

## Effect of Foliar Application of Bio and Micronutrients Fertilizer on Increasing Productivity of Fenugreek Yield

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**Abstract:** Two field experiments were carried out at Wadi El-Rayan, Fayoum Governorate, Egypt, during the two successive winter seasons of 2011/2012 and 2012/2013 to study the foliar applications effect of Yeast Bread and Fetrilon Combi-2 at three rates and mixture on growth, yield, yield components and chemical constituents of two fenugreek cultivars.

The results could be summarized as follows: Significant differences were found among the studied fenugreek cultivars at 75 and 105 days from sowing, plant height (cm), number of branches and leaves /m<sup>2</sup> (g), leaf area (cm<sup>2</sup>), leaf area index, specific leaf area and specific leaf weight except leaf area index at 105 days from sowing. Also there were significant differences between two fenugreek cultivars in yield and its components. Giza-3 cultivar significantly exceeded Giza-2 cultivar in all yield characters under study. Protein, carbohydrate and oil percentage of fenugreek seeds significantly affected by cultivars. Giza-3 cultivar significantly surpassed Giza-2 cultivar in protein and oil percentage, while Giza-2 cultivar significantly exceeded Giza-3 cultivar in carbohydrate percentage. The effect of foliar application on growth parameters was significant. Foliar application of Yeast Bread + Fetrilon Combi-2 at 400 L/ fed. was superior in respect of plant height, number of branches and leaves /m<sup>2</sup> (g), total dry weight /m<sup>2</sup> (g), leaf area (cm<sup>2</sup>), leaf area index, specific leaf area and specific leaf weight. Yield and yield components of fenugreek plants significantly affected by the foliar application of Yeast Bread, Fetrilon Combi-2 and mixture of them. The highest values were recorded by the plants spraying with Yeast Bread + Fetrilon Combi-2 at 400 L/ fed. Plants treated with Fetrilon Combi-2 at 400 L/fed., were much superior in seed content of protein, carbohydrate and oil percentage. Data concluded that spraying Giza-3 cultivar with Yeast Bread + Fetrilon Combi-2 at rate of 400 L/fed., could be useful for improving the productivity and nutrient status of fenugreek plants at Wadi El- Rayan, Fayoum Governorate, Egypt.

**Kew words:** Fenugreek- Yeast Bread- Micronutrients Fertilizer- Yield.

### Introduction

Fenugreek (*Trigonella*) is the oldest medicinal plant in the world. Most popular species of this genus is *Trigonella foenum graecum*, where the term "foenum-graecum" means 'Greek hay' pointing to its use as a forage crop in the past, fenugreek is grown mainly as a spice crop in the recent times. The plant is believed to be native to the Mediterranean region<sup>1,2</sup>. Fenugreek seed contains 45-60% carbohydrates, mainly mucilaginous fiber (galactomannans), 20-30% proteins high in lysine and tryptophan, 5 - 10% fixed oils (lipids), pyridine alkaloids, mainly trigonelline (0.2 - 0.38%), choline (0.5%), gentianine and carpaine, the flavonoids apigenin,

luteolin, orientin, quercetin, vitexin and isovitexin, free amino acids, such as 4-hydroxyisoleucine (0.09%), arginine, histidine and lysine, calcium and iron, saponins (0.6 - 1.7%), glycosides yielding steroidal sapogenins on hydrolysis (diosgenin, yamogenin, tigogenin, neotigogenin), cholesterol and sitosterol, vitamins A, B1, C and nicotinic acid and 0.015% volatile oils (n-alkanes and sesquiterpenes)<sup>3,4</sup>. Fenugreek can be a very useful legume crop for incorporation into short-term rotation and for hay and silage for livestock feed, for fixation of nitrogen in soil and its fertility<sup>5</sup>. Fenugreek is medicinal plants that use in disease sometherapy. It use for blood lipids and sugar decreasing in diabetic and non diabetic peoples and have

