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Original Research Paper

Studies on Effects of Flyash and Plant Hormones Treated Soil on Increased Oil Content in Seeds of *Sesamum indicum*

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ABSTRACT

Sesamum is one of the most ancient cultivated crops in India. *Sesamum* (Family Pedaliaceae) is a genus of annual or perennial herb or occasionally shrub found in the warmer regions like Africa, Asia and Australia. About six species are recorded in India of which *S. indicum* is widely cultivated. In Chhattisgarh state there are many thermal power plants like NTPC, BCPP, CSEB, etc., which continue to discharge large quantities of flyash having alkaline nature. Soils of Chhattisgarh state are acidic (red, yellow). Soil acidity is responsible for Al^{3+} ion toxicity, which leads to reduced microorganism activity, and Mo and Zn deficiency. Al^{3+} ions affect plant growth in acidic soil inhibiting root length, uptake of nutrients and reducing crop yield. In plants, IAA and GA were used as growth hormones. Plant growth parameters were compared for plain and flyash and hormone treated soil.

INTRODUCTION

Sesamum indicum is one of the most ancient cultivated crops in Chhattisgarh in India. Seeds of the plant yield an edible oil. Indiscriminate use of NPK fertilizers removes trace elements fastly from the soil (Shorrocks 1981). Flyash can be used as a soil ameliorator which also neutralises the acidity developed in soil. Flyash has following properties:

1. It is basic in nature to ameliorate soil acidity.
2. It is a reserve of trace elements to replenish their deficiency in soil.
3. Its physico-chemical properties and texture help to mix homogeneously with soils (Singh 1997).

Biotechnologically, in the present work on sesame, soil acidity has been ameliorated by flyash for increase in plant growth and increase in oil content. Plant growth hormones like GA and IAA were also used for better crop yield and oil content. Flyash is a good source of NPK along with Ca, Zn, Mn, Mo and Fe, etc.

MATERIALS AND METHODS

Keeping the above objectives in view, the work was conducted in pots with flyash in red and lateritic soils of the Hasdeo irrigation project area. Soil, flyash and their various combinations were analysed for their physico-chemical properties. Mineral content of soil and flyash are given in Table 1, and physico-chemical properties of their different combinations in Table 3. Soils and flyash were mixed in different proportions and homogenized by grinding and sieving. Combinations were taken in pots. The details of each combination are given in Table 2.

Table 1: Comparison of mineral content of soil and flyash.

S.No.	Parameters	Original Soil	Flyash
1.	SiO_2 (%)	78.37	60.10
2.	Al_2O_3 (%)	7.38	17.88
3.	Fe_2O_3 (%)	4.62	6.90
4.	TiO_2 (%)	1.05	1.73
5.	P_2O_5 (%)	0.17	0.16
6.	SO_3 (%)	0.22	0.20
7.	CaO (%)	1.14	1.53
8.	MgO (%)	1.23	2.25
9.	Alkalies (%)	0.94	1.31
10.	pH	5.06	8.27
11.	Elect. Condutivity (mmhos/cm)	0.04	0.15
12.	Org. Carbon (%)	0.34	0.31
13.	Cat. Ex. Capacity (%)	7.70	2.90
14.	Total Nitrogen (%)	0.041	0.003
15.	Available N (%)	0.041	0.001
16.	Available P_2O_5 (ppm)	2.00	27.00
17.	Available K_2O (ppm)	52.00	56.00
18.	Available Ca (ppm)	2.06	0.73
19.	Available Zn (ppm)	2.12	1.08
20.	Available Mn (ppm)	42.40	0.40
21.	Available Fe (ppm)	57.10	1.20

Table 2: Details of combination of soil, flyash, hormones and NPK.

S.No.	Symbols used	Combination of soil, flyash, hormones and NPK
1.	A	Plain soil
2.	B	90 % W/W Soil + 10 % W/W Flyash + NPK (500:400:200)
3.	C	80 % W/W Soil + 20 % W/W Flyash + NPK (500:400:200)
4.	D	70 % W/W Soil + 30 % W/W Flyash + NPK (500:400:200)
5.	E	60 % W/W Soil + 40 % W/W Flyash + NPK (500:400:200)

Note: 0.001M solution of IAA and GA sprayed on each pot.

