Chapter 5

DISCUSSION
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The percent larval mortality differs with different concentrations of aqueous leaf extracts of different plants. Mortality of larvae is directly proportional to the concentration of aqueous leaf extracts and duration of exposure. The aqueous leaf extract of *Ranunculus sceleratus* was highly toxic to root-knot nematode, *Meloidogyne incognita* (J2) followed by *Launaea nudicaulis*, *Eclipta alba*, *Abutilon indicum*, *Euphorbia hirta*, *Lindenbergia indica*, *Pluchea lanceolata*, *Alternanthera philoxeroides*, *Stellaria media* and *Tridax procumbens*.

The different concentrations of aqueous leaf extracts of different plants viz. *Abutilon indicum*, *Alternanthera philoxeroides*, *Eclipta alba*, *Euphorbia hirta*, *Launaea nudicaulis*, *Lindenbergia indica*, *Pluchea lanceolata*, *Ranunculus sceleratus*, *Stellaria media*, and *Tridax procumbens* significantly inhibited the hatching of root-knot nematode, *Meloidogyne incognita* to a varying degree. Larval emergence was directly proportional to extract concentrations.

When the chickpea (*Cicer arietinum*), green gram (*Vigna radiata*) and pea (*Pisum sativum*) plants were treated with aqueous leaf extracts of *Abutilon indicum* Linn, *Alternanthera philoxeroides*, *Eclipta alba*, *Euphorbia hirta*, *Launaea nudicaulis*, *Lindenbergia indica*, *Pluchea lanceolata*, *Ranunculus sceleratus*, *Stellaria media*, and *Tridax procumbens* at the rate of 20g and 30g doses the plant growth was almost equal or slightly increased but it was non-significant in both doses of leaf extracts, as compared to the control.
Similar results were obtained in green gram (*Vigna radiata*) and pea (*Pisum sativum*) in both doses (20g and 30g). The two doses of leaf extracts of different plants had no significant difference in root nodule formation, chlorophyll and protein contents in all the three host crops.

From the above results it is proved that all the leaf extracts of different plants used had neither phytotoxic effect nor they improved the plant growth or had any manuring effect. There is no significant difference in plant growth in both the doses (20g and 30g) of leaf extracts over control.

The chickpea (*Cicer arietinum*), green gram (*Vigna radiata*) and pea (*Pisum sativum*) plants were treated with aqueous leaf extract of *Abutilon indicum*, *Alternanthera philoxeroides*, *Eclipta alba*, *Euphorbia hirta*, *Launaea nudicaulis*, *Lindenbergia indica*, *Pluchea lanceolata*, *Ranunculus sceleratus*, *Stellaria media* and *Tridax procumbens* at the rate of 20g and 30g doses and then inoculated with 1000 juvenile (J2) of root-knot nematode, *Meloidogyne incognita*, an increase in plant growth was recorded to a varying degree. The highest growth was in *Ranunculus sceleratus* treated plants followed by *Launaea nudicaulis*, *Eclipta alba* and *Abutilon indicum*. In other plant extracts, there was no significant improvement in the plant growth than the untreated nematode inoculated plants. In all treatments the growth was higher in 30g than 20g aqueous leaf extract.

Similar results were obtained in green gram (*Vigna radiata*) and pea (*Pisum sativum*) in the doses (20g and 30g). The growth was increased to a varying degree. The highest growth was in *Ranunculus sceleratus* followed by *Launaea nudicaulis*, *Eclipta alba* and *Abutilon indicum*.
The root nodule formation was also influenced by aqueous leaf extracts of different plants. Highest nodule formation was in the three crops treated with aqueous leaf extracts of *Ranunculus sceleratus* followed by *Launaea nudicaulis, Eclipta alba* and *Abutilon indicum*. In all treatments the number of nodules was higher in 30g than 20g aqueous leaf extract.

Gall formation was also decreased in the three crops viz., chickpea (*Cicer areitinum*), green gram (*Vigna radiata*) and pea (*Pisum sativum*) treated with aqueous extracts of different plants. The lowest gall formation in these crops treated with aqueous leaf extracts was in *Ranunculus sceleratus* followed by *Launaea nudicaulis, Eclipta alba* and *Abutilon indicum*. The 30g aqueous leaf extract was more toxic than 20g.

Root-knot nematode population both in soil and the root tissues was also decreased in the three crops chickpea (*Cicer areitinum*), green gram (*Vigna radiata*) and pea (*Pisum sativum*) treated with 30g aqueous leaf extracts of different plants, followed by 20g. The lowest nematode population was recorded in all the three crop plants treated with aqueous leaf extracts of *Ranunculus sceleratus* followed by *Launaea nudicaulis, Eclipta alba* and *Abutilon indicum*.

