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ORIGINAL ARTICLE **OPEN ACCESS**

Effect of Different Algal Powder on Growth and Productivity of Sunflower (*Helianthus annus* L.)

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ABSTRACT
Numerous types of algae nurture luxuriously in Ujani reservoir. Those species found abundantly used for experimental purpose. The selected five algal species (Synechococcus aeruginosus, Spirulina plantensis, Cladophora crispata, Spirogyra jugalis and Chara fragilis) were considered primarily as source of compost/nourishment and its effect evaluated on growth and productivity of Sunflower. Overall the application of algae significantly increases the plant height, number of leaves, and yield as compared to control. Compare to all algae, the application of Synechococcus aeruginosus could be a promising option for yield enhancement and production of sunflower plant.
Key Words – Growth, Sunflower, Algae, supplement, Biofertilizer

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INTRODUCTION

Ujani is one of the important reservoirs and it occupies a geographical area of Pune, Solapur and Ahmednagar districts of Maharashtra. Ujani backwater is ironic in algal diversity. As the importance of reservoir, present research work has been carried out by collecting algae from fresh water of Ujani reservoir. At selected sites of Indapur (Taratgaon, Kandalgaon, Malwadi, Kalthan, Palasdev, Dalaj & Takrarwadi) algae show great diversity. *Chara fragilis*, *Spirogyra jugalis, Synechococcus aeruginosus, Spirulina platensis, Cladophora crispata, Chara excelsa, Microcystis aeruginosa, Oedogonium formosum, Oedogonium spurium, Cladophora callicoma, Characium ambiguum, Crucigenia tetrapedia, Mougeotia vivans, Spirogyra subsala, Zygnema melanosporum,, Gyrosigma baikalensis, Gloeocapasa rupestris, Spirulina major, Nostoc muscorum, Hydrodictyon reticulum* etc. algae found in mass quantity in selected sites. As compare to other algae *Cladophora crispata, Spirogyra jugalis, Chara fragilis, Synechococcus aeruginosus, Spirulina platensis* are found in huge quantities. So these algae were selected for experimental purpose and as per the aim of experiment decided to check the effect of selected algae on the growth and productivity on Sunflower crop.

For experiments Sunflower variety - Mordan was selected. Selected sunflower variety is improved variety and it is continuously cultivated in Indapur Taluka largely in Kharif season.

Sunflower oil and its bi-products has greater demand than before because of increased human population, and it is necessary to fulfill the demand to intensify the efforts for expansion of sunflower productivity [1]. In the international market the sunflower oil is in 4th place, and there is a demand of sunflower as well as other oil crops like soyabean, rapeseed, safflower, peanut, palm oil, mustard oil etc. in the international market [2].

Sunflower is good source of edible oil. This selected crop has a great economic value in national and international market. This crop has a short season for harvesting. In rain fed areas Sunflower (Variety - Mordan) is cultivated on large scale, but if it is cultivated in well irrigated land then productivity increases. The use of algae as a fertilizer for many years known to us. It is useful as a growth supplements in agriculture to increase the growth parameters of plant (crop yield, fruit fresh weight, improved fruit yield, high chlorophyll levels in the plant leaves, improved nutrient uptake by the crops, enhancement of seed germination) along with that it also increases the plant resistance against stress conditions and decrease the incidence of fungal diseases [3-6, 30-32, 15, 18, 22, 27].

The outcome of seaweed application is as a result of various components that may act synergistically at different concentrations, while their mode of action still remains unknown [7]. The use of bio fertilizers as

applied to some crops such as maize, legumes, tubers, and oilseeds crop has been reported [2, 8]. The soil amended with microbial-based formulated fertilizer (bio fertilizer) promotes plant health and crop yield with intents of proffering long-lasting solutions to the problems associated with the continuous use of chemical fertilizers in enriching soil fertility for crop productivity [9-11].

Recently researchers found that seaweed fertilizers commonly used as a fertilizer because of the presence of their NPK content and trace elements and metabolite which are similar to plant growth regulators [12]. El-Barody *et al*., [6]) found that addition of different successive extracts of *Asparogopsis taxiformis* thallus powder to the soil, as a bio fertilizer, gave significant increase in the growth of *Vicia faba*. Sabh *et al.,* [22] reported that fourfold increase in NPK content of the plants treated with *Sargassum* sp. Compared to negative control.

Many researchers found that use of cyanobacteria beneficial for rice and other crops such as wheat, rice and maize [21, 11, 12].

