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YIELD AND QUALITY OF LEMONGRASS PLANTS (*CYMBOPOGON FLEXUOUS* STAPF) AS INFLUENCED BY FARM YARD MANURE AND FOLIAR APPLICATION OF BREAD YEA

[54]

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ABSTRACT

Two field experiments were carried out at the National Research Center, Giza, during the two successive seasons of 1999 and 2000 to evaluate the influence of farm yard manure (FYM) and foliar application of bread yeast (Y) solely or in combination, on the vegetative growth, yield, productivity and oil quality of lemongrass plants (*Cymbopogon flexuous* Stapf). Appreciable effects of various treatments were identified from all of the studied characters through the two cuts during both growing seasons. Spraying plants with bread yeast gave higher values for all characters than those obtained from the treatments of FYM. The most pronounced increments in height, number of tillers, yield, as well as, essential oil percentages, the content of (Citral A and Citral B), chlorophylls, carotenoids, total carbohydrates and NPK content and up take, resulted from the combination of FYM combined with bread yeast. The same trend of results were observed during both seasons and through the two cuts. To obtain highest yield with high quality of lemongrass oil, it could be recommended to supply the plants with $16m^3$ FYM two weeks before transplanting during the field preparation and spray the plants three times with 4g/lt yeast. The first spray after one month from transplanting, then repeated one month later. The third one after one month of the first cut.

Key words: Lemongrass, Farm yard manure (FYM), Yeast, Vegetative growth, Essential oil, Citral A, Citral B

INTRODUCTION

Cymbopogon flexuous Stapf, Family Gramineae, is one of the most important aromatic plants. The extracted oil is usually used in folk medicine as diuretic, diaphoretic, stomachic, carminative and tonic (**Rinzler, 1990**). It is also used as anti-rheumatic and against diarrhea. Lemongrass leaf oil is an important source of citral, apart from being esthentically important because of its characteristic lemon note, is processed to yield B-ionones which serve as starting mate-

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rial for the synthesis of vitamin A (**Neelam *et al* 1993**).

Organic fertilization by using FYM or other organic wastes is a practice adopted to provide plants with their nutritional requirements without having the undesirable impacts on environment like those produced by chemical fertilizers. This practice help in improving the physical characters of the soil and sustain the increased soil fertility. It is used to produce and / or improve yield and quality of edible products like medicinal and aromatic crops without the use of any synthetic chemicals for fertilization or for disease control. **Schachtschable (1979)** maintained that organic manure holds moisture, maintains sufficient pore spaces to permit good air circulation and drainage of the excessive water, he adds that composts from plant residues and animal dropping constitute one type of humus which contributes to the soil fertility. It has been reported that the use of FYM with or without mineral amendments had increased plant growth, herb and oil yields in a great number of important aromatic plant crops. **Choudhury *et al* (1986)** obtained maximum essential oil from *Ocimum basilicum* when FYM was added to NPK in the fertilization regime. The organic form of N gave the best herb and / or oil yields (**Caria *et al* 1996**). Similar results were obtained by **Mallanagouda *et al* (1995)** on coriander, *and* **El-Gendi *et al* (2001)** on sweet basil.

The various positive effects of applying active bread yeast as a newly used biofertilizer were attributed to its unique properties as it contains different nutrients, higher percentage of proteins, large amount of vitamin B and the natural plant growth hormone (cytokinin). In addition, application of active bread yeast was very effective in releasing Co2 which reflected on improving net photosynthesis (**Larson *et al* 1962 and Idso *et al* 1995**). The effect of active bread yeast on improving growth and productivity was reported by **Ahmed (1998)** on marjoram plants, **Shadia *et al* (1998)** on Roselle plants, and **Naguib and Khalil (2002)** on *Nigella sativa*.

Little work could be traced in the literature concerning the effect of FYM application and or/ bread yeast alone or in combination on the volatile oil containing plants; therefore, the present work was carried out to detect the effective level of FYM and the best concentration of bread yeast on the productivity and the quality of lemongrass plants.

MATERIAL AND METHODS

Two field experiments were carried out at National Research Center farm at Giza during the two successive seasons 1999 and 2000 to study the effect of FYM and foliar application of bread yeast either alone or in combination on lemon grass plants.

