Discussion
DISCUSSION

Since air pollution is a relatively new factor in agriculture, its impact including on diseases caused by various biotic pathogens needs to be thoroughly examined. The present study was a step in this direction and considered two groups of pathogens: *Anguina tritici* (biotic) and air pollutants (abiotic) on a common host (wheat). The host-parasite relationships of both pathogens were different. The expected impacts of both pathogens separately in artificial treatments on wheat were direct. However, combined impacts were different. Both the pathogens interacted antagonistically, whenever they combined together irrespective of pre, post and concomitant inoculations. That’s why according to antagonistic interaction formula, the combined effects of both pathogens (P_1 and P_2) were always found less than the sum of their individual effects (effect P_1 P_2 < effect P_1 + effect P_2).

For example in table 12, the shoot length of wheat in control, P_1 (nematode), P_2 (0.05 ppm), and P_1 P_2 (0.05 + N (Pr)) treatments was 65.9, 59.2, 61.0 and 57.8 respectively. The reduction in length due to P_1 was 65.9 - 59.2 = 6.7 cm; in P_2: 65.9 - 61.0 = 4.9 cm and in P_1 P_2: 65.9 - 57.8 = 8.1 cm. Now: P_1 P_2 < P_1 + P_2 or 8.1 < 6.7 + 4.9 or 8.1 < 11.6. So, 8.1 is less than 11.6.
SECTION-I (SO₂)

Sulphur dioxide exposures induced the juveniles mortality in DDW suspension. The effect was consistently concentration and time dependent. Perhaps SO₂ by dissolving in water lowered the pH of suspension which might have become toxic to *A. tritici*. The inhibition in hatching of *M. incognita* and *M. javanica* due to SO₂ has been observed by Singh (1989).

All the concs of SO₂ suppressed the seed germination of wheat. The suppression of enzymatic activities, which are vital for the seed germination are mainly regarded as mode of action of the pollutants for adverse effect on seed germination (Pierre and Queiroz, 1981; Tanaka *et al.*, 1982). Nandi *et al.* (1980) observed reduction in seed germination of *Phaseolus aureus*, when exposed to SO₂, O₃ singly and combinations. Their study indicated that the reduction caused by exposures resulted from reduced activities of catalase and peroxidase and reduction in protein content of the seed during the seed germination. Singh (1989) also observed the reductions in seed germination of chickpea and lentil when exposed to different concs of SO₂.

Plant growth and yield of wheat were considerably suppressed by SO₂. All the concs were found to be toxic to this crop. The toxic effects of SO₂ have also been observed on chickpea, lentil (Singh, 1989), pea (Singh *et al.*, 1995), eggplant, okra, tomato (Khan and Khan, 1994 a, b; 1997;
Khan et al., 1995), jowar (Dodd and Dolley, 1998), wheat (Agrawal and Verma, 1997; Deepak and Agrawal, 1999). Actually SO$_2$ enters through stomata in the mesophyll tissue of the leaves and reacts with water to produce sulphite ion (SO$_3^{2-}$) which slowly oxidized to sulphate ion (SO$_4^{2-}$). The SO$_3^{2-}$ is about 30 times more toxic than SO$_4^{2-}$ (Thomas et al., 1943). The suppression was apparently due to the interference of SO$_2$ in various metabolic processes related to synthesis of pigments (Khan and Khan, 1993; Sharma and Prakash, 1991). SO$_2$ causes conversion of chlorophyll into pheophytin and reduces it in a photosynthetically inactive compound (Launorth and Dodd, 1981). Disturbance in synthesis of pigments may reduce photosynthesis leading to decrease in overall plant growth, yield and carbohydrate contents (Pierre and Queiroz, 1981; Tanaka et al., 1982). The structural intensity of proteins is also disturbed by the accumulation of HSO$_3^-$ and SO$_3^{2-}$ as a result of SO$_2$ concentration. Thus, the reductions in growth, yield, photosynthetic pigments, carbohydrate and protein contents of wheat are in support of other researches (Khan and Khan 1994 b, 1997; Kumar and Yadav, 1986; Panigrahi et al., 1992; Prakash et al., 1989; Singh et al., 1995, 1997).