A decrease of egg masses per plant was also recorded in three crops viz., chickpea (*Cicer arietinum*), green gram (*Vigna radiata*) and pea (*Pisum sativum*) to a varying degree when treated with aqueous extracts of different plants. The lowest egg masses per plant was in *Ranunculus sceleratus* followed by *Launaea nudicaulis, Eclipta alba* and *Abutilon indicum*. 
The chlorophyll and protein contents in the three crops were increased to a varying degree when treated with leaf extracts of different plants as compared to untreated inoculated plants. The highest increase was recorded in *Ranunculus sceleratus* followed by *Launaea nudicaulis, Eclipta alba* and *Abutilon indicum* obtained significant healthy.

From the above *in vitro* and *in vivo* experiments, it has been proved that *Ranunculus sceleratus* has nematotoxic properties that not only inhibited the reproduction of root-knot nematode, *Meloidogyne incognita* effectively than other test plants but also increased the growth of chickpea, green gram and pea plants.

To compare the efficacy of *Ranunculus sceleratus* with well-known plants having nematicidal properties viz., *Tagetes erecta, Azadirachta indica* and chemical nematicide carbofuran. Some experiments were carried out by preparing leaf extracts in different chemicals and tested against root-knot nematode, *Meloidogyne incognita* larvae for their mortality and hatching. Although the carbofuran being a nematicide is highly effective against root-knot nematode, *Meloidogyne incognita* but when compare *Ranunculus sceleratus* with *Azadirachta indica* and *Tagetes erecta*, the *Ranunculus sceleratus* found equally effective as the *Azadirachta indica* in all treatments against root-knot nematode, *Meloidogyne incognita*. The ethyl acetate extract of dry leaves of three plants viz., *Ranunculus sceleratus, Tagetes erecta, and Azadirachta indica* proved slightly better for the mortality and hatching of root-knot nematode, *Meloidogyne incognita* followed by hot, cold, fresh aqueous, butanol and chloroform extracts over control (Water). Our results are also in confirmity with those of Cristobal-Alejo *et al.*, (2006); Frohne and Pfander (1984) and Kumar *et al.*, (2001).
When aqueous leaf extracts of different plants @ 20g and 30g of *Ranunculus sceleratus*, *Tagetes erecta* and *Azadirachta indica*, a nematicide, carbofuran (@ 1g a.i./kg soil and 1.5g a.i/kg soil) were applied to the test plants chickpea (*Cicer arietinum*), green gram (*Vigna radiata*) and pea (*Pisum sativum*) and then inoculated with 1000 juvenile (J2) of root-knot nematode, *Meloidogyne incognita*. The plant growth, number of nodules, chlorophyll and protein contents were highly increased, whereas, the nematode population both in soil and root tissues, number of galls, egg-masses and reproduction factor (Rf) were highly reduced in plants treated with carbofuran (1.5g a.i./kg soil) followed by carbofuran (1g a.i./kg soil), *Azadirachta indica* (30g), *Ranunculus sceleratus* (30g) and *Tagetes erecta* (30g) aqueous extracts.

From the above mentioned experiments it is further proved that *Ranunculus sceleratus* is again equally effective as *Azadirachta indica* for the control of root-knot nematode.

It has been concluded from present research that *Ranunculus sceleratus* leaf extracts are a source of cheap and effective nematicide of root-knot nematode.

*Ranunculus sceleratus* L. is an annual plant belonging to Ranunculaceae along with other nine wild plants screened for nematotoxic activity. It is widespread in Aligarh. Studies on its antinematode properties are lacking but antifungal, antiviral, antimicrobial have been reported viz., the antifungal (Mishra and Dixit, 1978; Mares, 1987; Singh and Tripathi, 1995; Qasem, 1996; Schinella et al., 2002), insecticidal (Bhattacharyya et al., 1993), antiviral (Haibo Li et al., 2005) and pharmacological (Prieto et al., 2003). The
nematicidal effects of *Ranunculus sceleratus* in our studies are in agreement with those obtained fungicidal, antimicrobial effects of *Ranunculus sceleratus* and other *Ranunculus spp.* described above. The leaf extract of this species proved to be the nematotoxic against root-knot nematode. Its nematicidal potential was confirmed through different experiments and the extracts of this species to be highly effective at both (20g and 30g) concentrations. Therefore, *Ranunculus spp.* might be considered as possible source of natural nematicides against root-knot nematode and other plant parasitic nematodes.

There is a need to expand these studies to include work on the nematicidal activities of the extracts or residues of *Ranunculus sceleratus* under field conditions, and chemical analysis of extracts to isolate and identify the nature of nematicidal compounds.

**Indiscriminate use of synthetic pesticides for controlling nematodes is likely to give rise phytotoxicity, environmental pollution and nematode resistance. Unsafe use of pesticides may result in poisoning of humans is a problem especially in developing countries (Conway, 1995; Yudelman et al., 1998).**

There is a need to develop naturally occurring nematicide which may be less toxic to man and animals but as effective against nematodes of various crops as synthetic ones. The future looks bright for identifying new classes of pesticides from natural plants to replace the synthetic dangerous and expensive chemicals used at present. Plants may serve as a novel alternative source of pesticides, over 2000 species have been reported to contain secondary metabolites that possess control properties. The cooperation of nematologist, breeders,
chemist, ecologist and others in the field of agriculture is necessary to achieve maximum progress in this important field of research.