Physicochemical Characterization Of Industrial Waste And Its Effect On The Growth of Ladyfinger Plant

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Abstract : The physicochemical characterization of soyawaste (industrial waste), three different soils and irrigation water was carried out. Growth of ladyfinger plants was studied in 0% (control), 2%, 5%, 10% 15%, 20% soyawaste-soil blending. The seeds of ladyfinger were sown in each polythene bag containing above blended soils. The replication of each system was also prepared. Growth of each plant was regularly monitored after every month up to the three months from the date of sowing for all the three types of soyawaste blended soils. The field experiment was performed in rainy, winter and summer seasons. Data obtained showed that 5%-10% soyawaste-soil blending improved the physical properties of the soil and also contributed to the better growth and yield of ladyfinger plant than the control in all the three season. Thus, the present study provides the feasible alternative for the safe disposal of industrial wastes like soyawaste by using them in proper ratio by blending for better plant growth.

Keyword : ***Soyawaste, blended soil, growth parameters, physicochemical characterization***

1. INTRODUCTION

Environment plays a key role in regulating the different life processes of all living beings and it must be suitable for the sustainable development of all living beings. In some respect, the human activities over the past several centuries have made the environment unfavorable or polluted. Increased industrialization and thereby the generation of large amount of industrial wastes is one of the major cause of environmental pollution. The waste generated from various industries is usually discharged on land or into the sources of water. Industrial wastes may vary in composition depending upon its sources of production. The industrial wastes contain various organic and inorganic chemical compounds which causes detrimental effects on the growth of plant and germination process (Wins and Murugam, 2010; Vijayakumari and Kumudha, 1990). In developing countries like India, the disposal of domestic and industrial waste is becoming a problem of great concern which may cause land, water and air pollution. Soil mainly consists of mixtures of organic and inorganic matters and water. The essential micronutrients required for plant growth are C, H, O, N, P, S, K, Ca, Mg, Fe *etc*. N, P and K are usually supplied in the form of manure and fertilizers to the soil. Due to soil contamination by industrial effluent both soil health and crop productivity is affected. These wastes contain some heavy metals, toxic components, various harmful gases, several organic and inorganic compounds (Manunatha, 2008). Heavy metals (Farooqi, 2009) gets accumulated in the living cells which causes the decrease in cell activities, inhibition of growth and various deficiency/diseases in plants. Therefore the utilization of industrial effluents for the irrigation of crop can be proved beneficial to control the pollution load (Medhi et al, 2008).

However, use of industrial waste for irrigation have been practiced throughout the world (Tripathi et al, 2011) which provide farmers with a nutrient enriched water supply and society with reliable and inexpensive wastewater treatment and disposal (Feigin et al, 1991). But this is being done without knowing the effects of contaminants present in the effluents on the quality and growth of different plants.

The present study is a part of systematic work undertaken to study the effect of effluents on the growth of various plants and thereby to control the pollution load by studying the growth of ladyfinger plants in the soil blended with soya waste (an industrial waste).

2. RESEARCH METHODOLOGY

2.1 Collection of industrial waste and irrigation water

The soyawaste, an industrial waste from Rasoya Proteins Pvt. Limited, Wani, Dist. Yavatmal (India) was collected in a clean and dry polythene bottle of 5 liter capacity without leaving any air gap and closed tightly. This bottle was first cleaned with chromic acid and then by distilled water before filling. The sample was then transported to the laboratory for analysis and stored in a cool place away from light (Manivasakam, 2002; Greenberg et al, 1989). The soyawaste was collected and analyzed at the beginning of each season. Similarly, irrigation water sample was taken from the well in each season after dipping bucket in the well to a sufficient depth and withdrawing water from the middle of the well and then taken in clean polythene bottles without leaving any air gap. The samples were then transported to the laboratory for analysis.

