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Effect of algae on seedling growth of "Queen of Forages

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Abstract- Algae make a major contribution to the fertility of soil. It has been suggested that algae assist higher plant growth by supplying growth substances. In the present work, Oscillatoria sp. and Spirogyra sp. were used as inoculum in plate culture and pot culture of *Medicago sativa* L. The result revealed that addition of all algal extracts can enhance seed germination, seedling growth, length of radical, number of leaves and plant height. In plate culture, Weed extract of Spirogyra sp. promoted the germination and seedling growth of treated seed. The field studies also revealed substantial increase in % of germination, No. of leaves and Plant height of alfalfa under the effect of weed extract. Statistical analysis showed that there are significant differences in % germination, length of radical, plant height, root length and number of leaves as compared to control.

Keywords: Spirogyra sp.; Oscillatoria sp.; *Medicago sativa* L.; seed germination; % germination; Plant height; Length of radical;

1 INTRODUCTION

Alfalfa (*Medicago sativa* L.) is a widely grown perennial herbaceous legume. Valued as a forage crop due to its high feeding value and wide adaptability, alfalfa is an important rotational crop, providing soil structure, nitrogen contribution, and pest management benefits. Alfalfa is highly valued for animal feed because of its high protein content, high intake potential, and digestibility. Alfalfa can provide the sole plant component in many livestock feeding programs when supplemented with the proper minerals. The majority of alfalfa is grown in mixture with perennial forage grasses to extend the usefulness of the crop and reduce alfalfa induced bloating in animals. Alfalfa will tolerate rotational grazing, but stands may be weakened under heavier grazing pressure. Alfalfa may be grown in pure stands for quality livestock feed high in crude protein, for on-farm storage as dried hay or haylage or for dehydration processing into meal or pellets.

Alfalfa is an important rotational crop. Alfalfa improves soil structure due to the effects of a large deeply penetrating taproot that contributes to soil aeration and organic matter content. Established alfalfa when plowed down, contributes significantly to the nitrogen requirement of following crops in the rotation. A thick forage stand containing at least 50% legume such as alfalfa, will contribute 100 kg/ha nitrogen to the nitrogen requirement of the following crop. Alfalfa also serves as an important break crop for pests specific to other crops, especially cereal and corn crops. Alfalfa, along with other cultivated crops such as clover and canola, is a source of pollen for foraging honey bees. From agro-biological point of view, alfalfa gathers a number of particularities: resistance to drought and low temperatures, good revaluation of irrigation water, high capacity for regeneration after mowing, high rate of competitiveness.(4)Algae are a very large and diverse group of eukaryotic organisms, ranging from unicellular genera such as chlorella and the diatoms to multi-cellular forms such as the giant kelp, a large brown alga that may grow up to 50 meters in length. It has been estimated that there are about 9,000 species of macroalgae broadly classified into three main groups based on their pigmentation (for example, Phaeophyta, Rhodophyta, and Chlorophyta, or the brown red and green algae, respectively). Some Species are used as biofertilizers in agriculture. (13)

The benefits of Algae as sources of organic matter and fertilizer nutrients have led to their use as soil conditioners for centuries. About 15 million metric tones of algal products are produced annually, a considerable portion of which is used for nutrient supplements and as bio-stimulants or biofertilizers to increase plant growth and yield.(5) Numerous studies have revealed a wide range of beneficial

effects of algal extract applications on plants, such as early seed germination and establishment, improved crop performance and yield, elevated resistance to biotic and abiotic stress, and enhanced postharvest shelf-life of perishable products.(6)(7)

2 METHODOLOGY

2.1 Algal Biomass and growth Condition

The algae obtained from natural lake. According to its morphology and microscopic observations it is identified as Spirogyra species and Oscillatoria species belonging to green algae and brown green. Figure 5 and 6 shows the microscopic image of both algal sp.

2.2 Growth medium:-

Bold's basal growth medium and BG 11 medium used for Spirogyra species and Oscillatoria species. Both species was grown in several 1-l glass jars containing medium (modified Bold basal medium AND BG 11 medium) in order to obtain stock algal culture to be used during the experiments.(8)(9)

2.3 Algae Extract

The cultures were harvested and the cells washed with distilled water. Cell extracts were made by grinding the algae in distilled water with a pestle and blender. An algal suspension containing 5.0 g fresh algal material in 500 ml of distilled water is referred to as a 1% extract.

