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GENETIC IMPROVEMENT FOR GROWTH AND OIL YIELD OF SELECTED GENOTYPES OF SOME BASIL SPECIES UNDER DIFFERENT TYPES OF ORGANIC FERTILIZATION

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ABSTRACT

A field experiment was conducted in South Tahrir, Behira Governorate, Egypt, to investigate the effect of different types of organic fertilization on ten quantitative characters among 15 basil genotypes belonging to three species of basil. Treatment types of organic fertilization were (0), (T1), (T2) and (T3). The genetic variation was observed to be high among genotypes and fertilizers for all studied characters in both generations. G.C.V% values were high for LG, LFW, HFW, HDW, EO% and EOY in two generations. Very high heritability values were recorded for SDW and EOY/plant. However, moderate heritability values were noted for SFW and HFW in both generations. As similar, the genetic advance was observed to be high for, LG, LFW and HFW; these results indicated the gene expression response for organic fertilization in selected genotypes of basil. Association analysis of studied characters revealed high significant positive correlation between essential oil yield with NPB, LFW, LDW, HDW, and EO%,. Regarding to the mean performance of different studied traits, superior genotypes were identified for direct or further use in breeding programs to improve basil species under organic fertilization.

Keywords: *Ocimum* species, genetic improvement, genetic parameters, oil yield, organic fertilization.

INTRODUCTION

Genus *Ocimum*, Fam. *Lamiaceae*, collectively called basil, has long been acclaimed for its diversity. *Ocimum* comprises more than 30 species of herbs and shrubs from the tropical and subtropical regions of Asia, Africa and South America, but the main center of diversity appears to be Africa (Paton, 1992). It is a source of essential oils and aroma compounds, a culinary herb and an attractive fragrant omamental (Morales *et al* , 1996).

Plant extractions are used in folk medicine, and have been shown to contain a biological activity as an insecticidal, nematicidal, fungestic and antimicrobial (Albuquerque, 1996).

Beside the volatile oils, basil contains alkaloids, flavonoides, glycosides, ascorbic acid and carotenes (Sammbamurty and Subrahamanyan, 2000). Medicinally, the plant is useful in a variety of human and animal diseases treatment such as: malaria, colic, vomiting, common cold, cough and skin diseases (Bhattacharjee, 1998).

The organic fertilization is a very important factor for providing plants with their nutritional requirements. Such agriculture methods are particularly interest and significantly important in the newly reclaimed sandy soil, where they not only help in increasing and stabilizing soil fertility, but also sustain and improve the chemical and physical characteristics of the soil (Kandeel *et al.*, 2002 & Maria Isabella and Barbieri, 2006).

The importance of basil is increasing and has undoubtedly a promising future in Egypt, especially, when cultivates in new reclaimed sandy soil (Abd El-Raouf, 2001).

Many investigators reported that adding organic manures as fertilizers led to stimulate biodegradation through increasing the population and the activity of micro-organisms in the soil (Parr, 1975).

The genetic improvement of any crop depends up on the existence of initial variability for rational genetic improvement through selection and hybridization of diverse genotypes (Ahmed and Khaliq, 2002). Considering genetic parameters important, estimates of GCV, PCV, h^2_b and correlation between different characters were determined among selected genotypes of different species of basil (Aboud *et al.*, 2004; and De Masi *et al.*, 2005).

In the present work, the principal aim is to investigate the genetic improvement of growth and oil yield of 15 genotypes of three species of basil under different organic fertilization treatment types, also to evaluate variability among selected genotypes using genetic parameters and relationships between oil yield as main product and the other characters.

MATERIALS AND METHODS

1- Layout of field experiments.

A field experiment was conducted in two successive seasons (2004 and 2005) using three basil species (*Ocimum basilicum, Ocimum citrates* (local market, Egypt) and *Ocimum gratissimum* (botanical garden, Aswan, Egypt). These species were grown under sandy soil conditions (Sand 95.3, Silt 5.3, Clay 6.3, pH 8.30, Organic matter 0.8%, N 92.2 ppm) at the experimental farm of South Tahrir, Behira Governorate.

Three studied species received different types of organic fertilization (Table a): 0, unfertilized (control), T1 (35 m^3 cattle manure/fad.), T2 (20 m^3 compost/fad.) and T3 (20 m^3 chickens manure/fad.). Fertilizers were applied before transplanting. Seeds of the all 15 genotypes for 3 studied species of basil were selected from the base population of the previous generations (2002 and 2003) for high yield in sandy soil under organic fertilization conditions. These 15 parents (1-15) seeds were sown in bed on 15[th] March and 35 days after. Planting seedlings were transplanted to the field in both generations. During the flowering stage, five plants of each replicate/entry of different generations, were harvested in two cuts during July and September in both generations by cutting the vegetative parts of the plants 15 cm a above the soil surface.

Table (a): Analytical data of organic manures

Report / manure	Moisture %	Elements			Organic		C / N ratio
		N	P	K	carbon %	matter %	
Cattle	6.21	1.61	0.73	2.42	26.38	45.85	19.5:1
Chicken	4.07	2.74	0.63	3.34	17.23	36.05	18.2:1
Compost	24.17	1.45	0.27	0,82	28.91	47.15	19.4:1

2- Plant records:

Plants records were considered on individual plant for:

1- Linear growth by cm (LG). 2- Number of primary branches (NPB).
3- Leaves fresh weight g/plant (LFW). 4- Leaves dry weight g/plant (LDW).
5- Stem fresh weight g/plant (SFW). 6- Stem dry weight g/plant (SDW).
7- Herb fresh weight g/plant (HFW). 8- Herb dry weight g/plant (HDW.
9- Essential oil % (EO %). 10- Essential oil yield g/plant (EOY).

3- Statistical procedures:

The experimental design was split plot with three replicates. General statistical procedures were practiced according to standard methods given by Steel and Torrie (1980).

