Chapter V

CONCLUSION

CONCLUSIONS

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The present investigation yielded wealth of information. The following are some of the important conclusions:

5.1. Field survey of general vegetation:

All the herbs, shrubs and tree species in close proximity (0.5 Km.) of the pollution source, exhibited visible damage due to heavy load of pollution.

Among the herbs, *Boerhavia diffusa, Evolvulus alsinoides, Gomphrena celosioides, Portulaca quadrifida, Trianthema monogyna* etc., exhibited resistance by the absence of any visible damage at 1.5 Km. distance.

Among the tree species *Mangifera indica* L. exhibited severe damage and higher sensitivity.

Terminalia catappa, Ficus benghalensis, Streblus asper etc., were less sensitive to pollution.

5.2. Study on trees growing along the National Highway No. 8:

This study revealed that same aged trees growing along the National Highway No. 8 were exhibiting a high variation in growth performance due to existing industrial and auto -exhaust pollution.

Among the seven sectors studied (Fig 2.2.1.), trees growing at sector four, where a fertilizer plant is located showed severe damage in growth parameters.

Among the two species investigated, i.e. *Dalbergia sissoo* and *Syzygium cumini* the former one is highly sensitive to pollution than the later.

5.3. Field Survey of fruit trees:

Among the three species of fruit trees studied, mango is found to be highly sensitive to pollution and gets severely damaged. Jamun is highly resistant and also exhibited good growth at pollution zone during favourable spell. Rayan exhibited intermediate sensitivity and response to pollution.

In all the three tree species fruit yield was drastically reduced at highly polluted stations like Angadh, Ranoli, Dhanora and Bajwa. At these stations, 25 to 35% of mango trees completely stopped fruit production whereas it was 10 to 20% in rayan.

The mango fruit production reduced 50 to 70% at highly polluted stations like Angadh, Ranoli, Bajwa and Dhanora as compared to control. At medium polluted stations like Koyali, Sankarda, Chhani, Ankodia, Dumad and Undera the reduction in fruit production was 35 to 40% and at Ampad fruit yield was least affected.

In rayan, fruit yield reduced 37 to 50% at highly polluted stations like Angadh, Bajwa, Ranoli and Dhanora, as compared to control. Yield reduction was 10 to 30% at medium polluted stations, whereas at Ampad it was least affected.

In jamun, fruit yield reduction was 30 to 50% at high pollution zone i.e. Ranoli, Angadh, Dhanora and Bajwa. 15 to 25% reduction in fruit production was recorded at Koyali, Sankarda and Chhani. At all remaining stations no significant reduction was observed.

In this study, foliar sulphur content in all the three species was observed higher than control at the pollution zone. This indicates, sulphur dioxide is the major pollutant in the ambient air at these stations.

The pollutant accumulation i.e. sulphur accumulation in foliar tissues was maximum in mango, intermediate in rayan and comparatively less in jamun. Higher accumulation of sulphur in mango may be due to higher uptake and low rate of metabolism which may be responsible for greater sensitivity. This was well reflected by high degree of damage to most of the parameters investigated, resulting into high reduction in fruit yield.

In all the three species, foliar chloride content was very high at Ranoli. This clearly reflected that chlorine is the major localized pollutant at Ranoli, where a Alkalies and Chemicals plant is located.

The observations indicated that jamun species may be more sensitive to chlorine pollution singly or in mixture with other pollutants like SO_2, NOx etc., than the sulphur dioxide and nitrogen oxides pollution individually or in combination.

The sensitivity of mango to chlorine pollution was closer to sulphur dioxide pollution.

Rayan exhibited higher sensitivity to sulphur dioxide pollution than chlorine pollution.

To reduce the entry of toxic gases into the foliar tissues all the three species exhibited reduction in stomatal index at pollution zone as compared to control.

Thus the higher sensitivity of mango is due to higher stomatal frequency per unit area, rendering greater entry of toxic gases and higher accumulation of pollutants in the foliar tissues.

The high resistance of jamun is due to comparatively lesser stomatal number per unit area, thick cuticle and less accumulation of pollutants in the foliar tissues. Rapid growth of jamun during favourable spell shows its high rate of metabolisation which may keep the accumulation in safe limit.

