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Rokade RD

Department of Botany, Arts,
 Science and Commerce College,
 Rahata, Maharashtra, India

Wabale AS

Padmashri Vikhe Patil College
 of Arts, Science and Commerce,
 Pravaranagar, Maharashtra,
 India

Varpe BD

Shri Sadguru Gangagir
 Maharaj Science, Gautam Arts,
 and Sanjeevani Commerce
 College, Kopergaon.
 Ahmednagar, Maharashtra,
 India

Pachore MV

Swami Muktanand College of
 Science Yeola, Savitribai Phule
 Pune University, Pune,
 Maharashtra, India

Corresponding Author:**Rokade RD**

Department of Botany, Arts,
 Science and Commerce College,
 Rahata, Maharashtra, India

Effect of algal biofertilizer on the growth of *Phaseolus vulgaris* L.

Rokade RD, Wabale AS, Varpe BD and Pachore MV

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Abstract

The effect of algae as a biofertilizer was tested on the growth of kidney bean seeds. The seeds were soaked overnight in different concentrations of an algal extract (1%, 5%, 10%, 15%, 20%, 25%) and compared with a control soaked in distilled water. The best results for seed germination, root and shoot growth, and overall plant height, were seen when the algal extract was used at a 15% concentration. This shows that algae can be an effective natural fertilizer for plant growth.

Keywords: Algal Extract, Biofertilizer, Seed germination, Root length, Shoot length, Total height, etc.

Introduction

Kidney bean (*Phaseolus vulgaris* L.), commonly known as Rajma, is a legume belonging to the Fabaceae family. It is widely grown in Maharashtra and is cultivated for both tender green beans and dry beans. Kidney beans are an essential part of many diets globally due to their nutritional value and low cost as a source of protein. These beans are particularly popular in Indian cities and are commercially grown, earning the title of "King of Nutrition" due to their high protein and fibre content. Additionally, kidney beans are used to manage obesity due to their healthy nutritional profile.

In this study, the Chitra variety of kidney beans was used, which are uniform in size, healthy in appearance, and obtained from the Agriculture Centre in Rahata, Ahmednagar. The application of biofertilizers plays a vital role in attractive crop yields. Using biofertilizers is important for getting good crop yields. However, using chemical fertilizers and pesticides for a long time can harm the environment and human health. These chemicals may increase food production in the short term, but they negatively impact the land's productivity and pose health risks.

Among the various types of organic fertilizers, freshwater algae is one of the most readily available options. Algal extracts have been shown to positively impact seed germination, seed vigour, and overall seedling growth. The benefits of algae are attributed to the occurrence of essential trace essentials and metabolites like growth regulators. These substances improve key plant growth factors, such as shoot and root length, seedling height, and vigour index.

This study discovers the effect of freshwater algae as a liquid biofertilizer on the growth and yield of kidney beans (*Phaseolus vulgaris* L.), aiming to offer an environmental and sustainable alternative to chemical fertilizers.

Materials and Methods

Freshwater algae were collected from Astagaon village, Rahata, Maharashtra. The algae were cleaned carefully with tap water to eliminate impurities and the algae samples were put in plastic bags with water to stop it from evaporating during transport. Once they arrived at the lab, the algae were dried in the shade. After they were completely dry, they were crushed into a fine powder using a crusher. The powdered samples were then kept in a refrigerator to preserve their quality until required for use in subsequent experiments. This process ensured that the algal biofertilizer was ready for application in the growth trials of *Phaseolus vulgaris* L.

Boiling Methods

To make the algal extract, 100 gram of fine algal powder was mixed with 1000 ml of distilled water and boiled at 100°C until the capacity reduced toward 100 ml. The extract was then filtered through muslin cloth, resulting in a 100% standard algal extract. From this, different concentrations were prepared, including 1%, 5%, 10%, 15%, 20%, and 25%. Distilled water was used as a control for comparison. This method of preparing the extract was based on the work of Bhosale *et al.* (1975) [5].

Experimental Setup -

To test how the algal extract affects kidney bean seed germination, the paper towel method from Singh *et al.* (1972) was used. In the experiment, 20 seeds were soaked in different amounts of algal extract for 12 hours. After soaking, the seeds were placed on germination paper. The experiment was repeated three times for accuracy.

On the germination paper, 20 soaked seeds were placed on one side, while a clean polythene sheet was placed on the other side. The seeds were arranged in four rows of five

seeds each. The germination paper was moved from the right side, with a plastic sheet wrapped around it and secured with rubber bands. This rolled germination paper was then placed vertically in a beaker with just enough water to keep it moist.

