Effect of Cement Dust on Growth Parameters of Tomato (*Lycopersicon esculentum* L.)

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Abstract

The effect of cement dust on the growth parameters of tomato (*Lycopersicon esculentum* L.) was studied. The cement dust (@ 2 g plant^{-1}) exerted both inhibitory and promotory effects on different growth parameters. The decrease in number of leaves (59.69 and 67%), leaf area (69.92 and 68.59%), root length (25.39, 49.64%), shoot length (63.39 and 48.11%), plant circumference (34.48 and 58.33%), dry weight of leaves (69.97 and 71.76%), dry weight of plant (61.68 and 75.28%) and increase in specific leaf area (-0.25 and -11.66%) in cement dust treated plants. However, root/shoot length ratio (-106.89%), specific leaf weight (-2.5%) increased and leaf weight ratio (21.73%), leaf area ratio (21.76%) decrease after 45 days of seedling growth as compared to control. but leaf weight ratio (21.73%) and leaf area ratio (21.76%) decreased it next to 45 days seedling growth as compared to control. But, after 65 days of seedling growth, specific leaf weight (7.35%), root/shoot length ratio (2.85%) decreased and leaf weight ratio (-14.89%), leaf area ratio (20.25%) increased as compared to control.

1. Introduction

Cement is the critical ingredient in concrete, not natural products, locking together the sand and gravel constituents in an inert matrix; it is the 'glue' which holds together much of modern society's infrastructure. The Indian cement industry is world's second-largest producer after China and is the third-largest consumer. However, per capita cement consumption is abysmally low compared to developed nations. The cement industry, part of the manufacturing sector, plays a pivotal role in the infrastructure development of the country. Cement demand is derived from real estate, infrastructure & industrial sectors. The performance of the cement industry is therefore largely dependent on overall economic growth of the country.

On the other hand, cement industry also plays a vital role in the imbalances of the environment and produces air pollution hazards (Agrawal et al., 2006). The cement dust is the source of particulate matter deposits on the buildings and plants, producing a significant effect. Air pollution has become a major threat to the survival of plants in the industrial areas (Gupta and Mishra, 1994). Rapid industrialization and addition of the toxic substances to the environment is responsible for altering the ecosystem (Iqbal and Shafig, 2001).

Prasad and Inamdar (1990), the reduction in the number of flowers and yield of black gram (*Vigna mungo* (L) Hepper) was studied due to cement dust pollution. The effect of cement dust on growth parameters of *Albizia lebbeck and Dadonia viscosa* has been studied (Iqbal and Shafig, 2001). Abdullah and Iqbal (1991) found stomatal clogging of *Iphonia grantioides and Boiss* up to 81% due to cement dust and particulate matter. The reductions in root and shoot lengths and leaf area in mustard plants grown in pots at different sites experiencing variable pollutant concentrations as compared to wheat, mung bean and palak (Agrawal et al., 2003; Rai et al., 2007).

Cement dust consist of many toxic elements which may be hazardous not only to the worker but also to the vegetation in the surrounding area (Wankhade and Garg, 1989). Keeping this in view, the present study was undertaken to find out the effect of cement dust on morphological parameters of tomato

2. Materials and Methods

Investigations were carried out on the effect of cement dust @ 2g plant^{-1} on growth of tomato (*L. esculentum)* in the garden of the Department of Environmental Science, Babasaheb Bhimrao Ambedkar University, Lucknow. Seedlings were raised from randomly grown seeds in small pots filled with loam soil (2:1; loam soil: natural manure). The cement dust (Ca_3SiO_5 50-70%: Ca_2SiO_4 15-30%: $Ca_3Al_2O_4$ 5-10%:$Ca_4Al_nFe_{2-n}O_7$ 5-15%

and 3-8% oxides of calcium and magnesium) 2 g plant^{-1} was sprayed by bulb sprayer or duster 4 oz (Centro) on the treated plants, twice a week for 6 weeks. After every week, position of the pots was changed for obtaining random results and then in these weeks, we were selected two days (45 and 65 days after treatment). Three replicates were maintained for each treatment and irrigation was provided by tap water. At the end of the experiment, the plants were uprooted carefully from the pots and were washed under tap water.

2.1. *Plant growth analysis*

Data on growth parameters viz., number of leaves, leaf area, root and shoot length, plant circumference, dry weight of leaves, dry weight of plant, root/shoot length ratio, specific leaf area, specific leaf weight, leaf weight ratio, leaf area ratio were recorded at two stages i.e. 45 and 65 days after sowing (DAS). Ten plants of uniform size were selected from each of the control and treatment pots for growth analysis. Plant samples were separated into stem, root and leaves and their leaf area was measured by plotting the plucked leaves on graph paper and area was calculated. Dry weight of the plant parts was obtained by placing the plant material in an electric hot air oven at 80^0C for two days. The leaf area ratio (LAR) and specific leaf weight (SLW) were calculated using the formula (Gardner et al., 1985).