Offsets of lemongrass plants (*Cymbopogon flexuous* Stapf) were obtained from Agriculture Research Centre, Ministry of Agriculture. Offsets were planted on 15th. of March during the two successive seasons respectively, in plots (2 X 2 m^2) arranged in a complete randomized system. Every plot has 3 rows, the distance between plants was 40 cm. i.e. 15000 plant / feddan. FYM was added at two levels 16 and 20 m^3/fed during the soil preparation two weeks before transplanting. Foliar application of bread yeast was done three times at two concentrations 2 and 4 gm/lt, the first was sprayed one month after cultivation (15 April), the

second one month later (15 May) while the third spray took place one month after the first cut (last week of September).

Treatments were as follows:

1– Control plants grown in soil without fertilizers and sprayed with distilled water
2 – 16 m^3 FYM / fed. = FYM (1)
3 - 20 m^3 FYM / fed. = FYM (2)
4 – 2 gm / lt. bread yeast = Yeast (1)
5 – 4 gm / lt. bread yeast = Yeast (2)
6 – FYM (1) +Yeast(1)
7 – FYM (1) +Yeast(2)
8 – FYM (2) +Yeast(1)
9 – FYM (2) +Yeast(2)

Physical and chemical analyses of the experimental field soil were

3.9% coarse sand, 29.7 % fine sand. 25.5 % silt, 38.4 % clay (clay loamy) and 2.5 % organic matter. Available P= (31) ppm., N content = (168) ppm., K= (25) ppm. Fe = (1.28) ppm., Na = (35.20) ppm. and Mg.= (4.2) ppm.

The properties of the used FYM were as follows

Ash	organic carbon	organic matter	C/N ratio	pH	E.c. (m.mhos / cm)	K	P	N
46%	31.74 %	54.60 %	22:1	7.85	5.23	0.58%	0.49%	1.42%

Two cuts were taken during each growing season, the first was performed during the last week of August and the second one during the last week of November. (Cuttings were performed at 10 cm. above ground). The following measurements were recorded; plant height cm/plant (measured from the ground surface to the highest point of the leaves after gathering them together before cutting), No. of tillers / plant, fresh and dry weights (of the cuts) gm/plant, and ton / feddan.

Chemical determinations

Oil content in the fresh leaves was determined according to **Egyptian Pharmacopoeia (1984).** Oil constituents were determined, in the fresh herbs of the first cut of the first and second seasons, by GLC apparatus: Varian, model 3700 with flame ionization detector (FID), column stain. St., DEGS 10 % on chromosorb WAW, 80 – 100 mesh, as solid support. Column length 2 mx 1/8" SS diameter. Injector temperature was programmed from 70 – 90° at 4°/ minute and was operated with nitrogen as carrier gas at rate of 30 ml / min.

The qualitative determination of the different constituents of the oil of lemongrass was performed by comparing the relative retention times of different peaks with those of the pure authentic samples. More confirmation was carried out by injection of authentic samples with the oil. The quantitative determination of each compound was calculated on the basis of peak area corresponding to each compound.

Determination of pigments (chlorophyll a, b and total carotenoids content) in the fresh leaves was carried out ac-

cording to **Moran (1982).** Total carbohydrate content in the dry leaves was determined by the method described in the **A.O.A.C. (1990)**. Nitrogen (modified micro-Kjeldahl as described by **Bremner and Mulvaney (1982)**. Phosphorus and potassium% were determined by the method described by **Cottonie *et al* (1982)** and **Chapman and Pratt (1978),** respectively.

The obtained data were compared by using least significant difference test (LSD) as reported by **Gomez and Gomez (1984).**

RESULTS AND DISCUSSION

Growth characters

Plant height

Data in Table (1) show progressive increments in plant height due to the applied treatments at the two cuts during the two seasons. The highest increment was obtained from the combined treatment of FYM at 16 m^3 / fed. + 4 g /l t yeast where the relative percentage of improvement over control was (31.97, 29.12, 61.41 and 42.26%) through the first and second cuts during the two seasons, respectively. On the other hand, the lowest increments were detected due to the single treatments of FYM at the level of (16 m^3/fed.).

