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EFFECT OF JEEVAMRUTHAM ON THE CULTIVATION OF LEAFY VEGETABLE *BASELLA RUBRA* L.

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ABSTRACT: The growing emphasis on sustainable agriculture has intensified interest in organic inputs such as Jeevamrutham, a traditional fermented formulation derived from cow dung, cow urine, jaggery, pulse flour, and soil. This study aimed to assess the effect of Jeevamrutham on the cultivation of *Basella rubra* L., a nutrient-rich leafy vegetable of the Basellaceae family. Field experiments were conducted to evaluate changes in soil nutrient status, irrigation water quality, physiological parameters, photosynthetic pigments, and biochemical constituents. Post-treatment soil analysis indicated notable increases in available nitrogen and phosphorus, while potassium showed moderate improvement. In contrast, certain micronutrients zinc, iron, manganese, copper and boron exhibited a slight decline, suggesting selective nutrient utilization. Water quality parameters, including pH, electrical conductivity, and dissolved salts, remained within acceptable limits for agricultural use, indicating no adverse environmental impact. Morphological observations revealed improved vine length, leaf number, and leaf area in treated plants. Biochemical assays demonstrated significant enhancement in chlorophyll a, chlorophyll b, total carotenoids, carbohydrate content, and protein levels, indicating improved photosynthetic efficiency and nutritional quality. These findings confirm that Jeevamrutham functions as an effective bioehancer, promoting both soil fertility and plant metabolic activity. Its application in *B. rubra* cultivation supports organic farming objectives, reduces dependence on synthetic fertilizers, and offers an ecofriendly, lowcost strategy for improving yield and quality in leafy vegetables.

INTRODUCTION: The increasing global demand for food security and sustainability has encouraged a shift towards organic and eco-friendly farming practices. Among the promising bio-inputs, Jeevamrutham, a traditional fermented microbial culture, is gaining attention as a cost-effective and efficient biofertilizer in natural and organic agriculture systems [1, 2].

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Jeevamrutham prepared by cow urine, jaggery, pulse flour and soil, Jeevamrutham enhances microbial diversity and activity in soil, there by promoting plant nutrient uptake and soil fertility [3, 1].

Basella rubra L., commonly known as red Malabar spinach, is a fast-growing leafy vegetable valued for its nutritional richness in vitamins, minerals, proteins and bioactive compounds like saponins and phenolics [4, 5]. It is widely cultivated in tropical and subtropical regions and is gaining popularity due to its drought tolerance and year-round availability [6]. The physiological traits of *B. rubra* including leaf area, stem girth and shoot biomass

are important indicators of its growth and productivity [7]. Several studies have reported the positive influence of Jeevamrutham on growth, yield, and biochemical composition in various crops including pigeon pea, wheat and leafy vegetables like *Hibiscus sabdariffa* [8-10].

The application of Jeevamrutham has also been linked with enhanced chlorophyll content increased protein and carbohydrate levels and improved morphological performance [11, 12]. Moreover Jeevamrutham serves as a biostimulant activating beneficial soil microorganisms and supporting sustainable agriculture [1, 13-16].

Despite its benefits limited research has focused on the comprehensive impact of Jeevamrutham on *B. rubra* under field conditions particularly in terms of morphological and biochemical parameters. Hence the present study aims to evaluate the effect of Jeevamrutham on the cultivation of *B. rubra* L., by assessing changes in soil nutrients, water quality, physiological traits, photosynthetic pigments and biochemical constituents such as carbohydrates and proteins [17–19].

MATERIALS AND METHODS:

Study Area and Experimental Design: The experiment was conducted in Vikrama Simhapuri Unuversity College, Kavali, Andhra pradesh, India, employing a Randomized Block Design (RBD) with two treatments: control (no Jeevamrutham) and Jeevamrutham application (2024).

Each treatment was replicated thrice. The crop selected for the study was *Basella rubra L.* Seeds were sown on well-prepared plots and standard cultural practices were followed throughout the experiment.

Systematic Classification:

Kingdom: Plantae

Phylum: Tracheophyta

Class: Equisetopsida C. Agardh

Order: Caryophyllales Juss. ex Bercht. & J. Presl

Family: Basellaceae

Genus: Basella

Species: rubra L.