2.2. *Determination of growth variables*

Data were analyzed using one-way ANOVA for comparing the treatment over control with three number of replicates and Least Significant Difference (LSD) at $p \leq 0.05$.

Plant circumference (cm) was measured via thread and then scale

Root/Shoot length ratio (cm cm^{-1})	=	Root length / Shoot length
Leaf weight ratio (g g^{-1})	=	Leaf dry weight / Total plant dry weight
Specific leaf area (cm^2 g^{-1})	=	Leaf area / Leaf dry weight
Leaf area ratio (cm^2 g^{-1})	=	Leaf area / Total plant dry weight
Specific leaf weight (g cm^{-2})	=	Leaf dry weight / Leaf area

3. Results and Discussion

The studies indicated that cement dust caused both inhibitory and promontory effects on tomato plant. The inhibitory effect reduced the number of leaves**,** root length, shoot length, leaf area, plant circumference, dry weights of leaves and plant. However, the root/shoot length ratio and specific leaf weight initially increased (up to 45 days) and then decreased (at 65 days) as compared to control. Specific leaf area increased, leaf weight ratio and Leaf area ratio decreased after 45 days of seedling growth when compared to control. But after 65 days, leaf weight ratio and leaf area ratio were increased as compared to control. The effect of cement dust treatment on various growth parameters of tomato have been presented (mean±S.D.) in Table 1 and percentage inhibition in Figure 1 to 4 along with their respective controls.

Figure 1 data (effect of cement dust) revealed that with respect to number of leaves, root length (cm) and shoot length (cm) in treated plant were decreased up to 59.69%, 67% ($^{**}p<0.01$); 25.39%, 49.64% ($^{**}p<0.01$) and 63.39% and 48.11% ($p>0.05$) as compared to control. Similarly, Figure 2 indicate that leaf area (cm^2) decreased up to 69.92%, 68.59% ($p>0.05$); plant circumference (cm) decreased up to 34.48%, 58.33% ($^{**}p<0.01$) and leaf dry weight (g) decreased up to 69.97% and 71.76% ($^{**}p<0.01$). The Figure 3 represent that the plant dry weight (g) decreased up to 61.68% , 75.28% ($^{**}p<0.01$); root/shoot length ratio (cm cm^{-1}) increased up to -106.89 and decreased up to 2.85% (($^{**}p<0.01$) and specific leaf area (cm^2 g^{-1}) increased up to -0.25% and -11.66% ($p>0.05$). Figure 4 represents that the specific leaf weight (g cm^{-2}) increased up to -2.5% and decreased up to 7.35% ($p>0.05$); leaf weight ratio (g g^1) and leaf area ratio (cm^{2}g^{-1}) both decreased up to 21.73% and 21.76% after 45 days of seedling growth as compared to control. But, after 65 days of seedling growth, both the parameters were increased up to -14.89% and -20.25% ($^{**}p<0.01$) as compared to control. This study indicated that cement dust had a significant effect on the growth of tomato.

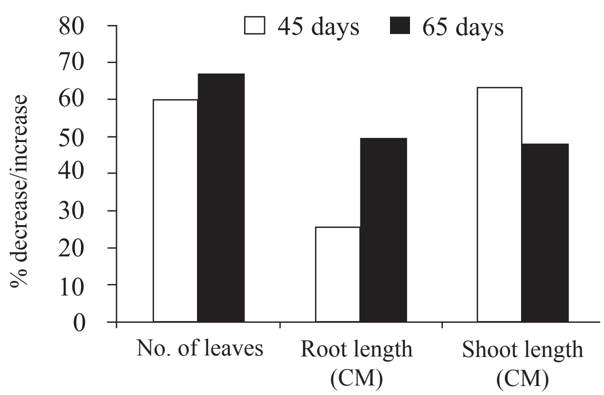
Toxic compounds such as fluoride, magnesium, lead, zinc, copper, beryllium, sulfuric acid and hydrochloric acid were found to be emitted by cement manufacturing plants (Andrej, 1987). Reduction in plant height, number of leaves, leaf area dry weight, plant circumference, specific leaf area and weight and leaf area ratio and weight ratio of tomato showed that the losses are generally attributed to the cement dust which contained toxic metals. Decreased plant height might be due to the decrease in phytomass, net primary production and chlorophyll content in response to the cement dust in *Vigna mungo* (black gram) (Prasad and Inamdar, 1990) .

