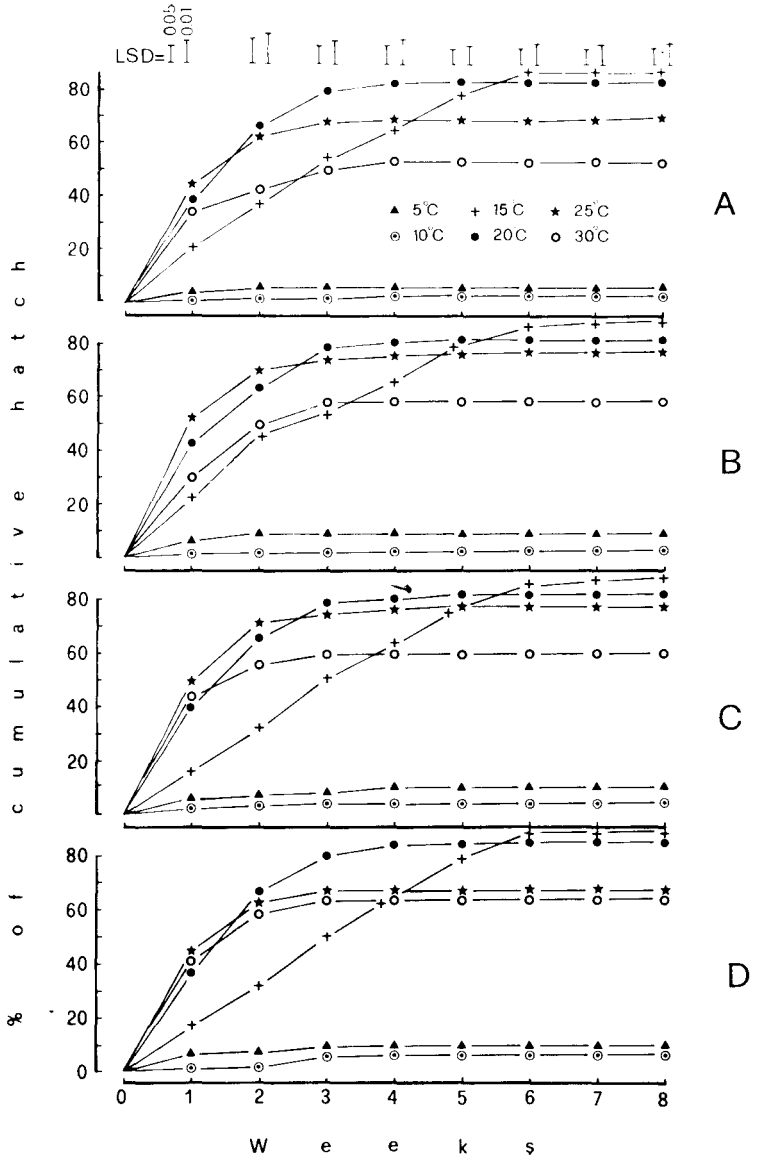

Fig. 1 - Influence of temperature on the egg hatch of *Meloidogyne arenaria* in root leachates of susceptible « Roma VF » (A) and resistant « IAS-1 » tomato (B), and « Creso » wheat (C), and distilled water (D).

