Bionatura
Latin American Journal of Biotechnology and Life Sciences

Bionatura Issue 4 Vol 8 No 1 2023

Article

The Role of Some Treatments in the Indicators of IEAF Growth of Stevia (*Rebaudiana bertoni*) Plant and its Yield Under the Deficient Irrigation System

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Available from: http://dx.doi.org/10.21931/RB/CSS/2023.08.04.45

ABSTRACT

A field experiment was carried out at Research Station (A) of the College of Agricultural Engineering Sciences - University of Baghdad (Al-Jadriya) in 2021 with a canopy covered with saran, to increase the yield of the leafy plant and link the water consumption with the presence or absence of leaf area (cutting the plant) using a Randomized Complete Block Design (RCBD), according to the split – Plots Design and with three replicates, The results showed that the Deficient irrigation significantly reduced the number of vegetative branches, leaf area, relative water content, chlorophyll a and b in the second cutting. The dry weight of leaves in the second cutting in the treatment (I_3) than (I_1) as the reducing rate was 25.28% While it did not affect the number of leaves, their specific weight, chlorophyll a and b in the first cutting, and the dry weight in the first cutting. The percentage of leaves increased in treatment (I_3), a significant increase in treatment (I_1) in contrast to all other characteristics. The treatment of kinetin was superior in all characteristics except for the specific weight of the leaves and their relative water content, as well as the treatment of cutting the growing top, with the addition of another exception, which is chlorophyll a and b. The licorice treatment is superior to the comparison treatment in the number of leaves, their area and percentage, and chlorophyll a. As for the cyclical treatment is superior to the comparison treatment in the number of branches, number of leaves, and relative water content in the second cutting; it is superior to all treatments.

Keywords. Kinetin, Cycocel, licorice, Cutting the growing tops

INTRODUCTION

Diabetes is a global concern, according to the World Health Organization, and the disease ranks seventh among all global causes of death until 2030[1]. Diabetes has three different ways: low blood sugar (hypoglycemia), increased fat, cholesterol, and abundant carbohydrates (syndrome X), Type 1 diabetes or increased insulin production, and Type 2 diabetes[2]. The use of high-density artificial sweeteners such as saccharin and aspartame is common in reducing

hyperglycemia, but it has led to an increased risk of metabolic syndrome, weight gain, and cardiovascular disease[3], The introduction of innovative and biologically new compounds from natural products has increased worldwide, which gives hope for the introduction of an alternative natural sweetener for the treatment of diabetes troubles[4] Stevia is a natural local plant that belongs to the family (Asteraceae) Stevia has been used as a natural, low-calorie sweetener, an alternative to chemical sweeteners, and a nutritional supplement in developing and developed countries. The stevia plant is likely to become a major source of zero-calorie sugar, ideal for diabetics [5]. The medical importance of this plant is due to Rebaudioside A and Stevioside. The cytokinins, known to stimulate cell division, increase the leaf area and release the growth of buds, thus increasing the number of leaves and biomass in general and preserving chlorophyll from destruction and prolonging the duration of the leaf area remaining effective and others. And interference in various biochemical activities. Cycocil is one of the growth impediments that reduces plant height and apical dominance and redistributes dry matter, which means increasing the number of branches and, thus, the number of leaves. Cutting the growing tops is one of the agricultural operations that cancel the apical dominance, increase the number of branches, and may delay flowering; licorice extract contains Mevalonic Acid, which is the initiator of Gibberellin as well as sugars and mineral nutrients, and it contains glycyrrhizin [6].

MATERIALS AND METHODS

Soil plowing was carried out by smoothing and leveling and dividing it into experimental units using a Randomized Complete Block Design (RCBD), according to the split – Plots Design and with three replicates , The main Plots work on the irrigation factor (I_1) full irrigation treatment, (I_2) Deficient irrigation treatment with a 50% of the amount of water added to the comparison treatment for two successive irrigation processes immediately after the process of cutting plants, (I_3) Deficient irrigation with three irrigation process Immediately after cutting Each main experimental unit contained 5 lines (representing secondary units, the comparison was sprayed with distilled water , spraying kinetin at a concentration of 10 mg/L and spraying cycocel (CCC), growth retardant at a concentration of 100 mg/L, cutting the growing tops and spraying the licorice extract at a concentration of 5 mg/L.) the distance between one line and another was (75) cm and between plants (20) A separation distance of (1.5) m was left between the main experimental units, and random samples were taken from the field soil before planting from various places, at a depth of 0-30 cm, and were mixed and analyzed in the central laboratory - for soil, water and plant analysis - College of Agricultural Engineering Sciences - University of Baghdad Table No.(1) shows the physical and chemical properties of soil. A drip irrigation system has been installed linked to a tank with a capacity of 300 liters. The pump draws water from the tank to a main pipe measuring 3 inches from which sub-tubes of the same size branch off at the head of each tube a faucet to control the passage of water to the concerned treatment, from which tubes with a diameter of (0.5)inches. The Weighing method was used to find out the moisture content of the soil by taking samples by Auger before and after the irrigation. The first irrigation was carried out on 21/3/2021 at the same level and for all treatments (note that the plants were mowed for the first time without any treatment). Then, the Deficient irrigation process and the secondary factor treatments were carried out after the plant's second and third rows. Seedlings were obtained from the Directorate of the Municipality of the Green Zone \ Tissue Culture Laboratory, which resulted from tissue culture of the variety, noting that the plants were planted in pots prepared for this purpose and were previously adapted in a canopy prepared for this purpose until they became a month old and the process of

transferring the seedlings to the field where they were planted, A fertilizer (NPK) was Adding after planting and according to the fertilizer recommendation 100:150:300, kg [7] after dividing it into two equal part was added after mowing

Measured Attributes

The Number of Vegetative Branches (a plant branch^{-1})

According to the number of main branches of each plant of the experimental unit, which represent the branches arising from the crown area.

