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ORIGINAL ARTICLE **OPEN ACCESS**

A study on the morphological and selected biochemical parameters in Fenugreek plants treated with Jasmonic acid

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ABSTRACT

The phytohormone Jasmonic acid and its derivatives are common cyclopentanone chemicals that have impacts on several levels of morphology, physiology, cellularity, and molecular structure. The goal of the current study was to comprehend the physiological and biochemical alterations in fenugreek that resulted from jasmonate treatment, with a focus on protein content and carbohydrate contents. After initiation of several jasmonic acid treatment regimes, growth in terms of entire plant length was observed on day 7. Protein content, carbohydrate content and chlorophyll content were increased in dose dependent manner in the seedlings treated with jasmonic acid. All jasmonic acid levels considerably boost overall plant growth. This demonstrates that the high quantities of jasmonic acid promote adventitious root production, root growth, and have a favourable impact on shoot growth.
Key word: Jasmonic acid (JA), plant growth, biochemical content, Chlorophyll.

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INTRODUCTION

Plants are constantly being attacked by a variety of external forces. Plants depend on a varied collection of receptors to trigger a complex innate immune system in response to the environmental stresses [1]. These receptors are capable of detecting a wide range of signals, including internal systemic regulatory signals like phytohormones and exterior signals generated by pathogens like elicitors. The phytohormones such as jasmonic acid (JA), salicylic acid (SA), and ethylene trigger the pathways involved in plant defense reactions [2,3].

JA involves in the plant defense against different environmental stresses. Plants have developed intricate mechanisms to repel, poison, or draw in their natural foes. These mechanisms are controlled by phytohormone signalling, particularly the JA signalling system [4]. Jasmonates have gained attention for potential uses in human health due to their anti-inflammatory and anti-cancer characteristics [5]. JA and MeJA are involved in signaling the plant's reaction to injury and disease assault in several higher plants [6]. These hormones cause particular proteins to be produced and offer plants resilience to stress in situations involving salinity, cold, water, and mechanical stress such as pathogen assault and wounding. JA had distinct effects on seedling root growth [7,8].

The current study focusses on the impact of jasmonic acid on certain biochemical reactions in the development of *Trigonella foenum-graecum* L. seedlings, examine the growth of the seedlings under different concentration of Jasmonic acid (5-25 µM), the quantify protein and carbohydrates determine the effects of jasmonic acid on chlorophyll stability index,

MATERIAL AND METHODS

Fenugreek (*Trigonella foenum-graecum L.*) seeds were thoroughly washed with deionized water after being surface sterilised with 0.1% mercuric chloride solution for 30 seconds. 20 seeds were put in each petri dishes that had been double-lined with filter sheets which were hydrated for 7 days with distilled water. Healthy seedlings were placed in boiling test tubes containing solutions of jasmonate at various concentrations, including 5µM, 10µM, 15µM, 20µM and 25µM, kept in the same environment for an additional seven days. Each set had five duplicates, and a control set of seedlings was kept in distilled water. The seedlings were examined for morphological characteristics and different biochemical indicators after seven days [7].

Morphological parameters

The root and shoot portions of the plants were separated after being properly rinsed with deionized water. Both the root and the shoot's length were measured in centimetres.

Total chlorophyll test.

Using the Amon technique (1949), the total chlorophyll content in the leaves of control and seedlings treated with jasmonic acid was calculated. [9].

Total Carbohydrate content

The total sugars in plant seedlings subjected jasmonic acid was determined by Anthrone method [10].

Total protein test

Protein content in the seedlings were estimated by Lowry et al., (1951) A standard curve made from bovine serum albumin was used to determine the protein content in the plant seedlings subjected to jasmonic acid [11].

