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VARIABILITY, CORRELATIONS AND PATH- COEFFICIENT ANALYSIS IN TWO POPULATIONS OF MULTI- CUT BARSEEM CLOVER

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ABSTRACT

Breeding for forage yield in multi-cut barseem clover requires information related to the nature and magnitude of environmental and genetic variations and the degree of association of forage with other traits. One- hundred and forty four half-sib families from each of Khadarawi and Meskawi multi-cut barseem cultivais were evaluated in two separate experiments. Variability was the highest for plant height, but the lowest for dry matter percent in both populations. Heritability was of moderate magnitude for all studied characters, with the highest values for plant height (75.71 and 67.96 for Khadarawi and Meskawi populations, respectively.), but the lowest for seasonal green forage yield (52.03 and 52.30 for Khadarawi and Meskawi populations, respectively.). The expected gain from selecting the highest 10% of families were 29.30 and 37.52% for dry forage yield, 43.46 and 43.02% for plant height, 30.87 and 40.69% for stem diameter and 22.14 and 24.43% for dry matter percent of Khadarawi and Meskawi populations, respectively. In Khadarawi population, strong positive correlation at the phenotypic and genotypic levels, were found between seasonal dry forage yield and both plant height and mean number of tillers/plant. In contrast, the correlation was strong and positive at the genotypic level only with stem diameter, mean leaf area/plant and leaf/stem ratio. In Meskawi population, seasonal dry forage yield was strongly and positively correlated at the phenotypic and genotypic levels with mean plant height, mean stem diameter and mean number of tillers/plant. Also, strong positive phenotypic and genotypic associations were detected between stem diameter and dry matter percent and between leaf area/plant and plant height. Path-coefficient analysis, at phenotypic and genotypic levels, showed that Khadarawi seasonal dry forage yield was directly affected by dry matter percent, seasonal fresh forage yield, plant height and number of tillers/plant, in that order. Meanwhile, Meskawi seasonal dry forage yield was orderly directly affected by seasonal fresh forage yield and dry matter percent.

Key words : *Multi-cut barseem clover, variability, correlation, path- coefficient analysis.*

INTRODUCTION

Multi-cut barseem clover (*Trifolium alexandrinum,* L) is widely grown as a forage crop in Egypt. The duration of the production season varies among types. Meskawi type provides green forage for about seven months from November to May. Khadarawi type has a more prolonged production season extending to late July. Farmers choice of the two types depends upon the prevailing crop rotation and / or their need to forage.

Variability is the base for any improvement program. The success of breeding work depends upon the magnitude of genetic nature of variability. Variability in barseem germplasm was detected by several workers(Radwan , 1970; Ali, 1977; EL-Nehrawi, 1980; Radwan *et al.* , 1983; Hassaballa, 1984; Rammah *et al.* 1984, Bakheit, 1985; Mikhiel, 1987; Awad, 1988; Bakheit and Mahdy, 1988; Geweifel and Rammah, 1990; Ahmed, 1992; Ragab, 1997; Ahmed, 2000 and Abdel Gawad, 2003).

Heritability estimates for green forage yield were found to be low to moderate, ranging from 24 to 44% (Ali, 1971; Radwan *et al.*, 1971; EL-Nehrawi, 1980; Mikhiel, 1987; Bakheit and Mahdy, 1988) or high from 81 to 92% (Bakheit, 1986; Mahdy, 1988; Ahmed, 1992 and Ahmed, 2000). Heritability for yield was slightly larger on dry than on fresh bases, reflecting the better estimation of the average yield by considering variation in moisture content (Bakheit, 1986).

Radwan (1970) reported that genotypic correlation was larger in magnitude than phenotypic correlation, but had the same significance. He reported positive correlation for yield with plant height. The magnitude of correlation coefficients was larger when dry forage was related to forage characters rather than fresh yield. In another study, Radwan *et al.* (1983) concluded that plant height was the character of the highest correlation with forage yield.

Path- coefficient analysis provides estimates of direct and indirect effects on one trait *via* other variables. Bakheit (1986) found that seasonal fresh forage yield had the highest positive direct effect on seasonal protein yield (0.841), followed by mean dry matter percentage (0.461), whereas, the mean protein percentage showed the minimum direct (0.172), and indirect influence on seasonal protein yield.

