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EFFECT OF PLANTING DISTANCES, PHOSPHORUS AND NITROGEN + FOLIAR FERTILIZAION ON GROWTH AND YIELD OF STEVIA CROP

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ABSTRACT: Two field trials were conducted in a administration field at Faqous Distrect, Sharqia Governorate in the two summer seasons of 2018 and 2019. This work was aimed to investigate the effect of planting distances, phosphorus and nitrogen fertilization on growth and productivity of stevia crop. The treatments consists of two planting distances, 25cm and 50cm between hills; phosphorus fertilization, without and with 15.5kg P_2O_5/faddan as well as four nitrogen fertilization treatments (15and 30kg N /fad. each with and without foliar nutrient application). The results indicate that plant height and number of branches/plant did not significantly differed due to planting distances and phosphorus fertilization. Number of branches/ plant was significantly increased by increasing nitrogen levels up to 30kg/fad. compared with 15kg N/fad. Significant increments were observed by 50cm planting distance and adding 100 kg super phosphtate at the2nd and 3 third cut only by number of leaves/plant in the first season. The results showed significant increments due to planting stevia on 50cm distance and adding 100kg superphosphate by plant fresh weight, leaves fresh and dry weights/plant in the two season and all cuts excpect the first one by leaves fresh weight in the first season. On the other hand, total fresh yield/fad. leaves fresh and dry yields/fad. were significantly higher by planting stevia at 25cm distance and adding 100kg superphosphate/fad. Concerning the effect of adding 30 kg N/fad. and foliar application, there were significant increments in all studied characters of stevia by all cuts in the two seasons except plant height, which the differences did not reach the level of significance. Positive significant interaction effects were detected only by the interaction between planting distance and phosphorus fertilization on plant fresh weight, total fresh yield/fad. Leaves fresh and dry yields/fad, also between planting distance and adding 30 kg/fad. nitrogen fertilization on leaves fresh weight, total fresh yield/fad. and leaves fresh and dry yields/fad.

Key words: Stevia (*Stevia rebaudiana* Bertoni), planting distance, phosphorus, nitrogen, foliar fertilization.

INTRODUCTION

Stevia (*Stevia rebaudiana*, Bertoni) is known as a natural sweetness plant in the world belong to the family asteracae. Stevia leaves contain compounds about 250 to 300 sweeter than the table sugar (**Kumar, 2002**). Stevia crop was recently known and cultivated in Egypt for its sweetener leaves. The main substance of interest is stevioside which concentrate in stevia leaves. In Zagazig district at the experimental farm of the Faculty of Agriculture, stevia was cultivated since about 10 years and more than 10 years in Egypt. It is worthy to mention that the sweetness of stevia has no calories which is very suitable for diabetics. Stevia is an perennial herbs grown in Egypt in summer season and gave 3-4 cuts per year. Growth and yield of stevia crop are affected by agronomic practices, like planting distance, phosphorus and nitrogen fertilization as well as foliar nutrient application.

The highest amounts of stevioside were found in the upper young growing branches, whereas the loweast were found in the senescent branches (**Bondarev *et al*, 2003**). Growth and yield of stevia significantly increased when fertilized with NPK fertilizers (**Chalapathi *et al*., 1999**).

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Macronutrients, N, P and K as well as micronutrients Ca, Mg and sulfer S are importants for growth of the plant tissue (**Wiedenhoeft, 2006**).

Kumar *et al*. (2013) stated that applying nitrogen with different froms help and encourage the rooting of stevia propagation in the Ms media and encourage the growth of twelve weeks old shoots. Planting stevia on ridges 70 cm width on the two sides of ridges with hill apacing, 15 cm under nitrogen fertilizer level 30kg N/ha., gave the maximum values of leaves fresh weight, leaves dry weight, fresh weight/ plant/ cut as well as stevioside percentage. On the other hand, planting stevia 50cm and 20cm between ridges and hills gave the highest number of branches/plant.

