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# NEMATICIDAL ACTIVITY OF PHENOLIC COMPOUNDS AGAINST MELOIDOGYNE INCOGNITA

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**Summary**. Of 55 phenolic compounds tested, eleven exhibited high activity against juveniles of *Meloidogyne incognita*. The presence of a quinone group, whether ortho or para, was associated with high nematicidal activity. Meta-hydroxy as well as coumarin groups also induced high activity against the root-knot juveniles. Maximum activity was recorded with coumestrol and juglone.

Many compounds like acetylenes, terpenoid aldehydes, propionic acid derivatives and phenolic acids are known to possess nematicidal activity. In the present investigation, we tested a wide range of phenolic compounds having different substituents in their molecules in order to assess which groups are important for the nematicidal activity against *Meloidogyne incognita* (Kofoid *et* White) Chitw.

## Material and methods

Freshly hatched second stage juveniles ($J_2$) were obtained from pure cultures maintained on eggplant. The nematicidal activity of the chromatographically pure test compounds was assayed as follows. Two ml of an aqueous solution of each compound were added to one ml of a water suspension of 300 $J_2$ to provide a final product concentration of 1100 ppm. There were three replicates of each test compound and the distilled water control. The glass vials used were placed in the dark at 27 ± 1°C for 48 h. A layer of tissue paper was then placed across the mouth of each vial, secured with a rubber band, and the vial inverted in a small beaker containing 5 ml of 1000 ppm streptocycline. Nematodes recovered in the beaker after 24 h were counted and per cent mortality calculated by the formula $\frac{B - A}{B} \times 100$ where B is the number of nematodes recovered in the control and A the number of nematodes recovered after the treatment.

## Results and discussion

Of the 55 phenolic compounds tested (Table I), 11 exhibited high degree of nematicidal activity, the highest being in coumestrol and juglone. Coumestrol is a phytoalexin produced in *Phaseolus vulgaris* L. in response to fungal infection. Antibacterial activity has also been associated with coumestrol (Lyon and Wood, 1975) and Keen and Brueggar (1977) considered that it may be nematicidal. Production of coumestrol and psoralidin in response to *Pratylenchus scribneri* in lima beans is knowm (Rich *et al.*, 1977). Accumulation of coumestrol following infection with *P. scribneri* has been demonstrated though it did not exhibit any fungaltoxicity (Kuc *et al.*, 1976).

Juglone, which occurs naturally in *Juglans regia* is a monohydroxy phenolic compound like coumestrol. There is no information on its nematicidal properties, although a high degree of activity was exhibited in the present investigation. This activity could be due to the presence of a paraquinone group. Dihydrocaffeic acid quinone also possessed high activity. Structural changes brought about by oxidation of 0-dihydroxy grouping to quinone in caffeic acid have been reported to induce high nematicidal activity (Mahajan *et al.*, 1985). The present results support the view that the quinone group, whether ortho or para in position is associated with high nematicidal activity. Apigenin glucoside is a flavonoid compound and several related comounds are known to be produced in response to infection with *Monilinia fructicola* (Woodward, 1980) but low nematicidal activity was shown by its aglycon i. e. apigenin.

2,6, dihydroxy benzoic acid and gentisic aldehyde having meta dihydroxy grouping showed high nematicidal activity, indicating the importance of this moeity. Transcinnamic acid is already known to possess high activity against root-knot nematodes (Mahajan *et al.*, 1985). In the present investigation, its derivatives p-methoxycinnamic acid and m-hydroxycinnamic acid (m-coumaric acid) were also found to have comparable nematicidal activity. 3-phenyl phenol exhibited high activity. Phenyl derivatives of phe-

Table I - *Nematicidal activity of some phenolic compounds against* Meloidogyne incognita.

| Compound | Mortality (%) | Compound | Mortality (%) |
|---|---|---|---|
| Coumestrol | 100.0 | Genistein | 49.7 |
| Juglone | 100.0 | Dihydro-rohinetine | 48.9 |
| Dihydro caffeic acid | 98.7 | Quercetegetin | 45.5 |
| 2,6-Dihydro benzoic acid | 98.7 | Phloretic acid | 45.4 |
| Apigenin-7-0-glucoside | 98.1 | 3,4,5-trimethoxy benzoic acid | 44.0 |
| Genist aldehyde | 98.1 | Angelicin | 42.9 |
| p-methoxycinnamic acid | 97.1 | 4,6,7-trihydroxy flavanone | 42.3 |
| m-coumeric acid | 97.0 | 2-methoxy cinnamic acid | 39.9 |
| DOPA | 96.8 | Taxifolin | 36.5 |
| 3-phenyl phenol | 95.4 | B-methyl umbelliferin | 35.9 |
| 7-hydroxy-coumarin | 90-3 | 4-OH-3-ome-mandelic acid | 35.8 |
| Isovanillin | 69.8 | Arbutin | 35.5 |
| 3,4-OH 5-ome-benzaldehyde | 68.3 | Rockogenin | 35.2 |
| Syringaldehyde | 66.6 | 3-OH-4,5-dimethoxy benzoic acid | 35.0 |
| D-Salicin | 66.6 | 3-OH-flavone | 34.1 |
| Rhamnetin | 65.4 | Isoferulic acid | 33.7 |
| 3-OH-benzoic acid | 60.8 | 5,7-OH-flavone | 32.4 |
| Haminarine | 60.6 | 5,7-OH-3,4,5-dimethoxy flavone | 31.6 |
| 3,5-dimethoxy benzoic acid | 60.3 | Phloretin | 29.4 |
| p-OH-benzoic acid | 58.9 | Acacetin | 28.5 |
| Daphenetin | 57.3 | 2,4,4-OH-3-methoxy chalkone | 24.3 |
| Saligenin | 56.1 | Quercetin | 23.7 |
| 2,4,4-OH chalkone | 54.9 | Daidezein | 23.5 |
| Veratric acid | 53.4 | Apigenin | 20.5 |
| 2,6-dimethoxy benzoic acid | 52.4 | Fuslin | 17.9 |
| 3,5-dimethoxy cinnamic acid | 52.3 | 2,4-dimethoxy cinnamic acid | 4.7 |
| 4-OH coumarin | 51.2 | | |
| Chrysin | 49.8 | C.D. (0.05) | 14.3 |
| 3,4-dimethoxy cinnamic acid | 49.7 | (0.01) | 18.8 |

nols are used as fungicides in citrus (Rajzman, 1972). 7-OH-coumarin also possessed high activity, as coumarin moeity also forms part of coumestrol, it appears that the activity in coumestrol is due to the coumarin group. Furthermore, coumarin can be derived from cinnamic acid and its derivatives, thus showing that cinnamic acid moeity is associated with nematicidal activity.

The compounds that exhibited low activity can broadly be grouped into two types, one group lacking cinnamic acid moeity and the other lacking phenolic OH group. Interestingly, the compounds having two methoxyl groups viz., 2,6-dimethoxy benzoic acid, 3,5-dimethoxy cinnamic acid, 3,4-dimethoxy cinnamic acid and 2,4,4'-OH-3-methoxy chalkone also showed poor activity, though possessing cinnamic acid moeity. This could be due to the deactivating action of the methoxyl group present in the ortho or meta position.

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