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Response of Flyash and Sewage Sludge on Growth Parameters of Radish (*Raphanus sativus L.*) and Soil Health

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Abstract

The experiment was conducted to the study "Response of flyash and sewage sludge on growth parameters of radish (*Raphanus sativus L.*) and soil health". The area selected for the present investigation is situated at research farm in the College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences to study the effect of flyash and sewage sludge and inorganic fertilizer application on the physical and chemical properties of soil and yield of Radish. The details of various material used and methods followed for achieving the objectives of the present investigation have been under climate, weather properties design and planting materials. The treatments were allocated in randomized block design with three replication and four levels of flyash and sewage sludge. The treatment T_3 (10 ton/hac^{-1} flyash and 5 ton/hac^{-1} sewage sludge) came with the best result in terms of yield of radish and improvement in the soil health. The available N, P and K and the other parameters in the experimental period shows improved soil health because flyash and sewage sludge contains appreciable amount of N, P and K therefore, it brings significant increase in available Nitrogen, Phosphorus, and Potassium of post-harvest soil of Radish grown soil.

Key Words: Flyash, Sewage Sludge, Physical, Chemical, Potassium, Phosphorus and Radish

Introduction

Protection of Environment is the most vital issue today explosive population growth, rapid growth in science and technology, massive industrialization, use of various chemicals in agriculture is most important. The human activities are the factors threatening the very quality of life (Sharma *et al*. 2000). Over the last few decades, depending on the place and time, environmentalist have been primarily concerned with eutrophication, heavy metals, synthetic chemicals, ration nuclides, sedimentation and hot water (Moore and Ramamurthy 1984).The use of wastes in agriculture, forestry and land reclamation has been increasingly identified as an important issue for soil fertility, soil conservation and residue disposal. Sewage sludge is a concentration suspension of solids, largely composed of organic matter, usually rich in mineral nutrients. In addition to major plant nutrients, sewage sludge contains trace elements that are essential for plant growth (Ergene 1985). However, sewage sludge also contains heavy metals and soluble salts, which could be toxic to the soil (McGrath *et al.* 2000) and plants could be a source of contamination due to its potential leaching to groundwater (Gasco*et al*. 2005).

In India about 90 million tons offlyash is produced per year from burning an approximately 200 million tones per year producing ash ponds that occupies 65 thousand acres of land. Nearly 73% of India's total installed power generation capacity is thermal, and 90% of it is coal based. The world band has questioned India that by 2015 disposal of coal ash would require thousand m^2 to 1 km^2 of land per person. The use flyash in agriculture has been based on its neutralising potential and

supply of essential elements such as Ca, B, S and Mo. It has been reported to be a repository of nutrients which help in reclamation of alkaline and saline soil and also improve soil properties for plant growth (Kesh et al. 2003). The radish, *Raphanussativus*, is a member of a cruciferae family native to Europe or Asia. It was once grown on a small scale in all areas of U.S. and also as a green house vegetable. The word *Raphanus* comes from the Greek word meaning quick appearing or early grown (Thompson and Kelly, 1957).

Materials and Method

The present study entitled "Response of SLASH on Growth Parameters of Radish (*Raphanussativus L.*) and Soil Health"comprise of a plot experiment which was laid out at the Nursery of Environment Science, Sam Higginbottom Institute of Agriculture & Technology Sciences (Deemed to be-University), Allahabad during Rabi season. The field work was done in the Department of Forestry and Environment Research field, Sam Higginbottom Institute of Agriculture & Technology Sciences (Deemed to be-University), Allahabad and the research lab work was done in the Environmental Science Laboratory, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad. 30 plots for the experiment and soil sampling were done. Soil samples were taken for the field of forest nursery. The experiment was laid out in a 10x3 factorial design with four levels of flyash and sewage sludge at the rate of 0,5,10 and 15 tonnes ha^{-1} and recommended dose of fertilizers and their combinations with 10 treatments. The treatments were replicated three times randomly in each treatment.

Results and Discussion

Growth Parameters of Radish:

The present results in table 1.1. shows that all the growth parameters which were taken for the Radish plant shows the similar pattern for the respected treatments i.e. the maximum readings recorded in height of the plant (23.86), the number of leaves (21.87), root length (23.44), fresh weight (142.33) and dry weight (54.00) of the plant as well as the yield (q/hac^{-1}) was (260) recorded maximum in the treatment T3 (10 ton/hec-1 flyash + 5 ton/hec-1 sewage sludge). On the other hand, same as in the case of maximum growth, minimum growth of the plant was recorded in the treatment T0 i.e. the parameters height of the plant (17.97), the number of leaves (16.86), root length (17.79), fresh weight (88.66) and dry weight (10.24) of the plant as well as the yield (q/hac^{-1}) was (150) with the application of application (0 ton/hec-1 flyash + 0 ton/hec-1 sewage sludge) (**Kauthale*et al*. 2005**), (**Siddharth*et al.* 2011**).

Table 1.1.Effect of (Sewage Sludge+Flyash) on the Growth Parameters of Radish Crop

Treatment	Plant Height (cm)	No. Of Leaves	Root Length (cm)	Fresh Weight (gm)	Dry Weight (gm)	Yield (q/ha)
T_0	17.94	16.86	17.79	88.66	10.24	150
T_1	20.16	18.44	20.77	120.94	23.66	200
T_2	20.96	19.36	20.66	132.89	42.79	240
T_3	23.86	21.87	23.44	142.33	54.00	260
T_4	22.04	20.08	21.04	126.66	36.04	210
T_5	22.21	20.62	21.22	139.68	49.88	220
T_6	21.64	20.92	21.79	140.46	50.76	250
T_7	21.86	19.72	20.69	114.92	24.26	205
T_8	21.76	19.43	19.22	109.64	20.74	210
T_9	20.25	18.34	19.06	100.76	12.36	170

Data appended in table 1.2. that maximum Soil particle density (g/cm^{-3}) was (2.63) at T5 Increasing the sewage sludge application rate significantly increased due to saturation percentage, porosity and organic matter content in soil. This may be due to high organic matter content in sewage -sludge and flyash.