Growth and yield attributes of stevia plants significantly increased with the advancement of growth period, 60 DAP (**Zaman *et al*., 2017**). The recommended rate of NPK as 60. 30 and 50 kg/fad., respectively added to stevia plants caused significantly increments in plant height, branches and leavse number/ plant, leaves fresh yiels/fad., as well as total fresh and dry yield/ fad., (**Mostafa, 2019; Mohammed *et al*., 2019; Tadesse, 2019).** Adding nitrogen had significant effects on plants height, number of beanches, leaf area index (**Gatie *et al*., 2021**). Adding nitrogen fertilization and biofertilizers had significant effects on growth and yield and yield of stevia (**Caballero *et al*., 2021; Youssef *et al*., 2021**). The aim of this study was to investigate the influence of planting distance, phosphorus fertilization as well as nitrogen fertilization and nutrient foliar application on growth and yield of stevia under the conditions of Faquos district, Sharqia Governorate.

MATERIALS AND METHODS

Two field experiments were carried out in administration field at Faqous district, Sharqia Governorate, Faculty of Agriculture, Zagazig University during the summer seasons of 2018 and 2019. This work was conducted to study the effect of planting distance, phosphorus and nitrogen fertilization with foliar application on growth and yield of stevia (*Stevia rebaudiana*, Bertoni) crop variety Strecia every. Experiment included 16 treatments which were the combinatios of two planting distance, two levels of phosphorus and four nitrogen fertilization treatments (two levels of nitrogen with and without foliar nutrient application) in three replications. Planting distances (25 and 50cm) were allocated in main plots and phosphorus levels (without and with 15.5 P_2O_5) were arranged in sub- plots, while the following four nitrogen treatments were distributed in the sub-sub plots:

1- 15 k g N/ faddan.

2- 15 k g N/ faddan + foliar nutriention.

3- 30 k g N/ faddan.

4- 30 k g N/ faddan + foliar nutriention.

The foliar nutrient (Biogreen) applied contains macro and micro nutrients. Each mg/kg contains the following major elements: Nitrogen (N) 18, phosphorous (P_2O_5) 18, potassium (K_2O) 18, magnesium (Mgo) 1.5 and sulfur (S) 2.7 It also contains the following trace elements: Iron (Fe) 250, manganese (Mn) 170, zinc (ZN) 125, copper (Cu) 50 and boron (B) 35. The distance between ridges were 50 cm. The experimental soil was silty sand in texture. Physical and chemical soil properties are coarse sand 24.3%, silt 34.5% and clay 14.8% as well as organic matter 1.46%, total $CaCo_3$ 0.20%, PH 7.39%, N 0.07%, P 0.005% and K 0.008% ppm. Seedling of stevia plants in age of 45 day were transplanted at the first of April using one plant/ hill while in the second season were ratoons, plants.

Stevia plants yielded three cuts in the first season (2018), but gave two cuts only in the second one (2019). At each cut the following assessments were recorded:

1- Plant height (cm).

2- Branches No/plant.

3- leaves No/plant.

4- Plant fresh weight (g)

5- Leaves fresh weigh/ plant.

6- Total fresh yield (kg/fad.)

7- Leaves fresh yield (kg/fad.)

8- Leaves dry yield (kg/fad.)

Recorded data of stevia growth and yield were statistically analysis as split-split plot design in three replications, according to **Gomez and Gomez (1984) and Analytical Software (2008)**. Duncan's multiple range test was used to verify the significant differences between of treatments.

RESULTS AND DISCUSSION

Growth and yield of stevia are affected by some important agronomic managements such as planting distances, phosphorus and nitrogen fertilization as well as nutrient foliar application. Obtained results on growth traits and productivity of stevia in both seasons will presented and discussed under the three main headings as follows:

1- Effect of planting distances.

2- Effect of phosphorus fertilization.