The first count for seed germination percentage was done after 5 days, and the final count was done after 9 days (Agrawal R.L., 1976). To measure total seedling growth, various factors such as root length, shoot length, and overall seedling height were observed. This method allowed for careful monitoring of seed germination and growth at different algal extract concentrations.

Percentage of seed germination.

$$\text{Germination \%} = \frac{\text{No. of seed germinated}}{\text{Total no. of seeds}} \times 100$$

Total seedling Height = Shoot Length + Root Length



Seed Germination of *Phaseolus vulgaris* L. (Control Condition)



1% concentration



5% concentration



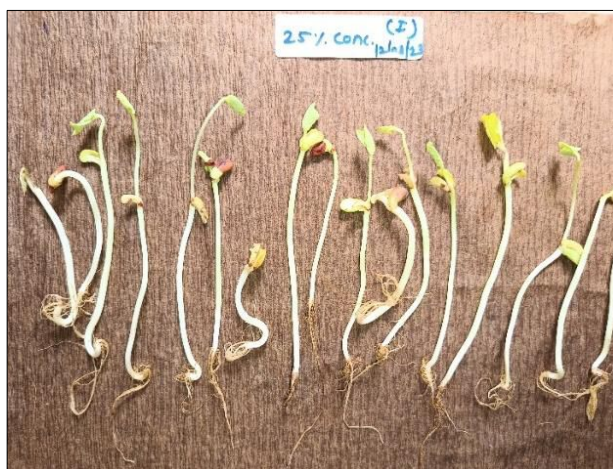
10% concentration



15% concentration



20% concentration



25% concentration

Table 1: Replication -I (R₁)

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇
Shoot Length (cm)	18.91	18.14	18.66	19.24	22.81	16.85	13.47
Root Length (cm)	10.78	9.25	10.35	10.51	11.72	9.45	7.65
Total Plant Height(cm)	29.70	27.39	28.39	30.03	34.53	26.66	20.77

Table 2: Replication -II (R₂)

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇
Shoot Length (cm)	18.99	19.58	19.65	20.20	23.24	15.91	16.48
Root Length (cm)	8.36	9.74	9.8	9.26	10.93	9.38	7.38
Total Plant Height (cm)	27.35	29.32	29.48	29.47	34.18	25.30	23.86

Table 3: Replication -III (R₃)

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇
Shoot Length (cm)	21.43	19.88	20.17	19.59	22.86	11.91	14.89
Root Length (cm)	7.64	5.34	6.48	7.54	10.23	5.76	6.11
Total Plant Height (cm)	28.27	25.23	26.66	28.25	32.97	7.67	21.00

Table 4: Mean of all Three Replications (R₁+R₂+R₃)

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇
Shoot Length (cm)	19.77	19.2	19.49	19.67	22.97	14.89	14.94
Root Length (cm)	8.92	8.11	8.87	9.10	10.96	8.19	7.04
Total Plant Height (cm)	28.44	27.31	28.17	29.25	33.89	23.19	21.87

T₁ - Control, T₂ - 1% Conc., T₃ - 5% Conc., T₄ - 10% Conc.,
T₅ - 15% Conc., T₆ - 20% Conc., T₇ - 25% conc.

Results

The results showed that the freshwater algal extract had a positive effect on kidney bean seed germination, root length, shoot length, and total seedling height. Among the different concentrations tested, the 15% algal extract concentration showed the best results. It resulted in the highest shoot length, root length, and total seedling height. Additionally, the 15% concentration also produced the highest seed germination rate, compared to the control group (which used distilled water). This indicates that the 15% algal extract is the most effective for promoting seed growth and improving seedling health in kidney beans.

**Fig:** Various Types of Concentration

Discussion

The results showed that the 15% algal extract concentration produced the best results for seed germination, root length, shoot length, and total seedling height. Other concentrations of algal extract also showed positive effects on some of these factors in kidney beans. For example, the total seedling height at different concentrations was as follows: 27.31 cm at 1%, 28.17 cm at 5%, 29.25 cm at 10%, 33.89 cm at 15%, 23.19 cm at 20%, 21.87 cm at 25%, and 28.44 cm at the control. The 15% concentration had the highest seedling height compared to the control. In terms of seed germination, the percentage at 1%, 5%, 10%, 15%, 20% and 25% was higher than at the control, with 100% germination at the 15% concentration. This shows that blue-green algal extract is very effective in promoting kidney bean seedling growth.

Conclusion

The results of the experiment show that the algal extract improved seed germination, increased the height of the seedlings, compared to the control group. Many farmers are now using fresh water algal extract as a biofertilizer. This biofertilizer is a low-cost, eco-friendly product that helps reduce environmental pollution. Then the farmers in their ponds easily available the algal material. So, algal mixture is used for experimental study.

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