Effects of Bio-Stimulants on Pre and Post-Harvest of *Hippeastrum hybridum* Cv. Baby Star

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ABSTRACT

*Hippeastrum hybridum* cv. “Baby star” is grown for its ornamentals’ cut spike as well as a pot and bedding plants. Plants were exposed to eight foliar application with one month intervals of two biostimulants, dry yeast extraction at the rates of 3.0-4.0-5.0 and 6.0 g/l and seaweed extraction (algal extraction) at the level of 1.0-2.0-3.0 and 4.0 ml/l and control treatment (0.0). Using seaweed extraction at 2 ml/l greatly affected the vegetative growth, resulting in the highest plant height, leaves fresh and dry weights, leaf area. The lowest flowering time resulted from using seaweed at 1 ml/l. The vase life of cut spikes was increased by using dry yeast extraction at the level of 5 g/l or seaweed extraction at 3 ml/l, in the two seasons. However, spike length and its dry weights were greatly increased by 4 ml/l of seaweed foliar spray. The highest cut flowers in vase was obtained using yeast foliar spray at 5.0 g/l or seaweed foliar spray at 3ml/l Bulbs volumes and weights were also affected using seaweed foliar spray at the rate of 2 or 4 ml./L in the two seasons, respectively. Seaweed foliar spray 2 ml/l resulted in the highest chlorophyll content as well as yeast extraction at 4.0 g/l. However, the highest anthocyanin content in petals’ spike was obtained using 5 g/l from yeast foliar application.

Keywords: *Hippeastrum hybridum*, biostimulants, seaweed extract, dry yeast extract, vase life, bulbs

1. Introduction

*Hippeastrum hybridum*, Amaryllidaceae family is a popular lovable inflorescence, used for either fresh cut flower or flowering pot plant (Abdelkader, 2012) and (Youssef and Abd El-Aal, 2014). They are prized for their color, and they add to indoor landscapes. The agricultural sector is facing many challenges nowadays to boost productivity. Biostimulants were a novel and eco-friendly approach, which reduce the need for synthetic fertilizers (Colla and Rouphael, 2020). Plant biostimulants attract great interest in modern agriculture. (Chiaiese et al., 2018) stated that microalgae (blue-green algae) attract growing interest from both scientists and plant growers. Being an organic and biodegradable, seaweed extract is considered an important source of nutrition for sustainable agriculture (Masoud and Abou-Zaid, 2017). Seaweed is a product highly enriched with macro and micro elements, amino acids, vitamins, cytokinin, auxins, and other growth substances that affect plants’ metabolism thus, enhance the growth process (Gawade et al., 2019) and (Abbas, 2013). It was reported that seaweeds act as chelators; they magnify the utilization of mineral nutrients, improve soil structure and aeration, stimulate root growth. They act as biostimulants, enhancing plant growth, yield, flower and fruit production, improving postharvest shelf life, and increasing resistance to biotic and abiotic stresses (Kahkashan et al., 2017). Another natural safety biofertilizer is the dry yeast. It acts as a natural source of cytokinin that stimulates cell division and enlargement as well as protein synthesis and nucleic acid (Abbas, 2013). Shafeek et al., (2015) reported that Bewer’s yeast is one of the richest and high-quality proteins, amino acids, and a rich source of essential minerals, trace elements, and vitamins. Ali, (2017) showed that, yeast extract had stimulatory effects on several plant processes such as chlorophyll formation, protein synthesis, and cell division. Additionally, yeast extracts is considered protective agents due to their content of sugar, amino acids, proteins, and several vitamins. Yeast extract is a
valuable source of carbohydrates, phytohormones, i.e., cytokinin, which enhance cell division and enlargement (Hassan et al., 2015).

Therefore, the aim of the investigation was to study the effects of two biostimulants applications as a foliar spray and tested their effects on pre/post harvest of vegetative growth quality, flower quality, and their shelf life and their corms production of *Hippeastrum hybridum* cv. “Baby star”.