3- Effect of nitrogen fertilization and foliar nutrition.

Effect of Planting Distance

The effect of planting distance on growth parameters and each of fresh and dry yields of stevia are presented in Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9.

Planting stevia on 25cm distances had no significant increments on plant height and number of branches/ plant, at all cuts in the two season compared with 50 cm planting. Also, number of branches/plant at all cuts showed insignificant increments when Stevia was planted on 50 cm distance in the two seasons compared with 25cm distance. Number of leaves /plant of 50cm distance was significantly higher at the second and third cut in the first season only, while did not reach the level of significance at the first season and at the two cuts in second season. On the other hand plant fresh weight at all cuts in the two seasons were significantly increased by 50 cm distance compared with 25 cm.

Leaves fresh and dry weights/plant was significantly increased by planting stevia on 50cm distance compared with 25cm distance at the second and third cuts in the first season and at the two cuts in the second season. These results were true in the two seasons and all cuts of stevia. The increments in number of leaves/ plant fresh and dry weights/plant in stevia plants may be expected due to wide planting soil area which occupied by stevia plants grown at 50 cm distance, compared to its planted in narrow distances.

Leaves fresh yield/fad., (Table 8) was significantly higher by planting stevia at 25 cm distance compared with 50 cm distance at all cuts in the two seasons. The higher value of leaves fresh at 25cm distance was due to the higher plant number per unit area, which about twice it planted at 50 cm distance. Similar results were obtained by **Shivani *et al.* (2019)**.

Phosphorus Fertilization

Concerning the effect of phosphorus fertilization on growth and yield traits of stevia (Tables1-9), the results revealed that plant height and number of branches/plant increased by adding 100 kg ordinary superphosphate, but these increments did not reach the level of significance. In all cuts and in the two seasons the increments in plant height were 4.6%, 4.1%, 10.3%, 4.6% and 4.6%in all cuts in the two seasons, respectively. Number of leaves/plant at the second and third cut of the first season as well as plant fresh weight were significantly increased due to adding 100 kg ordinary superphosphate in both growing seasons (Tables 3 and 4). Plant fresh weight was increased due to adding phosphorus fertilization by 16.8%, 33.2%, 57.9%, 54.5% and 54.4% in the two seasons and at all cuts, respectively, compared with check one.

Leaves fresh and dry weights/plant were significantly increased due to phosphorus fertilization in the first season, and second season but, did not reach the level of significance in the first cut at the first season (Table 5 and 6).

Adding 100 kg superphosphate caused significant increaments in total fresh yield/ faddan, leaves fresh yield/faddan and leaves dry yield/faddan in the two seasons as well as all cuts except leaves dry yield at the first cut in the first seasons (Tables 7, 8 and 9). The important organ of stevia plant is the leaves which contains namely the various steviosides types which consider

Table 1. Effect of planting distances, phosphorus and nitrogen + nutrient foliar fertilization on stevia plant height (cm) during summer seasons of 2018 and 2019

Main effects and interactions	1st season (2018)			2nd season (2019)	
Planting distance cm	1st Cut	2nd Cut	3rd cut	1st Cut	2nd Cut
D 25 cm	46.51	51.51	52.27	52.55	54.15
D 50 cm	46.35	51.35	49.96	52.37	53.95
F- test	N S	N S	N S	N S	N S
LSD 5%					
Phosphorus fertilization (kg/fad.)					
P 0 (without)	45.39	50.39	48.39	51.28	52.83
P 100 (kg/fad.)	47.47	52.47	53.38	53.64	55.27
F- test	N S	N S	N S	N S	N S
LSD 5%					
Nitrogen fert. + foliar (kg N/fad.)					
15	46.02	51.02	50.43	52.01	53.55
15 +foliar	45.04	50.02	48.20	50.88	52.40
30	47.40	52.40	50.35	53.57	55.20
30 + foliar	47.25	52.25	55.50	53.38	55.02
F- test	N S	N S	N S	N S	N S
LSD 5%					
Interactions effects					
D * P	N S	N S	N S	N S	N S
D * N	N S	N S	N S	N S	N S
P * N	N S	N S	N S	N S	N S
D * P * N	N S	N S	N S	N S	N S

Where: NS and * refers to not significant and significant at 5% level, respectively.

