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Assessing the Efficacy of Freshwater Algal Isolates as Liquid Biofertilizers on Seed Germination of Safflower (*Carthamus tinctorious* L.)

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Abstract

The present study evaluates the potential of freshwater algal extracts obtained from the Pravara River and Pravara Left Canal as natural liquid bio-fertilizers for improving seed germination and seedling growth of Safflower (*Carthamus tinctorius* L.). Different concentrations of algal extracts were tested, including aqueous and cow urine-based formulations. Among the treatments, the 20% cow urine-based algal extract from the Pravara Left Canal (T6) showed the highest effectiveness, achieving maximum seed germination (95.00%), shoot length (11.66 cm), root length (16.06 cm), and total plant height (27.16 cm) compared to control treatments.

The findings reveal that combining algal extracts with cow urine significantly enhances the growth performance of safflower compared to aqueous algal extracts alone. Moreover, algal species collected from the Pravara Left Canal demonstrated greater effectiveness than those from the Pravara River in promoting germination and growth parameters. Statistical analysis using two-way ANOVA confirmed that the variations in seed germination, shoot length, root length, and total plant height among treatments were highly significant ($p < 0.05$). These results are consistent with previous studies highlighting the beneficial effects of algal and seaweed-based liquid fertilizers, confirming their ability to enhance nutrient uptake, stimulate plant metabolism, and promote overall plant growth. Therefore, freshwater algal extracts, particularly when enriched with cow urine, present a sustainable, cost-effective, and eco-friendly alternative to synthetic fertilizers, supporting environmentally friendly agricultural practices in the Pravara River Basin.

Keywords: Freshwater Algae, Biofertilizer, Biometric parameters, Plant growth

Introduction

Freshwater ecosystems, including rivers and canals, are among the most dynamic and productive habitats that support a wide range of biodiversity. Among these, freshwater algae play a crucial role in maintaining the ecological balance of aquatic environments. They are primary producers, forming the base of the aquatic food chain, contributing significantly to oxygen production, nutrient cycling, and overall water quality. Moreover, algal communities are highly sensitive to environmental changes and serve as effective bio-indicators for assessing the health of aquatic ecosystems.

The Pravara River and its Left Canal, located in the Ahilyanagar District of Maharashtra, are significant freshwater resources supporting agricultural activities, fisheries, and domestic water supply for nearby communities. However, in recent years, these water bodies have been facing increasing anthropogenic pressures such as agricultural runoff, industrial discharge, domestic sewage, sand mining, and changing climatic conditions. These factors alter the physicochemical properties of water, which directly affect the composition, diversity, and distribution of freshwater algal communities.

Despite the ecological and economic importance of the Pravara River basin, there is a lack of comprehensive studies focusing on freshwater algal diversity and their spatial and seasonal distribution patterns. Previous studies on algal flora in Maharashtra have been limited and largely concentrated on major rivers like the Godavari, Bhima, and Krishna, leaving smaller yet ecologically significant rivers like the Pravara underexplored. The absence of baseline data makes it difficult to monitor ecosystem health, predict algal blooms, and develop effective conservation strategies.

Therefore, there is a pressing need to study the diversity and distribution of freshwater algae in the Pravara River and Pravara Left Canal. This research aims to identify the species composition, analyze seasonal variations, and examine the relationship between water quality parameters and algal distribution. The findings will provide critical insights into the ecological functioning of these freshwater systems and contribute to sustainable management and conservation of aquatic biodiversity in the region.

Materials and Methods

Collection of Algal Sample

Fresh water algal samples were collected from the canals and rivers of Rahata tahsil of Ahmednagar district. The collected algal material was handpicked and washed with water to remove the unwanted impurities and soils particles. Algal material collected from different sides were kept in separate plastic bags of suitable sizes and brought to the laboratories. Aher and Wabale (2019) recorded algal diversity form fresh water farm pond, with the help of this collected fresh water algae were identified

Preparation of Algal Powder

Wash algal material was dried under shade in the laboratory. Completely dried material was grind in a grinder to obtain the fine powder. Algal powder was stored in airtight plastic container for further use i.e. for preparation of extract in order to study their potential as a biofertilizer.

Preparation of Algal extracts

To study the effect of algal extracts on seed germination,shoot and root length of safflower[*Carthamus tinctorius*] were prepared by using aqueous extract method by using urine of Indian breed khillar. 10 gm of algal powder extract is prepared with 100 ml of cow urine by boiling it and a final volume is made 10 ml. from this various concentration of extract was made as 1%,5%, 10%, 20% and 25%. In this concentration safflower seeds were soaked for 12 hours. These soaked seeds were placed for germination by using between paper method (R.L.Agrawal). First count was taken on 4^{th} day and second on 14^{th} day. 3 sets were prepared and germination, shoot and root count was taken.