The main objectives of this study were to :

1-Estimate genetic variability in "Meskawi" and "Khadarawi" multi-cut barseem populations.

2-Estimate correlations between forage yield and related characters.

3-Detect the relative contribution of vegetative characters to seasonal dry forage yield, through path- coefficient analysis.

MATERIALS AND METHODS

The materials used were the two major populations of multi-cut barseem clover " *Trifolium alexandrinum*, L."; namely, Meskawi and Khadarawi. Khadarawi is characterized by a longer growing season than Meskawi. The Meskawi population was represented by a composite of 48 farmers' seed lots,

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whereas, the Khadarawi population comprised 46 seed lots from farmers' and seed markets. Seed collection covered the governorates of Beheira, Gharbia, Kafr ElSheikh, Minufyia, Dakhalia, Bani- Sueif, Minia, Fayoum and Sohag. Seeds of each population were planted with adequate distance isolation in the Agricultural Experimental Station of Alexandria University during 2000 – 2001 season. Seeds, at the rate of 31.4 kg. ha^{-1}, were hand drilled in rows, 4.0 m long and 20 cm apart (2.5 g per plot). At flowering, 320 and 410 plants, from Meskawi and Khadarawi populations, were randomily selected, respectively. Seeds of each plant were harvested separately to represent a half-sib family. One-hundred and forty four half-sib families with enough seeds from each population were saved.

In 2001 – 2002 season, the half-sib families from each population were evaluated in a seperate experiment. Experiments were sown on October 3rd and 5th, 2001, for Meskawi and Khadarawi, respectively. Both experiments were set as a randomized complete block design, with three replicates. Half-sib families were sown in single rows, 1.5 m long and 20 cm apart. Seeding rate was 31.4 kg. ha^{-1} (1.03 g. $plot^{-1}$). Family rows were alternated with single rows of commercial Meskawi seeds. Green forage yield was determined from the middle one meter of each plot ($0.2m^2$) from five cuts taken after 60,100,135,165 and 195 days from sowing, in Meskawi experiment, and seven cuts taken after 60,100,135,165, 195,225 and 255 days from sowing in Khadarawi experiment. Dry matter percentage was determined for each cut by drying 100g samples to a constant weight at 70 ċ, and percentages were averaged over cuts and were used for estimating dry forage yield. Plant height was recorded for each cut as the average of five measurements for each plot, then, the average over all cuts was recorded. Similarly, ten random plants from each plot were used for measuring average number of leaves / stem dry weight ratio, tillers number / plant, stem base diameter (mm) and leaf area / plant.

Data were statistically analyzed for each population as outlined by Steel and Torrie (1980). Estimates of genetic (σ^2_g), phenotypic (σ^2_p), environmental (σ^2_e) variances and heritability on mean of plot basis as $h^2 = \sigma^2_g / \sigma^2_p$ were calculated as given by Hallauer and Miranda (1981). Phenotypic (P.C.V) and genotypic (G.C.V) coefficients of variability were calculated, according to Burton and De Vance (1953). Genotypic and phenotypic correlation coefficients were calculated from the phenotypic and genotypic components of variance and covariance, following Johanson *et al.* (1955). Path- coefficient analysis was carried out, according to the procedure applied by Dewey and Lu (1959). The path correlation analysis partitions the correlation coefficient into direct and indirect effects through alternate pathways (r_{xp}). Dry forage yield was selected as the resultant variable and other traits (Fig. 1) as causal factors.

