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SHORT COMMUNICATION

Freshwater Algae: A Treasure Trove for Sustainable Agriculture

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ABSTRACT
The increasing reliance on chemical fertilizers in modern agriculture poses a significant threat to soil fertility and environmental sustainability. To mitigate this issue, the use of biofertilizers has emerged as a promising alternative. Biofertilizers, derived from natural sources such as algae, can enhance soil health and crop productivity without harming the environment. In this study, freshwater algae were collected from rivers and canals in the Rahata tehsil region and processed into a fine powder. Aqueous and Indian Khillar cow urine extracts of various concentrations were prepared using this powder. Safflower (Carthamus tinctorius L.), a leafy vegetable, was selected as the test plant. Seeds of safflower were soaked in the algal extract concentrations, and the experiment was conducted during the rabbi season of 2020 using a Randomized Block Design (RBD) method. The study consisted of six treatments with four replications each. The results showed that the 20% algal extract with cow urine exhibited significant positive effects on safflower growth. Fresh leaves analyzed after 60 days of treatment displayed a maximum increase in chlorophyll and ash percentage. This study demonstrates the potential of freshwater algae as a sustainable alternative to synthetic chemical fertilizers. The use of algal extracts as a liquid biofertilizers, when applied at the recommended dose, can enhance soil fertility and crop productivity while minimizing environmental harm.
Keywords: Biofertilizer, Algae, Safflower, RBD, chlorophyll.

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INTRODUCTION

The modern agricultural sector has become increasingly reliant on the use of chemical fertilizers to enhance crop yields and meet the world's growing food demands. However, the excessive and indiscriminate use of these synthetic fertilizers has been linked to a range of negative environmental and health consequences.

One of the most significant concerns associated with chemical fertilizers is their impact on soil fertility. The prolonged use of these fertilizers can lead to soil degradation, nutrient depletion, and a decline in overall soil health. This can have far-reaching consequences, including reduced crop yields, decreased water quality, and increased greenhouse gas emissions [1].

In contrast, biofertilizers offer a more sustainable and environmentally friendly alternative for promoting crop growth and improving soil fertility. Biofertilizers are natural, biologically-based products that contain living microorganisms, such as bacteria, fungi, or algae, which can enhance soil health and promote plant growth.

Algae, in particular, have been recognized for their potential as a biofertilizer. Many species of algae have been found to form symbiotic relationships with plant roots, providing essential nutrients and promoting healthy plant growth. The use of algae-based biofertilizers can help to improve crop productivity, enhance soil fertility, and reduce the environmental impact of agricultural practices [2].

By adopting biofertilizers, such as algae-based products, farmers can reduce their reliance on synthetic chemical fertilizers and promote more sustainable and environmentally friendly agricultural practices. This can help to maintain soil health, conserve natural resources, and ensure the long-term viability of agricultural ecosystems. Safflower (*Carthamus tinctorius* L.) is a valuable oilseed crop renowned for its

rich content of polyunsaturated fatty acids, which play a crucial role in reducing cholesterol levels in the blood. Beyond its nutritional benefits, safflower is a versatile crop with various uses.

The vibrant flowers of safflower serve as a natural source of edible colors, adding a splash of vibrancy to various culinary delights. Moreover, these flowers have been found to possess several medicinal properties, making them a valuable asset in traditional medicine.

In India and neighboring countries, the tender leaves and shoots of safflower are relished as a nutritious potherb and salad, providing a burst of freshness and flavor to local cuisine. The leaves of safflower are an excellent source of dietary fiber, minerals, vitamins, and antioxidants [2-3], making them a nutritious addition to a healthy diet.

Overall, safflower is a multifaceted crop that offers a range of benefits, from its nutritional and medicinal properties to its versatility in culinary and traditional uses. Safflower is a valuable oilseed crop, rich in polyunsaturated fatty acids, which have been shown to help reduce cholesterol levels in the blood. Moreover, the flowers of safflower serve as a natural source of edible colors and exhibit several medicinal properties, making them a valuable asset in traditional medicine. The tender leaves and shoots of safflower are also consumed as a nutritious potherb and salad in India and neighboring countries, providing a rich source of essential nutrients [4]. Notably, safflower leaves are an excellent source of dietary fiber, minerals, vitamins, and antioxidants, as reported in previous studies [5].