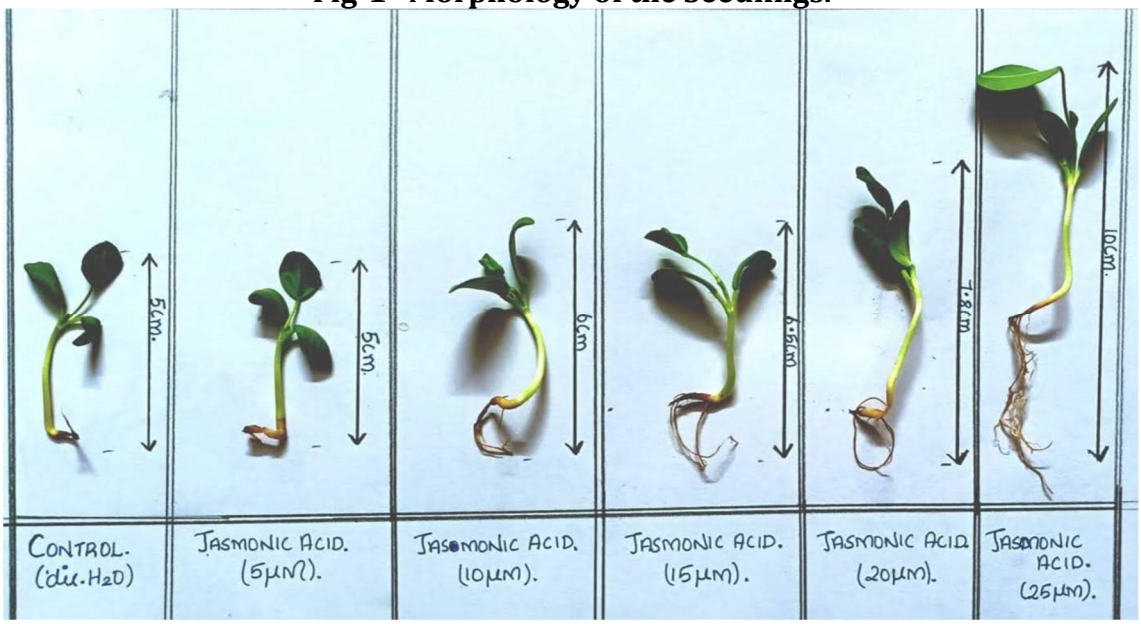
RESULT AND DISCUSSION

The results of the present study about the impact of jasmonic acid during seedling growth on total protein, carbohydrates, chlorophyll, and tolerance indicators in high yielding fenugreek (*Trigonella foenum-graecum L.*). are discussed in the following

Morphological parameters

The growth of the plants in terms of the whole plant length is recorded on 7th day after treatments with jasmonic acid. The lengths of the fenugreek seedlings were observed and presented in fig-1.

Fig-1 Morphology of the Seedlings.



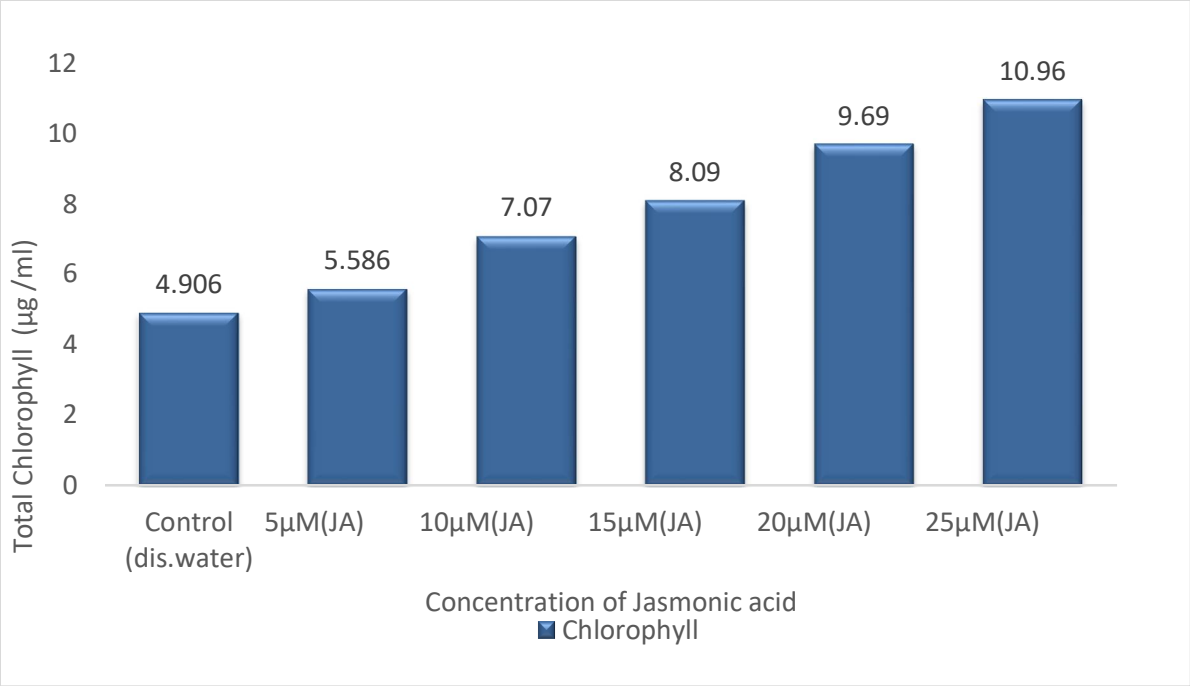
The growth of seedlings i.e., the lengths of the seedlings gradually increased with increase in concentration of jasmonic acid. In general, low concentration of jasmonic acid has no impact on the growth of the seedlings. Whereas 25 μM jasmonic acid treated seedlings showed considerable increase when compared to control seedlings.

