EFFECTS OF ACID MIST ON THE GROWTH OF *ALBIZIA LEBBECK* (L.) BENTH. AND *LEUCAENA LEUCOCEPHALA* (LAM.) DE WIT.

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ABSTRACT: Effects of acid mist on the growth of *Albizia lebbeck* and *Leucaena leucocephala* were examined at different pH levels in the natural environmental conditions in the Department of Botany, University of Karachi. The height of *A. lebbeck* and *L. leucocephala* was greatly reduced at pH 4.0. However, the height of *L. leucocephala* was less affected as compared to *A. lebbeck* at the above mentioned pH level. The numbers of leaves were also reduced at pH 4.0 in both the species. Overall investigation revealed that *L. leucocepha!a* was more tolerant to acid mist as compared to *A. lebbeck.*

KEY WORDS: Acid mist, Growth, Periods, pH levels, plants.

INTRODUCTION

The pollution constituents that are emitted into the atmosphere are either gases or particulates. Particulate matters consist of fine solids or liquid droplets suspended in the air. The large sized particulates are fly ash, dust soot, fumes and the smaller sizes are smoke and mist. Mists are liquid particles, which may arise from vapor condensation, chemical reactions or by atomization of a liquid e.g. steam. Mist causes reduction in the visibility because it absorbs light reaching to the ground surface and in this way reduces the light intensity, which in turn affects the global climate of the area. It also affects the atmospheric temperature and atmospheric relative humidity. Shams and Iqbal (1986) have studied some climatic and bioclimatic parameters in Karachi. They found that air temperature of urban areas was higher, whereas, the atmospheric relative humidity and wind velocity of urban areas were lower as compared to sub-urban areas. This may be due to the presence of particulate matters emitted from the industries and automobile activities. The other effects of particulate matter include soiling of surfaces, corrosion, damage to buildings and wood etc. Liquid aerosol and mist fall on the surface of leaves and fruits and may cause damage to the leaves and fruits. Dod *et ai.* (1986) studied the presence of sulfate and carbonaceous aerosols in Beijing, China. Thomas and Hendricks (1956) studied that the acidic mist present in the urban atmosphere causes soiling of leaves and fruits. Ahmed *et ai.* (1986) showed the reduction in protein and chlorophyll contents of plants of the urban areas.

Air pollution due to acid rain or mist was a global problem. The effects were greater in the vicinity of the sources, but the fall stalk policy in the individual industrial plant contributes a worldwide problem of acid rain. Britain erected 2 m high smoke stacks at its generating stations; United States took a similar approach, increasing the heights of their stacks to more than 300 m high (LaBastille, 1981).

It is often difficult to observe the direct effects of low pH treatments on photosynthesis and growth parameters in vascular plants because of the presence of a highly hydrophytic cuticle that may neutralize acid rain reduction and effectively alter the chemical composition of the rain (Adams and Hutchinson, 1984). Acid deposition can alter physiological processes such as photosynthesis, or can cause visible injury to leaves, such as chlorosis, necrosis, and premature leaf fall (Koslowski and Contatinidou, 1986). Acid precipitation includes rain, snow, hail and fog. Acidic substances and their precursors are formed when fossil fuels are burned to generate power and provide transportation. These substances are principally acids derived from oxides of sulfur and nitrogen, which lead to the deposition of derived sulfuric acid (H2SO4) and nitric acid (HN03) or their salts. Trites and Bidwell (1987) found that rain of pH 3.0 caused serious effects on the leaves, resembling Ca, Mg, P or N2 deficiency symptoms but no effect on carbon dioxide exchange and growth rate of nitrogen was seen. They have also observed a decline of photosynthetic oxygen evolution with decreasing pH of the acid rain. They found that reduced photosynthetic activity was due to depigmentation at pH below 3.5. Seip *et ai.* (1999) described sulfur dioxide emissions are at present the major cause of acid precipitation, but emissions of nitrogen oxides are increasing. Soils and soil waters seem to be acidified in many areas in southern China (Seip *et ai.*, 1999). Pollution has affected the vitality of forests and other vegetation particularly in and close to urban areas.

Hussain *et al.* (2000) evaluated the herbaceous plants exposed to simulate acid rain exhibited a wide variety of symptoms with lesions developing on both vegetative and reproductive structures. Korthals *et al.* (2000) examined a progressive increase in wax production in response to acid mist in seedlings of *Pinus sylvestris* and *P. contorte*. Effect of simulated acidic rain treatments has been observed on yield and carbohydrate contents of green pepper *Capsicum annum* cv. NP-46A (Shri and Kumar, 2000). The plants were treated in different pH of acidic rains and recorded number of flowers and fruits per plant, carbohydrate contents of stem and leaf fractions were adversely affected. Velikova *et al.* (2000) found that acid rain (pH 1.8) significantly increased peroxidase and decreased catalase activities at the first hours after treatment. Later both enzyme activities were enhanced that could contribute to the scavenging and detoxification of active oxygen species.