The analysis of variance (ANOVA) and broad sense heritability (h^2_b) were generally assigned for the data of each season and each cut under control according to Robinson *et al.*, 1951.

The phenotypic coefficient of variability (P.C.V %) $\sigma_{p/x}$ x 100 and genotypic coefficient of variability (G.C.V %) $\delta_g/$ □ x 100 were computed according to Burton, 1952. The expected genetic advance from selection ΔG.A % was computed according to Johnson *et al.*, 1955.

4- Determination of essential oil content %.

The volatile oil percentage of plant dry herb at every cut was estimated according to **Guenther, 1961**. The essential oil content % was measured on basis of volume/weight x 100. Essential oil yield g/plant was computed from multiplication of leaves dry weight g/plant x essential oil %.

RESULTS

1- Analysis of variance and mean performance.

Analysis of variance for ten characters related to essential oil yield was shown in Tables 1 and 2. Highly significant variations were observed among all studied characters in genotypes, fertilizers and interaction, except LFW, SFW and HFW in both cuts and generations. Mean performance of investigated genotypes in both generations, are presented in Tables 3 and 4 under the three types of fertilizers T1, T2 and T3 with control. Genotypes 11, 12, 14 and 15 had the highest HFW values in both cuts and generations.

The highest HDW, EO % and EOY values were observed in genotypes no. 7, 8, 10, 11, 13, 14 and 15 in first and second cuts in both generations, using types T1, T2 and T3 of fertilizers. It is also observed that second cut had high values than the first cut in most characters. Comparing with control treatment, fertilizers type T2 and T3 gave high values of LG, NPB, LDW, SFW, HFW and HDW in both cuts in the first season. In the second season, treatment of fertilizer type F3 revealed the highest values of LG, LFW, and LDW in both cuts while, NPB was high only in the first cut. Oil yield showed high values with T2 and T3 in both generations comparing with control (Tables 3 and 4).

2- Genetic parameters of variation:

Means, range, mean square, phenotypic and genotypic coefficient of variability, broad sense heritability % and genetic advance % for all studied characters in both cuts and generations are given in Tables 5 and 6.

The mean values of HDW were (62.83 ± 1.43) and (76.42 ± 1.37) for first and second cuts respectively. Ranges were wide in all studied characters in both cuts and generations. Mean values were high and ranges were wide in the second cuts more than the first cut in both generations. Mean squares of ten studied characters for 15 genotypes of two cuts and generations indicated significant differences. The significant variation among different species revealed considerable levels of genetic variability in studied characters beside quantitative variation for herb dry weight and oil yield.

Variability studies revealed that phenotypic coefficient of variation (P.C.V %) values were higher than genotypic coefficient of variation. In first season, (G.C.V %) values ranged from 2.148 (SFW) to 15.028 (EOY) and 2.691 (SFW) to 15.50 (SDW) in first and second cut respectively.

In the second season, (G.C.V %) ranged from 3.624 (SFW) to 21.171 (EOY) and 3.59 (SFW) to 17.58 (SDW) in first and second cut respectively. P.C.V and G.C.V were found to be higher in EO %, EOY and SDW in both generations, indicating the presence of high level of genetic variability for studied characters.

Heritability values for all characters were high to moderate in both generations. From the study of heritability in first and second cut in both generations, it is concluded that heritability estimates were high for (LG, LDW, HDW, EO and EOY) and (SDW, HDW, EO, and EOY) in first and second cut respectively in the first generation. Similar results were observed in the second generation too. Characters LFW, SFW and HFW had a moderate heritability values in the second cut in both generations (Tables 5 and 6).

In the present investigation, it was interesting to note a high genetic advance for , LG, LFW, HFW and HDW traits in both seasons.

3- Correlation between characters.

Phenotypic and genotypic correlation coefficients between all possible pairs of studied characters in two cuts in both generations are presented in Tables 7 and 8. Results demonstrated that genotypic correlation coefficient estimates were higher than their corresponding phenotypic estimates.

In the first generation, phenotypic correlation coefficient among EOY and other nine attributes which are presented in Table 7. Results of the first cut showed that EOY trait had highly significant and positive correlation with HDW only, while in the second cut, it had highly significant and positive correlation with NPB, LFW, LDW, SDW, HFW, HDW and EO % at phenotypic and genotypic correlations. Also, there was highly significant and positive correlation between LG with SFW, SDW, HFW and HDW in genotypic coefficients level. Data was showed also, highly significant positive correlation between EOY and all characters except LG and SFW traits. It was also observed highly significant and negative correlation between NPB with SFW.

Table (1): Mean square of ten quantitative studied characters in two cuts in the first generation (2004) of basil genotypes under organic fertilization treatments.

Source of Variation	d. f.	Linear growth (cm) (LG)		No. of primary branches (NPB)		Leaves fresh weight g/plant (LFW)		Leaves dry weight g/plant (LDW)		Stem fresh weight g/plant (SFW)	
		1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Replicates	2	47.421	49.875	1.046	1.804	223.933	268.950	6.234	12.372	118.842	147.917
Fertilizers (a)	3	594.088**	55.398**	9.517**	9.430**	837.467**	924.663**	138.128**	77.115**	165.569**	102.285**
Error (a)	6	1.223	1.123	0.026	0.038	4.467	4.513	0.122	0.232	2.460	3.124
Genotypes (b)	14	532.330**	703.827**	2.305**	7.606**	846.048**	448.821**	51.121**	46.730**	96.077**	194.298**
a x b	42	6.029*	6.817*	0.435**	0.594**	8.054	32.588*	2.858**	2.463**	3.745	6.718
Error (b)	112	3.575	4.029	0.079	0.140	16.946	19.481	0.477	0.873	8.875	11.350
L.S.D at 0.05		0.570	0.547	0.083	0.101	1.090	1.096	0.180	0.248	0.809	0.912
at 0.01		0.864	0.828	0.125	0.153	1.652	1.660	0.273	0.376	1.226	1.381

