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The role of organic fertilizer, chitosan, amino acids and seaweeds extract in enhancing the growth, yield and active ingredient of *Cassia acutifolia* Delile plants

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Abstract

A field experiment was conducted during the two successive seasons of 2019 and 2020 to elucidate the impact of compost as organic manure (0, 10, 20 and 30 m^3 /feddan) (feddan = 4200 m^2 = 0.420 hectares = 1.037 acres) and some stimulant substances namely (0, chitosan at 500, 1000 and 1500 ppm, amino acids at 100, 200 and 300 ppm and seaweeds extract at 1, 2 and 3 ml /l), as well as, their interactions on plant growth aspects (plant height, leaves dry weight /plant and per feddan and herb dry weight/ plant), pod yield /plant and per feddan, total anthraquinone glycosides percentage and total anthraquinone glycosides yield /plant and per feddan of Alexandrian senna (*Cassia acutifolia* Delile) plants. The obtained results indicated that applying compost at all levels resulted a significant augment in all studied parameters, except for the low level (10 m^3 /feddan) regarding plant height, leaves dry yield/plant and per feddan and herb dry weight/plant, in the first season. The most effective treatment in augmenting these traits was given by using compost at the high level (30 m^3 /feddan). Foliar spray with the three examined stimulant substances, at all concentrations, led to a significant augment in all aspects, except for 500 ppm chitosan concerning leaves dry yield /plant and per feddan, In the second season, 500 ppm chitosan, 100 ppm amino acids and 1 m /l seaweeds extract, in the first season and, 100 ppm amino acids concerning total anthraquinone glycosides percentage, in the second season. Clearly, foliar spray with seaweeds extracts at 3 ml /l proved to be more effective in increasing the tested characteristics. Obviously, the interaction was statistically significant effect on all studied aspects. Utilizing compost at the high level (30 m^3 /feddan) with seaweeds extract at 3 m /l gave the most effective treatment in augmenting these traits.

Keywords: *Cassia acutifolia*, compost, chitosan, tryptophan, methionine, cysteine, seaweeds extract.

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1. Introduction

Alexandrian senna (*Cassia acutifolia* Delile) belongs to Fabiaceae (Leguminaceae) family, it is a member of the most important medicinal and pharmaceutical plants. The plant is herbaceous shrub and is desert origin (Bruneton, 1995). It is native to Northern and Northeastern Africa. The plant is widely grown in semi desert and sudano sahelian regions of Africa, including Egypt, Morocco, Mali, Sudan and Mouritania (Bruneton, 1995; Iwu, 1990; Leung and Foster, 1996; Wichtl and Bisset, 1994). The senna plant has the most widely utilized anthranoid drug and it is used in medicine as a laxative effect via it taken as a tea in powdered form (Bradley, 1992; Der Marderosian, 1999; Leung and Foster, 1996). The laxative effect for senna is due to that the leaves and pods contain anthraquinone glycosides which called laxative or purgative glycosides**.** Recently, the world focused his attention to lowering the effect of environmental pollution and improving human health by decreasing the application of mineral fertilizers and pesticides in agricultural production. Organic farming has been the best agricultural practices of productivity of different crops which have supported for the environment (Narkhede *et al*., 2011). However, the quality and quantity of yield of medicinal and aromatic plants were positively responded to applying organic fertilization (Badalingappanavar *et al*., 2018). Also, the previous investigators showed that organic fertilizers act an alternative source to meet the nutrient requirements in planting medicinal and aromatic plants. Organic farming is expanded rapidly and has seen as a sustainable alternative to chemical-based cultivation system (Panda, 2006). Organic manures are positive alternative to mineral fertilizers for improving the soil structure (Dauda *et al*., 2008). Furthermore, organic fertilizers contain plant growth substances (IAA and GA3), macronutrients, necessary micronutrients and useful microorganisms (Natarajan, 2007; Sreenivasa *et al*., 2010). The efficiency of organic manures on augmenting the growth and yield of some legume plants was described by Sakr (2005), Ali *et al*. (2014) and Ibrahim (2014) on senna (*Cassia acutifolia*) and Balakumbahan and Rajamani (2010) and Reddy and Kayina (2012) on senna (*Cassia angustifolia*), Patel *et al*. (2010) and Nattudurai *et al*. (2014) on cluster bean, and Shehata (2013), Abdou *et al*. (2017), Abo El- Ezz (2019) and Abd El-Aal *et al*. (2022) on guar. Also, organic fertilizers elevated total anthraquinone glycosides (Ali *et al*., 2014; Ibrahim, 2014) on senna (*Cassia acutifolia*)**.** Chitosan is a polysaccharide [2-Amino-2-deoxy-beta-D-glucosasmine] (Peniston and Johnson, 1980). This compound is biopolymer a chitin derivative, is completely for the environment, it is characterized by unique properties like, bioactivity and bio-compatibility (Dias *et al*., 2013). Chitosan acts the change of metabolic due to the plants treated with chitosan become more resistance to viral, bacterial and fungal infections (Al- Hetar *et al*., 2011). Moreover, the application of chitosan as a foliar spray resulted an enhance in plant growth, yield and induces synthesis of secondary metabolites in the plants such as, polyphenolics, flavonoids, lignin and phytoalexins (Emami Bistgani *et al*., 2017; Xoca-Orozco *et al*., 2017). The stimulative effect of chitosan on plant growth (Sheikha, 2011 on *Phaseolus vulgaris*; Mondal *et al.*, 2013 on mung bean; El-Tanahy *et al*., 2012 on cowpea; Abou-Muriefah, 2013 on common bean) on yield (Chibu *et al*., 2002 and Lee *et al*., 2005 on soybean; El-Tanahy *et al*., 2012 on cowpea). In recent years, amino acids application is a widely utilized in agricultural and horticultural practices for increasing the crop productivity due to the physiological and biochemical roles of amino acids like, acting in synthesis of vitamins, enzymes, co-enzymes, pigments, terpenoids, purine and pyrimidine bases (Kamar and Omar, 1987), besides, they have to be precursors or activators of phytohormones and plant growth hormones (Goss, 1973; Taiz and Zeiger, 2002). Numerous studies were explored that amino acids increased the growth of various plants for examples: Saeed *et al*. (2005) on soybean; Mahmoud *et al*. (2021) and Mahmoud (2021) on roselle, and Ali *et al.* (2019) on coriander. Also, concerning the yield (Saeed *et al*., 2005 on soybean; Zewail, 2014 on common bean; Sadak *et al*., 2015 on faba bean; Mahmoud *et al.*, 2021 and Mahmoud, 2021 on roselle; Ali *et al*., 2019; Abdullatif, 2019 on coriander). In addition, Zewail (2014) on common bean, Talaat and Youssef (2002) on basil and Talaat (2005) on *Pelargonium graveolens*, regards the chemical constituents. Nowadays, seaweeds extract has been become one of the most important stimulant substances applied for enhancing agricultural and horticultural crops might be attributed to the beneficial influences of seaweeds extract which were examined by many authors like, Ho *et al*. (2003) and Fornes *et al*. (1993) mentioned that seaweeds extract is used as a natural fertilizer and is considered as an excellent source of organic matter. In addition, it contains a lot of macro and micronutrients namely, (N, P, K, S, Ca, Mg, Fe, Zn, Mn and Co). It has widely used in enhancing the growth and development of several plants due to it contains plant growth hormones (auxins, gibberellins and cytokinins) and amino acids, vitamins and many nutritional elements like, N, P, K, Ca, Zn, Mn, Fe, B, Cu, Co and Mo (Begum *et al*., 2018; Stirk *et al*., 2004; Zamani *et al*., 2013). The unique role of seaweeds extract in augmenting the growth have to be discussed on guar (Abd El-Aal *et al.*, 2022; Ramya *et al*., 2011; Thirumaran *et al*., 2009; Vijayanand *et al*., 2014) on fenugreek (Mahmoud, 2021; Mahmoud *et al.*, 2021; Tarraf *et al*., 2015) on roselle, regarding the yield, Vijayanand *et al*. (2014), Khater and Rania (2016) on guar, Rathore *et al*. (2009) on soybean, Zodape *et al*. (2010) on mung bean, Arthur *et al.* (2003) and Jayasinghe *et al.* (2016) on pepper, Zodape *et al.* (2008) on okra, Mahmoud *et al*. (2021) and Mahmoud (2021) on roselle, besides El-Leithy *et al*. (2019) on *Plectranthus amboinicus*, concerning chemical constituents. Therefore, the objective of this investigation was to study the impact the of compost as organic manure, some stimulant substances (chitosan, amino acids and seaweeds extract) and their interactions on plant growth traits, yield and active ingredient of Alexandrian senna (*Cassia acutifolia* Delile) plants to figure out the most suitable treatment for improving these characteristics.