Inhibitory effects of SO$_2$ on development of stomata might be a morphological adaptation of wheat leaves to check excessive transpiration, with accompanying effects on pollutant uptake. SO$_2$ can injure the stomatal
apertures, fixing the pore in an open position (Black and Unsworth, 1980). In a number of plants e.g. barley, eggplant, maize and okra wider apertures of stomata have been observed in polluted atmosphere (Khan and Khan, 1991, 1994a, b; Mejernik and Mansfield, 1970). The increment in number and length of trichomes in 0.05 ppm were perhaps due to defense mechanism to keep them away from leaf surface. However, at higher concs they were adversely affected due to toxic effect of gas.

*A. tritici* is a very serious pathogen of wheat causing “Ear cockle” disease. In the present study a susceptible variety HD-2329 to *A. tritici* (Kausar, 2002) was selected. All the levels caused basal swellings, crinkling and twisting of leaves. Infected ear heads were thinner and deformed with broken and distorted awns and contained galls. The galls were green in the beginning and later become comparatively brown and black at maturity. Due to stunted growth all the other parameters as yield, biochemical and leaf characters were also affected adversely. The severity of disease was inoculum level dependent. Similar damaging effects of *A. tritici* on wheat in India have also been observed by Gupta and Swarup (1968), Kausar *et al.* (2006), Kaushal (1998), Khan and Athar (1998), Paruthi and Bhatti (1990) and Parveen *et al.* (2002).

Sulphur dioxide singly or in combination caused chlorosis and browning and necrosis of the leaves of wheat. Similar symptoms have also
been observed earlier on the leaves of green plants (Barret and Benedict et al., 1970; Kausar et al., 2006; Khan and Khan, 1994 a, b; Singh, 1993; Taylor and Edaton, 1966). SO₂ by causing pheophytinization and photo-oxidation of the leaf pigments (Varshney and Garg, 1979) would have induced the symptoms.

The reduction in plant growth and productivity in combined sets were less than the nematode alone inoculated set. The intensity of disease appeared to be decreased in SO₂ exposed treatments. Therefore, it can be implied that SO₂ stressed wheat plants are likely to suffer less pathogenic damage caused by *A. tritici*. Possibly, the two adverse factors: gaseous pollutant and aerial nematode interacted antagonistically and improved slightly the plant growth and yield. However, the improvements were not significant when compared to control. Because SO₂ directly caused enough damage to wheat plants. The seed galls formation was also not observed at higher concs as all juveniles were killed. Because this is an aerial parasite, which remains in very exposed position to polluted atmosphere. Further, they were dependent on the epidermal cells for their host parasite relationship. But SO₂ might have injured the epidermal cells and reduced the leaf surface area available for feeding sites of larvae. Several other obligate fungal and nematode parasites are known to be sensitive to SO₂
In exposed plants, irrespective of the inoculum levels, leaf pigments were reduced in comparison to unexposed plants. However, the reduction was inoculum level and SO$_2$ conc dependent. Reduced chlorophyll of the leaves and lowered enzymatic activities in exposed plants would cause reduction in plant growth, yield and carbohydrate contents. Protein contents of wheat seeds were reduced by exposures of the plants in all treatments in comparison to unexposed plants. SO$_2$ + A. tritici exhibited antagonistic interaction in their effect on protein content of seeds. Direct interference of the air pollutants in the metabolic activities of plants related to protein synthesis and indirect effects by causing poor plant growth possibly reduced protein contents (Cracker and Starback, 1972; Khan and Malhotra, 1983; Singh, 1989; Singh, 1993; Singh et al., 1993).

Stomata have been found to be adversely affected by SO$_2$ and A. tritici alone and in combination and were correlated with the extant of the leaf injury. Fewer stomata with reduced size revealed the self-defense of the wheat plant to check the entry of gaseous pollutants in leaf. However, wide apertures of stomata were due to SO$_2$ injury to epidermal and guard cells (Khan and Khan, 1991; Unsworth and Black, 1981). Increment in number and size of trichomes at low conc were apparently the
morphological adaptations of the plant to defend from the pollutants. Trichomes are known to offer outer line of physical defense against the toxic gases (Levin, 1973). Similar responses of trichomes on leaf surface of *Abelmoschus esculantus*, chickpea, *Croton bonplandianus*, eggplant, *Euphorbia hirta*, lentil, and *Psidium guajava* were recorded by Ghause and Khan (1978), Gupta and Ghause (1987 a, b), Khan and Khan (1994 b, 1997), Singh (1989) and Zaidi et al. (1979). The interactive effects of SO$_2$ and *A. tritici* on leaf epidermal characteristics of wheat were antagonistic. The inhibitory effect of the SO$_2$ exposures might have resulted from direct toxic effect on *A. tritici*. In a study, Weber et al. (1979) found different responses of some nematodes infecting soybean exposed to SO$_2$ and O$_3$ alone and in combination. Reproduction and development of *Heterodera glycines* and *Paratrichodorus minor* were inhibited but *Belonolaimus longicaudatus* was not affected. SO$_2$ enhanced reproduction of *Paratylenchus penetrans*. Foliar injury of begonia induced by SO$_2$ exposures inhibited the *Aphelenchoides fragariae* population.