Result and Discussion

The fresh water algal extracts were tested for their potential as liquid bio fertilizers on Safflower (*Carthamus tinctorius* L.). During the present work fresh water algal samples of Pravara left canal and Pravara River were collected and extracted in distilled water as well as in cow urine respectively. T1 and T2 were treated as the control (Distilled water and cow urine respectively). Seed germination in safflower was tested with various concentrations of algal extracts. It was noted that percent seed germination enhanced in 20% concentration of the algal extract for aqueous and cow urine respectively. Therefore, only 20% algal aqueous and cow urine extracts of both Pravara Left Canal and Pravara River were considered for field trails. T3-T6 were considered the treatments as

T3- 20% aqueous algal extract (Pravara River)
T4- 20% Cow urine algal extract (Pravara River)
T5- 20% aqueous algal extract (Pravara Left Canal)
T6- 20% Cow urine algal extract (Pravara Left Canal)

Effect of fresh water algal on seed germination and seedling growth of Safflower (*Carthamus tinctorius* L.)

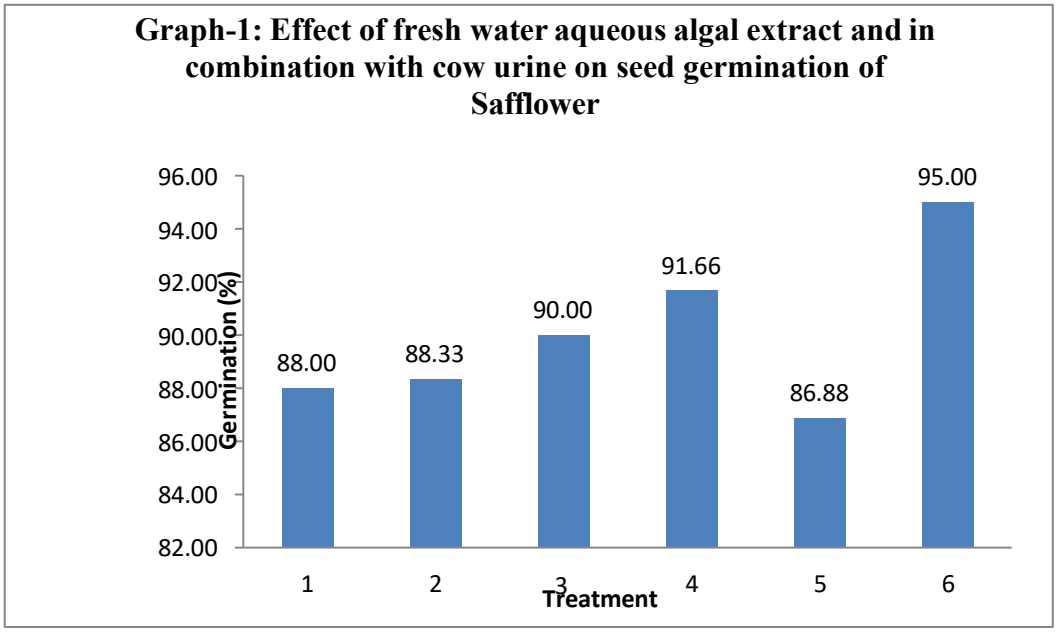
Table-1: Effect of fresh water algal extract on germination (%), shoot length (cm), root length (cm) and total height of Safflower (*Carthamus tinctorius* L.)

Treatment	Germination %	Shoot length in cm (mean)	Root length in cm (mean)	Total Height in cm (mean)
T1	**88.00**	**9.96**	**13.30**	**22.99**
T2	88.33	11.10	14.63	25.73
T3	90.00	10.74	12.96	23.70
T4	91.66	11.10	12.73	24.39
T5	86.88	10.60	13.46	24.06
T6	**95.00**	**11.66**	**16.06**	**27.16**

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	37.37898	5	7.475797	3.994176	0.0167	2.901295
Columns	24953.83	3	8317.943	4444.118	0.0000	3.287382
Error	28.07512	15	1.871674			
Total	**25019.28**	**23**				

Seed Germination:



T1 (Control- DW) recorded 88 percent of seed germination, whereas T2 (Control-20% CU) reported 88.33 percent of seed germination.