2. Materials and methods

2.1 Experimental site and treatments description

The present investigation was conducted during the two successive season of 2019 and 2020 at the private farm, Towa, Minia governorate, Egypt to examine the effect of compost as organic manure and some stimulant substances (Chitosan, amino acids and seaweeds extract), as well as, their interactions on plant growth aspects, yield and active ingredient of Alexandrian senna (*Cassia acutifolia* Delile) plants. The seeds of this plant were obtained from Medicinal and Aromatic plants Department, Horticulture Research Institute, Agricultural Research Central, Giza, Egypt**.** A split plot design was allowed in this study with 3 replicates, compost treatments considered as the main plots (A) included 4 levels, while stimulant substance treatments were in the sub-plots (B) included 10 treatments, thus, the interaction treatments (A×B) involved 40 treatments. The seeds were soaked in water for 24 h., then four seeds were sown, immediately on April 1st, in both seasons, in the experimental plot at (1.8 × 2.1 m) in hills, 30 cm. apart and 60 cm distance between the rows. Fourty days after the sowing, the growing seedlings were thinned to one plant /hill, therefore, each plot contained 21 plants. Physical and chemical characteristics of the used soil are listed in Table (1).

Table (1): Physical and chemical characteristics of the experimental soil (average of the two seasons).

Soil texture	Organic matter (%)	$CaCO_3$ (%)	E C (m.mohs/cm)	pH (1:2.5)	Available			Water soluble ions (meq/l) in the soil paste				
					N (%)	P (ppm)	K (mg/100g)	Ca^{++}	Mg^{++}	HCO_3	Cl^-	SO_4
Loamy	0.75	2.54	0.95	7.67	0.11	0.18	3.3	3.2	2.0	2.6	2.3	5.8

The four compost treatments (A) were as follows: 0 (unfertilized plants), 10, 20 and 30 m³/ feddan such fertilizer called, compost El-Neel was obtained from New Minia City and were added during the soil preparation. Table (2) showed the Physical and chemical properties of the used compost.

Table (2): Physical and chemical properties of the used compost (average of the two seasons).

Content	Value	Content	Value
pH (1-2.5)	7.5	Total phosphorus (%)	0.8
E.C. (mm/cm)	3.3	Total potassium (%)	0.89
C:N Ratio	15.9	Fe ppm	1630
Organic matter (%)	39.5	Mn ppm	96
Organic carbon (%)	23.9	Cu ppm	178
Total nitrogen (%)	1.5	Zn ppm	92

The three examined stimulant substances (B) were as follows: Control (no sprayed plants), chitosan at 500, 1000 and 1500, amino acids as a mixture (tryptophan, methionine and cysteine) at 100, 200 and 300 ppm and seaweeds extract at 1, 2 and 3 ml/ l. Chitosan was obtained from National Research Center, Giza, Egypt. Amino acids were obtained from Al-Gomhoria chemical company, Egypt. Oligo x product contains seaweeds extract was obtained from the United for Agricultural Development. Chemical analysis of the applied seaweeds extract is presented in Table (3). The plants were foliar sprayed with these stimulant substances, till run off, three times at two week intervals starting June 1st, in both seasons, one day period was allowed between the spraying of the three substances. Triton B as a wetting agent was added to all sprays.

Table (3): Chemical analysis of the used seaweeds extract.

Organic components	Value	Growth regulators	Value	Macro and micro elements	Value	Macro and micro elements	Value
Carbohydrates	35%	IAA	0.03%	Organic (N)	3.12%	Mg	0.58%
Total amino acids	6%	Cytokynins	0.02%	P_2O_5	2.61%	Fe	150 ppm
Manitol	4%			K_2O	4.71%	Zn	70 ppm
Alginic acid	10%			CaO	0.25%	Mn	13 ppm
Betaines	0.04%			S	3.56%	B	60 ppm
				Mg	0.58%	I	30 ppm

All other agricultural practices were performed as usual. At the termination (the first week of October) of the two seasons, the following data were recorded as follows: plant height (cm), leaves dry yield (g) /plant and (kg) per feddan was calculated, herb dry weight (g) /plant, number of pods /plant, pod yield (g) /plant and per feddan was calculated. Also, total anthraquinone glycosides percentage in the dried leaves was determined according to ASEAN (1993), then total anthraquinone glycosides yield g/ plant was calculated by multiplying anthraquinone glycosides percentage in leaves dry yield (g) /plant, as well as total anthraquinone glycosides (kg) /feddan, was calculated. All attained data were tabulated and statistically analyzed according to MSTATE-C (1986) using the L.S.D. test at 5% to know the differences among all treatments according to Mead *et al*. (1993).

