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Effect of Nano Seaweed Extract on Tillaring Pattrin, growth and yield of Barley Varieties

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Abstract: Two field experiments were conducted in the fields of the College of Agricultural Engineering Sciences, University of Baghdad (Al-Jadriya) during the winter seasons of 2019-2020 and 2020-2021. In order to study the response of three barley cultivars (IPA 99, IPA 265 and Bohoth 244) to seaweed extract in its regular and nano form, and its reflection on the quantitve and qualitve traits of barley, yield and tillering patterns. The results of the experiment showed that the tillering pattern of formation of tillers was excelled in plants of cultivar IPA 265 with a 10 g l^{-1} of nano concentration of seaweed extract, It recorded 6.30 and 6.27 tillers plant^{-1} for both seasons, respectively. The spray treatment with nano seaweed extract 10 g l^{-1} was excelled in most of the studied traits (quantitative, growth, and qualitative traits) And it converges in its effect with a 20 g l^{-1} regular concentration. The cultivar IPA 265 excelled in plant height, kinetin content of leaves and percentage of fertile tillers. while IPA 99 cultivar excelled in flag leaf area, chlorophyll content, spike length, number of grains per spike, harvest index, percentage of protein and gluten. The cultivar Bohoth 244 excelled in leaf area duration , grain growth rate, 1000-grain weight, and carbohydrate percentage. The concentration of 10 g l^{-1} of nano seaweed extract was significantly excelled in most growth traits except for seed growth rate, 1000 seed weight, and harvest index trait. The concentration 20 g l^{-1} of regular seaweed extract for both seasons.The interaction was significant in most of the studied traits by adopting the differences test based on the least significant difference test except for the leaf content of kinetin. It can be concluded that the use of nano seaweed extract at concentration of 10 g l^{-1} and the cultivation of the cultivars IPA 99 and IPA 265 provide with significant increase in seed yield of barley in the tillering pattern formation and the increase percentage of formation of fertile tiller of the barley plant growth and qualitative traits.

Keywords: Nano Seaweed, Tillaring Pattrin, growth, Barley Varieties

1. INTRODUCTION :

The barley crop (*Hordeum vulgare*.L) is considered one of the strategic crops, where it is grown on a large scale in the world and the Arab world for the purpose of benefiting from it as a green feed from its grains in human and animal nutrition. It is also used in many food industries such as malt and gluten-free foods. The low production problem of barley crop in Iraq is one of the impediments that limit the expansion of its cultivation. Zahedi et al. (2020) found that the use of nanocomposites increases crop productivity, due to an increase in plant growth and an increase in metabolic reactions. The nanocomposites improve seed germination, vitality and growth indicators such as leaf area, plant height, number of leaves, chlorophyll and photosynthesis rate. Szczepanek et al. (2018) indicated that treating barley with seaweed extract (Kelpak) 2 L ha^{-1} has a positive effect on the number of grains per spike, the weight of 100 grains, and the grain yield. Abdul-Jabbar and Nouri (2013)however, found that spraying with seaweed extract on two barley cultivars at a concentration of 4 ml L^{-1}.It achieved an increase in the total number of tillers and the number of fertile tillers for both cultivars, as the number of fertile tillers reached 3.74 tillers m^{-2}. Al-Mubarak (2008) found that when planting two cultivars of barley (IPA 99 and genotype 12-9) there were significant differences in the percentage of protein in grain, where the genotype 12-9 achieved the highest average of 10.35% While the IPA 99 gave the lowest average of 8.0%. Pankaj et al. (2015) found significant differences in the physiological growth traits (crop growth rate and relative growth rate) and vegetative growth (plant height and leaf area index) when cultivating three barley cultivars. Al-Tamimi and Muhammad (2007) found when cultivars of barley, Aryl, Barjouj, and Tessa were cultivated, there were significant differences between them in the yield traits (number of spikes, number of grains per spike, and weight of 1000 grains).

2. MATERIALS AND METHODS:

Two field experiments were conducted in the fields of the College of Agricultural Engineering Sciences - University of Baghdad (Al-Jadriya) according to the Randomized Complete Block Design (RCBD)during the winter seasons 2019-2020 and 2020-2021,by arranging the split plots with three replication .In order to study the response of three barley cultivars to seaweed extract in their regular and nano forms and their reflection on the quantity and quality traits of barley yield. The experiment soil was plowed by two orthogonal plows using the Moldboard plows and was smoothing with disc harrows. It was leveled and divided into experimental units with dimensions of 2 * 2 m. The number of experimental units was 45 units for the experiment. The study included two factors, the first (main plot) included three cultivars of barley registered with the Agricultural Research Department (Bohoth 244, IPA 265 and IPA 99). The second factor (subplot) included five different concentrations of seaweed extract in its regular and nano forms (0, 10 regular , 20 regular , 5 nano and 10 nano) g l^{-1}.The seeds of the two experiments were sown on 11/15/2019 and 11/15/2020, with a seed quantity of 120 kg. ha^{-1}. The experiment soil was fertilized with urea (46% N) at an average of 200 kg N ha^{-1} was added in two batches, the first at the elongation stage and the second at the booting stage, and triple superphosphate (46% P2O5) was used at an amount of 100 kg ha^{-1} was added in one batch when preparing the soil (Jadoa, 1995) Crop service operations were conducted by irrigation and weeding as needed in the field.

Preparation of nanocomposites:
The solution was treated with ultrasonic waves using a device of UP200ht Hielscher at the Ministry of Industry / Department of Physical Research to convert the solutions into nano sizes.Where a wave of energy up to 50 watts was shed for a period of 30 minutes, a solution was obtained in which seaweed particle size reached 60 nm .It was added to the prepared solutions above as well as the water used in the control treatment (0 mg, l^{-1} of seaweed) and a small amount of cleaning fluid was added to reduce the surface tension and help spread. The spraying process was conducted on the vegetative parts in two batches, the first on 25/12/2019 at the growth stage ZGS: 21 (the stage of emergence of the first tiller) before sunset until wetness, and the process was repeated a month after the first spray with concentrations (0, 40 regular, 80 regular , 20 nano. and 40 nano) mg l^{-1} per spray of seaweed.