Minimum percent seed germination (86.88) was observed in T5-20% aqueous algal extract (Pravara Left Canal) followed by 90.00 percent in T3-20% aqueous algal extract (Pravara River) and maximum percent seed germination (95.00) was noticed in T6-20% Cow urine algal extract (Pravara Left Canal) followed by 91.66 in T4-20% Cow urine algal extract (Pravara River). From the above results it was confirmed that 20% Cow urine algal extract (Pravara Left Canal) enhanced the seed germination.

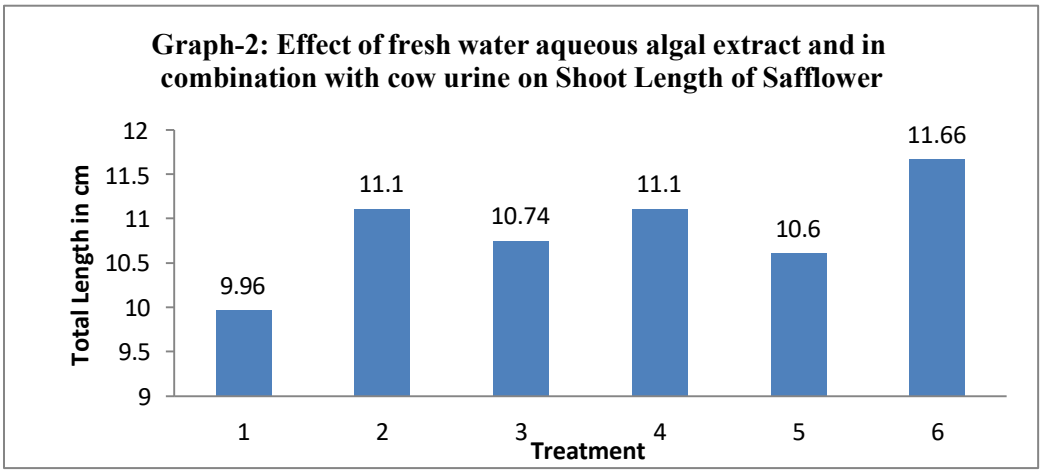
The above data reveals that maximum seed germination is enhanced due to the use of cow urine in combination with algal extract than that of only aqueous algal extracts. It was also reported that seed germination was enhanced by the use of algal species collected from Pravara left canal than that of Pravara River, in both aqueous algal extract as well as algal extract in combination with cow urine. The two way anova reported significant results.

A similar result was obtained by Renuka Bai *et al*., (2008). They observed highest percent seed germination in *Phaseolus aureus* with the use of seaweeds. The effect of seaweed extract on seed germination percentage was reported as *Ulva fasciata*>*Asparagopsis taxiformis*> *Sargassum wightii*>Control. Thirumaran *et. al*. (2009) found that seeds of *Abelmoschus esculentus* treated with low concentrations of Seaweed Liquid Fertilizer with or without chemical fertilizers show good response in terms of seed germination. Abhang (2009) reported that 5 to 20% concentration of extracts in Blue Green Algae increased the seed germination process in fenugreek, spinach, chilli and tomato.

Shoot Length:

T1 (Control- DW) showed 9.96 cm shoot length, whereas, T2 (Control-20% CU) reported 11.1 cm shoot length. T3 (20 % Aqueous algal extract-Pravara river) gave 10.74% cm shoot length, T4 (20 % Aqueous algal extract-Pravara river) gave 11.10% cm shoot length and T5 (20% Cow urine algal extract –Pravara river)

showed 10.60 cm shoot length. In T6 (20 % cow urine algal extract – Pravara left canal) 11.66 cm shoot length was found.