2. Materials and Methods

A pot experiment was carried out during the two successive seasons of 2018 and 2019 at Ornamental Plants Research Branch, Antoniades Botanical Gardens in Alexandria, Egypt. The research investigated the effect of two biostimulants Yeast dry extraction as a foliar spray, at a concentration of 3.0, 4.0, 5.0, or 6.0 g/l or Algae extraction or as named seaweed extraction at concentrations of 1.0, 2.0, 3.0, or 4.0 ml/l on the growth, flowering, corms production, postharvest, and chemical constituents of *Hippeastrum hybridum* cv. “Baby star”.

2.1. Plant Material

Bulbs of *Hippeastrum hybridum* cv. “Baby star” with an average of 5cm. diameter was planted in 20 cm. diameter plastic pot in sandy soil on August 14th, 2018, and 2019, in the first and second seasons, respectively. Pots were placed in an uncontrolled greenhouse. Each pot was supplied with 2 g. of N.P.K. (19:19:19) fertilizer added with irrigation tap water in 250 ml./pot. The fertilizers were added and repeated in eight applications at one-month intervals after 21 days from planting. Chelated Zn, Mn, and Fe were added at 0.50 g./pot in irrigation tap water in 250 ml./pot after two months from planting as one application. Potassium was added as one spray application after starting flowering directly at the rate of 2 ml./L until runoff. Other common cultural practices were performed as needed. At the beginning of leaves vigour, after two months, plants were sprayed with the biostimulants dry yeast at concentrations of 3.0, 4.0, 5.0, or 6.0 g/l or seaweed extract at concentrations of 1.0, 2.0, 3.0, or 4.0 ml/l until runoff. In addition, control plants was sprayed with tap water. The foliar spray treatments applications were applied and repeated eight times at one-month intervals.

2.2. Data recorded

2.2.1. Pre-harvest measurements of growth parameters
- Plant height (cm.)
- Number of leaves.
- Leaves fresh weights (g.).
- Leaf area (cm².).
- Leaves dry weights (g.).
- Stem diameter (cm.)
- Flowering time: calculated as the number of days from planting to the shown colour stage.
- Spike length (cm.): recorded after detaching spike from between leaves.
- Spike thickness (cm.): recorded just before putting the spike in the vase.

2.2.2. Post-harvest measurements:
- Water uptake/spike (g.).
- Loss of spike fresh weights (g.) L.S.F.W.it was determined at the fading stage.

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L.S.F.W. \, (\%) = \frac{Initial \, fresh \, weight - Final \, fresh \, weight}{Initial \, fresh \, weight} \times 100
\]

- Spike vase life (days): calculated as the number of days from the shown colour stage in the vase to the fading stage.
- Spike diameter (cm.): the maximum diameter of the spike at the full opening stage.
- Spike dry weights (g.) at the end of vase life.
2.2.3. Hippeastrum bulbs measurements:
- Bulbs volume (cm$^3$).
- Bulbs fresh weight (g).

2.2.4. Hippeastrum chemical analysis:
- Total chlorophyll: determined in fresh leaves with SPAD instrument as described by Yadava, (1986) at the beginning of the flowering stage.
- Anthocyanin pigment content: determined in flower spike with the method described by Mancinelli, et al. (1988) at the fading stage.

2.3. Statistical analysis
The experiment layout was a randomized complete block design (R.C.B.D.). It consists of nine treatments with three replicates; each replicate contains four pots. The data were statistically analysed according to the method described by Snedecor and Cochran, (1989). The means of the individual factors were compared by the L.S.D. test at a 5% probability level.

