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Role of Growth Substances in Simulating Pleiotropic Effects Controlling Homeostais in Lemon Grass *Cymbopogon citratus* (STAPF)

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ABSTRACT :

Contradicting physiological functioning of GA, CCC and KI, termed as physiological sinks were induced in wheat to simulate the pleiotropic action of dwarf Rh_t genes. In this view, a highly homogeneous dwarf clones of lemon grass was subjected to biotically increasing duplicative doses of gibberellic acid (GA_3), kinetin (Ki) and cycocel (CCC), against salinization in two successive cuts, in two seasons (1983 and 1984), respectively. The results obtained declared physiological homeostasis in essential oil yield as well as phytochemical characteristics participated in the interrelated system including metal uptake, carbohydrates, photosynthetic pigments and dry matter. Significant relationships gave evidence of the existence of pleiotropic action attributable to simulations of dwarf genes in lemon grass.

Key words : Dwarfing genes, homeostasis, pleiotropic effects, growth regulators, lemon grass, Cymbopogon citratus STAPF. essential oil production, phytochemical traits. metabolic regulations.

INTRODUCTION

Variation in phytochemical characters of vegetatively propagated crops occurd as features of physiological and developmental homeostasis (El Ballal et al., 1983) where significant oscillations occured in some particulate characters while convergence in other phenotypic expressions compensated simultaneously, due to variability in major components of cyclic environments. According to Langridge (1963) the metabolic rigidity was among the major factors promoting propagation and multiplicity. The homeostatic components attributable to genotype - environmental interaction (Westerman and Lawrence, 1970) was due to inherent deviations in history of genotype. Therefore, it was not due to randomness to deduce repeated microvariations in cultivated plants under stress of growth substances, nor to exclude their adaptive values from inferring the elements of extranuclear inheritance, i.e. cellular organells and possibility of developing conditioned line (Moore and Eglington, 1973), when growth substances were used in good medium of major elements. Gale and Youssefian (1983) conducted on response of pleiotropic effects of dwarf alleles Rht_1, Rht_2 and Rht_3 in isogenic lines of wheat i.e. Norin 10. These gibberellin sensitive dwarfing genes interaction with edaphic factor, assessed through pleotropic effects were related to suitability in different climatic conditions. The mode of action of gibberellin insensitive Rht alleles and chlormequat (CCC) suggested that they might both operate through similar mechanisms (Gale, 1979). In this view an experiment employing near isogenic lines to test for a genotype growth regulator interaction was conducted.

Williams and Cartwright (1980) reported that their effects reported from BAP application on dominance in barley resembled those of cycocel (CCC) on spring wheat (Linser, 1968). It was evident that the selective survival of the dominant tilers therefore was a hormone - controlled phenomenon closely analagous to apical dominance, Langer et al. (1973) which might be regulated in vivo by a complex of interaction of several endogenous hormones and priority "sinks" may be maintained by monopolizing a limiting supply of cytokinin coming from the roots. Thus if cytokinin supply was augmented either through an improved nutritional status or by feeding exogenous cytokinins then more and/or larger "sinks" could result (Williams and Cartwright 1980). However, cycocel depended upon its blocking gibberellin biosynthesis and these of the Norin 10 genes on a block in gibberellin utilization (Gale, 1979). Thus it seemed that GA and Cytokinins had opposing effects in this system (Jones and Kaufman, 1971, and Wooley and Wareing, 1972). In lemon grass as a vegetatively propagated species the possibility of obtaining variations in growth from one clone obtained through a selection program, was due to the fact that variation in homogenous back ground might occur only through exogenous factors translated as adaptive barriers. This physiogenic assembly seldom occured except in long term adaptations and hence precipitated microvariations that indured long conserved as features for cryptic polymorphism. This work aimed at simulating microvariations in different physiological traits to declare the pattern controlling homeostasis of essential oil production in lemon grass using different concentrations of GA, CCC and KI, through induction of physiologically different sinks" by spaced and altered hormon X single genotype interaction. Pleiotropic effects among genes, could be simulated in this manner, to signify the existence of dwarfism genes RHt.

MATERIALS AND METHODS

1. Material :

Plant material, used in this investigation consisted of unified clones of lemon grass (Cymbopogon citratus, STAPF) choiced on basis of 3 years term resistance against stressed environment including high salinity and drought, vegetative growth and biological yield of the canopy. The selection stress area was located in the drainage area of NRC Experimental farm at Al-Kanater - Al-Khayria near Shalakan (Kalubia Governorate) through 1980-1983 seasons.