2.4 Germination of seeds by plate method

Air-dried seeds of lucerne were soaked in water extracts of both algae sample for 24h. Seeds, without algal extract, served as control. Percentage of germination was estimated by spreading 10 seeds on filter papers placed in glass Petri-dishes containing 5.0 ml of a cell extract. Petri dishes containing seeds with 5.0 ml of distilled water served as a control. The Petri-dishes were placed at natural illumination at 25 °C.(5)(12)

2.5 Pot Method

Ten healthy seeds of alfalfa plant were then grown in 1 liter pots for 60 days. No fertilizer was applied, but soil of treated seedlings was sprayed with 200 ml of algal extract every seven day, respectively. From respective pots after every 10 days interval, Count the number of germinated seed, No. of leaves & Plant heights.

2.6 Statistical analysis

Statistical analysis was performed with one way ANOVA, using software KyPlot Version 2.0 beta 13(©1997-2000 Koichi Yoshioka). Means were separated using the Least Significant Difference (LSD) test at $P<0.05$.(10)(5)

3. Tables and Figures

Table 1 The Effect of Algae Extract on *Medicago sativa* in Plate culture

	CONTROL	SAMPLE 1	SAMPLE 2
% GERMINATION	0.88 ± .02	0.84 ± .04	0.86 ± .04
LENGTH OF RADICLE	20.09 ± 6.17	25.64 ±7.39	32.11±10.996

* Significant at the 0.05 level

Table 2 The Effect of Algae Extract on *Medicago sativa* in Pot Culture

POT METHOD	CONTROL	SAMPLE 1	SAMPLE 2
%GERMINATION	0.58 ± 0.08	0.48 ± 0.03	0.54 ± 0.09
NO. OF LEAVES	23.76 ± 6.92	27.54 ± 7.64	19.25 ± 5.94
PLANT HEIGHT	21.34 ± 6.62	19.38 ± 5.71	15.47 ± 5.01

* Significant at the 0.05 level Sample 1 = Oscillatoria sp. Sample 2 = Spirogyra sp.

Table 3 ANOVA of % Germination in Plate Culture & Length of radical of germinated seed

		SS	*DF*	*Ms*	*F(CAL)*
% GERMINATION IN PLATE METHOD	BETWEEN GROUPS	0.004	2	0.002	0.33
	WITHIN GROUPS	0.072	12	0.006	
	TOTAL	0.076	14		
LENGTH OF RADICLE OF GERMINATED SEED	BETWEEN GROUPS	361.9812	2	180.991	0.51
	WITHIN GROUPS	4217.032	12	355.933	
	TOTALS	4633.013	14		

*

*Significant at the 0.05 level

Table 4 ANOVA of % Germination in Pot Culture, Leaf Number & Plant Heights

		SS	*DF*	*MS*	*F(CAL)*
%GERMINATION IN POT METHOD	BETWEEN GROUPS	0.0211	2	0.011	0.3992
	WITHIN GROUPS	0.397	15	0.025	
	TOTAL	0.42	17		
NO.OF LEAVES	BETWEEN GROUPS	206.93	2	103.46	0.3657
	WITHIN GROUPS	4243.12	15	282.88	
	TOTALS	4450.06	17		
PLANT HEIGHT	BETWEEN GROUPS	107.21	2	53.61	0.264
	WITHIN GROUPS	3050.10	15	203.33	
	TOTAL	3157.33	17		