3. Results and Discussion

3.1. Effect of two biostimulants foliar applications on Pre-harvest measurements of growth parameters

3.1.1. Plant height (cm)
Data presented in table (1) showed that the plant height was greatly affected by the algae extract at a concentration of 2 or 4 ml/l. Data present indicated that these biostimulants gave the tallest plant height among the study (69.10 and 69.40 cm) compared to the control (58.13 and 56.51 cm) in the two seasons, respectively. Our results were in agreement with those found by De Lucia and Vecchietti, (2012) on lilium. Our results also agree with those found by Kahkashan et al., (2017) on Polianthes tuberosa. Seaweed extraction greatly affected the plant height. El-Sayed et al., (2018) showed that seaweed extract greatly affected the stem length of Dahlia pinnata. On Gladiolus grandiflorus cv. “American beauty,” Pansuriya et al., (2018) showed that seaweed and other biostimulants had a great effect on the vegetative growth of the plants. The results of our investigation also agree with the findings of Waly et al., (2019) on Rosmarinus officinalis. Seaweed extraction greatly affected the plant height. The results also agree with the findings of Abdou et al., (2021) on gladiolus plants.

Table 1: Average of the plant height (g.), leaves number and leaves fresh weights(g) of Hippeastrum hybridum as affected by seaweed extraction and yeast extraction concentrations in the seasons of 2018 and 2019.

| Treatments       | Plant height (cm) | Number of leaves | Leaves fresh weights (g) |
|------------------|-------------------|------------------|--------------------------|
|                  | 2018   | 2019   | 2018 | 2019 | 2018 | 2019 |
| Control at 0.0   | 58.13  | 56.51  | 5.33 | 4.67 | 87.28 | 76.06 |
| Yeast at 3g/L    | 62.79  | 63.12  | 6.67 | 6.00 | 113.28 | 124.27 |
| yeast at 4g/L    | 63.28  | 68.08  | 8.33 | 7.00 | 218.30 | 183.22 |
| yeast at 5g/L    | 60.07  | 58.77  | 7.00 | 7.67 | 175.75 | 185.79 |
| yeast at 6g/L    | 54.80  | 55.60  | 7.00 | 6.33 | 181.95 | 191.72 |
| Algae at 1ml/L   | 62.73  | 64.12  | 6.67 | 7.00 | 207.54 | 213.48 |
| Algae at 2ml/L   | 69.10  | 69.40  | 8.33 | 7.67 | 217.11 | 243.45 |
| Algae at 3ml/L   | 65.73  | 62.27  | 5.33 | 7.00 | 153.57 | 197.82 |
| Algae at 4ml/L   | 66.27  | 68.67  | 5.00 | 6.00 | 180.44 | 172.08 |
| L.S.D at 0.05    | 5.34   | 4.26   | 1.51 | 1.49 | 70.61 | 91.12 |

3.1.2. Number of leaves/plant
The data in table (1) showed that algae extraction foliar spray at the level of 4, 5 or 6 g/l or seaweed (2 ml/l) had a great effect on the number of leaves/plant, which resulted in 8.33 and 7.67
leaves/plant in the two seasons, respectively, compared with the control plants (5.33 and 4.67) leaves/plant. The results in our investigation were in agreement Kakhkashan et al., (2017) on Polianthes tuberosa cv. “Prajwal”. They also agree with the findings by Abdou et al., (2018) on Gladiolus grandiflorus cv. “Peter pears”, the results on dahlia found by (El-Sayed et al., 2018), and the findings by Abdou et al., (2021) on gladiolus.

3.1.3. Leaves fresh weight (g)

The same trend of results was obtained on the leaves’ fresh weight using a foliar application of yeast extract (4, 5 or 6 g/l) or seaweed (1, 2, 3 or 4 ml/l), it resulted in the same high significant compared to the control treatment. The data in table (1) resulted in the highest leaves fresh weight (217.11 and 243.45 g./plant) by using seaweed at 2 ml/l application. The data in our investigation are in agreement with those found by De Lucia and Vecchietti, (2012) on lilium and Shafeek et al., (2015) on Allium cepa. They also agree with those found by Waly et al., (2019) on Rosmarinus officinalis plants and also the findings on gladiolus plants by Abdou et al., (2021).