Table 2. Effect of planting distance, phosphorus and nitrogen + nutrient foliar fertilization on No. of branches/ stevia plant during summer seasons of 2018 and 2019.

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	**1st Cut**	**2nd Cut**	**3rd cut**	**1st Cut**	**2nd Cut**
D 25 cm	18.95	20.95	21.90	21.41	22.05
D 50 cm	20.80	22.80	22.20	23.52	24.22
F- test	N S	N S	N S	N S	N S
LSD 5%					
Phosphorus fertilization (kg/fad)					
P 0 (without)	18.68	20.68	19.60	21.12	21.75
P 100 (kg/fad)	21.07	23.07	24.40	23.81	24.52
F- test	N S	N S	N S	N S	N S
LSD 5%					
Nitrogen fert. + foliar (kg N/fad)					
15	15.70b	17.70b	18.20b	17.75b	18.29b
15 +foliar	18.45ab	20.45ab	18.52b	20.85ab	21.48ab
30	22.70a	24.70a	23.08ab	25.65a	26.40a
30 + foliar	22.66a	24.66a	27.70a	25.61a	26.37a
F- test	*	*	*	*	*
LSD 5%	5.46	5.46	8.07	6.16	6.25
Interactions effects					
D * P	N S	N S	N S	N S	N S
D * N	N S	N S	N S	N S	N S
P * N	N S	N S	N S	N S	N S
D * P * N	N S	N S	*	N S	N S

Where: NS and * refers to not significant and significant at 5% level, respectively.

Table 3. Effect of planting distance, phosphorus and nitrogen + nutrient foliar fertilization on No. of leaves/ stevia plant during summer seasons of 2018 and 2019

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	**1st Cut**	**2nd Cut**	**3rd cut**	**1st Cut**	**2nd Cut**
D 25 cm	390.5	270.3b	264.6b	441.3	454.4
D 50 cm	395.7	399.3a	386.8a	447.1	460.6
F- test	N S	*	*	N S	N S
LSD 5%		54.38	102.64		
Phosphorus fertilization (kg/fad)					
P 0 (without)	372.6	275.9b	246.5b	421.0b	433.6b
P 100 (kg/fad)	413.6	393.8a	404.9a	467.4a	481.4a
F- test	N S	*	*	N S	N S
LSD 5%		75.91	151.27		
Nitrogen fert. + foliar (k g N/fad)					
15	296.0d	277.3c	289.9b	334.5d	344.6d
15 +foliar	363.3c	330.3bc	275.7b	410.5c	422.8c
30	425.8b	339.8ab	309.1b	484.2b	495.6b
30 + foliar	487.3a	392.1a	42802a	550.7a	567.2a
F- test	*	*	*	*	*
LSD 5%	46.51	61.59	97.30	52.58	54.12
Interactions effects					
D * P	N S	N S	N S	N S	N S
D * N	N S	N S	*	*	N S
P * N	N S	N S	N S	N S	N S
D * P * N	N S	N S	N S	N S	N S

Where: NS * and refers to not significant and significant at 5% level, respectively.

