Research Article

# Effect of Dust Particles on the Growth of Vegetables and Orchards of Quetta City

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**ABSTRACT**

An investigation on dust storm deposited on some orchards leaves *Prunus amygladus* Mill, *Prunus armeniaca* L. and *Prunus persica* L.(Almond, Apricot, and Peach) and some vegetables *Brassica alba* L., *Solanum lycopersicum* L. and *Coriandrum sativum* .L (Cabbage, Tomato. Coriander was studied in Quetta city during 2011, because wind storm and sand storm are the common phenomena in arid regions of Balochistan. It has important impact on nutritional values of vegetables and fruits of Quetta. Quetta is considered as fruit garden, so our main emphasis is on the orchards but besides this some vegetables commonly present in the wind erosion seasons were evaluated. Chemical analysis showed that Pb concentration deposited with dust particles on leaves ranged between 1.00- 2.00 mg/g, that was the maximum deposition among other orchards and vegetable leaves. Mn concentration ranged between 1.12- 1.31 mg/g, Cu concentration ranged 1.11- 1- 46 mg/g, which followed by Zn concentration that ranged between 1.14-1.72 mg/g, less amount 0.34- 1.44 mg/g of Ni deposition was found. Dust deposition was negatively effect on the productivity of fruits and vegetables. Results were negative correlation at P< 0.05 level of significance.

**Keywords:** Dust fall, Orchards and vegetables, Toxic metal.

## INTRODUCTION

The term dust fall refers to aerosols with diameter equal to or greater than 10 µm and has the capability to settle down after temporary suspension in air.[1-3] The dust fall pollutants are primary air pollutant have complex material with variable in size and contain heavy metals.[4] It has been investigated the influence of weather on the concentration of inhalable particulates.[5] They concluded that wind speed and atmospheric pressure could be used to predict the concentration of Al, Cu, Fe and Pb particulate matters.[6] During the process of dust storms, a complete aeolian sedimentary cycle takes place, like erosion, transportation and deposition. Dust may negatively effect on photosynthesis, respiration, transpiration and allow the penetration of phytotoxic gaseous pollutants. Most of the plant communities are affected by dust deposition.[7] The positive or negative effects of dust collection determine whether an ecosystem is a dust source or sink and can also directly reflect the loss and accumulation of soil resources.

Therefore, it has been suggested that dust plays an important role in many bio-geochemical processes.[8-10] Many studies suggested that nutrient input is a function of aeolian dust and an important factor affecting soil nutrients, especially in those regions where winds often occur.[11-13] Some studies concluded that dust fall can enrich various nutrients like P, K, Mg, Na, Ca, Fe, Cu and Mn in surface soil.[14,15] However, dust pollution affects not only human health but also ecological health of a region.[16-19] The dust impairs visibility the particulate dust falling on leaves may cause foliar injuries, reduction in yield, change in photosynthesis and transpiration.[20] Monitoring of the effects of dust particles on vegetation is very important.[21,19] It is concluded that when dust deposited on vegetation, the plant growth were affected.

Dust fall pollutants are a matter of great concern in Quetta city and its contamination directly effect on food chain and nutritional quality of vegetable and orchards. Rate of urbanization increasing from three decades and severe droughts from last decades badly effect the vegetation of Quetta city. Dust storm is due to wind and sand storms of Quetta might be it origin from Dasht-e-Lout, south eastern Iran which reduce the visibility of one kilometer. It has been reported that dust storms are usually caused by the action of strong persistent winds on dry, fine-grained, and loose soil.[22] The primary ecological factors of dust storms are due to early snow melt, rainfall, and geographical feature of Quetta city. Quetta city is located in the mountainous region of Pakistan and is the capital of the province of Balochistan. It lies approximately 30° latitude and 67° longitude. Previously no work was done on the dust deposition on orchards and vegetables of Quetta, so the aim of this study was to investigate the particles present in dust fall and its effect on some orchards and vegetables.

## MATERIALS AND METHODS

Strong winds with dust fall occur in Quetta city from March to August. The annual average temperature is 24°C. The average temperature was–12°C in the coldest month (January) and 40°C in the hottest month (July). After cold winters, numerous dust storms occur.

### Dust sample collection and chemical analysis

The experiment started on March to June 2011. Falling dust samples were collected from three different locations of orchards and vegetable gardens samples were collected on monthly basis. *Prunusamygladus* Mill, Prunusarmeniaca L. and *Prunuspersica* L.(Almond, Apricot, and Peach) and some vegetables *Brassica alba* L., *Solanumlycopersicum* L. and *Coriandrum sativum* .L (Cabbage, Tomato. Coriander) were selected from orchard and vegetable gardens, 15 to 20 leaves sample were collected from different plants. Dusts deposited on them were analyzed for Pb, Mn, Cu, Zn and Ni, through atomic absorption spectrophotometer model 2380 PERKIN ELMER and X-ray fluorescence spectrophotometer. Analysis was done by using complete random block design with three replicates. Each value is the mean of 10 values; the data obtained was subjected to the statistical analysis for mean, and standard deviation analysis of variance (ANOVA). Level of significance was checked at 0.05 levels.