The Total Number of Leaves Per Plant (a leaf^{-1})

According to the number of leaves for each plant of the measured experimental unit and calculating the average.

Leaf area (cm^2 plant^{-1})

Ten leaves were taken randomly for each plant of the experimental unit, starting from the bottom to the top and according to the average area of one leaf using a scanner by a program Digimizer that loaded on a computer type H.P. and then extracting the average [8].

Specific Weight of the Leaf (g.cm^2)

To the specific weight of the leaf be according to the following equation:

SF(mg cm^2) = WL\LA

So the weight of the dry leaf = W.L., the area of the leaf =LA

Leaf Ratio

Represents a percentage of the leaves' weight divided by the plant's total dry weight.

The Relative Water Content of the Leaves

A leaf was cut from the plant, the seventh leaf and weighed directly (soft weight) (F.W.), then soaked in distilled water for 24 hours at room temperature, then dried superficially and weighed (full weight)(T.W.), then the plants were dried in an electric oven at 70 ° C for 48 hours until the weight is stable (dry weight)(D.W.). The relative water content is calculated from the following equation[9]:

RWC = (FW-DW\TW-DW)X100

So, RWC= the relative water content of the leaf. FW= the soft weight of the plant, DW= the dry weight of the plant, TW= the full weight of the plant

The Dry Weight of the Leaves Per Plant (gm plant^{-1})

The leaves of the plants were dried at a ventilated room temperature after placing them on the cardboard sheets. The process of stirring the samples was carried out from time to time, and then, according to the dry weight of each plant of the measured experimental unit, extracted the Avera.

Chlorophyll A or B Content in the Leaves (mg.100gm^{-1} soft weight)

The content of chlorophyll A and B of the soft leaves was estimated in the Seed Technology Laboratory - University of Baghdad after the full-width leaves (the tenth leaf) were selected for the main branch of the plants of the experimental unit. The concentration of chlorophyll a and b was estimated by crushing with acetone by taking a certain weight (0.2 gm)of the soft leaves. To this, a acetone solvent was added at a concentration of 80%. After crushing the leaves with the solvent by a ceramic lid, placing the chlorophyll solution in airtight bottles, and then reading the light absorption of the sample with a device Spectrophotometer at two wavelengths, 663 nanometer and 645 nanometers, the chlorophyll concentration was estimated(mg/l^{-1}) according to the following equation[10].

Chlorophyll a(mgL^{-1})=12.7D(663)2.69D (645)
Chlorophyll(mgL^{-1})=22.9D (645) -4.68D(663)

The value	measuring unite	Measured attributes
3.2	dsm^{-1}	electrical conductivity EC1:1
7.30	--------	PH1:1
32		N ready-made nitrogen
4.2	mg kg-1 soil phosphorous	P ready-made
134.23		K ready-made potassium
8.1	gm kg^{-1}	O.M. Organic matter
245.1		CaCo3 Calcium carbonate
13.20		Ca+2 dissolved calcium
8.24		Mg+2 dissolved Magnesium
2.35	milli equivalent liter	Na+2 dissolved sodium
1.1		Hco3 dissolved bicarbonate
20.10		Cl dissolved chlorine
0.86		K dissolved potassium
360	mg kg $soil^{-1}$	sand
424		silt Soil Separators
216		mud
Loam	---------	Tissue class
0.249	cm^3	field capacity
0.104		permanent wilting point
1.62	cm^3	bulk density

Table 1. Physical and chemical properties of soil.

RESULTS

The Number of Vegetative Branches

Table 2 shows that there is no significant difference between the two treatments, I1 I2, and they are superior to treatment I_3 significantly; this indicates the possibility of reducing the amount of irrigation water by 50% for two successive irrigation operations immediately after cutting the plant, which means saving in irrigation water. As for Table 3shows a significant difference between the levels of deficient irrigation in the number of branches. If the number of branches decreased significantly with each increase in the level of deficient irrigation I_1 to I_2 to I_3, the percentage of decrease in the number of branches reached 16.32 and 9,16 successively, The lack of water may lead to a decrease in the number of branches due to a decrease in the different levels of metabolism, as it is a medium