2. Methods

2.1 Field techniques :

This work has been conducted at Experimental farm of National Research Centre at Dokki, Cairo. Explanted tillers of uniform compacted culm diameter, linear growth length were planted in pot, 30 cm. Diameter, on 1st of May in both 1983 and 1984 seasons.

The plants were irrigated with tap water for control and a proper weight of sodium chloride and calcium chloride 1 : 1 dissolved in water for the concentrations of 2500, 5000 and 10000 ppm during the first season. The 10000 ppm concentration was nullified and 1250 ppm was used during the second season owing to the death of plants under the highest concentration. The irrigation was carried with salt solution as needed to maintain soil water content at 65% of water holding capacity. The used growth regulators were : Gibberellin (GA_3) 0, 100 and 200 and 400 ppm Cycocel : 9, 500, 1000 and 1500 ppm and Kinetin : 0, 1, 5 and 10 ppm. The first spray of growth regulators was one month after planting and the second was done one month later. All plants received the same agricultural practices. The first cut was taken after six months after planting, while the second was three months later.

2.2 Phytochemical evaluations :

Determination of photosynthetic pigments (Chlorophylls a, b and total carotenoids) in fresh herb according to Wettestien (1957). Dry weight basis determination included nitrogen and protein according to Yeun and Follard (1952), phosphorus according to Jackson (1958), total carbohydrates and total soluble carbohydrates (%) according to Dubois et al. (1965), and potassium was determined by atomic absorption spectrophotometry using a Perkin Elmer Model 370 A.A. Spectrophotometer. The essential oil content (%) was determined by the water distillation method (Guenther, 1961) on fresh weight basis. The essential oil yield was obtained by multiplying the content by the harvested fresh weight (g/plant).

2.3 Covariance analysis :

The covariance analysis was conducted according to El-Ballal et al (1983) to declare the pattern of homeostasis among simulated (hormonex genetic back ground) modules. The covariance analysis included computation of straight and reciprocal regression coefficients as well as correlation coefficients among 16 determined and/or computed traits, to measure the degrees of pleitropic gene action.

RESULTS AND DISCUSSION

1. Degree of association among traits :

Data presented in table (1) find the estimates of simple correlation coefficients among fourteen traits related to dry matter and essential oil production in lemon grass. These data include only the significant estimates that support that utilization of different growth regulators with different modes of action and/or concentrations could really induce physiologically different sinks at the same genetic back ground. It is clear that multiplicity in physiological traits had occured to the extent that significant degrees of associations were far enough to simulate a hypothesized model for studying the pattern controlling homeostasis.

2. Pattern of interrelated system :

The reader could follow regression coefficients assigned in tables (2 and 3) through their sign a (direction) and magnitude s (or weight of given characters regressions on particulate the others). These comparisons could enable identification of sequence of validated interrelated system, as follows :

Table 1. Simple correlation coefficients matrixs among dry matter and chemical constituents of lemon grass under combined effect of GA, CCC, KI and salinity treatments measured in two cuts of two successive seasons.