Soil pore space (%) was (55.58) at (5 ton/hec-1 flyash + 10 ton/hec-1 sewage sludge), whereas the minimum Soil particle density (g/cm^{-3}) was (2.15) T8 but with slightly different the minimum pore space (%) of the Soil (42.28) was in T3 (10 ton/hec-1 flyash + 5 ton/hec-1 sewage sludge). The data in table 1.2 was totally different with the Soilbulk density (g/cm^{-3}) recorded as (1.41) T9 (15 ton/hec-1 flyash + 15 ton/hec-1 sewage sludge) and the minimum soil density (g/cm^{-3}) was (1.22) at T7 (15 ton/hec-1 flyash + 10 ton/hec-1 sewage sludge). Similar were the findings reported by Mendoza *et al.*(2006) and Malla and Totawat *et al.*(2006).

Table 1.2. Effect of Flyash and Sewage sludge on Soil Physical Properties of Radish Crop

Treatment	Bulk Density (g cm^{-3})	Particle Density (g cm^{-3})	Pore Space (%)
T_0	1.25	2.61	53.33
T_1	1.32	2.62	51.60
T_2	1.39	2.53	43.57
T_3	1.25	2.42	42.28
T_4	1.38	2.36	51.36
T_5	1.28	2.63	55.98
T_6	1.37	2.54	52.19
T_7	1.22	2.35	46.37
T_8	1.31	2.15	48.28
T_9	1.41	2.27	50.86

Data appended in table 1.3. that maximum pH was recorded at $T_9$was (7.92) This might be due to reduction of pH value due to presence of the decomposition of sewage sludge and flyash in the soil, it bring significant in pH of post-harvest soil of radish grown plot. EC (dSm^{-1}) was (0.31)The decomposition of organic materials released acid or acid forming compounds that reacted with the sparingly soluble salts already present in the soil either converted that into soluble salts or at least increased their solubility.(Sarwar*et at.*2008),

Organic Carbon (%) was (2.54) observed that both rates of compost resulted in an increase of soil organic matter status. A combination of compost and chemical fertilizer provide further helpful in increasing the organic carbon level of the soil.(Sarwar*et al.* 2003). Nitrogen (kg/ha^{-1}) was (170.35) because Sewage sludge and flyash contains appreciable amount of nitrogen therefore, it brings significant increase in available nitrogen of post harvested soil. (Malla and Totawat, 2006).

In table 1.3 The Phosphorus (kg/ha^{-1}) was (15.50), and Potassium (kg/ha^{-1}) was (25.90) was observed with the application (15 ton/hec-1 flyash + 15 ton/hec-1 sewage sludge) Phosphorus is second major element for the plant growth. It is an integral part of adenosine diphosphate (ADP) and adenosine triphosphate (ATP); the two compounds are involved in almost all energy transformation in plants. Perhaps the availability of this nutrient is the most dynamic in the soil. Besides other factors, its availability is controlled by soil pH, clay content, calcareousness and organic matter percentage of the soil. (Pattanayak *et al*. 2001). Phosphorus is also due to higher content of potash in sewage sludge and flyash thus brought significant increase in available potash of

harvested soil. Similar result also reported by (Hussein 2009).

Whereas the minimum pH was T_0 (7.08), EC (dSm^{-1}) was (0.22), Organic Carbon (%) was (2.14), Nitrogen (kg/ha^{-1}) was (155.17), phosphorus (kg/ha^{-1}) was (12.13), and Potassium (kg/ha^{-1}) was (24.13), with the application (0 ton/hec-1 flyash + 0 ton/hec-1 sewage sludge).

Table 1.3. Effect of Flyash and Sewage sludge on Physico-chemical Properties of soil of Radish Crop

Treatment	pH	EC (dSm^{-1})	Organic Carbon (%)	Nitrogen (Kg ha^{-1})	Phosphorus (Kg ha^{-1})	Potassium (Kg ha^{-1})
T_0	7.08	0.22	2.14	155.17	12.13	24.13
T_1	7.11	0.23	2.22	156.37	12.53	24.35
T_2	7.21	0.24	2.24	156.77	12.73	24.54
T_3	7.33	0.25	2.28	157.27	13.26	24.68
T_4	7.52	0.26	2.31	158.57	13.70	24.78
T_5	7.54	0.27	2.36	159.33	13.80	24.95
T_6	7.65	0.28	2.39	159.80	14.23	25.20
T_7	7.74	0.29	2.46	160.43	14.73	25.41
T_8	7.84	0.30	2.50	160.86	15.20	25.71
T_9	7.92	0.31	2.54	170.33	15.50	25.90

Conclusion

The findings of present study may be concluded that the treatment T_3(10 ton/hec-1 flyash + 5 ton/hec-1 sewage sludge) as in all of plant parameter plant height (cm), number of leaves per plant in and maximum plant root length (cm), maximum fresh weight (gm), maximum dry weight (gm), and maximum total yield (q/ha-1) occurred the same among the other treatments. On the other hand, the impact of different levels of flyash and sewage sludge on physicochemical properties of soil which shows that the pH and EC exhibits a deceasing trend, the concentration of Nitrogen, Phosphorous and Potassium increases, whereas organic carbon decreases. The post-harvest accumulation levels of flyash and sewage sludge in soil increases from control to treatment T_9 (15 ton/hec-1 flyash + 15 ton/hec-1 sewage sludge) respectively during the period of study.

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