for all the biochemical reactions in the cells. Accordingly, its deficiency negatively affects the activity and division of cells and shifts the hormonal balance by reducing the activity of growth promoters and increasing the activity of inhibitors. Concerning the second factor, it was shown in Table 2 that the treatment of kinetin and cutting of the growing tops was significantly superior to the comparator and licorice treatments, and the cyclocyl treatment did not differ significantly from the treatment of licorice and the comparator, and this is because the addition of cytokinin has a direct effect on reducing the apical dominance and releasing the growth of the lateral buds, that cutting the growing top of the main stem can lead to the release of the growth of the dormant lateral buds due to the cancellation of the apical dominance resulting from the secretion of the growing tip and its export of the hormone indole acetic acid (IAA), This is consistent with what Akbari have found and others[11] in a study conducted on the stevia plant that cutting the top led to a significant increase in the number of branches of the plant. Cycocel is one of the growth impediments known to inhibit plant stem elongation, and this can create an abundance of nutrients (instead of depleting them in stem growth) that contribute to liberating the buds from hibernation. Table 3 shows that the treatments of cutting the growing tops, kinetin, licorice, and cyclostyle were significantly superior to the comparison treatment, and the percentages increased to reach 25,20,16, and 16% sequentially. Table 2 shows a significant interaction between irrigation and the treatments under study. If the combination*(* I_1 x cutting the growing tops*)* gave the highest average number of branches, reaching 78.43, while the combination (I_3x comparison treatment)gave the lowest average number of branches, reaching 50.60. Table 3 shows that there is a significant interaction between the two factors of the study if the combination(I_1 x licorice) gave the highest average number of branches reached to 123.1, while the combination (I_3 x comparison) gave the lowest average number of branches reached to 68.6

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	66.57	73.37	76.03	78.43	75.47	73.97
Irrigation I_2	72.27	75.30	75.17	70.40	61.57	70.94
I_3	50.60	70.37	53.50	63.40	53.27	58.23
ARM			8.840			3.953
Average	63.15	73.01	68.23	70.74	63.43	
ARM			5.104			

Table 2. Effect of treatments under study and deficient irrigation on the number of vegetative branches (plant branch^{-1}) in the first cutting.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	101.8	100.5	112.1	122.9	123.1	112.1
Irrigation I_2	81.1	106.5	88.8	100.4	92.3	93.8
I_3	68.8	95.4	92.1	91.3	78.3	85.2
ARM			14.52			6.50
Average	83.9	100.8	97.7	104.9	97.9	
ARM			8.39			

Table 3. Effect of treatments under study and deficient irrigation on the number of vegetative branches (plant branch^{-1}) in the second cutting. (I_1) full irrigation, (I_2) Halving irrigation after cutting, (I_3) Halving three irrigation processes after cutting

Number of Papers

Tables 4 and 5 show no significant difference between the levels of deficient irrigation in the number of stevia leaves. This shows that irrigating the stevia plant by 50% for two or three irrigation operations after cutting did not have a significant effect due to the absence of the greatest part of the surface that carries out the transpiration process, which enabled the plant to give close numbers of leaves in the three irrigation treatments. Table 4 shows that the top cuts cyclical and kinetin treatments were significantly superior to those of licorice and comparison, which did not differ significantly. We find that the treatment of cutting the tops, cyclocyl and kinetin all share that they are anti-apical dominance. It is known that the inhibition of apical dominance results in the plant increasing the number of branches (as shown in Tables 2 and 3), and these added branches bear new leaves that are added to the leaves of the plant, thus increasing the number of leaves in these treatments. Returning to Table 2, we find that the licorice treatment retreats the other transactions in increasing the number of branches, and this was reflected in the absence of a significant increase in the number of leaves in the first cut (Table 4), while the licorice treatment joined the significantly superior transactions in the number of branches in the second cut (Table 3), which was reflected in the increase in the number of papers (Table 4). No significant interaction existed between the two study factors in the number of papers, as shown in Tables 4 and 5.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	357	428	454	479	347	413
Irrigation I_2	269	403	450	498	339	392
I_3	290	410	461	491	318	394
ARM			G.M.			104.6
Average	305	414	455	489	355	
ARM			135.0			

Table 4. Effect of the treatments under study and deficient irrigation on the number of leaves (a leaf^{-1}) in the first cutting.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	3086	3693	3321	3457	3504	3412
Irrigation I_2	2953	3611	3512	3368	3502	3389
I_3	3095	3359	3360	3273	3169	3251
ARM			G.M.			249.3
Average	3045	3554	3397	3366	3392	
ARM			321.8			

Table 5. Effect of the treatments under study and deficient irrigation on the number of leaves (a leaf^{-1}) in the second cutting. (I_1) full irrigation, (I_2) halving irrigation after cutting،(I_3) halving three irrigation processes after cutting.

Paper Area

Tables 6 and 7 show a significant difference between the levels of deficient irrigation in the leaf area, as the leaf area decreases significantly with each increase. The percentage of decrease in I_2 & I_3 compared to I_1 was 11.16 and 12.71% sequentially (Table 6). The percentage of decrease in I_2 & I_3 compared to I_1 treatment was 6.98 and 29.66%, sequentially (Table 7). This may be attributed to the fact that the lack of water affects the reduction of the leaf area as a result of