The Egyptian newly reclaimed sandy land is characterized as arid and semi-arid regions with poor soil nutrients, low organic matter, low water holding capacity and high nutrient leaching losses therefore the occurrence of macro and micro-nutrient deficiency. These factors reduced plant growth and development as well as limited the crop production therefore we could avoid these factors by foliar application techniques particularly, the micronutrients. Micronutrients have been used in improving growth and productivity in fenugreek<sup>7, 8, 9</sup>. It has been found by<sup>10</sup> that spraying fenugreek plants in the three concentrations of zinc (0.4, 0.5 and 0.6%), there is the highest number of branches plant<sup>-1</sup> (6.57), number of pods plant<sup>-1</sup> (51.80) and maximum seed yield (1544.43 kg/ ha.) were obtained with foliar application of 0.5% zinc.

Biological fertilizer is applying as economically compatible compactly which lead reduction in using chemical fertilizers, improving soil fertility status to enhance plant production. Yeast Bread is considered as a type of biofertilizer which is usually added to soil or as foliar application to crops<sup>11</sup> because it content of many nutrient elements as well as its role in producing important substances like growth regulators such as gibberellins, auxins<sup>12</sup>. Yeast treatment was suggested to participate beneficial role in improving growth and yield of some crops<sup>13,14,15,16</sup>.

Increasing Fenugreek yield per unit area can be achieved by breeding high yielding cultivars. Significant differences in Fenugreek cultivars have been shown by many workers<sup>17, 18,19,20,21</sup>. The objective of this study is investigate growth, yield and its components as well as some chemical constituents of two cultivars of fenugreek as affect by foliar application of Yeast Bread , Fetrilon Combi-2 and mixture at Wadi El-Rayan, Fayoum Governorate, Egypt.

## Material and Methods

Two field experiments were carried out at Wadi El-Rayan, Fayoum Governorate, Egypt, during the two successive winter seasons of 2011/2012 and 2012/2013 to study the effect of foliar application of Yeast Bread , Fetrilon Combi-2 at three rates and mixture on growth, yield ,yield components and some chemical constituents of two fenugreek cultivars. Some physical and chemical characters of soil (30 cm depths) in the experimental site were as follows: sand 52.5%, silt 20%, clay 27.5%, pH 8.02, organic matter 0.84 % ,CaCO<sub>3</sub>, 20.9%, EC 2.9 mmhos/cm<sup>3</sup>, soluble N 74 ppm soil measured as described by<sup>22</sup>. The treatments were arranged in split plot design with three replications where the fenugreek cultivars (Giza-2 and Giza-3) occupied the main plots, while sub-plots were devoted to foliar application of Yeast Bread, Fetrilon Combi-2 (200, 300 and 400 Liter /fed.) and mixture were arranged randomly in the subplots.

Yeast Bread extract was dissolved in water followed by adding sugar at a ratio of 1: 1 and kept 24 hours in a warm place for reproduction. Fetrilon Combi-2 (FC) [it contains Fe (4%), Zn (4%), Mn (3%), B (1.5%), Mg (2.2%), Cu (0.5%), Mo (0.05%) and S (2.8%)]. Foliar fertilizer treatments were sprayed on plant foliage twice during fenugreek plant growth period at 35 and 55days after sowing. Seeds of fenugreek were planted on December 2<sup>nd</sup> and 6<sup>th</sup> in the first and second seasons, respectively, two random samples of one square meter from each plot were taken at 75 and 105days after sowing to determine, plant height (cm), number of branches/ m<sup>2</sup>, number of leaves/ m<sup>2</sup>, total dry weight/ m<sup>2</sup> (g), leaf area {LA(cm<sup>2</sup>)} was determined according to<sup>23</sup>, leaf area index { LAI=leaf area per plant cm<sup>2</sup>/land area per plant (cm<sup>2</sup>)} was determined according to<sup>24</sup>, specific leaf area {SLA=leaf area per plant (cm<sup>2</sup>)/Air volume per plant (cm<sup>3</sup>)} was determined according to<sup>25</sup>, Specific leaf weight {SLW =leaf dry weight (g)/ leaf area (cm<sup>2</sup>)} was determined according to<sup>26</sup>. At harvest, a random sample of one square meter were taken from each plot to determine, plant height (cm), number of pods/m<sup>2</sup>, weight of pods/ m<sup>2</sup> (g), seed weight/ m<sup>2</sup>(g) and 100 - seed weight (g). In addition, seed, straw, biological yield (kg/fed.) and harvest index were determined from the whole plot. Protein and carbohydrate percentages in seed

were determined of infratec1241 Grain Analyzer. Oil percentage was determined according to the method described by<sup>27</sup>. Statistical analysis of the obtained results was done using (F. test and L.S.D.) according to<sup>28</sup>.