Source of Variation	d. f.	Stem dry weight g/plant (SDW)		Herb fresh weight g/plant (HFW)		Herb dry weight g/plant (HDW)		Essential oil % (EO %)		Essential oil yield g/plant (EOY)	
		1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Replicates	2	5.163	4.137	1290.067	1618.400	32.388	46.596	0.054	0.044	0.024	0.029
Fertilizers (a)	3	86.757**	6.311**	2117.052**	1664.889**	423.918**	261.701**	0.315**	0.100**	0.843**	0.392
Error (a)	6	0.159	0.082	18.096	30.844	0.730	0.772	0.001	0.001	0.001	0.001
Genotypes (b)	14	179.441**	43.604**	5379.190**	3522.857**	345.658**	242.241**	1.239**	0.695**	0.728**	0.671**
a x b	42	2.368**	0.154	41.163	22.603	8.180**	7.559**	0.009**	0.008**	0.010**	0.011**
Error (b)	112	0.392	0.304	96.202	118.733	2.419	3.355	0.004	0.003	0.002	0.002
L.S.D at 0.05		0.206	0.148	2.195	2.865	0.441	0.453	0.016	0.012	0.014	0.012
at 0.01		0.312	0.224	3.324	4.340	0.668	0.687	0.024	0.019	0.021	0.018

*, ** Significant at 5% and 1% levels.

Table (2). Mean square of ten quantitative studied characters in two cuts in the second generation (2005) of basil genotypes under organic fertilization treatments.

Source of Variation	d.f.	Linear growth (cm) (LG)		No. of primary branches (NPB)		Leaves fresh weight g/plant (LFW)		Leaves dry weight g/plant (LDW)		Stems fresh weight g/plant (SFW)	
		1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Replicates	2	52.604	54.362	1.046	1.787	225.633	258.117	8.347	13.336	123.867	149.942
Fertilizers (a)	3	228.506**	90.894**	23.486**	6.226**	386.867**	116.137**	104.995**	54.235**	168.741**	344.169**
Error (a)	6	1.013	0.953	0.018	0.032	4.611	3.354	0.183	0.105	2.074	2.894
Genotypes (b)	14	465.801**	560.557**	5.753**	13.650**	957.643**	556.417**	155.238**	112.307**	403.976**	280.458**
a x b	42	8.305**	9.218**	1.810**	0.717**	4.319	12.879	6.740**	4.439**	14.193**	11.028
Error (b)	112	3.861	4.276	0.074	0.139	17.483	18.977	0.595	0.919	9.248	11.368
L.S.D at 0.05		0.619	0.504	0.069	0.093	1.108	0.945	0.221	0.167	0.743	0.878
at 0.01		0.787	0.763	0.105	0.141	1.678	1.431	0.335	0.253	1.125	1.329

Source of Variation	d.f.	Stems dry weight g/plant (SDW)		Herb fresh weight g/plant (HFW)		Herb dry weight g/plant (HDW)		Essential oil % (EO %)		Essential oil yield g/plant (EOY)	
		1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Replicates	2	7.041	5.728	1346.533	1673.333	36.271	43.017	0.047	0.046	0.025	0.033
Fertilizers (a)	3	179.568**	78.583**	1541.007**	1209.422**	411.321**	102.130**	0.100**	0.075**	0.586**	2.734**
Error (a)	6	0.216	0.146	25.585	29.600	0.806	0.580	0.001	0.001	0.001	0.001
Genotypes (b)	14	280.952**	113.390**	5304.476**	3768.00**	491.860**	311.667**	1.643**	0.890**	1.654**	2.171**
a x b	42	4.507**	6.377**	57.039	45.105	5.723**	42.203**	0.008**	0.006**	0.013**	1.752**
Error (b)	112	0.509	0.411	100.287	123.438	2.630	3.243	0.003	0.003	0.002	0.003
L.S.D at 0.05		0.240	0.197	2.609	2.807	0.463	0.393	0.014	0.015	0.014	0.020
at 0.01		0.363	0.299	3.953	4.252	0.702	0.595	0.021	0.023	0.021	0.030

*, ** Significant at 5% and 1% levels.

Table (3). Mean (□), Range (R), of all studied traits in two cuts in the first generation (2004) of basil genotypes under organic fertilization treatments.

