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Response of cherry tomato (*Solanum lycopersicum var. cerasiforme*) grown under the influence of fly ash and its effects on soil health in eastern plains of Prayagraj U.P.

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Abstract
A pot experiment was carried out at Green shade, in Forest Nursery & Research Centre, College of Forestry Department of Environment Sciences & NRM, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Rabi season 2019. To study the "Response of Cherry Tomato *(Solanum lycopersicum var. cerasiforme)* Growth Under the Influence of Fly Ash and Its Effects on Soil Health in Eastern Plains of Prayagraj U.P.". The experiment was laid out in R.B.D (Randomized Block Design) design with twenty five treatments and three replications. The treatments comprised of fly ash 0%, 10%, 20%, 30%, 40% and 50% and together with soil. The results revealed that 40 % fly ash significant effect on plant height (87.800), number of leaves (57.333), number of flower per plant (27.113), fresh weight of plant (366.897), dry weight of plant (64.800),. The soil fertility has increased significantly by 40% fly ash due to high contents of (%)Organic Carbon (0.627), Bulk Density (1.157), Particle Density (2.473), (%) pore space (65.930), water holding capacity (66.600), Soil pH (7.803, Soil EC (0.220), which was observed significantly in post-harvest in soil. Significant increase in available Nitrogen (281.847), Phosphorus (46.267) and Potassium (258.710) was recorded.

Keywords: cherry tomato, fly ash, green shade, R.B.D, pot

Introduction
Fly Ash (FA), a finely divided residue of coal burning power-generating plants, holds the potential to contaminate our environment. FA is a potential source of many macro and microelements to the plants including some toxic metals (Mehra *et al.*, 1986) [5]. The alkaline nature of FA has its use as amendment in agricultural fields. However, non-judicious application of FA to soil deteriorates soil quality as well as depresses crop growth (Shukla *et al.*, 2003) [7]. It contains almost all the essential plant nutrients but deficient in nitrogen and phosphorus (Deepa Katiyar *et al.*, 2012) [3].

Fly ash used agriculture is mainly based on its limiting potential and supply of nutrients. The ashes are good source of available secondry nutrient (Ca, Mg, S) and micronutrient(Zn, Fe, Cu & Mn) the texture being sandy silt to silty loam improve WHC and percolation in sandy as well as clay soil are beneficial effects. (Singh *et al.* 2008, Pandey *et al. 2009*, Singh and Agrawal 2010) [12, 6, 11].

Cherry tomato *(Solanum lycopersicum var. cerasiforme)* is a botanical and small sized garden variety of cultivated tomato**.** Cherry tomatoes may contain more beta-carotene than lycopene. It is mainly considered as "protective food" based on its nutritive value, antioxidant molecules such as carotenoids, particularly lycopene, ascorbic acid, vitamin E and phenol compounds particularly flavonoids (Sepat *et al*., 2013) [10]. Lycopene has important dietary properties since it reduces the risk of several types of cancer and heart attacks (Dorgan *et al*., 1998; Clinton, 2005) [2, 4]. In recent years, consumption of tomato is also suggested for lowering the risk of human diseases (Al-Amri, 2013) [1]. Cherry Tomato is considered as the outstanding source of special nutrients needed in the diet is by its nutritive value (per 100 gm. of edible portion).

Materials and Methods
Experimental site
The investigation on "Response of Cherry Tomato *(Solanum lycopersicum var. cerasiforme)* Grown under the Influence of Fly Ash and its Effects on Soil Health in Eastern Plains of Prayagraj U.P." was conducted at Department of Environmental Sciences and NRM, at Green Shade, in Forest Nursery & Research Centre, College of Forestry,

Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj.

Collection of fly ash samples & source of cherry tomato seeds

The fly ash was collected from the IFFCO, Phulpur, Prayagraj, (UP), India. The certified seeds of the cherry tomatoes varieties were taken from IARI PUSA, Delhi.

Parametes

A. Physiological Study

Plant height (cm)
No. of Leaves per plant
No. of Flower per Plant

B. Fresh & Dry Weight of Plants

Plant Fresh Weight (gm)
Plant Dry Weight (gm)

C. Yield and yield attributes

Number of Fruit yield

D. Physical and Chemical Analysis

pH, EC,BD, PS%, WHC, OC%, N,P,K

Results and Discussion

Response of Fly Ash on Plant Height (cm.) of Cherry Tomato (*Solanum lycopersicum* var. *cerasiforme*)

The maximum plant height was recorded as 87.800 at 90 DAS with the application T_5: Fly ash 40% +60% Soil and the minimum plant height 12.143 were recorded in T_0: Control.