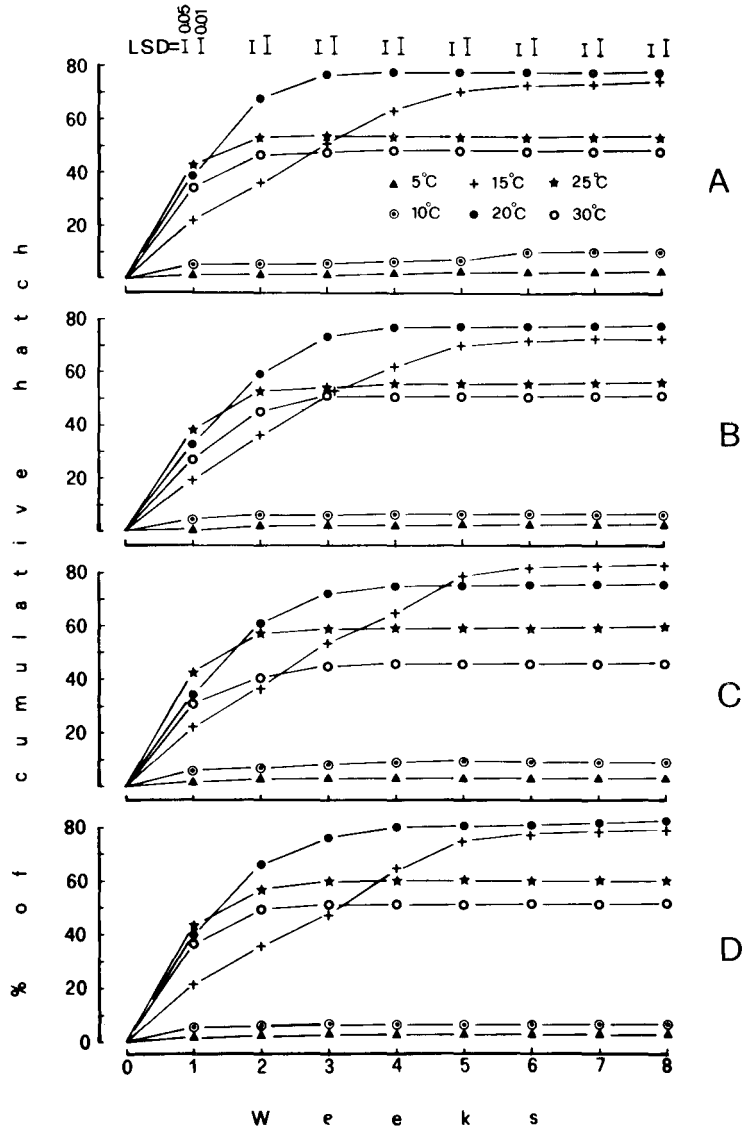

Fig. 2 - Influence of temperature on the egg hatch of *M. hapla* in root leachates of susceptible « Roma VF » (A) and resistant « IAS-1 » tomato (B), and « Creso » wheat (C), and distilled water (D).

temperature similar numbers of eggs hatched in all leachates (Fig. 1 A-D).

Hatch of *M. hapla* eggs at 5 and 10° C ranged from 5 to 10% of the initial number of eggs and was less ($P = 0.01$) than that at other temperatures in all leachates and at all time intervals (Fig. 2 A-D). At 15° C egg hatch was 74-82% of the initial egg number and was similar to that at 20° C after 8 weeks but was less than at 20° C in all leachates between 1 and 2 weeks. At 15° C maximum egg hatch was reached at 5-6 weeks which was longer than at other temperatures. The total numbers of eggs hatched at 8 weeks was greater at 15 and 20° C ($P = 0.01$) than at 25 and 30° C in all leachates. Hatch of eggs at 25° C was similar in susceptible and resistant tomato root leachates, but after 8 weeks was greater ($P = 0.01$) than that at 30° C in wheat root leachate and distilled water. At each temperature similar numbers of eggs hatched in all leachates (Fig. 2 A-D).

Hatch of *M. incognita* eggs at 5 and 10° C was less ($P = 0.01$) than at other temperatures in all leachates and at all time intervals and was 4-10% of the initial number of eggs (Fig. 3 A-D). There were no differences in the egg hatch in all leachates at 15, 20 and 25° C after 8 weeks. However, the rate of egg hatch was less up to 3 weeks at 15° C ($P = 0.05$) than at 20, 25 and 30° C in all leachates between 1 and 3 weeks. Maximum egg hatch was achieved at 5 to 6 weeks and was longer than at other temperatures (Fig. 3 A-D). Fewer eggs hatched at 30° C ($P = 0.01$) than that at 15, 20 and 25° C in susceptible and resistant tomato root leachates but in wheat root leachate and distilled water the hatch was similar to that at 25° C after 8 weeks. At each temperature similar numbers of eggs hatched in all leachates (Fig. 3 A-D).

Hatch of *M. javanica* eggs at 5 and 10° C was less ($P = 0.01$) than that at other temperatures in all leachates after 8 weeks and was 5-10% of the initial number of eggs (Fig. 4 A-D). There were no differences in the numbers of eggs that hatched in all leachates at 15 and 20° C after 8 weeks. However, at 15° C maximum egg hatch of 65-78% of the initial numbers of eggs was not achieved until 3-4 weeks in susceptible tomato and wheat leachates and 4-5 weeks in resistant tomato leachate and distilled water. Egg hatch after 8 weeks at 15 and 20° C was similar to that at 25° C in susceptible and resistant tomato root leachates, but was greater ($P = 0.05$) than at 25° C in wheat root leachate and distilled water. Egg hatch at 25° C was greater ($P = 0.01$) than at 30° C in susceptible and resistant tomato root leachates, but was similar in wheat root leachate and distilled water