Marking plants:

After the seedlings reach the stage of two to three tillers appearances, The section of the guarded plants within the planting rows (sub plots)was marked with wooden pegs of distinctive red colors to remain in the experimental units throughout the season to measure the traits studied. As marks were placed on two models with a length of (50 cm) from each line and randomly from each treatment within the experimental units. Then the number of plants within the specified models was calculated and the number of plants in these distances was fixed for use in traits studies

3. RESULTS AND DISCUSSION

The tillers appearance pattern:

When studying the effect of five concentrations of nano and regular seaweed on the of three cultivars of barley cultivated with a space of 15 cm, it was found that it was different. It is noticed from (Fig. 1) that the plants recorded a convergent number of tillers in the first week of reading, that is, 30 days after cultivation, the number of tillers continued to increase slowly until the sixth week of reading, then it significantly increased in the seventh and eighth week until it reached its highest level at the ninth week for reading, the treatments of spraying with nano and regular seaweed extract recorded the highest average number of tillers at 3.9141, 5.0951, 6.1818, 4.8687 and 5.7829 tillers plant^{-1} for the first season and 3.8951, 5.1364, 6.1718, 4.8697 and 5.8384 tillers plant^{-1} for the second season and for concentrations 0, 5 nano , 10 nano , 10 regular and 20 regular , respectively .It is also noted that the effect of 5 nano and 10 regular on the one hand and 10 nano and 20 regular on the other hand show the effect of the nano seaweed treatment and made it converge in Its effect is double the concentration of regular (no-nano) seaweed. The spraying treatment with 10 g l^{-1}nano seaweed extract recorded the highest average of the tillers number amounting to 6.1818 and 6.1718 tillers plant^{-1} for both seasons, respectively, with an increase of 58 and 58.5% on the control treatment, 21.4 and 20.1% on the 5 gm l-1nano-seaweed extract treatment, 27 and 26.8% for the 10 g l^{-1} regular seaweed extract treatment 6.9 and 5.8% for the 20 g l^{-1}regular seaweed extract treatment for both seasons, respectively. While the control treatment recorded the lowest average number of tillers 3.9141 and 3.8951 tillers plant^{-1} for both seasons, respectively. Then followed by a decrease in the numbers of tillers for all treatments to give the final numbers at the last reading, when the numbers reached 3.3687, 4.6414, 5.8182, 4.4141 and 5.4192 tillers plant^{-1} for the first season and 3.393942, 4.676759, 5.863637, 4.449497 and 5.449497 tillers plant^{-1} for the second season for the treatments and concentrations 0, 5 nano, 10 nano, 10regular and 20 regular , respectively, the 10 g l^{-1} treatment excelled and gave the number of tillers for the last reading for the both seasons, respectively. The reason for the 10 g l^{-1}nano seaweed extract excelled on the rest of the treatments may be due to the fact that the foliar fertilizer extracted from seaweed contains high levels of cytokinins, auxins, and amino acids and a number of macro and micro mineral elements that stimulate cell division and expansion as well as lead to a balance in the physiological and biological processes affecting the growth of roots and increasing their ability to absorb water and nutrients soluble in it, which is positively effect on the growth of the vegetative system and the supply of side branches with the necessary food, which reduces the death rate due to competition, The reason the nano-seaweed excelled on regular seaweed is due to the fact that nanomaterials possess a high percentage of surface atoms that cover the largest area of the surface of the molecule, which gives it high surface energy that enables it to cross the wall of what gives it high cellular activity (Qureshi et al., 2018).

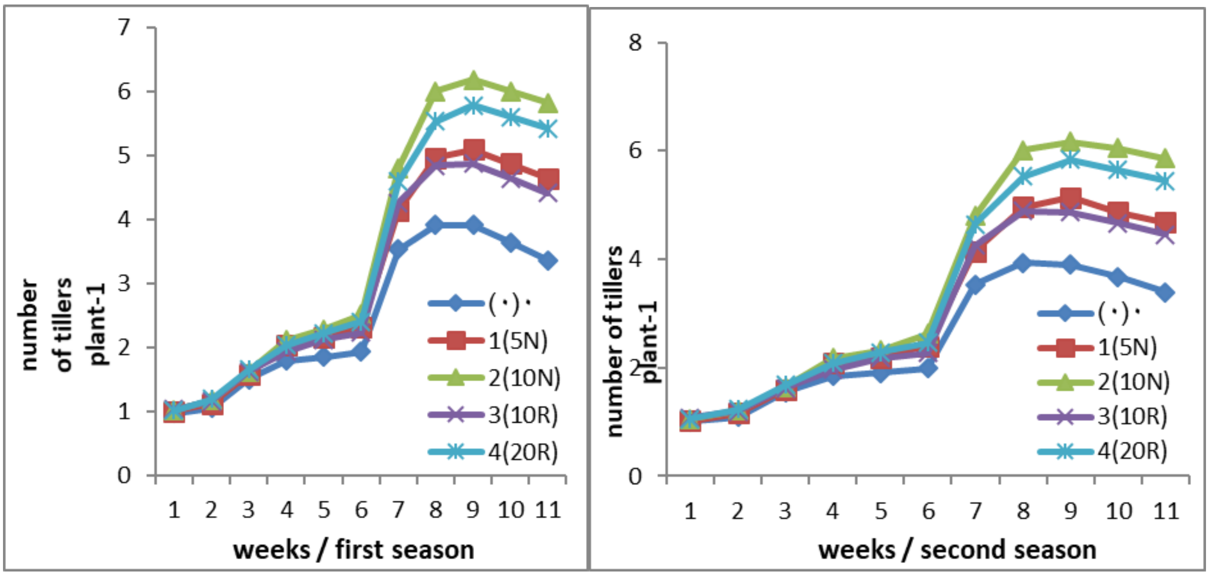

Figure 1. Weekly tillering pattern of barley as influenced by concentration nano and regular seaweed extract

Figure (2) shows that the number of tillers differed according to the three cultivars grown under the influence of nano and regular seaweed extract, with a space of 15 cm between the planting row. As the cultivars exhibited the same behavior in the first week of reading, That is, after 30 days of cultivation, the number of tillers within the space (50 cm treatment) was taken with a slow increase from the first week of reading until sixth week of reading, then there was a significant increase in the seventh and eighth week until it reached its maximum number in ninth week, in which the number of tillers reached 5.18788, 5.2576 and 5.0606 tillers plant $^{-1}$ for the first season and 5.2109, 5.2363 and 5.1001 tillers plant $^{-1}$ for the second season for the cultivars IPA 99, IPA 265 and Bohoth 244 respectively. The IPA 265 cultivar recorded the highest number of tillers in the ninth week with an increase of 1.4 and 0.5% on IPA 99, 3.9 and 2.7% on Bohoth 244 and for both seasons, respectively. While the cultivar Bohoth 244 recorded the lowest average of the number of tillers amounting to 5.0606 and 5.1001 for both seasons, respectively. Then followed by a decrease in the number of tillers due to the death of a number of those tillers and for all cultivars until the numbers recorded at the end of the eleventh week, the last reading was 4.7515, 4.8212 and 4.6242 tillers plant $^{-1}$ for the first season and 4.7848, 4.8575 and 4.6575 tillers plant $^{-1}$ for the second season and for the mentions cultivars above, respectively, and the cultivar IPA 265 numerically excelled, as the average number of tillers was 4.8212 and 4.8575 tillers plant $^{-1}$ for both seasons, respectively. The reason for the IPA265 cultivar may be due to the different cultivars in the nature of growth and elongation and the ability to produce tillers that are related to the genetic structure and the extent of the response of each to the environmental conditions prevailing during the growing season and this is consistent with the findings of Abdul-Jabbar and Nouri (2013).

