Response of Eggplant (*Solanum melongena* L.) to fly ash and brick kiln dust amended soil

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Abstract:
In the present study, the effect of different fly ash and brick kiln dust levels in soil (0%, 5%, 10%, 20%, 30%, 40% and 50%) were observed on growth performances and yield of eggplant. For the experiment, one kg of each mixture was filled in pots and the pots containing only soil served as Control. The plant growth (length of shoot and root; fresh wt. and dry wt. of shoot and root; leaf / plant; leaf area / plant; branch / plant) and yield (flower / plant; flower size; fruit / plant; fruit size) parameters were taken. Plant growth and yield were significantly increased from 5 to 30% level in fly ash amended soil and from 5 to 40% level in brick kiln dust amended soil. However, at higher levels i.e. 40 & 50% levels in fly ash and 50% level in Brick kiln dust, growth and yield parameters reduced significantly. The perusal of the data revealed that 20% level of fly ash and 30% level of brick kiln dust amendments in soil were found to be ideal level for the better plant growth and yield of eggplant.

Keywords: Brick kiln dust, eggplant, fly ash, plant growth, yield.

Introduction

Air pollution is the major problem in the developing countries. The pollutants responsible for causing air pollution are grouped as gaseous pollutants and particulate air pollutants. The particulate air pollutants include fly ash, brick kiln dust, cement dust, textile dust, metallic dust, lime dust, pesticides dust, fumes, mist, vapours, etc. These particulate pollutants have created several ecological and environmental problems. However, recently fly ash and brick kiln dust have been found beneficial to plants.

Fly ash is the residue from coal combustion in thermal power plants. Indian coal has 30-40% fly ash content (Kumar *et al*., 2000) and at present nearly 100 million tons of fly ash per year is being produced from the thermal power stations spreading throughout the country. Fly ash has been found beneficial for the growth of plants due to the presence of several plant nutrients (Adriano *et al*., 1980). Its amendment in soil upto 40 per cent level brings about an increase in the growth and yield of cucumber, maize, okra, potato, tomato and wheat (Kausar, 2007; Khan, 2007; Khan and Khan, 1996; Mishra and Shukla, 1986; Raghav and Khan, 2002).

The second major industrial pollutant in India is brick kiln dust. Wood and coal are used as raw materials in brick kilns for making bricks. The product of complete combustion of fuel in brick kilns mainly consists of several gases and a large amount of brick kiln dust in powdered waste form. Recently Upadhyay, 2004 has reported beneficial impact of brick kiln dust on *Brassica juncea* and *Linum usitatissimum*. So, keeping in view the recent agricultural utilization of these two industrial particulate wastes, it was planned to evaluate their effect on eggplant (*Solanum melongena* L.).

Materials and Methods

Sources of Fly Ash and Brick Kiln Dust: Fresh fly ash was collected in gunny bags from Thermal Power Plant, Kasimpur, situated 20 Km away from Aligarh and brick kiln dust was collected in gunny bags from the brick kiln, Manzoor Garhi, situated about 15 Km away from Aligarh. Both particulate air pollutants were brought to the Department of Botany, A.M.U., Aligarh, for conducting the experiments.

Collection and Preparation of Soil: For experimental work, soil was collected from agricultural field upto a depth of 20 cm, after scrapping of the surface litters . Before utilization, the soil was steam sterilized keeping in gunny bags in the autoclave at 20

lb pressure for 20 minutes. The autoclaved soil was dried and then mixed with particulate pollutants in different ratios separately.

Test Plant: The eggplant (*Solanum melongena* L.) cv. Shivani was selected as test plant. The certified seeds of eggplant sterilized in 0.01% $HgCl_2$ for 15 minutes were sown in 20 x 20 cm clay pots. After emergence of four leaves stage, seedlings were transplanted to pots for growth experiments.

Experiment: For the experiments, fly ash / brick kiln dust were mixed with autoclaved soil to obtain following levels (w/w):

F_1 = Control (only autoclaved soil) (0% level)
F_2 = 5% fly ash / brick kiln dust + 95% autoclaved soil (5% level)
F_3 = 10% fly ash / brick kiln dust + 90% autoclaved soil (10% level)
F_4 = 20% fly ash / brick kiln dust + 80% autoclaved soil (20% level)
F_5 = 30% fly ash / brick kiln dust + 70% autoclaved soil (30% level)
F_6 = 40% fly ash / brick kiln dust + 60% autoclaved soil (40% level)
F_7 = 50% fly ash / brick kiln dust + 50% autoclaved soil (50% level)

One kg of each fly ash mixture was filled in 15 cm clay pots. The pots containing only soil served as control. Total 140 pots (7 treatments x 4 weeks x 5 replicates) were prepared. Fifteen days old seedlings at four leaves stage were transplanted to each pot. The pots were kept on glasshouse bench at 25-27^{0}C. Pots were arranged in randomized block design on glasshouse benches. After two months, plants were harvested carefully. The plant growth (length of shoot and root; fresh wt. and dry wt. of shoot and root; leaf / plant; leaf area / plant; branch / plant) and yield (flower / plant; flower size; fruit / plant; fruit size) parameters were taken. Data was analyzed statistically for significance.

Results

Plant Growth: The data represented in table 1 shows that all the plant growth parameters (length, fresh wt. and dry wt. of shoot and root, leaf number, leaf area, branch number) were significantly increased at all fly ash combinations as compared to inoculated control set. The plant growth was better in 5, 10, 20 and 30% combinations irrespective of control, maximum being at 20% level of fly ash. Thus, all above growth parameters were decreased in 40 and 50% fly ash when compared to control (Table 1).