Number of tillers

The application of different treatments of FYM or foliar sprays of bread yeast had exerted the number of tillers per plant to reach significant levels with all sorts of treatments for the two cuts during the two seasons. The superiority was obtained by plants that received 16 m^3 FYM + 4 gm./lt. yeast. The pronounced effect of foliar sprays with bread yeast on vegetative traits could be due to its essential bio-constituents like carbohydrates, proteins, GA_3, IAA, cytokinins and vitamins as vitamin A, B and C as well as mineral contents, **Larson *et al* (1962)**. These constituents can cause stimulatory effect on cell division and enlargement, protein and carbohydrate synthesis, as well as chlorophyll formation. **(Kraig and Haber, 1980 and Castel Franco & Beake, 1983)**. FYM enlarged the good effects of yeast on growth measurements beside improving the physical characters of the soil and sustaining the soil fertility.

Fresh and dry weight of herb per plant and yield per feddan

Concerning the response of lemongrass plants to different treatments of FYM and yeast on the fresh and dry weights of herb per plant and consequently per feddan, it could be identified from Table (1), that the foliar application of yeast resulted heavier plants compared to the weights of plants supplied with both concentrations of FYM. It would be seen that FYM improved these characters in comparison to unfertilized and unsprayed (control) plants. The heaviest herb weight per plant either the fresh or the dry resulted from combined treatment of FYM at 16 m^3 / fed. + 4 gm / lt. yeast through the two cuts and during the two seasons.

The relative percentages over control through the two cuts were (68.37, 67.83 %) and (61.32, 62.73 %) for the fresh yield and by (71.81, 68.30 %) and 61.27, 46.17 %) for the dry yield during the first and second seasons, respectively. The

Table 1. Growth and yield of lemongrass plant as affected by farm yard manure and foliar application of bread yeast during 1999 and 2000 seasons.

First season

Characters	Plant height (cm)		No. of tillers/ plant		Fresh weight (g)/plant		Dry weight (g)/plant		Fresh weight ton/fed.		Dry weight ton/fed.	
Treatments	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Control	73.2	86.2	43.3	54.2	440.3	609.5	124.4	153.5	6.605	9.134	1.866	2.303
16 m^3/Fed FYM = (1)	77.6	90.6	55.3	67.3	562.3	778.3	157.8	196.0	8.435	11.675	2.367	2.940
20 m^3/Fed FYM = (2)	79.3	93.3	59.5	69.8	605.1	837.5	169.8	210.9	9.077	12.563	2.547	3.164
2 g / lt yeast = yeast (1)	81.3	94.3	60.7	71.7	617.2	853.9	173.3	215.1	9.258	12.809	2.599	3.227
4 g/lt yeast = Yeast (2)	86.5	99.2	64.7	73.3	657.9	910.6	184.7	230.3	9.869	13.659	2.771	3.455
FYM (1) + Yeast (1)	91.4	103.5	66.6	75.4	677.2	927.2	190.0	233.5	10.158	13.908	2.850	3.503
FYM (1) + Yeast (2)	96.6	111.3	73.5	80.4	747.4	1022.0	213.7	258.4	11.121	15.330	3.206	3.876
FYM (2) + Yeast (1)	93.7	106.4	71.0	79.6	721.9	997.2	202.6	251.1	10.829	14.958	3.039	3.766
FYM (2) + Yeast (2)	95.4	108.4	69.3	76.5	704.7	963.6	197.8	236.8	10.571	14.454	2.967	3.552
LSD 5%	8.6	11.3	8.4	7.8	20.1	36.8	10.6	14.8	0.758	1.123	0.157	0.220
						Second season						
Control	71.0	83.3	42.8	58.7	10.3	490.5	106.7	122.6	6.155	7.358	1.601	1.839
16 m^3/Fed FYM = (1)	80.6	85.6	48.6	60.3	465.9	503.9	121.1	125.9	6.989	7.559	1.817	1.889
20 m^3/Fed FYM = (2)	86.3	91.6	51.9	64.5	497.5	538.9	129.4	134.7	7.463	8.084	1.941	2.021
2 g / lt yeast = yeast (1)	89.3	94.8	53.8	66.8	515.7	558.2	134.1	139.6	7.736	8.373	2.012	2.094
4 g/lt yeast = Yeast (2)	97.5	103.5	58.7	72.9	562.8	609.2	146.3	152.3	8.442	9.138	2.195	2.285
FYM (1) + Yeast (1)	99.0	105.1	59.6	75.1	571.7	627.5	184.6	156.8	8.576	9.413	2.229	2.352
FYM (1) + Yeast (2)	114.6	121.0	69.0	85.8	661.9	716.9	172.1	179.2	9.929	10.754	2.582	2.688
FYM (2) + Yeast (1)	108.0	113.7	65.6	80.1	629.3	669.3	163.6	167.3	9.439	10.040	2.454	2.510
FYM (2) + Yeast (2)	114.3	117.3	68.8	83.9	659.9	701.1	171.6	175.3	9.899	10.517	2.574	2.630
LSD 5%	5.2	7.6	3.9	3.5	38.4	36.8	10.3	0.4	2.32	1.123	0.212	0.220

