SUMMARY

Biocontrol of plant pathogens is now preferred because of environmental risks and health hazards involved in the use of chemical pesticides. Biopesticides which can be indigenously developed and used for management of root-knot nematodes are currently in focus. A number of microorganisms including fungi have shown promise as effective biocontrol agents which can be used for development of biopesticides. The present study aimed to examine possibilities of developing effective biopesticides for the management of root-knot nematodes using indigenous microbial resource.

To achieve this objective at first surveys were conducted in some localities in the district of Aligarh, Agra, Etah, Bulandshahr and Ghaziabad located in the western part of the state Uttar Pradesh to assess the level of infestation of root-knot nematodes in vegetable fields and to identify the microorganisms particularly fungi naturally involved in biocontrol of root-knot nematodes in this area. Root samples of vegetable crops collected from the districts were thoroughly examined for the presence of root-knot nematode infection and soil fungi infecting egg masses/eggs of root-knot nematodes. The level of infection of egg masses/eggs was also determined. Fungi from infected egg masses/eggs were isolated, identified and maintained in stock for further studies.

Root samples of the vegetable crops collected from the districts showed moderate to heavy infection. The per cent occurrence of the disease ranged between 36-67 in the samples and the total frequency of the disease in the districts was 52.3%. Root gall index (GI) and egg mass index (EMI) ranged from 1-5 and 0-5, respectively. Meloidogyne incognita and M. javanica were prevalent species of root-knot nematodes on different vegetable crops, occurring singly or concomitantly. M. arenaria was also present in some samples.

A total of 62 species of fungi were isolated from the egg masses of the root-knot nematodes present in the root samples. Fusarium oxysporum, Verticillium chlamydosporium, Paecilomyces lilacinus and Rhizoctonia bataticola were found infecting eggs of root-knot
nematodes. *P. lilacinus* and *R. bataticola* were studied further for assessing their biocontrol efficiency.

Effect of culture filtrates of two isolates of *P. lilacinus* local-isolated from the root samples; foreign-obtained from Peru) and *R. bataticola* on juvenile hatching and mortality of *M. incognita* was studied by application in water using different concentrations. Culture filtrates of *P. lilacinus* (both isolates, foreign and local) and *R. bataticola* effectively killed the juveniles of *M. incognita* and inhibited the juvenile hatching. The effects were, however variable depending upon the fungus involved. Time duration of exposure and concentration had direct bearing in killing the juveniles and inhibiting their hatch.

Efficiency of *P. lilacinus* (foreign & local) isolates and *R. bataticola* for colonizing egg masses of *M. incognita* was tested in artificial medium (PDA) under aseptic conditions. Both the fungi colonized egg masses and were capable of destroying the eggs. *P. lilacinus* isolates were, however, more effective.

The efficiency of *P. lilacinus* (local isolate) and *R. bataticola* for control of *M. incognita* on tomato was studied in artificial inoculations under glasshouse conditions. In simultaneous and sequential inoculations, *P. lilacinus* and *R. bataticola* suppressed the adverse effects of *M. incognita* on plant growth, resulting in improved plant growth. The disease intensity was reduced as root galling and egg mass production were greatly suppressed. Highest percentage of egg infection occurred when the plants were applied with either of the fungi, two or three weeks prior to nematode inoculations.

When the plants were inoculated with *M. incognita*, *P. lilacinus* and *R. bataticola* simultaneously, plant growth greatly improved in comparison to the plants inoculated with the nematode alone. In combined inoculation, GI and EMI were lowest. Percentage of infected eggs was found to be highest in combined inoculation of both the fungi. Nematode population was also reduced.

In case of plants where the roots were dipped in the culture filtrates of *P. lilacinus* / *R. bataticola* and inoculated with *M. incognita* juveniles, the lengths, fresh and dry weights of the plants were greater than plants inoculated with the nematode. The dipping of the roots for 30
min was better than 10 or 20 min dipping. Intensity of the disease was reduced in all the dip time but 30 min dip was the best as root galling, egg mass production and nematode population were greatly reduced.

Growth and sporulation of *P. lilacinus* on various organic substrates (agricultural wastes and other organic materials) in order to dispense it in the field was studied. Gram husk was superior to other materials used in the study as it contained the highest spore count of *P. lilacinus*. Application of the organic substrates grown with *P. lilacinus* improved growth of tomato plants infected with root-knot nematode, *M. incognita* by suppressing root galling and nematode development. Highest improvement in growth parameters of the nematode infected plants occurred when the treatments were applied with the fungus cultured on gram husk.

Growth of tomato plants was highest when 4, 6 and 8 g gram husk cultured with *P. lilacinus* was added. Root galling and nematode development was also reduced by the application of the above mentioned doses of *P. lilacinus* cultured on gram husk.

Effect of varying temperatures on growth of four different isolates of *P. lilacinus* designated as P11, P12, P13 and P14 obtained from Peru (foreign), Bulandshahr (local), Jhansi and Hyderabad respectively and their mixtures designated P15 was investigated to determine a suitable temperature for their growth. Mean fungal dry weight of all the isolates was greatest at 24 to 28 °C.

Biocontrol efficacy of four different isolates of *P. lilacinus* was compared in artificial inoculations. All the four isolates of *P. lilacinus* and their mixture were effective in suppressing the root-knot nematode and improving the plant growth. The efficacy of the isolates, however, varied both for plant growth and root-knot development. The isolates P1 1, P1 2 and their mixtures were equally effective.

Effect of temperature and moisture on spore attachment of *Pasteuria penetrans* to the second stage juveniles of *M. incognita* was examined. Attachment of the spores of *P. penetrans* to the nematode body occurred at all the three temperatures tested with minimum number of spores/ J2 being observed at 10 °C. The spore attachment increased with the
increase in exposure period from 24 to 72 h at all the three temperatures. Maximum and minimum spore attachment was observed at 50 and 25 per cent moisture levels.

Both *P. lilacinus* and *P. penetrans* and their combination (*P. lilacinus* + *P. penetrans*) were effective in suppressing the root-knot nematode and improved the plant growth. *P. lilacinus* was comparatively more efficient than *P. penetrans* in this respect. The combined efficiency of both the microbes was better than *P. lilacinus* alone.