

## Comparative Analysis of Kabuli and Desi Chickpea Growth Parameters under *Cystoseira indica* (Thivy et Doshi) Mariha, 1968 Compost Application

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### ABSTRACT

Seaweeds function as bio-fertilizers because they possess growth-promoting substances. Since chickpeas are an important agricultural crop consumed worldwide, this study focused on the effects of brown seaweed *Cystoseira indica* as compost on the physical parameters of Desi and Kabuli chickpeas. *C. indica* was applied in five concentrations: 5%, 25%, 45%, 65%, and 85%, along with a control group. The best results for shoot and root lengths, plant height, and weight were observed in 25%, 45%, and 65% concentrations. However, the highest number of pods in both varieties was recorded in the 5% compost treatment.

**Keywords:** Chickpeas, *Cystoseira indica*, Bio-fertilizer, Growth Promoters.

### 1. INTRODUCTION

Chickpeas (*Cicer arietinum* L., family Fabaceae/ Leguminosae) are highly nutritious legumes that are consumed across Asia, Africa, Europe, the Middle East and parts of the United States. It is the third most produced leguminous crop in the world (Kurakula, *et al.*, 2021). Chickpeas are rich in proteins and carbohydrates, and their protein is considered of higher quality when compared to other pulses (Jukanti *et al.*, 2012; Merga & Haji, 2019). The two main types of chickpeas that are used worldwide are Desi (small, dark brown coloured with thick seed coat) and Kabuli (larger and light coloured with thin seed coat). Several chemical and organic fertilizers are used and recommended for increasing the production of chickpeas (Kumar *et al.*, 2021; Megersa, 2021), but work on the use of seaweeds in the form of compost as a possible source of fertilizer for chickpeas is rare, particularly in this region.

Seaweeds are rich in nutrients, vitamins, minerals, trace elements and phytohormones, which contribute to enhanced plant growth, higher root and shoot development and protect plants against pathogens (Rhimou *et al.*, 2010; Alves *et al.*, 2016). Therefore, this study aims to evaluate the effects of brown seaweed *Cystoseira indica* used as compost on the growth parameters of chickpeas, including their root and shoot lengths, fresh weights and the number of leaves, flowers and pods.

### 2. MATERIALS AND METHODS

**Sample Collection:** Seaweed *Cystoseira indica* was collected from the Karachi coast during March and April of 2022. Samples were washed thoroughly with tap water to remove epiphytes, sand particles, and other debris. A few samples were kept in 4% formalin, while the remaining were shade-dried, ground to fine powder, and stored at room temperature till further use.

Desi and Kabuli chickpea seeds were bought from the local market of the University of Karachi. According to the International Seed Testing Association (ISTA) guidelines, seeds of uniform size and colour were selected for the experiment, while discoloured or wrinkled seeds were discarded.

**Compost Preparation:** The preparation of compost was based on the procedure of Zahid, (1999) with the modification of the concentration of seaweed compost used. About 500g of soil was taken in each pot in concentrations of 5%, 25%, 45%, 65% and 85%, along with the control pots without seaweed compost. All pots were watered daily for decomposition purposes.

#### 2.1 Measurement of Physical Parameters

After one week of pot preparation, viable seeds of Desi and Kabuli chickpeas were sterilized using 0.1% mercuric chloride for one minute and then washed thoroughly with sterilized distilled water. The sterilized seeds were imbibed in tap water for an hour. After an hour, 5 seeds were sown in each pot of control, 5%, 25%, 45%, 65% and 85% compost.

Once seeds were germinated, physical parameters including shoot length, number of leaves, flowers and pods were taken every week. Root length and whole plant length were measured after the harvesting of the plants. Fresh weights of whole plants and pods were also recorded after harvesting. All experiments were carried out in duplicates, but the figures shown here represent the mean values of each parameter studied.

### 3. RESULTS AND DISCUSSION

Chickpeas are a highly proteinaceous agricultural crop, as they are responsible for providing about 27% of dietary protein globally (Yadav *et al.*, 2005). The purpose of this research was to study the effects of brown seaweed *Cystoseira indica* used as compost on the physical characteristics of Desi and Kabuli chickpeas. *C. indica* was tested in five different concentrations- 5%, 25%, 45%, 65% and 85%. Each concentration was tested in duplicate. The experiment was carried out from October 2022 to January 2023, during which shoot length and number of leaves, pods and flowers were measured weekly, while root length, plant weight, and height of whole plants were taken after harvesting. While the data was collected in duplicates for every parameter, the figures represent mean values. Figures 1 and 2 show the effects of *C. indica* used as compost on the growth parameters of Desi and Kabuli chickpeas, respectively. In the past, the use of organic compost has been termed as beneficial for agricultural purposes (Baldantoni, *et al.*, 2016), and a study conducted by Eyraş *et al.*, (2008) describes the use of powdered seaweeds as beneficial for crop plants. However, very few studies have been conducted on using powdered seaweeds as compost for chickpeas.

