ABSTRACT

Studies were undertaken to manage the root-knot nematodes by the application of fly ash on three major vegetable crops of India. Fly ash is a major particulate air pollutant in India. The annual production is about 120 MT. For experiments, fresh fly ash was collected from Thermal Power Plant, Kasimpur, U.P., India. In the present research, it was tried to evaluate its potential against the root-knot nematodes for successful cultivation of vegetable crops. Two most common and frequently occurred species of root-knot nematodes (M. incognita and M. javanica) were selected for all the experiments. The highly susceptible cultivars of three important vegetables (okra cv. Long Green, cucumber cv. Poona Kheera and pepper cv. Suryamukhi Green) were taken for the study. The study was divided into three major sections.

SECTION-I

In this section, incidence, frequency and intensity of root-knot disease and the identity of species of Meloidogyne associated with vegetable crops in 5 districts of Western Uttar Pradesh (Aligarh, Bulandshahr, Gautam Buddha Nagar, Ghaziabad and Mahamaya Nagar) were undertaken. Highest incidence and intensity of root-knot disease was found in the vegetable fields of Aligarh district followed by Bulandshahr, Ghaziabad, Mahamaya Nagar and Gautam Buddha Nagar. Similarly, incidence and intensity of disease was also determined vegetable-wise. Highest incidence and intensity were noticed on eggplant
followed by tomato, okra, pepper, cucumber and cabbage. Three species—M. incognita, M. javanica and M. arenaria were identified to be present in the area. Of the three identified species, M. incognita and M. javanica were more common and frequent than M. arenaria. Disease intensity in terms of gall index (GI) and egg mass index (EMI) was maximum in case of M. incognita and minimum in M. arenaria. The survey indicates that root-knot nematodes would affect the plant growth and can cause appreciable yield losses to vegetables, if suitable measurement step will not be taken.

Another experiment was conducted to analyze the physico-chemical properties of various levels of fly ash amended soil (0, 5, 10, 20, 30, 40, 50, 75 and 100%). The pH, EC, CEC, WHC, sulphate, chloride, phosphorus and potassium were increased in all the levels of fly ash and maximum increase was observed at 100% fly ash level. While nitrogen content was gradually decreased as the level of fly ash was increased.

**SECTION-II**

Eight different concentrations of fly ash-extract (5, 10, 20, 30, 40, 50, 75 and 100%) were tested against hatching and mortality of root-knot nematodes. All the levels of fly ash-extract significantly suppressed the hatching of M. incognita and M. javanica juveniles. Inhibition (%) in hatching of juveniles was directly proportional to the levels of fly ash-extract. As the level of fly ash increased, inhibition in hatching of both the juveniles was also increased. Similarly, all the levels of fly ash-extract
were harmful to juveniles of both the nematodes. All the above levels of fly ash-extract killed the juveniles of both the nematodes. The mortality (%) was directly proportional to concentration as well as number of days increased. However, inhibition (%) in hatching and mortality (%) of juveniles was greater in *M. javanica* as compared to *M. incognita*.

Penetration of juveniles was retarded at all the levels of fly ash in roots of all the three crops (okra, cucumber and pepper). Penetration of the juveniles of both the nematodes was inversely proportional to the fly ash ratio. As the levels of the fly ash were increased, less number of juveniles of *M. incognita* and *M. javanica* were penetrated. Similarly, development of juveniles of both the nematodes was delayed and suppressed at all the levels of fly ash. At last, in fourth week none of the juveniles reached to mature female stage except at 5-10% fly ash levels. However, effect of fly ash was slightly more on *M. javanica* than *M. incognita*.

**SECTION-III**

Soil application of fly ash was found beneficial to all the three crops (okra, cucumber and pepper). All parameters were increased significantly up to 30% levels of fly ash, maximum being at 20% level in all the crops. Nematode inoculated plants also showed improvement in their plant growth, yield and photosynthetic pigments under the influence of fly ash. However, in combined treatments all parameters were increased significantly from 10 to 30% levels, highest being at 20% level
+ nematode combination. While at 40% level, all the parameters were at
par in single fly ash amended treatment or in combination with any
nematode, on any crop. In rest of the combinations, nematodes effects
were suppressed completely. So from 50 to 100% fly ash amended soil +
nematode showed similar results as single fly ash amended treatments,
however growth was slightly less than fly ash amended soil without
nematode.

At the same time, development of galls, egg masses and
reproduction were completely checked. Fly ash and nematodes together
interacted antagonistically. The study showed that fly ash was best to the
plant growth and productivity at lower level (20%) and toxic to root-knot
nematodes at all the levels. The beneficial level of fly ash in all
parameters for all the three crops can be arranged as follows- 20% >
30% > 10% > 5% > C > 40% > 50% > 75% > 100%. The beneficial
effect of fly ash + nematodes combination can be arranged as follows-
20% > 30% > 10% > uninoculated control > 5% > 40% > 50% > 75% >
100% > inoculated control.

Best dose of fly ash (20%) together with different inoculum levels
of nematodes (250; 500; 1,000; 2,500; 5,000 and 10,000), affected
variably to growth, yield and photosynthetic pigments of all the three
crops. All parameters were significantly decreased as the inoculum level
increased. All parameters were found highest with best dose and low
inoculum level (20% fly ash + 250 N) compared to control set. However,
this dose was effective enough to kill the nematodes except in plant inoculated with highest level (10,000), where some individuals of root knot nematodes were able to slightly affect the plant growth, yield and photosynthetic pigments. However, none of the galls or egg mass was produced. So, it can be summarized that 20% fly ash is the best dose for these crops. Because this dose is increasing the growth of plants and also managing the root-knot nematodes.

From the present study it appeared that all the levels of fly ash were harmful for hatching, penetration and development of juveniles of both the nematodes - *M. incognita* and *M. javanica*. At the same time the soil application of fly ash was beneficial for all the three crops and most suitable level was found 20%. This level (20%) can be recommended for the management of root-knot nematodes in the vegetable fields. The use of fly ash in the agricultural fields will improve the fertility of soil and on the other hand it will control the nematodes. The disposal problem of huge amount of fly ash will also be solved.