Characters	Cuts	Control		Organic fertilization treatments					
				T1		T2		T3	
		Mean □±S.E	Range R	Mean □±S.E	Range R	Mean □±S.E	Range R	Mean □±S.E	Range R
LG	I	76.82±1.96	65.70 – 86.2	80.96 ± 1.83	67.8 – 88.4	83.05 ± 1.76	71.7 – 91.6	85.38 ± 1.71	74.8 – 94.8
	II	83.92±1.98	70.14 – 95.16	85.47 ± 1.95	72.16 – 95.20	86.53 ± 1.94	72.5 – 97.7	87.01 ± 1.94	73.4 – 98.12
NPB	I	11.47±0.176	10.30 – 12.4	12.23 ± 0.15	11.4 – 13.6	12.36 ± 0.136	11.2 – 13.0	12.55 ± 0.113	11.8 – 13.3
	II	15.49±0.225	13.20 – 17.2	15.99 ± 0.17	14.6 – 17.3	16.50 ± 0.239	15.0 – 18.3	16.41 ± 0.228	14.4 – 17.5
LFW	I	172.19±2.04	158.3 – 184.3	176.33 ± 2.23	159.3 – 188.7	180.47 ± 2.26	162.4 – 193.2	181.69 ± 2.26	165.5 – 192.4
	II	185.86±1.67	173.7 – 193.8	190.05 ± 1.48	176.8 – 198.6	192.31 ± 1.51	178.2 – 198.1	196.73 ± 2.21	183.4 – 212.7
LDW	I	27.40±0.525	24.62 – 31.16	29.24 ± 0.585	26.24 – 34.22	30.90 ± 0.588	25.36 – 33.72	31.21 ± 0.602	26.24 – 34.66
	II	39.05±0.539	35.14 – 41.17	40.23 ± 0.534	47.14 – 42.60	40.84 ± 0.459	37.16 – 43.15	42.18 ± 0.649	38.18 – 46.73
SFW	I	126.28±0.838	120.5 – 132.4	128.68 ± 0.838	121.2 – 133.8	130.09 ± 0.613	125.1 – 133.9	130.57 ± 0.779	124.5 – 135.2
	II	143.4 ± 1.12	136.3 – 151.3	145.37 ± 1.11	138.2 – 153.2	145.64 ± 0.986	138.2 – 151.2	143.06 ± 1.13	139.2 – 154.2
SDW	I	23.38 ± 0.478	20.8 – 27.13	23.63 ± 0.523	20.12 – 27.75	24.02 ± 0.493	21.30 – 28.12	24.21 ± 0.483	21.45 – 28.42
	II	24.31 ± 0.929	20.12 – 31.16	26.63 ± 1.08	20.82 – 32.14	27.48 ± 1.00	21.55 – 32.62	28.20 ± 0.982	21.55 – 32.78
HFW	I	414.28 ± 5.99	368.94 – 449.8	421.99 ± 5.52	391.17 – 455.65	427.02 ± 5.25	397.15 – 460.2	429.78 ± 5.32	399.94 – 460.72
	II	463.86 ± 4.29	438.2 – 503.4	470.49 ± 4.55	445.6 – 515.7	476.24 ± 4.60	448.3 – 522.4	476.97 ± 4.41	453.4 – 518.3
HDW	I	62.83 ± 1.43	55.67 – 74.15	66.95 ± 1.52	57.35 – 78.84	68.85 ± 1.40	60.17 – 79.38	69.73 ± 1.38	60.8 – 79.85
	II	76.42 ± 1.37	68.4 – 86.3	78.40 ± 1.26	70.2 – 86.5	80.69 ± 1.16	71.6 – 86.88	81.83 ± 1.05	74.8 – 87.2
E. oil %	I	2.6 ± 0.083	2.0 – 3.20	2.69 ± 0.081	2.10 – 3.30	2.73 ± 0.086	2.20 – 3.40	2.80 ± 0.085	2.20 – 3.30
	II	2.35 ± 0.068	1.80 – 2.80	2.42 ± 0.063	1.90 – 2.80	2.45 ± 0.062	1.90 – 2.80	2.45 ± 0.060	1.90 – 2.80
E. oil yield g/plant	I	1.63 ± 0.063	1.28 – 2.15	1.80 ± 0.066	1.43 – 2.29	1.88 ± 0.067	1.50 – 2.38	1.95 ± 0.063	1.59 – 2.40
	II	1.80 ± 0.066	1.36 – 2.36	1.90 ± 0.063	1.49 – 2.32	1.98 ± 0.058	1.54 – 2.30	2.01 ± 0.061	1.48 – 2.33

T1 = 35 m^3 cattle manure/fad. T2 = 20 m^3 compost/fad. T3 = 20 m^3 chickens manure/fad.

Table (4). Mean (□), Range (R), of all studied traits in two cuts in the second generation (2005) of basil genotypes under organic fertilization treatments.

Characters	Cuts	Control		Organic fertilization treatments					
				T1		T2		T3	
		Mean □±S.E	Range R	Mean □±S.E	Range R	Mean □±S.E	Range R	Mean □±S.E	Range R
LG	I	81.93 ± 1.83	69.8 – 92.4	84.81 ± 1.66	72.8 – 93.4	85.55 ± 1.56	75.3 – 96.3	87.35 ± 1.55	76.2 – 97.8
	II	86.81 ± 1.89	72.16 – 96.18	88.65 ± 1.89	74.3 – 98.22	89.27 ± 1.65	77.14 – 97.14	90.16 ± 1.57	78.88 – 98.8
NPB	I	10.76 ± 0.272	8.7 – 12.3	11.85 ± 0.254	10.2 – 13.6	12.26 ± 0.229	10.8 – 14.2	12.32 ± 0.240	10.3 – 13.8
	II	15.54 ± 0.321	13.8 – 17.8	15.91 ± 0.304	14.25 – 18.24	16.32 ± 0.261	14.8 – 17.9	16.31 ± 0.295	15.2 – 17.9
LFW	I	176.09 ± 2.31	158.3 – 188.6	179.41 ± 2.37	160.7 – 191.2	181.9 ± 2.36	164.2 – 195.4	182.57 ± 2.25	166.7 – 194.2
	II	186.33 ± 1.94	171.2 – 197.4	187.94 ± 1.74	178.14 – 195.22	188.54 ± 1.69	178.2 – 201.2	190.19 ± 1.89	180.12 – 204.8
LDW	I	31.09 ± 0.799	26.14 – 36.12	33.54 ± 0.928	28.18 – 39.12	34.25 ± 1.22	28.14 – 42.16	34.38 ± 0.953	29.14 – 40.15
	II	40.0 ± 0.876	32.17 – 45.14	41.68 ± 0.903	34.24 – 47.12	41.83 ± 0.805	34.13 – 47.28	42.62 ± 0.749	37.18 – 47.33
SFW	I	128.52 ± 1.29	118.16 – 138.16	131.74 ± 1.55	122.13 – 143.61	132.19 ± 1.72	125.14 – 146.7	132.89 ± 1.70	124.18 – 145.22
	II	142.01 ± 1.41	132.4 – 153.2	145.0 ± 1.44	134.12 – 155.2	146.71 ± 1.16	136.2 – 151.16	148.49 ± 1.25	138.14 – 158.3
SDW	I	25.84 ± 0.752	22.14 – 32.14	27.83 ± 0.957	22.18 – 35.22	28.18 ± 0.731	23.14 – 32.15	28.93 ± 0.964	24.18 – 35.12
	II	27.86 ± 1.27	18.26 – 36.14	30.53 ± 1.33	21.22 – 40.13	32.10 ± 1.25	23.65 – 39.13	32.11 ± 1.27	23.18 – 41.12
HFW	I	424.79 ± 5.88	371.8 – 455.7	431.99 ± 5.16	382.2 – 455.2	437.49 ± 5.26	487.2 – 460.9	436.95 ± 5.74	385.2 – 460.7
	II	473.84 ± 4.58	445.14 – 515.2	480.32 ± 4.53	452.2 – 520.3	482.62 ± 4.43	455.5 – 525.14	486.15 ± 5.06	453.16 – 523.17
HDW	I	65.92 ± 1.72	53.14 – 78.13	69.78 ± 1.67	59.72 – 83.83	72.39 ± 1.69	60.84 – 87.12	72.24 ± 1.64	62.57 – 84.68
	II	75.53 ± 1.22	69.85 – 85.92	77.31 ± 1.11	72.14 – 85.83	79.16 ± 1.09	72.8 – 86.75	79.62 ± 1.11	73.17 – 86.81
E. oil %	I	2.45 ± 0.096	1.9 – 3.0	2.54 ± 0.099	1.9 – 3.2	2.55 ± 0.091	2.0 – 3.1	2.55 ± 0.099	2.0 – 3.2
	II	2.39 ± 0.064	1.9 – 2.8	2.43 ± 0.067	1.9 – 2.9	2.41 ± 0.089	1.9 – 2.9	2.41 ± 0.069	1.9 – 2.8
E. oil yield g/plant	I	1.67 ± 0.092	1.22 – 2.29	1.83 ± 0.100	1.28 – 2.52	1.91 ± 0.090	1.39 – 2.45	1.92 ± 0.104	1.4 – 2.56
	II	1.84 ± 0.065	1.36 – 2.23	1.91 ± 0.067	1.37 – 2.28	1.99 ± 0.061	1.5 – 2.37	2.06 ± 0.084	1.39 – 2.78