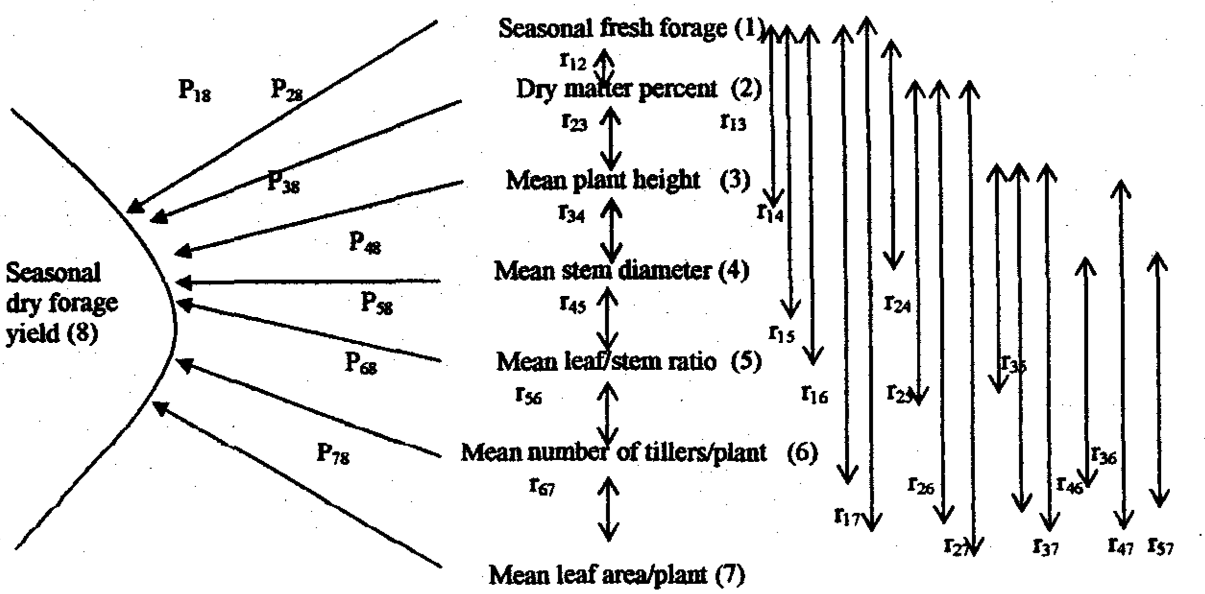

Fig. 1. Path diagram showing causal relationships of seven predictor variables with the response variable seasonal dry forage yield. One-directional arrows (→)represent direct path (P) and two-directional arrows (↔) represent correlations (r).

RESULTS AND DISCUSSION

Analysis of variance indicated highly significant differences ($P \leq 0.01$) in forage yield and other characters among the half-sib families from Khadarawi and Meskawi populations (Table 1). Means of vegetative characters from Khadarawi families were relatively higher than the corresponding values from Meskawi families, except for the mean dry matter percentage and the mean leaf / stem ratio, where Khadarawi families exhibited lower values (11.136 vs. 13.671 % and 40.79 vs. 43.825 %). Wide ranges in means of half-sib families were recorded for all studied characters in both populations. These results confirmed the presence of substantial variability for forage yield and other characters among the half-sib families in each of the two multi-cut types.

Table 1 : Mean squares from ANOVA, ranges and means of half-sibs for forage characters of 144 half-sib families from each of Khadarawi and Meskawi types of barseem clover .

Character	Range	Mean	Mean square	
			Half - sibs	Error
		Khadarawi		
Seasonal Fresh forage (kg / 0.20 m^2)	2.825 – 0.867	2.023	0.5669**	0.1460
Mean dry matter (%)	13.890 – 9.508	11.136	11.935**	2.017
Seasonal dry forage (g/ 0.20 m^2)	525.83 – 140.68	238.14	8268.78**	1089.87
Mean plant height (cm)	66.46 – 46.95	58.143	947.05**	91.84
Mean stem diameter (mm)	4.147 – 1.60	3.130	1.865**	0.3230
Mean leaf / stem ratio (%)	54.17 – 35.14	40.79	353.881**	80.26
Mean number of tillers / plant	10.727 – 3.377	7.107	9.865**	2.041
Mean leaf area / plant (cm^2)	15.070 – 7.123	11.549	19.532**	4.409
		Meskawi		
Seasonal Fresh forage (kg / 0.20 m^2)	2.419 – 0.763	1.504	0.622**	0.1450
Mean dry matter (%)	17.78 – 12.32	13.671	24.419**	4.799
Seasonal dry forage (g/ 0.20 m^2)	381.29 – 100.22	204.104	10641.65**	1580.81
Mean plant height (cm)	71.437 – 40.057	53.417	911.93**	123.86
Mean stem diameter (mm)	3.520 – 1.340	2.293	1.5521**	0.2240
Mean leaf / stem ratio (%)	53.313 – 36.847	43.825	345.10**	76.181
Mean number of tillers / plant	8.720 – 2.910	4.610	4.515**	0.7416
Mean leaf area / plant (cm^2)	16.653 – 8.089	11.029	25.856**	3.947