In recent years, use of seaweed extracts have gained in popularity due to their potential use in organic and sustainable agriculture, as a means to avoid excessive fertilizer applications and to improve mineral absorption. Dhargalkar and Pereira [4] found that seaweed extracts are biodegradable, non-toxic, ecofriendly and non-hazardous to humans, animals and birds.

According to [20, 24] cyanobacteria play a vital role in conservation and increase the soil fertility. As a result of cyanobacterial activities found: 1. Increase in growth by improving material such as vitamins, hormones and organic matter. 2. Enrichment of soil micro biota after their death and decomposition.

Also, under saline environment, application of cyanobacteria to the soil lead to improve the soil organic matter, which is consequently, increased the soil biological activity by enhancing the soil CO2 evolution leading to increase the soil fertility [26]. The blue-green algae (cyanobacteria) are capable of fixing the nitrogen from atmospheric and transform it into an available form of ammonium required for plant growth.

Adverse environmental conditions (climatic and edaphic), crop management issues and less availability of nutrients result in reduction of sunflower crops (seeds & oil contents) and their products.

The application of organic manure plus synthetic fertilizer could influence the yield and quality of sunflower [2].

From review of literature, it reveals that application of algae has beneficial impact on growth and yield of various crops. For the said experiment algae considered as a bio fertilizer because it helps in N_2 fixation primarily and it is also good source of minerals.

So keeping this in view, it has been decided to study the effect of selected algae (*Synechococcus aeruginosus and Spirulina plantensis* (Blue green algae) and other algal members *Viz. Cladophora crispata, Spirogyra jugalis* and *Chara fragilis*) on growth and productivity of Sunflower crop.

MATERIAL AND METHODS

Algae collection and preparation:

Fresh algae of *Cladophora crispata, Spirogyra jugalis, Chara fragilis, Synechococcus aeruginosus, Spirulina platensis* were collected from different locations such as Taratgaon, Kandalgaon, Malwadi, Kalthan, Palasdev, Dalaj, and Takrarwadi of Ujani reservoir, Maharashtra, India. Then the algae were washed thoroughly with tap water to remove extraneous materials and brought to the laboratory in plastic bag containing water to prevent evaporation. Samples were then shade dried until constant weight obtained. After drying, fine powder was prepared in grinder. The powdered samples subsequently stored in refrigerator until used.

Plant material

Seeds of Sunflower (*Helianthus annus* L.) were surface sterilized with ethanol 70% and washed by sterile distilled water, then dried in shadow open air. The seeds were planted in 30 cm diameter earthen pots containing mixture of 1:1 autoclaved peat and sand soil. Every pot (Polythene bags) contained 1 seed. They watered every week.

Growth measurements

Numbers of leaves after 21 days of plantation, plant height at the time of harvesting, size of ear head at the time of harvesting, number of seeds obtained and total yields of selected crops were recorded.

The treatments

The experiment was carried out in different five sets. First set was considered as control was treated with only sterilized soil (10kg).

Second set was arranged with sterilized soil and compost (10kg sterilized soil + 100gm compost).

For third set 10kg sterilized soil + 100gm algal powder of five selected algae were mixed well and used for the same experiment.

For the fourth experimental set 10kg sterilized soil and 100gm compost (organic fertilizer) along with different selected algal powder 100gm mixed well and used for the fourth experimental set.
For the fifth experimental set, 10kg sterilized soil + 100gm NPK (19:19:19) Inorganic fertilizer + 100gm algal powder of five selected algae.
According to our aim to observe the effect of different algal powder on growth and productivity the experiment was carried out in triplicates and in three different seasons.
As per our goal to see the effect of various algal powders on growth and productivity of sunflower the experiment was carried out in triplicates and in three different seasons.
To check the growth and productivity of Sunflower some parameters was considered such as number of leaves per plant after 21 days, height of the plant after maturity, Size of ear head at the time of harvesting, number of seeds obtained and total weight of seeds on per plant (Yield).