stimulatory effects of FYM and / or the yeast on the yield obtained is a reasonable results attributed to their influence on increasing plant height and number of tillers. The beneficial effect of yeast on plant growth and yield was supported by the results of **Subbo Rao (1984)**. He showed that active dry yeast contains high amounts of four vitamins, especially B which plays an important role in improving growth and controlling the incidence of disease and reduced at a low extent the great use of insecticides which caused an adverse effect on growth and productivity of plants.

Chemical contents

Essential oil content

It could be observed from Table (2) that the applied treatments of FYM and / or yeast had a promotive effect on oil percentages and oil yield of lemongrass herb through the two cuts and during the two growing seasons. Yeast was more effective in this concern, whereas the increments were more obvious with the combined treatments of FYM and yeast. Both concentrations of 2 and 4 g / lt. Yeast greatly increased oil yield especially when combined with 16 m^3/fed. FYM. Single treatments of yeast or FYM produced moderate effects on both of the oil percentages and oil yield through the two cuts and during the two seasons. The control plants produced the lowest values. **Robinson, (1973)** stated that the induced effects of treatments may be due to the fact that the yeast contains vitamins which are recognized as coenzymes involved in specific biochemical reactions in the plant such as oxidative and non-oxidative carboxylation processes. He, also stated that biochemical active pyrophosphates are the units which condense the forms of many varied forms that constitute the terpenes. In the same time, FYM caused higher efficiency in synthesizing biochemical metabolites due to higher available levels of fertilization.

These data are in harmony with data obtained by **Scheffer *et al* (1993)** on *Achillea millefolium*, **Ahmed (1998)** on marjoram, **Tarraf *et al* (1999) and Refaat & Balbaa (2001)** on lemongrass.

Essential oil constituents

As for the effect of different treatments on the constituents of the oil extracted from lemongrass plants, it is evident from Tables (3 and 4) that citral A and citral B are the major components in the oil. They reached (25.280 and 48.170%) and (25.762 and 47.601 %) for the first and the second seasons, respectively. Citronellal recorded (6.487 % and 6.439) as means for all treatments, followed by the hydrocarbon myrcene that consisted (5.011 and 6.097%) for both seasons respectively.

The treatment with FYM and / or foliar application of bread yeast were beneficial and effective in increasing the total content of (citral A and B). The increment was obvious with yeast treatments than with FYM treatments, while their combination resulted in the highest concentration of citral (A and B).

All treatments decreased the hydrocarbon myrcene. The highest decrement was observed with the treatment of 2 g / lt. yeast. The previous results indicated that the application of yeast and FYM had directed the biosynthesis process in general towards the formation of some hydrocarbons as well as oxygenated

Table 2. Essential oil content and yield of lemongrass plants as affected by farm yard manure and foliar application of bread yeast during 1999 and 2000 seasons.

Characters	First season 1999					Second season 2000				
	Oil %		Oil yield cc / plant		Seasonal yield	Oil %		Oil yield cc / plant		Seasonal yield
Treatments	1st cut	2nd cut	1st cut	2nd cut	lt/fed.	1st cut	2nd cut	1st cut	2nd cut	lt/fed.
Control	0.91	0.88	4.007	5.364	140.57	0.88	0.85	3.611	4.169	116.70
16 m^3/Fed FYM = (1)	0.93	0.89	5.229	6.927	182.34	0.91	0.87	4.240	4.384	129.36
20 m^3/Fed FYM = (2)	0.93	0.90	5.627	7.538	197.48	0.92	0.87	4.577	4.688	138.98
2 g / lt yeast = yeast (1)	0.92	0.89	5.678	7.600	199.17	0.90	0.87	4.641	4.856	142.46
4 g/lt yeast = Yeast (2)	0.92	0.90	6.053	8.195	213.72	0.92	0.88	5.178	5.361	158.09
FYM (1) + Yeast (1)	0.95	0.92	6.433	8.530	224.45	0.94	0.90	5.915	6.024	179.09
FYM (1) + Yeast (2)	0.99	0.94	7.399	9.607	255.09	0.96	0.91	6.354	6.524	193.17
FYM (2) + Yeast (1)	0.97	0.92	7.002	9.174	242.64	0.96	0.91	6.041	6.091	181.98
FYM (2) + Yeast (2)	0.98	0.94	6.906	9.058	239.46	0.94	0.91	6.203	6.380	188.75
LSD 5%	-	-	0.112	0.220	0.18	-	-	0.134	0.198	16.32

Table 3. Oil constituents of lemon grass plants as affected by farmyard manure and foliar application of bread yeast during 1999 season.