** Significant at 0.01 level of probability.

Phenotypic and genotypic variances, phenotypic and genotypic coefficenties of variability, heritability, genetic advance from selection and genetic advance as percentage of the character mean are presented in Table 2. The major portion of the total variance was contributed by the genotypic component rather than environmental component for all vegetative characters in both populations. Phenotypic coefficient of variability in seasonal dry forage amounted to about 25 and 33% of half-sibs means, whereas, genotypic coefficient of variability was 21 and 27% for Khadarawi and Meskawi, respectively. Mean plant height showed the highest values of phenotypic and genotypic coefficients of variation (33.37and 29.04; 36.81and 30.34 for Khadarawi and Meskawi half-sibs, respectively). Meanwhile, mean dry matter percent showed low phenotypic and the least genotypic coefficients of variation (20.72 and 16.33; 24.63 and 18.71 for Khadarawi and Meskawi half-sibs, respectively).

Heritability estimates for Khadarawi ranged from 75.71 percent (for plant height) to 52.03 percent for seasonal green forage yield. This, also, was true in Meskawi, where, the highest estimate of heritability was recorded for plant height (67.96 percent), but the lowest value was recorded for seasonal green forage (52.30 percent). Estimates of heritability for most vegetative characters in the two types were of moderate magnitude. Heritability estimates for seasonal dry forage yield in both populations (68.71 and 65.64 percents for Khadarawi and Meskawi, respectively) was larger in magnitude than those of seasonal green forage yield (52.03 and 52.30 percents for Khadarawi and Meskawi, respectively), suggesting that variation in dry matter percent contributed to better estimation of seasonal forage yield. These results are in accordance with the finding of Radwan *et al.*,(1983) who reported estimates of heritability ranging from low to medium values, and those of Ahmed (1992) who obtained a moderate estimate of 69.4 percent for green forage heritability. Meanwhile, the results disagreed with the findings of Ali (1971), Radwan *et al.* (1971), EL-Nehrawi (1980) and Mikhiel (1987) who reported low estimates between 24 to 44 percent for forage yield. Bakheit and Mahdy (1988), Bakheit (1989), Ahmed (1992) and Ahmed (2000) reported high estimates differed from 84.1 to 95.2 percent for vegetative characters of barseem.

Estimates of expected gain from selection showed that, if the top 10% of half-sib families were selected for seasonal dry forage yield, the average of the selections would be increased by 69.75 and 76.58 g/0.20 m^2 for Khadarawi and Meskawi, respectively. These figures amounted to 29.29 and 37.52% increase over the mean of half-sibs of the respective type. Likewise, in both populations of barseem a significant improvement would be expected in plant height and stem diameter. Supposed increases in these characters were 25.27 cm (43.46%) and 0.9663 mm (30.87%), for Khadarawi population, and 22.98 cm (43.02%) and 0.933 mm (40.69%) for Meskawi. The expected gain from selection for other characters were above twenty percent (Table 2). The genetic coefficient of variation is a measure of relative genetic variability. Commonly, breeders can't rely on genetic coefficient of variation alone, because it is a function of both genetic variation and population mean. The expected genetic advance is more appropriate to compare the gain from selection than heritability as the former combines heritability, phenotypic variation and selection differential. High genetic advance values for seasonal dry forage yield, plant height and stem diameter indicated that these characters were governed largely through the additive effect of genes and the improvement in these traits might be achieved through phenotypic selection (Johnson *et al.*,1955.).