Item		Season	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	General 1st cut	Average 2nd cut
Nitrogen	x_1	1st	—	0.23	—	0.56	—	0.49	0.25	—	—	—	0.25	—	—	—	—	—	1.2464	1.617
		2nd	—	0.54	0.33	0.56	0.34	0.55	0.23	—	—	—	0.20	—	0.23	—	0.20	—	1.2827	1.7743
Potassium	x_2	1st	0.27	—	−0.48	0.37	0.54	—	0.42	0.36	−0.40	−0.38	—	−0.46	−0.48	−0.42	—	−0.54	2.3564	2.4815
		2nd	—	—	—	0.71	0.48	0.60	—	−0.33	−0.52	−0.40	0.51	−0.39	−0.30	−0.56		−0.27	1.833	2.371
Phosphorus	x_3	1st	—	0.49	—	—	−0.20	—	0.27	0.38	0.38	0.40	—	—	0.39	0.30		0.31	0.3834	0.2975
		2nd					−0.28		0.35	0.40	0.36	0.40	−0.20	0.40	0.22	0.44		0.38	0.3383	0.2903
T.Carbohydrate	x_4	1st	0.55				0.39	0.78	−0.48		−0.35	−0.24				−0.46	−0.21	−0.41	14.376	11.635
		2nd	0.45				0.61	0.98	0.31	0.21	−0.39	−0.27	0.44			−0.33			19.523	14.396
T.Soluble Sugars	x_5	1st		0.72	−0.52				−0.20	−0.64	−0.58	−0.66	−0.30	−0.86	−0.76	−0.78		−0.80	3.223	2.539
		2nd	0.35	−0.44		0.40		0.44		−0.60	−0.67	−0.65	0.52	−0.65	−0.22	−0.61	−0.33		3.592	3.237
Nm Soluble Sugars	x_6	1st	0.48	−0.49		0.92	0.32						0.27	0.44			0.27		11.178	9.097
		2nd	0.35	−0.34		0.93					0.42		0.37	0.37		−0.22			15.895	11.16
Oil %	x_7	1st		−0.37	0.46		0.33										0.28		0.524	0.2608
		2nd	0.22		0.34		0.93			0.24		0.20				0.59	0.28		0.3703	0.2608
Chlor (a)	x_8	1st	−0.20	−0.47				0.33			0.80	0.57	0.66	0.59	0.81	0.67	0.63	0.70	1.3024	1.528
		2nd	0.48		0.41	0.27	−0.21	0.38			0.85	0.98	−0.39	0.56	0.43	0.64	0.34	0.62	2.08	1.594
Chlor (b)	x_9	1st		0.94		0.43	−0.23	0.50	0.29	0.61		0.89		0.41	0.66	0.64	0.62	0.64	0.7084	0.57
		2nd	0.29	0.23	0.42	0.32		0.42		0.59		0.93	−0.78	0.47	0.46	0.64	0.31	0.59	0.5507	0.75
Chlor (a)+(b)	x_{10}	1st		−0.42	0.22	0.25	−0.46	0.43		0.96	0.68		0.52	0.57	0.80	0.69	0.65	0.71	2.0068	2.0935
		2nd	0.56		0.52	0.43		0.53		0.95	0.81		−0.53	0.55	0.45		0.35	0.62	2.662	2.3533
Chlor a/b ratio	x_{11}	1st	−0.34	−0.24		0.49	−0.33	−0.34	−0.22	0.31	−0.54			0.43	0.51	0.30	0.40	0.37	1.8344	2.793
		2nd	0.23							0.32	−0.54			−0.21	−0.30	−0.41		−0.29	4.1217	2.173
N.S. Sugars/T.S.S. ratio	x_{12}	1st		−0.60	0.46	0.32	−0.87	−0.65		0.57	0.41	0.56			0.75	0.67		0.72	4.1504	4.419
		2nd		−0.53	0.27	0.20	−0.80	0.54	−0.31	0.42	0.37	0.45				0.51	0.36	0.41	4.602	3.664
T.Carotenoids	x_{13}	1st		0.43	0.20		−0.49	0.29	0.33	0.74	0.79	0.67		0.55		0.63		0.69	0.7456	0.878
		2nd		0.31	0.39	0.22	−0.20	0.33		0.72	0.50	0.71		0.35		0.25	−0.66	0.33	1.75	0.819
Oil Yield	x_{14}	1st	−0.24	−0.78	0.67	−0.26	−0.68		0.74	0.29	0.40	0.27		0.51	0.55		0.33	0.91	0.1062	0.147
		2nd	−0.32	−0.32	0.48	−0.23	−0.74		0.65				−0.27	0.60			0.30	0.71	0.157	0.084
Chlor a+b/T.carot	x_{15}	1st				0.29		0.34		0.43		0.56	0.21					0.30	2.7024	2.406
		2nd					0.27			0.32	0.37	0.38			−0.36	−0.24			2.346	2.917
Dry Matter	x_{16}	1st	−0.33	−0.72	0.66	0.26	−0.88		0.32	0.46	0.20	0.40	0.29	0.73	0.47	0.58			6.5792	21.635
		2nd	−0.20	−0.35	0.44	0.28	−0.66		0.49	−0.41			−0.26	0.47	0.21	0.88	0.34		17.2067	8.6467

Estimates of 1st cut are plotted above the diagonal, estimates of 2nd cut are plotted down the diagonal.

Table 2. All possible regression coefficients among chemical characteristics of lemon grass in two cuts of 1st season under combined effects of GA, CCC, KI and saline treatments.