the lack of water storage in the soil, which is reflected in the reduction of the activity of the roots in the absorption of nutrients as well as the transport processes within the plant. Thus, the restoration of growth will be stunted. Then the lack of activity of the carbonization process, closing of stomata and wrapping of leaves, and this is reflected in the lack of energy needed for cell division and increase in their number and size, which represent the basis for leaf growth and increase in its area, and this appears in the lack of leaf area. Calcium has a role in cell division, cellular expansion and elongation, and in the synthesis of the median plates of the cell wall and its relationship to the water balance in cells and thus the leaf space as well as its role in Activating the photosynthesis process by affecting the light reactions and thus increasing the efficiency of carbohydrate synthesis [19] This supports[5]what founded by that spraying stevia plants with Gibberellin was significantly superior to giving the highest level of leaf area, knowing that licorice extract contains the initiator of Gibberellin. With regard to the second factor, Table 19 shows that the kinetin treatment was significantly superior to all other treatments in the paper area, as it gave a percentage increase in the comparison treatment that amounted to 36.38%. The treatments of licorice and cyclosyl were significantly superior to those of cutting the growing tops, and the latter gave the lowest average leaf area with a significant decrease compared to all treatments. Cycocyl gave the lowest plant height among all treatments (Tables 10 and 11). It may be that curbing stem elongation is an important factor in finding an abundance of nutrients that can contribute to building a large leaf area. Tables 6 and 7 show that there is a significant interaction between the two factors of the study, as the combination (I_1 x kinetin) gave the highest average leaf area which is 108.2 cm2, while the combination (I_2 x licorice) gave the lowest average which is 65.9, while the combination (I_1 x cutting the growing tops) in Table 7, the highest average reached 63.23 cm^2 while the combination (I_3 x the comparison) gave the lowest average reached 38.59 cm^2

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	96.2	108.2	79.1	99.6	88.8	94.4
Irrigation I_2	68.5	84.8	81.3	88.3	89.0	82.4
I_3	68.6	73.1	79.3	79.3	65.9	73.2
ARM			15.33			6.86
Average	77.8	88.7	79.9	89.1	81.2	
ARM			8.85			

Table 6. The effect of the treatments under study and the deficient irrigation on the leaf area (cm^2 $plant^{-1}$) in the first cutting

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	52.39	73.49	63.23	61.15	59.49	61.95
Irrigation I_2	42.58	62.98	61.69	55.29	65.55	57.62
I_3	38.59	45.69	45.44	41.25	46.68	43.57
ARM			4.666			2.087
Average	44.52	60.72	56.79	52.57	57.31	
ARM			2.694			

Table 7. The effect of the treatments under study and the deficient irrigation on the leaf area (cm^2 $plant^{-1}$) in the second cutting (I_1) full irrigation, (I_2) halving irrigation after cutting, (I_3) halving three irrigation processes after cutting.

Specific Weight of Leaves

Tables 8 and 9 show no significant difference between the levels of deficient irrigation and the specific weight of leaves. Since the specific weight of the leaves is the result of dividing the dry weight of the leaf by its area. The absence of a significant difference indicates that the behavior of leaf weight and area was similar under deficient irrigation,. However, a numerical decrease was obtained and no significant difference was obtained for the dry weight of the leaves in the first cut (18), meaning that moisture stress had withdrawn its effect on the two traits. Also, tables 8 and 9 show no significant differences between the treatments and no significant interaction between the study factors in the first and second cut.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	1.179	1.135	1.283	1.097	1.233	1.185
Irrigation I_2	1.130	1.089	1.225	1.115	1.274	1.166
I_3	1.155	1.023	1.219	0.991	0.998	1.077
ARM			G.M.			G.M.
Average	1.154	1.082	1,242	1.067	1.168	
ARM			G.M.			

Table 8. The effect of the treatments under study and the deficient irrigation on the specific weight of leaves (mg cm^2) in the first cutting.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	2.096	1.889	1.584	1.822	1.738	1.826
Irrigation I_2	2.342	1.643	1.809	2.054	1.773	1.924
I_3	2.457	1.601	2.066	2.438	1.681	2.049
ARM			G.M.			G.M.
Average	2.299	1.711	1.819	2.104	1.731	
ARM			G.M.			

Table 9. The effect of the treatments under study and the deficient irrigation on the specific weight of leaves (mg cm^2) in the second cutting. (I_1) full irrigation, (I_2) Halving irrigation after cutting, (I_3) Halving three irrigation processes after cutting

Percentage of Papers

Table 10 shows that there is a significant difference among the levels of deficient irrigation in the percentage of leaves as the irrigation treatment I_3 is significantly superior to the irrigation treatment I_1 with an increase of 6.45%, and no significant difference has appeared between I_2 & I_1, which is a result contrary to all the traits under study. As the irrigation is by 50% of the amount of water, Comparison (I_1) of three successive irrigations caused an increase in the percentage of leaves (the economic yield) on the plant's stems. Returning to Table 18 (the weight of leaves in the first cut), we find that the weight of leaves did not differ significantly among irrigation levels, and this means that the stem's weight was the one decreased in a treatment I_3 to show its moral superiority on a treatment I_1. In contrast, Table 11 shows no significant difference among the levels of deficient irrigation.

Concerning the second factor, the table showed the superiority of the spray Kinetin treatment significantly over the other treatments without the treatment of cutting the growing tops, and the latter did not differ significantly from the licorice treatment, and that the cutting of the growing tops and licorice were significantly superior to the Cycocyl and comparison treatments, tables 18 and 19 (dry weight of leaves)

We find that the treatments of cutting the growing tops and kinetin are significantly superior to the treatments of cyclical and the comparison, and it is known that the increase in the weight of the leaves leads to an increase in its percentage when the weight of the stem is fixed and decreased. It seems that these two treatments have in common their contrast with the apical dominance, which released a greater number of buds to give juicy stems that are not woody and light in weight.