## Results and Discussion

### I-Effect of cultivars:-

Data presented in Table (1) show that significant differences between Giza-2 and Giza-3 cultivars in growth parameters of fenugreek plants at 75 and 105 days from sowing, i.e. plant height (cm), number of branches and leaves/ m<sup>2</sup>, total dry weight/ m<sup>2</sup> (g), leaf area (cm<sup>2</sup>), leaf area index, specific leaf area and specific leaf weight expect leaf area index at 105 days from sowing. It could be concluded that varietal differences between fenugreek cultivars may be due to genetical differences between cultivars and differences between genotypes concerning partition of dry matter. The results of cultivar differences in growth parameters obtained in this study are in agreement with those obtained by<sup>29, 18, 19, 30, 31</sup>. Recently,<sup>21</sup> who noticed that there was a strong varietal influence on growth characters. Among the varieties, BARI Methi 2 showed the best results in terms of plant height and number of branches per plant.

**Table (1): Effect of cultivars on growth parameters of fenugreek plants at 75 and 105 days from sowing (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Cultivars	Plant height(cm)	Number of		Total dry weight/ m <sup>2</sup> (g)
		branches	leaves	
(m <sup>2</sup> )				
75 days from sowing				
Giza-2	24.94	52.42	251.97	462.26
Giza-3	27.08	53.28	254.23	476.09
LSD at 0.05	0.32	0.11	0.21	0.01
105 days from sowing				
Giza-2	28.48	56.45	222.47	523.74
Giza-3	30.49	59.96	222.82	571.23
LSD at 0.05	0.02	0.09	0.13	0.36

**Table (1 cont.): Effect of cultivars on growth parameters of fenugreek plants at 75 and 105 days from sowing (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Cultivars	LA (cm <sup>2</sup> )	LAI	SLA (cm <sup>2</sup> /cm <sup>3</sup> )	SLW (g/cm <sup>2</sup> )
75 days from sowing				
Giza-2	15.82	0.1722	20.94	0.1635
Giza-3	15.62	0.1692	19.94	0.1723
LSD at 0.05	0.14	0.0005	0.03	0.0007
105 days from sowing				
Giza-2	12.75	0.1416	18.86	0.1894
Giza-3	12.72	0.1412	17.94	0.1953
LSD at 0.05	0.02	NS	0.07	0.0004

There were significant differences between two fenugreek cultivars in yield and its components in Table (2). Giza-3 cultivar significantly exceeded Giza-2 cultivar in yield and yield components. Such increase in seed yield might be due to the increase in number and weight of pods/m<sup>2</sup>, weight of seeds / m<sup>2</sup> and o 100-seed weight (g). The results are in conformity with<sup>20</sup> who reported that Giza-3 cultivar significantly surpassed Giza-2 cultivar in yield and yield attributes, i.e. plant height, number of pods/m<sup>2</sup>, weight of pods/plant, weight of grains/m<sup>2</sup>, weight of 100 grains, straw yield and biological yield (kg/fed.).<sup>31</sup> concluded that fenugreek

cultivars significantly differed in yield and its components except plant height, number of pods/m<sup>2</sup>, and 100 seed weight, biological yield/fed. and harvest index in both seasons. Cultivar differences in yield and its components in this study are in harmony with the results obtained by <sup>19,29</sup>.