The phenotypic (r_p) and genotypic (r_g) correlation coefficients between seasonal dry forage yield and vegetative characters of Khadarawi (above diagonal) and Meskawi (below diagonal) are given in Table 3. The estimate of genotypic correlation was generally larger in magnitude than the corresponding estimate of phenotypic correlation. This indicates that character associations and correlated responses to selection was affected by environmental factors. In Khadarawi population, a strong positive correlation, at the phenotypic and the genotypic levels, were found between seasonal dry forage yield and mean plant height or mean tiller number/plant. The associations between seasonal dry forage yield and mean stem diameter or mean leaf area/plant were strong and negative at the phenotypic level, whereas, these correlations were strong and positive at the genotypic level. Also, a strong positive correlation for dry forage yield and mean leaf/stem ratio was detected at the genotypic level only. In Meskawi population, positive and strong phenotypic and genotypic correlations were recorded between seasonal dry forage yield and mean plant height, mean stem diameter and mean tiller number/plant. Strong positive phenotypic and genotypic associations were detected between mean stem diameter and mean dry matter percent and between mean leaf area/plant and mean plant height. In both populations, the correlations of green forage yield with the studied characters, at the phenotypic and genotypic levels, were lower in magnitude than those of dry forage yield. This may indicate that associations with green forage yield were less predictive of yield. The results of Meskawi population are in agreement with those reported by Radwan (1970), Bakheit (1986) and Ahmed (1992).

Table 2 : Phenotypic variance (δ^2_p), genotypic variance (δ^2_g), phenotypic coefficient of variation (P.C.V), genotypic coefficient of variation (G.C.V), heritability % (h^2), genetic advance (G.A) and genetic advance (as %) of mean for forage characters of Khadarawi and Meskawi multi- cut Barseem clover.

Character	δ^2_p	δ^2_g	Estimate				
			P.C.V	G.C.V	h^2 (%)	G.A units	G.A (%)
Khadarawi							
Seasonal Fresh forage (kg / 0.20 m^2)	0.2862	0.1403	36.66	26.51	52.30	0.4741	23.44
Mean dry matter (%)	5.323	3.306	24.63	18.71	57.68	2.465	22.14
Seasonal dry forage (g/ 0.20 m^2)	3482.84	2392.97	33.23	26.93	65.64	69.745	29.29
Mean plant height (cm)	376.55	285.07	36.81	30.34	67.96	25.269	43.46
Mean stem diameter (mm)	0.8370	0.5140	35.61	29.02	66.40	0.9663	30.87
Mean leaf / stem ratio (%)	171.47	91.207	29.38	21.60	54.06	11.979	29.36
Mean number of tillers / plant	4.6490	2.6080	24.33	30.67	62.94	2.081	29.27
Mean leaf area / plant (cm^2)	9.450	5.041	30.41	24.50	64.92	2.821	24.43
Meskawi							
Seasonal Fresh forage (kg / 0.20 m^2)	0.3040	0.1590	26.18	18.52	52.03	0.4959	32.97
Mean dry matter (%)	11.3390	6.540	20.72	16.33	62.11	3.34	24.43
Seasonal dry forage (g/ 0.20 m^2)	4601.09	3020.28	24.78	20.54	68.71	76.58	37.52
Mean plant height (cm)	386.55	262.69	33.37	29.04	75.71	22.98	43.02
Mean stem diameter (mm)	0.6667	0.4427	29.23	22.91	61.41	0.933	40.69
Mean leaf / stem ratio (%)	165.82	89.64	29.16	23.41	53.19	11.974	27.32
Mean number of tillers / plant	1.9990	1.2580	30.34	22.72	56.10	1.5306	33.20
Mean leaf area / plant (cm^2)	11.25	7.303	26.62	19.44	53.35	3.745	33.96

Table 3 : Phenotypic (r_p) and genotypic (r_g) correlation coefficients among characters of 144 half-sib families of Khadarawi (above diagonal) and Meskawi (below diagonal), multi-cut barseem clover.

