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RESPONSE OF COWPEA (*VIGNA UNGUICULATA* L.) PLANT TO SEAWEED AND YEAST EXTRACTS

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Abstract

Two field trials were conducted to study the effect of seaweed and yeast extracts on cowpea (*Vigna unguiculata* L.) plant. Three concentrations of seaweed; 0.5, 1 and 2 ml/ l and three others of yeast; 2, 4 and 6g/l were adopted. Seaweed concentrations affected positively shoot height, main stem length and diameter as well as the total leaf area in the 1st season with mostly significant differences. No significant differences in most of morphological characters were detected in plants received 0.5ml/ l seaweed vs. control in the 2nd season as compared to the 1st one. They were the best compared to those received the two higher seaweed concentrations concerning yield characters in both seasons. Considerable seed index was produced in the 1st season, the trait increased by 4.05% in the 2nd one. Plants treated by seaweed at 1ml/ l tended to give vegetative growth at the expense of forming and filling pods. These plants contained the highest photosynthetic pigments, the highest total leaf area, fresh and dry weights in both growing seasons. But, no promising yield characters were achieved. Significant decrease by 35.6% was detected in dry weight of shoots and by 3.9% in fresh weight in plants received seaweed at 2ml/ l vs. control in the 1st season. An enhancement in both fresh and dry weights clearly observed in plants received the treatment in the 2nd season, while producing lower photosynthetic pigments. The same observation was exhibited concerning yield characters. They surpassed the control without significant difference by 3.91% for seed index. All yeast concentrations had positive effect on shoot's height and main stem length in both seasons. Plants treated by 4g/ l were the best concentration. Those were possessed reduced fresh and dry weights of shoot in the 1st season, and moderate ones in the 2nd season. Plants sprayed by yeast at 6g/ l produced relatively higher fresh and dry weights of shoot with no significant differences vs. control in both seasons. Insignificant increase was obtained in total leaf area/plant due to the treatment, surpassed the control by 47.91% and 20.21% in the 1st and 2nd seasons, respectively. Negative effect clearly exhibited in all fruit traits of plants received the 4g/ l and 6g/ l yeast concentrations, except for the number of seeds / pod. Plants seemed to be failed in pod filling, lower seed index was produced. Maximum total photosynthetic pigments were produced in foliage of cowpea plants treated by 2g/ l yeast extract, surpassed those of the untreated ones by 67.3%. Those plants possessed maximum total leaf area in the 1st season and considerable one in the 2nd season. Results exhibited good exploitation of assimilates and best dry matter accumulation reflected on higher fresh and dry weight production in the 1st season. Moreover, fruiting, developing and filling pods were enhanced. All yield characters were increased by such concentration. Percentages of increment were 3.31 and 6.43% for seed index in the 1st and 2nd seasons, respectively.

Key words: Cowpea, *Vigna unguiculata* L., seaweed, dry yeast, morphology, photosynthetic pigments and yield characters.

Introduction

Cowpea (*Vigna unguiculata* L.) is an important vegetative legume crop belonging to family fabaceae grown in Egypt either for local consumption or exportation (Abdel-Aziz and Salem, 2013). The crop utilized either for dry seeds or green pods (Abbas and Akladious, 2013). It is considered as rich source of protein, vitamins, minerals, carbohydrates and dietary fibers (Gonçalves *et al.*, 2016).

Seaweeds are types of macroscopic marine algae. Applying seaweeds as manure in farming practice is very ancient and common among the Romans, Britain, France, Spain, and China. The culture of them for manure was recorded in Ireland and South Africa (Thirumaran *et al.*, 2009). The application of seaweeds showed improvement in crop yield, seed germination, pest resistance and in tolerating some harsh environmental conditions like frost (Arthur *et al.*, 2003; Vashishta *et al.*, 2004; Barsanti and