Compounds	Treatments									Total	Mean
	Cont.	FYM_1	FYM_2	Yeast (1)	Yeast (2)	$FYM_1 + Y_1$	$FYM_1 + Y_2$	$FYM_2 + Y_1$	$FYM_2 + Y_2$		
α-pinene	0.013	0.212	0.171	0.140	0.220	0.230	0.140	0.217	0.127	1.470	0.163
Myrcene	7.483	5.938	6.082	2.415	4.012	2.880	6.176	3.771	6.342	45.099	5.011
Limonine	0.098	0.918	2.034	1.112	0.190	1.027	1.062	1.014	1.111	8.566	0.952
1,8-Cineole	0.125	0.860	0.956	1.650	0.130	0.940	0.640	0.750	0.542	6.593	0.732
6-Methyl-5-hepten-2-one	0.198	1.147	1.683	0.320	0.412	0.897	0.866	0.849	0.547	6.919	0.769
Citronellal	11.652	7.816	4.783	6.225	6.816	6.906	4.127	5.838	4.220	58.383	6.487
Camphor	0.160	0.610	0.373	0.525	0.318	0.628	0.018	0.506	0.086	3.224	0.358
Linalool	0.204	0.680	0.631	0.618	0.416	0.489	0.507	0.216	0.516	4.277	0.475
Citral A (Geranial)	19.212	23.140	24.485	25.618	27.927	24.646	28.452	26.193	27.848	227.52	25.28
Citral B (Neral)	44.980	46.481	47.671	49.111	49.540	48.620	49.683	48.892	48.551	433.53	48.170
Geranyl actate	1.649	1.073	1.428	1.349	1.012	0.013	0.330	0.118	0.018	6.990	0.777
Citronellol	1.111	0.288	1.251	0.221	0.213	0.630	0.012	0.213	0.065	4.004	0.445
Nerol	1.120	0.180	0.110	0.080	0.022	0.288	0.182	0.320	0.320	2.622	0.291
Geraniol	1.415	0.753	0.722	0.224	0.672	0.712	0.612	0.540	0.187	5.837	0.649
Total	89.500	90.096	92.380	89.608	91.900	92.595	92.807	89.437	90.480	817.803	
Unidentified	10.500	9.904	7.620	10.392	8.100	7.405	7.193	10.563	9.520	8.197	

Table 4. Oil constituents of lemon grass plants as affected by farm yard manure and foliar application of bread yeast during 2000 season.

Compounds	Treatments									Total	Mean
	Cont.	FYM_1	FYM_2	Yeast (1)	Yeast (2)	$FYM_1 + Y_1$	$FYM_1 + Y_2$	$FYM_2 + Y_1$	$FYM_2 + Y_2$		
α-pinene	0.011	0.117	0.044	0.142	0.227	0.171	0.218	0.172	0.209	1.311	0.146
Myrcene	8.463	6.608	8.514	2.518	2.011	11.085	6.490	4.176	5.012	54.877	6.097
Limonine	0.110	0.713	0.974	1.002	0.082	0.261	0.177	1.034	0.237	4.590	1.148
1,8-Cineole	0.137	0.268	1.234	1.407	0.127	0.142	0.062	0.956	0.340	4.673	0.519
6-Methyl-5-hepten-2-one	0.098	1.404	0.109	0.650	0.204	0.097	0.067	0.683	0.110	3.422	0.38
Citronellal	10.886	6.696	8.533	5.349	4.696	6.906	5.980	4.783	4.123	57.952	6.487
Camphor	0.077	0.519	0.518	0.506	0.408	0.028	0.067	0.373	0.066	2.226	0.247
Linalool	0.141	0.683	0.621	0.516	0.507	0.089	1.031	0.631	0.080	4.299	0.478
Citral A (Geranial)	18.309	21.210	22.418	26.540	28.315	28.646	28.452	28.631	29.341	31.862	25.762
Citral B (Neral)	45.820	45.517	45.210	48.849	49.683	48.331	49.547	47.118	48.337	428.41	47.601
Geranyl actate	1.649	0.956	1.067	1.248	1.033	0.003	0.335	0.428	0.004	6.723	0.747
Citronellol	0.211	0.306	0.303	0.222	0.228	0.039	0.064	0.251	0.033	1.657	0.184
Nerol	0.023	0.186	0.094	0.012	0.018	0.319	0.004	0.039	0.218	0.913	0.101
Geraniol	0.489	0.781	0.668	0.316	0.510	0.048	0.078	0.699	0.045	3.634	0.404
Total	86.424	85.964	90.307	89.277	88.049	96.165	92.572	89.974	88.155	806.937	
Unidentified	13.576	14.036	9.693	10.723	11.951	7.835	1.428	12.026	11.845	93.113	