In present investigations, the adverse effects of *A. tritici* on various parameters were highest in pre-inoculation followed by post-inoculation and least in concomitant inoculation exposures. The variation in the adverse effect of *A. tritici* on parameters of plants might be due to variation in the infection caused by pre, post and concomitant inoculations. Slightly
less reduction in the concomitant inoculation exposure of SO₂ gives an evidence of direct effect on the nematodes (juveniles) making them incapable to climb on growing points, while in pre-inoculation exposure, no pollution stress was occurred for one week, so highest reduction was recorded. In the post-inoculation exposure also the direct effect of pollutants can be envisaged because the exposed plants before inoculation of the nematodes had already altered physiological status. This altered status of the exposed plants might have changed the chemical nature of the feeding sites. Thus, nematode could not cause enough damage. There was generally the effect of SO₂. Similar results have also been observed by Weber et al. (1979) on begonia. They obtained greater inhibition in reproduction of *A. fragariae* on begonia leaves, when exposed to SO₂ and SO₂ + O₃ mixture prior to nematode inoculation. Present findings also confirm the results of Singh (1989), Singh (1993) and Khan and Khan (1994 a, 1997), who worked on root-knot nematodes, *M. incognita* and *M. javanica* exposed to SO₂ in chickpea, lentil, soybean, tomato and okra plants.

Both SO₂ and *A. tritici* together in various combinations of pre, post and concomitant or with different inoculum levels or exposed with different concs of SO₂ interacted antagonistically, ultimately causing less reduction on the various parameters than the sum of their individual
effects. In this respect, the interaction of SO₂ and *A. tritici* was antagonistic. The findings show that SO₂ exposures affected all the living components of the systems.

SECTION-II (ACID RAIN)

Acid rain causes morphologically and anatomically injury to plants (Wood and Bormann, 1974), producing symptoms as chlorosis and necrosis in leaves (Shriner, 1978). The biotic plant pathogens are also affected by the acidity (Asai and Futai, 2005; Khan and Khan, 1994c; Singh, 1989).

In present study, all pH levels of SAR were harmful to *A. tritici* juveniles. As acidity levels were increased the juveniles mortality increased. It was due to direct effect of acidity on nematode larvae. The juvenile hatching of root-knot nematodes is known to be affected by the pH level. The optimum pH for hatching is 7, and inhibition occurs at pH level lower than 7 (Ahmad and Khan, 1964; Wallace, 1966). SAR also adversely affected the seed germination of wheat. The toxic effects of sulphate ions might have adversely affected the physiological and biochemical activities of seeds during the germination. The inhibition in seed germination by acidified rain has also been observed on chickpea, lentil and *Clitoria ternatea* (Shauqat and Shafiq, 1998; Singh, 1989).

Chlorosis, necrotic lesions and tip injury on leaves were observed in plants exposed to SAR. Symptoms were more pronounced in pH 3.0,
Johnston and Shriner, (1985) also observed leaf tip necrosis in wheat at pH 4.3 and 2.3. While, no foliar injury was observed in wheat plants exposed to pH 5.0 and 4.0 levels. It was due to low sensitivity of monocots to acid rain based on visible effect of foliage (Singh and Agrawal, 2004). Lee et al. (1980) reported that even if visible injuries did not develop under SAR conditions, reduction in plant growth could be detected. The adverse effects of simulated acid rain on plant growth, yield, photosynthetic pigments, carbohydrate and protein contents were directly correlated with pH level of the rain. Shriner and Johnston (1981) have also concluded that pH level was mainly responsible for growth reductions of soybean caused by acid rain. The reports available in literature show that reduction in growth and yield of crop plants generally occurs when plants are exposed to acidified rain (Evans et al., 1986; Johnston and Shriner, 1985; Singh, 1989; Singh and Agrawal, 1996).