T1 = 35 m^3 cattle manure/fad. T2 = 20 m^3 compost/fad. T3 = 20 m^3 chickens manure/fad.

generation, phenotypi
August, 2006

indicated highly significant
oil yield and other
SFW, HDW and

In second generation, phenotypic correlation coefficients among essential oil yield and other attributes are presented in Table 8. Results indicated highly significant and positive correlation between EOY with LDW, SFW, HDW and EO % at both phenotypic and genotypic correlations. On the other hand, it was observed low and negative correlation values between NPB with LG, LFW, LDW, SDW, HFW and HDW.

4- Promising cultivars and correlations.

Genetic divergences in 15 genotypes of different sources were grouped into three clusters. Cluster pattern explained the direct association of fertilizers types with oil and herb yield (Table 9). The highest values of herb fresh and dry weight, oil content % and oil yield under treatment of fertilizers types T1, T2, T3 and 0 (control) are presented in Table 9. Results indicated that, genotypes no. (2 and 4) in group I, (8 and 10) in group II and (14 and 15) in group III had the highest values in herb fresh and dry weight and oil yield in both generations.

DISCUSSION

The pooled analysis of variance and treatment mean squares were significant for all studied traits, suggesting the presence of wide variation among genotypes and organic fertilizers types. Variability was higher for all traits indicating that these traits were governed by additive gene effect with low environmental effect. These results are in accordance with the finding of Szabo *et al.*, 1997; Dhar, 2002.

From GCV and PCV estimates, exhibited magnitudinally higher values than other characters in both generations Singh *et al.*, 1998, also reported the similar results, high magnitude of genetic variance which suggested the presence of high genetic variability of selected genotypes of basil. These results are in agreement with the results of Seidkr-Ozykowska and Kazmierczak 2001; Blank *et al.*, 2004. The proportion of variation, which is heritable, was not sufficient to determine the GCV alone. This could be done with the help of heritability estimates and genetic advance.

Broad sense heritability estimates were seemed to be a satisfactory tool for selection based on phenotypic performance of basil genotypes. In the present study, heritability estimates were ranged from high to moderate for studied characters. High heritability values of LG, SDW, HDW, Oil %, and Oil yield suggested that, selection for these traits under different organic fertilization types may would be more effective.

The data of selected genotypes mean performance under organic fertilization indicated that, the mean values in genotypes 2, 4, 8, 10, 14 and 15 had the maximum values of growth and oil yield under F3 fertilizer type treatment. The differences of results may be attributed to the differences of fertilizers types in genetic materials and environmental conditions. This finding had analogy with studies already reported by Maria Isabella and Barbieri, 2006; Singh *et al.*, 1998 suggested that, traits with high heritability coupled with high expected genetic advance may be response better selection. High heritability coupled with high genetic advance values for traits LG, LFW, HFW, and HDW it is inferred that, simple selection among basil

Table (5). Mean ($\bar{x}$±S.E), range R, mean square M.S, phenotypic coefficient of variation P.C.V%, genotypic coefficient of variation G.C.V%, broad sense heritability h^2_b % and expected genetic advance GA%, for ten quantitative characters in two cuts of basil genotypes in the first generation (2004) under control treatment.