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Gualtieri, 2006; Rathore *et al.*, 2009; Partani, 2013; Zewail, 2014; Abu Seif *et al.*, 2016 and Kocira *et al.*, 2018). Promotive, nutritive and protective effects were also reported on vegetable plants. They enhance plants' tolerance against biotic and abiotic stresses (Byan, 2014 and Bulgari *et al.*, 2015). Certain mechanisms were proposed concerning the improvement of crop growth by applying seaweed extracts. Phytohormones, macronutrients, certain micronutrients are among their constituent. Secondary metabolites as amino acids and vitamins were also reported (Barsanti and Gualtieri, 2006 & Selvam and Sivakumar, 2013). The importance of seaweed extract in rising the chlorophyll level in leaves of different plants was previously reported (Selvam and Sivakumar, 2013). Chlorophyll enhancement was attributed to the presence of betaines as a constituent of seaweeds (Whapham *et al.*, 1993 and Blunden *et al.*, 1997). Yeast is a unicellular eukaryotic microorganism belongs to kingdom fungi (Vashishta and Sinha, 2003). Yeasts have many economic importances; used in agriculture practices as a biostimulant agent either as a soil treatment or for preventing diseases in pre and post-harvest crops (Hatoum *et al.*, 2012). Yeast extracts have favorable and beneficial effect on plants, enhancing plants growth characters and yield (Fawzy *et al.*, 2010 and El-Shafey *et al.*, 2016). The authors attributed this enhancement to the presence of cytokinins, hormones, sugars, amino and nucleic acids, vitamins and minerals as important constituents of yeasts. Enhancement of photosynthetic pigments by applying yeast extract was considered (Abou El-Yazied and Mady, 2012 & El-Shafey *et al.*, 2016). Agriculture practices nowadays are moving more towards applying the bio-stimulants. They are safe on the environment, improve yield quality and quantity and increase plant resistance to stress conditions (Bulgari *et al.*, 2015).

The present work was laid out to investigate the influence of applying yeast or seaweed extracts on cowpea. Vegetative growth, photosynthetic pigments and fruit characteristics were considered.

Materials and Methods

Two field experiments were conducted during two successive summer seasons 2017 and 2018 at the Agricultural Experimental and Research Station, Faculty of Agriculture, Cairo University, Giza, Egypt. Seaweed and yeast extracts were adopted as foliar application on cow pea (*Vigna unguiculata* L.) plants. The cultivar "Taiba" was used in this study. Seeds were obtained from the Vegetable crops Research Section, Agricultural Research Center (ARC), Giza, Egypt. Seeds were sown on 4th of April in both seasons.

Seaweed extract was applied at three concentrations; 0.5(S_1), 1(S_2) and 2(S_3) ml/l. Three others of dry yeast extract; 2 g/l (Y_1), 4 g/l (Y_2) and 6 g/l (Y_3) were also used, in addition to the control plants (Tap water). The first application with these extracts was 6 weeks after sowing and the second was two weeks later.

Vegetative growth characters were estimated two weeks after the second spray (10 weeks after sowing). They included shoot height (cm), main stem length (cm) and number of internodes/main stem , main stem diameter (cm), number of branches, total leaf area/plant (cm^2), fresh weight of shoot (g) and dry weight of shoots (g). Chlorophyll a, b and carotenoids were determined in fresh leaves by colorimetric method at the same age in the 2nd season. This was according to Lichtenthaler and Wellburn (1985). Yield characters were estimated at harvest, 5 months after sowing. Number of pods/plant, weight of pod/plant, number of seeds/pod and weight of 100 seeds were considered.

The layout of the experiment was Randomized complete block design with three replications. The cultural practices utilized in vicinity were applied according to recommendations.

Results and Discussion

Morphological characters

Effect of seaweed extract

All seaweed treatments affected positively shoots height, main stem length and diameter as well as total leaf area in the 1st season table 1. The differences were mostly significant vs. control. Plants received the lowest concentration (0.5 ml/l) possessed the highest shoots with longest main stems, maximum increment percentages obtained over control were (26.9%) and (44.95%) respectively. Lower number of branches (4.67), moderate total leaf area (3456.17) and reduced fresh and dry weights of shoot (100.79g and 16.35g respectively) were produced. Considerable significant increments were achieved in the latter traits (151.35g and 27.16g for fresh and dry weights of shoot respectively) in plants treated by the median seaweed concentration (1ml/l). Number of internodes was affected positively by applying the treatment, it surpassed the control without significant difference. Maximum percentage of increment over control was achieved in total leaf area/plant (70.9%). Drastic significant decrease was observed in dry weight of shoots (13.65g) in plants treated by seaweed at (2ml/l) compared to untreated control plants (21.20g). The percentage of reduction was 35.6%. A reduction was

also detected for fresh weight of shoots (118.67) treated by such treatment, but it wasn't drastic or significant (3.9%).