Similarly, SAR also hampered to all biochemical parameters of wheat. Photosynthetic pigments were inhibited with respect to acidity levels. Reduction in the pigments was perhaps due to removal of Mg$^{2+}$ from the tetrapyrrol ring of chlorophyll molecule by H$^+$ (Foster, 1990) or due to the increase in transpiration rate by acid rain (Evans et al., 1977). Similar results were observed on alfalfa, lentil, chickpea and tomato leaves (Khan and Khan, 1994 c; Takemoto et al., 1988; Singh, 1989). Recently,
reduction in photosynthetic pigments have also been observed in many crops i.e. mustard, radish, potato and *Phaseolus vulgaris* (Agrawal *et al.*, 2005; Kausar *et al.*, 2005; Khan and Devpura, 2005; Varshney *et al.*, 2005).

The reduction in carbohydrate contents might have been caused through the overall poor growth leading to poor yield (seeds). Proteins were also reduced in seed of wheat exposed to SAR. Such an effect could be due to inhibition of amino acid under acidic condition, which is a constituent of protein synthesis. Reduction in protein contents has also been observed by acid rain in chickpea, lentil, soybean, wheat etc. (Evans *et al.*, 1981, 1983; Khan and Devpura, 2005; Singh, 1989). Surprisingly, leaf epidermal characters response pattern to SAR was similar to those of SO₂ effects (Section-I). But causes were different. Foster (1990) recorded appreciable losses of K⁺, Ca++ and Mg++ from the foliage of tomatoes exposed to acid rain at pH 5.6-2.5. These losses might have been responsible for the wide aperture of stomata of wheat plants treated with SAR. The trichomes number and length was increased in plants exposed to pH 5.0. It may be due to adaptive response induced in plants to provide mechanical defense against pollutant (Levin, 1973). Similar result was observed on tomato at pH 5.6 by Khan and Khan (1994 c). However, this response was failed at higher acidity levels (pH 4.0 and 3.0), where,
number and length of trichomes were suppressed. Perhaps presence of sulphite ion in higher amount was directly responsible for suppression.

The response pattern of wheat to different inoculum levels of *A. tritici* singly was more or less same as discussed in SO₂ section. Interaction between SAR and *A. tritici* in all the combinations on wheat crop was antagonistic. The combined impacts of both irrespective on plant growth, yield, photosynthetic pigments, carbohydrate and protein contents and leaf epidermal characters were almost similar to those of combined impacts of SO₂ and *A. tritici* in respective combinations. However, magnitudes of effects and amounts of suppression varied. The causes were perhaps same as discussed previously in SAR single exposures. The magnitudes of effects and amount of suppressions caused by SAR were slightly less than SO₂. However, when both factors combined together caused some suppression in all considered parameters but these suppressions were less than the sum of their individual effects. Actually SAR directly affected to both nematode as well as plant. Due to antagonistic effect of SAR, nematode could not survive longer, thus caused less or negligible damage to wheat.

The effect of acid rain on nematodes has gained negligible study. The decreased root infection and reproduction of *M. hapla* in red kidney beans under the stress of acid rain was demonstrated by Shriner (1978).
Bolla and Fitzsimmons (1988) found that reproduction of *Bursaphelechus xylophilus* was decreased in pine seedlings treated with acid rain. Singh (1989) observed reduced gall formation and reproduction of *M. incognita* and *M. javanica* on chickpea and lentil treated with acid rain. Khan and Khan (1994 c) observed antagonistic interaction between SAR and *M. incognita* on tomato. The present findings are in accordance to these observations. Some cockles occurred at higher inoculum levels (10,000) with lowest SAR level (pH 5.0). This might be due to escape of some larvae from the influence of SAR, which succeeded in developing disease. Cockles formation occurred in the plants where pre as well as concomitant inoculation-exposure were done, while, in post-inoculation treatments cockles were not formed. This difference indicated the alterations in the physiology which made plants tolerant to nematode infection (Evans, 1982; Bolla and Fitzsimmons, 1988). Thus effect of nematodes varied in relation to SAR levels as well as inoculation patterns. Consequently, the interactive effects also varied on various parameters.

**SECTION-III (FLY ASH)**

Although fly ash is a particulate air pollutants but it contains various utilizable plant nutrient elements such as Ca, Mg, Fe, Cu, Zn, K, Mn, B, S, and P along with appreciable amounts of heavy metals (Adriano *et al.*, 1980). The response of plants to micro and macro-nutrients in fly ash may vary
from beneficial effects of small concentrations of nutrient element to toxic effects of high concentrations of many elements (Chang et al., 1977). Fly ash also influences plant diseases caused by biotic pathogens, including plant parasitic nematodes.