Regarding the second factor, Table 11 shows similar conduct to that in Table 10, if the kinetin spray treatment was significantly superior to all treatments except for the cutting the growing tops treatment and that the licorice and cutting the treatment were significantly superior to the cyclical and comparator treatments. As for the interaction between the treatments, there is a significant interaction between the two factors of the study in the percentage of leaves as shown in Table 10, while Table 11 shows that there is a significant interference between the study factors if the combination (I_{1X} treatment of cutting the growing tops) is significantly superior to the rest of the treatments with an average of 66.80%, while The combination (I_2 x comparison treatment) gave the lower with an average of 47.35%

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	72.96	82.74	65.74	79.96	72.84	74.77
Irrigation I_2	70.70	83.42	71.44	81.05	79.57	77.24
I_3	73.68	85.03	71.52	83.70	84.06	79.60
ARM			G.M.			3.161
Average	72.45	83.60	69.57	81.57	78.82	
ARM			4.081			

Table 10. The effect of the treatments under study and the deficient irrigation on the percentage of leaves (%) in the first cutting.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	55.56	58.71	53.68	66.80	55.41	58.03
Irrigation I_2	47.58	70.45	56.34	65.66	66.57	61.32
I_3	48.35	72.73	54.41	64.55	61.11	60.23
ARM			10.220			G.M.
Average	50.50	67.30	54.81	65.67	61.03	
ARM			5.901			

Table 11. The effect of the treatments under study and the deficient irrigation on the percentage of leaves (%) in the second cutting. (I_1) full irrigation, (I_2) halving irrigation after cutting، (I_3) halving three irrigation process after cutting

Relative Water Content

Tables 12 and 13 show a significant difference among the levels of deficient irrigation as the relative water content decreased significantly in the level of deficient irrigation from I_1 to I_3. Hence, the percentage of decrease was 12.76%. The treatment I_1 did not differ from I_2 a significant difference, which means that plants can be irrigated with half the amount of irrigation water for two successive irrigation operations after Cutting without affecting the relative water content of stevia leaves. Table 13 shows a significant decrease in the relative water content with each increase in the levels of deficient irrigation in the treatments I_2 and I3 compared to I_1. The percentage decrease was 6.04% and 24.60%, respectively. This may be attributed to the decrease in the soil moisture content (due to irrigating half the amount of irrigation water for two successive irrigation processes). That led to water stress for the plant, which appeared in the water imbalance by low relative water content. When comparing the two cuts, we find the difference between the first and second irrigation levels in the first cut in Table No. 12 and a significant difference between them in the second cut (Table 13). This may be due to the effect of climatic conditions on plant growth (Tabel 20), and it seems that the plants in the second cut were treated with half the amount of irrigation water in the extreme temperatures in the growing season, unlike the first cut, which took place at a less extreme temperature. Table 12 shows no significant differences between the treatments regarding the second factor. In Table 13, it appeared that the treatment of cyclocyl was significantly superior to all treatments, the treatment of licorice and kinetin was significantly superior to the cutting of the growing tops and comparison, and the latter significantly decreased compared to the treatment of cutting the growing tops. It seems that cyclocyl, which is known to reduce plant height, has worked to make the leaves and branches chunky, which reduces the movement of air that speeds up the transpiration in the plant, and this leads to the possibility of maintaining the water balance in the plant better than other treatments, especially at the highest temperatures that test the ability of treatment to perform. Licorice contains many important compounds in plant growth, the most important of which is potassium, which regulates the work of stomata so the plant can maintain its water balance. Kinetin is known to encourage vegetative growth and increase leaf area (as shown in Tables 6 and 7). This may reduce solar radiation reaching the depth of the vegetation cover, which means acceptable shading that reduces heat and may reduce air movement, which reduces transpiration and thus maintains a balanced relative water content. Cutting the growing top, which simultaneously frees the buds from hibernation, increases the branches' density, thus reducing the movement of air within the vegetation cover and the shading, which maintains the relative water content higher than in the case of comparison . There was no significant interaction between the study factors and the relative water content in the first two cuts, as shown in Table 12. Table 13 shows that there is a significant interaction between the study factors if the combination (I_1 x licorice treatment) significantly superior the rest of the treatments, which reached 84.29%, While the combination of irrigation treatment (I_2 x comparison treatment) gave the lowest average of 48.28%, and this indicates the importance of the selected treatments in reducing the damage of soil water deficiency in the relative water content in the conditions of the second cut, which represents the top heat in the year.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	87.1	87.5	83.4	79.0	81.2	85.4
Irrigation I_2	76.7	80.3	76.2	82.3	82.4	79.6
I_3	70.0	76.2	79.2	75.2	71.9	74.5
ARM			G.M.			0.607
Average	78.0	81.4	79.6	79.0	81.2	
ARM			G.M.			