### Table 2: Average of the leaf area (cm3.), leaves dry weights (g.), stem diameter (cm.) and flowering time (days) of Hippeastrum hybridum as affected by seaweed extraction and yeast extraction concentrations in the seasons of 2018 and 2019.

| Treatments  | Leaf area (cm³) | Leaves dry weight (g) | Stem diameter (cm) | Flowering Time (days) |
|-------------|-----------------|-----------------------|--------------------|-----------------------|
|             | 2018            | 2019                  | 2018               | 2019                  |
| Control at 0.0 | 1209.14        | 1212.03               | 6.71               | 7.47                  | 4.60               | 3.94               | 251.00             | 251.67             |
| Yeast at 3g/L | 1515.35        | 1859.70               | 12.02              | 11.96                 | 4.96               | 4.76               | 251.33             | 245.33             |
| Yeast at 4g/L | 2604.59        | 3039.73               | 15.05              | 14.75                 | 4.44               | 4.33               | 260.33             | 249.33             |
| Yeast at 5g/L | 2260.84        | 2703.91               | 13.00              | 13.99                 | 4.43               | 4.56               | 238.33             | 244.67             |
| Yeast at 6g/L | 2318.38        | 2494.94               | 12.99              | 11.05                 | 4.30               | 4.55               | 242.33             | 246.00             |
| Algae at 1ml/L | 2956.06        | 3061.21               | 14.93              | 10.61                 | 4.56               | 4.72               | 229.67             | 237.67             |
| Algae at 2ml/L | 3427.65        | 3512.99               | 15.21              | 15.20                 | 4.14               | 4.50               | 247.67             | 250.33             |
| Algae at 3ml/L | 2018.88        | 2710.04               | 13.98              | 8.30                  | 4.83               | 4.45               | 252.33             | 243.67             |
| Algae at 4ml/L | 1974.72        | 2419.22               | 12.58              | 10.60                 | 5.20               | 4.74               | 246.00             | 239.67             |
| L.S.D at 0.05 | 1236.10        | 1175.92               | 4.42               | 3.54                  | 0.52               | 0.46               | 11.88              | 8.63               |

3.1.4. Leaf area (cm³)

The data in table (2) showed that a foliar application of seaweed extract at the rate of yeast extract (4, 5 or 6 g/l) or seaweed (1 or 2 ml/l) had the same high significant effect. The highest leaf area was obtained using treatment of seaweed at 2 ml/l was 3427.65 and 3515.99 cm³ compared to the control plants (1209.14 and 1212.03 cm³) in the two seasons, respectively. Those findings were in agreement with the results found by Masoud and Abou-Zaid, (2015) on Ruby seedless grapevines using a spray application of seaweed and yeast. The same results were obtained by El-Sayed et al., (2018) on dahlia plants using seaweed extract.

3.1.5. Leaves dry weight (g)

The data present in table (2) indicated, yeast extract 4 g/l or seaweed 2 ml/l gave the same high significant of the leaves dry weight (15.21 and 15.20 g./plant) in the seasons of 2018 and 2019, and (15.05 and 14.75 g./plant) with the yeast extraction in the two seasons, respectively. Those results were in agreement with the findings by Abdou et al., (2018) on gladioli, (El-Sayed et al., 2018) on dahlia, Waly et al., (2019) on Rosmarinus officinalis and by Abdou et al., (2021) on gladiolus plants.

3.1.6. Stem diameter (cm)

The data represented in table (2) showed that the foliar application of seaweed extract at the level of yeast extract (3 g/L.) or seaweed (3 or 4 ml/l) gave significant increase in stem diameter (5.20 and 4.74 cm), compared to the control treatment (4.60 and 3.94cm) in the two seasons, respectively.
3.1.7. Flowering time
Calculated as the number of days from planting to the shown colour stage (days). Data in table (2) showed that the least days taken to reach the shown colour stage was recorded using a foliar application with seaweed at the rate of (1.0 ml/l) was 229.67 and 237.67 days in the two seasons, respectively, compared with the control 251.00 and 251.67 days in the seasons of 2018 and 2019. Foliar application with seaweed mainly resulted in an increase in the number of days needed to reach the shown colour stage. El-Sayed et al. (2018) noted that, seaweed treatment resulted in a significant increase in the number of days needed to reach flowering in *Dahlia pinnata*.

