Studies on effect of carbon based nanomaterial, novel plant growth promoting agents on growth of jasmine (Jasminum sambac Ait.)

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Abstract
Multi-carbon nanotubes (MWCNTs) having an average particle size of 71.81 nm with different concentration of MWCNTs (3 and 7 g/L) and graphene oxide having a diameter of 65.99 nm with different concentrations (20 and 40 mg/L), hydrogen rich water (500 ppb and 1000 ppb) and with three concentration of sodium hydrosulfide (0.5 mg, 5 mg, 50 mg) as foliar spray along with absolute control were used as a foliar spray at 15 days interval during 60 days of growth period in jasmine (Jasminum sambac). This study provided some insights into the use of carbon based Nanomaterials. The multi-walled carbon nanotubes (MWCNTs) with 3 g/L treated plants had maximum plant height (57.91 cm), internodal length (4.94 cm), number of leaves (170.55), plant spread E-W (46.01 cm), N-S (55.69 cm). Whereas, graphene oxide treated plant with 20 mg/L showed a promotional effect on plant growth attributes.

Keywords: Carbon nanotube, graphene oxide, jasmine, hydrogen rich water, vegetative growth

Introduction
Jasmine (Jasminum spp.) is a historically grown "queen flower" of the Oleaceae family that is incredibly fragrant and appreciated for its distinctive Aroma. These species are used to produce flowers and value-added products like essential oils, absolutes, and concretes (Bera et al. 2015) [1]. The Oleaceae family's historically regarded “queen flower,” Jasmine (Jasminum spp), is incredibly fragrant and prized for its distinctive Aroma. The Indian native Jasmine sambac, sometimes referred to as Arabian Jasmine or Tuscan Jasmine, has a powerful fragrance and opens at night and closes in the morning. It is used to produce essential oils, concrete, and absolute and has a strong sweet scent. In folk medicine, flowers are used as an antispasmodic, aphrodisiac, antimicrobial, and wound healer (Arun et al. 2016; Hirapara et al. 2017) [2, 3]. It is anticipated that chemicals like graphene oxide, a powerful antibacterial agent, will enhance plant growing conditions and enhance plant development (He et al. 2018) [4]. By keeping the above information into account, it is necessary to investigate novel compounds in the technology used to produce Jasminum sambac Cv. Ramanathapuram Gundumalli. As a result, the current study proposes the use of graphene oxide, sodium hydrosulfide, hydrogen-rich water, and multiwalled carbon nanotube to examine the effects on plant growth, flower bud development, and floral quality over the growing season.

Materials and Methods
The present study was conducted during 2021-2022 at Instructional farm, madanapuram, college of horticulture, mojerla, sri Konda laxman Telangana state Horticultural University. The experiment was laid out in Randomized Block design with three replications and ten treatments. comprising of Multi-Walled Carbon Nano tubes (MWCNTs), Graphene oxide, Sodium hydrosulfide and Hydrogen Rich Water (HRW) sprayed 15 days intervals from the date planting up to 60 days of growth period to study the influence of the treatments on growth, yield, quality, and shelf life of Jasmine (Jasminum sambac Ait.) Cv. Ramanathapuram Gundumalli.

As per the treatment details, one spray of each treatment was taken with hand operated pump pressure sprayer om whole established plant after planting. The required concentration of Multi walled Carbon Nano Tube (MWCNTs) which was synthesized by super growth method, and graphene oxide and Sodium Hydrosulfide procured from Sigma Aldrich Chemicals, India, and Hydrogen Rich water prepared with two concentrations (500 ppb and 1000 ppb)by using...
Wellon molecular Hydrogen Generator about 2 litre of solution of each treatments was sprayed per plant at the time of application at fifteen days intervals from date of First application to 60 days growth period on established plants of one year old. The observation were recorded from nine plants in each treatment on Plant height, Number of nodes Inter nodal length, Number of leaves per plant. Plant spread E-W. The data was collected at fifteen days intervals from date of First application to 60 days growth period.

Results and Discussion

Effect on Growth Parameters

The data presented in table 2 showed significant difference in growth parameters due to chemical sprays.

Plant height

The results indicated in table 1 Multi-walled carbon nanotube (MWCNTs) at 3g/lit as a foliar spray of T1 recorded significantly maximum mean of plant height at 15 days (21.83 cm), at 30 days (36.15 cm) at 45 days (47.27 cm), at 60 days (53.26 cm) whereas, the treatment control T0 recorded minimum mean of plant height at 15 days (21.53 cm), at 30 days (25.40 cm) at 45 days (28.96 cm), at 60 days (32.75 cm) which might be explained by the mechanism of thigmomorphogenesis when auxin activity increases and plant growth increases, which stimulates the growth of the plant's stems. This result is similar with what Smirnova et al. (2011) [9] reported in Onobrychis.

Internal length

The maximum mean of internal length was observed Multi-walled carbon nanotube (MWCNTs) at 3g/lit as a foliar spray extension growth in inter nodal length at 15 days (3.82 cm), 30 days (4.03 cm), 45 days (4.46 cm) and 60 days (4.94 cm) whereas, the treatment control T0 recorded minimum mean of nodes per primary shoot at 15 days (3.15), at 30 days (3.9) at 45 days (3.47), at 60 days (4.14). Since arginine is a significant source of nitrogen storage in the plant metabolome and is thought to play a role in synthesis and plant growth, an increase in nitric oxide accounts for an increase in chlorophyll content. Additionally, glutathione synthase and reductase as well as MWCNTs have an impact on the gene expression of arginine. This research contradicts the agricultural outcomes given by Mukherjee et al. (2016) [10].