**Table (2): Effect of cultivars on yield components of fenugreek plants (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Cultivars	Plant height (cm)	Number	Weight	Seed weight (g/m <sup>2</sup> )	100-seed weight (g)
		of pods			
		(m <sup>2</sup> )	(g/m <sup>2</sup> )		
Giza-2	25.98	250.89	156.01	112.91	1.87
Giza-3	27.95	251.90	157.07	113.90	2.00
LSD at 0.05	0.47	0.05	0.04	0.06	0.02

**Table (2cont.): Effect of cultivars on yields and chemical constituents of fenugreek plants (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Cultivars	Seed	Straw	Biological	Harvest index	Protein	Carbohydrate	Oil
					yield (kg/fed.)		
Giza-2	548.35	868.53	1416.88	38.70	24.01	44.07	12.69
Giza-3	552.06	884.22	1436.28	38.44	24.20	44.02	13.07
LSD at 0.05	0.37	0.95	1.32	0.01	0.06	0.01	0.10

Data presented in Table (2) indicated that protein, carbohydrate and oil % of fenugreek seeds significantly affected by the cultivars. Giza-3 cultivar significantly exceeded Giza-2 cultivar in protein and oil percentages. While Giza-2 cultivar significantly surpassed Giza-3 cultivar in carbohydrate percentage. Chemical content variation of different fenugreek varieties was reported by <sup>31</sup>.

## II-Effect of foliar application:-

**Table (3): Effect of foliar application on growth parameters of fenugreek plants at 75 and 105 days from sowing (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Foliar application	Plant height (cm)	Number of		Total dry weight/ m <sup>2</sup>
		Branches (m <sup>2</sup> )	Leaves (m <sup>2</sup> )	(g)
75 days from sowing				
Yeast	25.25	51.25	251.87	467.72
200 FC L/fed.	25.61	52.49	252.61	468.66
300 FC L/fed.	25.79	52.78	252.91	468.99
400 FC L/fed.	25.94	52.97	253.03	469.25
Yeast+200 FC L/fed.	25.87	53.29	253.55	469.55
Yeast+300 FC L/fed.	26.68	53.47	253.78	469.90
Yeast+400 FC L/fed.	26.95	53.70	253.94	470.13
LSD at 0.05	0.31	0.12	0.15	0.05
105 days from sowing				
Yeast	28.30	57.24	221.18	537.72
200 FC L/fed.	28.63	57.54	221.35	540.84
300 FC L/fed.	28.84	57.73	221.53	543.30
400 FC L/fed.	28.90	57.90	221.69	549.05
Yeast+200 FC L/fed.	30.22	58.77	224.01	550.39
Yeast+300 FC L/fed.	30.63	59.02	224.31	552.76
Yeast+400 FC L/fed.	30.90	59.25	224.45	558.32
LSD at 0.05	0.04	0.03	0.15	0.27

The effect of foliar application on growth parameters were significant (Table 3). Foliar application of Yeast Bread + Fetrilon Combi-2 at 400L/fed., was superior in respect of plant height, number of branches and leaves/ m<sup>2</sup>, total dry weight / m<sup>2</sup>(g), leaf area (cm<sup>2</sup>), leaf area index, specific leaf area and specific leaf weight. The enhancement of growth parameters of fenugreek plant treated by Fetrilon Combi-2 at 400L/fed. was more pronounced than those treated by Yeast Bread treatment. There were no significant differences between plant treated by Fetrilon Combi-2 at 300L/fed. and plant treated by Fetrilon Combi-2 at 400L/fed.

Foliar application of Yeast Bread might be due to that yeast induces nutrient minerals absorption through general improvement due to the ability of yeast to increase the production of stimulants for plant growth, especially Gibberellins, Auxins and Cytokinins which act to improve the plant cell division and its growth. Additional, micronutrients often act as co-factors in enzyme systems and participate in redox reactions, in addition to having several other vital functions in plants. Most importantly, micronutrients are involved in the key physiological processes of photosynthesis and respiration<sup>32</sup>. Foliar applications of micronutrient mixture were found to improve all the studied growth parameters and biochemical activities of fenugreek plants irrespective to their growth under non-saline or saline conditions<sup>33</sup>. Similar results were obtained by<sup>19,31</sup>.