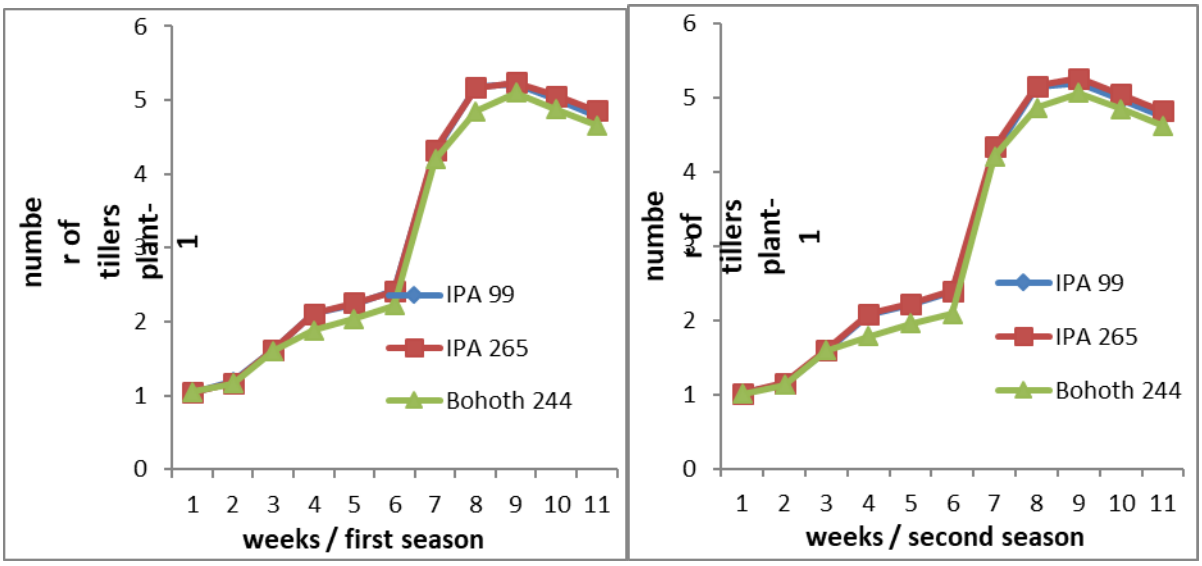

Figure 2. Weekly tillering pattern of three barley cultivars

Plant height (cm):

The IPA 265 cultivar excelled by giving the highest average of plant height, which was 98.13 and 97.95 cm for both seasons, respectively, which differed significantly from Bohoth 244 in the second season. this may be due to this difference between cultivars in plant height to the genetic differences between cultivars as well as the difference in response .It the different hormonal content of auxin and gibberellin, which are responsible for the elongation and expansion of cells.As for the effect of seaweed extract spraying treatments, it was significant in this trait, where it is noted from (Table 1) The 10 g L^{-1} nano treatment was excelled and gave the highest average plant height of 101.41 and 101.08 cm for both seasons, respectively. As for the interaction between the cultivars and the seaweed extract, significant differences were observed in both seasons.The combination of Bohoth 244 with spraying 10 g l^{-1}nano was significantly excelled with an average value of 105.40 and 105.03 cm in both seasons, respectively. While the interaction between IPA 99 and without adding seaweed extract gave the lowest average of 83.30 and 78.77 cm for both seasons, respectively. It was noted that increase in plant height is greater when using nano levels (5 nano and 10 g nano) compared to the increase in spraying non-regular seaweed in all cultivars under study and for both seasons.

Flag leaf area (cm^2):

IPA99 cultivar excelled by giving the highest average flag leaf area which was 12.09 and 12.43 cm2 for both seasons, respectively.The reason for the difference between the cultivars in flag leaf area trait may be due to the difference in their genetic structure, their ability to photosynthesis, the activity and effectiveness of the compounds formed and the enzymes that contribute to increased cell division, including flag leaf cells, which leads to an increase in their area (Manea and Kazem, 2014).This is in agreement with Andosh and Al-Dhahiri (2020), who indicated the difference in the flag leaf area between the cultivars of barley used in their study. Where, the control treatment gave the lowest average plant height of 87.63 and 85.41 cm in both seasons, respectively. The reason may be due to the positive role of the extracts in activating the building of auxin inside the plant by activating certain enzymes that affect a series of subapical cell divisions leading to an increase in plant height (Verklij, 1992),This is consistent with Abdul-Jabbar and Nouri (2013).As for the effect of seaweed extract spraying treatments, it was significant in this trait, where it was noted that the treatment of 10 g l^{-1}nano was excelled. The highest average flag leaf area was recorded at 11.69 and 11.09 cm^2 in both seasons respectively, and the control treatment without spraying gave the lowest average of 9.45 and 9.20 cm2 in both seasons, respectively. This may be due to the fact that the foliar fertilizer extracted from seaweed contains high levels of cytokinins, auxins, amino acids, and a number of macro and Micro mineral elements that stimulate cell division.This result is consistent with what Abdul-Jabar et al. (2012) found when spraying it on cultivars of wheat.As for the interaction between the cultivars and seaweed extract, it is noted that there are significant differences .The combination of IPA 99 and 10 g l^{-1}nano seaweed gave the highest value of the interaction, which amounted to 14.22 and 14.57 cm^2 for both seasons, respectively, compared to the interaction treatment of Bohoth 244 and without spraying, which gave the lowest average of 8.71 and 8.14 cm^2 for both seasons, respectively.