Similarly in case of brick kiln dust, all the plant growth parameters were significantly increased as compared to control. The plant growth was better in 5, 10, 20, 30 and 40% combinations irrespective of control, maximum being at 30% level of brick kiln dust. However, all plant growth parameters were reduced in 50% brick kiln dust when compared to control (Table 2).

Plant Yield: Fly ash amendments also beneficial to the yield parameters of eggplant (number of flower / plant, flower size, number of fruits / plant and fruit size). These parameters were significantly increased in the treatments with 5 to 30% fly ash levels, maximum being at 20% level. At higher levels (40 and 50%), yield parameters declined gradually when compared to control (Table 3).

In brick kiln dust amendments, all the above yield parameters were significantly increased in the treatments with 5% to 40% levels, maximum being at 30% level. At higher level (50%), all the yield parameters declined when compared to control (Table 4).

Discussion

Soil application of fly ash and brick kiln dust at lower levels (up to 30% level) were found beneficial for the plant growth and yield of eggplant in the present study, maximum being at 20% level in case of fly ash and at 30% level in case of brick kiln dust. Thus, fly ash is more beneficial to plant growth and yield of eggplant as compared to brick kiln dust. The beneficial effect of fly ash at lower levels (10 – 30%) have already been observed on many crops - soybean, cabbage, chickpea, cucumber, lentil, maize, potato, wheat, tomato etc. (Mishra and Shukla, 1986; Singh, 1989; Khan and Khan, 1996; Raghav and Khan, 2002; Kausar, 2007). However, higher levels (40 and 50%) were found harmful to growth and yield parameters of eggplant. This shows that the available nutrients present in fly ash and brick kiln dust were beneficial at certain levels for utilization of a particular plant species. Thus, both fly ash and brick kiln dust can be used as an eco-friendly non-conventional fertilizer at 20% and 30%

levels respectively because they will improve the growth and yield of plants. At the same time, the disposal problem of huge amount of fly ash and brick kiln dust will also be solved.

Conclusion

Fly ash and brick kiln dust amendment in soil improved plant growth and yield of eggplant. Highest increase was observed at 20% level in fly ash and 30% level in brick kiln dust. The study showed that fly ash and brick kiln dust were beneficial to the plant at lower levels i.e. 20% and 30% respectively.

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Table 1: Effect of fly ash on plant growth performance of eggplant.

Treatments	Length (cm)		Fresh wt. (g)		Dry wt. (g)		Leaf/	Leaf area/	Branch/
FA (%)	Shoot	Root	Shoot	Root	Shoot	Root	plant	plant (cm^2)	plant
Control	48.2	26.6	111.3	57.0	15.8	10.2	44	106	11
5	51.1	28.7	115.0	58.8	17.3	10.8	45	109	13
10	54.8	29.1	119.6	60.1	20.4	11.3	47	111	15
20	56.3	31.0	123.6	65.5	25.2	13.8	51	115	18
30	55.0	28.9	120.1	59.7	20.9	10.5	46	110	16
40	47.2	25.4	10.5	56.4	15.6	10.0	43	105	12
50	36.0	18.2	101.0	46.2	14.0	8.7	33	61	7
LSD at 5%	2.31	1.20	3.50	1.02	0.78	0.25	0.8	2.1	1.5

Each value is a mean of five replicates.

Table 2: Effect of brick kiln dust on plant growth performance of eggplant.

Treatment	Length (cm)		Fresh wt. (g)		Dry wt. (g)		Leaf/	Leaf area/	Branch/
BKD (%)	Shoot	Root	Shoot	Root	Shoot	Root	plant	plant(cm^2)	plant
Control	39.6	19.6	99.0	48.5	14.0	7.0	32	69	8
5	43.1	21.3	103.3	51.4	16.2	7.7	36	73	10
10	46.8	23.9	108.9	53.2	17.5	8.4	40	104	12
20	47.3	24.0	109.6	53.7	18.4	9.1	41	106	14
30	50.4	27.6	115.5	57.3	21.2	10.5	45	109	16
40	46.0	23.5	108.4	54.1	17.6	9.2	39	103	12
50	35.5	17.4	96.7	44.0	13.1	6.5	30	53	7
LSD at 5%	2.27	1.21	3.11	1.75	1.81	0.52	3.1	2.6	1.3

Each value is a mean of five replicates.

Table 3: Effect of fly ash on yield of eggplant.

Treatments	Yield of eggplant			
FA (%)	Flower/ plant	Flower size (cm)	Fruit/ plant	Fruit size (cm)
Control	9	2.8	7	10.5
5	11	3.4	10	11.8
10	13	3.6	12	12.2
20	16	4.0	14	15.0
30	13	3.8	12	13.4
40	8	2.7	7	9.3
50	5	2.5	3	6.1
LSD at 5%	1.26	0.13	1.52	0.07

Each value is a mean of five replicates.

Table 4: Effect of brick kiln dust on yield of eggplant.

Treatments BKD (%)	Yield of eggplant			
	Flower/ plant	Flower size(cm)	Fruit/ plant	Fruit size (cm)
Control	6	2.4	4	5.1
5	7	2.5	6	7.7
10	8	2.6	8	8.8
20	10	3.0	8	10.0
30	13	3.8	11	13.2
40	7	2.5	6	8.5
50	3	2.2	2	4.6
LSD at 5%	0.72	0.03	1.14	1.17

Each value is a mean of five replicates.