In the present study fly ash-extract was tested against *A. tritici* juveniles. The rate of the juveniles mortality was directly proportional to concentration and time intervals. This might be due to presence of toxic compounds i.e. dibenzofuron, dibenzo-p-dioxine and heavy metals (Helder et al., 1982). Similar results were also observed by Tarannum et al. (2001) and Khan and Iram (2005) on *M. incognita* and *M. javanica*. Juvenile hatching of root-knot nematodes was also suppressed by fly ash-extract and fly ash amended soil (Khan and Iram, 2005; Singh, 1989; Tarannum et al., 2001).

Seed germination of wheat was not much affected at lower level of fly ash-extract. It might be due to presence of many micro and macro-nutrients in fly ash-extract (Wong and Wong, 1989). But higher concs showed deleterious effect on seed germination, perhaps due to presence of some toxic elements. Mishra and Shukla (1986) also observed that lower conc (0.5 to 1.0 %) of fly ash had no effect on seedling of corn and soybean, while higher conc caused deleterious effect on the seedlings.
Wheat plant dusted with different doses of fly ash did not show any visible injury. Interestingly, the lower dose (1.25 g m\(^{-2}\)) was found beneficial to plant growth, yield, photosynthetic pigments, carbohydrate and protein contents of wheat. It was due to availability of more than 10% water soluble components like S, Ca, Mg especially boron through leaf surface (Elseewi et al., 1980). The absorption of water soluble salts has also been observed by Rohrman (1971). The transport of the elements through intact cuticles and stomata has been reported by Murray (1994). The absorbed elements actually improved the plant growth. Other side photosynthetic pigments were also increased which led to increase the photosynthetic rate. Thus the cumulative effects caused increment in all the considered parameters of wheat. Present findings also confirm the results of Mishra and Shukla (1986) on maize, and Siddiqui and Singh (2005) on wheat at lower dusting rate.

However, higher dusting rate of fly ash adversely affected the wheat plant. Actually fly ash formed a thick layer on the surface of leaves and stem. Thick layer interferes with incidence of light and thus retards the photosynthesis (Mishra and Shukla, 1986). Reduction in chlorophyll content at high dusting rate is attributed to the alkalinity caused by excessive soluble salts on the leaf surfaces (Elseewi et al., 1980), and also due to increase foliar temperature, which retards chlorophyll synthesis.
(Mark, 1963). Reduced photosynthetic pigments perhaps caused less production of food in leaves and insufficient supply of food material to plants, which led to reduction in all the growth parameters. Ultimately, all other parameters like yield, carbohydrate and protein contents were reduced. Similar results have also been observed with high dusting rates of fly ash on maize (Mishra and Shukla, 1986), wheat (Siddiqui and Singh, 2005), potato (Raghav, 2006). Similar results with cement dust were also found earlier on bean by Darley (1966), at 3.8 g m$^{-3}$ and on *Vigna mungo* by Prasad and Inamdar (1990).

All stomatal parameters were increased at 1.25 g m$^{-2}$ foliar application, while width of aperture was widened. It was due to the deposition of fly ash particles on the leaf surface of guard cells (Mishra and Shukla, 1986), stimulated the mechanism of regulating the opening and closing of the stomata and prevents them from being closed (Fluckiger *et al.* , 1979; Krajickova and Mejstrik, 1984). While in heavily dusted leaves (2.5 and 5.0 g m$^{-2}$) a thick layer of dust was formed, which checked the opening and closing mechanism by plugging the stomata and also caused reduction in their numbers. However, the number and length of trichomes were increased at 1.25 g m$^{-2}$ fly ash dust. The stimulation of trichome number and increment of length might be a morphological adaptation of wheat plant against the dust particles to prevent on leaf
surface, in order to provide physical defense against toxic gases and particulate matter (Levin, 1973). Raghav (2006) also reported similar results on potato plant. However, at higher dose (5.0 g m\(^{-2}\)) the length and number of trichomes were suppressed significantly. It might be due to failure of adaptive response of plant because of high dust fall.

The response pattern of wheat to different inoculum levels of *A. tritici* singly was more or less same as discussed in SO\(_2\) section.