Shivani, *et al.,* (2022) reported that treatments under salt stress had a big impact on growth traits including plant height and the number of primary and secondary branches. Generally speaking, cell division and cell elongation are two significant physiological processes that have an impact on plant development in terms of plant height, number of leaves, branches, etc., and ultimately result in a reduction in the overall accumulation of dry matter [12].

Total chlorophyll content

The total chlorophyll content in leaves of control and jasmonic acid treated plants was estimated (fig 2). The total chlorophyll content was enhanced with increasing concentrations of jasmonic acid. Total chlorophyll content over control was high in 250 μM jasmonic acid concentration. Jasmonic acid treatments (250μM) resulted a increase in chlorophyll content when compared to control. From the present study it is inferred that jasmonic acid promotes the total chlorophyll content on the plants.

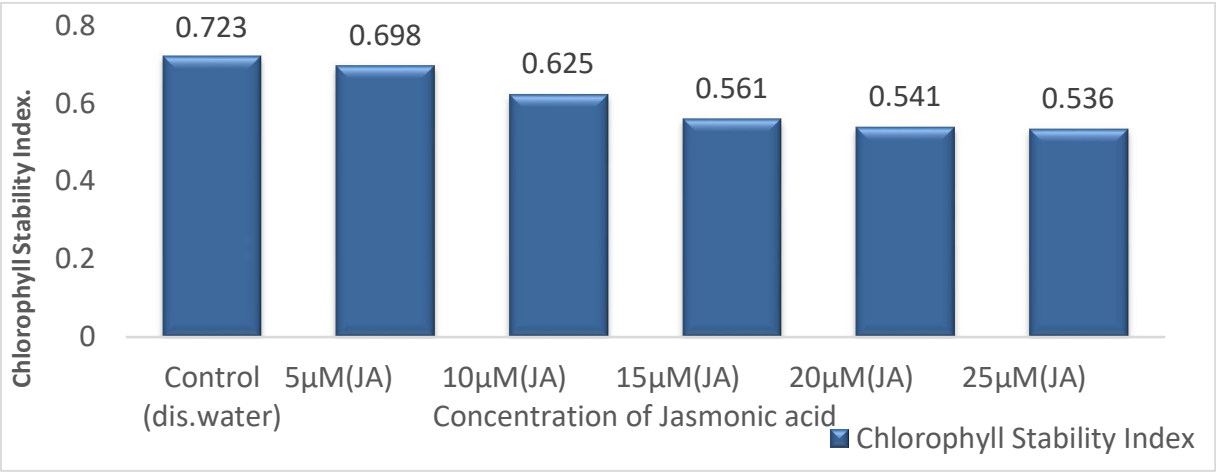
Fig-2 Total Chlorophyll Content



Chlorophyll stability index

The chlorophyll stability index in leaves of control and jasmonic acid treated plants was calculated (Fig 3). The chlorophyll stability index was found to be elevated with increasing concentrations of jasmonic acid. The loss of chlorophyll over control was high in 250 µM JA concentration. JA treatments (250µM) resulted a decrease in chlorophyll content when compared to control. Jasmonic Acid promotes the senescence and abscission of leaves by chlorophyll degradation.

Fig-3 Chlorophyll stability Index



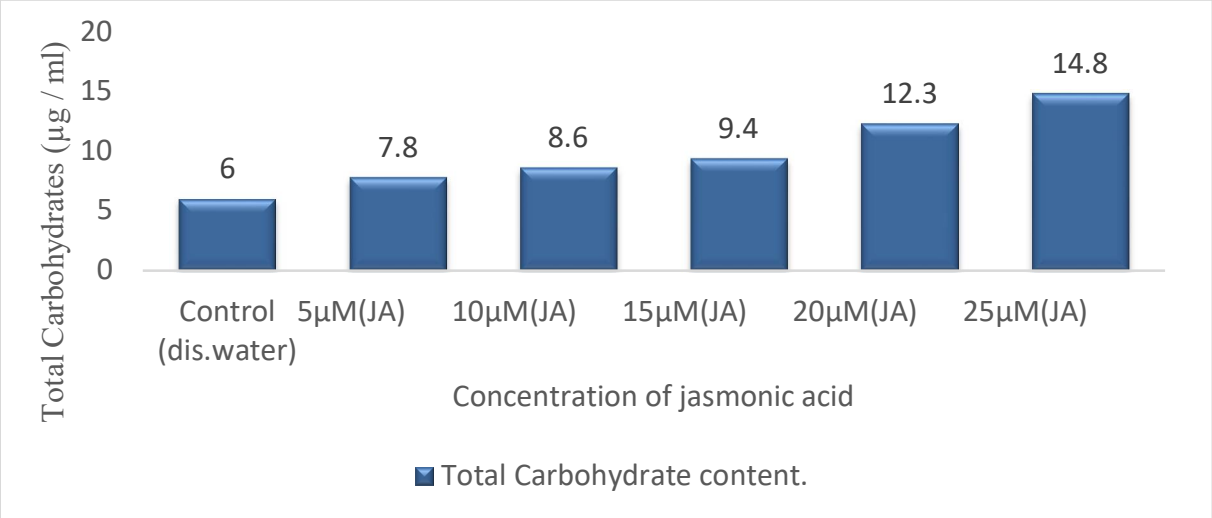
When compared to control seedlings, jasmonic acid-treated seedlings had a higher CSI (Chlorophyll Stability Index). The CSI is completely off the control at greater concentrations. The rise in CSI may be brought on by the breakdown of chlorophyll and the suppression of photosynthesis-related proteins by jasmonic acid.