Leaf Area Duration (LAD) (day):

The different cultivar's provide with significant difference in leaf area duration effective for both seasons, the Bohoth 244 cultivar excelled, and the longest leaf area duration was 125.95 and 125.68 days for both seasons, respectively. While the IPA 256 cultivar recorded the least effective leaf area duration of 104.77 and 105.47 days for both seasons, respectively. This is consistent with the findings of Muhammad (2010), who referred to the different cultivars as a result of the variation in genetic factors that control the physiological phenomena of the cultivars. Table (1) shows that the adding of seaweed extract led to a significant increase in the number of leaf area duration to remain effective in both seasons of the study .The 10 g l^{-1} nano seaweed spraying recorded the highest average of 128.01 and 126.60 days for both seasons, respectively, compared to the control treatment, which gave the lowest average number of days at 103.72 and 103.70 days for both seasons, respectively. The reason may be due to the role of seaweed extract in increasing the leaf area, the rate of crop growth and the relative growth rate, which resulted in an increase in the vital processes in the plant by activating the photosynthesis process and the increase in the availability of nutrients by the plant led to a delay in senescence of the leaves and then an increase in the leaf area duration this agreed with (Kardiner, 1990). Results indicated that there was a significant interaction between the cultivars and the seaweed extract spray, where the combination the Bohoth 244 with 10 g l^{-1}nano excelled for both seasons, and it gave the highest average for this trait that reached 142.13 and 137.70 days for both seasons, respectively. While the combination of IPA 265 cultivar with spraying control gave the lowest average number of leaf area duration effective, as it reached 97.13 and 98.63 days for both seasons, respectively.

Leaf content of chlorophyll (SPAD):

The results in Table (1) showed the cultivar IPA 99 significantly excelled in giving the greatest value of leaves chlorophyll content, which amounted to 40.87 and 40.66 mg g^{-1} fresh weight for both seasons, respectively While the Bohoth 244 cultivar gave the lowest average for the trait which was 34.76 and 34.50 mg g^{-1} fresh weight for both seasons, respectively .The reason for the IPA 99 cultivar excelled may be due to the different cultivars in the nature of growth and elongation and the ability to produce tiller that are related to the genetic structure and the extent of their response to the environmental conditions prevailing during the growing season, this is consistent with the findings of Abdul-Jabbar and Nouri (2013).It is noticed from Table (1) that there are significant differences in the content of chlorophyll in leaves when spraying seaweed extract . The level of 10 g l^{-1} nano seaweed significantly excelled with the highest average of 42.95 and 42.67 mg g^{-1} for both seasons respectively, which compared to the control treatment that gave the lowest average for this trait of 26.78 and 26.59 mg g^{-1} fresh weight for both seasons, respectively. The reason may be due to seaweed containing many nutrients and plant hormones that enter into the formation of pigments or activate from their manufacturing processes, the most important of which are nitrogen and cytokinins, this consistent with what was found by Khan et al., (2009).It was also found that there was a significant interaction between the cultivars and the treatment of seaweed extract, where the combination of IPA 99 with spraying the concentration of 10 gm l^{-1} nano seaweed excelled for both seasons, and it gave the highest average for this trait of 48.17 and 48.11 mg g^{-1} fresh weight for both seasons, respectively. While the combination of Bohuth 244 with and control treatment of seaweed gave the lowest percentage of total chlorophyll content of the leaf, as it reached 22.63 and 23.47 mg g^{-1} fresh weight for both seasons, respectively.

Crop Growth Rate (g m^{-2} day^{-1})(CGR) :

The results in Table (1) indicated that spraying with seaweed extract had a significant effect on the crop growth rate, where the spraying at the level of 10 g l^{-1} nano recorded the highest average for the trait, which was 32.37 and 32.43 g m^{-2} day^{-1} for both seasons. Where, the control treatment without spraying gave the lowest average of 15.52 and 15.97 g m^{-2} day^{-1} for both seasons respectively, the spraying with seaweed extract has contributed to the content of nutrients and growth regulators that may be the reason for the increase in the crop growth rate as happened from an increase in of vegetative growth components represented by the plant height and the flag leaf area of , which led to an increase in the efficiency of the photosynthesis process, which led to an increase in the dry matter of the plant and an increase in its weight, and then an increase in the crop growth rate this agreed with (Kardiner, 1990)As for the interaction, it is noted from Table (1) that there is a significant interaction between the cultivars and spraying with seaweed extract. Where IPA265 with 10 g L^{-1} nano spraying excelled for both seasons and gave the highest average for this trait which was 33.39 and 34.42 g m^{-2} day^{-1}. While the combination of IPA99 cultivar with control gave the lowest average CGR, as it reached 11.67 and 12.12 g m^{-2} day^{-1} for both seasons, respectively.

Fertile tillers percentage (%):

Results showed that IPA 265 cultivar was significantly excelled in giving the largest percentage of fertile tillers , which amounted to 58.85 and 59.85% for both seasons respectively, while the cultivar Bohuth 244 gave the lowest average of 52.60 and 53.91% for the both seasons respectively, which did not differ significantly from the IPA99 cultivar .The reason for the excelled IPA 265 cultivar may be due to the different cultivars in the nature of growth , elongation and the ability to produce tillers that are related to the genetic structure and the extent to which each of them responds to the environmental conditions prevailing during the growing season. This is consistent with the findings of Abdul-Jabbar and Nouri (2013).It is also noted from Table (1) that there were significant differences in the percentage of fertile tillers when spraying seaweed extract. The level of 10 g l^{-1} nano significantly excelled the average spike product efficiency of 57.86 and 58.87% for the both seasons respectively, which did not differ significantly from the level of 20 g l^{-1} nano, which recorded 55.16 and 56.98% for the both seasons respectively, compared to the control treatment that gave the lowest The average for this trait was 51.76 and 51.16% for the both seasons, respectively. The reason for the excelled may be due to the importance of nano seaweed extracts in raising the efficiency of nutrient use, where it has a high surface area, which improves the absorption of nutrients and increases its permeability into the plant and its efficient participation in all biological processes. Reducing the particle size leads to an increase in the specific surface area and the number of particles per unit area of the extract, and this is consistent with what was found by Suppan (2017). As for the interaction, it is noted from Table (1) that there is a significant interaction between the cultivars and the spraying of seaweed extract. The combination of IPA 265 with 5 g l^{-1}nano spray for the first season and 10 g l^{-1} nano for the second season was excelled, with the highest average for this trait amounting to 62.08 and 62.23%, and they did not differ significantly between them and for both seasons, respectively. While the combination of IPA 99 cultivar with treatment without spraying gave the lowest average spike efficiency of 46.52 and 47.83% for both seasons, respectively.

