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Management of barren land soil using waste algal residue and agricultural residue

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Abstract

The research reported here provides an information of significant effects of algal residue left after extraction of algal oil and agricultural wheat residue in its biofortified form as compost on physico-chemical properties of barren land soil including crop growth. About 400 million tones of crop residue are produced in India alone. In areas where mechanical harvesting is practiced, a large quantity of crop residue are left in crop fields, which can be recycled for nutrients supply. To avoid the problem of disposal of crop residue the farmers resort to burning of crop residues which not only leads to loss of huge biomass but also cause environmental pollution additionally cause killing of beneficial soil insects and microorganisms. The recycling of organic residue has advantage of converting surplus farm wastes into useful products for meeting nutrient requirements of crops. In addition to being a source of plant nutrients, organic residues improves the physico-chemical and biological properties. So the endeavour was to benefit the agricultural sector by using and recycling the waste organic residues with the added benefit to controlling the pollution level too.

Keywords*:* Algal residue, Algal oil, Agricultural residue, Biofortified, Compost, Environmental Pollution Recycling, Farm Wastes.

Introduction:

Organic farming is the form of agriculture that relies on crop rotation, green manure, compost, biological pest control and mechanical cultivation to maintain soil productivity and control pests, excluding the use of synthetic fertilizers. Present study was therefore, planned with the objective of reclaiming the barren land soil using the waste algal residue left after extraction of algal oil and waste agricultural residue as compost.

The agricultural residue are good sources of plant nutrients and are important competent for stability of agricultural ecosystem. About 400 million tones of crop residue is produced in India alone. In areas where mechanical harvesting is practiced , a large quantity of crop residue are left in the crop fields which can be recycled for nutrients supply. To avoid the problem of disposal the farmers resort to burning of crop residues which not only leads to loss of huge biomass but also cause environmental pollution additionally cause killing of beneficial soil insects and microorganisms.

However, unlike removal or burning, incorporation of organic residue builds up soil organic matter, soil N and increase the total and available P and K contents of soil. the recycling of organic residues has the advantage of converting the surplus farm wastes into useful products for meeting the nutrients requirements of crops.

Composting is the natural biological process carried out under controlled aerobic conditions. Organic matter is metabolized by microorganisms and consumed by invertebrates. The resulting nutrients are retained to the soil to support plant growth.

In addition to being a source of plant nutrient, organic residues improves the physico-chemical and biological properties of soil related to their bulk and particle density, particle size distribution and water holding capacity, buffering action, quantity and quality of nutrients and favourable pH value. Amongst other improvements, the soil becomes more resistant to stresses such as draught, diseases and toxicity with overall improvements in uptake

of plant nutrients. The soil processes and active nutrient cycling capacity increases because of vigorous microbial activity. So the endeavor is to benefit the agricultural sector by using and recycling the waste organic residues with the added benefit of controlling the pollution level too.

Materials and methods

The barren land soil was collected from the road side area where no vegetation was found. The pretreatment soil analysis was done for different physico-chemical properties such as the soil pH by pH meter, organic carbon by Walkley Black's rapid titration method, C:N ratio by Kjeldahl's method, moisture content, water holding capacity.

For the post treatments soil analysis same physico-chemical properties were estimat**ed.**

Treatments: three treatments were given to the barren land soil.

(1) Treatment of barren land soil with algal residue- The soil and the algal residue were mixed in ratio of 4:1.

(2) Treatment with agricultural residue- A pit of 10 cm^2 , 15cm depth was dug in ground and was filled with multiple layers of wheat residue, cow dung and barren land soil. 3-5 liter water was poured on the pit and covered with the plastic seat completely for 3 months and then used for observations of different plant growth.

(3) In combined treatment, a mixture of algal residue and barren land soil was prepared in 1:4 ratio and it was mixed with the compost in ration of 1:1.

Now 3 pots of approximately 300 gm capacity were taken for each treatment and eight seeds of *Glycine max, Cicer arienticum* and *Capsicum annum* were sown separately.

Results

The barren land soil was treated with different organic residues and following observations were made by comparing

g certain physico-chemical properties of untreated soil (control) with treated soil (Table 1) and by observing different growth parameters in certain seeds (Table 2).

Table 1: Changes in physicochemical properties of barren land soil

Physicochemical properties	Control	Algal residue treated	Agricultural compost	Combined
Soil pH	6.1	7.1	6.8	7.0
Percentage Moisture content	1.94	4.24	9.63	10.94
Water holding capacity	40.19	63.17	70.68	82.68
Organic carbon	-0.28	1.60	2.20	1.28
C:N ratio	11:1	17:1	20:1	18:1