It was observed that shoot length showed increased growth in the months of November and December 2023, as both types of chickpeas had maximum length during these two months (Figure 3). In Desi chickpeas, 25% and 65% concentrations of compost showed the best results, while in Kabuli chickpeas, 65% concentration had the highest shoot length. Desi chickpeas showed maximum shoot length (28.9 cm) in 25% concentration in November and 32.16cm in pots containing 65% seaweeds in December. The Kabuli variety had the highest shoot in December which was 63cm in 65% concentration. In Desi chickpeas, shoot length declined in 85% concentration (22.58cm), but still, the least growth was observed in the control, which was 4.18cm. In Kabuli chickpeas, pots of control and 5% concentrations showed the least growth in shoot length (7cm and 10 cm, respectively). Previously, Kalaivanan *et al.*, (2012), have reported that the concentration of 25% seaweed liquid extract (SLE) obtained from green seaweed *Caulerpa scalpelliformis* showed optimum results in shoot length and fresh weight of black gram (*Vigna mungo* L., Hepper), while another study conducted by Abdel Latef, *et al.*, 2017, concluded that brown seaweed *Sargassum muticum* and red algae *Jania rubens*, when used as seaweed liquid fertilizer in small quantity (1%), increase growth in chickpeas and decreases their soil salinity. Kumari *et al.*, (2013), have proven that increasing concentrations of *Sargassum johnstonii* Setchell & Gardner when used in granular and powdered form as fertilizer increases shoot length and number of branches in tomato plants.

It was also observed that Desi chickpeas had the maximum number of leaves in 85% compost in December (52), whereas Kabuli chickpeas showed the best results at 65% concentration in the same month (63). In both varieties, control showed the least results; which were 14 and 9 leaves in Desi and Kabuli chickpeas, respectively. Overall, the number of branches decreased during the last month of the experiment (Figure 4). El-Yazied *et al.*, (2012) have also reported that increasing the concentration of seaweed compost increases leaf quality, including its area and weight. Karthik & Jayasri, (2023) mentioned that the maximum concentration of seaweed fertilizer tested (30%), exhibited a large number of leaves in *Vigna radiata* (Mung Beans).