Performance of cowpea plants treated with various seaweed concentrations in the 2nd season presented in table 2. Plants sprayed by 0.5 ml/l did not varied significantly in all studied characters compared to control except for the number of internodes/main stem. As the applied seaweed concentration was elevated to 1 ml/l, most of the morphological traits behaved better vs. Control. The differences were considerably significant except for length and diameter of main stem. Maximum total leaf area (48.6%) over control was obtained by applying this concentration. Worthy, plants received seaweed at 1ml/l were the highest total leaf area, fresh and dry weight producers in both growing seasons .Raising seaweed concentration up to 2ml/l affected positively the studied characters compared to untreated control except for stem diameter and number of branches. The increments were significant only in height, fresh and dry weight of shoots. Total leaf area in plants received 2ml/l seaweed was increased by 38.49 and 22.89 % over control for the 1st and 2nd seasons respectively.

Contradicting to the 1st season, no significant differences were detected comparing plants received the lowest rate of seaweed and control plants in all studied morphological characters except for the number of internodes, 14 vs. 15.67. Also, an enhancement clearly observed in plants treated by the highest seaweed concentration (2ml/l) especially fresh and dry weights. Consequently, the significance between the two higher rates (1 ml/l and 2 ml/l) was disappeared in most of vegetative characters under study. The foregoing morphological results exhibited variable responses of plants received the same seaweed concentration in both seasons reflected on their performance. This may be interpreted by the influence of variable soil and/or air conditions prevalent in the two growing seasons.

Many workers reported growth promotion in plants treated by seaweeds. They attributed it to their contents of carbohydrates, macro and micro elements, vitamins, plant growth regulators as auxins cytokinins , gibberellins

Table 1: Effect of different concentrations of seaweed and yeast on the vegetative growth of cow pea plants two weeks after the second spray in the 1st season (2017).

Character Treatment	Shoot Height (Cm)	Length of the main stem (cm)	Number of internodes	Diameter of the middle internode (cm)	Number of branches	Total leaf area/plant (cm^2)	Fresh weight of shoot(g)	Dry weight of shoot(g)
Control(Tap water)	54.75	35.7	17.0	0.57	7.67	2397.62	123.5	21.20
S_1(0.5ml/l)	69.50	51.75	16.0	0.87	4.67	3456.17	100.79	16.35
S_2(1 ml/l)	67.00	48.75	18.00	0.6	6.67	4098.26	151.35	27.16
S_3(2 ml/l)	62.25	41.50	15.00	0.6	5.00	3320.44	118.67	13.65
Y_1(2g/l)	61.50	37.50	16.0	0.6	8.00	4273.43	199.1	17.91
Y_2(4g/l)	67.50	50.75	17.67	0.70	5.00	3274.87	111.15	16.18
Y_3(6g/l)	65.8	44.73	16.6	0.6	5.33	3546.37	115.25	21.28
$L.S.D_{0.05}$	5.92	4.35	1.38	0.13	1.32	1189	11.66	4.28

S_1, S_2, S_3: Seaweed extract Y_1, Y_2, Y_3: Yeast extract.

Table 2: Effect of different concentrations of seaweed and yeast on the vegetative growth of cow pea plants two weeks after the 2nd spray season (2018).

Character Treatment	Shoot Height (Cm)	Length of the main stem (cm)	Number of internodes	Diameter of the middle internode (cm)	Number of branches	Total leaf area/plant (cm^2)	Fresh weight of shoot(g)	Dry weight of shoot(g)
Control(Tap water)	65.30	50.00	14.00	0.67	3.00	2773.69	85.60	14.40
S_1(0.5ml/l)	64.50	50.90	15.67	0.60	3.00	3246.22	80.60	14.60
S_2(1 ml/l)	69.80	53.70	16.67	0.60	4.00	4120.77	115.70	21.60
S_3(2 ml/l)	68.90	53.90	15.00	0.60	3.00	3408.62	110.90	20.90
Y_1(2g/l)	66.60	55.20	14.00	0.60	2.67	3065.86	63.90	12.30
Y_2(4g/l)	69.00	58.07	15.67	0.57	2.33	3015.99	67.67	14.00
Y_3(6g/l)	66.07	55.60	16.33	0.57	2.67	3334.12	86.33	15.73
$L.S.D_{0.05}$	2.19	5.46	1.02	0.07	0.98	985.23	17.53	3.15