Table 3: Physico-chemical properties of different combinations of soil and flyash.

Sl. No.	Symbols	pH	EC	Oxides and N conc. (%)					Trace elements conc. (ppm)			
				SiO_2	Al_2O_3	P_2O_5	CaO	N	Mn	Fe	Zn	Mo
1	A	6.25	0.082	77.00	15.00	0.15	1.19	0.006	47	40	54	3.5
2	B	6.40	0.085	77.50	15.50	0.18	1.49	0.008	48	42	60	3.9
3	C	6.52	0.090	77.55	16.00	0.20	1.50	0.006	50	42	55	4.5
4	D	6.88	0.120	78.00	17.00	0.22	1.60	0.005	52	45	60	4.6
5	E	6.90	0.129	79.00	17.70	0.24	1.68	0.007	56	47	62	4.7

Separation of oils: The seeds of *Sesamum,* selected for the phytochemical studies, were collected and dried in absence of sunlight. The seed were crushed and refluxed with petroleum ether (60-80°C) in a Soxhlet extractor for 8-10 hours. The extracted oil, thus, obtained was subjected to determination of various physical constants using standard methods. Table 5 reports these physical constants

Table 4: Plant growth parameters of sesame after pot experiment.

Treatments (Symbols)	No. of seeds per siliqua	Leaf length (cm)	Grain yield q/ha	Straw yield q/ha
A	20	5	0.5	6
B	30	7	2	7
C	40	8	3.5	10
D	45	9	5.5	10
E	52	10	6.5	12

Table 5: Physical constants of the common oil obtained from sesamum seeds.

S.No.	Constants	Sesamum oil
1.	Oil percentage by weight	40.4
2.	Colour	light red yellow
3.	Specific gravity (at 25°C)	0.922
4.	Refractive index	1.467
5.	Iodine value	118
6.	Saponification value	186.9
7.	Acid value	1.0-4.0
8.	Thiocyanogen value	75
9.	Percentage of saponifiable matter	1.5-2.5

Table 6: Physical constants of the sesame oil obtained after the treatment.

S.No.	Symbol	Specific gravity (g/cc)	Refractive index	Sap. value	Iodine value
1.	A	0.920	1.421	187	124
2.	B	0.921	1.469	189	124
3.	C	0.919	1.468	192	125
4.	D	0.916	1.470	194	126
5.	E	0.928	1.472	196	130

of the oil obtained from *Sesamum* seeds.

The oil of *Sesamum* differ from the other common oils having a higher refractive index, iodine value and saponification value. Sesame oil is rich in oleic and linoleic acids which together account for 85% of the total fatty acids. The physical constants of oil after pot experiment are given in Table 6.

RESULTS AND DISCUSSION

Plant growth parameters of sesame after the experiment are given in Table 4. Results obtained from the pot experiments show that the *Sesamum indicum* responded positively to flyash amended soils. Mishra & Shukla (1986) and Sarangi et al. (1997) also reported that the nutrients from flyash are beneficial to the plants.

Application of flyash increased the plant growth. The flyash contains Zn, Mn, Mg and Mo, etc., and due to soil and different parts of plant various growth hormones and enzymes get activated, which has been concluded by many other workers (Adams & Lund 1968, Rathore 1995).

The pH value of less than 7 has negative effect on root length and on availability of nutrients to plants. The uptake of Zn increases concentration of nitrogen. Increased uptake of Zn may reflect increase in grain yield due to increase in number of pods per plant. This is also supported by the work of Savithri et al. (1984) and Kapur et al. (1977). Increased grain yield in flyash amended soil has been reported by Sarangi et al. (1997). Increased enzyme activity has been studied by Mishra et al. (1979) and Khamparia (1985). In treatment "E" (40% flyash and 60% soil) IAA and GA may increase uptake of nutrients.

The results suggest that flyash treated soil helps in the plant growth as shown by results of the experiment. On amendment of soil with flyash, pH and electrical conductivity values turn in the favourable direction, which facilitate the uptake of nutrients and trace elements by plants.

The cumulative effect of flyash and hormones in the present work has been observed to increase plant growth parameters like root length, leaf area, chlorophyll content, and oil content of sesame seeds as also reported by Bozkurt & Karacal (2001).

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