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IMPACT ASSESSMENT OF BRICK KILN EMISSIONS ON THE FOLIAGE OF SOME VEGETABLE CROPS

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A study carried out to ascertain the impact of brick kiln emissions on the seven common vegetable crops of Kashmir valley viz. *Solanum melongena* var.Local; *Lycopersicon esculentum* var. Local; *Phaseolus vulgaris* var.Contender; *Brassica oleracea* var. Purple Vienna; *Capsicum annum* var.Local; *Capsicum annum* var. Grossum cv.Local and *Cucumis sativus* var.Local has revealed severe losses in the foliar photosynthetic pigments (chlorophyll- a, b, carotenoids and total chlorophyll) in the population growing at the polluted site . Foliar N contents exhibited sever losses only in *B.oleracea*, *C. annum* (both Local and Grossum) and *C.sativus*. Whereas, other species did not show any significant loss due to pollution stress. P and K contents on the other hand exhibited varied trends in stressed population. Foliar total carbohydrate, ascorbic acid and proline contents recorded significant losses in the population growing under pollution stress.

Keywords : Ascorbic acid; NPK; Proline; Photosynthetic pigments; Vegetable crops.

Introduction

The natural environment is regularly contaminated with chemicals and noxious gases released by the factories, industrial units, thermal power plants, automobiles and brick kilns. Air pollutants from various sources enters through stomata[1] and then passes into intercellular spaces of mesophyll tissue causing various kinds of foliar injuries[2], physiological and biochemical perturbations and growth reductions[3-8]. In the recent past much work has been done to evaluate the impact of coal smoke pollution on vegetation[4-7] however no such work has been carried out in district Budgam of Kashmir valley where about more than hundred make shift coal fired brick kilns have deteriorated the ecology of the area. According to our estimates around 15000 trees are cut annually in the area (for land clearing and establishment of brick kilns) and approximately 260 hac (4 inch thick) of land is lost annually for making bricks. On an average in each brick kiln about 135 tons of low grade Assam coal is burnt in one season (June-Oct) and thus a lot of fly ash and noxious gases like SO_2, NO_2 and CO_2 is released in to the atmosphere. Further in each kiln about 750 liters kerosene oil, 300 liters petrol and 1.66 tons of fire wood is burnt in one operational season. The present work was executed with the main objective to have an environmental impact assessment of the foliage of seven common vegetables of Kashmir valley to coal smoke pollution emanating from various brick kilns.

Materials and Methods

The present investigation was under taken at Division of Environmental Sciences, SKUAST-K, Shalimar, Srinagar in the year 2004-05. The samples of the seven vegetable crops viz.,Brinjal (*Solanum melongena* L. var.Local); Tomato (*Lycopersicon esculentum* Mill.var. Local); Beans (*Phaseolus vulgaris* L. var. Contender); Knoll-kohl (*Brassica oleracea* L. var.Purple Vienna); Red pepper (*Capsicum annum* L.var. Local);Bell pepper (*Capsicum annum* L.var Grossum cv.Local) and Cucumber (*Cucumis sativus* L.var.Local)were collected randomly from the vegetable gardens at Nasarulahpora Budgam within a distance of about ½ Km from the brick kilns. The other set of samples which served as control was collected from the farmer's field at Shalimar, Srinagar situated at a distance of about 25 Km from Budgam. The foliar samples were collected at pre-flowering, flowering and post-flowering stages and the data of individual samplings were pooled together to get mean values. The leaf samples were analyzed for photosynthetic pigments (chlorophyll a, b, carotenoids, total chlorophyll) by non maceration method[9]. The determination of total N, P, and K contents were also accomplished by micro Kjaldhal's method[10]. Ascorbic acid, proline and total carbohydrate contents were determined by the method given by Sadasivum and Manikam[11-13]. The data were finally subjected to CRBD analysis[14] and computed by *t-test*.

Table 1. Effect of brick kiln emissions on the foliar photosynthetic pigments (mg /g fresh weight) of some vegetable crops.

Species	Site	Chlorophyll-a	Chlorophyll-b	Carotenoids	Total Chlorophyll
Solanum melongena	C	0.49	0.33	0.20	0.82
	P	0.40 (-18)*	0.28 (-15)*	0.17 (-15)*	0.68 (-17)*
Lycopersicon esculentum	C	0.65	0.25	0.15	0.90
	P	0.50 (-23)*	0.20 (-20)*	0.13 (-13)**	0.70 (-22)*
Phaseolus vulgaris	C	0.15	0.09	0.06	0.24
	P	0.12 (-20)*	0.08 (-11)*	0.05 (-17)*	0.20 (-20)*
Brassica oleracea	C	0.70	0.26	0.14	0.96
	P	0.52 (-25)*	0.20 (-23)*	0.11 (-21)*	0.72 (-25)*
Capsicum annum Var.Local	C	0.06	0.05	0.04	0.11
	P	0.04 (33)*	0.04 (20)*	0.03 (25)*	0.08 (27)*
Capsicum annum Var.Grossum	C	0.11	0.06	0.03	0.17
	P	0.07 (36)*	0.05 (16)**	0.02 (33)*	0.12 (29)*
Cucumis sativus	C	0.09	0.05	0.02	0.14
	P	0.05 (44)*	0.04 (20)**	0.01 (50)*	0.09 (35)*

Figures in parentheses indicate percent reduction over control
*,** Significant at 0.1 and 0.5% level respectively, C = Control site, P = Polluted site