		Seasonal fresh forage	dry matter(%)	Seasonal dry forage	Plant height	Stem diameter	Leaf/stem ratio	No. of tillers/ plant	Leaf area/plant
Seasonal fresh forage	r_p		0.1614*	0.0059	0.0158	0.3821**	0.0294	0.1561	0.1194
	r_g		0.2592**	0.0063	0.0224	0.5055**	0.0359	0.2063*	0.1501
Dry matter %	r_p	0.1514		0.0018	0.0193	- 0.0524	0.0401	-0.2233**	- 0.1702*
	r_g	0.1606*		0.0025	0.0264	0.6245**	0.0917	0.5593**	0.3919**
Seasonal dry forage	r_p	0.0003	0.0033		0.6289**	- 0.8960**	0.2969**	0.9335**	- 0.8025**
	r_g	0.0006	0.0142		0.9772**	0.6164**	0.8293**	0.9382**	0.8907**
Plant height	r_p	0.0152	0.0346	0.6017**		0.1858*	0.3764**	-0.3764**	- 0.9111**
	r_g	0.0221	0.0509	0.6610**		0.3241**	0.4294**	0.2398**	0.1751*
Stem diameter	r_p	0.3569**	0.7230**	0.5760**	0.2782*		0.0219	0.0560	0.0461
	r_g	0.5278**	0.8425**	0.6127**	0.3032**		0.0389	0.0571	0.1380
Leaf/stem ratio	r_p	0.0394	0.0577	0.3460**	0.4825**	0.0251		0.3293**	0.4070**
	r_g	0.0468	0.0789	0.3850**	0.5822**	0.0353		0.6362**	0.4509**
No. of tillers/ plant	r_p	0.1583	0.4760**	0.6960**	0.4016**	0.0289	0.3122**		0.4019**
	r_g	0.2765**	0.4864**	0.7003**	0.4838**	0.1222	0.6494**		0.4899**
Leaf area/ plant	r_p	0.1152	0.2039**	0.2709**	0.7195**	0.0768	0.3250**	0.3811**	
	r_g	0.1355	0.3016**	0.3680**	0.8007**	0.1323	0.6362**	0.3965**	

* and ** Indicates significance at 0.05 and 0.01 levels of probability, respectively.

Path correlation analysis provides direct and indirect effects *via* other characters. The effect of each character on seasonal dry forage yield was worked out at the phenotypic and genotypic levels for the two populations (Table 4). In Khadarawi, dry matter percent had the greatest positive direct effect on seasonal dry forage yield at both phenotypic and genotypic levels (0.6178 and 0.5878, respectively). Dry matter percent had a high positive indirect effect on seasonal dry forage yield via leaf area/plant. A possible explanation of this is that plants with large leaf area/plant had more photosynthates that contribute to seasonal dry forage yield. The weak association between seasonal dry forage yield and dry matter percent is probably due to negative indirect effects of stem diameter and tiller number/plant. The second highest direct effect on seasonal dry forage yield was recorded by seasonal fresh forage yield (0.5504 and 0.4709 at phenotypic and genotypic levels, respectively). A weak correlation of seasonal fresh forage yield and seasonal dry forage yield, was probably due to negative indirect effect of stem diameter and leaf area/plant. The third highest direct effect on seasonal dry forage yield was given by plant height (0.457 and 0.4798 at phenotypic and genotypic levels, respectively). A positive indirect phenotypic effect of plant height on seasonal dry forage yield was expressed *via* leaf area/plant. Tillers number/plant played a role in higher seasonal dry forage yield as reflected by the considerable amount of direct effects (fourth highest in ranking)(0.2517 and 0.2276 at phenotypic and genotypic levels, respectively).

As for Meskawi population, fresh forage yield had the greatest positive direct effect on seasonal dry forage yield at phenotypic and genotypic levels (0.9381 and 0.8853, respectively). Negative indirect effects of leaf/stem ratio and tillers number/plant were responsible for the weak correlation between fresh forage and dry forage yields. The second highest positive direct effect on seasonal dry forage yield was expressed by dry matter percent (0.7281 and 0.6826 at phenotypic and genotypic levels, respectively). Negative indirect effects of leaf/stem ratio and number of tillers/plant accounted for the weak correlation between dry seasonal yield and dry matter percent. Positive direct effects on seasonal dry forage yield were recorded by plant height, stem diameter and leaf area/plant. In the meantime, strong positive correlations existed between plant height and leaf area/plant and between stem diameter and dry matter percent (Table 3).