3.2. Effect of two biostimulants foliar applications on hippeastrum postharvest measurements:

3.2.1. Water uptake (g)
From the data recorded in table (3), it was noted that treatments of seaweed (2 ml/l) or yeast extraction at the level of (4 g/l) gave the highest water uptake in the spike vase life (64.27 and 67.63) and (64.88 and 64.49) in the two seasons respectively, compared with the control (59.32 and 60.48) in seasons of 2018 and 2019. Improving the water uptake of the spike could lead to an improvement in the vase life of cut spikes compared with the untreated plants with biostimulants.

3.2.2. Loss of spike fresh weight (L.S.F.W.) (%);
From the data resulted in table (3), it was noted that all treatments in our investigation had no significant difference on the loss of spike fresh weight in the two seasons.

Table 3: Average of the flowering time (days), water uptake (g.) and loss of spike fresh weight (%), vase life (days) and spike length (cm.), of *Hippeastrum hybridum* as affected by seaweed extraction and yeast extraction concentrations in the seasons of 2018 and 2019.

| Treatments     | Water uptake (g) | LSFW (%) | Vaselife (days) | Spike length (cm) |
|----------------|------------------|----------|-----------------|-------------------|
|                | 2018  | 2019  | 2018  | 2019  | 2018  | 2019  | 2018  | 2019  | 2018  | 2019  |
| Control at 0.0 | 59.32 | 60.48 | -14.00 | -14.76 | 7.67  | 8.33  | 52.83 | 51.47 |
| Yeast at 3g/l  | 61.90 | 64.55 | -18.64 | -16.03 | 11.67 | 10.67 | 62.00 | 60.00 |
| Yeast at 4g/l  | 64.88 | 64.49 | -16.21 | -14.51 | 9.00  | 9.33  | 57.33 | 59.93 |
| Yeast at 5g/l  | 64.30 | 62.78 | -19.19 | -10.26 | 13.67 | 12.00 | 63.53 | 60.00 |
| Yeast at 6g/l  | 59.57 | 58.84 | -26.26 | -10.63 | 11.00 | 10.67 | 58.83 | 57.42 |
| Algae at 1ml/l | 64.41 | 62.35 | -17.25 | -7.87  | 13.67 | 10.00 | 66.23 | 63.50 |
| Algae at 2ml/l | 64.27 | 67.63 | -10.49 | -9.22  | 10.33 | 10.33 | 59.67 | 65.42 |
| Algae at 3ml/l | 63.24 | 61.84 | -11.30 | -12.04 | 10.67 | 12.33 | 63.60 | 67.17 |
| Algae at 4ml/l | 64.18 | 63.28 | -2.00  | -6.57  | 10.67 | 11.00 | 68.93 | 72.20 |
| L.S.D at 0.05  | 3.93  | 3.76  | N.S   | N.S   | 3.12  | 2.17  | 8.91  | 11.01 |

3.2.3. Spike vase life (days)
From the data recorded in table (3), it was recorded that the applications of foliar spray with either yeast extract at 5.0 g/l or seaweed extraction at the level of (1 or 3 ml/l) had the high significant vase life (13.67 and 12.0 days), (13.67 and 10.00) or (10.67 and 12.33 days) in the two seasons, respectively, compared with the control (7.67 and 8.33 days). The results were in agreement with those found by Gawade et al., (2019) on chrysanthemum. They noted that biofertilizers (seaweed extract, humic acid, and other biostimulants) increased the shelf vase life of chrysanthemum. This is may be because biofertilizers contain cytokinin and auxins that might have increased the antioxidant levels and resistance to senescence. They noted such a metabolic activity of narrowing the C:N ratio by the significant accumulation of carbohydrates. It was also demonstrated by Kakkashan et al., (2017) that seaweed treatments resulted in the highest vase life (11.67 days) compared with the control (7.67 days) in *Polianthes tuberosa*. 