* Significant at the 0.05 level

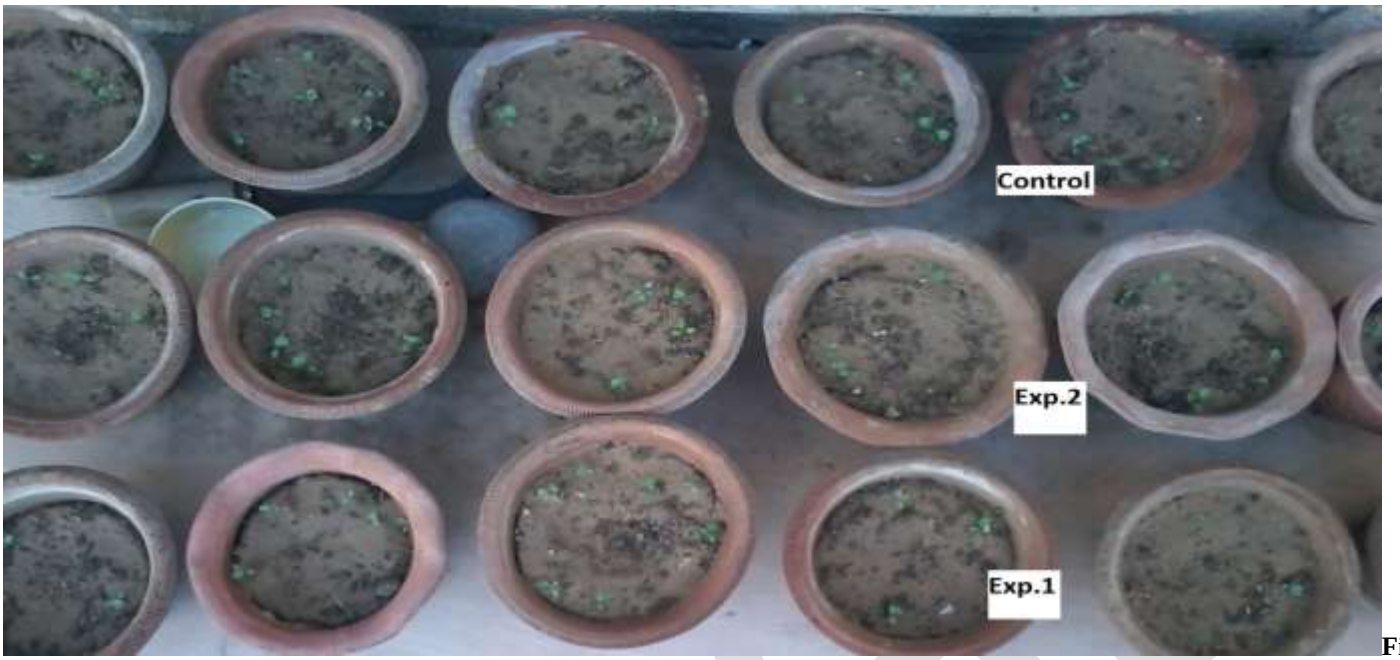

Fig.1 10 Days Pot Method

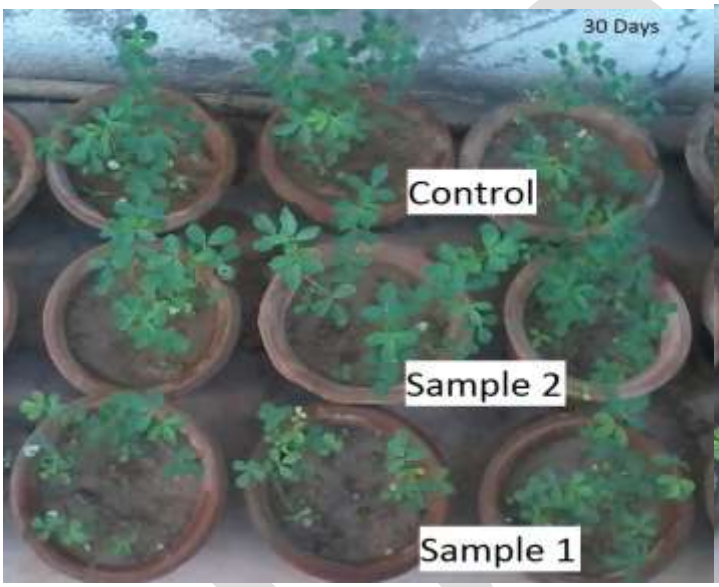

Fig.2 30 Days Pot Method

Fig.3 40 Days Pot Method

Fig.4 50 Days Pot Method

Fig.5 Oscillatoria sp.

Fig.6 Spirogyra sp.