Rayan also exhibited lesser stomatal frequency per unit area but the pollutants accumulation was high. Milky latex present in the plant body may be providing resistance against air pollution, but more intensive study is required to prove this.

The chlorophyll fluorescence studies revealed higher reduction in mango leaves, moderately in jamun and comparatively less in rayan leaves at pollution zone. This also supports the biochemical observations that degradation of photosynthetic pigments was less in rayan leaves which may be due to the presence of milky latex.

Soil study showed that no significant variation in soil parameters at different observation stations. Soil observations did not show remarkable correlation with ambient air pollutants concentrations except at the highly polluted stations like Angadh and Ranoli.

5.4. <u>Field exposure study</u>:

This study revealed that the change in wind direction influenced the extent of damage to the plants, but at Damapura and Angadh the plants exhibited severe damage in all the three seasons regardless of the wind direction. This was due to the closer proximity of the source, Nandesari Industrial Estate which discharges high concentrations of mixture of pollutants into the ambient air.

Tree saplings growing at Bajwa and Koyali were maximum damaged during winter when they were in windward direction to the pollution source.

At all the remaining stations, i.e. Fajalpur, Ranoli, Sankarda, Omkarpura and Padamla plants were affected more during monsoon and summer when they were in windward direction to the source during the major part of the season.

Plants growing at Bajwa, Omkarpura and Ranoli were subjected to high concentration of pollutants at random due to occasional discharge or accidental leakage of high emission of pollutants.

This study also supports the first phase of investigation i.e. mango is highly sensitive to industrial pollution and the deleterious effect was well reflected in various morphological and biochemical parameters resulting into high reduction in fruit yield.

Jamun saplings exhibited fairly good recovery during favourable spells. Recovery was intermediate in rayan and much less in mango.

Rayan saplings exhibited visible damaging symptoms only at highly polluted stations like Damapura, Angadh, Omkarpura and Ranoli. At remaining stations no visible symptoms were observed in the plants, but the biochemical observations revealed the hidden injury in the plants.

5.5. Artificial fumigation study:

This study revealed that the exposed SO_2 concentration (60 $ppmh^{-1}$ accumulative SO_2 dose) caused visible damage to mango saplings, whereas subtle injury in rayan and jamun saplings. Thus, among the three species mango was observed to be highly sensitive to sulphur dioxide exposure.

This study also revealed that ascorbic acid treatment mitigated the SO_2 deleterious effect on plants. Thus ascorbic acid may be used as antidote against SO_2.

In mango, amelioration effect was comparatively more with 10 µmoles ascorbic acid concentration, while in jamun and rayan more amelioration was observed with 100 µmoles ascorbic acid treatments. Thus this preliminary study on the abatement of SO_2 effect clearly indicates that the optimum dose of antidote may vary from species to species.

5.6. Future scope of the study:

The present study revealed, the response of fruit trees to air pollution which differs from species to species at different stations in the pollution zone. The response or the damage to the other economically important fruit trees should also be investigated in the pollution zone.

Rayan species exhibited less visible damage due to industrial pollution and occupied intermediate position between mango and jamun in sensitivity to pollution. Further studies can be carried out to determine whether the milky latex in this species offers protection to chlorophyll pigments from pollution effect by absorbing and/or neutralizing the entered pollutant/s. Similarly studies on other latex bearing plants may help to trace the resistant species to air pollution. It will be helpful for the town planners and foresters to select such resistant species for green belt.

The studies on the recovery behaviour of plant species is very important to agriculturists in pollution zone. As the mango showed least recovery during the favourable spell, such species may be replaced by other resistant fruit tree species showing higher recovery, to get maximum fruit yield. The recovery behaviour of other fruit yielding trees like Citrus limon Burm. (lemon, ver. Limbu), Achrus sapota L. (sapodilla plum, ver. Chikku), Carica papaya L. (papaw, papaya), Musa paradisiaca K. var. sapientum K.S. (Banana, ver. kela) etc., can be studied to select the resistant ones.

In the present preliminary investigation only two amelioration treatments (10 and 100 µmoles) were employed. In further studies the optimum dose may be determined to obtain maximum amelioration of major pollutants damage to economic plants. Cost benefit ratio of such treatments have to be worked out to counteract the pollution effect in the field condition.