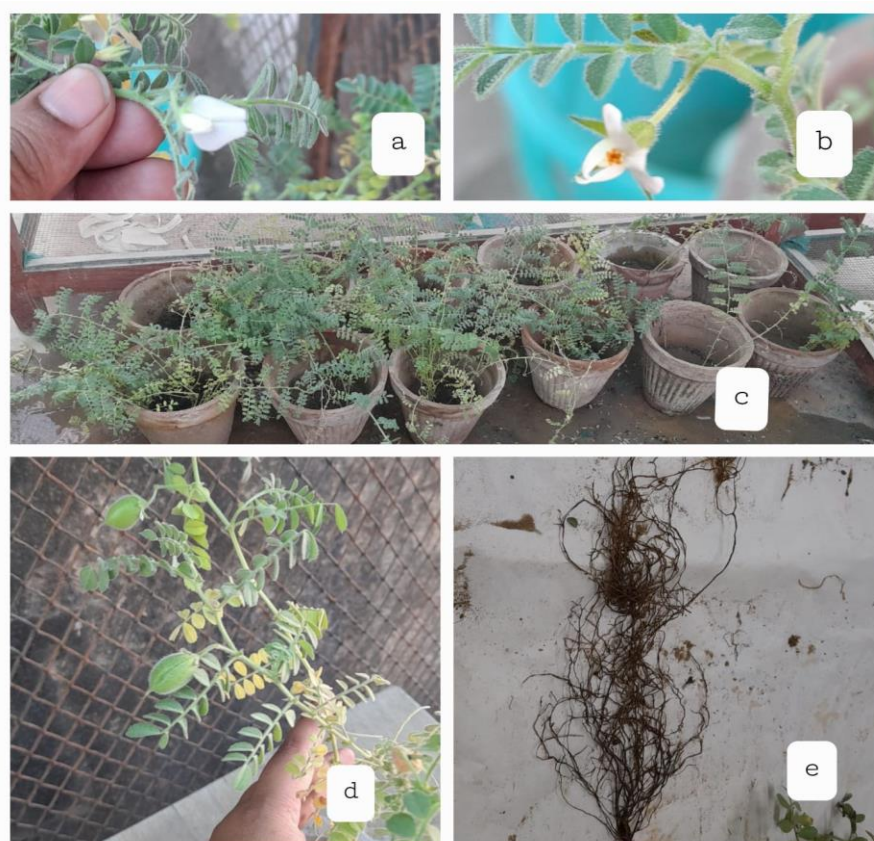
It was revealed after harvesting that Desi chickpeas showed maximum root length in 45% concentration (25cm) while Kabuli chickpeas had maximum root length in 65% concentration (50.5cm). The minimum root lengths were observed in 65% of Desi chickpeas (9.92cm), and 85% of Kabuli chickpeas (29cm), as shown in Figure 5. A study by Kaladharan *et al.*, (2019) showed that adding mulch of brown seaweed *Sargassum wightii* caused a significant increase in root biomass of Okra and Cowpea. Leila *et al.*, (2018) have also observed that 30% and 50% concentrations of extracts obtained from brown seaweed *Cystoseira mediterranea* showed the best results in the growth parameters of barley. The maximum plant weight (10.5g) and plant height (75.1cm) were observed in 25% concentration for Desi chickpeas and in 65% concentration of compost for Kabuli chickpeas (15.67g weight and 73.75cm plant height). The minimum mean plant height was 40.94 cm in 65% of Desi chickpeas and 35cm in the control of Kabuli chickpeas. The minimum weights of plants were 3.98g in 65% concentration in Desi chickpeas and 3.12g in 5% concentration of Kabuli chickpeas, as shown in Figures 6 & 7. A study carried out by Sortino *et al.*, (2013) revealed that lower concentrations of soluble substances obtained from organic compost show more positive effects in red pepper plants, and are less hazardous than chemical fertilizers. Zahid, (1999) also stated that gram showed maximum fresh weight in 20% concentration when grown in compost made from green seaweed *Codium iyengarii*.

Although 25% concentration of seaweed manure caused the highest number of buds (11) in Desi chickpeas, most of the buds did not bloom. Similarly, 65% concentration of compost caused the presence of most buds in Kabuli chickpeas nine, but the ratio of blooming of buds into flowers was lower (Figure 8). In comparison, 5% and 85% concentrations had the highest number of flowers in both varieties. Plants of Desi chickpeas had one and two flowers in 5% and 85% of pots, respectively. Kabuli chickpeas had two and four flowers in concentrations of 5% and 85% (Figure 9). Similar to the number of flowers, 5% concentration showed the maximum number of pods

in Desi and Kabuli chickpeas, which were 1.33 g and 3.16 g (mean values), while in 85%, flowers did not develop into pods in Kabuli chickpeas (Figure 10).

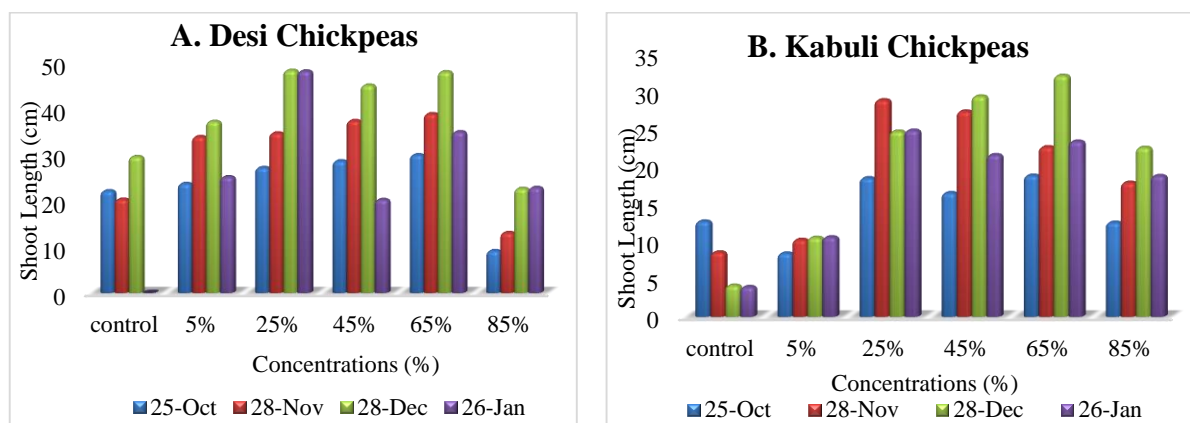


**Figure 1:** Growth Parameters of Desi Chickpeas. a: maximum shoots in December, b: flowering in 5% pots, c: pod in 5% pots, and d: maximum root in 45% concentration.

