Organic seaweed nano powder effect on growth and yield attributes of pigeonpea

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ABSTRACT
In the field experiment Sargassum myricocystum extract at 1% concentration for 3 h soaking with foliar spray 5% at vegetative and flowering stages were effective by recording higher plant height, total chlorophyll content, leaf area index, crop growth rate, relative growth rate and yield attributes, such as pod yield plant$^{-1}$ and seed yield ha$^{-1}$ in both kharif, 2014 and rabi, 2015 seasons. The per cent increase of pod yield plant$^{-1}$ and seed yield ha$^{-1}$ was 13.4 and 18.3%, respectively. The other seaweeds viz., Gracilaria edulis, Caulerpa racemosa were less effective, but the effect was better than water.

Key words: Brown seaweed, Foliar spray, Organic, Pigeonpea, Seed yield.

INTRODUCTION
Pigeonpea [ Cajanus cajan (L.) Mills.] is one of the major grain legume crops grown in the tropics and subtropics and accounts for about 5% of world legume production. It is the fifth prominent pulse crop in the world and second most important pulse crop after chickpea in India. India is ranking first having about 90% of the world area and 85% of production. In India area occupied by pigeon pea is about 3.61 million ha with total production of 2.70 million tonnes but average productivity is quite low (7.47 q/ha) (Tiwari et al., 2014). It finds an important place in the farming system adopted by small and marginal farmers in a large number of developing countries and it restores the soil fertility by fixing atmospheric nitrogen. World Health Organization recommends 80 grams of pulses per person per day. Based on this recommendation, India needs to produce 35 million tonnes of pulses annually to meet the national requirement. The reason for low productivity includes several factors such as cultivation in rain fed and marginal lands, use of old and low quality seeds by the farmers which in turn give poor germination, delayed emergence and sick seedlings that lead to poor yield. To meet out the demand of qualitative higher production use of organic fertilizer will definitely give significant results. In recent years, the use of natural seaweed as fertilizer is being substituted for conventional synthetic fertilizer.

Seaweeds are rich source of growth promoting substances (Sylvia et al., 2005) such as IAA, kinetin, zeatin and gibberellins (Zodape et al., 2010) auxins and cytokinins (Zhang and Ervin, 2004); metabolic enhancers; macro and micro elements (Strik et al., 2003), amino acids, vitamins and beneficial results from their use in crop plants like early seed germination and establishment, improved crop performance and yield, elevated resistance to biotic and abiotic stress and enhanced post harvest shelf life of seeds (Bluden, 1994). Unlike chemical fertilizers, manure derived from living resources are biodegradable non toxic, non-polluting and non hazardous to soil ecosystem, humans, animals and birds (Dhargaltear and Pereira, 2005). Considering the above beneficial effects of seaweeds an attempt was made to identify the effect of organic seaweed nano powder on growth and yield of pigeonpea.

MATERIALS AND METHODS
The marine algae Sargassum myricocystum, Caulerpa racemosa and Gracilaria edulis collected from Mandapam coast, Tamil Nadu, were washed with seawater initially to remove macroscopic epiphytes and sand particles and then with fresh water to remove adhering salt. The materials were shade dried for 2 weeks followed by oven drying at 40°C for 24 h and powdered. The ground seaweeds were ball milled for 5 h using ball mill to get near nano size powder (100 nm) (Fig. 1). Seaweed extracts were prepared as described by Bhosle et al. (1975) with minor modifications. Acetone and methanol in the ratio of 1: 1 were added to 100 g of the dried powder of each species and kept overnight with intermittent stirring and extracted through rotary evaporator at 40°C and 45 rpm. Pigeonpea cv. Co (Rg) 7 seeds were soaked in seaweeds extract (Sargassum myricocystum, Gracilaria edulis and Caulerpa racemosa) @ 5% for 3 h. Foliar spray was given at vegetative and flowering stages (5%). The plants were observed for growth and yield attributing characters viz., plant height, total chlorophyll content (Arnon, 1949), leaf area index, relative growth rate (Williams, 1946) and yield attributes, such as pod yield plant$^{-1}$ and seed yield ha$^{-1}$ in both Kharif, 2014 and Rabi, 2015 seasons. The data obtained from experiments were

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analysed by the ‘F’ test of significance following the methods described by Rangaswamy (2002).

RESULTS AND DISCUSSION

Among the seasons, Kharif 2014, registered highest plant height (131.9 cm), chlorophyll content (4.7 mg g⁻¹), leaf area index (4.9), relative growth rate (66.5 mg g⁻¹ d⁻¹), pod yield / plant (66.8 g) and seed yield/ ha (1163 kg) compared to Rabi 2015 (121.8, 4.5, 4.8, 64.9, 61.5 and 1075 for plant height (cm) chlorophyll content (mg g⁻¹), leaf area index, relative growth rate (mg g⁻¹ d⁻¹), pod yield/plant (g) and seed yield/ha (kg), respectively (Table 1 and 2).