compounds. The same identification revealed that there was a decrement in other components content such as citronellal, citronellol and geranyl acetate. On the other hand, variable effects (ascendingly or descendingly) were noticed in the contents of some components such as myrcene or limonene.

It could be concluded that the effect of yeast may be attributed to its content of vitamins and minerals, and to their role in affecting the lemongrass oil. These findings coincide with the findings of **Gamal El-Din *et al* (1997); Tarraf *et al* (1999) and Refaat & Balbaa (2001)** on lemongrass.

Chlorophylls and total carotenoids contents

Chlorophylls a, b and their total and carotenoid content presented in Table (5) revealed that the fertilization treatments increased the content of these pigments in the herb of lemongrass plants. Similar trend of results were observed for total chlorophylls and total carotenoids. In most cases the combined treatments with 16 m3 / fed. (FYM_1) and 4 gm / lt. yeast ($Yeast_2$) gave the highest values of these pigments. These increments may be due to the enhancing effects of yeast on accumulation of carbohydrates and chlorophyll formation. Also, the increase in the release of carbon dioxide through fermentation process effectively stimulates photosynthesis and accelerates the biosynthesis of carbohydrates. **(Roberts, 1976 and Barnett *et al* 1990)**. These results came similar to those of **Ahmed (1998)** on marjoram, **Verma *et al* (1996)** on *Dalbergia sisso* and **Wange *et al* (1995)** tuberose.

Carbohydrate contents

Total carbohydrate percentages shown in Table (5) indicated that there were significant positive effect resulted from different treatments compared to control. These observation were parallel through the two cuts and during the two seasons. The accumulation of total carbohydrates was superior in the treatment of $16m^3$ FYM + 4 g / lt yeast followed by the treatment of $20m^3$FYM + 2 gm / lt yeast. These character attained a parallel trend to the chlorophyll contents as photosynthetic pigments are the manufacturer of carbohydrates in plants. Also the positive impact of FYM on lemongrass should be attributed to its superior and improved role to supply the growing plants with the required micro and macro-nutrient elements.

Nitrogen, Phosphorus and Potassium contents and uptake

Data presented in Table (6) show that all applied treatments had increased the content and uptake of N,P and K as compared with the control. The highest increment was obtained from the combination treatment of 16 m^3 FYM + 4 g / lt yeast while the lowest was obtained from the control. The relative percentages of increment for this treatment were (41.30, 40.16%) for nitrogen, (23.45, 26.03%) for phosphorus, while it was (77.31, 37.50%) for potassium in the first and second cut, respectively during the first season. While these percentages were (40.24, 41.88%), (15.76, 15.09, 09) and (44.19, 37.62%) for N, P and K in the first and second cut during the second seasons respectively. These findings may be attributed to the enhancement effects of

Table 5. Chlorophyll content, total carotenoids and total carbohydrates in lemongrass plants as affected by farm yard manure and foliar application of bread yeast during 1999 and 2000 seasons.