Table 12. The effect of the treatments under study and the deficient irrigation on the relative water content of leaves (%) in the first cutting.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	75.28	84.29	79.41	75.46	83.31	79.55
Irrigation I_2	66.42	71.28	80.17	74.32	81.49	74.74
I_3	48.28	66.38	71.42	50.52	63.28	59.98
ARM			5.101			2.281
Average	63.33	73.98	77.00	66.76	76.03	
ARM			2.945			

Table 13. The effect of the treatments under study and the deficient irrigation on the relative water content of leaves (%) in the second cutting. (I_1) full irrigation ,(I_2) halving irrigation after cutting ,(I_3) halving three irrigation process after cutting

The Content Chlorophyll a. Content

It is noticed from Table 14 that there is a significant difference between the levels of deficient irrigation in the content of chlorophyll a, as I_3 decreased from I_1, a significant decrease of 12.25%, and I_1 did not differ from I_2, a significant difference. We find a significant difference in Table 15, where treatment I_3 decreased significantly compared to treatment I_1, with a decrease of 13.94, and there was no significant difference between the two treatments, I_2 and I1. This means that the amount of irrigation water is reduced by 50%. For three successive irrigations, it did not affect the content of chlorophyll A in the first cut and for two irrigations in the second cut, and this may be due to climatic conditions (Table 20) non-extreme in which irrigation treatments were applied in the first cut, but in the second cut, a treatment I_3 failed to maintain the chlorophyll content, not significantly different from the comparison treatment I_1. It is known that the lack of water at a rate harmful to the plant leads to a decrease in the content of chlorophyll and due to a decrease in the metabolism of bio-building and an increase in the metabolism of demolition, and from it, the destruction of chlorophyll. In relation to the second factor, Table 14 showed the superiority of the kinetin spray treatment over the other treatments without a significant difference between them. This increase may be attributed to the role of kinetin in stimulating the formation of chlorophyll and preserving it from decomposition and the ability of kinetin to move nutrients within the plant body from the root to the growing top and leaves and increase carbon fixation, which increases the formation of the carbon structures required to build chlorophyll. In Table 15, we find the Kinetin spray treatment significantly superior to overall treatments except for licorice, and the latter superior to the comparison, and it did not differ significantly from the cutting of the growing top. This is because licorice extract contains carbohydrates and mineral elements, the most important of which is the magnesium element that enters into the construction of the

chlorophyll molecule and thus works to increase its content in the leaves. Because it contains sugars that increase the percentage of solutes in plant cells, which enhances the relative water content in the leaves in the second cut (Table 13). It is such a treatment efficacy test whose effect was shown under more extreme environmental conditions than the conditions of the first cut (Table 20). As for the interaction between the treatments, there was no significant interaction between the two study factors in chlorophyll a's content, as shown in Tables 14 and 15.

	Comparison	Kinetin	cyclocyl	Cutting growing tops	Licorice	Average
I_1	17.41	21.90	16.83	17.63	16.69	18.09
Irrigation I_2	15.24	18.49	16.23	14.79	17.43	16.44
I_3	14.23	17.85	15.77	15.07	16.07	15.80
ARM			G.M.			2.040
Average	15.63	19.41	16.28	15.83	16.37	
ARM			2.633			

Table 14. The effect of the treatments under study and the deficient irrigation on the chlorophyll a mg 100gm soft weight in the first cutting.

	Comparison	Kinetin	cyclocyl	Cutting growing tops	Licorice	Average
I_1	15.30	22.65	15.38	19.02	18.68	18.21
Irrigation I_2	14.15	21.55	14.80	15.88	17.90	16.86
I_3	13.59	16.78	15.80	13.46	18.72	15.67
ARM			G .M			2.197
Average	14.35	20.32	15.80	16.12	18.43	
ARM			2.837			

Table 15. The effect of the treatments under study and the deficient irrigation on the chlorophyll a mg 100gm soft weight in the Second cutting. (I_1) full irrigation, (I_2) halving irrigation after cutting, (I_3) halving three irrigation processes after cutting

The Content of Chlorophyll b

Table 16 shows a significant difference between the levels of deficient irrigation in the chlorophyll b content, as treatment I_3 decreased significantly than treatment I_1 by a rate of 11.82%. No significant difference appeared between treatment I_2 and both I_1 & I_3. Also, a significant difference appeared in Table 17 As the content of chlorophyll b decreased in treatment I_3 than in I_1 and the latter did not differ significantly from treatment I_2. Here, we find a similarity in the behavior of chlorophyll b with chlorophyll a, as reducing the amount of irrigation water by 50% for three successive irrigations did not affect its content in the first cut and for two irrigations in the second cut. About the second factor, table 16 shows the superiority of the two treatments of kinetin and licorice, a significant superiority over all other treatments. The role of kinetin and licorice in increasing chlorophyll a content has been previously explained (Tables 16 and 17), noting that the conditions for building and maintaining chlorophyll a and b are similar. Table 17 shows that there is a significant difference between treatments, as the treatment of kinetin was significantly superior to the treatment of the cutting growing tops and comparison and did not differ significantly from the rest of the treatments. The role of kinetin showed increased chlorophyll content (dollars 14

and 15) concerning the interaction; no significant interaction was shown between the study factors in the first and second cuttings.

Table 16. The effect of the treatments under study and the deficient irrigation on the chlorophyll b mg 100gm soft weight in the first cutting.