Table 4. Effect of planting distance, phosphorus and nitrogen + nutrient foliar fertilization on stevia plant fresh weight (g) during summer seasons of 2018 and 2019

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	**1st Cut**	**2nd Cut**	**3rd cut**	**1st Cut**	**2nd Cut**
D 25 cm	111.90b	120.69b	116.29b	136.39b	140.48b
D 50 cm	145.85a	161.95a	154.61a	184,67a	195.21a
F- test	*	*	*	*	*
LSD 5%	26.02	26.70	26.02	29.39	30.29
Phosphorus fertilization (kg/fad)					
P 0 (without)	98.45b	111.63b	105.03b	126.15b	129.94b
P 100 (kg/fad)	159.30a	171,01a	165.87a	194.91a	200.75a
F- test	*	*	*	*	*
LSD 5%	45.9	50.14	48.01	54.33	55.93
Nitrogen fert. + foliar (k g N/fad)					
15	107.01b	120.19b	113.59b	135.83b	139.90b
15 +foliar	130.15ab	143.34ab	136.73ab	161.99ab	166.84ab
30	131.89ab	145.04ab	139.44ab	163.90ab	165.82ab
30 + foliar	146.45a	156.71a	153.05a	180.40a	185.52a
F- test	*	*	*	*	*
LSD 5%	29.96	30.92	29.79	32.14	33.26
Interactions effects					
D * P	*	*	*	*	*
D * N	N S	N S	N S	N S	N S
P * N	N S	N S	N S	N S	N S
D * P * N					

Where: NS and * refers to not significant and significant at 5% level, respectively.

Table 5. Effect of planting distance, phosphorus and nitrogen + nutrient foliar fertilization on leaves fresh weight (g) /stevia plant during summer seasons of 2018 and 2019

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	**1st Cut**	**2nd Cut**	**3rd cut**	**1st Cut**	**2nd Cut**
D 25 cm	60.55	50.44b	45.43b	54.28b	55.92b
D 50 cm	64.29	70.96a	68.35a	80.14a	82.59a
F- test	N S	*	*	*	*
LSD 5%		10.54	9.68	10.91	11.20
Phosphorus fertilization (kg/fad)					
P 0 (without)	59.85	49.04b	46.42b	55.41b	57.10b
P 100 (kg/fad)	64.99	72.87a	67.35a	79.06a	81.42a
F- test	N S	*	*	*	*
LSD 5%		7.00	13.45	15.24	15.81
Nitrogen fert. + foliar (kg N/fad)					
15	50.27 b	49.58c	46.63c	55.66b	57.33c
15 +foliar	52.59b	58.70bc	56.08bc	66.35ab	68.32bc
30	68.56a	60.38b	57.75ab	68.20a	70.31ab
30 + foliar	73.65a	75.45a	67.09a	75.72a	81.06a
F- test	*	*	*	*	*
LSD 5%	8.12	9.16	8.54	12.38	13.99
Interactions effects					
D * P	N S	*	N S	N S	N S
D * N	N S	N S	N S	*	*
P * N	N S	N S	*	*	N S
D * P * N					

Where: NS and * refers to not significant and significant at 5% level, respectively.

Table 6. Effect of planting distances, phosphorus and nitrogen + nutrient foliar fertilization on stevia leaves dry weight (g) / plant during summer seasons of 2018 and 2019

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	**1st Cut**	**2nd Cut**	**3rd cut**	**1st Cut**	**2nd Cut**
D 25 cm	18.05	14.30b	14.85b	16.18b	16.67b
D 50 cm	18.57	21.20a	21.72a	23.91a	24.62a
F- test	N S	*	*	*	*
LSD 5%		2.87	5.76	3.25	3.35
Phosphorus fertilization (kg/fad)					
P 0 (without)	17.85	14.60b	13.84b	16.52b	17.02b
P 100 (kg/fad)	18.78	20.80a	22.73a	23.57a	24.27a
F- test	N S	*	*	*	*
LSD 5%		4.03	8.51	4.53	4.71
Nitrogen fert. + foliar (kg N/fad)					
15	15.16b	14.70c	16.27b	16.60b	17.10c
15 +foliar	15.69b	17.50bc	15.48b	19.79b	20.37bc
30	20.45a	18.00ab	17.35b	20.33a	20.96ab
30 + foliar	21.96a	20.70a	24.04a	23.47a	24.17a
F- test	*	*	*	*	*
LSD 5%	2.42	3.26	5.16	3.69	3.79
Interactions effects					
D * P	N S	N S	N S	N S	N S
D * N	N S	*	*	*	*
P * N	N S	N S	N S	N S	N S
D * P * N	N S	N S	N S	N S	N S

Where: NS and * refers to not significant and significant at 5% level, respectively.