3. Results and Discussion

3.1 Plant height

The obtained data in Table (4) revealed that plant height of senna (*Cassia acatifalia*) was positively affected by the application of compost as organic manure, during the two experimental seasons. It appears that senna plants grown in compost at all levels, in both seasons, resulted a significant increase in plant height, except for the low level of compost (10 m³ /feddan), in the first season, as compared to unfertilized ones. Additionally, the tallest plants were given by supplying the high level of such manure (30 m³ /feddan) as ranged 28.2 and 26.4 % over control, in the first and second seasons, respectively. The unique role of organic manures in augmenting plant height was, also proved by Ali *et al*. (2014) and Ibrahim (2014) on senna plants, El-Kouny *et al.* (2004), El Keltawi *et al. (*2003) and Khatab (2016) on roselle, Abd El-Gawad (2007) and Rekaby (2013) on *Coriandrium sativum*. As for stimulant substance treatments, data in Table (4) showed that plant height of senna was positively responded to the use of the examined stimulant substances, during the two seasons. Obviously, foliar spray with all used materials, all concentrations led to a significant augment in plant height, in both seasons, comparing to no sprayed ones. Moreover, the most effective treatment in increasing such parameter was detected when spraying seaweeds extract at the high concentration (3 m /l) which increased it by 35.4 and by 36.0% over control, respectively during the two consecutive seasons. The beneficial role of chitosan in improving plant height was, also described by Ali *et al*. (2014) and Ibrahim (2014) on senna plants, El-Tanahy *et al*. (2012) on cowpea, El-Bassiony *et al*. (2014) on Kohlrabi plants, Hasan *et al*. (2020) on Kenaf, Hussain (2019) and Özkurt and Bektas (2022) on tomato, Mondal *et al*. (2011) on Indian spinach, Tarraf *et al*. (2015) on roselle, Mahmoud *et al*. (2021) on Kohlrabi plants (El-Bassiony *et al*., 2014), regarding amino acids, Mahmoud *et al*. (2021) on roselle, El-Leithy *et al.* (2019) on *Plectranthus amboinicus*, Abou El-Yazied *et al*. (2012) on snap bean, Ramya *et al*. (2011) on *Cyamopsis terragonolaba*, for seaweeds extract. In respect to the interaction, it was statistically significant effect on plant height of senna, in the two seasons. From the revealed data, it could be noticed that applying all combined treatments caused a significant increase in plant height, except for 0 compost with 100 ppm amino acid and, also compost at the low level (10 m^3 /feddan) without stimulant substances addition, during both seasons, in relative to untreated plants. In connecting the tallest plants were observed due to receiving senna plants compost at the high level (30 m³ /feddan) with seaweeds extract at 3 m /l or plus 2 m /l seaweeds extract, in comparison with those obtained by other combination treatments, during the two growing seasons, as clearly pointed out in Table (4).

Table (4): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on plant height (cm) of Alexandrian senna during 2019 and 2020 seasons.

Stimulant substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	43.3	45.3	49.3	55.0	48.3
Chitosan 500 ppm	47.3	54.5	57.2	62.3	55.3
Chitosan 1000 ppm	55.0	57.6	59.8	65.0	59.3
Chitosan 1500 ppm	58.9	59.7	63.5	69.7	62.9
Amino acids 100 ppm	46.4	52.0	58.0	63.0	54.9
Amino acids 200 ppm	52.0	55.4	60.8	65.7	58.5
Amino acids 300 ppm	55.5	57.1	64.0	69.0	61.4
Seaweeds 1 m/l	49.9	54.9	61.9	66.0	58.2
Seaweeds 2 m/l	53.1	58.7	65.9	71.4	62.3
Seaweeds 3 m/l	55.9	60.9	68.6	76.3	65.4
Mean (A)	51.7	55.6	60.9	66.3	
L.S.D. for 5%	A= 4.6 B= 2.5 A×B= 5.0				
Second season					
Control	45.8	48.7	53.1	58.0	51.4
Chitosan 500 ppm	53.2	59.0	62.2	65.9	60.1
Chitosan 1000 ppm	56.8	61.8	63.7	70.7	63.3
Chitosan 1500 ppm	62.2	65.1	69.9	74.8	68.0
Amino acids 100 ppm	50.7	58.6	61.8	64.3	58.9
Amino acids 200 ppm	53.8	60.2	64.9	71.5	62.6
Amino acids 300 ppm	58.5	63.3	66.5	72.5	65.2
Seaweeds 1 m/l	54.8	60.7	65.0	70.7	62.8
Seaweeds 2 m/l	58.5	63.5	68.0	75.2	66.3
Seaweeds 3 m/l	62.6	65.6	71.2	80.3	69.9
Mean (A)	55.7	60.7	64.6	70.4	
L.S.D. for 5%	A= 4.5 B= 2.7 A×B= 5.3				

3.2 Leaves dry yield

The given results in Tables (5 and 6) cleared that supplying senna plants with compost significantly influenced leaves dry yield /plant and per fed. in the two seasons. Obviously, senna plants grown in organic manure (compost) at all levels gave significantly higher dried leaves, except for the low level (10 m³ /feddan), in the first season, than the check treatment, during the two experimental seasons. It seems that the addition of the high level 30 m³ /feddan of compost proved to be more effective in increasing leaves dry yield than those revealed by other treatments and control, in both seasons. Numerically, this previous superior treatment augmented leaves dry yield by 26.9 and by 27.0% over unfertilized ones and produced 1320.0 and 1424.9 kg /feddan dried leaves, while the control recorded 1039.2 and 1121.4 kg /feddan dried leaves, in the first and second seasons, respectively. The capability of organic manures on augmenting leaf weight has been studied by Ali *et al*. (2014) and Ibrahim (2014) on senna plants, Mastan *et al*. (2020) on *Cassia angustifolia.* Concerning stimulant substance treatments, the listed data in Table (5 and 6) indicated that the application of these treatments positively affected leaves dry yield/ plant and per feddan during both seasons. Apparently, foliar spray with the three examined substances, at all concentrations, in the two seasons, resulted an increase leaves dry yield /plant and per feddan, except for the low concentration (500 ppm) of chitosan, in the second season, as compared to no sprayed plants. Clearly, higher significantly production of leaves dry yield was given by foliar spray with seaweeds extract at the high concentration (3 ml /l) than those obtained by other treatments and control, during the two consecutive seasons.