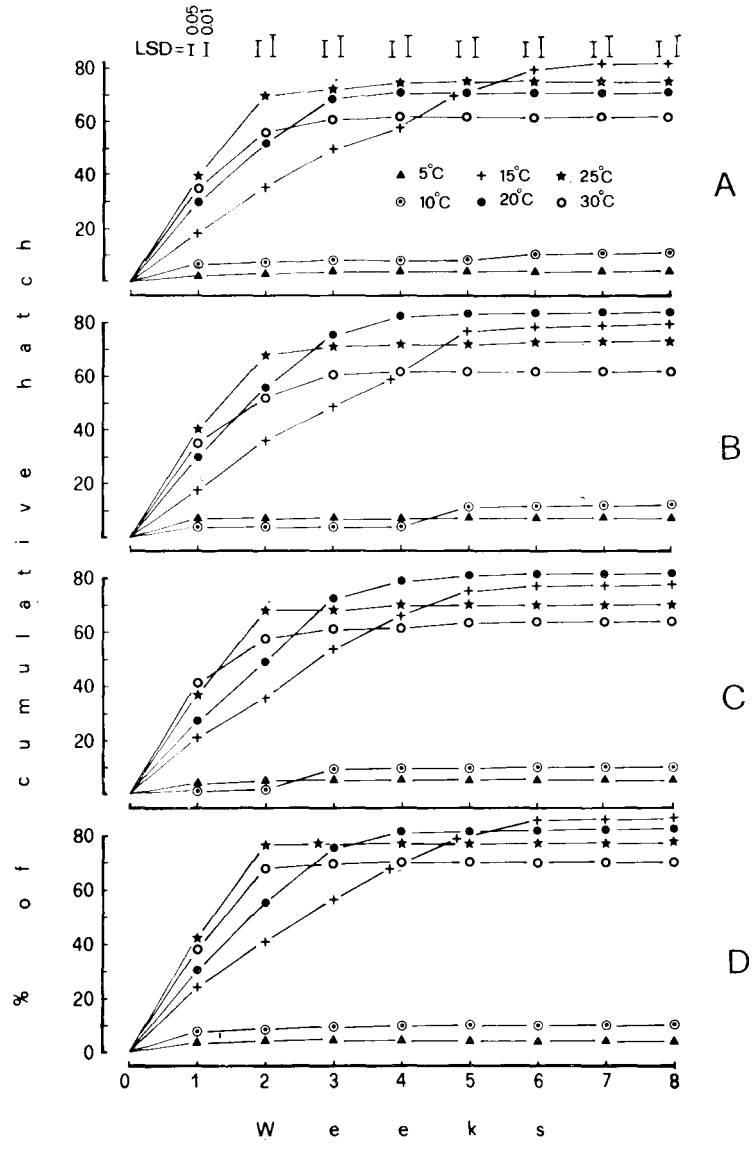

Fig. 3 - Influence of temperature on the egg hatch of *M. incognita* in root leachates of susceptible « Roma VF » (A) and resistant « IAS-1 » tomato (B), and « Creso » wheat (C), and distilled water (D).

