Chem Sci Trans., 2013, **2(3),** 853-858
DOI:10.7598/cst2013.456

Chemical Science Transactions
ISSN/E-ISSN: 2278-3458/2278-3318

RESEARCH ARTICLE

Growth of Soybean Plant (*Glycine Max*) in Soya Waste Blended Soil

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Received 29 November 2012 / Accepted 18 December 2012

Abstract: Physicochemical characterization of soya waste an effluent of soybean oil industry and three different soils was carried out. The growth of soybean plant was studied in 0, 2, 5, 10, 15, 20 and 30% *etc*. blended soil with soya waste. Growth of plants was monitored regularly after every month up to three months from the date of plantation for all the three soils in rainy, winter and summer seasons of the year 2009-10. From the commercial view point, overall maximum number of fruits was found in rainy season for 10-30% blending, in winter for 5-10% blending and in summer for 10% blending. The results of the present work shows the possibility of use of effluents by blending with soil for better plant growth.

Keywords: Blended soil, Industrial effluent, Plant growth, Soybean

Introduction

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.

Rapid industrialization, population explosion and more urbanization in India have created enormous problems of environmental pollution in terms of generating the variable quality and quantity of solid and liquid waste. In developing countries, there has not been much emphasis on the installation of sewage treatment plants and all the industrial effluents are generally discharged into the sewage system.

Intensive contamination of soil by sewage and industrial effluents has affected adversely both soil health and crop productivity. Sewage and industrial effluents are rich sources both beneficial as well as harmful elements. Since some of these effluents are rich sources of plant nutrients therefore soil provides the logical sink for these disposals. But many untreated and contaminated sewage and industrial effluents may have high concentration of several heavy metals[1,2] such as Cd, Ni, Pb and Cr.

It has been found by many workers that continuous disposal of industrial effluents on agricultural soils has resulted in soil sickness and also accumulation of some of the toxic metals in soil has been reported[3-7] which may pose serious human and animal health. In Punjab, groundwater has been contaminated by Hg and Pb to such an extent that it is causing mutation of DNA of the people, who drink it[8]. Soil ecosystem has been contaminated throughout the world by various anthropogenic activities resulting in health hazards through food chain[9-11]. Industrial wastes are major sources of pollution, therefore, on-site treatment is necessary before discharge into sewage system[12].

However, these effluents[18] are purposely used for irrigation due to scarcity of water especially for vegetables and fruits. Effluent for irrigation has been practiced for centuries throughout the world[14,15]. It provides farmers with a nutrient enriched water supply and society with a reliable and inexpensive system for wastewater treatment and disposal[16]. This is being done without knowing the effects of contaminants present in effluents on the growth and quality of different plants. Very little work is reported in the literature on the effect of soya waste on the growth of soybean. The present paper 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 soya bean plants in the soil blended with soya waste.

Experimental

Soya waste, an effluent from Rasoya Proteins Pvt. Limited, Wani Dist- Yavatmal (India) was collected in a clean container. The standard methods[17] were used to measure pH, electrical conductivity, Ca, Mg, Na, K, chlorides, sulphates, bicarbonates present in the water sample and soya waste. Seeds of soybean were collected from Market. Soil samples collected at 25 cm depth were air dried and powdered. Three different types of soil S_1, S_2 and S_3 were blended with soya waste in wt% 0, 2, 5, 10, 15, 20% *etc.* and were kept in clean polythene bags. All plants were watered equally with same period and same water. All chemicals used were of GR/AR Grade.

The height, number of leaves and number of fruits of each plant were recorded after every month for three months. The observations were taken in rainy, winter and summer seasons.

Results and Discussion

Table 1 shows the results of physicochemical parameters of soya waste and water. The physicochemical characteristics of the soils S_1, S_2 and S_3 are shown in Table 2. Observations of growth of soybean plant with respect to plant height, number of leaves, flowers and fruits for three soils were recorded.