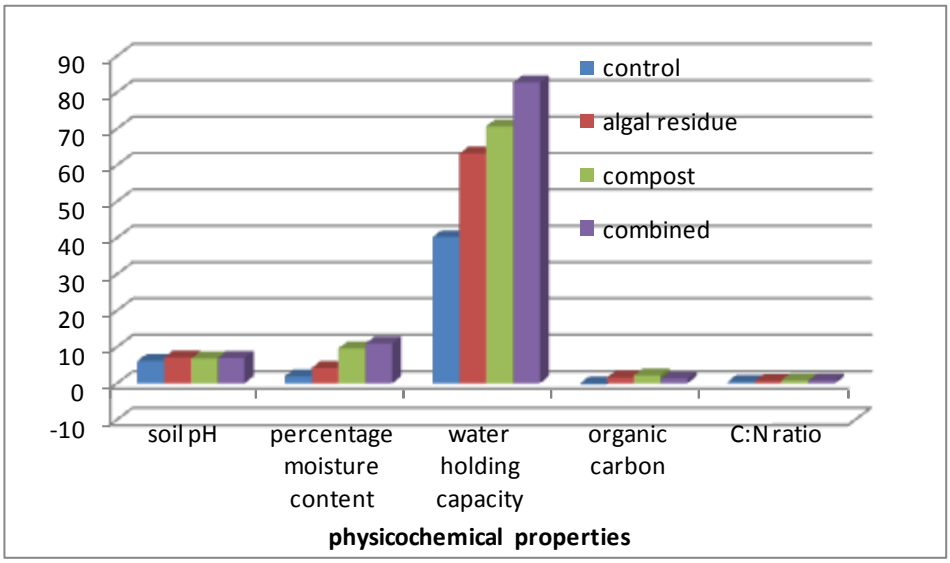

Fig 1.Graphic analysis of physicochemical properties

Table 2: Observations for growth parameters in selected seeds

Parameters	Plants / Treatments	Soybean	Gram	Chilli
1.Percentage Seed germination	Control	-	12.5	-
	Algal residue	75.0	37.5	62.5
	Compost	75.0	75.0	50.0
	Combined	87.5	100.0	75.0
2. Shoot height (cm) (After 15 days)	Control	-	-	-
	Algal residue	8.7	16.0	7.5
	Compost	10.2	18.2	5.0
	Combined	14.0	18.0	7.8
3. Root length (cm) (After 15 days)	Control	-	-	-
	Algal residue	5.0	3.0	2.0
	Compost	7.0	5.3	3.0
	Combined	6.2	8.3	4.2
4. Number of leaves	Control	-	-	-
	Algal residue	6	11	2
	Compost	8	13	3
	Combined	12	14	3