ITEMS		CUTS	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}
NITROGEN	x_1	1st		0.07		0.05		0.04	0.32				0.15					
		2nd		0.06		0.03		0.03		-0.06			0.07			0.42		-0.004
POTASSIUM	x_2	1st	0.74		-3.28	0.10	0.27		1.68	0.72	-1.82	-0.55		-0.004	-0.73	-4.75		-0.001
		2nd	1.26		-4.46		0.46	-0.13	-3.25	-0.67	3.53	-0.46	-0.21	-0.15	-1.14	-1.14	-6.29	-0.04
PHOSPHORUS	x_3	1st		-0.07			-0.01		0.76	0.11	0,25	0.09			0.91	3.39		0.001
		2nd		-0.05			-0.04		0.45			0.03		0.01	0.06	0.60		0.004
TOTAL CARBO-HYDRATE	x_4	1st	6.8	1.42			0.75	0.84	-7.43		-6.15	-1.34				-5.22	-13.09	0.001
		2nd	9.33					0.87			5.95	1.04	1.64	0.30	7.93	-7.93	1.65	
TOTAL SOLUBLE SUGARS	x_5	1st		1.09	-2.72				1.58	2.55	0.19	1.93	0.19	0.86	2.17	8.93		0.003
		2nd		1.13	-7.37			-0.13	-4.44		-4.57	-0.79	-0.46	-0.35	-2.06	-8.70		-0.08
NN SOLUBLE SUGAR	x_6	1st	5.43			0.72							0.17	0.004			0.10	
		2nd	8.65	-1.92		0.96	-0.78			1.83	7.30	1.83	-1.18	0.65	2.99		1.99	
ESSENTIAL OIL (%)	x_7	1st	0.20	0.10	0.64	-0.03	0.02										0.12	0.002
		2nd		-0.04	0.49		-0.02				0.12		-0.02		0.10	0.69		0.002
CHLOROPHYLL A	x_8	1st	0.18	1.30							1.82	0.42	0.77	0.08	2.02	0.30	0.55	0.60
		2nd	-0.64	-0.32				0.06			1.59	0.73	0.19	0.10	7.38	1.65	0.46	0.02
CHL. B	x_9	1st		-0.09	0.57	-0.02	0.06					0.29		0.41	0.66	1.41	0.24	0.02
		2nd		0.25		0.03	-0.13	0.66		0.23		0.20	0.13	0.03	0.57	0.87		0.003
CHL. A + B	x_{10}	1st		-0.26	1.86	-0.04	0.23			0.78	2.79		0.32	0.11	2.73	4.71	0.79	0.08
		2nd		-0.38	1.78	0.06	-0.27	0.10		1.25	2.31		0.03	0.13	1.63	1.98	0.77	0.02
CHL. A/B RATIO	x_{11}	1st	-0.28				0.01	0.002		0.57		0.13		0.05	1.08	1.31	0.22	0.03
		2nd	-1.76	-0.27		-0.15	-0.23	-0.10	-2.12	0.50	2.24					-0.73	0.36	0.02
R.S. SUGARS/T.S. SUGARS RATIO	x_{12}	1st		-0.05		-0.02	0.02	0.002		4.33	6.90	3.08	3.74		13.82	0.67		0.44
		2nd		-2.36	16.17	0.34	-2.16	0.66		3.21	6.01	2.40			5.76	16.11		0.17
TOTAL CAROTENOID	x_{13}	1st		-0.06	2.07		0.02			0.33	0.60	0.23	0.24	0.04		1.26		0.02
		2nd		-0.16	0.68		-0.12	0.03	1.06	0.40	1.11	0.28		0.05		1.66		0.01
OIL YIELD	x_{14}	1st		-0.05	1.58	-0.004	0.02			0.13	0.29	0.10	0.07	0.02	0.31		0.06	0.02
		2nd	-0.14	-0.10	0.75	-0.01	-0.05		0.79									0.004
CHL. A + B/T.CAROT. RATIO	x_{15}	1st				-0.001		0.002	0.65	0.71	1.61	0.54	0.39			1.85		0.03
		2nd																
DRY MATTER	x_{16}	1st		-0.06	1.64	-0.003	0.02			8.52	17.66	6.28	5.22	1.17	20.88	55.23	3.21	
		2nd																

RECIPRACEL REGRESSION ARE PLOTTED BELOW THE DIAGONAL.