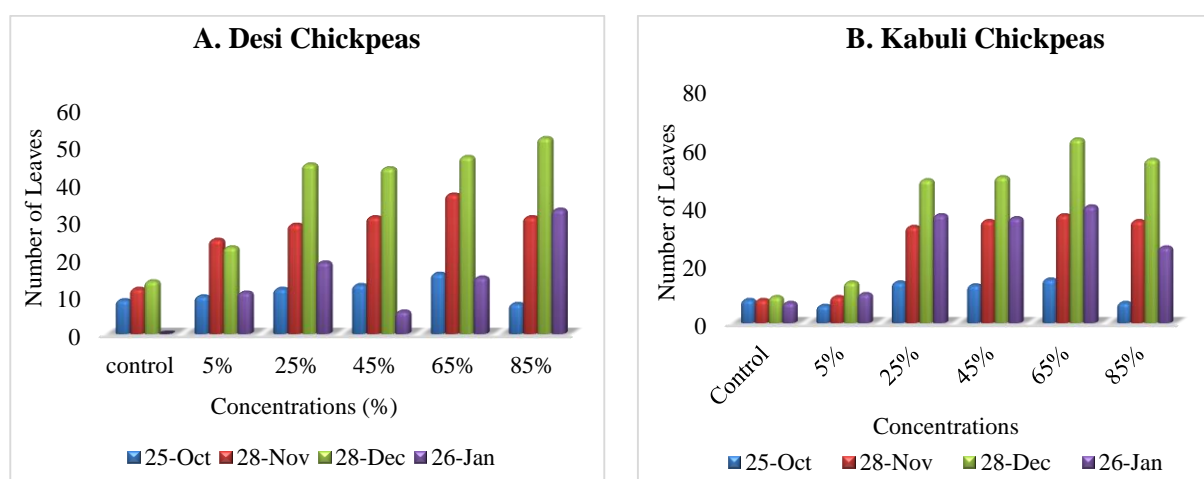


**Figure 2:** Physical Parameters in Kabuli Chickpeas. (a-b): Flowers observed in 5% concentration, (c): shoot lengths when in pots, (d): pods in 5% concentration, (e): maximum root observed in 65% concentration.

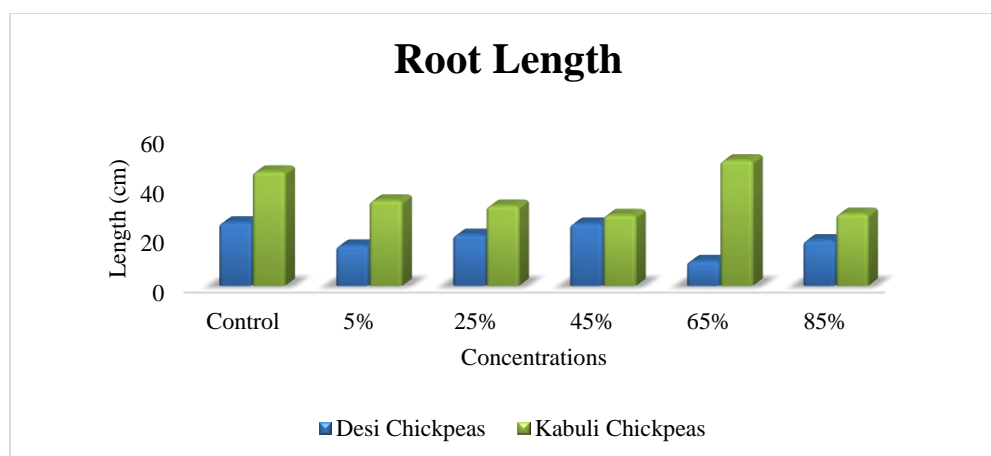
Overall, it was observed that 25%, 45%, and 65% concentrations of compost obtained from brown seaweed *C. indica* increased all physical parameters of both varieties of chickpeas, except for the number of flowers and pods, which were maximum in 5%. In the last two decades, the importance of seaweeds as manure has been described in many studies (Kaur, 2020), but less research is available on this aspect. Many researchers have explained the importance of seaweed liquid extracts (SLEs) and seaweed liquid fertilizers (SLFs) in increasing the germination rate and crop yield of different crops (Yuvaraj & Gayathri, 2017; Shakila *et al.*, 2019; Karthik & Jayasri, 2023). Moreover, the effects of seaweeds used as compost for higher yield of chickpeas have not been previously studied. Therefore, this research serves as a baseline for the use of seaweeds as compost from this region.