To support our finding Kumari, *et al.,* (2001) reported that with increasing levels of jasmonic acid in the groundnut cultivar, the CSI values varied. Chlorophyll degraded significantly at high JA (250 pM) concentrations; even after heating, the chlorophyll pigments in control and treated plants were different. The treated plants exhibited a significant difference in CSI values, with the higher the CSI value, the more chlorophyll degraded in JA-treated plants compared to the control plants [11].

Total carbohydrate test

The total carbohydrate content had expressed in (µg/ml) equivalent to glucose(standard). Total carbohydrates content is increased with plants treated with increased concentration of jasmonic acid. The resultant was observed that highest concentration contains 14.8µg/ml (Fig-4)

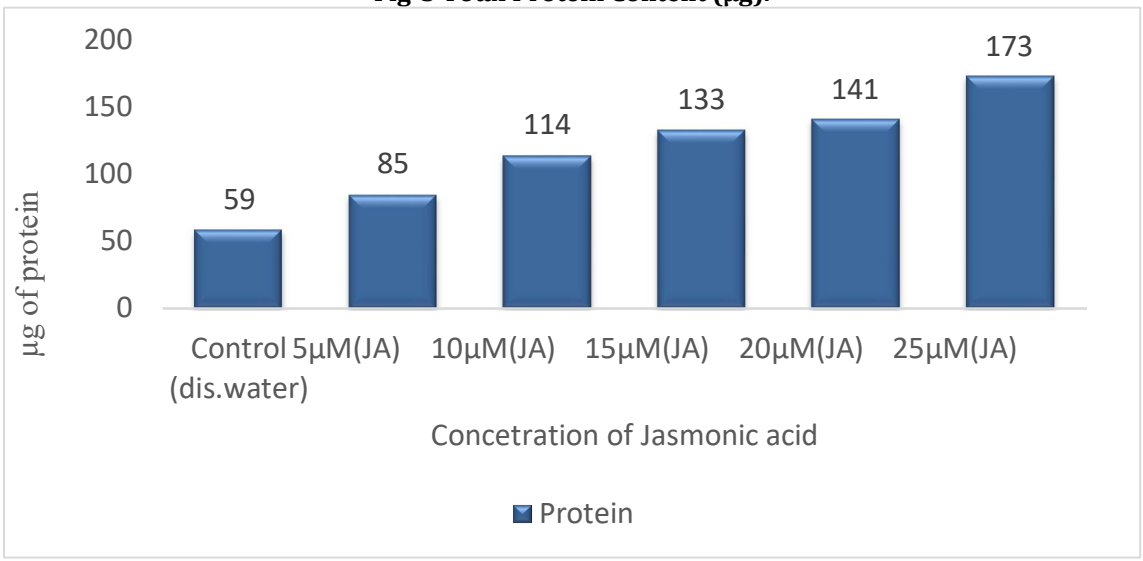
Fig-4 Total Carbohydrates Content (µg/ml).



Total protein test

Total protein content is increased as the seedlings is treated with increased concentration of jasmonic acid (Fig-5). The resultant was observed that highest concentration contains 173µg/ml) and infers that the protein content increased with increasing JA concentration. The total protein content had expressed in (µg/ml) equivalent to bovine serum albumin (standard).

Fig-5 Total Protein Content (µg).



In accordance with our studies, chickpea genotype BG-362, salt stress and methyl jasmonate concentrations have an impact on protein content at different stages. (Shivani, *et al.,* 2022). The findings showed that there was a substantial difference in total soluble protein concentration between treatments. While JA treatment (5 µM) had the lowest total soluble protein content throughout all development stages. The greater results were seen at 25 µM JA treated plants indicating that the protein content increased with increasing phytohormone concentration [12]

CONCLUSION

It is evident from the initial analysis that jasmonic acid is involved in a number of characteristics that cause the breakdown of chlorophyll, including CSI, total protein, and carbohydrates. Furthermore, it may be deduced that low concentrations have minimal impact, but greater concentrations have a considerable impact on the plant's biochemical and physiological processes.

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