Table 3. All possible regression coefficients among chemical characteristics of lemon grass in two cuts of 2nd season under combined effects of GA, CCC, KI and Saline treatments.

Item		Cuts	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}
Nitrogen	x_1	1st cut		0.44	0.83	0.03	0.08	0.03	0.85				0.03		-0.15		0.09	
		2nd cut				0.07	0.14	0.06	0.82	0.39	0.46	0.32	0.13			-2.06		-0.02
Potassium	x_2	1st cut	0.66			0.05	0.25	0.04		-0.24	-0.78	-0.21	0.10	-0.09	-0.24	-3.13		-0.03
		2nd cut					0.26	-0.08			0.54			-0.22	-0.78	-2.97		-0.04
Phosphorus	x_3	1st cut	0.13				-0.03		0.51	0.40	0.18	0.07	-0.01	0.03	0.06	0.81		-0.01
		2nd cut							0.30	0.08	0.15	0.07		0.02	0.16	0.70		0.01
T.Carbohydrates	x_4	1st cut	10.34	10.81			2.72	1.10	9.11	2.36	-8.98	-2.17	1.33			-28.13		
		2nd cut	3.11				1.10	1.02	1.47	3.49	1.72	0.39		0.39	2.62	9.82		0.17
T.Soluble Sugars	x_5	1st cut	1.43	2.87	-2.93	0.14				-1.54	-3.4	-1.15	0.35	-0.48	-0.60	-11.57	-0.63	
		2nd cut	0.91	0.76		0.15				1.43				-0.58	-0.94	-11.84	-0.43	-0.14
N Soluble Sugars	x_6	1st cut	8.97	8.04		0.87	1.74				8.57		1.00	1.08		-16.82		
		2nd cut	2.20	-1.46		0.85				1.90	4.14	1.82		0.97	3.57			
Oil %	x_7	1st cut	0.06		0.24	0.002				0.45		0.02				0.73	0.03	
		2nd cut	0.06		0.39									-0.02		1.09		0.01
Chlor (a)	x_8	1st cut	-0.42	-0.42	1.62	-0.02	-0.23		0.01		1.71	0.69	-0.10	0.17	0.46	4.74	0.25	0.08
		2nd cut	0.59		2.20	0.05	-0.10	0.07			1.15	0.70	0.23	0.15	1.53		0.25	-0.04
Chlor (b)	x_9	1st cut		-0.54	0.73	-0.02	-0.13	-0.02		0.42		0.32	-0.10	0.07	0.24	2.37	0.11	0.04
		2nd cut	0.18	0.10	1.13	0.03		0.04		0.30		0.30	-0.20	0.07	0.54		0.15	
Chlor (a)+(b)	x_{10}	1st cut		0.76	2.33	-0.03	-0.03	-0.36	1.73	1.41	2.68		-0.20	0.23	0.69		0.36	0.11
		2nd cut	0.96		3.86	0.11		0.15		1.29	2.15			0.22	2.05		0.45	
Chlor a/b ratio	x_{11}	1st cut	1.22	2.56	-3.13	0.15	0.76	0.14		-1.46	-5.87	-1.39			-1.18	-11.44		-0.13
		2nd cut	0.38							0.44	-1.45					-2.91		-0.04
N.S. Sugars/T.S.S. ratio	x_{12}	1st cut		-1.18	5.57		-0.86	0.12		1.93	3.22	1.32				12.96	0.89	0.17
		2nd cut		-1.25	4.04	0.10	-1.10	0.30	-4.20	1.18	2.05	0.93			2.08	13.35		0.14
T.Carotenoids	x_{13}	1st cut	-0.36	-0.57	0.84		-0.08				0.40	0.30	-0.07			1.73	-0.45	0.04
		2nd cut		-0.13	0.98	0.02	-0.05	0.03		0.34	0.46	0.25		0.06			-0.13	0.01
Oil Yield	x_{14}	1st cut		0.10	0.24	0.00	-0.03	0.00	0.47	0.09	0.17		-0.01	0.02	0.04		0.03	0.01
		2nd cut	-0.06	-0.03	0.32	-0.01	-0.05		0.38				-0.02	0.03			-0.02	0.01
Chlor a+b/T.carot	x_{15}	1st cut	0.44				-0.18		2.26	0.47	0.86	0.33		0.14	-0.96	3.01		
		2nd cut					-0.77			0.41	0.93	0.35			-0.97	-2.45		-0.05
Dry Matter	x_{16}	1st cut		-3.00	12.71					5.10	9.72	3.56	-0.63	0.98	2.87	43.28		
		2nd cut	-2.27	-2.71	21.60	0.46	-2.97		21.09	-3.73			-1.76	1.55	4.05	64.18	-2.47	