In the present study, an innovative approach was undertaken to develop a freshwater algal liquid extract as a sustainable biofertilizers. Freshwater algae were collected from Rahata tehsil of Ahmednagar district and evaluated for their efficacy as a liquid biofertilizers on Safflower (*Carthamus tinctorius* L.), a crop of significant economic and nutritional importance.

The use of freshwater algal liquid extract as a biofertilizers offers a promising approach for promoting sustainable agriculture and enhancing crop productivity, while minimizing environmental harm. This study aimed to investigate the efficacy of freshwater algal liquid extract as a biofertilizers on safflower, with a focus on its potential to improve crop growth, yield, and nutritional quality.

Following treatment, the fresh leaves of safflower were subjected to detailed analysis to assess the impact of the freshwater algal liquid extract on the plant's physiological and nutritional parameters. Specifically, the chlorophyll content and ash percentage of the treated safflower leaves were evaluated.

MATERIAL AND METHODS

Collection of Fresh Water Algae

Freshwater algae were collected from the designated study area, specifically from the canals and rivers of Rahata tehsil, Ahmednagar district. To ensure the quality and integrity of the samples, algae were carefully handpicked from the water bodies. Subsequently, the collected algae were thoroughly washed with running tap water to remove any unwanted impurities, soil particles, and debris.

Following the cleaning process, the algae samples collected from different locations were carefully stored in separate, sterile plastic bags of suitable sizes to prevent contamination and mixing of samples. The bags were then sealed and transported to the laboratory for further processing and analysis. This meticulous collection and handling procedure helped ensure the accuracy and reliability of the subsequent experiments.

Preparation of Algal Powder

The washed algal samples collected from the river and canal were separately subjected to shade drying in the laboratory, ensuring that the delicate algal cells were not exposed to direct sunlight or high temperatures. This gentle drying process helped preserve the biochemical integrity of the algae.

Once the algal samples were completely dry, they were ground into a fine powder using a mechanical grinder, as described by Aher and Wabale [1]. This powdering process helped increase the surface area of the algae, facilitating the extraction of bioactive compounds.

The resulting algal powder was stored in airtight plastic containers to maintain its quality and prevent contamination. These containers were then sealed and labeled, ready for further use in the preparation of algal extracts. The ultimate goal of this process was to investigate the potential of these algal extracts as a liquid biofertilizers, exploring their ability to promote plant growth and development.

Preparation of Algal extracts

To investigate the impact of algae on the growth and development of safflower, two types of extracts were prepared using Indian breed Khillar cattle urine and aqueous solutions. Specifically, 10 grams of algal powder were mixed with 100 ml of cow urine and aqueous solutions separately, and then boiled down to a final volume of 10 ml. This process helped to concentrate the bioactive compounds present in the algae.

Six distinct treatments were prepared in glass bottles, each with a specific composition:

- T1: Control (Distilled Water)

- T2: Control Cow Urine 20%
- T3: Aqueous Algal Extract (Pravara River) 20%
- T4: Cow Urine + Algal Extract (Pravara River) 20%
- T5: Aqueous Algal Extract (Pravara Canal) 20%
- T6: Cow Urine + Algal Extract (Pravara Canal) 20%

These treatments were then used for spraying on the experimental plot, allowing for a comprehensive evaluation of the effects of algae on safflower growth and development.

Testing the effect of liquid biofertilizer on safflower

Following the preparation of the algal extracts, safflower seeds were subjected to a 12-hour soaking treatment in the various concentrations. This soaking process allowed the seeds to absorb the bioactive compounds present in the algal extracts, potentially enhancing their germination and growth.

The soaked seeds were then sown in the experimental plot, which was designed to accommodate six treatments with four replications each. This experimental design enabled the researchers to evaluate the effects of the different algal extract treatments on safflower growth and development.

In addition to the seed soaking treatment, the plants in the experimental plot also received a liquid spray of the six treatments. This spray treatment was applied to the plants to provide an additional source of nutrients and bioactive compounds, potentially enhancing their growth and development.