Table (5): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on leaves dry yield (g) /plant of Alexandrian senna during 2019 and 2020 seasons.

Stimulant substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	40.2	40.4	43.6	48.8	43.3
Chitosan 500 ppm	46.5	47.8	50.5	53.7	49.6
Chitosan 1000 ppm	47.3	49.1	51.2	55.1	50.6
Chitosan 1500 ppm	50.0	52.6	55.3	60.2	54.5
Amino acids 100 ppm	43.5	47.9	51.6	55.3	49.6
Amino acids 200 ppm	45.4	49.9	53.9	60.5	52.4
Amino acids 300 ppm	48.5	50.5	56.3	62.2	54.4
Seaweeds 1 m/l	47.4	51.2	55.8	59.3	53.4
Seaweeds 2 m/l	48.2	53.6	58.5	66.3	56.7
Seaweeds 3 m/l	50.7	54.9	63.8	72.6	60.5
Mean (A)	46.8	49.8	54.1	59.4	
L.S.D. for 5%	A= 4.4 B= 2.1 A×B= 4.2				
Second season					
Control	46.2	47.5	51.5	53.5	49.7
Chitosan 500 ppm	48.6	49.3	51.4	54.8	51.0
Chitosan 1000 ppm	50.3	51.5	54.3	58.3	53.6
Chitosan 1500 ppm	51.9	54.7	59.3	62.8	57.2
Amino acids 100 ppm	47.6	52.2	54.4	61.3	53.9
Amino acids 200 ppm	49.4	54.4	57.9	66.4	57.0
Amino acids 300 ppm	51.8	56.0	59.0	68.6	58.9
Seaweeds 1 m/l	50.2	55.3	65.9	67.8	59.8
Seaweeds 2 m/l	52.7	59.4	67.7	72.4	63.1
Seaweeds 3 m/l	56.0	60.8	69.1	75.2	65.3
Mean (A)	50.5	54.1	59.0	64.1	
L.S.D. for 5%	A= 2.1 B= 2.8 A×B= 5.6				

Numerically, this above-mentioned superior treatment increased dried leaves by 39.7 and by 31.4% over the check treatment and amounted 1344.5 and 1450.3 kg /feddan dried leaves, in relative to no sprayed ones (961.3 and 1104.3) kg /feddan dried leaves in both seasons, respectively. Numerous researchers reported that the use of chitosan enhanced leaf weight, such as, El-Tanahy *et al*. (2012) on cowpea, Mondal *et al*. (2011) on Indian spinach, El-Bassiony *et al*. (2014) on Kohlrabi plants and El-Bassiony *et al*. (2014) on Kohlrabi plants concerning amino acids and Ramya *et al*. (2011) on guar, regarding seaweeds extract. Tables (5 and 6) showed that leaves dry yield /plant and per feddan of Alexandrian senna were positively responded to the interaction treatments, in the two seasons. Obviously, supplying senna plants with most combined treatments led to a significant augment in dried leaves, comparing to untreated plants, during the two growing seasons. In this connection, senna plants grown in compost at the high level (30 m^3 /feddan) with spraying seaweeds extract at the high concentration (3 ml /l) was the most effective treatment in increasing aspects which yielded 1613.8 and 1671.6 kg /feddan dried leaves against untreated plants gave 893.3 and 1026.7 kg /feddan dried leaves, during the two consecutive seasons, respectively.

Table (6): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on leaves dry yield (kg) /feddan of Alexandrian senna during 2019 and 2020 seasons.

Stimulant Substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	893.3	897.8	968.9	1085.1	961.3
Chitosan 500 ppm	1033.3	1062.9	1121.7	1193.5	1102.8
Chitosan 1000 ppm	1051.1	1090.5	1136.7	1223.8	1125.5
Chitosan 1500 ppm	1111.2	1168.9	1228.9	1336.9	1211.5
Amino acids 100 ppm	966.7	1064.4	1146.7	1228.9	1101.7
Amino acids 200 ppm	1008.9	1108.9	1198.7	1344.4	1165.2
Amino acids 300 ppm	1077.7	1122.2	1252.1	1381.9	1208.5
Seaweeds 1 m/l	1053.3	1137.8	1240.0	1317.8	1187.2
Seaweeds 2 m/l	1071.1	1191.1	1300.3	1474.1	1259.1
Seaweeds 3 m/l	1125.5	1220.0	1418.7	1613.8	1344.5
Mean (A)	1039.2	1106.4	1201.3	1320.0	
L.S.D. for 5%	A= 97.0 B= 45.1 A×B= 90.1				
Second season					
Control	1026.7	1055.5	1145.0	1189.8	1104.3
Chitosan 500 ppm	1080.0	1095.5	1142.2	1217.8	1133.9
Chitosan 1000 ppm	1117.0	1144.4	1206.7	1296.1	1191.0
Chitosan 1500 ppm	1152.8	1215.5	1317.8	1395.5	1270.4
Amino acids 100 ppm	1057.8	1160.0	1208.2	1362.2	1197.0
Amino acids 200 ppm	1097.8	1208.9	1286.7	1475.5	1267.2
Amino acids 300 ppm	1151.3	1245.1	1311.7	1523.8	1308.0
Seaweeds 1 m/l	1115.5	1228.7	1464.4	1506.7	1328.8
Seaweeds 2 m/l	1171.5	1320.0	1504.4	1609.8	1401.4
Seaweeds 3 m/l	1243.5	1351.2	1534.7	1671.6	1450.3
Mean (A)	1121.4	1202.5	1312.2	1424.9	
L.S.D. for 5%	A= 46.5 B= 50.5 A×B= 101.0				

3.3 Herb dry weight /plant

The presented results in Table (7) exhibited that the application of compost significantly affected herb dry weight /plant of senna, during the two consecutive seasons. It appears that herb dry weight /plant was significantly increased due to the addition of compost at all levels, in both seasons, except for the low one (10 m³ /feddan), in the first season, as compared to unfertilized plants. Clearly, treating senna plants with compost at the high level (30 m^3 /feddan) registered the heaviest dried herb /plant as ranged 26.0 and 26.5% over the check treatment, in the two seasons, respectively. The important role of organic manures in increasing herb weight was, also reported by Ali *et al*. (2014) and Ibrahim (2014) on senna plants.