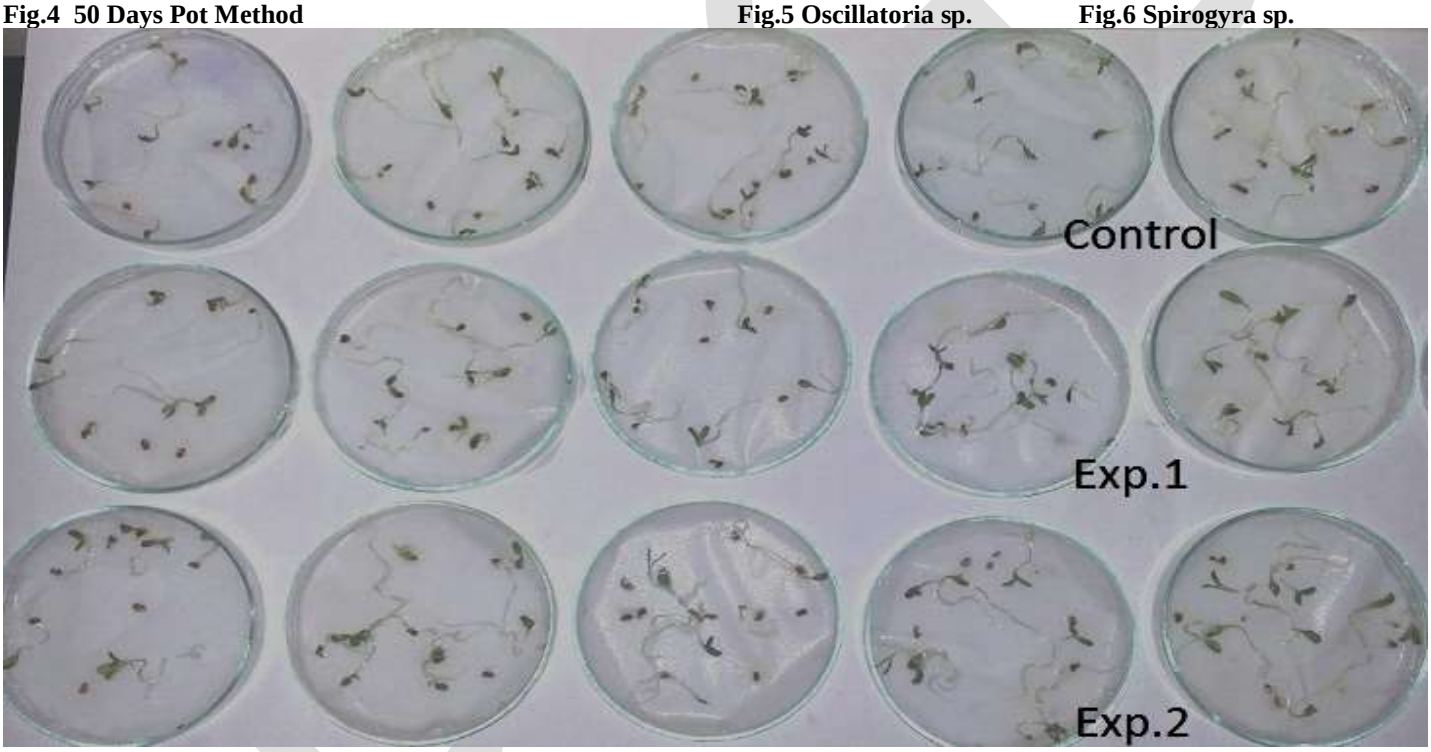

Fig.7 Plate Method After 4 Days

4 RESULTS AND DISCUSSION

In the plate culture of alfalfa , the germination of seeds soaked with algae extract was faster as compared to seeds soaked in distilled water as control. For untreated seeds of alfalfa germination began after 36 hours, whereas germination of seeds treated with several algae extract began earlier. In treated seeds, however, length of radical of germinated seed were recorded higher than control after 6 days. Whereas seed treated with Spirogyra sp. was recorded higher than seed treated with Oscillatoria sp..

In pot culture of lucerne plant, comparison of control and treatment plants with one way ANOVA showed that treatment groups have a significant difference in seed germination, plant height and number of leaves as compared to control. However, effect of algal culture is not the same for all parts of plants and in different plants. In addition, effect of different algal inoculum was not the same in different plants. For example, Spirogyra sp. showed more positive effect on most vegetative characters of alfalfa plant, whereas *Oscillatoria sp.* showed less positive effect on vegetative characters of studied plants. Also among several studied vegetative

characters, leaf number highest in the plants treated by Oscillatoria sp. as compare to the plants treated by distilled water and Spirogyra sp.. Plant height showed the most difference in seed treatments by Spirogyra sp. whereas least differences in seed treated by Oscillatoria sp.

5 CONCLUSION

The results obtained in the first part of this work showed that presoaking seeds by algal extract accelerates seed germination and radical length of germinated seed. The second part of this research revealed that algal extract can enhance plant growth. Statistical analysis confirm that there is a significant difference in plant height, number of leaf, Percentage germination treated plants as compared to control. The review of literatures showed that the production of growth substances and vitamins by the algae may be partly responsible for the greater plant growth and yield. The capacity for biosynthesis of growth promoting substances such as auxins, amino acids, sugars and vitamins (Vitamin B12, Folic acid, Nicotinic acid and Pantothenic acid) also can enhance plant growth. The other reason that can suggest for increased plant growth by using algae extract is that, the growth of algae in soil seems to influence the physical and chemical properties of soil. The water stable aggregate significantly increase as a result of algal growth and thereby improves the physical environment of the plants. Results of this study showed that Spirogyra sp. have ability to promote vegetable growth higher than Oscillatoria sp..and they are appropriate candidate for the formulation of a biofertilizer. Spirogyra sp. needed more study for application as a biofertilizer.

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Abbreviations :
SS = SUM OF SQUARE
SD = Standard deviation
Df = Degree of Freedom
S.E.M= Standard error mean
Ms = mean square