2.2 Selection of agricultural crop species and experimental soil

The seeds of ladyfinger of make Ankur were collected from market. Three soil samples were procured from three different fields of Dongargaon village Dist. Yavatmal State- Maharashtra (India). The samples were taken at 25cm depth from the surface and sampling was carried out by quartering method (Chattopadhyay, 1998). The soil samples were then air dried and powdered and stored in clean and dry polythene container. These samples were subjected for the evaluation of pH, EC, Texture, bulk density, WHC, porosity, Ca, Mg, K, Na, P and micronutrients like Cu Zn, Mn, Fe were determined using AAS Chemito AA 203 (Lindsay and Norvell, 1978)

2.3 Experimental details

Preparation Soil-Soyawaste blends:. Three different soils S_1, S_2 and S_3 were dried and powdered and each soil was mixed thoroughly with 0, 20, 50, 100, 200 gms of soyawaste to get 1 kg of soil-soyawaste blends. Thus, 0% (Control), 2%, 5%, 10%, 15% and 20% blending concentrations were prepared. Similarly, one replicate of each system was prepared. All these different blends were then dried and filled in a different polythene bag.

Three seeds of ladyfinger sown in each bag and all the systems were watered equally with same period and the same irrigation water. The height, number of leaves, number of flowers, number of fruits of each plant recorded (Mean values of each parameter of each system and its replicate was recorded) when the plants were fully matured. Finally dry weight of each plant was noted after drying. The experiment was carried out in rainy, winter and summer season.

3. RESULTS AND DISCUSSION

Table 1.1 shows the results of physicochemical analysis of soyawaste and irrigation water in rainy (June), Winter (November) and Summer (April). Soyawaste is a slightly alkaline, dark brown liquid and contains excess of TDS, Ca, Mg, Na, K, Chlorides, sulphates and considerable amounts of macro and micro nutrients. Table 1.2 shows the characterization of three different types of soils S_1, S_2 and S_3.

The field experiment was started in rainy season (June-September), it was found that among all % blending of soil S_1 with soyawaste, the optimum values for plant height (18 inch), leaves (39), flowering (21), number of fruits (16) and dry weight (8.2 g) was recorded at 10% blending. Among S_2-soyawaste blendings, the highest of plant height (19.5 inch), leaves (36), flowering (26), number of fruits (19) and dry weight (8.7 g) was observed at 10% blending. In case of S_3-soyawaste system, optimum values for growth parameters was reported at 5% blending as plant height (19.5 inch), leaves (40), flowering numbers (27), fruits (22) and dry weight (13.2 g). Thus, the investigation showed that, 10% soyawaste-soil blending for S_1 and S_2 and 5% blending for S_3 is reported as optimum level blending and there was a positive influence on the plant growth which might be due to the plants may absorb optimum level of plant nutrients at this blending. In winter, the growth parameters plant height (15 inch), number of leaves (30), flowering (22), number of fruits (15) and dry weight (8.8g) in S_1 at 10% blending. For $S_{2,}$ the maximum values of plant height (16 inch), number of leaves (33), flowering (20), number of fruits (13) and dry weight (8.7g) were recorded at 5% blending. In case of S_3 also, the highest growth parameters i.e. plant height (18 inch), number of leaves (33), flowering (21), number of fruits (12) and dry weight (9.0 g) was observed at 5% blending. Thus, 10% blending for S_1 and 5% blending for S_2 and S_3 emerged as optimum level blending in winter. In summer, for S_{1-} soyawaste blending, optimum values of plant height (22 inch), leaves (40), flowering (22), number of fruits (13) and dry weight (12.3g) were observed at 10% blending. Whereas in $S_{2,}$ the highest of plant height (21 inch), number of leaves (35), flowering (19), fruits (11) and dry weight (10.3 g) were observed at 5% blending. Similarly, in case of $S_{3,}$ at 5% blending, the optimum values of plant height (19 inch), leaves (40), flowering (25), fruits number (15) and dry weight (8.9 g) were recorded. Thus, 10% blending for S_1 and 5% blending for S_2 and S_3 were found to be optimum level blending in summer. It is also found that, further increase or decrease in the blending concentration causes reduction in the growth parameters of the ladyfinger plant which may be attributed to the improved soil structure and enhanced nutrient availability. It is observed that, the plant growth is increased from control to the optimum blending and then decreases. This might be due to the fact that, beyond these blending concentrations, the toxicity level of the waste or effluent increased which resulted in decreased plant growth and at these blending concentrations, the role of growth regulators and the balance between promoters and inhibiters, which shift due to the trace element composition of soyawaste.