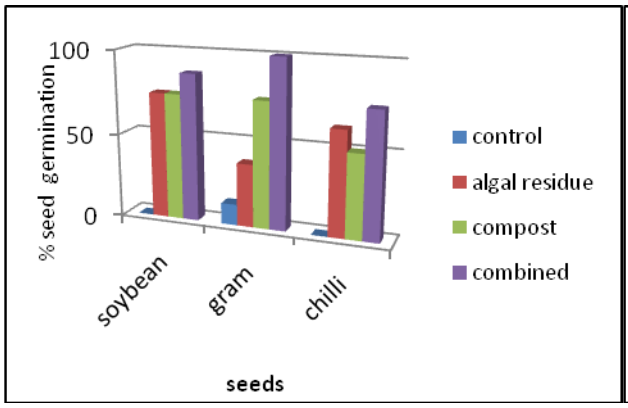

Fig.2.Graphic analysis for percentage seed germination

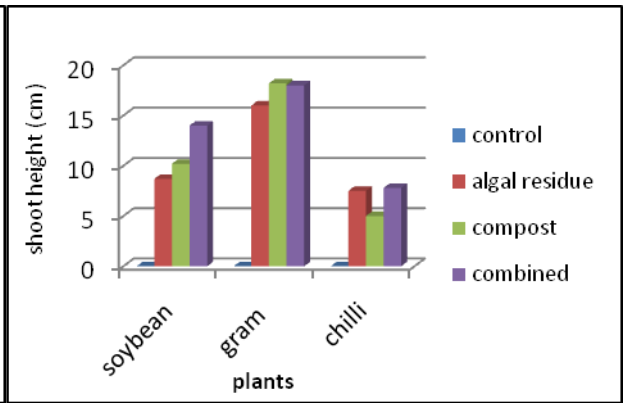

Fig.3. Graphic analysis for shoot height

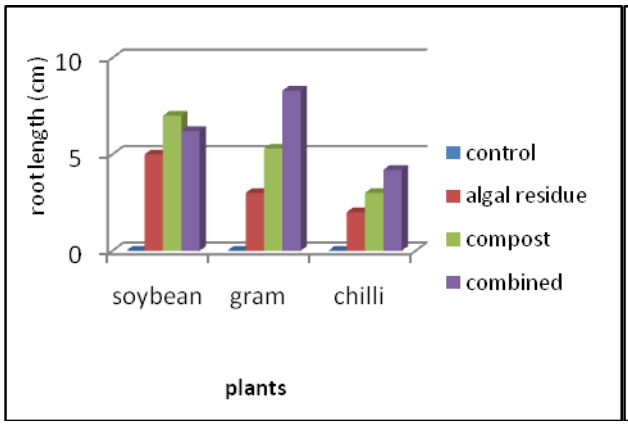

Fig.4. Graphic analysis for root length

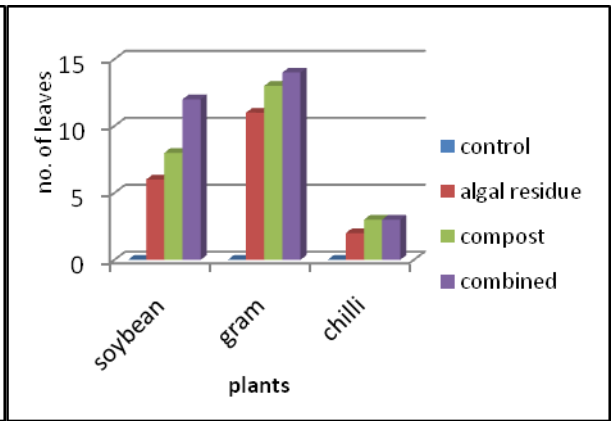

Fig.5.Graphic analysis for number of leaves

Discussion

The different physicochemical properties such as soil pH, percentage moisture content, water holding capacity, organic carbon, C:N ratio were estimated(Table1). The soil pH which was near acidic in control was shifted towards the neutrality in all the treated samples . A study done by M. Saber *et al.*, (2010) also revealed that initial neutral pH values of different composted residue were slightly shifted towards acidity before settling around neutrality. the soil moisture content was found to be increased from 1.94% in control to 4.24%, 9.63% and 10.94% in algal residue treated, agricultural compost and combined treatment respectively. The incorporation of organic residue also leads to reduction of evaporation of the soil water (Mandal *et al.*, 2004). The water holding capacity in the untreated soil was very low in comparison to the treated samples as in algal residue treated soil 63.17%, agricultural compost 70.69%, combined treatment 82.68%. the central role of soil organic carbon in maintaining soil function and plant productivity in agro-ecosystem has long been recognized. The organic carbon in untreated soil was found to be a negative value -0.28%. Marten (2000) also reported a negative value of organic carbon and nitrogen in the soil not treated with the plant residues. The organic carbon content of the soil can be increased by incorporation of the organic residues. In present work, the algal residue and agricultural compost have proved to increase the organic carbon upto 1.6-2.2% from the initial extensively low value in control. The 2 elements in organic matter which are extensively important, especially in their relation or proportion to each other are C and N. This relation is called C:N ratio. The C:N ratio in organic matter means the amount of carbon relative to amount of nitrogen present. The C:N ration in control was estimated as 11:1 and the ratio was shifted to a better range in treated soil viz. 17:1, 20:1, 18:1 in algal residue treated, agricultural com[post and combined treatment respectively.

The growth efficiency parameters viz: percentage seed germination, shoot height, root length and number of leaves were also observed (Table 2). The results in the combined treatment of organic residue were extremely good in comparison to other and in untreated soil it was least. In

case of control only one gram seed was germinated and it was died due to the lack of nutrients required.

From the studies done, we can observe that in case of algal treatment the soil fertility increased due to an increase in soil pore with having the filamentous structure, there was increased biomass after their death and decomposition. The salinity of soil would be reduced (Wilson, 2006). The increased water holding capacity can be through the jelly structure of alga (Roger and Reynaun, 1982).

Prakash *et al.*, (2007) has evaluated that towards this end of agriculture solid waste compost could serve as a valuable organic matter source give the shortage of organic nutrient source. According to Iyenger and Bhave (2005), the key feature of composting is the generation of heat by biological activities during decomposition of the substrate materials. The composting temperature kills the pathogen and weed seeds. Because of these positive effects the organic residue of algal and agricultural can prove to be extremely valuable towards the agricultural sector for a good quality and quantity of the crop.

Conclusions

The present study with respect to reclaiming the barren land soil by using the waste algal residue left after extraction of algal oil and agricultural wheat residue in biofortified form showed consistently significant results. The pH of soil was shifted from near acidic to neutrality besides that the moisture content, water holding capacity, organic carbon and C:N ratio was also increased on adding the organic residues as compare to the control which is a good indicator for crop productivity. The organic carbon in the barren land soil was estimated by Kjeldahl's and Walkley Black's method and found as -0.28 % to 0.1% whereas in treated soil the organic carbon was shifted to 1.28-2.2%. the C:N ratio was also unfavourable in barren land soil (11:1) and after the treatment it increased towards 17:1 to 20:1. The growth efficiency parameters such as percentage seed germination, shoot height, root length and number of leaves were also found to be favourable for growth of different plants. The results for different seed germination and crop production in control were negative due to the deficiency of required moisture content, water holding capacity, organic carbon, C:N ratio. By the study it is clear that the incorporation of waste organic residues in barren land soil can convert it into a fertile soil as these treatments were able to increase the range of all the required nutrients and were also successful to fulfill the physical, chemical and biological requirements needed in a healthy soil.

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