Table 7. Effect of planting distances, phosphorus and nitrogen + nutrient foliar fertilization on stevia total fresh yield (kg/fad.) during summer seasons of 2018 and 2019

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	1st Cut	2nd Cut	3rd cut	1st Cut	2nd Cut
D 25 cm	3486.00a	3868.40a	3895.30a	4376.80a	4465.70a
D 50 cm	2843.50b	2782.50b	2886.70b	3144.30b	3238.60b
F- test	*	*	*	*	*
LSD 5%	634.50	575.51	885.54	716.01	738.86
Phosphorus fertilization (kg/fad)					
P 0 (without)	2428.60b	2839.90b	2690.00b	3204.10b	3305.40b
P 100 (kg/fad)	2544.80a	3811.00a	4092.00a	4212.00a	4338.90a
F- test	*	*	*	*	*
LSD 5%	388.20	576.38	1393.49	441.67	451.28
Nitrogen fert. + foliar (kg N/fad)					
15	2401.00c	4035.50a	3008.90b	3050.60c	3142.90c
15 +foliar	2603.80bc	2903.00bc	2511.10b	3280.00bc	3378.60bc
30	3197.70ab	3496.80ab	3372.40b	3951.40ab	4070.00ab
30 + foliar	3736.40a	4035.50a	4671.60a	4560.10a	4696.90a
F- test	*	*	*	*	*
LSD 5%	605.81	619.21	1104.29	684.78	704.85
Interactions effects					
D * P	*	*	*	*	*
D * N	*	*	*	*	*
P * N	N S	N S	N S	N S	N S
D * P * N	*	N S	N S	*	*

Where: NS and * refers to not significant and significant at 5% level, respectively.

Table 8. Effect of planting distances, phosphorus and nitrogen + nutrient foliar fertilization on stevia leaves fresh yield (kg/fad) during summer seasons of 2018 and 2019

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	1st Cut	2nd Cut	3rd cut	1st Cut	2nd Cut
D 25 cm	1965.90a	2423.40a	2142.40a	2352.30a	2422.40a
D 50 cm	1378.40b	1530.40b	1587.60b	1729.30b	1781.20b
F- test	*	*	*	*	*
LSD 5%	225.90	343.46	486.94	394.32	405.99
Phosphorus fertilization (kg/fad)					
P 0 (without)	1490.60b	1561.90b	1479.50b	1765.00b	1817.90b
P 100 (kg/fad)	1853.70a	2391.90a	2250.60a	2316.70a	2385.70a
F- test	*	*	*	*	*
LSD 5%	213.80	223.75	766.93	241.45	249.23
Nitrogen fert. + foliar (kg N/fad)					
15	1428.00b	1443.20c	1645.90b	1677.70c	1726.90c
15 +foliar	1521.40ab	2321.60a	1381.10b	1804.30bc	1858.50bc
30	1715.60ab	1923.20b	1854.80b	2173.30ab	2238.50ab
30 + foliar	2023.00a	2219.50ab	2569.40a	2508.10a	2583.30a
F- test	*	*	*	*	*
LSD 5%	501.86	524.04	607.29	376.59	387.68
Interactions effects					
D * P	*	*	*	*	*
D * N	N S	N S	*	*	*
P * N	N S	N S	N S	N S	N S
D * P * N	N S	N S	N S	*	*

Where: NS and * refers to not significant and significant at 5% level, respectively.