Character / Treatments	Chlorophyll content (mg/100 g fresh weight)						Total carotenoids mg/g		Total carbohydrates %	
	a	b	T	a	b	T	1st cut	2nd cut	1st cut	2nd cut
	First cut			Second cut						
First season										
Control	4.28	2.96	7.24	3.55	1.86	5.41	3.41	1.92	14.20	15.20
16 m^3/Fed FYM = (1)	4.75	3.80	8.05	3.67	1.93	5.70	3.59	1.68	16.47	18.27
20 m^3/Fed FYM = (2)	4.88	3.78	8.66	3.67	1.98	5.65	3.51	1.74	16.86	18.70
2 g / lt yeast = yeast (1)	4.90	3.68	8.58	3.56	1.96	5.52	3.66	1.73	16.84	17.11
4 g/lt yeast = Yeast (2)	4.92	3.73	8.65	3.54	1.90	4.84	3.6.2	1.66	17.33	19.22
FYM (1) + Yeast (1)	5.66	4.35	10.01	4.35	2.39	6.74	4.42	1.92	17.50	20.00
FYM (1) + Yeast (2)	5.88	4.40	10.28	4.39	2.61	7.00	4.81	2.02	18.66	20.50
FYM (2) + Yeast (1)	5.72	4.48	9.70	4.47	2.47	5.94	3.69	1.78	18.11	20.17
FYM (2) + Yeast (2)	5.79	4.40	10.19	4.42	2.61	7.03	4.68	2.00	18.47	19.30
Second season										
Control	4.28	2.96	7.24	3.55	1.96	5.51	3.51	1.92	16.50	17.81
16 m^3/Fed FYM = (1)	4.62	3.19	7.81	4.03	2.13	6.16	3.69	2.09	17.33	18.52
20 m^3/Fed FYM = (2)	4.67	3.20	7.87	3.90	2.17	6.17	3.75	1.58	17.56	18.76
2 g / lt yeast = yeast (1)	4.79	3.34	8.13	4.14	2.20	6.34	3.86	2.14	17067	18.88
4 g/lt yeast = Yeast (2)	4.89	3.41	8.70	4.30	2.39	6.69	4.35	2.05	17.93	19.16
FYM (1) + Yeast (1)	4.96	3.71	8.67	4.37	2.45	6.82	4.42	2.12	18.22	19.47
FYM (1) + Yeast (2)	5.38	3.90	9.28	4.64	2.68	7.32	4.81	2.26	18.67	20.33
FYM (2) + Yeast (1)	5.13	3.78	8.91	4.49	2.57	7.06	4.62	2.19	18.21	20.00
FYM (2) + Yeast (2)	5.15	3.79	8.94	4.46	2.59	7.05	4.68	2.20	18.67	20.00

Table 6. Macronutrients content and up take 3 / plant in lemongrass plants as affected by farm yard manure and foliar application of bread yeast treatments during 1999 and 2000 seasons.

First season

Characters	N%		P%		K%		N%		P%		K%	
Treatments	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Control	1.38	1.22	0.145	0.146	2.16	2.19	1.72	1.87	0.18	0.22	2.69	3.36
16 m^3/Fed FYM = (1)	1.48	1.30	0.162	0.162	3.41	2.35	2.56	2.80	0.28	0.34	5.91	5.06
20 m^3/Fed FYM = (2)	1.53	1.35	0.165	0.163	3.32	2.80	2.83	3.11	0.31	0.38	6.13	6.45
2 g / lt yeast = yeast (1)	1.59	1.41	0.165	0.166	3.31	2.60	2.51	2.76	0.26	0.33	5.22	5.10
4 g/lt yeast = Yeast (2)	1.63	1.44	0.167	0.167	3.38	2.67	2.77	3.03	0.28	0.35	5.74	5.63
FYM (1) + Yeast (1)	1.74	1.53	0.169	0.122	3.51	2.83	3.31	3.57	0.32	0.40	6.67	6.61
FYM (1) + Yeast (2)	1.95	1.71	0.179	0.184	3.83	3.00	4.17	4.42	0.38	0.48	8.19	7.75
FYM (2) + Yeast (1)	1.79	1.57	0.176	0.178	3.62	3.11	3.63	3.94	0.36	0.45	7.33	7.81
FYM (2) + Yeast (2)	1.93	1.69	1.690	0.184	3.60	2.81	3.82	4.00	0.33	0.44	7.12	6.65
						Second season						
Control	1.64	1.60	0.165	0.159	2.15	2.10	1.75	1.96	0.18	0.19	2.29	2.57
16 m^3/Fed FYM = (1)	1.75	1.71	0.173	0.164	2.89	2.99	2.12	2.15	0.21	0.21	3.50	3.76
20 m^3/Fed FYM = (2)	1.81	1.77	0.174	0.164	2.90	2.99	2.34	2.38	0.22	0.22	3.75	4.03
2 g / lt yeast = yeast (1)	1.88	1.84	0.178	0.192	2.69	2.85	2.52	2.57	0.24	0.24	3.61	3.98
4 g/lt yeast = Yeast (2)	1.92	1.88	0.181	0.179	2.65	2.90	2.81	2.86	0.26	0.27	3.88	4.42
FYM (1) + Yeast (1)	2.05	2.01	0.181	0.180	3.08	2.90	3.78	3.15	0.33	0.28	5.69	4.55
FYM (1) + Yeast (2)	2.30	2.27	0.191	0.183	3.11	2.98	3.96	4.07	0.33	0.33	5.35	5.34
FYM (2) + Yeast (1)	2.11	2.06	0.191	0.183	3.10	2.89	3.45	3.45	0.31	0.31	5.07	4.83
FYM (2) + Yeast (2)	2.27	2.23	0.189	0.180	3.10	2.89	3.89	3.91	0.32	0.32	5.32	5.07