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3.2.4. Spike length (cm.)

From the data recorded in table (3), it was demonstrated that foliar spray with either yeast at the level of 3 g/l or seaweed at (1.0, 3.0, or 4.0 ml/l) gave the highest spike length 62.0 and 60.0 cm., 66.23 and 63.50 cm., 63.6 and 67.17 cm., or 68.93 and 72.20 cm. in the two seasons, respectively, compared with the control (52.83 and 51.47 cm.) in 2018 and 2019. Our results are in agreement with those found by Abdou et al., (2018, I). They noted that seaweed extracts and other biostimulants significantly increased the spike length of *Gladiolus grandiflorus* cv. “Peter pears” compared with the untreated plants. Our results also agree with those found by Abdou, et al. (2021) on gladiolus. They declared that seaweed extraction and yeast, led to significant increases in spike length.

3.2.5. Spike thickness (cm.)

From the data recorded in table (4), it was declared that all the foliar treatments of dry yeast or seaweed extraction did not have a significant effect on the spike thickness in our investigation in both seasons of 2018 and 2019.

3.2.6. Spike diameter (cm.)

It was recorded in table (4) that the spike diameter present was not significantly affected by all the treatments used in our investigation. (Abdou et al., 2021) stated that seaweed extraction and yeast lowered the florets diameter of *Gladiolus grandiflorus* cv. “Eurovision”.

3.2.7. Spike dry weight (g.)

The data recorded in table (4) declared that the highest spike dry weight was found by using seaweed foliar spray at the rate of 4 ml/l was 3.64 and 3.52 g. compared with the control (2.61 and 2.53 g.) in the two seasons, respectively. It was found out by El-Sayed et al., (2018) that the application of seaweed resulted in a significant increase in the flower dry weight of *Dahlia pinnata*. Seaweed application was found to increase flower bud dry weight in lilium cv. “Brindisi” (De Lucia and Vecchietti, 2012).

**Table 4**: Average of the spike diameter (cm.), spike dry weights (g.) and spike thickness (cm.) of *Hippeastrum hybridum* as affected by seaweed extraction and yeast extraction concentrations in the seasons of 2018 and 2019.

| Treatments      | Spike Diameter (cm.) | Spike dry weight (g.) | Spike thickness (cm.) |
|-----------------|----------------------|-----------------------|-----------------------|
|                 | 2018     | 2019     | 2018     | 2019     | 2018     | 2019     |
| Control at 0.0  | 13.83    | 30.50    | 2.61     | 2.53     | 1.85     | 1.78     |
| Yeast at 3g/l   | 16.17    | 17.83    | 2.94     | 3.02     | 2.04     | 2.05     |
| Yeast at 4g/l   | 14.17    | 16.67    | 2.56     | 2.61     | 1.93     | 1.86     |
| Yeast at 5g/l   | 14.17    | 15.83    | 3.22     | 3.06     | 2.28     | 2.02     |
| Yeast at 6g/l   | 14.67    | 15.83    | 2.86     | 2.86     | 2.08     | 2.23     |
| Algae at 1ml/l  | 14.67    | 15.00    | 3.08     | 3.04     | 2.05     | 1.98     |
| Algae at 2ml/l  | 15.33    | 15.33    | 3.05     | 3.02     | 2.16     | 1.96     |
| Algae at 3ml/l  | 14.33    | 14.00    | 2.98     | 2.99     | 1.99     | 1.85     |
| Algae at 4ml/l  | 14.67    | 15.50    | 3.64     | 3.52     | 2.23     | 2.26     |
| L.S.D at 0.05   | N.S.     | N.S.     | 0.34     | 0.27     | N.S.     | N.S.     |