**Table (3cont.): Effect of foliar application on growth parameters of fenugreek plants at 75 and 105 days from sowing (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Foliar application	LA (cm <sup>2</sup> )	LAI	SLA (cm <sup>2</sup> /cm <sup>3</sup> )	SLW (g/cm <sup>2</sup> )
75 days from sowing				
Yeast	15.25	0.1655	19.73	0.1623
200 FC L/fed.	15.38	0.1667	20.03	0.1648
300 FC L/fed.	15.60	0.1695	20.25	0.1660
400 FC L/fed.	15.92	0.1718	20.44	0.1680
Yeast+200 FC L/fed.	15.86	0.1730	20.60	0.1695
Yeast+300 FC L/fed.	15.95	0.1737	20.94	0.1713
Yeast+400 FC L/fed.	16.10	0.1749	21.08	0.1735
LSD at 0.05	0.15	0.0004	0.04	0.0010
105 days from sowing				
Yeast	12.39	0.1378	17.79	0.1787
200 FC L/fed.	12.58	0.1397	17.97	0.1823
300 FC L/fed.	12.68	0.1407	18.10	0.1873
400 FC L/fed.	12.77	0.1418	18.21	0.1955
Yeast+200 FC L/fed.	12.86	0.1425	18.77	0.1987
Yeast+300 FC L/fed.	12.91	0.1433	18.94	0.2008
Yeast+400 FC L/fed.	12.97	0.1442	19.04	0.2032
LSD at 0.05	0.02	0.0004	0.04	0.0010

\* {Fetrilon Combi-2 (F C), Liter (L), Feddan=2400m<sup>2</sup>(fed.)}

**Table (4): Effect of foliar application on yield components of fenugreek plant (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Foliar application	Plant height (cm)	Number	Weight	Seed weight (g/m <sup>2</sup> )	100-seed weight (g)
		of pods			
		(m <sup>2</sup> )	(g/m <sup>2</sup> )		
Yeast	26.19	250.75	155.84	112.75	1.61
200 FC L/fed.	26.52	251.01	156.13	112.96	1.74
300 FC L/fed..	26.81	251.21	156.32	113.10	1.88
400 FC L/fed	26.89	251.34	156.41	113.28	1.95
Yeast+200 FC L/fed.	27.21	251.63	156.74	113.71	2.05
Yeast+300 FC L/fed.	27.44	251.83	156.95	113.91	2.11
Yeast+400 FC L/fed.	27.73	252.01	157.40	114.13	2.24
LSD at 0.05	0.34	0.05	0.04	0.05	0.01

**Table (4cont.): Effect of foliar application on yields and chemical constituents of fenugreek plants (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters Foliar application	Seed	Straw	Biological	Harvest index	Protein	Carbohydrate	Oil
	yield ( kg/fed.)				%		
Yeast	530.23	846.76	1376.99	38.51	23.43	43.48	12.39
200 FC L/fed.	540.83	857.05	1397.89	38.69	23.69	43.75	12.55
300 FC L/fed.	554.96	866.98	1421.94	39.03	23.86	43.87	12.70
400 FC L/fed.	556.07	882.91	1438.99	38.65	23.86	43.95	12.85
Yeast+200 FC L/fed.	556.10	889.82	1445.91	38.46	24.33	44.10	13.00
Yeast+300 FC L/fed.	556.55	893.18	1449.72	38.39	24.72	44.51	13.23
Yeast+400 FC L/fed.	556.69	897.94	1454.63	38.27	24.88	44.67	13.44
LSD at 0.05	0.87	1.52	1.87	0.05	0.08	0.04	0.07