The experiment was started in rainy season and the optimum value for plant height was observed by blending for S_1 at 15 % (22 inches) while for soil S_2, the optimum height was at 20% (22 inches) and for soil S_3 it was at 15% (20 inches). This may be due to high WHC and porosity of S_1 and S_2. The optimum values of plant leaves for S_1 were found at 15% (67 leaves), for S_2 at 20% (68) where as for S_3, the leaves were maximum at 15% blending (73 leaves). This variation might be due to high phosphorous content in S_3 which aids in root development, flower initiation and seed and fruits development .The maximum flowering was observed at 15% (49) for S_1 while for S_2 at 20% (42) and for S_3 it was observed at 15%(43). Figure (1) shows number of fruits for S_1, S2 and S_3 at various concentrations. The maximum fruits for S_1 were found at 10% (32) whereas for S_2 and S_3, the fruits were maximum at 20 % (28) and 30% (31) respectively. Therefore, 15% and 10% for S_1, 20% for S_2 and 15% and 30% blending concentration for S_3 emerged as optimum level concentration for soybean plant. This might be due to the soya waste effluent being rich source sodium (0.94 meq/L), potassium (0.47 meq/L) and sulphates (3.21 meq/L) and other plant nutrients. The use of soya waste at these concentration resulted in reduced toxicity and better utilization of plant nutrients like Na, Cl, N, P & K. Similar results were obtained by Sahai[18] *et al.*, in rice crop wherein they noticed that at 5% effluent concentration, the overall growth was better than in control whereas at higher concentration the growth was retarded.

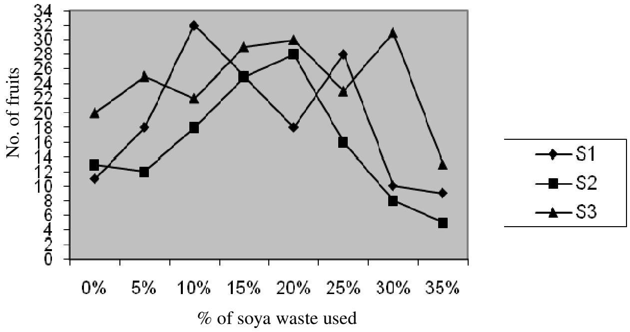

Figure 1. No. of fruits in Sep-2009

Table 1. Physicochemical characteristics of soya waste and water

S No.	Parameters	Soya waste	Water
1	pH	7.66	7.18
2	Conductivity	1.345 mS/cm	3.41 mS/cm
3	Calcium	3.9 meq/L	4.8 meq/L
4	Magnesium	1.8 meq/L	1.6 meq/L
5	Sodium	0.94 meq/L	0.71 meq/L
6	Potassium	0.47 meq/L	0.41 meq/L
7	Bicarbonates	1.6 meq/L	2.0 meq/L
8	Chlorides	1.6 meq/L	2.0 meq/L

Table 2. Physicochemical characteristics of soils

S. 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	P as phosphate, kg/hectre	16	18	20
6	Na%	0.52	1.78	0.63
7	K, kg/hectre	552	625	289
8	Organic C %	0.39	0.34	0.49
9	Ca %	36	27	29.25
10	Mg %	3.68	9.20	3.68
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

In winter, the optimum height for S_1 was at 20 % (23 inches), for S_2 it was at 20% (15 inch) and for S_3 it was at 15% (16.5 inches). The maximum leaves were found for S_1 at 15% (75), for S_2 at 20% (69) and for S_3 at 15% (77). The flowering was maximum at 20% (36) for S_1, for S_2 it was also at 20% (38) and for S_3 at 10% (42). Figure 2 shows the number of fruits for soils S_1, S_2 and S_3 at different concentrations. For S_1 the maximum fruits were observed at 20 % (24), for S_2 also the optimum value was at 20 % (27) and for S_3 it was at 10 % (28). Thus, in winter, 15% and 20% for soil S_1, 10% and 20% for S_2 and for S_3, 10% and 15% blending concentration are the optimum level concentration for soybean plant. The fairly good results for S_3 may be attributed to the better % of organic C, P and Fe in S_3. However, higher or lower concentrations of the effluent than these in respective soils decreased the growth parameters of soybean plant. These findings are in accordance with the observations recorded by Somashekar[19] *et al.*, in jowar, bajra and rice.