Table (7): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on herb dry weight (g) /plant of Alexandrian senna during 2019 and 2020 seasons.

Stimulant substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	54.2	56.3	63.3	69.0	60.7
Chitosan 500 ppm	57.7	58.9	66.7	70.7	63.5
Chitosan 1000 ppm	58.7	61.7	70.0	72.7	65.7
Chitosan 1500 ppm	61.7	65.0	73.3	75.3	68.8
Amino acids 100 ppm	55.6	57.0	63.4	69.6	61.4
Amino acids 200 ppm	58.1	60.9	69.3	75.0	65.8
Amino acids 300 ppm	60.5	65.0	73.2	77.3	69.0
Seaweeds 1 m/l	58.4	60.8	64.8	70.4	63.6
Seaweeds 2 m/l	60.6	63.8	73.1	80.0	69.4
Seaweeds 3 m/l	62.3	69.6	74.3	81.3	71.9
Mean (A)	58.8	61.9	69.2	74.1	
L.S.D. for 5%	A= 4.3 B= 3.1 A×B= 6.2				
Second season					
Control	56.2	59.5	63.7	69.4	62.2
Chitosan 500 ppm	58.6	65.5	68.6	74.7	66.8
Chitosan 1000 ppm	60.1	68.5	73.1	78.3	70.0
Chitosan 1500 ppm	63.4	75.0	77.4	82.7	74.6
Amino acids 100 ppm	56.8	64.9	68.2	72.7	65.7
Amino acids 200 ppm	62.5	70.0	72.4	81.7	71.6
Amino acids 300 ppm	66.2	73.0	77.0	82.7	74.7
Seaweeds 1 m/l	64.7	66.9	71.0	75.1	69.4
Seaweeds 2 m/l	67.1	71.7	76.3	84.3	74.9
Seaweeds 3 m/l	70.9	73.9	80.0	90.3	78.8
Mean (A)	62.6	68.9	72.8	79.2	
L.S.D. for 5%	A= 5.1 B= 3.8 A×B= 7.7				

It is evident from the obtained data in Table (7) that herb dry weight /plant of senna was positively responded to the utilization of stimulant substance treatments, during the two growing seasons. Foliar spray with the three studied substances at all concentrations, in both seasons, caused a significant elevate in herb dry weight /plant, except for chitosan at 500 ppm, amino acids at 100 ppm and seaweeds extract at 1 ml /l, in the first season, as compared to no sprayed ones. Clearly, the most effective treatment in augmenting such aspect was detected resulting from spraying seaweed extract at 3 ml /l which increased it by 18.5 and by 26.7% over no sprayed ones, during the two experimental seasons, respectively**.** The capability of chitosan on enhancing herb weight has to be examined on cowpea by El-Tanahy *et al*. (2012) on Kenaf by Hasan *et al*. (2020), on tomato by Ozkurt and Bektas (2022), on roselle by Mahmoud *et al*. (2021) and on fenugreek plants by Tarraf *et al*. (2015) regarding amino acids and on roselle by Mahmoud *et al*. (2021), concerning seaweeds extract. Obviously, the interaction effects between the two studied factors on herb dry weight /plant of senna has statistically significant, in the two seasons. It seems that most combined treatments led to a significant increase in herb dry weight /plant, comparing to untreated plants, during both seasons. Apparently, plants grown in compost at the high level (30 m³ /feddan) with seaweeds extract at 3 m /l, followed by with seaweeds extract at 2 ml/l proved to be more effective in augmenting herb dry weight/ plant than those observed by other combination treatments, during the two consecutive seasons, as clearly declared in Table (7).

3.4 Pod yield

The presented data in Tables (8 and 9) postulated that pod yield /plant and per feddan of Alexandrian senna were significantly affected by the application of compost, during the two growing seasons.

Table (8): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on pod yield (g) /plant of Alexandrian senna during 2019 and 2020 seasons.

Stimulant substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	90.2	95.3	101.8	109.5	99.2
Chitosan 500 ppm	93.9	102.3	109.0	113.1	104.6
Chitosan 1000 ppm	110.9	119.7	125.6	140.3	124.1
Chitosan 1500 ppm	112.4	121.9	133.3	142.6	127.6
Amino acids 100 ppm	90.9	103.4	109.1	130.4	108.5
Amino acids 200 ppm	107.7	119.3	128.7	135.2	122.7
Amino acids 300 ppm	115.0	128.0	136.0	140.7	129.9
Seaweeds 1 m/l	100.6	116.9	117.3	134.0	117.2
Seaweeds 2 m/l	104.5	127.0	139.1	146.1	129.2
Seaweeds 3 m/l	116.0	134.7	141.7	153.3	136.4
Mean (A)	104.2	116.9	124.1	134.5	
L.S.D. for 5%	A= 7.6 B= 4.8 A×B= 9.6				
Second season					
Control	97.8	101.4	109.4	120.2	107.2
Chitosan 500 ppm	101.5	109.9	119.0	128.2	114.7
Chitosan 1000 ppm	115.1	128.9	137.4	142.2	130.9
Chitosan 1500 ppm	127.7	138.4	144.2	150.2	140.1
Amino acids 100 ppm	102.0	114.6	128.0	131.0	118.9
Amino acids 200 ppm	105.0	134.9	136.3	142.8	129.7
Amino acids 300 ppm	115.0	139.9	143.6	153.4	138.0
Seaweeds 1 m/l	113.4	128.1	128.5	137.2	126.8
Seaweeds 2 m/l	131.5	134.6	141.3	159.9	141.8
Seaweeds 3 m/l	135.0	142.3	155.5	165.7	149.6
Mean (A)	114.4	127.3	134.3	143.1	
L.S.D. for 5%	A= 8.2 B= 4.2 A×B= 8.5				

It is obvious that these traits were significantly increased due to the addition of compost at all levels, comparing to unfertilized plant in both seasons. Apparently receiving senna plants compost at the high level (30 m³

/feddan) produced the maximum value of pod yield as ranged 29.1 and 25.1% over the check treatment and registered 2989.6 and 3179.6 kg /feddan pod, while the control gave 2315.7 and 2542.3 kg /feddan pod, during the two seasons, respectively.

Table (9): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on pod yield (kg) /feddan of Alexandrian senna during 2019 and 2020 seasons.