Characters	Cuts	Mean $\bar{x}$±S.E	Range R	Mean Square M. S	Coefficient of variation C.V%	Phenotypic of variation P.C.V%	Genotypic of variation G.C.V%	Heritability h^2_b %	Genetic advance G.A%
LG	I	76.82 ± 1.69	65.70- 86.20	128.972	8.53	8.764	8.418	0.923	17.74
	II	83.92 ± 1.98	70.14- 95.16	214.038	9.14	10.264	9.964	0.942	23.31
NPB	I	11.5 ± 0.163	10.60- 12.50	1.193	5.48	5.833	5.304	0.826	1.54
	II	15.49 ± 0.225	13.20- 17.20	2.924	6.37	6.675	6.216	0.868	2.53
LFW	I	172.19 ± 2.04	158.30- 184.30	188.006	4.60	5.00	4.378	0.764	18.03
	II	185.86 ± 1.67	173.72- 193.80	125.387	3.48	3.998	3.187	0.635	12.44
LDW	I	27.40 ± 0.525	25.93- 32.72	12.386	8.40	7.682	7.281	0.899	5.37
	II	39.03 ± 0.532	35.14- 41.17	12.751	6.28	5.405	5.092	0.887	4.99
SFW	I	126.29 ± 0.836	123.15- 132.87	31.491	6.56	3.243	2.148	0.439	4.44
	II	143.39 ± 1.120	136.33- 151.33	56.841	5.35	3.627	2.691	0.551	7.35
SDW	I	23.38 ± 0.492	21.35- 27.75	10.302	7.95	8.172	7.805	0.911	4.96
	II	24.97 ± 1.00	20.12- 31.16	45.339	15.57	15.701	15.505	0.975	11.07
HFW	I	414.28 ± 5.99	368.94- 449.80	1618.119	5.61	5.948	5.427	0.833	57.21
	II	463.86 ± 4.29	438.20- 503.40	828.571	4.58	4.095	3.297	0.648	32.56
HDW	I	62.83 ± 1.43	55.67- 74.15	92.645	8.85	9.068	8.731	0.927	15.10
	II	76.42 ± 1.37	68.40- 86.30	84.107	6.95	7.208	6.785	0.886	13.81
E. oil content %	I	2.60 ± 0.083	2.00- 3.20	0.313	12.45	12.581	12.344	0.961	0.907
	II	2.35 ± 0.068	1.80- 2.80	0.205	11.11	11.259	11.015	0.953	0.729
E. oil yield g/plant	I	1.63 ± 0.063	1.28- 2.15	0.181	15.04	15.276	15.028	0.975	0.699
	II	1.80 ± 0.066	1.36- 2.07	0.199	14.30	14.487	14.272	0.970	0.729

Table (6). Mean ($\bar{x}$±S.E), range (R), mean square (M.S), phenotypic coefficient of variation (P.C.V%), genotypic coefficient of variation (G.C.V%), broad sense heritability (h^2_b %) and expected genetic advance (GA%), for ten quantitative characters in two cuts of basil genotypes in the second generation (2005) under control treatment.

Characters	Cuts	Mean $\bar{x}$±S.E	Range R	Mean Square M. S	Coefficient of variation C.V%	Phenotypic of variation P.C.V%	Genotypic of variation G.C.V%	Heritability h^2_b %	Genetic advance G.A%
LG	I	81.93 ± 1.83	69.80 – 92.40	150.100	8.63	8.857	8.519	0.925	19.19
	II	86.81 ± 1.89	72.16 – 96.18	161.311	8.45	8.679	8.328	0.921	19.81
NPB	I	10.76 ± 0.272	8.70 – 12.20	3.344	11.18	10.014	9.712	0.941	2.91
	II	15.54 ± 10.76	13.80 – 17.80	4.646	8.00	8.253	7.881	0.912	3.33
LFW	I	176.09 ± 2.31	158.30 – 188.60	240.988	5.09	5.463	4.893	0.802	21.34
	II	186.32 ± 1.94	171.30 – 197.40	170.205	4.40	4.498	3.794	0.712	16.07
LDW	I	31.09 ± 0.799	26.14 – 36.12	28.713	9.95	10.146	9.851	0.942	8.54
	II	40.01 ± 0.876	32.17 – 45.14	34.539	8.48	3.705	8.368	0.924	9.20
SFW	I	128.52 ± 1.29	118.16 – 138.16	74.833	5.86	4.363	3.624	0.690	10.36
	II	141.98 ± 1.41	132.14 – 153.20	90.06	3.85	4.340	3.593	0.685	11.29
SDW	I	25.84 ± 0.752	22.14 – 32.14	25.426	11.27	11.441	11.176	0.955	8.13
	II	27.86 ± 1.270	18.24 – 36.14	72.430	17.63	17.752	17.577	0.980	14.06
HFW	I	424.77 ± 5.88	371.80 – 455.66	1556.214	7.36	5.717	5.175	0.819	55.29
	II	473.82 ± 4.58	453.14 – 515.17	943 50	3.74	4.234	3.471	0.672	35.91
HDW	I	65.92 ± 1.72	53.14 – 78.13	132.921	10.97	10.294	9.998	0.943	13.39
	II	75.53 ± 1.22	69.85 – 85.92	67.190	18.89	6 571	6.108	0.864	12.06
E. oil %	I	2.45 ± 0.096	1.9 – 2.90	0.411	15.08	15.272	15.052	0.974	1.05
	II	2.43 ± 0.069	1.9 – 2.80	0.216	11.06	11.270	10.965	0.952	0.748
E. oil yield g/plant	I	1.67 ± 0.092	1.22 – 2.29	0.378	21.24	21.340	21.171	0.986	1.02
	II	1.84 ± 0.065	1.36 – 2.23	0.191	13.75	13.856	13.641	0.969	0.715

Table (7). Phenotypic (above diagonal), genotypic (below diagonal), correlation coefficients among all studied traits of basil genotypes in two cuts in first generation (2004).