Results and Discussion

The visual observation of the foliage of all the vegetable crops at the polluted site showed that they were covered with a thick crust of fly ash and some leaves had also developed necrotic patches and even some had turned completely porous due to the effect of hot fly ash. The data (Table1) indicates that chlorophyll-a, b as well as total chlorophyll experienced significant reductions in the population growing at the polluted site. The per cent reduction in chlorophyll-a was highest in *C.sativus* var. Local (44 %) and the lowest in *S. melongena* (18%). Similar coal smoke induced chlorophyll destruction has been earlier reported by many workers[2,4-7,12,15]. The degradation of chlorophyll pigment might be due to the action of SO_2 on chlorophyll metabolism[16] or due to the SO_2 induced removal of Mg^{++} ions by two atoms of H^+ from chlorophyll molecule which converts chlorophyll into phaeophytin[17] or by the production of superoxide radicles by the action of sulphite with chlorophyll under illumination[18]. On the other hand some of the workers are of the opinion that H^+, HSO_3^-, SO_3^{-2} and SO_4^{-2} ions which are produced by SO_2 dissolution in the water in the cytoplasm are preferentially incorporated into thylakoid membrane[19] and induce chloroplast swelling[20]. Mandre and Tuulmets[21] have also opined that decrease in the light availability caused due to dust pollution may lead to decreased elemental uptake and hold the view that the inhibition of the absorption of the active parts of the solar radiation spectrum participating in the photosynthetic process might have directly contributed to the low concentration of chlorophyll in Norway spruce needles under the influence of the high level of dust pollution.

It is also evident from the data that in all the investigated species, chlorophyll-a recorded sever losses due to pollution stress compared to chlorophyll-b which may be ascribed to the inactivation of various enzymes associated with the synthesis and action of cholorophyll-a[22]. Carotenoid contents also recorded losses in all the investigated species which is in agreement with the earlier reports of many workers[4-8].

Table 2. Effect of brick kiln emissions on the foliar NPK, Total Carbohydrate, Ascorbic acid and Proline contents of some vegetable crops .

Species	Site	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Total carbohydrate (%)	Ascorbic acid (mg/g f.wt)	Prolein (µ mol/g f.wt)
Solanum melongena	C	1.87	0.69	1.50	32.00	0.20	3.43
	P	1.75 (6)[NS]	0.53 (23)*	1.40 (6)[NS]	26.00 (18)*	0.17 (13)**	2.60 (24)*
Lycopersicon esculentum	C	2.12	0.69	2.75	18.5	0.25	2.01
	P	1.96 (7)[NS]	0.58 (16)**	2.65 (3)[NS]	10.00 (46)*	0.15 (37)*	1.32 (34)*
Phaseolus vulgaris	C	4.50	0.60	1.75	30.00	0.25	3.96
	P	3.95(12)[NS]	0.58 (3)[NS]	1.50(14)**	18.00 (40)*	0.16 (34)*	2.12 (47)*
Brassica oleracea	C	3.00	0.90	2.00	26.00	0.39	1.66
	P	1.90 (37)*	0.85 (5)[NS]	1.95(2)[NS]	15.00 (42)*	0.21 (47)*	0.91 (45)*
Capsicum annum Var.Local	C	4.0	0.43	1.65	25.0	0.30	2.2
	P	2.5(33)*	0.29 (32)*	1.35 (30)*	20.0 (20)*	0.20(20)*	1.73 (21)*
Capsicum annum Var.Grossum	C	3.4	0.65	2.45	14.0	0.30	2.60
	P	2.7(20)*	0.50 (23)*	1.60 (34)*	10.50 (25)*	0.19(36)*	2.21(15)**
Cucumis sativus	C	4.4	0.55	2.60	40.0	0.31	2.20
	P	2.9 (34)*	0.50(9)[NS]	1.75(32)*	20.0 (50)*	0.16 (48)*	1.90 (13)*

Figures in parentheses indicate percent reduction over control
*,** Significant at 0.1 and 0.5% level respectively, NS=Non-significant
C = Control site, P = Polluted site

Air pollutants are well known to influence the mineral accumulation in plants directly or indirectly. In the present study it has been observed that the contents of essential mineral nutrients like N, P and K invariably decrease in the foliage of the affected population (Table 2). However, the loss in the N contents were non significant except in *B. oleracea, C. annum* var.Local; *C. annum* var. Grossum and *C. sativus.* Such losses in the N contents may be due to the loss in protein synthesis[23] or due to the inactivation of enzymes responsible for protein synthesis[24]. P also suffered significant loss in all the species except in *P. vulgaris*, *B.oleracea* and *C.sativus.* Such losses may be due to the inhibition of certain enzymatic activities involved in P metabolism. The data also indicates that K contents exhibited marked losses in *P. vulgaris*, *C. annum* var.Local; *C. annum* var. Grossum and *C. sativus* which signifies that brick kiln emissions hamper the K metabolism in plants. The losses in N,P and K contents in the foliage affected by coal smoke pollution has also been observed by many earlier workers[4-6].

The percentage of carbohydrate and ascorbic acid in the population growing at the test site was reduced more in *C. sativus* (50 % and 48 %) and least in *S. melongena* (18 % and 13%) . Such reductions are in agreement with some earlier observations[25]. On the other hand proline contents recorded highest loss in *P.vulgaris* (47%) and least in *C. sativus* (13 %). Such reductions have also reported by other workers[26].

So on the basis of present study it may be concluded that coal smoke pollution emanating from brick kilns affected various physiological and biochemical parameters of plants and relative response of different

species depends on the inherent characters of the species concerned.

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