The effect of fly ash on plant height was may be due to the nitrogen presence in fly ash which is important for plant height as it is major component of chlorophyll. Similar finding was also reported by N. K. Pani *et al*., (2015)

Table 1: Plant height (cm.) of cherry tomato

Treatment	Plant Height (cm)		
	30 DAS	60 DAS	90 DAS
T0	12.143	24.217	48.333
T1	15.500	30.450	58.603
T2	21.400	42.333	68.700
T3	26.900	52.500	77.300
T4	30.800	59.900	81.503
T5	39.700	69.900	87.800
T6	33.700	48.000	76.000

Response of Fly ash on number of leaves per plants of cherry tomato (*Solanum lycopersicum var. cerasiforme*)

The maximum number of leaves per plant were recorded as 57.333 at 90 DAS with the application T_5: Fly ash 40% +60% Soil, and the minimum number of leaves per plant was observed as 6.890 at 30 DAS in treatment T0: Control.

The effect of nitrogen on number of leaves may be due to its presence in fly ash content which is important as it contain major component i.e chlorophyll, which is useful to plant for photosynthesis. Similar finding was also reported by S. Gautam *et al*., (2012).

Table 2: Number of leaves per plant of cherry tomato

Treatment	Leaves per plant		
	30 DAS	60 DAS	90 DAS
T0	6.890	16.887	14.443
T1	14.223	39.890	31.000
T2	12.890	34.553	32.110
T3	13.777	39.443	35.447
T4	13.223	34.333	33.000
T5	19.443	55.223	57.333
T6	15.890	45.557	37.667

Response of Fly ash on number of flower per plant of cherry tomato *(Solanum lycopersicum var. cerasiforme).*

The effect of Fly ash in Soil on number of flower per plant was found to be maximum of 27.113 with the application of T_5: Fly ash 40% +60% Soil, and the minimum of 3.110 was found in T_0: Control.

Fly ash contains many nutrients such as Ca, K, Na, Mg & S which are necessary for plant growth. Similar finding was also reported by Sasmita Dash *et al.* (2017) & J. Omprasad *et al.*, (2018).

Table 3: Response of fly ash on number of flower per plant of cherry tomato

Treatment	Flowers per plants
T0	3.110
T1	15.887
T2	11.000
T3	7.443
T4	12.333
T5	27.113
T6	19.667

Response of fly ash on plant fresh weight (gm.) and plant dry weight (gm.) of plant in cherry tomato (*Solanum lycopersicum var. cerasiforme*).

The effect of Fly Ash in Soil on Plant fresh weight (gm.) of cherry tomato was found to be maximum of 366.897 with the application of T_5: Fly ash 40% +60% Soil, and the minimum Plant fresh weight (gm) of cherry tomato 165.517 was found in T_0: Control whereas Plant dry weight (gm) of cherry tomato was found to be maximum of (64.800) with the application of T_5: Fly ash 40% +60% Soil, and the minimum Plant fresh weight (gm.) of cherry tomato (42.667) was found in T_0: Control. Similar finding were also reported.

Table 4: Response of fly ash on weight plant (Fresh & Dry) of cherry tomato

Treatment	Weight of plants (gm)	
	Fresh	Dry
T0	165.517	42.667
T1	255.653	45.853
T2	267.383	53.500
T3	285.243	41.433
T4	313.237	41.883
T5	366.897	64.800
T6	355.583	53.167

Response of fly ash on number of fruits per plant of cherry tomato (*Solanum lycopersicum var. cerasiforme*).

The effect of Fly Ash in Soil on number of fruits per plant was found to be maximum of 23.557 with the application of T_5: Fly ash 40% +60% Soil, and the minimum number of fruit per plant 1.667 was found in T_0: Control.

The effect on number of fruits in plant may be due to fly ash content which is generated as a by- product of coal combustion and contains many nutrients such as Ca, K, Na, Mg &. Similar finding were also reported by J. Omprasad *et al.*, (2018).