Adverse effects of air pollutants on biomass of several crops (Keutgen et al., 2005). Significant reduction was recorded in the plant length of palak under elevated pollutant concentrations (Rai et al., 2007). The reduction in leaf area of strawberry than number of leaves (Keutgen et al., 2005). The plants of *L. leucocephala* were treated with soil extracts of various factories in laboratory conditions then percentage reductions in many growth variables like seed germination, shoot and seedling length which included length of root and shoot over

Table 1: Effect of cement dust on different growth parameters of tomato

S.No.	Growth parameters	After 45 days		After 65 days	
		Control	Treatment with cement dust	Control	Treatment with cement dust
1.	Number of leaves	22.33±0.57	9.00±1.11	32.00±2.00	10.50±1.32
2.	Root length (cm)	16.66±0.28	12.40±0.40	22.16±0.76	11.16±0.76
3.	Shoot length (cm)	56.00±2.00	20.5±2.50	61.6±1.52	32.00±2.64
4.	Leaf area (cm^2)	78.66±1.52	23.6±2.51	80.66±1.15	25.33±2.51
5	Plant circumference (cm)	2.90±0.10	1.90±1.00	3.60±0.17	1.50±0.05
6.	Leaf dry weight (g)	3.23±0.05	0.9±0.06	5.56±0.07	1.57±0.08
7.	Plant dry weigh (g)	6.29±0.01	2.41±0.01	12.46±0.04	3.08±0.07
8.	Root/shoot length ratio (cm cm^{-1})	0.29±0.00	0.60±0.05	0.35±0.00	0.34±0.01
9.	Specific leaf area (cm^2 g^{-1})	24.33±0.88	24.3±2.59	14.49±0.21	16.18±2.14
10.	Specific leaf weight (g cm^{-2})	0.04±0.00	0.04±0.00	0.06±0.00	0.06±0.00
11.	Leaf weight ratio (g g^{-1})	0.50±0.01	0.39±0.00	0.44±0.00	0.50±0.02
12.	Leaf area ratio (cm^2 g^{-1})	12.50±0.23	9.78±0.99	6.47±0.01	7.78±0.14

Values shown are the mean ± SD of three replicates, significant at $p \leq 0.05$



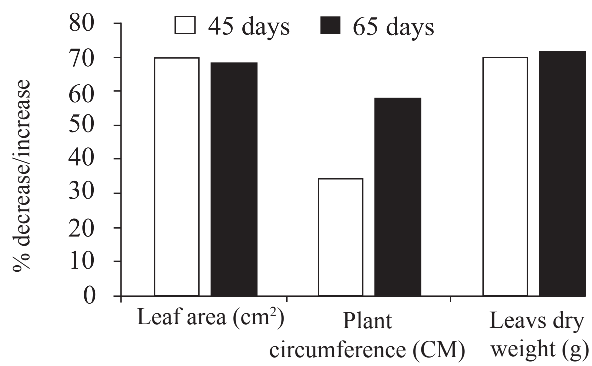
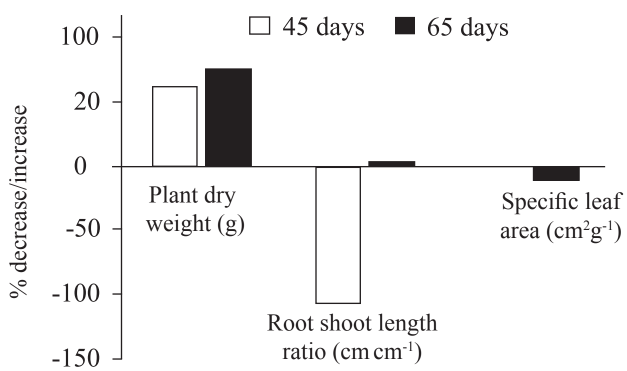


Figure 1 (left) & 2 (right): Percentage inhibition of number of leaves, root length, shoot length, leaf area, plant circumference and leaf dry weight after 45 and 65 days of seedling growth



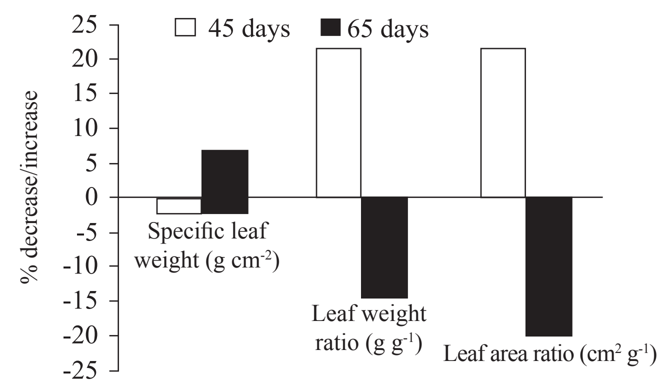


Figure 3 (left) & 4 (right): Percentage inhibition of number of leaves, root length, shoot length, leaf area, plant circumference and leaf dry weight after 45 and 65 days of seedling growth the soil extract of the control area (Atiq-ur-Rehman and Iqbal, 2006). Various workers have reported the reduction of plant growth as a consequence of pollution stress (Gupta and Iqbal, 2005; Maruthi et al., 2005, 2007), reduced the leaf area index; dry matter production and grain yield of sorghum and black-gram (Subha and Dakshinamoorthy, 2000).

4. Conclusion

The phenological behavior of *L. esculentum* was found to be highly affected by cement dust pollution. Therefore, it should not be planted in the vicinity of cement industrial areas.

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