Among the treatments, Sargassum myricocystum @ 1% for 3 h soaking and foliar spray (5%) recorded highest plant height (128.2 cm) at harvest stage, total chlorophyll content (4.88 mg g⁻¹), leaf area index (4.91), relative growth rate (66.5 mg g⁻¹ d⁻¹), pod yield/plant (69.1 g) and seed yield/ha (1225 kg) compared to control (124.8, 4.02, 4.69, 64.7, 59.8 and 1000 for plant height (cm), total chlorophyll content (mg g⁻¹), leaf area index, relative growth rate (mg g⁻¹ d⁻¹), pod yield/plant (g) and seed yield/ha (kg). The per cent increase of pod yield plant⁻¹ and seed yield ha⁻¹ was 13.4 and 18.3%, respectively. In the present study treated plants recorded higher of stomata compared to control plants (Fig 2 and Fig 3).

Table 1: Effect of organic seaweed nano powders on plant height (cm), total chlorophyll content (mg g⁻¹) and leaf area index in pigeonpea cv. Co (Rg) 7

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (harvest) (cm)</th>
<th>Total chlorophyll content (90 days) (mg g⁻¹)</th>
<th>Leaf area index (90 DAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ Water soaking</td>
<td>130.1</td>
<td>119.4</td>
<td>124.8</td>
</tr>
<tr>
<td>T₂ S. myricocystum (1%-3 h) + foliar spray (5%)</td>
<td>132.8</td>
<td>123.6</td>
<td>128.2</td>
</tr>
<tr>
<td>T₃ G. edulis (1%-3 h) + foliar spray (5%)</td>
<td>132.5</td>
<td>122.7</td>
<td>127.6</td>
</tr>
<tr>
<td>T₄ C. racemosa (1%-3 h) + foliar spray (5%)</td>
<td>132.0</td>
<td>121.5</td>
<td>126.8</td>
</tr>
<tr>
<td>Mean</td>
<td>131.9</td>
<td>121.8</td>
<td>126.9</td>
</tr>
</tbody>
</table>

Table 2: Effect of organic seaweed nano powders on relative growth rate (mg g⁻¹ d⁻¹) pod yield/plant (g) and seed yield/ha (kg) in pigeonpea cv. Co (Rg) 7

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Relative growth rate (60-90 DAS) (mg g⁻¹ d⁻¹)</th>
<th>Pod yield/plant (g)</th>
<th>Seed yield/ha (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ Water soaking</td>
<td>65.2</td>
<td>64.1</td>
<td>64.7</td>
</tr>
<tr>
<td>T₂ S. myricocystum (1%-3 h) + foliar spray (5%)</td>
<td>67.4</td>
<td>65.6</td>
<td>66.5</td>
</tr>
<tr>
<td>T₃ G. edulis (1%-3 h) + foliar spray (5%)</td>
<td>67.0</td>
<td>65.2</td>
<td>66.1</td>
</tr>
<tr>
<td>T₄ C. racemosa (1%-3 h) + foliar spray (5%)</td>
<td>66.5</td>
<td>64.8</td>
<td>65.7</td>
</tr>
<tr>
<td>Mean</td>
<td>66.5</td>
<td>64.9</td>
<td>65.8</td>
</tr>
</tbody>
</table>

T₁ Water soaking, T₂ S. myricocystum (1%-3 h) + foliar spray (5%), T₃ G. edulis (1%-3 h) + foliar spray (5%), T₄ C. racemosa (1%-3 h) + foliar spray (5%)
Seaweed extract can be used as a growth enhancer for a variety of plants at a lower concentration without any harmful effects. Plants sprayed with seaweed extract showed healthy growth with bright green and larger leaves, early flowering and fruit bearing as compared to the group where no seaweed extract was used (Abdel- Mawgoud et al. 2010). The increase in plant height by seaweeds might be due to seaweed extracts improve the absorption of nutrients through the roots causing additional and strong overall growth of the plant. Spraying of seaweed extracts on critical growth stages which was effectively utilized by the crop and expressed in higher growth and yield attribute. In addition, the readily available form of nutrients in foliar spray would assist for efficient absorption and subsequent transport enhancing growth parameters. Seaweed concentrates triggers early flowering and pod set in number of crop plants (Arthur et al., 2003). In many crops, the yield is associated with the number of flowers at maturity. As the onset of flowering, the number of flowers produced are linked to the developmental stage of plants, seaweed extracts probably encourage flowering by initiating robust plant growth.

Seaweed extract contain various betaines and betaine like compounds (Blunden and Gordon, 1986) enhances the leaf chlorophyll content in plants (Blunden et al., 1997) and reduction in chlorophyll degradation. Increase in LAI, CGR and RGR in Sargassum treated plants might be due to the transport of assimilates from the leaves to the developing sink which later caused senescence of leaves. Yield increases in seaweed-treated plants are thought to be associated with the hormonal substances present in the extracts, especially cytokinins. Cytokinins in vegetative plant organs are associated with nutrient partitioning; whereas in reproductive organs, high levels of cytokinins may be linked with nutrient mobilization. This was conformity with Kocira et al. (2013) in bean and Sugnathi (2014) in sunflower. 1% concentration of Caulerpa racemosa has proved increase in yield, growth and biochemical content in Vigna mungo (Abhilash et al., 2013). These results are in harmony with those obtained by Asir Selin Kumar et al. (2007) in bhendi; Rathore et al. (2009) in soybean; Sivakumar and Gandhi (2010) in blackgram; Flora and Rani (2012) in groundnut; Renukabai et al. (2013) in greengram; Sujatha and Vijayalakshmi (2013) in blackgram.

CONCLUSION
Seed treatment with Sargassum myricocystum @ 1% for 3 h with foliar spray (5 %) recorded higher growth and yield attributing characters.

REFERENCES