RESULTS AND DISCUSSION

Table - 1: Effect of different Algal Powder on Growth and Productivity of Sunflower

POT	No. of leaves After 21days	Height of Plant at harvesting time(cm)	Size of Ear head at harvesting time (cm)	No. of seeds Obtained	Total weight of Seeds(Yield) on plant (gm.)
Soil	13±0.57	83.5±0.296	8.7±0.360	395±0.577	16.6±0.305
Soil+ Compost	14±0.57	84.6±0.321	9±0.321	432±0.577	17.76±0.352
S+A1	15±0.57	84.5±0.554	9.8±0.375	535±0.881	18.81±0.283
S+A2	15±0.57	85±0.680	10±0.433	531±0.577	19.35±0.304
S+A3	16±0.57	86.4±0.233	10.1±0.463	541±0.666	19.74±0.306
S+A4	17±0.57	87.1±0.585	10.9±0.519	593±0.881	21.26±0.485
S+A5	16±0.57	86.6±0.296	10.7±0.360	561±0.577	19.94±0.461
S+C+A1	16±0.57	85.6±0.317	9.9±0.548	552±0.881	19.78±0.357
S+C+A2	17±0.57	86.4±0.230	10.2±0.491	562±0.577	20.05±0.419
S+C+A3	17±0.57	87.6±0.317	10.6±0.328	572±0.881	20.84±0.338
S+C+A4	18±0.57	91±0.371	11.4±0.550	604±0.577	22.77±0.574
S+C+A5	17±0.57	88.9±0.548	11.1±0.435	590±0.333	21.82±0.355
S+NPK+A1	17±0.57	90.8±0.491	10.8±0.493	621±0.577	23.26±0.573
S+NPK+A2	18±0.57	91.2±0.611	11.2±0.461	628±0.881	23.66±0.631
S+NPK+A3	18±0.57	91.6±0.348	11.5±0.378	642±0.666	24.3±0.472
S+NPK+A4	21±0.57	94.9±0.519	13±0.519	718±0.577	27.12±0.428
S+NPK+A5	19±0.57	92.5±0.384	12.4±0.416	677±0.881	26.48 ±0.351

*S=Soil; *C=Compost ; * NPK=19:19:19
*A1= *Cladophora crispata* * A2= *Spirogyra jugalis* * A3= *Chara fragilis*
*A4= *Synechococcus aeruginosus* * A5= *Spirulina plantensis*.

Plants cultivated with soil considered as a control. It gives fewer yields i.e. 16.6gm seeds compared to the rest of combinations. Other parameters also measured such as number of leaves after 21 days was recorded 13. Height of the plant at the time of harvesting 83.5 cm. and size of ear head was 8.7cm at the time of harvesting.
In the second set plants were cultivated with soil+ compost gives higher yield compare to control (soil) i.e.17.76 gm. seeds.
Third, fourth and in the fifth set different algal powder used as a bio fertilizers and it was observed that selected algae's were responsible for the enhancement of the yield.
The third set was designed with soil +different algal combinations and it was recorded that soil+ *Synechococcus aeruginosus* combination gives best result compare to soil+ *Cladophora crispata*, soil+ *spirogyra jugalis*, soil+ *Chara fragilis* and soil+ *Spirulina platensis*.
Plants was cultivated soil+ *Synechococcus aeruginosus* gives maximum yield and it shows, number of leaves 17 & 87.1cm height of the plant and 10.9 cm size of ear head and 21.26gm seeds (yield) were recorded at the time of maturity. Soil + *spirulina platensis* gives improved yield 19.94 gm. seeds compare to soil+ *Cladophora crispata* , soil+ *Spirogyra jugalis*, soil+ *Chara fragilis*.
Sunflower cultivated with soil +compost+ different selected algal powders gives good yield compare to first three sets (soil, soil+ compost, and soil+ different algal powders). Plants were cultivated with soil + compost + *Cladophora crispata* shows minimum yield i.e.19.78 gm. seeds and plants cultivated with soil + compost + *Synechococcus aeruginosus* gives maximum yield i.e. 22.77 gm. seeds (yield).

The last set of sunflower plants were cultivated with soil+ NPK (19:19:19) + different selected algae gives higher yield compare to first four sets.

Soil + NPK + *Synechococcus aeruginosus* combinations gives better result compare to other four combinations and parameters were measured i.e. total weight of seeds (27.12 gm), size of ear head 13 cm at the time of harvesting and 94.9 cm height of plant.

In above experiment no. of seeds /plant also recorded and it was observed that soil+ NPK+ *Synechococcus aeruginosus* gives maximum no. of seeds i.e.718 seeds /plant, then followed by soil + compost + *Synechococcus aeruginosus* (604 seeds/plant), soil+ *Synechococcus aeruginosus* (593 seeds/ plant). Soil+ compost gives 432seeds /plant and minimum no. of seeds was recorded under controlled condition i.e.395 seeds /plant (Table -1, Photoplate-1).