In summary, results indicated the presence of substantial genetic variability among half-sib families within each of the two populations of barseem for improving seasonal dry forage yield. The genetic variation among the half-sib families, in both populations, suggested that positive response to direct selection might be possible for all studied forage characters. The results of correlation and path-coefficient analysis indicated that selection for high fresh forage yield and high dry matter percent, in both populations, along with high plant height and high tillers number/plant in Khadarawi population would be the best indirect selection traits for improving seasonal dry forage yield of multi-cut barseem populations.

Table 4: Path-coefficient analysis of fresh forage yield, mean dry matter percentage, mean plant height, mean stem diameter, mean leaf/stem ratio and mean leaf area/plant, upon seasonal dry forage yield at the phenotypic and genotypic levels, of multi-cut barseem clover.

Pathways of association	Khadarawi		Meskawi	
	Phenotypic	Genotypic	Phenotypic	Genotypic
Dry forge yield vs. fresh forage yield				
Direct effect	0.5504	0.4709	0.9381	0.8853
Indirect effect via :				
Dry matter %	0.0997	0.1524	0.1102	0.1096
Plant height	0.0072	0.0107	0.0001	0.0001
Stem diameter	- 0.0692	- 0.0868	0.0046	0.0069
Leaf / stem ratio	0.0055	0.0059	- 0.0003	- 0.0003
Tillers / plant	0.0393	0.0469	- 0.0001	- 0.0002
Leaf area / plant	- 0.0327	- 0.0366	0.0046	0.0046
Dry forge yield vs. dry matter %				
Direct effect	0.6178	0.5878	0.7281	0.6826
Indirect effect via :				
Fresh forage yield	0.0888	0.1221	0.1420	0.1422
Plant height	0.0088	0.0127	0.0001	0.0002
Stem diameter	- 0.0095	0.1073	0.0093	0.0109
Leaf / stem ratio	0.0075	0.0149	- 0.0004	- 0.0005
Tillers / plant	- 0.0562	0.1273	- 0.0002	- 0.0003
Leaf area / plant	0.4657	0.0956	0.0082	0.0103
Dry forge yield vs. plant height				
Direct effect	0.4570	0.4798	0.0037	0.0037
Indirect effect via :				
Fresh forage yield	0.0087	0.0105	0.0143	0.0196
Dry matter %	0.0119	0.0155	0.0252	0.0347
Stem diameter	- 0.0337	- 0.0557	0.0036	0.0039
Leaf / stem ratio	0.0701	0.0703	- 0.0037	- 0.0040
Tillers / plant	- 0.0947	0.0546	- 0.0002	- 0.0003
Leaf area / plant	0.2493	- 0.0427	0.0289	0.0272
Dry forge yield vs. stem diameter				
Direct effect	- 0.1812	- 0.1718	0.0129	0.0130
Indirect effect via :				
Fresh forage yield	0.2103	0.2380	0.3348	0.4673
Dry matter %	- 0.0324	0.3671	0.5264	0.5751
Plant height	0.0849	0.1555	0.0010	0.0112
Leaf / stem ratio	0.0041	0.0064	- 0.0002	- 0.0002
Tillers / plant	0.0141	0.0129	- 0.00001	- 0.0001
Leaf area / plant	- 0.0126	- 0.0337	0.0031	0.0045
Dry forge yield vs. leaf / stem ratio				
Direct effect	0.1862	0.1638	- 0.0076	- 0.0069
Indirect effect via :				
Fresh forage yield	0.0162	0.0169	0.0369	0.0361
Dry matter %	0.0248	0.0539	0.0420	0.0539
Plant height	0.1720	0.2060	0.0018	0.0022
Stem diameter	- 0.0039	- 0.0067	0.0003	0.0005
Tillers / plant	0.0829	0.1448	- 0.0002	- 0.0004
Leaf area / plant	- 0.1114	- 0.1100	0.0131	0.0318
Dry forage yield vs. tiller no / plant				
Direct effect	0.2517	0.2276	- 0.0005	- 0.0006
Indirect effect via :				
Green forage yield	0.0859	0.0971	0.1487	0.2448
Dry matter %	- 0.1379	0.3288	0.3466	0.3320
Plant height	- 0.1720	0.1151	0.0015	0.0018
Stem diameter	- 0.0101	- 0.0098	0.0004	0.0016
Leaf / stem ratio	0.0613	0.1042	- 0.0024	- 0.0045
Leaf area / plant	- 0.1100	0.1195	0.0153	0.0135
Dry forage yield vs. leaf area / plant				
Direct effect	- 0.2736	- 0.2410	0.0402	0.0340
Indirect effect via :				
Green forage yield	0.0657	0.0707	0.1081	0.1199
Dry matter %	- 0.1051	0.2304	0.1485	0.2059
Plant height	- 0.4164	0.0840	0.0027	0.0030
Stem diameter	- 0.0084	- 0.0237	0.0010	0.0017
Leaf / stem ratio	0.0758	0.0739	- 0.0025	- 0.0044
Tillers / plant	0.1012	0.1115	- 0.0002	- 0.0002