The purpose of this study was to determine the effect of acid mist on the growth of *Albizia lebbeck* and *Leucaena leucocephala* in the natural habitat conditions.

MATERIALS AND METHODS

Seeds of *Albizia lebbeck* (L.) Benth. and *Leucaena leucocephala* (Lam.) de Wit. were collected from the University campus to determine the effects of acid mist on plants. All the seeds were sterilized with 0.85% chlorox ($CaOCl_2.H_2O$) for about 1-2 minutes and after that rinsed thoroughly with distilled water.

Before sowing, the seed germination was checked, by placing them on the moist filter papers in petridishes. 15 seeds of each species were sown in each pot at a depth of 2 cm. Each pot contained garden soil and manure in the ratio of 3:1. There were four replicates in all. Acid solutions of different pH (pH 4, 5, 6 and 7) were prepared with sulfuric acid. Potted plants were kept in the green house in the ambient conditions. The acid mist treatment was started when the seedlings acquire the height of about 5 cm in *Leucaena* sp. and 12 cm in *Albizia* sp., and was continued for three weeks. Potted plants were sprayed individually with different pH solutions (pH 4, 5, 6 and 7) twice a week. Acid mist treatment was supplemented by irrigation with water according to the need of individual plants, thus soil moisture content was kept uniform. Every week, the height of the plant and the number of leaves were recoded for each plant.

RESULTS AND DISCUSSION

Growth variables like height and number of leaves of *Albizia lebbeck* and *Leucaena leucocephala* were examined at different pH levels for a period of three weeks. Both plants, *A. lebbeck* and *L. leucocephala* were highly affected at pH 4 than pH 5 (Fig. la, b and 2a, b).

The height and number of leaves of A. lebbeck exhibited decrease at all pH levels (Fig. 1a and 2a). The height of this plant was found to be 0.0, 0.1, 0.2, 0.4 cm at pH 4.0, 5.0, 6.0 and 7.0, respectively after third week.

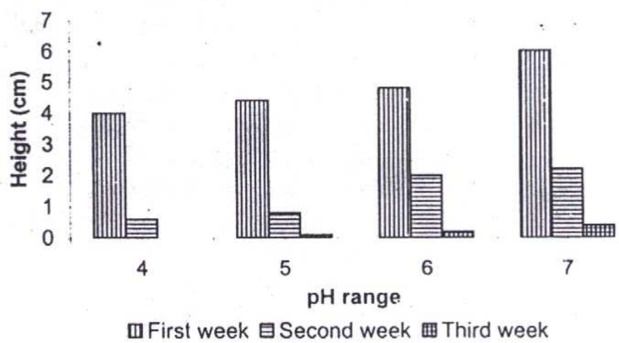

Fig. 1a. Effects of different pH range on the height of *Albizia lebbeck*

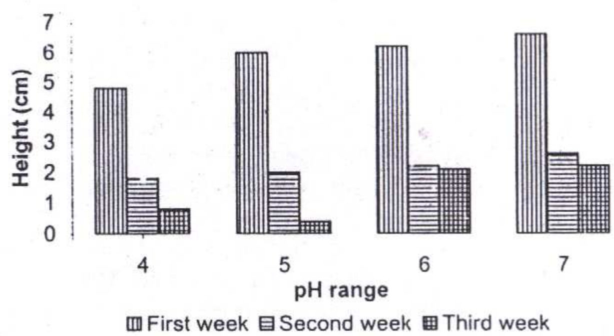

Fig. 1b. Effects of different pH range on the height of *Leucaena leucocephala*

The height and number of leaves of *L. leucocephala* were also badly affected to acid mist (Fig. lb and 2b). The height of *L. leucocephala* obtained were 0.8, 3.4, 2.1 and 2.2 cm at pH 4.0, 5.0, 6.0, 7.0, respectively at

the final week. At the above mentioned pH, the height was better during first and second weeks as compared to third week.