S_1, S_2, S_3: Seaweed extract Y_1, Y_2, Y_3: Yeast extract

and betains (Barsanti and Gualtieri, 2006, Rathore *et al*., 2009; Sutharsan *et al*., 2014; and Elansary *et al*., 2016). Others estimated no effect of applying seaweed (kelpak) on the mass of shoots and roots of bean plants (Beckett *et al*., 1994). In their seedling establishment experiment, Crouch and Staden (1992) reported that Seaweed concentrate applied as a soil drench significantly improved the growth of tomato seedlings. Yet, when applied as a foliar spray they had no significant effect on young plants. Warman and Munro-Warman, 1993 in their study on five vegetable crops concluded none of the seaweed or kelp extract improves growth of any of the vegetables under their study.

Effect of yeast extract

Majority of the morphological characteristics positively affected in plants sprayed by yeast at 2g/l in the 1st season table 1. But the increments over control were mostly insignificant. Plants received the mentioned concentration produced well developed vegetative growth. Relatively higher dry weight (17.91g), maximum total leaf area/plant (4273.43cm^2) and fresh weight of shoots (199.1g) were achieved by such treatment.

Plants treated by 4g/l yeast were the highest (67.5cm) with longer main stems (50.75cm). The percentages of increment over control were 23% and 42% respectively. Their stems possessed higher number of thicker internodes with mostly significant differences. On the other hand, minimum fresh and dry weights of shoot (111.15 and 16.18g respectively) were produced.

Plants sprayed by yeast at 6g/l exhibited moderate recorded values in most of morphological traits under study comparing to the other concentrations. They produced relatively higher fresh and dry weights of shoot; 115.25g and 21.28g respectively without significant differences vs. control. Considerable but insignificant increase was obtained in the total leaf area (3546.37cm^2) due to the treatment.

In the 2nd season, insignificant differences were detected between plants treated by yeast at 2g/l and those of the untreated control concerning most of the morphological traits. Fresh and dry weights of shoot were reduced table 2. The latter results considered as a varied performance of plants received the lowest yeast concentration compared to the 1st growing season.

Performance of morphological traits in plants received the highest yeast concentration (6g/l) was more or less as in those received the median one (4g//l) with no significant differences, except for height and fresh weight of shoots. A slight increment was detected in fresh and dry weights of shoot in plants sprayed by 6g/l over control without significant differences. They surpassed the control ones by 20.21% in total leaf area (cm2), all yeast concentrations affected positively the trait.

Many workers related the promotive effects of applying yeast on vegetative growth to the presence of vitamins especially B-group, high content of minerals particularly N, P and K, phytohormons as cytokinins, enzymes, amino acids and minerals which have stimulatory effect on cell division and cell enlargement. These effects might also be attributed to yeast's favorable influence on metabolism, photosynthetic pigments, biological and enzyme activity which encourage vegetative growth. (Ahmed *et al*., 2011; El-Shafey *et al*., 2016; and Xi *et al*., 2019). Taha *et al*., (2016) in their investigation on, stated that yeast extract applied at 15% had maximum stimulatory effect on plant height, stem and root fresh and dry weight of *Azadirachta indica* plants. They mentioned

Table 3: Effect of seaweed and yeast on yield characteristics of Cowpea plants in the 1st season (2017).

Character Treatment	Number of pods/plant	Average Weight of pod/plant (g)	Number of seeds/pod	Weight of 100 seed (g)
Control(Tap water)	14.00	3.06	5.33	21.77
S_1(0.5 ml/l)	13.33	2.03	4.33	18.73
S_2(1 ml/l)	9.33	2.16	7.67	12.61
S_3(2 ml/l)	13.00	1.81	5.33	13.22
Y_1(2g/l)	18.33	3.34	7.00	22.49
Y_2(4g/l)	9.00	1.92	6.0	17.24
Y_3(6g/l)	7.67	1.988	6.0	9.19
L.S.D.$_{0.05}$	7.96	0.72	2.04	9.11

S_1, S_2, S_3: Seaweed extract Y_1, Y_2, Y_3: Yeast extract

Table 4: Effect of seaweed and yeast on yield characteristics of cowpea plants in the 2nd season (2018).