Stimulant substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	2004.4	2117.8	2261.2	2433.3	2204.2
Chitosan 500 ppm	2087.6	2273.3	2421.4	2513.3	2323.9
Chitosan 1000 ppm	2463.8	2659.2	2790.6	3117.3	2757.7
Chitosan 1500 ppm	2497.8	2709.6	2961.6	3169.6	2834.6
Amino acids 100 ppm	2020.0	2297.8	2425.2	2898.6	2410.4
Amino acids 200 ppm	2392.6	2651.8	2859.2	3004.9	2727.1
Amino acids 300 ppm	2555.5	2844.4	3022.8	3127.2	2887.5
Seaweeds 1 m/l	2236.6	2597.4	2607.4	2977.7	2604.8
Seaweeds 2 m/l	2321.5	2822.6	3090.0	3246.3	2870.1
Seaweeds 3 m/l	2577.8	2992.6	3148.1	3407.4	3031.5
Mean (A)	2315.7	2596.6	2758.8	2989.6	
L.S.D. for 5%	A= 60.7 B= 98.8 A×B= 197.6				
Second season					
Control	2173.3	2253.8	2430.1	2671.3	2382.1
Chitosan 500 ppm	2256.5	2442.2	2645.1	2848.8	2548.1
Chitosan 1000 ppm	2557.0	2865.5	3054.3	3160.0	2909.2
Chitosan 1500 ppm	2837.0	3076.4	3204.4	3338.6	3114.1
Amino acids 100 ppm	2267.3	2546.0	2844.4	2910.4	2642.0
Amino acids 200 ppm	2333.3	2997.0	3028.1	3173.8	2883.1
Amino acids 300 ppm	2555.5	3108.1	3191.7	3408.9	3066.0
Seaweeds 1 m/l	2520.7	2845.9	2856.3	3048.9	2817.9
Seaweeds 2 m/l	2922.2	2991.5	3138.9	3552.6	3151.3
Seaweeds 3 m/l	3000.0	3161.4	3456.3	3682.9	3325.2
Mean (A)	2542.3	2828.8	2985.0	3179.6	
L.S.D. for 5%	A= 54.7 B= 81.2 A×B= 162.5				

The importance of organic manures in increasing pod weight has to be examined by Ali *et al*. (2014) and Ibrahim (2014) on senna plants, Mastan *et al*. (2020) on *Cassia angustifolia*. With respect to stimulant substance treatments, the data in Tables (8 and 9) exhibited that plants treated with the three studied substances positively affected pod yield /plant and per feddan, during the two experimental seasons. Clearly, foliar with the three tested stimulant substances, at all concentrations, led to significant augment in pod yield /plant and per feddan, in relative to no sprayed ones, during the two growing seasons. Obviously, plants treated with seaweeds extract at the high concentration (3 ml /l) proved to be more effective in increasing these aspects reached 37.5 and 39.6% over control, in the two seasons, respectively and produced 3031.5 and 3325.2 kg /feddan but no sprayed plants registered 2204.2 and 2382.1 kg /feddan pods, in the first and second seasons, respectively. The stimulative effect of chitosan on enhancing pod weight was, also concluded on cowpea (El-Tanahy *et al*., 2012), on fenugreek plants by Tarraf *et al*. (2015) concerning amino acids and regarding seaweeds extract on fenugreek plants. Accordingly, pod yield /plant and per feddan of senna were positively responded to the interaction treatments, during the two experimental seasons. It could be noticed that supplying the plants with all combined treatments resulted a significant increase in pod yield /plant and per feddan, except for 0 compost with chitosan at 500 ppm, amino acids at 100 ppm and compost at 10 m³ /feddan without spraying stimulant substances, in both seasons, besides 0 compost + amino acids at 200 ppm, in the second one, as compared to untreated plants. Moreover, senna plants grown in compost at the high level (30 m³ /feddan) with spraying seaweeds extract at 3 m /l (3407.4 and 3682.9) kg /feddan pods, followed by plants treated with compost at the same previous level plus spraying seaweeds extract at 2 ml /l (3246.3 and 3552.6) kg /feddan pods were the most effective treatments in augmenting pod yield, a while untreated plants recorded 2004.4 and 2173.3 kg /feddan pods, during the two consecutive seasons respectively, as clearly shown in Tables (8 and 9).

3.5 Total anthraquinone glycosides percentage

The presented results in Table (10) emphasized that the addition of compost positively affected total anthraquinone glycosides percentage, during the two growing seasons.

Table (10): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on total anthraquinone glycosides percentage of Alexandrian senna during 2019 and 2020 seasons.

Stimulant Substances (B)	Organic fertilization (A)				
	Control	10 m³	20 m³	30 m³	Mean (B)
First season					
Control	1.805	1.854	1.937	2.001	1.899
Chitosan 500 ppm	1.935	1.988	2.085	2.151	2.040
Chitosan 1000 ppm	2.042	2.084	2.151	2.229	2.126
Chitosan 1500 ppm	2.120	2.185	2.193	2.223	2.180
Amino acids 100 ppm	1.970	1.993	2.022	2.071	2.014
Amino acids 200 ppm	2.010	2.052	2.073	2.115	2.063
Amino acids 300 ppm	2.079	2.160	2.201	2.217	2.164
Seaweeds 1 m/l	1.993	2.034	2.122	2.223	2.093
Seaweeds 2 m/l	2.112	2.152	2.174	2.262	2.175
Seaweeds 3 m/l	2.165	2.233	2.255	2.281	2.233
Mean (A)	2.023	2.074	2.121	2.177	
L.S.D. for 5%	A= 0.017 B= 0.041 A×B= 0.083				
Second Season					
Control	1.830	1.881	1.954	2.025	1.923
Chitosan 500 ppm	1.995	2.089	2.111	2.163	2.090
Chitosan 1000 ppm	2.022	2.093	2.115	2.168	2.099
Chitosan 1500 ppm	2.033	2.097	2.127	2.154	2.103
Amino acids 100 ppm	1.897	1.967	1.993	1.999	1.964
Amino acids 200 ppm	2.011	2.050	2.064	2.088	2.053
Amino acids 300 ppm	2.066	2.027	2.088	2.103	2.071
Seaweeds 1 m/l	2.025	2.094	2.103	2.112	2.083
Seaweeds 2 m/l	2.062	2.117	2.133	2.197	2.127
Seaweeds 3 m/l	2.083	2.144	2.170	2.291	2.172
Mean (A)	2.002	2.056	2.086	2.130	
L.S.D. for 5%	A= 0.020 B= 0.073 A×B= 0.146				