The concomitant effect of foliar application of different doses of fly ash and different inoculum levels interacted antagonistically and all doses of fly ash were able to suppress the nematode effect and killed them. As a result plant growth, yield, photosynthetic pigments, carbohydrate and protein contents were better than nematode alone inoculated set. Even lower dose of fly ash was able to check the nematodes effects. So, lower dose (1.25 g m\(^{-2}\)) with lower inoculum level (2,500) was found beneficial to wheat plant. Only few galls were formed in treatments inoculated with 5,000 and 10,000 juveniles. The killing of nematodes was perhaps firstly due to presence of some toxic substances in fly ash and secondly deposition of fly ash formed a thick layer which might be acted as a barrier in the movement of the larvae. Actually larvae climb to growing points of seedlings and carried mechanically upto inflorescence (Paruthi and Bhatti, 1990). At higher inoculum level some of the juveniles were able to reach
the floral primordia and formed the galls. The higher doses of fly ash combined with nematodes suppressed all the considered parameters of wheat similarly, as discussed previously (fly ash without nematode experiment).

The leaf epidermal characters were affected positively at lower dose perhaps due to increment in health status of plant which led to increase leaf area (Mishra and Shukla, 1986). However, at higher doses all parameters of stomata and trichomes were decreased similarly as already discussed.

In present investigations, pre-inoculated treatments of all doses were found harmful to wheat plant followed by concomitant and post-inoculated treatments except post-inoculation with lower dose (1.25 g m\(^{-2}\)). Because in this treatment nematode could not affect too much to pre-dusted plant and other side the dose (1.25 g m\(^{-2}\)) is beneficial to the crop. In pre-inoculated set with lower dose all growth, yield, biochemicals and leaf characters were reduced because nematodes were present prior to dusting, so they could cause much damage before interaction, but later nematodes were killed by the foliar application due to which seeds were not transformed into galls. However, in higher doses, irrespective of pre, post and concomitant inoculations, reduction were observed in all the parameters of wheat. The antagonistic interaction was found in all combinations.
The soil application of fly ash ameliorated plant growth of wheat and suppressed the \textit{A. tritici} in pots. Improved plant growth with fly ash has been observed earlier (Elseewi \textit{et al.}, 1980; Mishra and Shukla, 1986). Due to better health status of plant, the yield, photosynthetic pigments, carbohydrate, protein contents and leaf characters of wheat were also increased. The beneficial effects of fly ash were found from 10 to 40\% levels in soil, and optimum being at 30\%. Similar beneficial effects on above parameters have also been observed on a number of crops like \textit{Brassica juncea}, cabbage, \textit{Capsicum}, chickpea, collard greens, corn, cucumber, groundnut, \textit{Lactuca sativa}, lentil, mustard green, okra, radish, rice, soybean, sunflower, tomato, \textit{Vigna mungo}, wheat etc. (Khan and Khan, 1996; Menon \textit{et al.}, 1990; Rengifo \textit{et al.}, 1996; Sahu and Dwivedi, 1999; Sarangi and Mishra, 1998; Siddiqui \textit{et al.}, 2000; Singh, 1989; Singh 1993; Singh and Singh, 1986; Tarannum \textit{et al.}, 2001, Upadhyay, 2004; Upadhyay and Khan, 2002). However, the responses of various crops were different to different levels of fly ash (10-50\%).

Higher level adversely affected the plant growth and other parameters of wheat. The adverse effects of fly ash at higher level of application are attributed to excess of micro nutrients (Adriono \textit{et al.}, 1980) and toxicity of compounds like dibenzofuron and dibenzo-p-dioxine as well as heavy metals found in fly ash (Helder \textit{et al.}, 1982; Mishra and
Shukla, 1986; Wong and Wong, 1986). Harmful effects of higher levels above 50% have been observed on Brassica juncea, chickpea, cucumber, lentil, Linum usitatissimum, maize, potato, soybean and tomato, (Mishra and Shukla, 1986; Pasha et al., 1990; Raghav, 2006; Raghav and Khan, 2002; Singh, 1993; Upadhyay and Khan, 2002). On the other hand, the soil application of fly ash checked the effect of A. tritici with respect to levels. This might be due to the excess of salts, toxic compounds and heavy metals which caused nematicidal effects on A. tritici either directly or within the host. Nematode might have lost its activities and later could not survive under the stress of fly ash. Loosing the activity and not reaching the mature stage of A. tritici is very important for the agriculture point of view, because there will be no loss to the crop. Thus soil application of fly ash with 30% level is useful, as it suppresses the A. tritici one hand, and improves the wheat crop on the other hand.