Number of leaves per plant

The plant was observed Multi-walled carbon nanotube (MWCNTs) at 3g/lit as a foliar spray produced maximum number of leaves per plant at 15 days (47.58), 30 days (88.26), 45 days (141.25) and 60 days (170.55) whereas, the treatment control T0 recorded minimum mean of nodes per primary shoot at 15 days (36.93), at 30 days (72.06) at 45 days (122.58), at 60 days (124.82). The combined morphological and physiological study showed that MWCNTs considerably increased plant growth and biomass compared to control after roughly 5–10 days of exposure in our experiment. Plants treated with MWCNTs demonstrated beneficial benefits that were dosage dependent on the quantity and size of leaves. In the case of garlic, Srivastava et al. (2014) [11] observed.

Plant spread

The plant spread in E-W direction was observed Multi-walled carbon nanotube (MWCNTs) at 3g/lit as a foliar spray recorded highest plant spread (E-W) at 15 days (19.19 cm), T9 at 30 days (30.76 cm), T1 at 45 days (38.91 cm) T1 at 60 days (46.01 cm). This implies that MWCNT application increased the amount of carbohydrates accumulated in leaves, which may have increased photosynthetic activities by extending the range of light wavelengths that activate a plant photosynthetic system. Normal plants absorb about 10% of full sunlight, but the applied MWCNTs passively transport and irreversibly localise within the lipid envelope of plant chloroplasts, promoting over three-fold higher photosynthetic activity. These are similar to the results reached by Giraldo et al. (2014) [12] and ultimately lead to an expansion of plant dispersion. More directly correlated with photosynthetic efficiency is plant spread.

Table 2: Effect of Carbon Based Nanomaterial, Sodium Hydrosulfide (NaHS) and Hydrogen Rich Water on plant height (cm) of Jasmine (Jasminum Sambac Ait.) Cv. Ramanathapuram Gundumalli

<table>
<thead>
<tr>
<th>Treatments</th>
<th>0 Days</th>
<th>15 Days</th>
<th>30 Days</th>
<th>45 Days</th>
<th>60 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0 (control) Deionized water (1 liter)</td>
<td>10.19±0.1a</td>
<td>14.4±0.14b</td>
<td>21.53±0.15c</td>
<td>27.66±0.21d</td>
<td>32.75±0.19e</td>
</tr>
<tr>
<td>T1-Multi-walled carbon nanotube (3 g/liter of water)</td>
<td>9.49±0.11a</td>
<td>21.83±0.1a</td>
<td>36.15±0.16a</td>
<td>47.27±0.1a</td>
<td>57.91±0.16a</td>
</tr>
<tr>
<td>T2-Multi-walled carbon nanotube (7 g/liter of water)</td>
<td>8.22±0.13b</td>
<td>19.39±0.16b</td>
<td>32.71±0.22b</td>
<td>43.11±0.32c</td>
<td>53.26±0.35c</td>
</tr>
<tr>
<td>T3-Graphene oxide (20 mg/liter of water)</td>
<td>8.28±0.07b</td>
<td>17.46±0.1c</td>
<td>30.31±0.09cd</td>
<td>39.23±0.08d</td>
<td>47.95±0.08d</td>
</tr>
<tr>
<td>T4- Graphene oxide (40 mg/liter of water)</td>
<td>7.75±0.36b</td>
<td>16.83±0.37cd</td>
<td>28.96±0.36d</td>
<td>37.37±0.37e</td>
<td>45.59±0.37e</td>
</tr>
<tr>
<td>T5-Sodium Hydrosulfide (0.5 mg/liter of water)</td>
<td>9.37±0.15a</td>
<td>15.57±0.21cd</td>
<td>25.40±0.2e</td>
<td>33.52±0.2g</td>
<td>41.45±0.19i</td>
</tr>
<tr>
<td>T6-Sodium Hydrosulfide (5 mg/liter of water)</td>
<td>8.15±0.77b</td>
<td>17.57±0.59de</td>
<td>25.83±0.75e</td>
<td>35.45±0.76f</td>
<td>44.38±0.77g</td>
</tr>
<tr>
<td>T7-Sodium Hydrosulfide (50 mg/liter of water)</td>
<td>9.49±0.14a</td>
<td>17.61±0.14c</td>
<td>28.96±0.16d</td>
<td>39.12±0.2d</td>
<td>48.94±0.2d</td>
</tr>
<tr>
<td>T8-Hydrogen rich water (500 ppb)</td>
<td>9.45±0.17a</td>
<td>17.29±0.32</td>
<td>31.34±0.34bc</td>
<td>42.40±0.57c</td>
<td>52.59±1.61c</td>
</tr>
<tr>
<td>T9-Hydrogen rich water (1000 ppb)</td>
<td>10.10±0.32a</td>
<td>21.62±0.05a</td>
<td>34.90±0.15a</td>
<td>45.53±0.14b</td>
<td>55.99±0.21b</td>
</tr>
</tbody>
</table>

Mean 9.049 17.976 29.609 39.069 48.081

S.E 0.311 0.522 0.532 0.541 0.559

C.D at 5% level 0.924 1.55 1.58 1.606 1.662

Results expressed as Means±SE
From this investigation it has been concluded that application of novel chemical such as MWCNT had profound effect on plant growth in jasmine. The results have confirmed the advantages of the MWCNT for jasmine plant growth promotion.

**References**