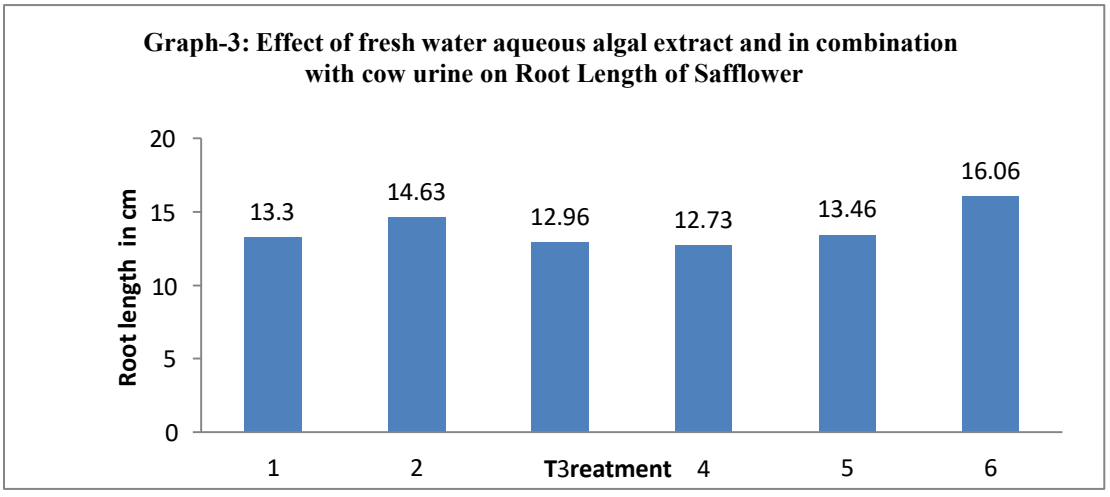


The above results showed that minimum shoot length was obtained in T1 treatment whereas maximum was reported in the T6 treatment i.e. 9.96 cm and 11.1 cm shoot length respectively. The obtained data reveals that maximum shoot length is enhanced due to the use of algal extract in combination with cow urine than that of only aqueous algal extract. It was also reported that shoot length was enhanced by the use of algal species collected from Pravara left canal than that of Pravara river, in both aqueous algal extract as well as algal extract in combination with cow urine. The two way anova reported significant results. Statistical analysis showed that there are noteworthy differences in % germination, length of radical, plant height, root length and number of leaves as compared to control.

Brahmhatt N. H. and Kalasariya Haresh S. (2015) showed the same work, that algal extracts can enhance seed germination, seedling growth, length radical, number of leaves and plant height. In plate culture, aqueous 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.

Renuka Bai *et al.,* (2008) reported that the effect of seaweed extracts obtained from *Ulva fasciata, Sargassum* VTT, and *Asparagopsis taxiformis* on the shoot length of *Phaseolus aureus*, were increased as compared to the control. Thirumaran (2009) observed maximum shooting length in *Abelmoschus esculentus* with a 20% concentration treatment of SLF.

Root Length:



T1 (Control- DW) showed 9.96 cm root length whereas T2 (Control-20% CU) reported 14.63 cm root length. T3 (20 % Aqueous algal extract-Pravara river) showed 12.96 cm root length and T4 (20% Cow

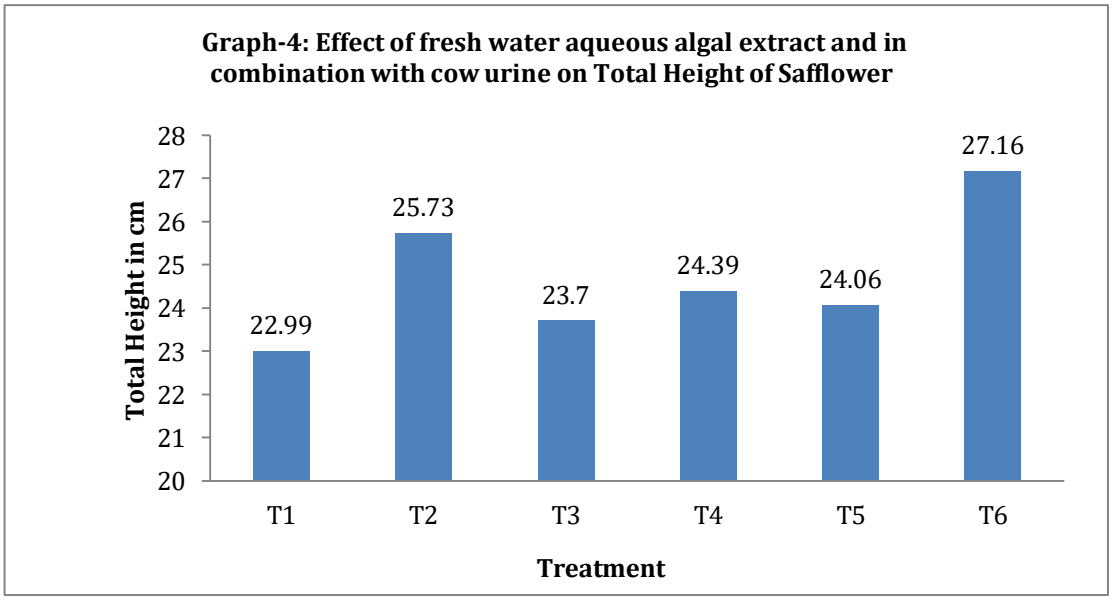
urine algal extract –Pravara river) gave 12.73 cm root length. In T5 (Aqueous algal extract –Pravara left canal) 13.46 cm root length was noticed whereas T6 (20 % cow urine algal extract – Pravara canal) gave 16.06 cm root length.