Character Treatment	Number of pods/plant	Average Weight of pod/plant (g)	Number of seeds/pod	Weight of 100 seed (g)
Control(Tap water)	13.67	1.455	6.33	15.08
S_1(0.5 ml/l)	14.67	1.70	7.33	15.69
S_2(1 ml/l)	11.33	1.392	7.67	13.37
S_3(2 ml/l)	15	1.483	7.00	15.67
Y_1(2g/l)	14.33	1.561	6.00	16.05
Y_2(4g/l)	11.00	1.301	7.33	12.39
Y_3(6g/l)	10.67	1.373	7.33	13.56
L.S.D.$_{0.05}$	1.561	0.165	1.363	1.9123

S_1, S_2, S_3: Seaweed extract Y_1, Y_2, Y_3: Yeast extract

that all dry yeast extract concentrations had no significant effect on stem diameter, number of leaves/plant and root length.

Photosynthetic pigments

Effect of seaweed extract

Data revealed that the maximum total pigments (0.935 mg/g F.W) was recorded by cowpea foliage sprayed with the median concentration (1ml/l). The percentage of increment over the untreated leaves was 84.4%. Considerable total photosynthetic pigments was 8.5% over control also obtained by 0.5 ml/l of seaweed. This as a result of raising chlorophyll a+b (0.41 mg/g F.W) as well as the total carotenoids' content (0.14 mg/g F.W). In other words leaves of cowpea plants received the two lower concentrations of seaweed extract possessed higher photosynthetic pigments compared to the untreated plants. Plants treated with the highest seaweed concentration (2 ml/l) their leaves gave the lowest readings of all chlorophyll parameters compared to the control plants (Fig. 1).

Blunden *et al*., (1997) stated the efficacy of low concentrations of seaweed (*Ascophylum nodosum*)

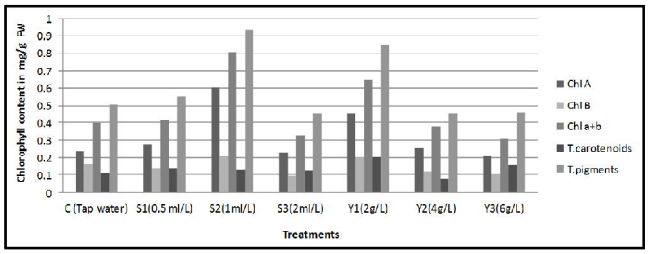

Fig. 1: Response of foliage leaves of cowpea plants concerning the photosynthetic pigments as affected by various seaweed and yeast concentrations two weeks after the second spray in the 2nd growing season 2018.

extract in raising chlorophyll contents when applied to soil or on foliage of tomato plants. Wapham *et al*., (1993) stated that the increments obtained in chlorophyll contents as a result of increasing seaweed concentrations were not steady. They added, peaks' of activity were resulted by several widely different concentrations.

Effect of yeast extract

Chlorophyll a, b and a+b seemed to decrease by increasing yeast extract concentrations up to 6g/l. Plant leaves sprayed by the two higher yeast concentrations exhibited considerable reduction in total photosynthetic pigments The percentages of reduction vs. control were 11.67 and 9.80% (for 4g/l and 6g/l respectively). Plants received the median yeast concentration (4g/l) gave the maximum ratio of chlorophyll a+b/carotenoids (4.82) compared to control and other yeast ones. This is due to lower total carotenoids recorded in foliage of such plants. The percentage of increment in total chlorophylls by leaves received yeast extract at (2g/l) over the control was 62.50%. The maximum total carotenoids (0.20mg/g F.W.) was also obtained. Hence, the total photosynthetic pigments in foliage of cow pea plants treated by such treatment surpassed those of the untreated ones by 66.67%. El-Shafey *et al*., 2016, on their investigations on faba bean crop related the chlorophyll enhancement to chlorophyll bio synthesis activation. The authors related such stimulation to the effect of yeast on the availability of essential nutrient, plant growth regulators, production, and suppressing pathogens.