3.3. Effect of two biostimulants foliar applications on hippeastrum bulbs measurements

3.3.1. Bulbs volume (cm³)

The data recorded in table (5) showed that using seaweed foliar spray with concentrations of 1, 2 or 4 ml/l or dry yeast extract at the rate of 3.0 g/l resulted in higher bulbs volume (89.0 and 89.33 cm³), (109.33 and 92.0 cm³), (104.33 and 86.33 cm³) and (96.00 and 103.33 cm³) in the two seasons, respectively, compared with the control (63.67 and 62.67 cm³) in the seasons of 2018 and 2019.
3.3.2. Bulbs fresh weight (g.)

The data recorded in table (5) demonstrated that, the bulbs’ fresh weight was greatly affected by the use of foliar spray with 1, 2 or 4 g/l of seaweed extract. It resulted in 80.59 and 86.06 g., 80.53 and 80.30 g., or 95.99 and 80.67 g. in the two seasons, respectively. The treatment of yeast foliar application at the rate of 3 g/l resulted in (90.58 and 80.76 g.) in the two seasons compared with the untreated plants (71.11 and 57.88 g.) in the two seasons, respectively. Our results were in agreement with those found by De Lucia and Vecchietti, (2012) on lily. They stated that seaweed extract had an average increase by 60% in bulb roots fresh weight compared with the untreated plants. Abdou et al., (2018) declared that a treatment with seaweed extract followed by dry yeast without significant differences between them on *Gladiolus grandiflorus* corms. They stated that the seaweed liquids contain macronutrients, trace elements, organic substances, i.e., auxins, cytokinin, and gibberellins, as well as vitamins and fatty acids. Yeast also can play a great role in making available nutrient elements for plants. These constituents led to promote nutrient uptake and then reflexes on the corms quality. Our results in this investigation also agree with those found by El-Sayed et al., (2018). They recorded that tuberous root fresh weights of *Dahlia pinnata* were stimulated by the use of seaweed extraction.

Table 5: Average of the bulbs volume (cm³.), bulbs fresh weights (g.) of *Hippeastrum hybridum* as affected by seaweed extraction and yeast extraction concentrations in the seasons of 2018 and 2019.

| Treatments       | Bulbs Volume (cm³) | Bulbs fresh weight (g) |
|------------------|--------------------|------------------------|
|                  | 2018               | 2019                  |
| Control at 0.0   | 63.67              | 62.67                  |
| Yeast at 3g/l    | 96.00              | 103.33                 |
| Yeast at 4g/l    | 94.00              | 87.00                  |
| Yeast at 5g/l    | 77.33              | 83.33                  |
| Yeast at 6g/l    | 77.33              | 87.33                  |
| Algae at 1ml/l   | 89.00              | 89.33                  |
| Algae at 2ml/l   | 109.33             | 92.00                  |
| Algae at 3ml/l   | 81.33              | 84.33                  |
| Algae at 4ml/l   | 104.33             | 86.33                  |
| L.S.D at 0.05    | 26.59              | 18.90                  |