Characters	Linear growth cm/plant (x_1)	Number of primary branches (X_2)	Leaves fresh weight g/plant (x_3)	Leaves dry weight g/plant (x_4)	Stems fresh weight g/plant (x_5)	Stems dry weight g/plant (x_6)	Herb fresh weight g/plant (x_7)	Herb dry weight g/plant (x_8)	Essential oil % (x_9)	Essential oil yield g/plant (x_{10})
					First cut					
x_1		-0.437	0.085	-0.006	0.708**	0.703**	0.848**	0.744**	-0.208	0.252
x_2	-0.632*		0.064	0.106	-0.152	-0.317	-0.354	-0.306	-0.455	0.134
x_3	-0.060	-0.173		0.898**	0.257	0.270	0.513	0.437	0.256	0.410
x_4	-0.104	-0.030	0.898**		0.200	0.327	0.376	0.493	0.267	0.471
x_5	0.786**	-0.769**	-0.184	-0.060		0.752**	0.744**	0.744**	-0.116	0.256
x_6	0.695**	-0.425	0.225	0.296	0.970**		0.788**	0.939**	-0.061	0.495
x_7	0.837**	-0.631	0.395	0.285	0.725**	0.803**		0.860**	-0.083	0.400
x_8	0.724**	-0.477	0.364	0.447	0.850**	0.943**	0.853**		0.001	0.574*
x_9	-0.278	0.419	0.188	0.220	-0.404	-0.094	-0.182	0.055		0.806**
x_{10}	0.220	0.076	0.386	0.450	0.212	0.483	-0.373	0.559*	0.801**	
					Second cut					
x_1		0.150	0.013	0.023	0.654**	0.677**	0.582**	0.501	-0.153	0.125
x_2	0.070		0.206	0.229	0.356	0.348	0.297	0.308	0.727**	0.690**
x_3	-0.169	-0.018		0.909**	0.313	0.304	0.463	0.359	0.530*	0.517*
x_4	-0.091	0.087	0.903**		0.268	0.304	0.366	0.331	0.660**	0.630**
x_5	0.685**	0.163	-0.155	-0.029		0.629*	0.654**	0.456	0.091	0.234
x_6	0.653**	0.270	0.163	0.205	0.606*		0.841**	0.849**	0.193	0.555*
x_7	0.563*	0.109	0.163	0.154	0.430	0.865**		0.943**	0.175	0.554*
x_8	0.460	0.212	0.208	0.220	0.330	0.833**	0.980**		0.233	0.662**
x_9	-0.215	0.713**	0.514	0.644**	-0.073	0.138	0.060	0.175		0.870**
x_{10}	0.088	0.684**	0.527*	0.625**	0.164	0.536*	0.571*	0.652**	0.866	

*, ** Significant at 5% and 1% levels.

Table (8). Phenotypic (above diagonal), genotypic (below diagonal), correlation coefficients among all studied traits of basil genotypes in two cuts in second generation (2005).

Characters	Linear growth cm/plant (x_1)	Number of primary branches (X_2)	Leaves fresh weight g/plant (x_3)	Leaves dry weight g/plant (x_4)	Stems fresh weight g/plant (x_5)	Stems dry weight g/plant (x_6)	Herb fresh weight g/plant (x_7)	Herb dry weight g/plant (x_8)	Essential oil % (x_9)	Essential oil yield g/plant (x_{10})
First cut										
x_1		-0.383	-0.248	-0.076	0.625**	0.456	0.695**	0.582*	-0.246	-0.150
x_2	-0.480		0.094	0.291	-0.102	-0.307	-0.306	-0.260	0.462	0.306
x_3	-0.428	-0.015		0.574*	-0.019	0.014	0.298	0.210	0.489	0.494
x_4	-0.151	0.248	0.538*		0.093	-0.091	0.344	0.318	0.421	0.591*
x_5	0.592*	-0.293	-0.357	-0.050		0.655**	0.699	0.774**	0.327	0.455
x_6	0.439	-0.355	-0.053	-0.129	0.703**		0.578*	0.746	0.379	0.437
x_7	0.665**	-0.465	0.134	0.276	0.616**	0.579*		0.807**	0.220	0.443
x_8	0.553*	-0.337	0.120	0.277	0.796**	0.741**	0.803**		0.327	0.585*
x_9	-0.305	0.442	0.472	0.399	0.290	0.365	0.170	0.302		0.874**
x_{10}	-0.190	0.288	0.497	0.584*	0.473	0.428	0.438	0.578*	0.872**	
Second cut										
x_1		0.256	0.540*	0.452	0.557*	0.538*	0.735**	0.726**	0.162	0.190
x_2	0.188		0.069	-0.032	0.612**	0.004	0.149	0.156	0.396	0.356
x_3	0.481	-0.112		0.720**	0.354	0.354	0.603*	0.612*	0.069	0.282
x_4	0.206	-0.123	0.706**		0.164	0.427	0.598*	0.663**	-0.098	0.215
x_5	0.503	0.564*	0.076	0.012		0.486	0.529*	0.583*	0.435	0.566*
x_6	0.511	-0.062	0.292	0.392	0.454		0.748**	0.799**	0.127	0.471
x_7	0.730**	-0.026	0.427	0.560*	0.306	0.783**		0.914**	0.180	0.519*
x_8	0.698**	0.052	0.528*	0.629*	0.490	0.794**	0.922**		0.258	0.648**
x_9	-0.237	0.356	-0.058	-0.168	0.388	0.085	0.070	0.196		0.891**
x_{10}	0.149	0.324	0.227	0.176	0.575*	0.451	0.520*	0.637**	0.887**	

*, ** Significant at 5% and 1% levels.

Table (9). Most important selected genotypes of basil, based on its herb and oil yield criteria under different fertilizers treatments types (0, T1, T2 and T3) in two generations (2004 and 2005).