Our finding compared with earlier work carried out by Mohan *et al*., [14] on *Cajanus cajan* (L.) and Sivasankari *et al*., [23] on *Vigna sinensis* L. crops, shows that use of algae responsible for increased yield and other growth parameters

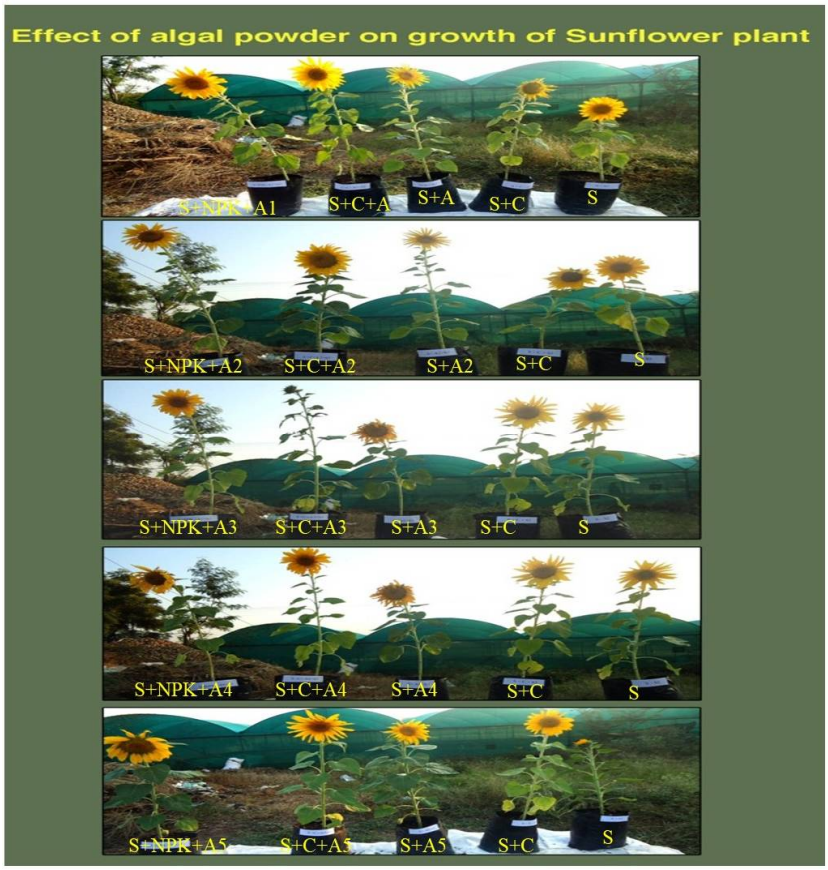
The enhancement of crop yield is may be due to the occurrence of some growth promoting elements in the seaweed extract [3, 7, 12, 27].

There was an increase in vegetative growth by the application of seaweed extract on marigold [20, 28] and our experimental findings compared with earlier studies, and concluded that the algal application responsible for enhancement of growth/yield of plant.

Increase in growth parameters, yield of sunflower compared with, control these results are agreement with those found by Rady *et al*., [17] who revealed that inculcation of common bean with Blue-green algae significantly increased photosynthetic efficiency, anti-oxidative activity, dry matter and seed yields, macro elements (N, P, and K).

From the above experimental data it was observed that *Synechococcus aeruginosus (*blue green alga) gives good results in all experimental sets i.e. when it combine with soil, compost and NPK(19:19:19). It was observed that there is a continuous increase in the growth parameters and yield of plant.

Photo plate -1 Effect of algal powder om growth of sunflower plant



S=SoilC=Compost ; NPK=19:19:19;Algae = A

*A1= *Cladophora crispata* * A2= *Spirogyra jugalis* * A3= *Chara fragilis* *A4= *Synechococcus aeruginosus* * A5= *Spirulina plantensis*.

CONCLUSION

Blue green algae (*Synechococcus aeruginosus* & *Spirulina plantensis*) as well as other algal members (*Cladophora crispata, Spirogyra jugalis* & *Chara fragilis*) are the good source of bio fertilizer. From the experimental study reveals that selected algae used as supplement with organic fertilizers as well as inorganic fertilizers responsible for the increased yield of plant. Result of the study shows that *Synechococcus aeruginosus* have significant potential to increase the growth/yield of Sunflower crop. On the basis of evidences found that algae are very good supplements to the inorganic fertilizers as well as organic fertilizers.

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