3.4. Effect of two biostimulants foliar applications on hippeastrum chemical analysis:

3.4.1. Total chlorophyll(SPAD. Units)

Data in table (6) on the chlorophyll content in the fresh leaves at the flowering stage, was detected using the SPAD instrument. It was declared that two treatments in our investigation gave a significant high level of chlorophyll content. Treatment of seaweed extract with the level of 2ml/l or yeast extraction at the level of 4 g/l gave the highest chlorophyll content in hippeastrum leaves (64.27 and 67.63 SPAD) or (64.88 and 64.49 SPAD) in the two seasons, respectively, compared with the control (60.09 and 60.48 SPAD) in seasons of 2018 and 2019. Our results were in agreement with those found by De-Lucia and Vecchietti (2012) on Lily. They noted that seaweed extraction resulted in higher SPAD values in leaves of Lily compared with untreated plants. The same trend of results was obtained by Abdou et al., (2018) on *Gladiolus grandiflorus cv." Peter pears"*. They demonstrated that the highest chlorophyll a and b contents were obtained using 3 cm³/L. of seaweed extract, followed by active dry yeast (5 g/l) without significant difference. Our results also agree with the findings by Waly et al., (2019) on *Rosmarinus officinalis*. They noted that using foliar seaweed extraction at 6 ml/l gave the highest value of chlorophyll a and b in the two seasons. The results also agree with the findings of El-Sayed et al., (2018) on Dahlia plants. They declared that seaweed extraction at the rate of 1 % gave the highest chlorophyll content in the two seasons.

3.4.2. Anthocyanin content

Anthocyanin was detected from petal of the flower at the postharvest fading stage. All the treatments used in our investigation were significantly increased than the control. The data presented in
Table (6) showed that the highest amount of anthocyanin content in petals spike was observed using the treatment of yeast foliar spray at the level of 5 g/l, resulted in (1.28 and 1.34) in the two seasons. Our results agree with the findings of Masoud and Abou-Zaid, (2017) on Ruby Seedlings Grapevines. They showed that all yeast extract treatments significantly improved skin berry anthocyanin compared with unsprayed ones.

From the previous data it is clear that bio-stimulants such as seaweed extraction and dry yeast extraction act as a stimulators on most of the plants tested parameters. Bulgari et al., (2015) stated that, bio-stimulants increase the leaf colour by stimulating the chlorophyll content. They declared that, application of bio-stimulants in floriculture allows high levels of sustainability, increase plants tolerance to abiotic and biotic stresses thus enhancing internal and external quality of the plants.

Table 6: Average of the total chlorophyll SPAD units and the anthocyanin content of *Hippeastrum hybridum* as affected by seaweed extraction and yeast extraction concentrations in the seasons of 2018 and 2019.

| Treatments          | Chlorophyll (SPAD units) | Anthocyanin content |
|---------------------|--------------------------|---------------------|
|                     | 2018 | 2019 | 2018 | 2019 |
| Control at 0.0      | 60.09| 60.48| 0.85 | 0.93 |
| Yeast at 3g/L       | 61.90| 64.55| 0.98 | 0.97 |
| Yeast at 4g/L       | 64.88| 64.49| 1.23 | 1.27 |
| Yeast at 5g/L       | 64.30| 62.78| 1.28 | 1.34 |
| Yeast at 6g/L       | 59.57| 58.84| 1.17 | 1.19 |
| Algae at 1ml/L      | 64.41| 62.35| 1.01 | 1.05 |
| Algae at 2ml/L      | 64.27| 67.63| 0.99 | 0.98 |
| Algae at 3ml/L      | 63.24| 61.84| 1.27 | 1.26 |
| Algae at 4ml/L      | 64.18| 63.28| 1.20 | 1.15 |
| L.S.D at 0.05       | 4.04 | 3.76 | 0.10 | 0.10 |

4. Conclusion

From the previous data it could be concluded that, using a eight foliar application with one month intervals of seaweed extraction at 2 ml/l greatly affected the vegetative growth of *Hippeastrum hibrydum* cv. “Baby star”, resulting in enhancing plant height, leaves fresh and dry weights, leaf area, bulbs volume and weights and total chlorophyll content in leaves. The least days taken to reach the shown colour stage was recorded using a foliar application with seaweed at the rate of 1.0 ml/l. However, the longest vase life for spike postharvest was obtained using foliar application of seaweed extraction at the level of 3.0 ml/l or yeast extraction at 5.0 g/l.

It is recommended to use eight foliar application with one month intervals of seaweed extraction at 2 ml./L to enhance pre and post harvest life of *Hippeastrum hibrydum* cv. “Baby star.”

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