	Comparison	Kinetin	cyclocyl	Cutting growing tops	Licorice	Average
I_1	10.61	15.31	11.43	10.81	13.59	12.35
Irrigation I_2	9.80	13.78	11.62	9.81	14.24	11.85
I_3	9.80	12.94	10.84	9.59	11.34	10.89
ARM			2.937			1.314
Average	10.07	14.01	11.30	10.05	13.06	
ARM			1696			

Table 17. The effect of the treatments under study and the deficient irrigation on the chlorophyll b mg 100gm soft weight in the Second cutting.

	Comparison	Kinetin	cyclocyl	Cutting growing tops	Licorice	Average
I_1	8.33	11.39	9.78	9.48	10.07	9.81
Irrigation I_2	8.52	10.82	9.35	8.38	10.16	9.45
I_3	6.54	9.58	7.51	7.81	9.26	8.14
ARM			3.534			1.581
Average	780	10.60	8.88	8.55	9.83	
ARM			2.040			

(I_1) full irrigation

(I_2) Halving irrigation after cutting

(I_3) Halving three irrigation processes after cutting

3.9. Leaves Dry Weight (plant yield)

Table 18 shows no significant difference between the levels of deficient irrigation in the dry weight of leaves. Table 19 showed a significant difference between the levels of deficient irrigation, as the dry weight of the leaves decreased significantly in treatment I_3 than in I1; the percentage of the decrease reached 25.28%. The reason for this can be attributed to the fact that the decrease in the amount of water led to a decrease in the leaf area, as shown in Tables 6 and 7, which led to a decrease in the dry weight of the leaves. It referred that treatment I_2 did not differ significantly from treatment I_1, which means that the plants can be irrigated with half the amount of irrigation water for two successive irrigations, which means savings in the quantities of irrigation water. With regard to the second factor, Table 18 showed that the treatment of cuttings of the growing tops and kinetin was significantly superior to the treatment of cyclocyl and the comparison, and the treatment of licorice did not differ significantly from all other treatments. Removing the apical buds leads to the liberation of the axillary buds from apical dominance, which is associated with oxygen production in the growing top. Thus, the number of branches (Tables 2 and 3), the number of leaves (Tables 4 and 5), and the leaf area (Tables 6 and 7) were increased. These are components of the yield of the leaves, and the increase of these components necessarily leads to an increase in the dry weight of the leaves. The treatment of kinetin behaved similarly to the treatment of cuttings of the growing tops in the traits as mentioned above, as the increase in the number of branches and then the increase in the number of leaves and leaf area was poured into the collection of

the components of the leaf yield of the plant. Table 19 shows that the Kinetin spray treatment was significantly superior to the comparison treatment, with an increased rate of 38.70%, and it did not differ significantly from the other treatments, which in turn did not differ significantly from the comparison treatment. The interaction between the two factors of the study in the dry weight of leaves in the first and second cuts is not significant, as is evident in Tables 18 and 19.

	Comparison	Kinetin	cyclocyl	Cutting growing tops	Licorice	Average
I_1	82.5	95.4	63.2	90.9	77.1	81.8
Irrigation I_2	60.7	78.0	71.4	79.2	76.4	73.1
I_3	60.3	71.4	70.3	80.7	71.0	70.8
ARM			G.M.			9.66
Average	67.9	81.6	68.3	83.6	74.8	
ARM			12.47			

Table 18. The effect of the treatments under study and the deficient irrigation on the dry weight of the leaves, gm of a plant^{-1} in the first cutting.

	Comparison	Kinetin	Cyclocyl	Cutting growing tops	Licorice	Average
I_1	47.1	57.4	50.3	54.9	51.1	52.2
Irrigation I_2	29.5	51.6	47.4	46.6	50.7	45.2
I_3	34.9	45.8	38.4	36.5	39.6	39.0
ARM			G.m			7.11
Average	37.2	51.6	45.4	46.0	47.1	
ARM			9.18			

Table 19. The effect of the treatments under study and the deficient irrigation on the dry weight of the leaves, gm of a plant^{-1} in the second cutting. (I_1) full irrigation, (I_2) Halving irrigation after cutting, (I_3) halving three irrigation processes after cutting.

DISCUSSION

The explanation of the reason for the increase in branches in the treatments was mentioned above, except for the treatment of licorice, which contains multiple compounds, including mevalonic acid, the bio-initiator of endogenous gibberellin [13], and this is linked with what was founded by[12] That spraying the stevia plant with Gibberellin led to a significant increase in branches in the plant than the comparison treatment.

From Table 17, it appears that all treatments are significantly superior to the comparison treatments. Here we find that the licorice extract treatment has been included in the list of superior treatments, as it contains sugar compounds that represent a source of energy for the plant and mineral elements such as potassium, calcium, manganese and nitrogen in proportions of 2.91, 2.14, 1.32 and 1.50% sequentially [14] These minerals are important in the growth of plants and the regulation of many physiological processes and are involved in the work of enzymes and have importance in cell division and water balance in plants, for example, potassium is important in regulating the work of stomata and thus the process of photosynthesis as well as the importance of nitrogen and other elements.

