Effect of foliar application of micronutrients, novel organic liquid fertilizer and sea weed extract on yield of okra [Abelmoschus esculentus L. (Moench)]

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Abstract
The experiment entitled “Effect of foliar application of micronutrients, Novel organic liquid fertilizer and Sea weed extract on okra [Abelmoschus esculentus L. (Moench)]” was carried out during kharif season of 2016-17 and 2017-18 at the Vegetable Research Scheme, Regional Horticultural Research Station, Navsari Agricultural University, Navsari, Gujarat. The experiment was conducted on fixed plot site with a set of nine treatments viz., the treatments comprising of two level of micronutrient mixture (Grade - I) (T1: Micronutrient mixture (Grade I) 1% and T2: micronutrient mixture (Grade I) 2%); three level of Novel organic liquid fertilizer (T3: Novel organic liquid fertilizer 0.5%, T4: Novel organic liquid fertilizer 1% and T5: Novel organic liquid fertilizer 1.5%); three level of Sea weed extract (T6: Sea weed extract 2%, T7: Sea weed extract 4% and T8: Sea weed extract 6%) and control (T9). The experiment was evaluated in Randomized Block Design (RBD).

Foliar treatment had a significant impact on almost all parameters included in the study. Among the different foliar treatments, Novel organic liquid fertilizer 1.5% had significantly the higher values of growth parameters viz., pod length (8.64 cm), pod diameter (1.43 cm), number of pods per plant (24.35), pod weight (11.45 g) and marketable pod yield (kg/plant and t/ha) i.e. 0.280 and 15.537 respectively.

Keywords: Okra, yield, micronutrients, novel organic liquid fertilizer and sea weed extract

Introduction
India has extremely varied and diverse physiography and agro-climatic condition, so there is wide variation in the types of vegetables that are grown in different seasons and parts of the country. In India, area become limiting factor for providing food to the large population of our country. Therefore, research toward regulation of plant growth as an important factor in improving the yield and quality of vegetable crops.

Okra is one of the most important and popular vegetable among different vegetables cultivated in India. In India, okra is cultivated in area of 5.07 lakh ha are and 60.03 lakh MT production with 12.0 MT/ha productivity. Andhra Pradesh having first rank while, Gujarat state rank fourth position in okra production. Gujarat occupy the 65660 ha area for okra and it produces 7.23 lakh MT with 11 MT/ha productivity (Anon., 2016) [6].

Okra [Abelmoschus esculentus (L.) Moench] is a member of the family Malvaceae and native to South Africa and Asia. Earlier, its botanical name was [Hibiscus esculentus (L.) Moench] under the section Abelmoschus of Hibiscus, established by Linnaeus in 1737. Okra is known by many local names in different parts of the world. For example, it is called lady’s finger in England, gumbo in the United States of America and bhindi in India. Okra pods are considered nutritious. It provides some human supplementary vitamins such as vitamin C, A, B- complex and minerals like calcium, potassium, iron and others (Adeooye and Opunta, 1996) [1].

Micronutrients disorder appears to be the most widespread and frequent problem in crop production worldwide, resulting in severe losses in yield and nutritional values. Micronutrients like, copper (Cu), zinc (Zn) and iron (Fe) are important for proper functioning of biological systems of plant but their deficiency and toxicity lead various disorders.

Sea weeds have been used as manure, cattle feed, food for human consumption and as a source of phyocolloids such as agar, alginic acid and carrageenan. Besides their application as farm yard manure (FYM), liquid extracts obtained from seaweeds have recently gained importance as foliar sprays for several crops because the extract contains growth promoting hormones
Materials and Methods
The present investigation entitled “Effect of Foliar Application of Micronutrients, Novel Organic Liquid Fertilizer and Sea Weed Extract on Okra [Abelmoschus esculentus L. (Moench)]” was carried out at Vegetable Research Station, Regional Horticultural Research Station (R.H.R.S.), ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during kharif 2016-17 and 2017-18. The experiment was taken on the okra crop. Okra variety “GAO-5” was selected for experiment. The treatments were given by foliar application. The experiment was laid out in a Randomized Block Design (RBD) with four replications.

Results
All the important attributes related to growth were significantly affected by various foliar applications. The Table 1 clearly indicated that among the various foliar spray, significantly the higher pod length (8.64 cm), pod diameter (1.43 cm), number of pods per plant (24.35), pod weight (11.45 g), and maximum marketable pod yield (kg/plant and t/ha) i.e. 0.280 kg and 15.537 tonne respectively were noticed under foliar spray of Novel organic liquid fertilizer 1.5 % (T5).

Discussion
The important attributes related to yield are viz. pod length, pod diameter, number of pods per plant and weight of pod (Table 1). All these were significantly affected by treatment of novel organic liquid fertilizer @ 1.5 %, except pod length in which treatment differences was found non-significant in both the year of study but pooled analysis was found significant. It is noteworthy that the okra crop responded well to application of Novel organic liquid fertilizers, seaweed extract and micronutrient mixture.

During the course of investigation, there was significant increase in pod characters by application of Novel organic liquid fertilizers 1.5 %. It might be due to higher carbohydrate accumulation in plant at early stages of growth as a resulted better nutrient supply, which causes an increased in pod size. Another favorable factor contributing for better pod characters might be the involvement of novel organic liquid fertilizer which contained fair amount of macro and micronutrients as well as growth promoting substances which induced better plant growth.