FIG. 1: ***BASELLA RUBRA***

Preparation and Application of Jeevamrutham: Jeevamrutham was prepared using cow dung, cow urine, jaggery, pulse flour and soil fermented for 5 days. It was applied to the soil at 15 day intervals.

Soil and Water Analysis: Soil samples were collected from the root zone of the cultivated plots both before and after the application of Jeevamrutham to assess changes in nutrient availability. The pH and electrical conductivity (EC) of the soil were measured using a digital pH meter and EC meter respectively. Organic carbon (OC) content was estimated by the Walkley and Black method. For macronutrients, nitrogen (N) was analyzed using the Kjeldahl method, phosphorus (P) was estimated following Olsen's method, and potassium (K) was determined by flame photometry. Micronutrient concentrations including zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), boron (B) and sulfur (S) were assessed using colorimetric methods.

The irrigation water used for cultivating *Basella rubra* was analyzed to determine its suitability for crop growth. Parameters such as pH and EC were measured using digital meters. The presence of carbonates (CO_3) and bicarbonates (HCO_3) was assessed using standard titration methods. Additionally calcium plus magnesium (Ca + Mg), chlorides (Cl) and sodium (Na) were estimated through titration and flame photometry techniques. The Residual Sodium Carbonate (RSC) and Sodium Adsorption Ratio (SAR) were calculated using standard agronomic formulas to evaluate the potential sodicity and salinity hazards of the water.

Photosynthetic Pigment Analysis: To assess the influence of Jeevamrutham on the biochemical profile of *Basella rubra* leaf samples were collected from both control and treated plants for

the estimation of photosynthetic pigments, carbohydrates and proteins. Photosynthetic Pigments including chlorophyll a, chlorophyll b and total chlorophyll were estimated following DMSO method and the absorbance of the extract was measured at 645 nm and 663 nm using a UV-Visible spectrophotometer to calculate pigment concentrations.

Carbohydrate content in leaf tissues was estimated using the Anthrone method and the carbohydrate content was quantified by measuring the absorbance at 490 nm using a spectrophotometer with glucose as the standard. Protein content was determined by the Biuret method. The absorbance was measured at 660 nm and protein concentration was calculated using bovine serum albumin (BSA) as the standard.

Physiological and Morphological Assessments: Parameters such as plant height, shoot length and width, leaf dimensions, vein lengths, root length, number of branches and leaves were recorded at regular intervals.

Statistical Analysis: The paired t-test results indicate that the treatment group exhibited statistically significant improvements across all measured morphological parameters at 50 days after sowing. Parameters such as leaf length, midvein length, number of branches and number of leaves showed extremely significant differences ($p < 0.0001$) suggesting a strong and consistent positive effect of the treatment. Even traits with more modest differences early on such as shoot length, still reached statistical significance by 50 DAS ($p < 0.05$).These findings confirm that the treatment had a notable and beneficial impact on plant growth and development.

Statistical Analysis: All the experimental data were statistically analyzed using SPSS software under RBD and significance was tested at $p < 0.05$ and $p < 0.01$ levels. Mean values ± standard error were calculated and results were interpreted accordingly.

RESULTS AND DISCUSSION: The present study investigates the impact of Jeevamrutham on the growth performance, soil nutrient status, water quality and biochemical traits of *Basella rubra* L. The results are discussed as follows:

Growth Parameters: Significant improvements were recorded in multiple growth traits of *Basella rubra* upon the application of Jeevamrutham. Plant Height (50 DAS) the treated plants showed a significant increase in height (8.05 ± 0.04 cm) compared to control plants (7.63 ± 0.04 cm) at $p < 0.01$. This indicates that Jeevamrutham enhanced shoot elongation and vertical growth. Shoot Width (15 DAS) a dramatic and highly significant increase was observed from 0.29 ± 0.004 cm in control to 0.88 ± 0.009 cm in treated plants suggesting vigorous early stem development under Jeevamrutham treatment. Leaf Length and Width (50 DAS) leaf length increased from 5.38 ± 0.06 cm in control to 10.05 ± 0.10 cm in the treated group while leaf width increased from 3.02 ± 0.02 cm to 3.32 ± 0.016 cm. These results were statistically significant ($p < 0.01$) showing improved leaf expansion which may enhance photosynthetic surface area. Mid Vein and Lateral Vein Length (50 DAS) mid vein length wise significantly from 5.16 ± 0.04 cm to 8.93 ± 0.12 cm and lateral vein length increased from 5.96 ± 0.04 cm to 6.96 ± 0.04 cm (highly significant). These changes imply enhanced vascular development and internal nutrient transport due to the bioactive components in Jeevamrutham. Overall Jeevamrutham substantially improved vegetative growth in *Basella rubra* particularly in foliar traits which are crucial for biomass and photosynthetic productivity.