Reciprocal regression are plotted below the diagonal

1. Dry matter is markedly affected by seasonal and/or subseasonal variability in the major environment, regardless of the diversity made by different hormonal functions or concentrations, i.e. biological yields of 6.58 and 17.21 vs. 21.64 and 8.65 g/plant were obtained from the two cuts during both interactions, respectively. However, essential oil content (%) showed clear homeostasis in relation to dry matter, where zero regressions were often noticed except in case of second cut in 2nd season with a highly significant coefficient of 21.09 were computed from regressing essential oil on dry weight.

Meanwhile, negative estimate from regressing soluble sugars on dry matter with a significant coefficient of - 2.97 in the same environment was computed, which denotes the compensation between soluble sugars (glycolic pathway or donners of Acetyl CoA) and essential oils (pool of isoprenoids originated from acetyl COA). The big difference between the high positive regression on one side and the negative low regression is probably attributed to the fact that essential oils are the final product of the assimilated active acetate meanwhile soluble sugars are the remainder as precursor. The regression between soluble sugars and essential oil content was zero due to pertained balance. This matter could be better emphasized by the direct negative regression of essential oil content on soluble sugars content (b = - 4.44) as in case of the 2nd cut of 1st season, where both items had no regression on dry matter.

However, in 1st cut of the same season they had positive regression of b = 1.58, but no direct regression on dry weight. Essential oil content (%) in the last case was not contradicting due to low dry matter content, e.g. 6.58 g/plant. However, they were competiting in case of winter season (2nd cut, 1st season) where growth was markedly increased to 17.21 g/plant, but the radient energy was limited. An interesting point is the increase of dry matter to 21.64 g/plant in the next season (1st cut 2nd season) but conserving a zero regression between this triangle as a direct reflection of developmental homeostasis that made the dry matter is the major contributor of essential oil yield.

2. Soluble sugars contradicted with phosphate content at negative regression coefficients of - 2.72 and 7.37 in the first season cuts as well as - 2.93 (non-significant) in the 2nd season 1st cut. Phosphate content regressed upon soluble sugars in these cases. This is to say that increase of soluble sugars resulted in limitation of phosphate content. Active sugars are prior to phosphorylation; e.g. glucose phosphate ... etc. Therefore, phosphate and essential oil content contributed low positive insignificant regression coefficients of comparable weights in either straight or reciprocal directs which reflects the balance between essential oils production and phosphate related compounds. Burmeister and Guttenberg (1960) believed that essential oil production acts as ways for capturing upretentious energy, as a system parallel to

unaerobic respiration. In view of the total physiological capacity spaced by different hormonal functions on the same genetic back ground made in this experiment the elusion of different physiological criteria in phosphorus content was in fact regressed upon the total surplus in upertentious energy; calculated as content of essential oil residues, in a highly significant manner, although with small regression estimates b less than 1.00 in both directions.

Phosphate was markedly regressed upon highly significant dry matter at coefficients of 1.64, 12.71 and 21.60 for 1st cut in 1st and 2nd seasons as well as 2nd cut/2nd - seasons, respectively. In this view the greater dry matter synthesis resulted in maximizing are phosphate accumulation.

3. Essential oil yield is the main objective of this communication. It regresses upon :

   a. Potassium content in negative manner where coefficients of -4.75, -1.14 vs. -3.13 and -2.97 (highly significant) were computed. Although, potassium was necessary for carbohydrate metabolism, particularly in initiated and developing new growth where highly significant regression of potassium on carbohydrates (%) was computed; e.g. 1.42 and 10.81 in first cuts of 1st and 2nd seasons, respectively.

b. Phosphate content (%) in a positive significant manner with coefficients of 3.34 and 0.60 (insignificant) in first season vs 0.81 and 0.70 (significant) in the second season. Seasonal variation was a character of the major environment, where components of physiological homeostasis were elaborated to accommodate overall mean essential oil yields of 0.105 and 0.157 vs. 0.147 and exceptionally 0.084 g/plant for the four cuts in seasons respectively.