\* {Fetrilon Combi-2 (F C), Liter (L), Feddan=2400m<sup>2</sup>(fed.)}

Table (4) observed that yield and yield components of fenugreek plants significantly affected by the foliar application of Yeast Bread, Fetrilon Combi-2 and mixture of them. Data show the highest values were recorded by the plants spraying with Yeast Bread + Fetrilon Combi-2 at 400L/fed. The improvements in the fenugreek yield with foliar application of Yeast Bread + Fetrilon Combi-2 at 400 L/fed. might be due to additive influence of improvement in yield and its components due the application of Yeast Bread + Fetrilon Combi-2 at 400 L/fed.. These stimulative effects of Yeast Bread enhanced yield were reported by many investigators on different crops<sup>13,19,14,11</sup>. These results may be due to yeast its Cytokinins content, and the high content of vitamin B5 and minerals yeast composition might be play a considerable role in orientation and translocation of metabolites from leaves in to the productive organs. And also might due to the minerals Fe, Zn, Mn, S, Mo, Cu and B content in the Fetrilon Combi-2, which have a great role in cell division and enlargement and induce the photosynthesis which in reflect on yield and its components. Numerous studies confirmed our positive response of foliar spray with micronutrients<sup>7, 8, 9,10</sup>.

Results in (Table 4) indicated that plants treated with Fetrilon Combi-2 at 400L/fed. were much superior in seed content of carbohydrate and oil % compared with Yeast Bread and Fetrilon Combi-2 at other rates sprayed plants. Foliar application of Yeast Bread +Fetrilon Combi-2 at 400 L/fed gave the highest values of protein carbohydrate and oil %. These results may be due to increase of growth and yield which in turn reflected positively on chemical of fenugreek seeds. In this respect,<sup>9</sup> advocated that micronutrients play a significant role towards improving growth, yield and quality of seed spices.

### III- Effect of interaction between fenugreek cultivars and foliar application:-

Data presented in Table (5) show that, the interaction between fenugreek cultivars and foliar application was significantly in all growth parameters of fenugreek plants at 75 and 105 days from sowing. It can be concluded that spraying plants of Giza-3 cultivar with Yeast Bread + Fetrilon Combi-2 at 400L/fed. gave the highest values of plant height (cm), number of branches and leaves/ m<sup>2</sup>, total dry weight/ m<sup>2</sup> (g) and specific leaf weight, while Giza-2 cultivar with Yeast Bread+ Fetrilon Combi-2 at 400 L/fed. gave the highest values of leaf area (cm<sup>2</sup>), leaf area index and specific leaf area at 75 and 105 days after sowing.

Table (5): Effect of interaction between cultivars and foliar application on growth parameters of fenugreek plants at 75 and 105 days from sowing (combined data of 2011-2012 and 2012-2013 seasons).

Parameters	Cultivars Foliar application	Plant height(cm)	Number of		Total dry weight/ m <sup>2</sup> (g)
			branches	leaves	
			(m <sup>2</sup> )		
75 days from sowing					
Giza-2	Yeast	24.19	49.86	250.56	460.25
	200 FC L/fed.	24.59	52.14	251.39	461.53
	300 FC L/fed.	24.75	52.61	251.88	462.14
	400 FC L/fed.	24.93	52.80	251.92	462.54
	Yeast+200 FC L/fed.	24.54	52.96	252.39	462.83
	Yeast+300 FC L/fed.	25.60	53.10	252.72	463.18
	Yeast+400 FC L/fed.	25.95	53.43	252.94	463.33
Giza-3	Yeast	26.31	52.63	253.18	475.18
	200 FC L/fed.	26.62	52.84	253.83	475.79
	300 FC L/fed.	26.82	52.94	253.94	475.84
	400 FC L/fed.	26.94	53.15	254.39	475.96
	Yeast+200 FC L/fed.	27.20	53.61	254.74	476.27
	Yeast+300 FC L/fed.	27.77	53.83	254.84	476.63
	Yeast+400 FC L/fed.	27.94	53.96	254.93	476.93
LSD at 0.05		0.44	0.17	0.22	0.08
105 days from sowing					
Giza-2	Yeast	27.24	55.25	220.14	522.22
	200 FC L/fed.	27.65	55.63	220.25	522.45
	300 FC L/fed.	27.85	55.80	220.43	522.63
	400 FC L/fed.	27.95	55.92	220.63	522.83
	Yeast+200 FC L/fed.	29.20	57.29	225.15	525.20
	Yeast+300 FC L/fed.	29.63	57.48	225.30	525.35
	Yeast+400 FC L/fed.	29.85	57.76	225.42	525.48
Giza-3	Yeast	29.36	59.24	222.23	553.23
	200 FC L/fed.	29.60	59.44	222.46	559.22
	300 FC L/fed.	29.82	59.66	222.63	563.98
	400 FC L/fed.	29.84	59.88	222.75	575.27
	Yeast+200 FC L/fed.	31.24	60.24	222.87	575.58
	Yeast+300 FC L/fed.	31.64	60.56	223.31	580.18
	Yeast+400 FC L/fed.	31.95	60.74	223.47	591.16
LSD at 0.05		0.05	0.05	0.21	0.38