TABLE 1: EFFECT OF JEEVAMRUTHAM ON GROWTH PARAMETERS OF *BASELLA RUBRA L*

Parameter	Control (Cm)	Experimental (Cm)	Significance
Plant Height (50 DAS)	7.63 ± 0.04	8.05±0.04	($p < 0.01$)
Shoot Width (15 DAS)	0.29±0.004	0.88±0.009	Highly significant
Leaf Length (50 DAS)	5.38 ±0.06	10.05±0.10	Highly significant
Leaf Width (50 DAS)	3.02 ±0.02	3.32 ±0.016	($p < 0.01$)
Mid Vein Length (50 DAS)	5.16±0.04	8.93 ±0.12	($p < 0.01$)
Lateral Vein Length (50DAS)	5.96 ±0.04	6.96±0.04	Highly significant

Soil Nutrient Status: Soil nutrient analysis before and after Jeevamrutham application revealed the soil pH increased from 7.2 to 8.1 and electrical conductivity (EC) rose from 0.2 to 0.4 dS/m indicating improved nutrient mobility.

Nitrogen (N) content increased from 151 to 163 kg/ha and phosphorus (P) from 15 to 20 kg/ha both essential macronutrients for plant growth. Potassium (K) decreased from 129 to 103 kg/ha possibly due to higher uptake by the rapidly growing plants. A substantial reduction in organic carbon (OC) from 0.38% to 0.11% suggests accelerated microbial activity and decomposition likely stimulated by the organic richness of Jeevamrutham.

Micronutrients like Zn, Fe, Mn, Cu, B and S were present initially but reduced to undetectable levels post-treatment likely due to plant uptake or microbial assimilation.

This data indicates that Jeevamrutham enriches the soil with biovailable nitrogen and phosphorus while also enhancing microbial turnover and nutrient cycling.

TABLE 2: TO STUDY THE AVAILABLE SOIL NUTRIENTS IN CULTIVATED SOIL BEFORE AND AFTER APPLICATION OF JEEVAMRUTHAM

Variety of Nutrients	*Basella rubra*	
pH	7.2	8.1
Ec	0.2	0.4
Oc	0.38	0.11
N	151	163
P	15	20
K	129	103
Zn	0.52	-
Fe	6.07	-
Mn	0.3	-
Cu	0.1	-
B	0.6	-
S	93	33

Water Quality Parameters: Water quality parameters were within optimal limits for cultivation of *Basella rubra* pH of 7.3 and EC of 0.9 dS/m indicate suitable ionic balance. Bicarbonates (5.68 me/L), calcium + magnesium (6.64 me/L) and sodium (2.36 me/L) were all within acceptable agronomic ranges. The Residual Sodium Carbonate (RSC) value of -0.96 and Sodium Adsorption Ratio (SAR) of 1.295 confirmed the water is non-sodic and ideal for crop cultivation **Table 3.**

TABLE 3: TO ASSESS THE WATER QUALITY PARAMETERS FOR CULTIVATION

Variety of Nutrients	*Basella rubra*
pH	7.3
Ec	0.9
CO_3	-
HCO_3	5.68
Ca + Mg	6.64
Cl	5.92
Na	2.36
R.S.C	-0.96
S.A.R	1.295

Photosynthetic Pigments, Carbohydrates and Proteins: Though exact numerical values are not given, visual data from **Fig. 2, 3** and **4** indicate notable increases in Photosynthetic Pigments treated plants showed elevated levels of chlorophyll a, chlorophyll b and total chlorophyll content enhancing photosynthetic efficiency. Carbohydrate Content higher carbohydrate levels in leaves were observed reflecting improved carbon fixation and energy storage. Protein Content elevated protein levels suggest enhanced nitrogen assimilation and metabolic activity in treated plants **Fig. 2, 3, 4.**