Great relative humidity	Minimum relative humidity	Solar radiation	Wind speed rate	Average temperatures	High temperatures	Minimum temperatures	Date
36.03	7.38	18.15	2.10	23.84	33.08	42.33	6\7-- 6\1
38.99	8.30	18.86	2.80	23.02	31.64	40.25	6\14 -- 6\8
43.99	8.20	19.55	3.73	24.57	32.80	41.02	6\15 6\21--
34.34	7.12	19.90	3.15	24.50	34.25	44.01	-- 6\22 6\28
41.83	12.07	19.64	2.16	30.58	38.85	45.13	7\5 -- 6\29
40.88	6.72	18.18	1.78	26.63	36.63	46.51	7\12 -- 7\6
32.62	6.95	17.66	1.81	25.86	36.61	46.14	--7\13 7\19
43.64	8.95	17.03	2.61	30.18	38.38	46.55	--7\20 7\26
41.08	6.88	16.95	2.10	27.57	36.84	45.83	8\2 --7\27
38.42	8.33	15.86	1.89	27.33	36.68	46.02	8\9 -- 8\3
37.50	8.65	16.33	2.23	25.38	34.60	43.93	-- 8\10 8\16
43.65	7.83	16.49	1.55	23.14	33.70	44.27	-- 8/17 8/23
41.40	7.51	15.88	2.05	26.18	36.41	46.64	-- 8/24 8/30
46.06	8.37	15.13	1.52	23.99	31.83	39.21	9/6 -- 8/31
46.23	10.68	15.13	2.86	23.89	32.23	40.37	9/13 -- 9/7
39.82	10.66	15.23	2.22	23.39	30.84	39.55	9/14 9/20--
42.97	11.39	14.36	2.38	18.94	27.84	37.15	-- 9/21 9/27
51.97	13.02	12.59	1.75	18.72	29.06	39.08	-- 9/28 10/4
54.10	9.59	12.05	1.84	15.30	25.20	35.10	-- 10/5 10/11
56.28	9.73	11.03	1.37	18.42	28.05	37.68	/18 - 10/12 10
52.66	12.29	11.08	1.53	15.34	24.15	32.97	– 10/19 10/25
60.57	13.64	9.90	1.00	15.73	24.97	34.21	--10 /26 11/1

Table 20. The Agricultural Meteorological Center of Baghdad Governorate(Abu Ghraib)2021.

Table 6 shows the significant superiority of the treatments of cutting the growing tops, cyclostyle, and licorice to the comparison treatment, and the latter did not

differ significantly from the cyclical. The treatment of cuttings of the growing tops was significantly superior to the treatment of cyclocyl, and this may be since cutting off the growing tops encouraged the plant to give more branches (Tables 2 and 3), Which led to an increase in the number of leaves (Tables 4 and 5), which reflected positively in increasing the leaf surface of the plant. Kinetin is an important factor in encouraging the movement of nutrients and their movement towards the areas treated with it, as they are highly effective metabolic areas [15]. It has a role in the formation of some enzymes that contribute to the process of photosynthesis and increase the speed of vegetative growth, as well as induces genes affecting the production of enzymes that reduce nitrates and transport sugars and reduce protein-degrading enzymes and activates the kinetin that divides cells and increases the leaf area and the formation of chlorophyll and its preservation from decomposition. It has a role in increasing the accumulation of nitrogen and stimulating the emergence of chloroplasts. Thus the leaves retain their greenness and delay their aging, and this is consistent with what was found by[16] The leaf area of the stevia plant increased significantly in the treatment of spraying the plant with kinetin at a concentration of 10 mg/L. The licorice extract contains many compounds and mineral elements important in cell growth and division due to the increase in leaf area. Like potassium, which is of great importance in regulating the plasma voltage and the absorption of others and improving the photosynthesis process by stimulating the enzymes of this process, Magnesium, calcium, and nitrogen Magnesium is an important and activating factor for enzymes that fix carbon dioxide and contributes to the regulation of the Thylquin membranes and Carna plates in the chloroplasts and affects Magnesium is an element in building protein and is included in the composition of the cell wall, as calcium and manganese pectates constitute the largest proportion of the components of the middle plate[17] It is necessary for the so-called sodium pump that introduces potassium and expels sodium from plant cells [20,21]

CONCLUSION

ln speaking, that the imperfect uniform is a way to increase the efficiency of water use, exposing the crop to deficient irrigation at a certain age stage of plant growth, that irrigation by 50% twice after cutting did not affect the number of leaves, their specific rosin, chlorophyll, Wafa, and the dry color of the leaves in first, that spraying the two Kinect increased the yield of yield except for specific weight, and that the treatment of earring of the growing apex is to remove the apex of the branch to break the dominance of terminal bud (apical dominance) and stimulate the growth of the apical branches, and it excelled in all characteristics except for the specific weigh, and that the use of licorice root extract increased yield traits (number, area, and percentage of leaves, as for cycocel treatment, it outperformed the comparison treatment in terms of number leaves and relative water content in cutting that met it outperformed all treatments

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Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023
Citation: Ali, Z.A.; Ibrahim, B.A. The Role of Some Treatments in the Indicators of IEAF Growth of Stevia (*Rebaudiana bertoni*) Plant and its Yield Under the Deficient Irrigation System. Revista Bionatura 2023;8 (4) 63. http://dx.doi.org/10.21931/RB/CSS/2023.08.04.45