The grain growth rate (mg week^{-1}):

The results in Table (2) that the Bohoth 244 cultivar in giving the highest average of the grain growth rate amounted to 0.79 and 0.78 mg week^{-1} and it did not differ significantly from the IPA 265 for both seasons respectively, while the IPA 99 cultivar gave the lowest average of 0.71 and 0.71 mg week^{-1} for both seasons, The reason for the excelled Bohoth 244 cultivar may be due to the different cultivars in the nature of growth and the ability to produce dry matter. The reason is also due to the decrease in the number of grains in the spike for this cultivar, which allowed the few grains to accumulate the largest amount of photosynthetic products, and this is evident in the trait of the weight of 1000 seeds.The excelled of Bohoth 244 cultivar also for its excelled in the leaf area duration , which continued carbon manufacturing and addition from the source to sink for a longer period compared to the rest of the cultivars, and this is consistent with what was reached by Abdul-Jabbar and Nouri (2013). It is also noted from Table (2) that there were significant differences for the grain growth rate when spraying seaweed extract, as the level of 20 g l^{-1} was significantly higher than normal with the highest average of 0.81 mg week-1 for the two seasons in a row compared to the control treatment that gave the lowest average for this trait It reached 0.71 mg week^{-1} for both seasons .The reason may be due to the role that these nutrients play in raising the efficiency of the photosynthesis process and increasing its products and providing an appropriate opportunity to reduce the state of competition between them for the results of food processed from the source.The grains' weight depends mainly on the increase in the activity of vital activities inside the plant and the improvement of growth and photosynthesis indicators, and then the transfer of its products to the growing grains (Al-Maeini and Al-Obaidi, 2015).As for the interaction, it is noted from Table (2) that there is a significant interaction between the cultivars and the spraying of seaweed extract. The combination of IPA 265 excelled with spraying the concentration of 20 regular, and it recorded the highest value for this trait of 0.87 mg week^{-1}, and it did not differ significantly from the cultivar Bohouth 244 for concentrations 10 regular and 20 regular for both seasons, respectively.While the combination of IPA 265 cultivar with control treatment gave the lowest value for the grain growth rate as it reached 0.66 mg week^{-1} for both seasons respectively.

Weight of 1000 grains (g):

Results however showed that the Buhouth 244 cultivar significantly excelled in giving the highest average for trait weight of 1000 grains, which amounted to 36.887 and 36.83 g for both seasons, respectively. While the IPA 99 cultivar gave the lowest average for the trait, which amounted to 35.447 and 35.24 g for both seasons, respectively, the reason for cultivar

Bohouth 244 excelled, may be due to the different cultivars in the nature of growth and the ability to produce dry matter. it also may due to the low number of grains in the spike of this cultivar, which allowed the few grains to accumulate the largest amount of photosynthetic products. This is clearly evident in the seeds growth rate, where the cultivar Buhuth 244 excelled, as well as the length of the leaf area duration, and this is consistent with the findings of Abdul-Jabbar and Nouri (2013).It is also noted from Table (2) that there were significant differences for the weight of 1000 grains when spraying seaweed extract, where the level of 20 g l^{-1} regular was significantly excelled and gave the highest average of 37,667 and 37.98 g. It did not differ significantly from the concentration of 10 g l^{-1}nano seaweed for the two seasons respectively, compared to the control treatment, which gave the lowest average for this trait amounting to 32,489 and 31.92 g for both seasons, respectively. This may be due to the role that these nutrients play in raising the efficiency of the photosynthesis process increasing its products and providing an appropriate opportunity to reduce the state of competition between them for food products processed from the source. The weight of the grains depends mainly on the increase in the activity of vital activities inside the plant and the improvement of growth indicators and photosynthesis, and then the transfer of its products to the growing grains, the reason is due to the excelled of this treatment in the grain growth rate (Khan et al., 2009).As for the interaction, it is noted however that there is a significant interaction between the cultivars and the spraying of seaweed extract, Where the combination Bohoth 244 with spraying the concentration of 20 g l^{-1} regular , as the highest value for this trait was recorded at 38,533 and 38.77 g and did not differ from the concentration of 10 gm. l^{-1} nano for the same cultivar and for the both seasons, respectively, while the combination in the cultivar IPA 99 with control treatment gave the lowest value for the weight of 1000 grains trait amounted to 30.367 and 30.13 g for the both seasons, respectively.

Number of grains per spike^{-1}

The results in Table (2) showed that the IPA 99 cultivar significantly excelled in giving the highest average of the number of grains per spike, as it reached 34.27 and 34.07 grains spike^{-1} for both seasons, respectively. While the cultivar Bohuth 244 gave the lowest average of 30.6 and 30.33 grains spike $^{-1}$ for both seasons, respectively.The reason for the excelled of IPA 99 cultivar may be due to the fact that the number of grains per spike is a quantitative trait that is positively correlated with genetic and environmental factors (Hari and Achla, 2010), It may be due to the high efficiency of this cultivar in converting the products of the process of metabolism from the vegetative part to the florets at pollination and maturity and the formation of emerging grains to increase the percentage of set flowers in them and reduce their abortion, and then increase the number of grains per spike.It is also noticed from Table (2)showed that there were significant differences for the number of grains in the spike when spraying seaweed extract, The level of 10 g l^{-1} nano significantly excelled the average of 34.00 and 35.11 grains spike^{-1} for both seasons, respectively. It did not differ significantly from 5 g l^{-1} nano and 20 g l^{-1} regular for the season (first season only) compared to the control treatment, which gave the lowest average for this trait amounting to 27.33 and 26.11 grains spike^{-1} for both seasons, respectively. The reason may be due to the role of seaweed extracts in increasing the efficiency of the photosynthesis process supplying it with primary elements and facilitating the process of transferring its products from the leaves to the pollinated flowers, which are seed initiators, reducing the intensity of competition for food by preparing the largest amount of it, Which reduces the rate of abortion of these flowers and increases the number of seeds in the spike, and This consistent with what Szczepanek and others (2018) found when adding it to the barley crop.As for the interaction, it is noted that there is a significant interaction between the cultivars and the spraying of seaweed extract. The combination of IPA 99 with a 10 g l^{-1} nano seaweed for both seasons excelled and gave the highest average for this trait of 36.67 and 37.67 grains spike^{-1} for both seasons, which did not differ significantly from the level of 20 g l^{-1} regular for the first season.While the combination of cultivar IPA 265 with treatment without spraying gave the lowest average number of grains in the spike, which amounted to 22.67 grain spike^{-1} for the first season, while Bohuth 244 with the control treatment recorded a value of 21.33 grain spike^{-1} for the second season.