Obviously, total anthraquinone glycosides percentage was significantly increased due to fertilizing senna plants with compost at all levels, in both seasons, compared to unfertilized ones. Apparently, the highest value, of such trait was detected when adding compost at the high level (30 m^3 /feddan) as ranged 7.6 and 6.4% over the check treatment, during the two experimental seasons. The role of organic manures in enhancing total anthraquinone glycosides percentage was, also cleared on senna plants (Ali *et al*., 2014; Ibrahim, 2014), on *Cassia angustifolia* (Mastan *et al*., 2020). It worthy that spraying senna plants with the three examined stimulant substances significantly influenced total anthraquinone glycosides, in the two seasons. It is clear that foliar spray with these substances at all concentrations, in both seasons, led to a significant augment in total anthraquinone glycosides %, except for the low concentration of amino acids (100 ppm), in the second season, in relative to no sprayed ones. Apparently, foliar spray with seaweeds extracts at the high concentration (3 ml /l) proved to be more effective in augmenting such parameter which increased it by 17.6 and by 12.9% over no sprayed plants, in the first and second seasons, respectively, as clearly indicated in Table (10). Data in Table (10) revealed that the interaction effect on anthraquinone glycosides percentage had statistically significant, during the two consecutive seasons. Clearly, the application of all combined treatments resulted a significant elevate in total anthraquinone glycosides percentage, except for the treatment of compost at 10 m^3 /feddan without stimulant substances, in both seasons, besides 0 compost plus amino acids at 100 ppm, compost at 10 m^3 /feddan without stimulant substances or without 100 and compost at 20 m^3 /feddan without stimulant substances, in the second season. Apparently, supplying the plants with the high level of compost (30 m^3 /feddan) with seaweeds extract at 3 ml /l followed by with seaweeds extract at 2 ml /l, then compost at the moderate level (20 m^3 /feddan) plus seaweeds extract at 3 ml /l proved to be more effective in augmenting total anthraquinone glycosides percentage than those obtained by other combination treatments, during the two seasons.

3.6 Total anthraquinone glycosides percentage

Data presented in Tables (11 and 12) revealed that total anthraquinone glycosides yield /plant and per fed. of senna were positively responded to the use of compost, in the two reasons. Obviously, these parameters were significantly increased resulting from receiving the plants such manure at all levels, in relative to unfertilized ones, during the two experimental seasons. Moreover, plants grown in the high level (30 m^3 /feddan) of compost achieved the most effective treatment in increasing total anthraquinone glycosides yield /plant and per feddan reached 36.2 and 35.6% over control, during the two growing seasons, respectively and, also yielded 28.85 and 30.45 kg /feddan total anthraquinone glycosides, while the check treatment recorded 21.11 and 22.53 kg /feddan total anthraquinone glycosides, in both seasons, respectively. The beneficial influence of organic manures on increasing total anthraquinone glycosides was also reported by Ali *et al*. (2014) and Ibrahim (2014) on senna plants, Mastan *et al*. (2020) on *Cassia angustifolia*.

Table (11): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on total anthraquinone glycosides yield g/ plant of Alexandrian senna during 2019 and 2020 seasons.

Stimulant substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	0.73	0.75	0.84	0.98	0.83
Chitosan 500 ppm	0.90	0.95	1.05	1.15	1.01
Chitosan 1000 ppm	0.97	1.02	1.10	1.22	1.08
Chitosan 1500 ppm	1.06	1.16	1.21	1.34	1.19
Amino acids 100 ppm	0.86	0.95	1.04	1.14	1.00
Amino acids 200 ppm	0.91	1.02	1.12	1.28	1.08
Amino acids 300 ppm	1.01	1.09	1.24	1.38	1.18
Seaweeds 1 m/ l	0.95	1.04	1.19	1.32	1.13
Seaweeds 2 m/ l	1.02	1.16	1.28	1.50	1.24
Seaweeds 3 m/ l	1.10	1.22	1.44	1.66	1.35
Mean (A)	0.95	1.04	1.15	1.30	
L.S.D. for 5%	A= 0.05 B= 0.07 A×B= 0.15				
Second season					
Control	0.85	0.90	1.01	1.09	0.96
Chitosan 500 ppm	0.97	1.03	1.09	1.19	1.07
Chitosan 1000 ppm	1.02	1.08	1.16	1.27	1.13
Chitosan 1500 ppm	1.06	1.15	1.26	1.35	1.20
Amino acids 100 ppm	0.91	1.03	1.08	1.23	1.06
Amino acids 200 ppm	0.99	1.12	1.20	1.39	1.17
Amino acids 300 ppm	1.07	1.14	1.23	1.44	1.22
Seaweeds 1 m/l	1.02	1.16	1.39	1.44	1.25
Seaweeds 2 m/l	1.09	1.26	1.45	1.59	1.35
Seaweeds 3 m/l	1.17	1.31	1.50	1.72	1.42
Mean (A)	1.01	1.12	1.24	1.37	
L.S.D. for 5%	A= 0.07 B= 0.06 A×B= 0.12				

In regard to stimulant substance treatments, the listed data in Tables (11 and 12) indicated that these examined substances significantly affected total anthraquinone glycosides yield /plant and per feddan, during both seasons. It is obvious that foliar spray with all concentrations of the three stimulant substances resulted a significant augment in these characteristics, during the two growing seasons, as compared to no sprayed ones. Apparently, the highest yields of total anthraquinone glycosides were given by foliar spray with seaweeds extract at the high concentration (3 ml /l) reached 63.7 and 48.2 % over no sprayed plants, in the two seasons, respectively and amounted 30.08 and 31.64 kg /feddan total anthraquinone glycosides in relative to control (18.37 and 21.35) kg /feddan total anthraquinone glycosides, during the two consecutive seasons, respectively.

Table (12): The influence of compost, chitosan, amino acids and seaweeds extract, as well as their interactions on total anthraquinone glycosides yield kg/ feddan of Alexandrian senna during 2019 and 2020 seasons.