Yield characteristics

Effect of seaweed extract

In the 1st season, various seaweed concentrations affected negatively most of yield characters compared to untreated control, the differences were mostly insignificant. Plants treated by 0.5 ml/l were the best compared to the two higher seaweed concentrations in both seasons (Tables 3 & 4). Higher weight of 100 seeds (18.73g) was produced in the 1st season. In the 2nd one, increments by 7.32, 16.44, 15.80 and 4.05% were achieved as plants received the treatment for number of pods/plant, weigh of pods/plant, number of seeds/pod and seed index respectively.

Plants received the median seaweed concentration 1ml/l produced the maximum number of seeds per pod (7.67) in both seasons. No promising yield characters were achieved by the treatment. The percentages of reduction calculated for seed index were 42.08 and 11.33% in the 1st and 2nd seasons respectively. When seaweed concentration was raised to 2ml/l in the 2nd season, insignificant increments by 9.73, 1.37, 10.58 and 3.91% were produced for number of pods/plant, weigh of pod/plant number of seeds/pod and seed index respectively. Beckett *et al*., (1994) on bean plants pointed out two ways by which seaweed (kelp) caused yield increment. Firstly, increase the source capacity of leaves led to increasing the supply of assimilates those permitted bean filling. This could be achieved by increasing leaf area or photosynthetic rates. Secondly they mentioned that applying kelpak could have increased bean weight by increasing the sink potential of beans for assimilates. They suggested an increment in cotyledon cell number and thus final bean mass. Warman and Munro-Warman, 1993 in their study on five vegetable crops, estimated no improvement achieved in crop yield by applying seaweed amendments over the control. Moreover slight reduction

in yield was occurred by applying the higher kelp extract rates.

It is worthy to mention that cowpea leaves treated by seaweed at 0.5 ml/l possessed photosynthetic pigments slightly increased over control. They recorded lower fresh and dry weights of shoot in the 1st season and moderate ones in the 2nd season. Total leaf area gave increments over control by 44.15 and 17.04 % for the 1st and 2nd seasons respectively. Meanwhile, those plants gave higher records of yield characters in both seasons without significant differences vs. control. Producing higher records of yield characters by such plants may be attributed to good exploitation of assimilates and best dry matter accumulation those reflected in developing and filling pods. Plants received the median seaweed concentration (1ml/l) were the highest photosynthetic pigments containers, the highest total leaf area, fresh and dry weight producers in both growing seasons. In other words the increment in fresh and dry weight of cowpea plants received seaweed at 1ml/l was accompanied by increments in both leaf area and photosynthetic pigments especially chlorophyll a+b (Featonby – Smith and Van Staden, 1984). It is clear that good photosynthetic pigments especially chlorophyll a+b (0.806 mg/g F.W.) led to considerable assimilation rate. Consequently, higher dry matter accumulation those reflected on producing considerable fresh and dry weight of cowpea plants' shoots received the treatment. No promising yield characters were achieved by this concentration, all affected negatively compared to untreated plants except for the number of seeds per pod. Beckett *et al*., 1994 estimated that increasing leaf area was not always accompanied with bean weight increasing. Hence, plants treated by the median seaweed concentration seemed to develop well vegetative growth at the expense of fruiting developing and filling pods in both seasons. Plants received 2ml/l possessed considerable fresh weight in the 1st season & fresh and dry weight in the 2nd one with significant differences. They produced lower photosynthetic pigments simultaneously with producing higher total leaf area in both seasons. Vegetative growth and fruiting were enhanced by the treatment in the 2nd season. Moreover, those plants surpassed the control in all yield characters under study without significant differences. The performance of yield characters observed in plants received the highest seaweed (2 ml/l) concentration were more or less as those of plants received the lowest one (0.5 ml/l). Hence, both behaved better in the 2nd season compared to the 1st one. The results exhibited good exploitation of assimilates resulted from higher total leaf area reflected on fresh and dry mass especially in the 2nd season. Also, reflected to some extent on fruiting and filling pods.

Effect of yeast extract

In the 1st season, the lowest yeast concentration 2g/l affected positively all yield characters under study. They surpassed the corresponding ones of the control without significant differences. Increments by 30.92, 9.15 31.33, and 3.31% were recorded for number of pods/plant, weigh of pod/plant number of seeds/pod, and seed index respectively. A reduction was observed in yield characters when yeast concentration was raised to either the median or the higher ones. The differences were insignificant except for weight of pod in plants received yeast at 4 or 6 g/l and seed index in those received 6g/l. Higher number of seeds/pod was produced by both treatments (6 vs. 5.33). Plants received the median yeast concentration (4g/l) produced considerably high seed index (17.24) without significant difference. Plants treated by the highest yeast concentration 6 g/l underwent drastic decrease in each of number of pods per plant and weight of 100 seeds. The percentages of diminishing were 45 and 57.79% respectively table 3.