Harvest index :

Results in Table (2) showed the IPA 99 cultivar significantly excelled in giving the highest average for the trait of harvest index amounted to 40,882 and 40.43 and it did not differ significantly from the IPA 265 cultivar for both seasons respectively, while the cultivar Bohouth 244 gave the lowest average for the trait amounted to 35,560 and 37.64 for both seasons respectively. The reason for the excelled of the IPA 99 cultivar may be due to the efficiency of the cultivar in converting the environmental inputs into an economic yield, and that the differences in the cultivars in the nature of growth and the ability to produce fertile tillers are related to the genetic structure, leaf area, chlorophyll content and the extent of their response to the environmental conditions prevailing during the growing season.The reason for the excelled can also be due to excelled of the cultivar in the number of grains per spike, and this is consistent with the findings of Abdul-Jabbar and Nouri (2013). It is also noted that there are significant differences for the harvest index when spraying seaweed extract.where The 20 g l^{-1} regular seaweed significantly excelled the average of 42,704 and 45.61 for both seasons, respectively, compared to the control treatment, which gave the lowest average for this trait, which amounted to 34.348 and 33.21 for both seasons, respectively. The reason may be due to the excelled of that treatment in the trait of the number of grains per spike and the percentage of fertile tillers, and this is consistent with what was found by Shah et al. (2013).Regarding the interaction, it was noted that there was a significant interaction between the cultivars and the seaweed extract spray, Where the combination of IPA 99 cultivar with spraying the concentration of 10 g l^{-1} nano seaweed excelled for both seasons, and it gave the highest average for this trait that reached 49.866 and 49.87 for both seasons, respectively, and it did not differ significantly with the combination 10 g l^{-1} nano for the same cultivar in the second season only, while the combination of Bohuth 244 with without spraying treatment gave the lowest value of the interaction amounted to 26.305 for the first season and the combination of IPA 265 with the control treatment the lowest value of 25.47 for the second season.

Grain yield (ton ha^{-1}):

Table (2) show the IPA 99 cultivar was significantly excelled in giving the highest average of the grain yield, as it reached 6.704 and 6.800 tons ha^{-1} for the two seasons respectively, and it did not differ significantly from the IPA 265 cultivar for the first season only, while the Bohuth 244 gave the lowest average reached 6.052 and 6,560 tons ha^{-1} for the two seasons respectively,The reason for the superiority of the IPA 99 cultivar in the trait of grain yield may be due to its superiority in the trait of the percentage of fertile tillers and its superiority in the number of grains in the spike and in the harvest index as well as its superiority in some growth traits such as leaf area and content of leaves from chlorophyll, and this is consistent with what AL-Menaie found (2013).

It is also noted from Table (2) that there are significant differences in the trait of grain yield when spraying seaweed extract The level of 10 gm l^{-1} nano significantly excelled with the highest mean of 7.404 and 7,680 tons ha-1 for the two seasons respectively compared to the control treatment that gave the lowest mean for this trait amounted to 4.264 and 4.360 tons ha^{-1} for the two seasons respectively The reason may be due to the importance of nano seaweed extracts in raising the efficiency of nutrient use, as it has a high surface area, which improves the absorption of nutrients, and reducing the particle size leads to an increase in the specific surface area and the number of particles per unit area of the extract (Suppan 2017)).Spraying nutrients in their nano form in the stages of plant growth led to the availability of these elements available for absorption for a longer period, which led to an increase in the efficiency of photosynthesis, which results in an increase in the average accumulation of dry matter and an increase in the fertilization process and the production of healthy and strong pollen, especially when the presence of zinc and its reflection on increasing the indicators of the economic yield while providing a sufficient amount of the processed food material in the leaves and benefiting from the rest of the plant parts, including spikelets (the main element in the formation of the economic yield) that leads to a good yield and this is consistent with what was reached by Shah et al. (2013). As for the interaction, it is noted from Table (2) that there is a significant interaction between the cultivars and the seaweed extract spray, where the combination IPA 265 with spraying the concentration of 10 g l^{-1} nano excelled for the two seasons and gave the highest average for this trait amounting to 7.960 and 7.840 tons ha^{-1} for both seasons, respectively. While the combination of IPA 99 cultivar with treatment without spraying gave the lowest average grain yield as it reached 4.016 tons ha^{-1} for the first season, and the combination of IPA 265 with treatment without spraying with a value of 4.120 tons ha^{-1} for the second season.

Crude protein percentage (%):

The results in Table (2) indicated that the IPA 99 cultivar excelled for quality of grain content of protein for both seasons, but the first season was not significant, where it recorded the highest average of 12,171 and 12.60% for both seasons respectively, and it did not differ significantly from the IPA 265 cultivar in the second season. The reason for the excelled of the IPA99 cultivar may be due to the fact that the protein trait is a quantitative trait that is positively correlated with genetic and environmental factors (Hari and Achla, 2010), Also, small grains give greater protein content than large grains, and this is consistent with Al-Amin and Rajbo (2019).As for spraying with seaweed extract, table (2) showed a significant effect on the grains content of protein, where the concentration of 10 g.l^{-1} nano recorded the highest average amounted to (13.724 and 13.26%) for the two seasons, respectively, and it did not differ significantly from the concentration of 20 normal for the second season only. while the control treatment without spraying gave the lowest average amounted to (9.516 and 10.21%) for the two seasons, respectively. Spraying with seaweed extract has contributed to what it contains of macro and micro-elements, growth regulators, and amino acids, where the amino acids main element in building proteins, and growth regulators, especially cytokinins, act as a catalyst for mRNA activity, the main element in the process of building proteins. This agrees with Abdul-Jabbar and others (2012), who indicated that there was an increase in wheat grain protein content when spraying seaweed, but it was not significant. As for the reason for the excelled of the nano-extracts on the regular extracts, it may be due to the fact that the first possesses nano-properties such as small size and reaction speed, which made the process of absorption from the plant faster and in larger quantities than the regular extract. This is consistent with what Qureshi et al. (2018) stated, who indicated that converting regular or synthetic plant extracts into a nano form increases their ability to absorb and interact within plant tissues. It is noticed from Table (2) that there is a significant interaction between the cultivars and spraying with seaweed extract, where the combination of IPA 99 with spraying the concentration of 10 g l^{-1} nano excelled, and the highest value for this trait was 14.363% for the first season and did not differ significantly from the IPA 265 cultivar and the combination IPA 265 with the same concentration for the second season, with a value of 13.26%, and it did not differ significantly from the cultivar IPA 99, While the combination of Bohuth 244 with treatment without spraying gave the lowest interaction value of 9.297 and 9.38% for both seasons, respectively. The reason for the excelled may be due to the different response of the cultivars to spraying with seaweed extract and that the absence of significant differences in the concentration of 10 g l^{-1} nano for the two cultivars IPA 99 and IPA 265 for both seasons is evidence of the genetic convergence of the cultivars to benefit from the spray factor.