This finding is corroborative with the work of Nennah & Kebbia (1983) in which they reported increased yield of sugarcane to about 20% by the irrigation of effluent from an integrated pulp paper mill. Sajid Ali and Masood Alam (2015) also reported that, the mixed effluent collected from Okhla industrial area phase-II has an adverse effect on seed germination and plant growth of Abelmoschus esculentus at higher effluent concentration but low concentration of effluent is less toxic and found suitable for seed germination and growth. Thakare et al (2013), reported similar results in soya bean (Glycine Max) by using soyawaste blended soil and found maximum growth and yield at 10% blending concentration. Kharub (2012) studied the effect of sewage sludge application on the growth of Abelmoschus esculentus and found that, the sewage sludge containing lots of essential nutrients and organic matter has positive effects on the growth of ladyfinger plants thus recommended (30+50)% doses of soil/sewage for the best and fast growth of plant. Some negative effects were also reported but these may be due to excessive concentrations of industrial waste which may lead to nutrient toxicity and other soil disorder (Siddharth Singh 2011).

From the commercial point of view, the overall maximum number of fruits was found at 5-10% blending for all the three types of soils in rainy, winter and summer season. Graphs 1, 2 and 3 show the variations of number of fruits with different % blending for S_1, S_2, S_3 in rainy, winter and summer season.

3. CONCLUSION

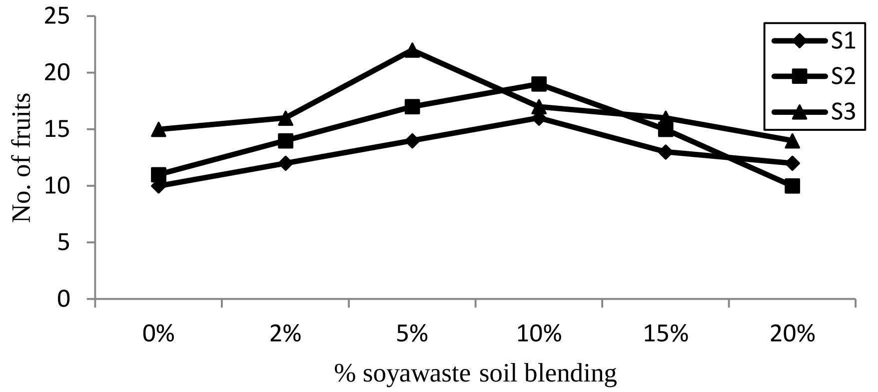
From the current work, it can be concluded that, 5% to 10% soil-soyawaste blending is beneficial for the growth and yield of ladyfinger plant in the soils of composition S_1, S_2 and S_3. That means soyawaste acts as an excellent source of essential nutrients for appreciably improving the texture and fertility of soil with significant increase in crop yield over the control at a particular blending and is supportive to the plant growth. Thus utilization of industrial wastes like soyawaste in agriculture may provide an alternative for its safe disposal without serious deleterious effects and may save the cost of fertilizers of farmers if used in a proper ratio by blending.

Table 1.1: Physico-chemical characteristics of soyawaste and irrigation water (I.W.) in three seasons