## RESULTS AND DISCUSSION

Quetta is considered as fruit garden due to diversity and heterogeneity of plant. Semi arid climate with significant variation in seasons effects on the major orchard and vegetation of Quetta city. The dust fall collected from orchards and vegetable foliages was analyzed for Pb, Mn, Cu, Zn and Ni concentration.

The toxic metal lead (Pb) was ranged between 1.96-2.00 mg/g in all the dust samples of orchards and vegetable leaves. Highest concentration of Pb was recorded from *Prunusamygladus* Mill (almond) leaves that were 2.00 mg/g. In the month of May and June, same concentrations were found from *Prunusarmeniaca* L and Coriandrum sativum .L in the same month Table (1-6), while minimum was found in Brassica *alba* L. (cabbage) leaves that was 1.00 mg/g in the month of March. Maximum dust fall deposited in the month of June. The concentration of lead may be correlated with high traffic density near the orchard gardens. Findings are similar to who support this observation.[23] High concentration of lead was also noticed, in the soil of different locations of Quetta city. Lead may enter the atmosphere by different human activities or by the use of lead containing products and by the vehicular emission such as by the used of Iranian gasoline which are commonly sold at different roads near highly populated area.[24]

Average concentration of Mn ranges from 1.12-1.31mg/g in selected plants Table (1-6). Maximum 1.42 mg/g in *Solanumlycopersicum* L. (tomato) leaves while lowest 1.11 mg/g was observed at *Brassica Alba* L. (cabbage) and Coriandrum sativum .L leaves in the month of March. On orchards leaves maximum deposition was noted as comparable to vegetables leaves. The deposition variation of Mn in both orchards and vegetable gardens were similar with less difference which is difficult to explain because both orchards and vegetable gardens are almost joint each other. May be it might be due to contamination in air, although less amount of Manganese is necessary for metabolic activity. The mean dust fall of Mn values were less than the critical level of 5mg/g as described by.[25]

The third abundant metal copper (Cu) also showed its presence in all the dust sample of Quetta city with small variation, ranged between 1.11mg/g -1.46mg/g in vegetation and orchards gardens, while mean differences ranged between 1.22 – 1.30 µg/g Table (1-6). Maximum copper concentration was found in *Prunusamygladus* Mil that was 1.46 µg/g in the month of June, while same concentration was calculated in three orchards leaves and two vegetable crops in the month of March. According to the classification with reference to available Cu content in the soil/dust the Cu status of dust fall under study was medium to high.[26]

Zinc concentration was present Table (1-6) in all the dust samples with large variation (1.14-1.72 mg/g in orchards and vegetables of selected leaves. Minimum concentration 1.14 mg/g was found in almost all the vegetable and orchards leaves although maximum deposition was found in the month of June. Zinc an essential and beneficial element for metabolic activity in low concentration which was present in all the dust samples collected from Quetta city, but with large variation. Generally, among all the observed metals it was second highest value. The high concentration of Zn has also been reported by.[10]

The Ni concentration Table (1-6) was found to be low at all the selected plants 0.34- 1.44 mg/g. However, less difference in maximum and minimum amount of Nickel were found while less variation was also found in different months. The variation of Ni concentration is difficult to explain, but it might be due to contamination of road dust/soil and addition of sewage on the roads by the over flow of sewage system. Nickel is naturally present in soil and water, usually in fewer amounts. Several plants require nickel for various metabolic activities.[27] Higher concentration of nickel may cause numerous adverse effects on plants.[28] Growth of most plant species is adversely affected by tissue concentration of nickel above 50 mg kg-1 dry weight.[29] Heavy metals are among the major contaminants of food supply and are considered the most important problem to our environment.[30] The effects of toxic substances on plants are dependent on the amount of toxic substance taken up from the given environment.