Table 9. Effect of planting distance, phosphorus and nitrogen+ nutrient foliar fertilization on stevia leaves dry yield (kg/fad) during summer seasons of 2018 and 2019

Main effects and interaction	1st season (2018)			2nd season (2019)	
Planting distance cm	**1st Cut**	**2nd Cut**	**3rd cut**	**1st Cut**	**2nd Cut**
D 25 cm	645.62a	749.40a	771.20a	846.40a	872.10a
D 50 cm	428.10b	550.90b	571.50b	622.50b	641.20b
F- test	*	*	*	*	*
LSD 5%	121.10	125.65	175.19	142.19	146.37
Phosphorus fertilization (kg/fad)					
P 0 (without)	508.30	562.30b	532.60b	635.40b	654.40b
P 100 (kg/fad)	565.42	738.10a	810.20a	834.10a	858.90a
F- test	N S	*	*	*	*
LSD 5%		76.81	275.77	86.32	89.14
Nitrogen fert. + foliar (kg N/fad)					
15	429.64c	574.90bc	595.60b	604.00c	621.90c
15 +foliar	510.60bc	799.00a	497.30b	649.60bc	669.00bc
30	563.08ab	534.40c	667.70b	782.30ab	805.80ab
30 + foliar	644.14a	692.30ab	924.90a	902.90a	929.90a
F- test	*	*	*	*	*
LSD 5%	119.60	119.99	218.61	135.69	139.52
Interactions effects					
D * P	N S	*	*	*	*
D * N	N S	*	*	*	*
P * N	*	N S	N S	N S	N S
D * P * N	N S	*	N S	N S	*

Where: NS and * refers to not significant and significant at 5% level, respectively.

as nature sweetness compounds. Phosphorus fertilization increased leaves fresh yield / faddan by 14.3%, 53.1%, 52.1%, 31.3% and 31.2% in the three cuts of the 1st season and the two cuts in the 2nd season, respectively. Phosphorus fertilization had exerted a profound significant improving impact on values of stevia fresh and dry weights of leaves/plant and per faddan.

Stimulating effect of P on cell division and biosynthesis of organic compounds especially carbohydrates could gives a logical explanation for the improving impact of P on stevia yield and yield components traits.

These results are in agreement with those obtained by **Mohammed, Mona (2019), Mostafa (2019) and Tadesse (2019)**.

Nitrogen Fertilization and Foliar Nutriention

The effect of nitrogen fertilization as well as nutrient foliar application on each of plant height, number of branches/plant, number of leaves plant, leaves fresh weight/plant, leaves dry weight/plant, total fresh yield/faddan, leaves fresh yield/faddan and leaves dry yield/ faddan are presented in Tables (1-9).

The results showed non significant effects for nitrogen fertilization with or without nutrient foliar application on plant height at the different cuts in both seasons. On the other hand, there were positive significant effects for increasing nitrogen fertilization up to 30kg N/faddan as well as nutrient follair application on number of branches/ plant, number of leaves/plant, plant fresh weight, leaves fresh and dry weights/plant (Tables 2- 6).

Stevia total fresh yield/fad., leaves fresh and dry yields/fad. were significantly increased due to increasing nitrogen fertilization up to 30kg N/fad., and with adding foliar nutrient fertilization compared with adding 30kg N/fad. On the other hand, foliar application of nutrient fertilization had significant increments in values of total fresh yield/faddan, leaves fresh yield / faddan and leaves dry yield/faddan (Tables 7-9).

Adding 30 kg N/faddan increased leaves fresh yield at the three cuts by 41.6%, 53.8% and 56.2% in the first season and by 49.5 % and 44.6 % at the two cuts in the second season, respectively. Vegetative growth parameters as well as total leaves yield/fad. of stevia plants

were increased as nitrogen fertilizer increased from 15 up to 30 kg N/fad. Such finding might be attributed to the effective role of N as essential constituent of protein, amino acids, co-enzymes, and certain hormones as well as chlorophyll. Also, its role in the synthesis of sucrose and reactions involving the utilization of sucrose as energy source for plant growth.