**Figure 3:** Shoot Length of Desi (A) & Kabuli (B) Chickpeas over Four Months

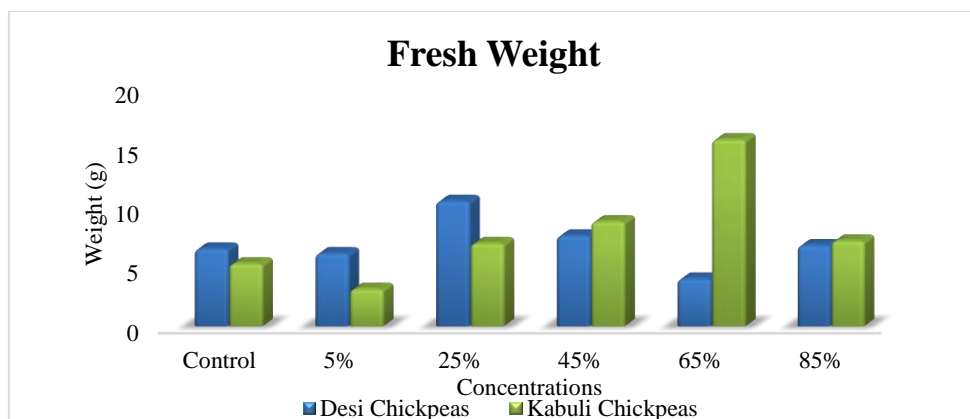


**Figure 4:** Number of Leaves in Desi (A) and Kabuli (B) Chickpeas over 4 Months

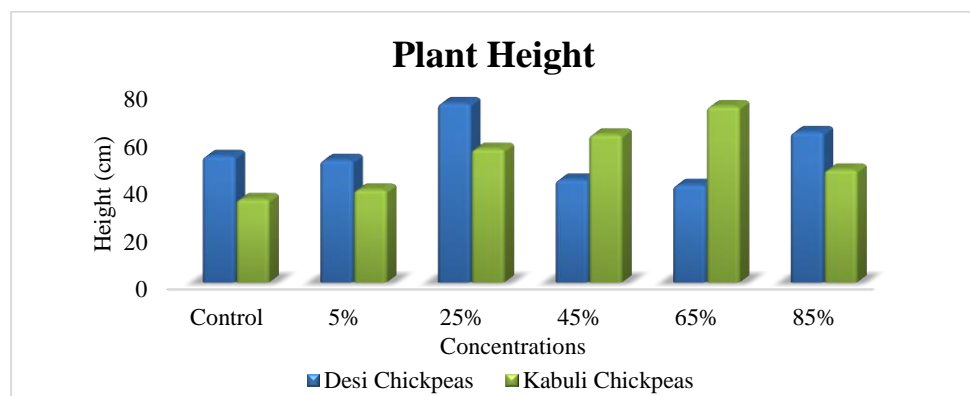


**Figure 5:** Root Length of Desi and Kabuli Chickpeas after Harvesting

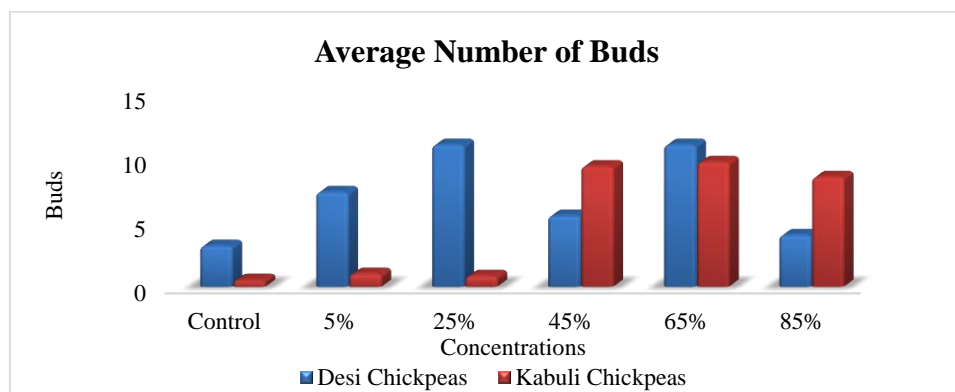




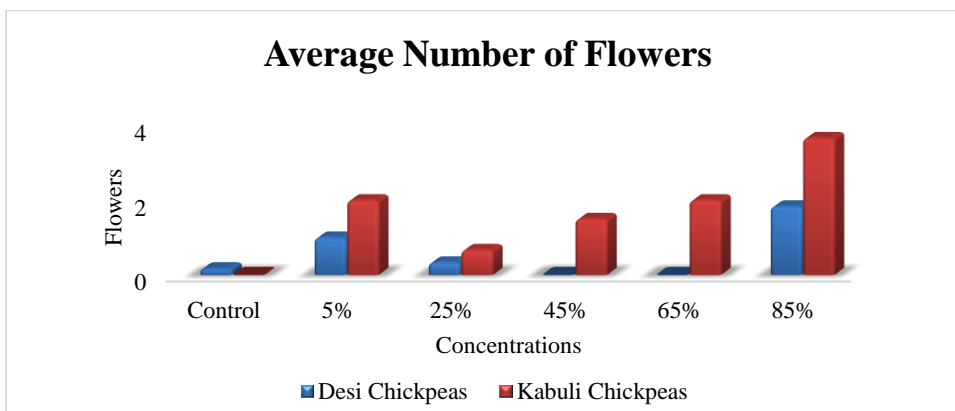
**Figure 6:** Fresh Weight (g) of Desi and Kabuli Chickpea Plants after Harvesting



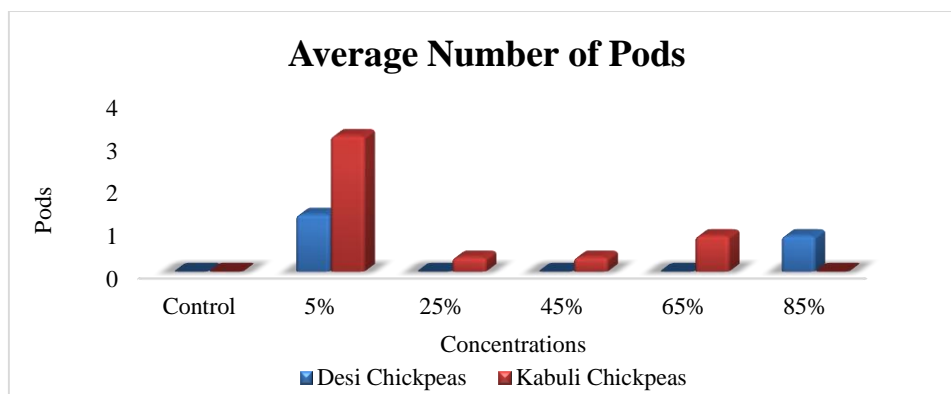
**Figure 7:** Plant Height (cm) of Desi and Kabuli Chickpeas after Harvesting



**Figure 8:** Average Number of Buds Observed in Desi and Kabuli Chickpeas



**Figure 9:** Average Number of Flowers in Desi and Kabuli Chickpeas



**Figure 10:** Average Number of Pods Found in Each Concentration

#### 4. CONCLUSION AND RECOMMENDATIONS

This study concludes that brown seaweeds used as compost are beneficial for the growth of plants and can easily replace other fertilizers. When used in 25%-65 % concentrations, *C. indica* showed optimum growth in Chickpea plants, and low concentration (5%) showed maximum fruit yield. However, the seaweed was required in bulk quantities to carry out this research. Therefore, it is further recommended that liquid extracts of *C. indica* should be tested to obtain the best results while using seaweed in low quantities. The incorporation of seaweeds as compost improves the soil quality and enhances the availability of nutrients associated with them. It also provides an idea to integrate algae into the agriculture sector of Pakistan to minimise expenditures and its export can become a source to surge the of revenue.

#### 5. ACKNOWLEDGEMENT

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