The above results showed minimum shoot length in T1 trail whereas maximum was reported in the T6 treatment i.e. 13.3 cm and 16.06 cm root length respectively. From the above data, it is revealed that maximum root length is enhanced due to the use of algal extract in combination with cow urine than that of only algal extract. It was also reported that root length was enhanced by the use of algal species collected from Pravara left canal than that of Pravara River, in both aqueous algal extract as well as cow urine algal extract samples. The two way anova reported significant results.

The same result was obtained by Mohan *et al*., (1994). Among the brown algae the extracts from *Padina* was found to be the most effective as it induce maximum root length and seedling growth followed by *Sargassum*. While in case of red algae *Helminhocladia* induced maximum activity. Xavier *et al*., (2000) determined that, seaweed liquid extracts of *Sargassum* and *Padina* at lower concentration leaded to increase the root length in cluster bean (*Cyamopsistetragonoloba* L.). Rajasulochana *et al*., (2008) reported that the maximum root length was recorded in seeds treated with a 1% concentration of *Ulva lactuca* extract in three plants (*Phaseolus mungo, Brassica juncea*, and *Trigonella foenum- graecum*) over the control.

Renuka Bai *et al.,* (2008) reported that seaweed extract obtained from *Ulva fasciata, Sargassum wightii* and *Asparagopsis taxiformis* has been found to be more effective in increasing the length of the main root of *Phaseolus aureus*. Thirumaram *et al.,* (2009) found that treatment of SLF obtained from *Rosenvingea intricata* showed maximum root length in *Abelmoschus esculentus*.

Total Height:



T1 (Control- DW) showed 22.99 cm total height and T2 (Control-20% CU) reported 25.73 cm total height. T3 (20 % Aqueous algal extract-Pravara river) showed 23.70 cm total height whereas T4 (20% Cow urine algal extract –Pravara river) showed 24.39 cm total height. In T5 (Aqueous algal extract – Pravara left canal) 24.06 cm total height was observed and in T6 (20 % cow urine + algal extract – Pravara left canal) 27.16 cm total height was found.

The above results showed that minimum total height was obtained in T1 treatment where as maximum was reported in the T6 treatment i.e. 22.99 cm and 27.16 cm total height respectively. From the above data, it is revealed that maximum total height is enhanced due to the use of algal extract in combination with cow urine than that of only algal extract. It was also reported that total height was enhanced by the use of algal species collected from Pravara left canal than that of Pravara River, in both

aqueous algal extract as well as cow urine algal extract samples. The two way anova reported significant results.

The same result was obtained by Venkataraman *et al.,* (1997) in the growing potential of seaweeds commonly available from mulberry shores, *Sargassum plagiophyllum*, and *Padinapavonica* on the growth of *Vignamungo* L. They reported an increase in growth of the treated plant in all concentrations (1%, 3%, 5%, 7%, and 10%) of seaweed liquid fertilizers. They observed the highest height (11.23% higher than the control) of plants treated with 1% seaweed liquid fertilizer. Abhang and Pingle (2012) worked on effect of foliar application of BGA extract on growth and yield of Fenugreek (*Trigonellafoenum-graecum* L.) var. Kasuri. They showed that application of *Noshecalcicola* and *Scytonemamillei* extract recorded highest plant height, no. of branches, no. of leaves, leaf area, fresh and dry weight, moisture percentage and green yield (191.20 g/ha) as compared to commercial fertilizer.

Conclusion

The present study demonstrated that freshwater algal extracts obtained from the Pravara River and Pravara Left Canal possess significant potential as natural liquid bio-fertilizers for enhancing the seed germination and seedling growth of Safflower (Carthamus tinctorius L.). Among the different treatments, the 20% cow urine-based algal extract from the Pravara Left Canal (T6) exhibited the highest effectiveness, resulting in maximum seed germination (95.00%), shoot length (11.66 cm), root length (16.06 cm), and total plant height (27.16 cm) compared to control treatments.

The findings indicate that combining algal extracts with cow urine significantly improves the growth performance of safflower compared to aqueous algal extracts alone. Furthermore, algal species collected from the Pravara Left Canal were observed to be more effective than those from the Pravara River in promoting germination and growth parameters. Statistical analysis using two-way ANOVA confirmed that the observed differences in seed germination, shoot length, root length, and total plant height among treatments were highly significant.

The results are in agreement with previous studies on the beneficial effects of algal and seaweed-based liquid fertilizers, confirming their ability to enhance nutrient uptake, stimulate plant metabolism, and promote overall growth. Hence, freshwater algal extracts, especially when combined with cow urine, can serve as an eco-friendly, cost-effective, and sustainable alternative to synthetic fertilizers.

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