Stimulant substances (B)	Compost levels (A)				
	Control	10 m^3	20 m^3	30 m^3	Mean (B)
First season					
Control	16.22	16.75	18.77	21.74	18.37
Chitosan 500 ppm	19.98	21.14	23.39	25.54	22.51
Chitosan 1000 ppm	21.52	22.75	24.52	27.20	24.00
Chitosan 1500 ppm	23.62	25.70	26.93	29.81	26.51
Amino acids 100 ppm	19.02	21.22	23.21	25.44	22.22
Amino acids 200 ppm	20.21	22.74	24.87	28.44	24.07
Amino acids 300 ppm	22.40	24.25	27.54	30.64	26.21
Seaweeds 1 m/l	21.01	23.18	26.47	29.43	25.02
Seaweeds 2 m/l	22.77	25.72	28.36	33.37	27.55
Seaweeds 3 m/l	24.33	27.15	31.97	36.85	30.08
Mean (A)	21.11	23.06	25.60	28.85	
L.S.D. for 5%	A= 2.60 B= 1.86 A×B= 3.73				
Second season					
Control	18.90	19.95	22.40	24.15	21.35
Chitosan 500 ppm	21.61	22.99	24.11	26.34	23.76
Chitosan 1000 ppm	22.59	24.05	25.68	28.12	25.11
Chitosan 1500 ppm	23.45	25.51	28.03	30.01	26.75
Amino acids 100 ppm	20.14	22.86	24.05	27.27	23.58
Amino acids 200 ppm	22.07	24.80	26.60	30.83	26.07
Amino acids 300 ppm	23.78	25.27	27.40	32.06	27.13
Seaweeds 1 m/l	22.67	25.79	30.99	31.99	27.86
Seaweeds 2 m/l	24.16	28.03	32.15	35.42	29.94
Seaweeds 3 m/l	25.93	29.01	33.32	38.30	31.64
Mean (A)	22.53	24.83	27.47	30.45	
L.S.D. for 5%	A= 1.14 B= 1.50 A×B= 3.00				

As for the interaction, it was statistically significant effect on total anthraquinone glycosides yield/ plant and per feddan of senna, during the two experimental seasons (Tables 11 and 12). In this connection, the application of all combined treatments led to a significant increase in total anthraquinone glycosides yield /plant and per feddan, except for 0 compost with 100 ppm amino acids, compost at 10 m^3 /feddan without stimulant substances, in the two seasons and, also compost at 20 m^3 /feddan without stimulant substances, in the first season, comparing to untreated plants. Moreover, plants treated with compost at the high level (30 m^3 /feddan) plus seaweeds extract at 3 ml /l proved to be more effective in augmenting these traits, in comparison with these defected by other combination. treatments, in the two seasons. Also, this previous treatment yielded 36.85 and 38.30 kg /feddan total anthraquinone glycosides, while untreated plants produced 16.22 and 18.90 kg /feddan total anthraquinone glycosides, in the first and second seasons respectively. From the obtained results, it could be discussed as follows: The increments in plant growth traits (plant height, leaves dry weight /plant and per feddan and herb dry weight /plant), pod yield /plant and per feddan, total anthraquinone glycosides percentage, total anthraquinone glycosides yield /plant and per feddan due to the addition of compost as organic manure reflected the positive, physiological and biological roles of organic manures which were described by some merits for examples: Organic manure contains microorganisms like Azotobacter and Azospirillum which they have been useful influence in N-fixing bacteria and release phytohormones (IAA, GA and cytokinins) which play an important roles in plant growth, dry matter and nutrient, absorption (Reynders and Vlassak, 1982). It has considered as a main source of N, P and S and, also, it contains high concentrations of B and Mo. Additionally, they indicated organic matter is a source of energy for the growth of Azotobacter (Bohn *et al*., 1985), besides, organic fertilizer can stimulates the microbial biomass (Suresh *et al*., 2004). Moreover, the basis of soil fertility depends on the presence of organic matter (Aboudrare, 2009). The primitive impact of chitosan on the examined characteristics may be due to the beneficial roles of chitosan such as chitosan is widely utilized in promoting plant defense (Bautista-Banos *et al*., 2003). The use of chitosan plays a multitude of biological processes in plant tissues namely, phytoalexins accumulation, promotes chitinases, elevates lignification, and synthesis of proteinase inhibitors (Wojdyla, 2001). Chitosan is vital role as an antibacterial (Sathiyabama *et al*., 2014), antifungal (Sathiyabama and Charles, 2015), antiviral (Kulikov *et al*., 2006) and bionematicidal agent (Silva *et al*., 2014). Furthermore, chitosan has been physiological influence in the plants, whereas it was affect the growth, plant tissues differentiation, seed germination elevates the rate of photosynthesis and acts as a causative agent of the secondary metabolites synthesis (Lopez-Moya *et al*., 2017). The use of amino acids resulted an improve in the examined parameters may be attributed to the functional roles of amino acids which were explained by many studies like, amino acids canable stimulate cell growth, improve cell division, cell enlargement and cell elongation (Pareek *et al*., 2000; Smith, 1982). Amino acids such are involved in some biochemical processes such as, synthesis of protein, enzymes, vitamins, alkaloids, amines and terpenoids (Arbid and Marquradt, 1985).

Available amino acids play an important role in elevate the assimilation of fertilizer, augment uptake of nutrients and water, raise a rate of photosynthetic, dry matter and increase crop yield (El-Shabasi *et al*., 2005; Sarojnee *et al*., 2009; Shaheen *et al*., 2010). Additionally, tryptophan is precursor of IAA and, also the precursor of ethylene is methionine. Besides, it is the precursor of some plant growth hormones, like, espermidine and espermine (Goss, 1973; Taiz and Zeiger, 2002). The application of seaweeds extract resulted an augment in these aspects could be explained in the light of the beneficial roles of seaweeds extract which were reported by many authors namely, Chapman and Chapman (1981) suggested that seaweeds liquid fertilizer contains plant growth hormones (auxins, gibberellins and cytokinins), macro and micronutrients, amino acids, vitamins and fatty acids. It is an excellent natural fertilizer and acts as good source of organic matter. In addition, it contains high amounts of nutritional elements such as, N, P, K, S, Ca, Mg, Fe, Zn, Mn and Co (Tung *et al*., 2003 and Fornes *et al*., 2005). Furthermore, seaweeds are a good source of many bioactive compounds like, protein, vitamins, essential fatty acids, minerals, carotenoids and dietary fiber (Osman and Salem, 2011). Finally, from the obtained results, it could be recommended to supply the soil of Alexandrian senna (*Cassia acutifolia* Delile) plants with compost at 30 m^3 /feddan and foliar spray with seaweeds extract at 3 ml /l to enhance the growth, pod yield and total anthraquinone glycoside yield under the conditions of this investigation.

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