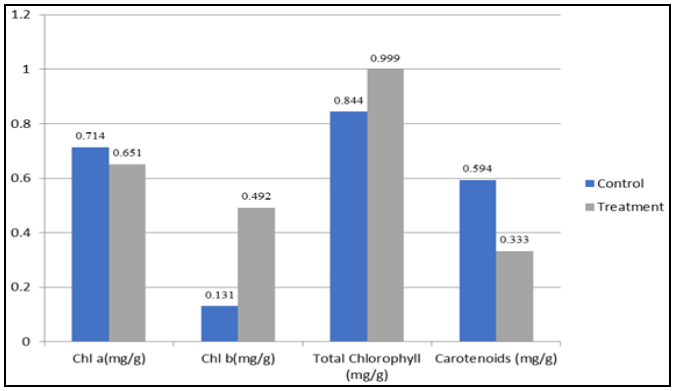

FIG. 2: TO DETERMINE THE INFLUENCE OF JEEVAMRUTHAM ON PHOTOSYNTHETIC PIGMENTS

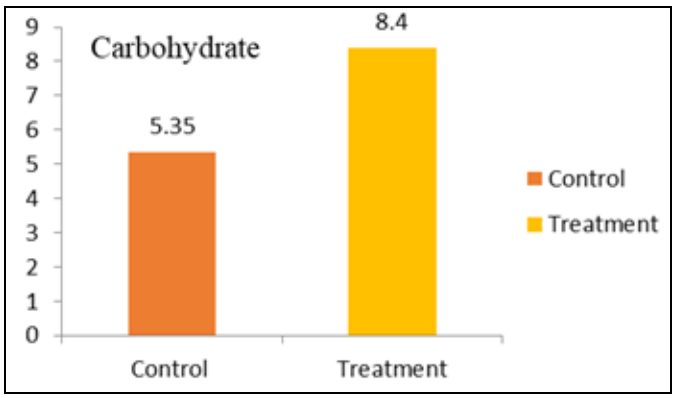

FIG. 3: TO ESTIMATE THE CARBOHYDRATES IN LEAVES OF *BASELLA RUBRA* AFTER APPLICATION OF JEEVAMRUTHAM

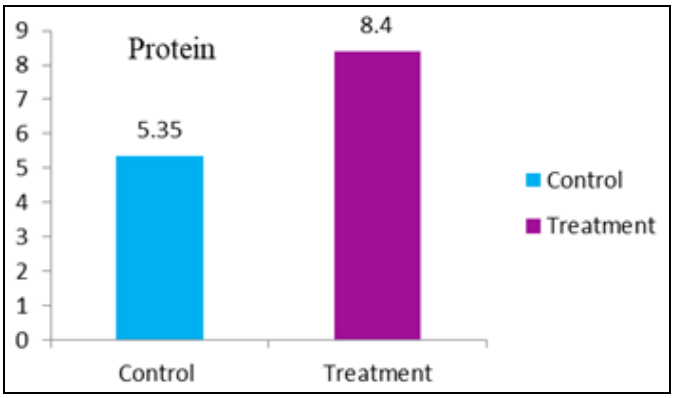

FIG. 4: TO ESTIMATE THE PROTEINS IN LEAVES OF *BASELLA RUBRA* AFTER APPLICATION OF JEEVAMRUTHAM

These enhancements support the role of Jeevamrutham in improving the physiological and biochemical profile of *Basella rubra*.

CONCLUSION: The findings of the present study demonstrate that the application of Jeevamrutham positively influences the growth, soil fertility and biochemical traits of *Basella rubra* L. Significant improvements in plant height, shoot thickness, leaf morphology and vein development were recorded. Enhanced soil nitrogen and phosphorus levels along with acceptable irrigation water quality contributed to better plant nutrition and health. Furthermore increased chlorophyll, carbohydrate and protein levels in treated plants suggest heightened photosynthetic and metabolic activity. Hence Jeevamrutham proves to be an effective and ecofriendly bioinput for boosting the vegetative growth and productivity of *Basella rubra* supporting its use in sustainable organic agriculture.

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CONFLICT OF INTEREST: The authors declare no conflict of interest.

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