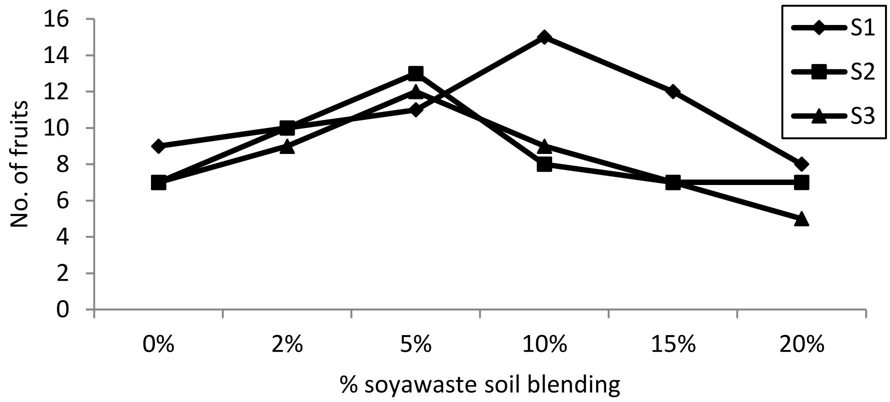
Sr. No.	Parameters	Soyawaste June'10	Soyawaste Nov'10	Soyawaste April'11	I.W. June'10	I.W. Nov.'10	I.W. April'11
1	TDS (ppm)	897	896	895	906	892	882
2	pH	7.34	730	6.90	7.44	7.33	7.10
3	E. C. (mS/cm)	3.38	3.40	3.45	3.18	3.23	3.27
4	Calcium (meq/L)	5.1	4.7	4.6	4.9	4.8	4.6
5	Magnesium (meq/L)	1.8	1.5	1.5	2.4	2.2	2.0
6	Sodium (meq/L)	0.73	0.70	0.70	0.78	0.77	0.65
7	Potassium (meq/L)	0.42	0.43	0.42	0.41	0.43	0.45
8	Bicarbonates (meq/L)	2.0	1.8	2.2	2.3	2.5	2.2
9	Chlorides (meq/L)	1.9	2.0	2.1	2.3	2.3	2.5
10	Sulphates (meq/L)	1.49	1.52	1.55	1.52	1.54	1.56

Table 1.2: Physico-chemical analysis of three different soils

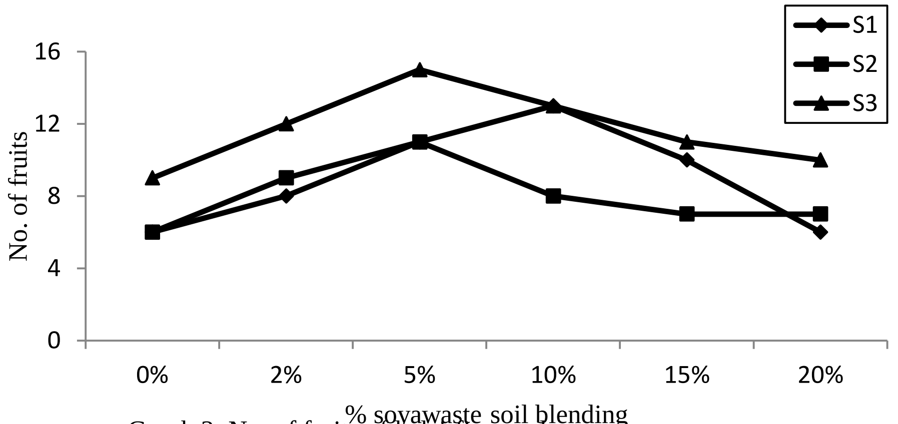
Sr. No.	Parameters	S_1	S_2	S_3
1	Bulk density (g/cc)	1.49	1.61	1.78
2	W.H.C. (%)	75.83	75.83	58.42
3	pH	7.63	7.70	7.65
4	Conductivity (mS/cm)	0.51	0.53	0.50
5	Available P (kg/ha)	16	18	20
6	Available K (kg/ha)	552	625	298
7	Na (%)	0.52	1.78	0.63
8	Organic C (%)	0.39	0.34	0.49
9	Ca (%)	36.0	27.0	29.2
10	Mg (%)	3.7	9.2	3.7
11.	Porosity (%)	60.05	54.52	35.63
12.	Moisture (%)	8.99	7.16	10.02
13.	Zn (ppm)	0.25	0.48	0.47
14.	Cu (ppm)	1.16	2.84	1.41
15.	Fe (ppm)	0.29	0.56	0.64
16.	Mn (ppm)	2.04	5.21	1.62



Graph 1: No. of fruits of lady'sfinger plant in rainy season



Graph 2: No. of fruits of lady'sfinger- Winter season



Graph 3: No. of fruits of lady'sfinger plant-summer season

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