c. Total carbohydrates in a negative manner with coefficients of - 5.22 and - 7.95 (significant) versus - 28.13 and 9.82 (N.S.), respectively. This regression pattern denoted that assimilated energy was either converted to primary metabolism or being stored as essential oil as reported by Burmeister and Guttenberg (1960). However, in the second season cut low essential oil content of 0.084 g/plant had not necessitated physiological contradiction on the general precursor and hence an exceptional positive insignificant regression of 9.82 was computed. This could be directly substantiated in different models as essential oil yield was regressed upon soluble sugars, that are capable of undergoing conversions via glycolic pathway. For example when chlorophyll a in first or summer cut of 1st season was the positive cause in regression pattern with essential oil yield per plant, but in a small coefficient of 0.30, i.e. highly significant, oil yield per plant was regressed in a highly significant positive coefficient of 8.93 on soluble sugars. This denoted that first cut or summer cut of 1st season exposed abundancy in spontaneous energy and hence linearity or steady state of enzymatic reaction did not compete on general precursors reacting as control mechanisms. Advancing a more little bit, when essential oil yield was highly significantly regressed upon chlorophyll a at a coefficient of 4.74 or times the same cut of previous season, this abundancy in chlorophyll a accumulation reflected that total available energy was limited and the concept limited resources (Adams and Grafuis, 1971) reacted in a converged model, where a case of physiological contradiction on the pool of glycolysis; i.e. pyruvate that reflecting a physiological fed back mechanism. In this particular, macro molecules were oriented to build up a safety mechanism structures such as quantasomes. Intense chlorophylls were in fact the biological tools of getting rid of upreteneous energy by their fed back irradiation or flourescence not by their capture as isoprenoid residues. Therefore, in this first cut 2nd season, essential oil yield regressed in highly significant negative manner with a coefficient of -11.57 on soluble sugars due to competition on the sequence product path way. Nevertheless, in winter or 2nd cut of both seasons this later model was operating and coefficients 0 - 8.70 and -11.84 (highly significant) were computed respectively. Total oil yield showed also highly significant coefficients of 0.73 and 1.09 as regressed on essential oil content (%) as over all cellular net work on isoprene conversion and opposite to -11.57 and -11.84 when regressed on soluble sugars in both cuts of second season.

4. Although, Chl. a, b, a+b and carotenoids differ in either content and degree of significance, they ran in parallel pattern. However, regression of essential oil yield on chlorophyll a/b ratio varied from 1.31 (non significant) in first cut 1st season to -11.44 (highly significant) in second cut of the same season. Negative insignificant estimated of -0.73 and -2.91 were generally computed in the second cut of both seasons. An interesting note was that chlorophyll a/b ratio and soluble sugars had confirming the same pattern of regression as causatives of total essential oil yield. This was since the reciprocal regression patterns were comparable. However, more different weight of regression of chlorophyll a/b denote balance in physiological sink (between PS II and PS_I) while soluble sugars were the chemical reservoir of metabolic over carry that compensate glycolysis and isoprenoid conversions and enzymatic rates. This was noticed from the following comparison on

regressing essential oil yield on soluble sugars; i.e. regression of 8.93, - 8.70 vs - 11.57 and - 11.84 (highly significant) or on chlorophyll a/b; i.e regression of 1.31, - 0.73 vs. -11.44 (highly significant) and - 2.91, respectively.

5. Upon dry matter where highly significant positive regression of 55.23, 43.28 and 64.18 were computed for first cut of 1st season and two cuts of 2nd season, respectively.

However, no significant regression of essential oil yield was materialized upon dry matter in the first season 2nd cut probably due to prevailed physiological homeostasis in essential oil yield/plant where maximal average was maintained, e.g. 0.147 without significance among treatments, which was contributed to developmental homeostasis in dry matter, e.g. insignificant variability around the highest recorded average weight of 21.64 g/plant which compensated significant microdeviations around the least essential oil content mean among seasons x cuts., e.g. 0.2006 %. However, the highly significant regression of 55.23 computed in the first season first cut due to developmental plasticity in homeostating the low average dry weight of 6.58 g/plant compensating the very high average oil content of 0.51 % (Highly significant) to realized physiological homeostasis around an average of 0.11 g/plant and highest discrepancy of 0.09 g/plant.