\* {Fetrilon Combi-2 (F C), Liter (L), Feddan=2400m<sup>2</sup>(fed.)}

**Table (5cont.): Effect of interaction between cultivars and foliar application on growth parameters of fenugreek plants at 75 and 105 days from sowing (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters		LA (cm <sup>2</sup> )	LAI	SLA (cm <sup>2</sup> /cm <sup>3</sup> )	SLW (g/cm <sup>2</sup> )
Cultivars Foliar application					
75 days from sowing					
Giza-2	Yeast	15.40	0.1677	20.20	0.1567
	200 FC L/fed.	15.50	0.1683	20.61	0.1607
	300 FC L/fed.	15.72	0.1710	20.76	0.1620
	400 FC L/fed.	15.89	0.1737	20.95	0.1640
	Yeast+200 FC L/fed.	15.95	0.1743	21.08	0.1650
	Yeast+300 FC L/fed.	16.06	0.1747	21.44	0.1673
	Yeast+400 FC L/fed.	16.24	0.1760	21.54	0.1690
Giza-3	Yeast	15.10	0.1633	19.25	0.1680
	200 FC L/fed.	15.25	0.1650	19.45	0.1690
	300 FC L/fed.	15.48	0.1680	19.74	0.1700
	400 FC L/fed.	15.95	0.1700	19.94	0.1720
	Yeast+200 FC L/fed.	15.76	0.1717	20.12	0.1740
	Yeast+300 FC L/fed.	15.85	0.1727	20.45	0.1753
	Yeast+400 FC L/fed.	15.96	0.1737	20.61	0.1780
LSD at 0.05		0.22	0.0006	0.06	0.0014
105 days from sowing					
Giza-2	Yeast	12.34	0.1370	18.24	0.1740
	200 FC L/fed.	12.60	0.1403	18.46	0.1770
	300 FC L/fed.	12.73	0.1407	18.63	0.1827
	400 FC L/fed.	12.81	0.1423	18.73	0.1933
	Yeast+200 FC L/fed.	12.88	0.1430	19.23	0.1970
	Yeast+300 FC L/fed.	12.93	0.1437	19.36	0.1990
	Yeast+400 FC L/fed.	12.98	0.1443	19.39	0.2027
Giza-3	Yeast	12.44	0.1387	17.34	0.1833
	200 FC L/fed.	12.56	0.1390	17.48	0.1877
	300 FC L/fed.	12.64	0.1407	17.56	0.1920
	400 FC L/fed.	12.72	0.1413	17.68	0.1977
	Yeast+200 FC L/fed.	12.83	0.1420	18.31	0.2003
	Yeast+300 FC L/fed.	12.88	0.1430	18.53	0.2027
	Yeast+400 FC L/fed.	12.97	0.1440	18.68	0.2037
LSD at 0.05		0.02	0.0006	0.06	0.0014

\* {Fetrilon Combi-2 (F C), Liter (L), Feddan=2400m<sup>2</sup>(fed.)}

The interaction between fenugreek cultivars and foliar application on plant height, number and weight of pods/m<sup>2</sup>, seed weight/m<sup>2</sup> (g), 100 –seed weight (g), seed, straw and biological yields (kg/fed.) were significant in Table (6). Giza-3 cultivar with spraying foliar Yeast Bread + Fetrilon Combi-2 at 400L/fed. gave the highest values of yield and its components compared with Giza-2 cultivar with the same spraying.