Almost both the yield attributes viz. pod yield per plant (kg) and total pod yield (t) per hectare were significantly influenced with application of Novel organic liquid fertilizers. Okra plant sprayed with 1.5 % Novel organic liquid fertilizers favorably influenced the growth parameters登记ing the higher values for all the yield attributes viz. pod yield per plant and total pod yield and proved superior over other treatments.

The higher values of yield per plant and total yield might be due to the higher production of dry matter, height of plant, branches and pods produced per plant. All these factors are very closely related to crop yield. The other reasons may be the effect of novel organic liquid fertilizer which contain macro and micronutrients. The nutrients N and K at higher rate exerted a significant positive influence on yield. The other bio-parameters which could have helped in the increase of yield were synthesis of carbohydrates and their translocation to the potential storage organs through better growth and more number of pods per plant. All these reasons individually or synergistically resulted in increased vegetative growth reflecting in terms of foliage production, plant height which in turn has increased the yield. Usefulness of the nutrients to determine the influence on pod characters of okra and its yield is adequately stressed and the present study also corroborated with the findings of Anon. (2011) [2] and Anon. (2014) [5] in banana; Anon. (2012) [3] in mango; Anon. (2013) [4] in papaya; Deore et al. (2010) [7] in chilli and Salunkhe et al. (2013) [8] in onion.

Table 1: Effect of different level of micronutrient mixture, Novel organic liquid fertilizer and Sea weed extract on yield and yield attributes of okra

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Pod length (cm)</th>
<th>Pod diameter (cm)</th>
<th>Number of pods per plant</th>
<th>Weight of pod (g)</th>
<th>Marketable pod yield (kg/plant)</th>
<th>Marketable pod yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: Micronutrient mixture (Grade I) 1 %</td>
<td>8.11</td>
<td>1.20</td>
<td>22.48</td>
<td>10.00</td>
<td>0.228</td>
<td>12.647</td>
</tr>
<tr>
<td>T2: Micronutrient mixture (Grade I) 2 %</td>
<td>8.18</td>
<td>1.21</td>
<td>22.72</td>
<td>10.22</td>
<td>0.233</td>
<td>12.952</td>
</tr>
<tr>
<td>T3: Novel Organic Liquid Fertilizer 0.5 %</td>
<td>8.29</td>
<td>1.25</td>
<td>23.47</td>
<td>10.53</td>
<td>0.249</td>
<td>13.842</td>
</tr>
<tr>
<td>T4: Novel Organic Liquid Fertilizer 1 %</td>
<td>8.57</td>
<td>1.39</td>
<td>23.70</td>
<td>11.31</td>
<td>0.269</td>
<td>14.925</td>
</tr>
<tr>
<td>T5: Novel Organic Liquid Fertilizer 1.5 %</td>
<td>8.64</td>
<td>1.43</td>
<td>24.35</td>
<td>11.45</td>
<td>0.280</td>
<td>15.537</td>
</tr>
<tr>
<td>T6: Sea weed extract 2 %</td>
<td>8.48</td>
<td>1.33</td>
<td>23.56</td>
<td>10.95</td>
<td>0.260</td>
<td>14.425</td>
</tr>
<tr>
<td>T7: Sea weed extract 4 %</td>
<td>7.78</td>
<td>1.17</td>
<td>22.06</td>
<td>9.09</td>
<td>0.205</td>
<td>11.397</td>
</tr>
<tr>
<td>T8: Sea weed extract 6 %</td>
<td>7.64</td>
<td>1.16</td>
<td>21.15</td>
<td>8.98</td>
<td>0.193</td>
<td>10.703</td>
</tr>
<tr>
<td>T9: Control</td>
<td>7.48</td>
<td>1.15</td>
<td>19.78</td>
<td>8.62</td>
<td>0.175</td>
<td>9.703</td>
</tr>
<tr>
<td>S.E.m. ±</td>
<td>0.26</td>
<td>0.03</td>
<td>0.50</td>
<td>0.22</td>
<td>0.010</td>
<td>0.547</td>
</tr>
<tr>
<td>C.D. at 5 %</td>
<td>0.72</td>
<td>0.09</td>
<td>1.40</td>
<td>0.63</td>
<td>0.028</td>
<td>1.551</td>
</tr>
<tr>
<td>C.V. %</td>
<td>9.58</td>
<td>7.73</td>
<td>6.60</td>
<td>6.67</td>
<td>12.93</td>
<td>12.93</td>
</tr>
</tbody>
</table>

Conclusions
On the basis of present investigation on the Effect of foliar application of micronutrients, Novel organic liquid fertilizer and sea weed extract on of okra [Abelmoschus esculentus L. (Moench)], it could be concluded that foliar spray with Novel organic liquid fertilizer@ 1.5 % (T5) found to be beneficial to pod length (8.64 cm), pod diameter (1.43 cm), number of pods per plant (24.35), pod weight (11.45 g) and marketable pod yield (kg/plant and t/ha) i.e. 0.280 and 15.537 respectively.
References