both yeast and FYM on some metabolic activities in plants which lead to good accumulation of nutrients. These results are in accordance with those found by **Shadia *et al*** (1998) on *Hibiscus sabdariffa* and **Naguib and Khalil** (2002) on *Nigella sativa*.

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مجلة حوليات العلوم الزراعية ، كلية الزراعة ، جامعة عين شمس، القاهرة، م (٤٧)، ع (٣)، ٨٥٩-٨٧٣، ٢٠٠٢

تأثير التسميد بمخلفات المزرعة و الرش بخميرة الخبز على محصول و نوعية الزيت لنبات حشيشة الليمون (*Cymbopogon flexuosus* stapf) [٥٤]

نبيلة يحيى نجيب[١]

١- قسم زراعة وإنتاج النباتات الطبية و العطرية المركز القومى للبحوث – الدقى – الجيزة – مصر

أجريت تجربتان حقليتان فى مزرعة المركز القومى للبحوث بالجيزة فى الموسمين المتعاقبين ١٩٩٩ و ٢٠٠٠ لبيان تأثير التسميد بمخلفات المزرعة و الرش بخميرة الخبز منفردين أو مجتمعين على النمو الخضرى ، ومحصول الزيت ومكوناته لنبات حشيشة الليمون.

استخدمت ثلاث مستويات من السماد العضوى (مخلفات المزرعة) هى صفر، ١٦و ٣٢م^{٣} /للفدان. ومستويان من خميرة الخبز هما ٢ أو ٤ جم / لتر. بالإضافة إلى نباتات المقارنة. أدت كل المعاملات إلى تحسن كل الصفات المدروسة. أظهرت النتائج إرتفاع القيم الناتجة عن معاملات الرش بالخميرة عن الناتجة عن معاملات التسميد بمخلفات المزرعة. بينما أدت المعاملة المشتركة بينهما لأفضل النتائج إذا قورنت بالمعاملات الأخرى.

تم الحصول على أفضل النتائج من المعاملة ١٦م^{٣} / فدان من مخلفات المزرعة + ٤جم/ لتر من خميرة الخبز حيث نتج عنها أعلى قياسات لطول النباتات و أكثر عدد للخلفات. كما كانت هذة النباتات الأكثر فى كلا من الوزن الخضرى والجاف. كما أعطت أعلى كمية من الزيت الطيار للنبات ومحصول الزيت للفدان. كما أظهر التحليل الكروماتجرافى للزيت زيادة النسبة المئوية للمركبين ستزال أ وستزال ب. كما تأثر محتوى النبات من السكريات الكلية والصبغات(كلوروفيل أ, ب و الكاروتينات) والعناصر الكبرى مثل النتروجين والفسفور والبوتاسيوم إيجابيا و ذلك خلال الحشتين الأولى والثانية فى موسمى الزراعة المتعاقبين.

للحصول على أعلى محصول من الزيت ذو الجودة العالية يمكن التوصية بإضافة ١٦م^{٣} / فدان من مخلفات المزرعة للتربة قبل الزراعة بأسبوعين بالإضافة إلى رش النباتات بخميرة الخبز بتركيز ٤جم / لتر ثلاث مرات, الأولى بعد شهر من الزراعة, الرشة الثانية بعد الأولى بشهر بينما الرشة الثالثة تجرى بعد شهر من الحشة الأولى.

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