**Table (6): Effect of interaction between cultivars and foliar application on yield components of fenugreek plants (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters		Plant height (cm)	Number	Weight	Seed weight (g/m <sup>2</sup> )	100-seed weight (g)
Cultivars	Foliar application		of pods			
			(m <sup>2</sup> )	(g/m <sup>2</sup> )		
Giza-2	Yeast	25.24	250.17	155.21	112.26	1.56
	200 FC L/fed.	25.56	250.46	155.58	112.37	1.72
	300 FC L/fed.	25.77	250.68	155.79	112.47	1.83
	400 FC L/fed.	25.84	250.86	155.87	112.73	1.91
	Yeast+200 FC L/fed.	26.26	251.14	156.24	113.36	1.99
	Yeast+300 FC L/fed.	26.47	251.39	156.47	113.48	2.00
	Yeast+400 FC L/fed.	26.73	251.57	156.91	113.70	2.11
Giza-3	Yeast	27.13	251.34	156.46	113.24	1.66
	200 FC L/fed.	27.47	251.57	156.68	113.55	1.75
	300 FC L/fed.	27.85	251.75	156.85	113.73	1.93
	400 FC L/fed.	27.94	251.81	156.95	113.83	1.99
	Yeast+200 FC L/fed.	28.15	252.12	157.23	114.05	2.12
	Yeast+300 FC L/fed.	28.41	252.26	157.42	114.34	2.21
	Yeast+400 FC L/fed.	28.73	252.45	157.89	114.56	2.37
LSD at 0.05		0.48	0.07	0.06	0.07	0.02

**Table (6 cont.): Effect of interaction between cultivars and foliar application on yields and chemical constituents of fenugreek plants (combined data of 2011-2012 and 2012-2013 seasons).**

Parameters		Seed	Straw	Biological	Harvest index	Protein	Carbohydrate	Oil
Cultivars	Foliar application	yield ( kg/fed.)						
Giza-2	Yeast	523.62	841.34	1364.96	38.36	23.21	43.49	12.24
	200 FC L/fed.	536.16	847.96	1384.11	38.74	23.55	43.79	12.35
	300 FC L/fed.	554.18	857.10	1411.28	39.27	23.81	43.87	12.55
	400 FC L/fed.	555.89	872.62	1428.51	38.91	23.90	43.95	12.65
	Yeast+200 FC L/fed.	555.96	879.53	1435.49	38.73	24.20	44.14	12.77
	Yeast+300 FC L/fed.	556.23	885.99	1442.21	38.57	24.59	44.54	13.00
	Yeast+400 FC L/fed.	556.43	895.16	1451.59	38.33	24.83	44.73	13.25
Giza-3	Yeast	536.84	852.17	1389.02	38.65	23.64	43.47	12.54
	200 FC L/fed.	545.51	866.15	1411.66	38.64	23.82	43.71	12.74
	300 FC L/fed.	555.74	876.86	1432.60	38.79	23.90	43.87	12.85
	400 FC L/fed.	556.26	893.21	1449.47	38.38	23.82	43.96	13.04
	Yeast+200 FC L/fed.	556.24	900.10	1456.34	38.19	24.45	44.07	13.23
	Yeast+300 FC L/fed.	556.87	900.37	1457.23	38.21	24.86	44.49	13.46
	Yeast+400 FC L/fed.	556.95	900.72	1457.67	38.21	24.93	44.61	13.62
LSD		1.23	2.14	2.64	2.64	0.11	0.05	0.11

\* {Fetrilon Combi-2 (F C), Liter (L), Feddan=2400m<sup>2</sup>(fed.)}

The interaction between fenugreek cultivars and foliar application significantly affect on protein, carbohydrate and oil %. Spraying plants of Giza-3 cultivar with Yeast Bread + Fetrilon Combi-2 at 400 L/fed. gave the highest values protein, carbohydrate and oil %.

## Conclusion

Results obtained, it might be concluded that foliar application of Yeast Bread and Fetrilon Combi-2 at 400L/fed., could be useful for improving the productivity and nutrient status of fenugreek plants at Wadi El-Rayan, Fayoum Governorate, Egypt.

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