Species	Genotypes	Cuts	Yield															
			Herb weight								Essential Oil (EO)							
			Fresh				Dry				%				g/plant			
			Control (0)	T1	T2	T3	Control (0)	T1	T2	T3	Control (0)	T1	T2	T3	Control (0)	T1	T2	T3
I	2	I	415.60	420.80	430.11	428.5	59.96	70.13	63.63	65.73	2.9	2.9	3.0	3.0	1.74	2.03	1.91	1.93
		II	473.50	482.60	485.8	488.5	80.2	82.4	83.6	83.8	2.3	2.3	2.3	2.3	1.84	1.9	1.92	1.97
	4	I	420.88	426.15	428.58	437.15	63.79	68.13	72.12	72.4	2.0	2.1	2.2	2.2	1.28	1.43	1.5	1.48
		II	458.7	463.4	476.8	469.6	75.3	78.2	81.11	78.13	1.8	1.9	1.9	1.9	1.36	1.49	1.54	1.59
II	8	I	394.5	400.24	411.66	408.8	60.33	63.25	67.75	64.28	3.2	3.3	3.3	3.3	1.88	1.92	2.3	1.98
		II	455.6	458.2	466.7	464.3	75.3	76.8	77.4	76.2	2.5	2.5	2.6	2.6	1.93	2.09	2.01	2.12
	10	I	395.22	404.9	413.84	415.15	57.7	61.13	63.68	66.18	2.8	2.9	3.0	3.1	1.62	1.77	1.91	2.02
		II	438.2	445.7	448.3	453.4	68.4	70.2	71.6	74.8	2.7	2.8	2.8	2.7	1.85	1.97	2.0	2.05
III	14	I	441.88	452.81	460.22	460.72	74.15	78.84	79.38	79.85	2.9	2.9	3.0	3.0	1.9	1.98	2.1	2.04
		II	482.60	488.4	461.8	498.2	82.7	83.14	84.11	85.0	2.3	2.4	2.5	2.4	2.15	2.29	2.38	2.4
	15	I	433.45	439.32	448.89	447.65	62.84	67.2	69.88	70.86	2.4	2.6	2.6	2.6	1.51	1.68	1.75	1.84
		II	503.4	515.6	522.4	518.30	86.3	86.5	86.88	87.2	2.4	2.5	2.5	2.5	2.07	2.23	2.26	2.18

T1 = 35 m^3 cattle manure/fad. T2 = 20 m^3 compost/fad. T3 = 20 m^3 chickens manure/fad.

genotypes can bring significant improvement in oil yield and its components growth characters.

The genotypic and phenotypic correlation coefficient worked out among different characters including oil yield revealed that in general, genotypic correlation were higher than corresponding phenotypic correlations in all cases, thereby suggesting strong inherit association between various characters were genotypically and phenotypically correlated with oil yield. These results are indicating that, oil yield may be improved through selection. The significant genotypic correlation between Oil yield and LFW, HFW, HDW and LDW may be related to greater photosynthetic capacity provided by more leaves and branches.

The results of correlation coefficients revealed that, the nature of correlations among various characters showed considerable variation. However, significant positive correlation among characters imply that, plant breeders can rely more on these characters for selection of superior genotypes in *Ocimum* genus.

Generally, these correlations indicated that, the association between essential oil yield and other characters were different in each generation. This is suggesting performance of cultivars changes from generation to other, thus, the selection response in dry weight and oil yield from other traits would be different in both generations.

Study on genetic divergence of 15 results from 3 distinct species of *Ocimum*. However, these species were diverged under different types of organic fertilizations, while genotypes obtained from the same species were generally different. This was observed also by Aboud *et al.*, 2004; Bowes *et al.*, 2004.

On basis of high growth herb and oil yield components, (2 and 4), (8 and 10) and (14 and 15) genetically diverged and were the superiors genotypes in three species respectively. These genotypes can be used in breeding programs for different traits in basil cultivars.

From the practical point of view, the increase in leaves fresh biomass and oil yield, induced by organic fertilization types can has positive effects, since, the commercial value of basil and its farmers incomes also depends on the amount of essential oil production.

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التحسين الوراثي للنمو و محصول الزيت لتراكيب وراثية منتخبة لبعض أنواع الريحان تحت طرز مختلفة من التسميد العضوي

كمال الدين عبد الحق عبود – رفاعي محمد حسين – محمد مصطفي إبراهيم
قسم الوراثة و السيتولوجي – المركز القومي للبحوث – الدقي – القاهرة – مصر

أجري هذا البحث بمزرعة جنوب التحرير – محافظة البحيرة – مصر خلال الموسمين الصيفيين (٢٠٠٤-٢٠٠٥) و ذلك لإنتخاب طرز متميزة من الريحان تحت ظروف التسميد العضوي وأثر ذلك علي الصفات الوراثية الكمية للمحصول داخل ١٥ سلالة منتخبة تنتمي الي ٣ انواع من الريحان. و قد كانت طرز التسميد المختلفة هي (سماد الماشية، الكومبوست، سماد "كتكوت بالإضافة للأرض العادية بدون تسميد للمقارنة).

و كانت اهم النتائج المتحصل عليها هي:

١- لوحظ وجود إختلافات وراثية عالية المعنوية بين السلالات و معاملات التسميد لكل الصفات المدروسة في الموسمين تحت الدراسة.

٢- كان معامل التباين الوراثي عاليا لصفات طول النبات، وزن الأوراق الطازجة، وزن العشب الطازج والجاف و كذلك نسبة الزيت الطيار في الموسمين.

٣- كانت قيم المكافئ الوراثي بمعناه الواسع و المكسب الوراثي المتوقع عالية لصفات وزن العشب الطازج، وزن الأوراق الطازج و طول النبات مما يعكس أهمية الإنتخاب لهذه الصفات في المحاصيل الورقية من النباتات العطرية و أيضا يعكس إستجابة السلالات للتسميد العضوي.

٤- أظهر تحليل التباين المشترك بين الصفات المدروسة وجود إرتباط موجب عالي المعنوية بين محصول الزيت الطيارو كلا من: وزن العشب الجاف، محتوي الزيت %، عدد الأفرع الرئيسية، وزن الأوراق الجافة و وزن الأوراق الطازجة خلال الموسمين.

٥- أعطت المعاملة السمادية بسماد الكتكوت أعلي تأثير في صفات النمو و محصول الزيت مقارنة بالمعاملات الأخري المدروسة، مما يشير الي إستجابة الصفات المدروسة في أنواع الريحان للمعاملات المختلفة من التسميد العضوي بدرجات متفاوتة و هذا يعطي انطباعا بأهمية التسميد العضوي للحصول علي أعلي إنتاج ممكن من الزيت الطيار و صفات المحصول الأخري. و قد أمكن الحصول علي سلالات متميزة في محصولي العشب و الزيت يمكن إستخدامها في برامج التربية للحصول علي سلالات وراثية ثابتة و متميزة في صفات المحصول.