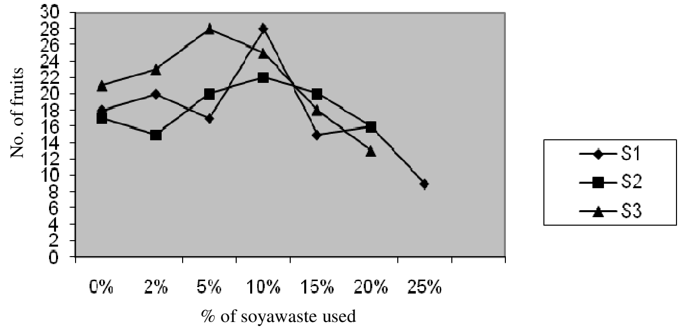

Figure 2. No. of fruits in March-2010

The optimum value for plant height in summer was found at 10% (19 inches) for S_1 and the optimum height for S_2 was also at 10% (19.5 inches). But for S_3, the maximum height was at 15 % (20 inches). The observations showed maximum leaves for S_1 at 5% (82), for S_2 at 15% (70) and for S_3 at 10% (81) blending concentration. The flowering for all the three soil samples S_1, S_2 and S_3 was found maximum at 10% blending concentration with 47, 34 and 35 flowerings respectively. This shows that, the nutrients present in 10% soya waste-soil blending concentration and weathering conditions were supportive to the flowering growth of plants. The number of fruits for S_1, S_2 and S_3 were as shown in Figure 3. 10% blending concentration for all the three soil samples S_1, S_2 and S_3 showed maximum fruits as 28, 22 and 20 respectively. Thus, in summer, 5% and 10% for S_1, 10% and 15% blending concentrations for S_2 and S_3 are the optimum level concentrations. The promotional influence on plant growth by these concentrations of effluents might be due to optimum level plant nutrients in the effluent.

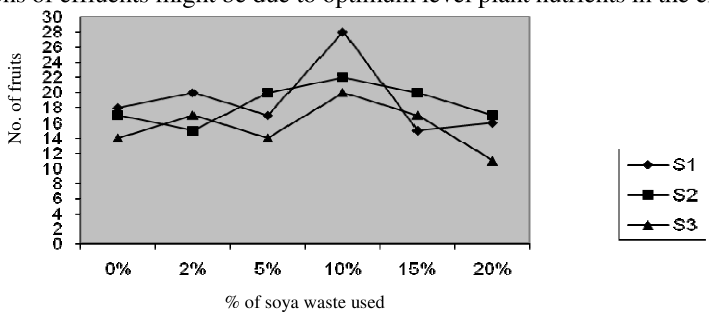

Figure 3. No. of fruits in July-2010

From the commercial view point overall maximum number of fruits was found in rainy season for 10-30% blending, in winter season for 5-10% blending and in summer for 10% blending. This indicates that, the ingredients present in the blends of soya waste and soil at particular concentration are supportive to the growth of plant.

Johnson[20] *et al.*, reported that plant growth on metallic ferrous mine soil is restricted by high concentration of toxic metals and by the low level of micro nutrients in the substrates. Results of field trials on calcareous and acidic soil showed that inert amendments may be more suitable for revegetation and for recreational purposes. Diluted spent wash increase the height, growth and yield of leaves vegetables[21] due to increase in nutrient uptake, nutrient of top vegetable[22], pulses, condiment and root vegetables also increased due to SP treatment.

Warhate[23] *et al.*, studied the impact of continuous mining on water and soil of Wani region. The study indicated the adverse influence of mining activities on soil quality. Shrivastava[24] *et al.*, studied the effect of effluent of paper mill industries on seed germination and early growth performance of Radish and Onion. He found that germination and early growth were decreased by chloro-alkali paper effluent. Islam[25] *et al.*, studied the impact of effluents on plant growth and soil properties and observed that the contaminated soil exerted significant negative effect on the growth, yield and nutrition of rice and grass plant grown in it and the reduction were more pronounced in rice. These negative effects may be ascribed to the excessive concentration of effluents.

Conclusion

From the results, 10-25% effluent-soil blending concentration showed positive results it means that ingredients present in soya waste are essential nutrients at particular concentration only and are supportive to the plant growth. Thus, utilization of soya waste in agriculture may save costs on fertilizer and facilitate the reduction in pollution load if used in proper ratio by blending.

Acknowledgement

One of the authors, P. B. Thakare is grateful to The Principal and the management of Arts, Commerce and Science College, Arvi, Tq. Arvi Dist., Wardha, M.S., India. Thanks are also due to The Principal and Head of Chemistry Department, Bapurao Deshmukh College of Engineering, Sevagram, Dist., Wardha, M.S., India, for providing all the laboratory facilities.

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