Unpredictable dust storm affects the orchards infrastructure and huge loss of vegetables during the

study period. The climate of Quetta city, due to drought might contribute towards dust storm formation. Visual injury symptoms decreased the productivity most of the plant. All the result were significant at P< 0.05 level. Vegetation has been suggested to play an important role in trapping dust, because it can produce surface roughness that reduces wind speed near the soil surface and thus reduces re-suspension of deposited dust.[31] Visible injury symptoms may occur and there is decreased productivity of crops and vegetables. Flower formation in orchards trees which usually occurs in late February or early March was delayed till mid April. It has been demonstrated that dust storms may enhance many environmental problems. It has negative potential effects on crop growth, soil formation and the spread of disease; they also cause a great degree of erosion, especially in arid regions.[6]

**Table 1:** Average Concentration of Elements (Mg/G) of *Prunus Amygladus* L. Leaves of Quetta City

| Months | Pb | Mn | Cu | Zn | Ni |
|---|---|---|---|---|---|
| March | 1.5 ± 0.02 | 1.12 ± 0.03 | 1.11 ± 0.02 | 1.14 ± 0.03 | 0.34 ± 0.02 |
| April | 1.7 ± 0.03 | 1.15 ± 0.03 | 1.20 ± 0.03 | 1.22 ± 0.02 | 0.90 ± 0.03 |
| May | 2.00 ± 0.03 | 1.20 ± 0.03 | 1.25 ± 0.02 | 1.59 ± 0.03 | 1.21 ± 0.02 |
| June | 2.00 ± 0.03 | 1.31 ± 0.03 | 1.46 ± 0.03 | 1.72 ± 0.02 | 1.44 ± 0.03 |
| Mean | 1.8 | 1.19 | 1.25 | 1.41 | 0.97 |

Each value is mean ± standard error of 10 determinations ANOVA (P < 0.05), (P > 0.05)

**Table 2:** Average Concentration of Elements (Mg/G) of *Prunus Armeniaca* L. Leaves of Quetta City

| Months | Pb | Mn | Cu | Zn | Ni |
|---|---|---|---|---|---|
| March | 1.2 ± 0.03 | 1.13 ± 0.02 | 1.11 ± 0.02 | 1.14 ± 0.02 | 0.34 ± 0.02 |
| April | 1.8 ± 0.02 | 1.17 ± 0.03 | 1.22 ± 0.02 | 1.31 ± 0.02 | 0.86 ± 0.02 |
| May | 1.9 ± 0.02 | 1.25 ± 0.02 | 1.26 ± 0.02 | 1.66 ± 0.03 | 1.26 ± 0.03 |
| June | 2.00 ± 0.03 | 1.31 ± 0.03 | 1.46 ± 0.03 | 1.72 ± 0.02 | 1.44 ± 0.02 |
| Mean | 1.72 | 1.21 | 1.26 | 1.45 | 0.97 |

Each value is mean ± standard deviation of 10 determinations; ANOVA (P < 0.05), (P > 0.05)

**Table 3:** Average Concentration of Elements (Mg/G) of *Prunus Persica* L. Leaves of Quetta City

| Months | Pb | Mn | Cu | Zn | Ni |
|---|---|---|---|---|---|
| March | 1.1 ± 0.01 | 1.12 ± 0.02 | 1.11 ± 0.01 | 1.14 ± 0.02 | 0.34 ± 0.03 |
| April | 1.5 ± 0.02 | 1.18 ± 0.01 | 1.29 ± 0.03 | 1.39 ± 0.02 | 0.92 ± 0.02 |
| May | 1.8 ± 0.01 | 1.27 ± 0.03 | 1.36 ± 0.02 | 1.70 ± 0.03 | 1.30 ± 0.03 |
| June | 2.0 ± 0.03 | 1.31 ± 0.02 | 1.46 ± 0.03 | 1.72 ± 0.01 | 1.44 ± 0.01 |
| Mean | 1.6 | 1.22 | 1.30 | 1.48 | 1.00 |

Each value is mean ± standard deviation of 10 determinations ANOVA (P < 0.05), (P > 0.05)

**Table 4:** Average Concentration of Different Elements (Mg/G) of *Brassica Alba* L. Leaves Of Quetta City

| Months | Pb | Mn | Cu | Zn | Ni |
|---|---|---|---|---|---|
| March | 1.00 ± 0.01 | 1.14 ± 0.02 | 1.11 ± 0.01 | 1.14 ± 0.02 | 0.34 ± 0.02 |
| April | 1.6 ± 0.03 | 1.17 ± 0.01 | 1.19 ± 0.03 | 1.30 ± 0.03 | 0.97 ± 0.03 |
| May | 1.7 ± 0.02 | 1.28 ± 0.03 | 1.26 ± 0.02 | 1.47 ± 0.01 | 0.99 ± 0.02 |
| June | 1.9 ± 0.01 | 1.11 ± 0.04 | 1.38 ± 0.01 | 1.62 ± 0.01 | 1.15 ± 0.0 |
| Mean | 1.55 | 1.17 | 1.23 | 1.38 | 1.17 |

Each value is mean ± standard deviation of 10 determinations; ANOVA (P < 0.05), (P > 0.05)