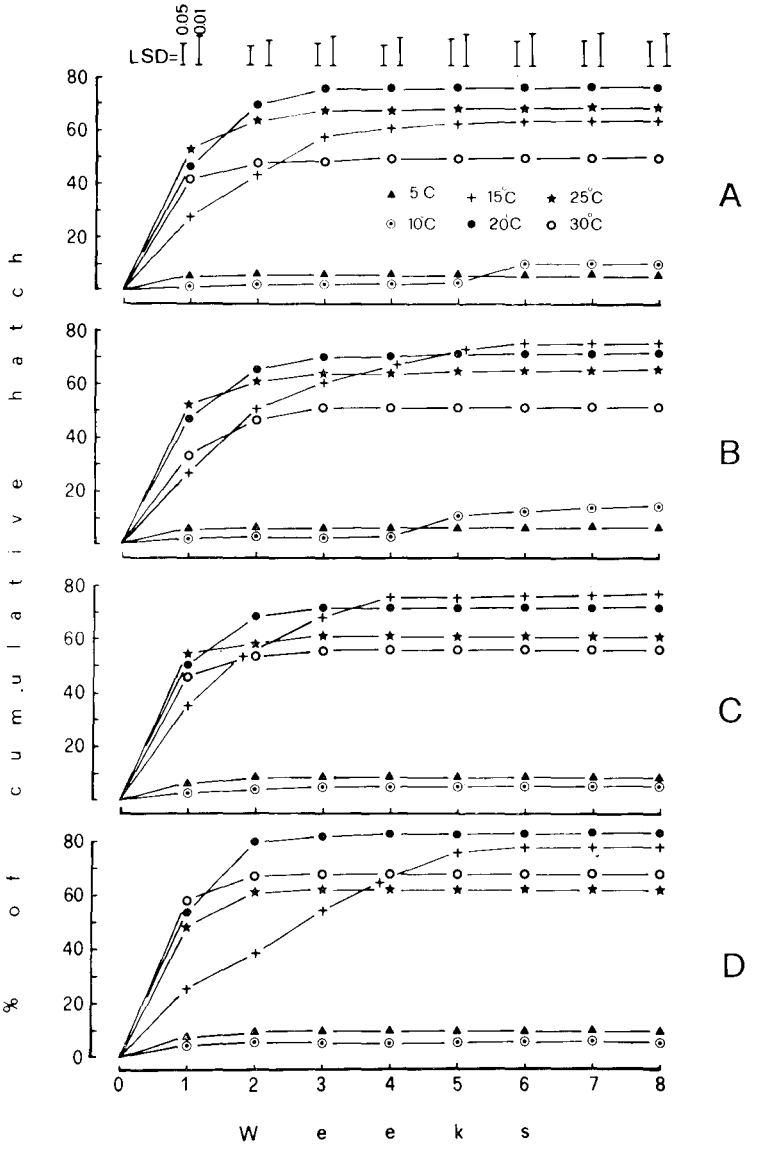

Fig. 4 - Influence of temperature on the egg hatch of *M. javanica* in root leachates of susceptible « Roma VF » (A) and resistant « IAS-1 » tomato (B), and « Creso » wheat (C), and distilled water (D).

at all time intervals. The total number of eggs that hatched at 30° C was less than at 15 and 20° C in all leachates. At each temperature similar numbers of egg hatched in all leachates (Fig. 4 A-D).

There were no differences between the cumulative hatches of *M. arenaria, M. hapla, M. incognita* and *M. javanica* eggs in all the leachates used, at each temperature and at all time intervals.

Discussion

Susceptible tomato « Roma VF » is a good host for *M. arenaria, M. hapla, M. incognita* and *M. javanica,* while wheat is a host for *M. incognita* and *M. javanica* but not for *M. arenaria* and *M. hapla.* The egg hatch of these root-knot nematode species was greatly influenced by temperatures but not by host. Bird and Wallace (1970), reported a thermal optimum at 30° C for *M. javanica* egg hatching, but in our experiment 20° C appeared to be more favourable than 30° C for the 2nd stage juvenile emergence of our population of *M. javanica* (Fig. 4 A-D). A temperature of 30° C was less favourable for juvenile emergence than 15, 20 and 25° C at which temperatures the hatch was about 60% of initial number of eggs. The time required by the eggs of these *Meloidogyne* species to achieve the maximum hatch was much longer at 15° C than at 20, 25 and 30° C (4-6 weeks vs 3 weeks or less).

Meloidogyne arenaria, M. incognita and *M. javanica* are widespread in warm climates, whereas *M. hapla* is more common in cool climates. However, in the range of temperatures used in our experiment there were no differences between the *Meloidogyne* species in the numbers of emerging juveniles. Watson and Lownsbery (1970) and Inserra *et al.* (1983), reported that 50 and 30% of *M. hapla* eggs of populations from California and Utah (USA), hatched at 9 and 10° C, respectively, but in our experiments less than 10% of the initial number of eggs hatched at 10° C. Our results suggest that populations of the same root-knot species but adapted to different climates can have different behaviour. Under our field conditions and cultural practices, such as fallow or rotation with no host plants, may not affect the population density decline of these *Meloidogyne* species in nematode infested areas. In absence of suitable hosts a faster decline of the nematode population densities should be expected at temperature ranging from 20 to 30° C than at 15° C or lower temperatures.

SUMMARY

The effect of root leachates of susceptible « Roma VF », resistant « IAS-1 » tomato and « Creso » wheat on hatch of *Meloidogyne arenaria, M. hapla, M. incognita* and *M. javanica* eggs was studied at 5, 10, 15, 20, 25 and 30° C over an 8 week period. The root leachates did not influence egg hatch but temperature greatly affected the 2nd stage juvenile emergence. There were no differences between the accumulated percent egg hatch for all species in all the leachates tested, at each temperature and at all time intervals. Less than 10% of the eggs hatched at 10° C, but more than 70% hatched at 15, 20 and 25° C. At 30° C hatches were about 60% of initial egg numbers. At 15° C egg hatching was completed in 5-6 weeks, but at 20, 25 and 30° C it was 3 weeks or less.

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