Field experiment:

A field experiment was conducted at the Arts, Commerce, and Science College, Satral, during the Rabi season of 2020. The experiment aimed to evaluate the effects of different algal extract treatments on the growth and development of safflower.

The experiment was designed using a Factorial Randomized Block Design (RBD), which allowed for the evaluation of six treatments on safflower, replicated four times. This design enabled the researchers to minimize experimental error, account for any variability in the experimental conditions, and accurately assess the treatment effects.

Foliar sprays of the six treatments were applied to the safflower plants at 15-day intervals, ensuring that the plants received a consistent and controlled dose of the algal extracts. This application schedule allowed the researchers to assess the cumulative effects of the treatments on safflower growth and development over the course of the experiment.

Estimation of chlorophyll and ash value:

Biochemical analysis of safflower leaves was conducted using standardized methods to estimate the levels of chlorophyll and ash content. These analyses provided valuable insights into the nutritional and physiological status of the safflower plants.

The estimation of chlorophyll content was performed using the method described by [3]. This widely accepted protocol involves extracting chlorophyll from leaf tissue using a solvent, followed by spectrophotometric measurement of the extracted chlorophyll.

The ash content of the safflower leaves was determined using a Muffle Furnace, which was set at a temperature of 1000°C. This high-temperature incineration process allowed for the complete combustion of organic matter, leaving behind a residue of inorganic ash. The ash content value was then calculated as a percentage of the initial sample weight, providing a quantitative measure of the mineral content of the safflower leaves.

RESULT AND DISCUSSION

The algal extract was evaluated for its potential as a biofertilizers on the seeds of safflower (*Carthamus tinctorius*). The results of the present investigation revealed that the algal extract exhibited a significant positive effect in the T6 treatment, which consisted of a 20% concentration of Cow Urine + Algal extract (Pravara Canal). This treatment outperformed the other treatment concentrations, demonstrating the potential of this algal extract as a biofertilizers.

These findings are consistent with those reported by Aher and Wabale [2], who observed significant growth promotion in okra (Abelmoschus esculentus) using a 15% concentration of farm pond aqueous algal extract. The similarity in results suggests that algal extracts can be a valuable source of nutrients for various crops, including safflower and okra. Furthermore, the use of cow urine as a medium for algal extract preparation appears to enhance its bio fertilizing properties, leading to improved crop growth and productivity.

Table1: Effect of algal liquid biofertilizer on ash percentage of safflower leaves.

	T1	T2	T3	T4	T5	T6
Ash %	12.13	12.3	14.8	16.08	15.19	16.74

Table 2: Effect of algal liquid biofertilizer on chlorophyll content of safflower leaves.

	T1	T2	T3	T4	T5	T6
Chlorophyll (mg/gm)	0.85	0.92	1.08	1.11	0.99	1.18

CONCLUSION

The present study demonstrates the significant positive impact of 20% freshwater algal extract combined with Indian cattle urine on the chlorophyll content of Carthamus tinctorius (safflower). Notably, the maximum chlorophyll content was obtained with the T6 treatment, surpassing the results of all other treatments. This finding highlights the potential of freshwater algae as a natural and sustainable alternative to synthetic chemical fertilizers.

Freshwater algae have emerged as a viable substitute for synthetic fertilizers, offering a more environmentally friendly and cost-effective solution. When applied in proper doses as a liquid fertilizer, freshwater algae can significantly enhance the nutritional value of safflower, transforming it into a highly nutritious leafy vegetable.

Furthermore, the study reveals that the ash content of safflower leaves was significantly higher in the 20% concentration treatment. This indicates that safflower leaves are an exceptionally rich source of minerals, which can substantially enhance the mineral content of one's diet when consumed regularly.

The preparation of such liquid biofertilizers is a straightforward process that can be easily adopted by farmers. By embracing this approach, farmers can reduce their reliance on chemical fertilizers, decrease costs, and promote the principles of organic farming. This sustainable practice has the potential to transform agricultural practices, fostering a more environmentally conscious and health-oriented approach to food production.

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