Percentage of gluten (%):

The results in Table (2) indicated the excelled of cultivar IPA 99 for gluten grain content in both seasons, where it recorded the highest average of 0.54 and 0.49% for both seasons, respectively, and did not significantly differ from the 265 variety for the second season only.The reason for the excelled of the cultivar IPA 99 may be due to the fact that gluten, which is one type of proteins, is a qualitative trait that is positively correlated with genetic and environmental factors (Hari and Achla, 2010).As for the spraying with seaweed extract, table (2) showed a significant effect on the gluten content of the grains, where the concentration of 10 g l^{-1}nano recorded the highest average of 0.73 and 0.74% for both seasons respectively, while the control treatment without spraying gave the lowest average of 0.73 and 0.74%. 0.10 and 0.04% for both seasons, respectively, Spraying with seaweed extract has contributed to what it contains macro and microelements, growth regulators, and amino acids, where the latter is the main element in building protein, and growth regulators, especially cytokinins, act as a catalyst for mRNA activity, the main element in the process of building proteins, and this is in agreement with Abdul-Jabbar and others (2012) who They indicated that there was an increase in the grain protein content of wheat than spraying seaweed, but it was not significant. As for the reason for the superiority of the nano-extracts on the regular extracts, it may be due to the fact that the first possesses nano-properties such as small size and reaction speed, which made the process of absorption by the plant faster and in larger quantities than the regular extract. This is consistent with what Qureshi et al. (2018) stated, who indicated that converting regular plant extracts into a nano form increases their ability to absorb and interact within plant tissues. As for the interaction, it is noticed from Table (2) that there is a significant interaction between the cultivars and the spraying with seaweed extract, Where the combination of IPA 99 with spraying the concentration of 10 g l^{-1} nano excelled, where the highest value for this trait was 0.97 and 0.10% for booth seasons, respectively. While the combination of Bohouth 244 and without spraying treatment gave the lowest interaction value, which was 0.10 and 0.07% for the two seasons, respectively. The reason for the excelled may be due to the different responses of the cultivars to spraying with seaweed extract and that the reason for the fact that the gluten percentage in barley is very low or close to zero is that the gluten in wheat consists of two proteins, the glutenin and the Gliadin, which are combined in the doughly process and in the presence of water, gluten is formed (Wang et al. 2017), As for barley, most of its proteins consist of glutelin and prolamin in large proportions, and albumin and globulin proteins in small proportions, so these proteins fail to form the gluten network when forming dough (Houde et al., 2018).

Carbohydrate percentage (%):

The results in Table (2) that the Bohouth 244 cultivar significantly excelled in giving the largest percentage of carbohydrate content of grains amounted to 75.693 and 74.91 for both seasons, respectively, while the IPA99 cultivar gave the lowest average for this trait amounting to 72.23 and 74.91% for both seasons, respectively. The reason may be due to the fact that the trait is one of the qualitative traits that is positively related to genetics factors (Hari and Achla, 2010), and that large grains give the highest content of carbohydrates compared to small grains, unlike protein, as shown in Table (31) and this agrees with Al-Amin and Rajbo (2019).The results in Table (2) indicated that spraying with seaweed extract had a significant effect on the carbohydrate content of grains, and spraying at the level of 10 g l^{-1}nano recorded the highest average of 78,500 and 77.52% for both seasons, respectively, and did not differ significantly from the rest of the treatments, while it gave The control treatment (without spraying seaweed) had the lowest average of 71,311 and 71.13% for both seasons, respectively. The reason for the increase may be due to the fact that seaweed extract had a positive effect on plant growth by increasing the permeability of cell membranes, stimulating enzymatic reactions, improving cell division, cell elongation, increasing the production of plant enzymes and stimulating intracellular vitamins. As well as its indirect effect on the various doughly process of the plant such as photosynthesis and glucose synthesis, which is reflected in the increase in vegetative growth and carbohydrate materials manufactured in the leaves and their transfer to the fruiting parts later, and this is consistent with what Abdul-Jabbar et al. (2012).As for the interaction, it is noted that there is a significant interaction between the cultivars and the spraying of seaweed extract for the first season only**.** The combination of Bohoth 244 with a concentration of 10 g l^{-1}nano seaweed was excelled with the highest interaction value of 79.400 and 78.73% for both seasons, respectively. While the combination of IPA 99cultivar with control gave the lowest average carbohydrate content of grains, which was 69.633 and 69.57 % for both seasons, respectively.

Table 1. Effect of seaweed extract treatments on growth traits of three barley cultivars

Treatments	Plant height (cm)		Flag Leaf Area (cm)		LAD (day)		chlorophyll (SPAD)		CGR		RGR		Fertile tillers (%)	
seasos	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
G.S														
0	87.63	85.41	9.45	9.2	103.72	103.7	26.78	26.59	15.52	15.97	0.0108	0.0105	50.57	51.16
5N	93.58	93.34	10.2	10.2	113.28	114.67	37.76	37.81	24.54	23.96	0.0131	0.0131	56.35	56.98
10N	101.41	101.08	11.69	11.9	128.01	126.6	42.95	42.67	32.37	32.43	0.0153	0.0151	57.86	58.87
10G	95.24	94.68	10.46	10.63	111.04	109.87	39.06	38.39	22.41	21.58	0.0123	0.0119	54.98	55.62
20G	97.13	97.82	10.61	11.17	108.71	109.97	41.11	40.9	21.74	21.43	0.0122	0.0118	54.97	58.06
LSD G.S 0.05	1.52	1.68	0.52	0.46	3.34	3.73	1.96	1.8	2.28	2.04	0.0012	0.0012	3.23	2.02
V														
IPA 99	89.76	88.77	12.09	12.43	108.14	107.73	40.87	40.66	22.91	22.62	0.013	0.0122	53.39	54.65
IPA265	98.13	97.95	9.92	10.07	104.77	105.47	36.96	36.65	24.78	24.73	0.013	0.013	58.85	59.85
Bohoth244	97.11	96.68	9.44	9.36	125.95	125.68	34.76	34.5	22.26	21.87	0.012	0.0121	52.6	53.91
LSD V 0.05	1.34	1.01	0.63	0.48	4.23	2.96	1.99	1.32	ns	ns	ns	ns	4.96	2.24
LSD G.S * V 0.05	2.64	2.9	0.9	0.8	5.79	6.46	3.4	3.11	3.95	3.54	0.0022	0.0021	5.59	3.49

Table 2. Effect of seaweed extract treatments on the quantitve and qualitve traits of three barley cultivars

Treatments seasons	**GGR**		**1000-grain weight (g)**		**Number of grainper spike**		**Harvest index (%)**		**Grain yield (T ha-1)**		**protein %**		**gluten %**		**carbohydrates (%)**	
seasos	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**
G.S																
0	**0.71**	**0.71**	**32.489**	**31.92**	**27.33**	**26.11**	**34.348**	**33.21**	**4.264**	**4.36**	**9.516**	**10.21**	**0.1**	**0.04**	**71.311**	**71.13**
5N	**0.76**	**0.76**	**36.633**	**36.33**	**33.89**	**33.33**	**40.257**	**42.14**	**7.02**	**7.12**	**11.558**	**11.61**	**0.6**	**0.54**	**73.989**	**72.02**
10N	**0.76**	**0.76**	**37.467**	**37.4**	**34**	**35.11**	**42.704**	**45.61**	**7.404**	**7.68**	**13.724**	**13.26**	**0.73**	**0.74**	**78.5**	**77.52**
10G	**0.72**	**0.71**	**36.089**	**35.83**	**30.67**	**31**	**38.01**	**39.76**	**6.608**	**6.88**	**11.979**	**12.13**	**0.18**	**0.13**	**73.544**	**73.87**