Table 5: Response of Fly ash on number of fruits per plant of cherry tomato

Treatment	Number of fruits per plant
T0	1.667
T1	12.443
T2	8.110
T3	5.887
T4	9.557
T5	23.557
T6	16.003

Response of fly ash on physical and chemical properties of soil

a) Physical properties

The observed value of pH in soil was recorded maximum of 7.803 T_5: Fly ash 40% +60% Soil, and minimum of 7.393 in T_0: Control. The observed value of EC in soil was recorded maximum of 0.220 T_5: Fly ash 40% +60% Soil, and minimum of 0.140 in T_0: Control. Fluctuations in pH were due to decomposition of Fly ash in the soil whereas EC increases in soil when organic materials of different nature were applied to the soil.

The observed value of Bulk Density (gcm^{-3}), Particle Density (gcm^{-3}), % Pore Space, Water Holding Capacity in soil was recorded maximum in T_5: Fly ash 40% +60% Soil which is 1.157, 2.473, 2.473, 66.600 respectively whereas the minimum observed value of BD ($g\ cm^{-3}$), PD ($g\ cm^{-3}$), % PS, (%) WHC was recorded in T_0: Control which is 1.023, 2.080, 50.243, 47.283 respectively. The significant increase in BD, PD, % PS and WHC was due to saturation percentage, porosity and organic matter content in soil.

b) Chemical properties

The observed value of (%) Organic Carbon in soil was recorded maximum of 0.627 in T_5: Fly ash 40% +60% Soil and minimum of 0.077 in T_0: Control. It is believed that the presence of organic carbon in fly ash significantly influences its extraction ratio. In case of especially high organic carbon content samples, the activated carbon is blown on incineration in order to remove pollutants.

The observed value for Nitrogen, Phosphorous and Potash (N,P,K) in soil was recorded maximum in T_5: Fly ash 40% +60% Soil which is 281.847, 46.267, 258.710 respectively whereas the minimum value was observed in T_0: Control which is 126.527, 19.500, 240.233 respectively. Fly ash contain appreciable amount of N,P,K which are considered as major element for plant growth and also helps the plant to fight off pests and diseases.

Table 6: Effect of different doses of fly ash on physical and chemical properties of soil

Parameters		Treatments						
		T0	T1	T2	T3	T4	T5	T6
Physical Parameter	pH	7.393	7.460	7.573	7.750	7.720	7.803	7.420
	EC	0.140	0.172	0.128	0.149	0.159	0.220	0.157
	BD	1.023	1.080	1.023	1.070	1.040	1.157	1.023
	PD	2.080	2.230	2.313	2.167	2.240	2.473	2.363
	PS%	50.243	50.280	58.443	56.307	60.247	65.930	54.000
	WHC	47.283	55.390	61.237	49.133	50.300	66.600	49.893
	OC%	0.077	0.237	0.620	0.313	0.281	0.627	0.410
Chemical Parameter	N	126.527	129.810	200.880	139.327	135.473	281.847	196.147
	P	19.500	24.767	22.700	31.033	30.170	46.267	43.933
	K	240.233	250.733	243.957	249.470	245.183	258.710	249.447

Conclusion

The experiment was conducted at Department of Environmental Sciences & NRM, at Green Shade, in Forest Nursery & Research Centre, College of Forestry, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj-211007, (U.P)., India. "Response of Cherry Tomato (*Solanum lycopersicum* var. cerasiforme) Grown Under the Influence of Fly Ash and Its Effects on Soil Health in Eastern Plains of Prayagraj, U.P." In view of above results the following conclusion were drawn.

The treatment T_5: (Fly ash 40% +60% Soil) may be conceded as in all of plant parameter the plant height (cm.) (87.800), number of leaves per plant (57.333), Plant Fresh weight (366.897gm.), Plant dry weight (64.800gm.) and total fruit (23.557) was found maximum and the minimum net return was found in T0 (Comtrol).

The impact of different levels of Fly Ash on physicochemical properties of soil which shows that the pH and EC exhibits a decreasing trend, the concentration of Nitrogen, Phosphorous and Potassium increases whereas organic carbon decreases, the post- harvest accumulation levels of Fly ash in soil increases from control to treament T19 respectively during the period of study.

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