Foliar nutrient application increased leaves fresh yield/faddan when added with 15 and 30 kg N/faddan by 6.5% and 17.9% in the first cut and by 60.4% and 15.49% in the second cut as well as by 19.1% and 38.5% in the third cut of the first season.

This finding is expected, since foliar nutritient contains macro and micro elements whom activates most of enzymatic reactions of metabolic processes. And, presented in the formula structure of photosynthetic pigments in plant.

Similar results concerning growth characters and yield of stevia as affected by nitrogen and nutrient foliar application were found by **Zaman *et al*. (2017), Mohamed, Mona *et al* (2019), Mostafa. (2019), Caballero, *et al*. (2021) and Gatie *et al*. (2021).**

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تأثير مسافات الزراعة والتسميد الفوسفاتى والنيتروجيني علي نمو ومحصول استيفيا

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أجريت تجربتان حقليتان في مزرعة استرشادية في فاقوس محافظة الشرقية في الموسم الصيفي للأعوام 2018، 2019 وذلك لدراسة تأثير مسافات الزراعة ، التسميد الفوسفاتى والنيتروجيني مع إضافة التسميد الورقي علي نمو ومحصول استيفيا صنف استراسيا. تمت الزراعة في أول أبريل في كلا الموسمين، حيث تم شتل شتلات استيفيا بعمر 45 يوم علي مسافتين 25سم ، 50 سم داخل الخطوط و50سم بين الخطوط في القطع الرئيسية ، والتسميد الفوسفاتى في صورة سوبر فوسفات أحادي الكالسيوم في معاملتين بدون ، 15.5 كجم بو$_2$ آ$_5$/ فدان أضيفت عند الزراعة ووزعت في القطع الفرعية ، بينما أضيف التسميد النيتروجيني في صورة نترات أمونيوم في 4 معاملات هي 15كجم ن/فدان بدون تسميد ورقي، 15 كجم ن / فدان مع التسميد الورقي بمعدل 1كجم/فدان وكذلك 30 كجم نيتروجين بدون التسميد الورقي ، ومع أضافة التسميد الورقي وضعت في القطع تحت المنشقة sub-sub-plots. وأضيف السماد النيتروجيني عند كل حشه بالمعاملات السابقة، حيث تم أخذ 3 حشات في الموسم الاول وحشتان فقط في الموسم الثاني. وتشير أهم النتائج المتحصل عليها أن مسافة الزراعة 50 سم بين الجور أعطت زيادة معنوية في عدد أوراق النبات في الحشة الثانية والثالثة في الموسم الأول و كان هناك زيادة معنوية في كل من وزن النبات الغض، عدد أوراق النبات والوزن والغض والجاف للنبات، بينما كانت هناك زيادة معنوية في المحصول الغض للفدان ومحصول الأوراق الغض والجاف للفدان عند الزراعة مع مسافات 25سم بين الجور وبالنسبة لتأثير التسميد الفوسفاتى ، وجد أن إضافة 15.5 كجم بو$_2$ آ$_5$/ فدان أعطت زيادة معنوية في عدد أوراق النبات، وزن النبات الغض، وزن الأوراق الغض والجاف للنبات وكل من المحصول الكلي الغض للفدان وكذلك محصول الأوراق الغض والجاف للفدان. أدى زيادة التسميد النيتروجيني إلي 30 كجم/فدان مع إضافة السماد الورقي إلي زيادة معنوية في عدد أفرع النبات، وعدد أوراق النبات، وزن النبات الغض، وزن الأوراق الغض والجاف، والمحصول الغض الكلي للفدان وكذلك محصول الأوراق الغض والجاف للفدان بالمقارنة بإضافة 15 وحدة أزوت للفدان.

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