20G	**0.81**	**0.81**	**37.667**	**37.98**	**33.44**	**32.44**	**34.683**	**35.16**	**6.932**	**7.24**	**12.389**	**13.2**	**0.41**	**0.38**	**75.267**	**74.93**
LSD G.S 0.05	**0.06**	**0.06**	**0.606**	**0.93**	**1.75**	**1.68**	**1.923**	**2.19**	**0.276**	**0.16**	**0.478**	**0.52**	**0.1**	**0.12**	**0.603**	**1.01**
V																
IPA99	**0.71**	**0.7**	**35.447**	**35.24**	**34.27**	**34.07**	**40.882**	**40.43**	**6.704**	**6.8**	**12.171**	**12.6**	**0.54**	**0.49**	**73.54**	**72.23**
IPA 265	**0.76**	**0.76**	**35.873**	**35.61**	**30.73**	**30.4**	**37.559**	**39.46**	**6.58**	**6.6**	**11.728**	**12.46**	**0.39**	**0.38**	**74.333**	**74.54**
Bohoth 244	**0.79**	**0.78**	**36.887**	**36.83**	**30.6**	**30.33**	**35.56**	**37.64**	**6.052**	**6.56**	**11.601**	**11.18**	**0.29**	**0.23**	**75.693**	**74.91**
LSD V 0.05	**0.03**	**0.05**	**0.754**	**1.21**	**1.96**	**2.16**	**3.226**	**1.44**	**0.304**	**0.16**	**Ns**	**0.7**	**0.15**	**0.15**	**0.988**	**1.1**
LSD G.S * V 0.05	**0.1**	**0.11**	**1.05**	**1.61**	**3.04**	**2.91**	**3.331**	**3.8**	**0.476**	**0.32**	**0.827**	**0.9**	**0.17**	**0.2**	**1.044**	**ns**

4. REFERENCES

[1] Abdul-Jabar، A.S.، A.S. Hussein and A. A. Mohammad . 2012 . Effect of the different seaweed extract (Seamino) concentrations on growth and seed chemical composition of two wheat varieties Rafidain J. of Sci. ،23(1):100-113.

[2] Abdul-Jabbar, Abdul-Aziz Sheikho and Atika Muhammad Nuri 2013. Study of the effect of seaweed extracts Soluamine and Algamix on some growth and productivity characteristics of two types of barley. Journal of Education and Science - Volume (26), Issue (1).

[3] Al-Maeini, Ayad Hussein, and Al-Obaidi Muhammad Owaid. 2015 . Scientific foundations for the management, production and improvement of field crops. Dar Al-Warith for printing and publishing. Baghdad, Iraq .

[4] Almubarak, Nader Falih Ali. 2008 . Effect of the growth regulator algebrain GA3 and potassium fertilizer K2SO4 on the qualitative characteristics of two cultivars of barley Hordium valgare L. planted for the purpose of grain fodder. Diyala Journal of Agricultural Sciences 32:133-146.

[5] Al-Tamimi, Raad Abdul-Karim and hana'an Hassan Muhammad. 2007. Response of some barley cultivars to nitrogen fertilization and seeding rates under desert conditions. Sebha University Journal 6(3):25-33.

[6] Andosh, Abdel Halim Rajab and Al Dhahiri Ibrahim Ali. 2020 . The effect of plant density on the growth and productivity of three cultivars of barley. (Hordeum vulgare

.L) Journal of Misurata University for Agricultural Sciences. Volume (1), Issue (2): 495-506.

[7] Hamad, Mahfouz Abdul Qadir. 2010. A comparative study of several genotypes of barley in yield and its components under the conditions of northern Iraq. Rafidain Agriculture Journal. Volume 38 (4):1-5.

[8] Hari Ram, Baljit Singh and Achla Sharma . 2010. Effect of Time of Sowing on the Field Performance of Barley (Hordeum vulgare L.) in Punjab. J Res Punjab agric Univ 47 (3 & 4) : 132-35.

[9] Kardiner, Franklin .1990. Physiology of Crop Plants. Dar Al-Fajr for Printing and Publishing. Cairo, Egypt.

[10] Khan Wajahatullah ، Mundaya N. Jithesh ، Alan T. Critchley and Balakrishan Prithiviraj . 2009 . Seaweed Extracts as Biostimulants of Plant Growth and Development . J Plant Growth Regul (2009) 28:386–399 .

[11] Pankaj، S. C.، P. K. Sharma، H. D. Chouksey and S. K. Singh . 2015. Growth and development pattern of barley varieties as influenced by data ofsowing nitrogen levels . Supplement on Agronomy 10(3): 1299-1302.

[12] Qureshi، A.، Singh، D. K. & Dwivedi، S. 2018 . Nano-fertilizers: A Novel Way for Enhancing Nutrient Use Efficiency and Crop Productivity. Int. J. Curr. Microbiol. APPl. Sci. 7، 3325–3335.

[13] Shah, M.T., Zodape, S.T., Chaudhary, D.R., Eswaran, K., Chikara, J .2013. Seaweed sap as an alternative liquid fertilizer for yield and quality improvement of wheat. J. Plant Nutr. 36:192–200.

[14] Suppan، B. S. 2017. APplying Nanotechnology To Fertilizer: Rationales، Research، Risks And Regulatory Challenge. Institute For Agriculture And Trade Policy. 1-21.

[15] Szczepanek M. ، B. Jaśkiewicz، and K. Kotwica . 2018. Response of barley on biostimulant application . research for rural development 2(1):49-54.

[16] Szczepanek M. ، B. Jaśkiewicz، and K. Kotwica . 2018. Response of barley on biostimulant application . research for rural development 2(1):49-54.

[17] Verklij، F.N. .1992. seaweed extract in agriculture and horticulture: areview. Biol – Agric. Hort – Int – J. 8(4)309-394. Literature cited.Wang، K.Q.، Luo، S.Z.، Zhong، X.Y.، Cai، J.، Jiang، S.T. and Zheng Z 2017. Changes in chemical interactions and protein conformation during heatinduced wheat gluten gel formation. Food chemist. Food chemistry، 214: 393-399.

[18] Zahedi، S. M.، Karimi، M. & Teixeira da Silva، J. A. 2020 .The use of nanotechnology to increase quality and yield of fruit crops. J. Sci. Food Agric. 100، 25-31.