**Table 5:** Average Concentration of Elements (Mg/G) of *Solanum Lycopersicum* L. Leaves of Quetta City

| Months | Pb | Mn | Cu | Zn | Ni |
|---|---|---|---|---|---|
| March | 1.0 ± 0.01 | 1.12 ± 0.01 | 1.11 ± 0.01 | 1.14 ± 0.01 | 0.34 ± 0.01 |
| April | 1.7 ± 0.02 | 1.19 ± 0.02 | 1.20 ± 0.02 | 1.32 ± 0.02 | 0.56 ± 0.03 |
| May | 1.9 ± 0.01 | 1.42 ± 0.01 | 1.31 ± 0.01 | 1.47 ± 0.02 | 0.92 ± 0.02 |
| June | 2.0 ± 0.02 | 1.30 ± 0.03 | 1.40 ± 0.03 | 1.59 ± 0.03 | 1.41 ± 0.03 |
| Mean | 1.65 | 1.25 | 1.25 | 1.38 | 0.83 |

Each value is mean ± standard deviation of 10 determinations; ANOVA (P < 0.05), (P > 0.05)

**Table 6:** Average Concentration of Elements (mg/g) of *Coriandum Sativum* L. Leaves of Quetta City

| Months | Pb | Mn | Cu | Zn | Ni |
|---|---|---|---|---|---|
| March | 1.10 ± 0.02 | 1.12 ± 0.03 | 1.11 ± 0.01 | 1.14 ± 0.01 | 0.34 ± 0.01 |
| April | 1.2 ± 0.01 | 1.16 ± 0.01 | 1.17 ± 0.03 | 1.47 ± 0.02 | 0.65 ± 0.02 |
| May | 1.7 ± 0.02 | 1.24 ± 0.02 | 1.25 ± 0.02 | 1.66 ± 0.02 | 1.30 ± 0.02 |
| June | 2.00 ± 0.03 | 1.31 ± 0.02 | 1.37 ± 0.03 | 1.72 ± 0.03 | 1.44 ± 0.03 |
| Mean | 1.50 | 1.21 | 1.22 | 1.49 | 0.93 |

Each value is mean ± standard deviation of 10 determinations; ANOVA ($P < 0.05$), ($P > 0.05$)

Moreover, the fine topsoil which is the most fertile portion might be removed, leaving the coarse soil fraction which contains lower nutrient levels and has a lower water-holding capacity.

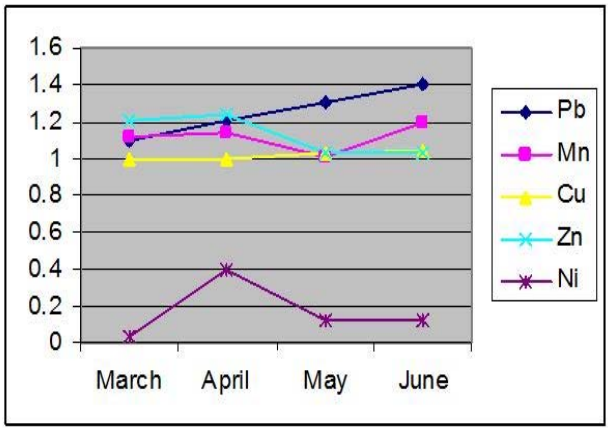


**Figure 1:** Mean concentration of different elements deposited on vegetables leaves of Quetta city.

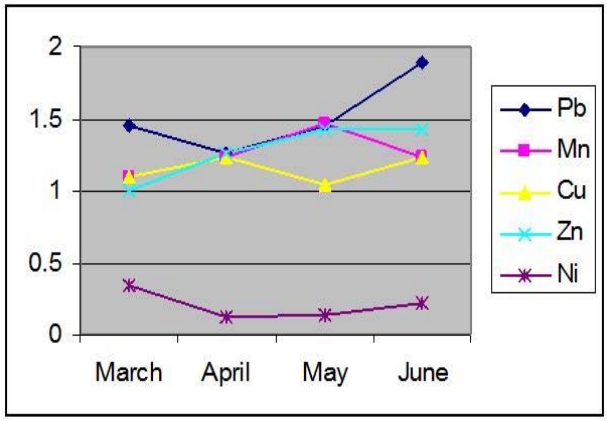


**Figure 2:** Mean concentration of different elements deposited on orchards leaves of Quetta city.

## CONCLUSION

Many plants are sensitive to dust storm which can damage the leaves, impair plant growth and limited primary productivity. Late flower opening in orchards delayed the fruit formation. On vegetables chlorsis and necrosis was found. Toxicity of metals depends on its concentration, some metals are highly toxic and the presence of such metals on orchards of Quetta is a subject of serious concern.

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