Application of increasing levels of GA_3 and/or NPK on wide collection of lemon grass grown in Egypt under vegetative reproduction had resulted in identification of highly significantly different levels of growth and physiologically activity which expressed marked homeostasis (El-Ballal et al., 1983). Lemon grass in tropic and semi-tropic (India) produces normal seeds. Therefore, this variability under vegetative reproduction could be attributed to a real genetic variation in the introduced seed stock. Applicating the concept conditioned lines (Moore and Eglington, 1979 and Davidson, 1965) genetic variation under cryptic polymorphism had resulted in identification of genetically stable clones against environmental stress in a long term program 1979 (El-Ballal, 1983) among which dwarf clones were recorded. Therefore, a random clone of lemon grass that exhibited clear stress to salinity was used, to simulate the pattern of homeostasis in essential oil production under stress of growth regulator which differ in function, e.g. GA3, Ki and CCC, and doses. This was in fact parallel to development of random homogenous lines in gibberellin - insensitivity reported by Gale and Youssefian (1983) for analysis of dwarfing Rht and rht alleles. In view of preceding studies with dwarfing genes in small cereals (Williams and Cartwright, 1980, Linser, 1968, Langer et al., 1973, Gale 1979, Jones and Kaufman, 1971 and Wooley and Wareing, 1972), the use of contradicting growth regulator could maintain different "sinks" in the metabolism. It is clear from the results presented in tables (1,2 and 3) demonstrated above that a significant pleiotropic gene action is existed among genes that were affected by different hormonal interactions where wide physiological and developmental expressions of homeostasis were simulated through association among traits, which was previously referred to as suitability to different edaphic and climatic factors by Gale and Youssefian (1983). In fact this fine concept given by them enabled the simulation of metabolic relationship (regulation) on basis of physiological and/or developmental probabilities of growth homeostated by applicating GA3, Ki and CCC on different edaphic stresses prepared by salinity treatments. These hormonal induced homeostasis that decalred significantly altered pleiotropic effects simulated a wide spectra of genotype environmental interactions where growth of the same genetic background could homeostate under stresses of simultaneous indeginous synthesis of phytohormones in vivo. However, the difference is that, if these growth or hormone like substances could really occur in these combination by a given clone or line ?. This gene X hormone simulation is essential to declare the nature of homeostasis. Essential oil producing taxa cannot be bred without knowledge with nature of homeostasis, specially when they are not capable of seed production such as genus Cymbopogon spp. in Egypt.

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مجلة الإمارات للعلوم الزراعية (١٩٩٣) ، ٥ : -

دور منظمات النمو في محاكاة التأثير المتعدد للجينات المقزمة التي تحكم الموائمة الفسيولوجية في حشيشة الليمون

ملخص :

استهدف هذا البحث التدليل على وجود جينات مقزمة Rht في حشيشة الليمون بالتعرف على مدى امكانية احداث تعبيرات متدرجة ومتزايدة في القيمة لعدد من الصفات الإنمائية والفسيولوجية المرتبطة ببعضها ارتباطا وثيقاً باستخدام عدة منظمات نمو مختلفة الدور الحيوي . مما يعكس في النهاية استحداث اختلافات جوهرية في الإمكانيات تأثر النظام الوراثي بتغير التفاعل الكمي والوظيفي مع تغير نوعية هذه المنظمات وتركيزاتها وهو ما يعبر عنه باحداث تغيرات متدرجة في نظام سحب مواد الطاقة أو مايسمى " البالوعة الفسيولوجية " . ولإستحداث ذلك استخدم حمض الجبريلك والسيكوسيل والسيتوكينين بتركيزات مختلفة في بيئات متدرجة الملوحة على سلالة خضرية قزمية متجانسة من حشيشة الليمون . وقد أخذت البيانات على ثمانية عشرة صفة من الصفات الكمية الخضرية والفسيولوجية لمدة عامين يتضمن كل منهما البيانات المأخوذة على حشتين من النمو الخضري . وقد دللت النتائج على حدوث تغيرات جوهرية متلازمة في الصفات المختلفة المرتبطة بتنظيم الموائمة الفسيولوجية في انتاجية الزيوت الطيارة . وأشير في البحث الى أن هذه الموائمة ترتبط بنظام تعبير الجينات المقزمة ذات التأثير المتعدد . وتقع اهمية هذا البحث في الإعتماد على نتائجه في تصميم دلائل الإنتخاب في برامج تربية السلالات الخضرية في حشيشة الليمون التي لا تكون بذور في مصر .