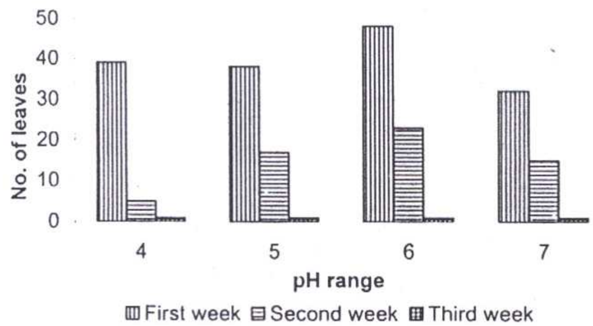

Fig. 2a. Effects of different pH range on the number of leaves of *Albizia lebbeck.*

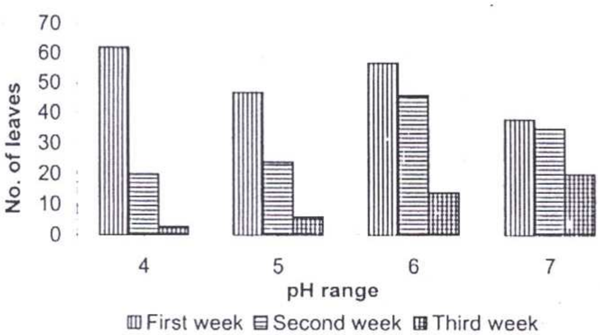

Fig. 2b. Effects of different pH range on the number of leaves of *Leucaena leucocephala.*

Consequences obviously ascertained that plants of *A. lebbeck* and *L. leucocephala* were adversely affected in height and number of leaves at different pH levels. Different results were expressed in height and number of leaves particularly, at third week because internal retarding was most severe when effects were determined in plants when sprayed at pH 4 whereas, plants were sprayed by the acidic solution concentration of pH 5 was less affected. Chappelka and Chevone (1986) found severe reduction in growth of white ash (*Fraxinus americana*) seedlings by acid rain. Plants were less affected which were treated with pH 7, since pH 7 was termed as neutral, hence, it was not affected on plants as compared to pH 4 and 5. Acid deposition occurs in the forms of rain, snow, mist and fog. Industry booming throughout the world, acid deposition is a growing danger. Its impact on aquatic areas, forests and all life forms is unhealthy and destructive. Two of the main sources of acid deposition are natural emissions and anthropogenic. Natural causes include volcano emissions, lightning, and microbial processes, while anthropogenic refers to industrial emissions and other man-made polluters. When nitric and sulfuric acids are released into the atmosphere by smokestacks, fuel combustion, or natural causes, they mix with water vapors at unusual proportions to cause acid deposition. Mostly coniferous forest is affected to acidic rain. Plant absorbs this acidic water and adverse effects appeared on leaves and other parts of plants. Visible symptoms and growth reduction of plants have been observed by some of the workers (Iqbal and Qadir, 1994; Wood and Borman, 1974; Leith *et al.,* 1989) with respect to acid mist. Wood and Bormann (1974) showed that acid mist did not have a significant effect upon the growth of seedlings of *Betula alleghaniensis*, but at pH 2.3 the same plant showed marked reduction in growth after 11 weeks of treatment. Reduction in growth, chlorophyll, photosynthetic activity, carbohydrate production in *Phaseolus vulgaris* was studied by Trites and Bidwell (1987). Impact of acid mist on the growth of *Eucalyptus* sp. and *Pongamia pinnata* was studied by Iqbal and Qadir (1994). The height, number of leaves and circumference of the above species were badly affected by the acid mist. The biomass accumulation of *Eucalyptus* sp. and *P. pinnata* was less at pH 3.0 and 4.0, but slightly increased at pH 5.0 and 6.0 in *P. pinnate* only. The maximum dry biomass was found at pH 7.0. The leaf area of *Eucalyptus* sp. and P. pinnate was also reduced at all pH levels, except in at *P. pinnata* pH 5.0, where it showed some 12.2 percent increase over pH 7.0.

The results in this study showed that both plants were badly affected by acid mist pollution, particularly, *A. lebbeck* which was greatly affected with relation to height. This result is in consistent with the findings of Elkiey and Ormrod (1987), where Eucalyptus plants were found to be sensitive to sulfur dioxide and nitrogen dioxide and less sensitive to ozone concentrations. Hanson and Mclaughlin (1989) have found significant reduction in the growth of red spruce seedlings treated with mist containing hydrogen peroxide. Height of *A. lebbeck* was more affected at pH 4 than other pH levels. Number of leaves of *A. lebbeck* and *L. leucocephala* was greatly affected to acid mist but *A. lebbeck* was comparatively more affected. The reduction in biomass may occur due to the reduced photosynthesis or increased respiration and this might be the result of reduced translocation of photosynthetic material. Leith *et al.* (1989) have also observed visible foliar injury and 40% foliar necrosis after 10 weeks by acid mist treatment at pH 2.5. These results are similar to the findings of Sigal and Johnston (1986). Chevone *et ai.* (1984) reported decrease in root dry wt., leaf area and mean relative growth rate of yellow poplar seedlings by acid rain. Irving (1987) had also observed similar results.

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Manuscript received 11-8-2005
Accepted for publication 01-12-2005