Results obtained in the 2nd season table 4 were more or less similar to those in the 1st one. All yield characters were increased by yeast application at 2g/l except for number of seeds/pod. The percentages of increment were 4.83, 6.85 and 6.43% for number of pods per plant, weight of pod/plant and seed index respectively.

All yield traits negatively affected in plants received the median and the highest yeast concentrations except for the number of seeds per pod. Those plants seemed to be failed in pod filling, as they produced lower weight of 100 seeds. The maximum significant reduction in seed index was recorded by applying the median concentration 4g/l, the percentage of decreasing is 17.84%. Results of the two higher rates contradicted with the 1st season. In the latter, the maximum significant diminishing (57.79%) was obtained by the highest yeast concentration (6g/l). Also, plants received yeast at 4g/l produced considerably high seed index (17.24) without significant difference vs. control. In other words, the performance of the two higher yeast concentrations varied concerning seed index comparing results obtained at harvest in both seasons.

Many investigators reported the importance of applying yeast on yield components, developing and filling pods (Ahmed *et al*., 2011 and El-Shafey *et al*., 2016). Abou El-yazied and Mady (2012) reported the efficacy of yeast treatment on reducing shedding percentage in broad bean plants consequently increasing the final green pods and seed yield. It improves vegetative, reproductive

growth, flower formation and set due to the presence of high auxins and cytokinins' content.

Worthily, maximum total leaf area in the 1st season were produced by plants received yeast extract at (2g/l). Maximum fresh, considerable dry weights and the maximum branches number were achieved in the 1st growing season. Good assimilates synthesized and well developed vegetative growth was achieved. In the 2nd season, higher levels of chlorophylls a+b as well as total carotenoids and higher total photosynthetic pigments were found in foliage of such plants. Whenever, no promising fresh and dry weights of shoot were obtained. In other words, Increment occurred in chlorophyll formation or in all photosynthetic pigments was not always accompanied by increasing fresh or dry weight. Comparing the two growing seasons, variable response of plants received 2g/l yeast was reflected on the performance of vegetative traits. This variability may be attributed to different seasonal conditions (air and/or soil) prevalent in both seasons. Whenever those plants exhibited good exploitation of assimilates and best dry matter accumulation reflected on fruiting, developing and filling pods. Consequently, higher records of yield characters were clearly observed, the results at harvest were harmonized in both seasons. Plants received the highest yeast concentration (6g/l) underwent reduction in setting, forming and filling pods. Hence, no promising yield characters were obtained. Meanwhile, they possessed considerably higher total leaf area in both seasons reflected on developing shoots with higher fresh and dry weights. All fruit traits negatively affected in plants received the 4 and 6g/l yeast except for the number of seeds per pod. Those plants seemed to be failed in pod filling, they were lower seed index producers. The performance of the two higher yeast concentrations varied concerning seed index comparing results obtained at harvest in both seasons. Abou EL-Yazied and Mady, 2012, estimated that increasing dry matter of leaves by yeast application was attributed to the improvement of photosynthesis process which led to accumulation of more dry matter in leaf which could be temporarily stored to the account of next well form flowers and pods.

Conclusion

Application of biostimulants is of great importance approaching to well vegetative growth and /or yield enhancement. Plants received seaweed at 0.5ml/l were the best concerning yield characters when compared to those treated by 1 ml/l and 2m/l concentrations in two successive seasons, surpassed the control in the second season. Plants treated by 1ml/ l possessed the highest photosynthetic pigments, the highest total leaf area, fresh and dry weights in both growing seasons. No promising yield characters were achieved. Maximum total photosynthetic pigments were produced in foliage of cowpea plants treated by 2g/ l yeast extract .Those plants possessed considerable total leaf area in both seasons. Results exhibited good exploitation of assimilates and best dry matter accumulation reflected on vegetative growth. Fruiting, developing and filling pods were enhanced. All yield characters were increased by such concentration. Hence, lower concentrations of seaweed and yeast extracts could be recommended.

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