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الملخص العربي

الاختلافات وعلاقات التلازم وتحليل معامل المرور في عشيرتين من البرسيم المصري متعدد الحشات

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تعتمد برامج التربية لزيادة محصول العلف الأخضر في البرسيم المصري متعدد الحشات علي المعلومات المتعلقة بطبيعة وحجم الاختلافات الموجودة بالعشائر والعلاقات بين الصفات الخضرية وصفة محصول العلف الأخضر والتأثير النسبي للعوامل البيئية علي صفات العلف. قيم ١٤٤ من الأنسال أنصاف الأشقة من عشيرتي صنفي الخضراوى والمسقاوي متعدد الحشات من البرسيم المصري في تجربتين منفصلتين. وفي كلتا العشيرتين ظهرت اختلافات بين الأنسال في جميع الصفات المدروسة، بلغت أقصاها في صفة ارتفاع النبات، بينما سجل أدناها في صفة نسبة المادة الجافة. وكانت تقديرات كفاءة التوريث متوسطة لجميع الصفات، حيث سجلت أعلي قيم لصفة ارتفاع النبات (٧٥,٧١ و ٦٧,٩٦ لكل من الخضراوى والمسقاوي علي الترتيب)، وأقل قيم لصفة محصول العلف الأخضر للموسم (٥٢,٠٣ و ٥٢,٣٠ لكل من الخضراوى والمسقاوي علي الترتيب). بلغ التحسن المتوقع من انتخاب أفضل ١٠% من عائلات أنصاف الأشقة ٢٩,٣٠ و ٣٧,٥٢% لصفة محصول العلف الجاف للموسم و ٤٣,٤٦ و ٤٣,٠٢% لصفة ارتفاع النبات و ٣٠,٨٧ و ٤٠,٦٩% لصفة سمك الساق، بينما سجلت أقل قيم للتحسين وهي ٢٢,١٤ و ٢٤,٤٣% لصفة نسبة المادة الجافة وذلك لعشيرتي الخضراوى والمسقاوي علي الترتيب. وفي عشيرة الخضراوى ظهرت تلازمات موجبة وقوية علي المستوي المظهري والوراثي بين محصول العلف الجاف للموسم وصفة ارتفاع النبات وكذلك مع صفة عدد الفروع القاعدية للنبات. بينما كانت تلازماتها موجبة وقوية علي المستوي الوراثي فقط مع صفة سمك الساق والمساحة الورقية للنبات ونسبة الأوراق إلي السيقان. أما في عشيرة المسقاوى فقد تلازمت صفة محصول العلف الجاف للموسم تلازمات مظهرية ووراثية قوية وموجبة مع صفات ارتفاع النبات وسمك الساق وعدد الفروع القاعدية للنبات، كما أتضح وجود تلازم موجب وقوي وراثي ومظهري بين كل من صفة سمك الساق وصفة نسبة المادة الجافة وكذلك بين كل من صفة المساحة الورقية للنبات وصفة ارتفاع النبات. وقد أظهر تحليل معامل المرور الوراثي والمظهري أن محصول العلف الجاف للموسم في عشيرة الخضراوى قد تأثر مباشرة بصفات نسبة المادة الجافة ومحصول العلف الأخضر وارتفاع النبات وعدد الفروع القاعدية للنبات بقوة تأثير تتناسب وترتيب الصفات السابقة. أما في حالة عشيرة المسقاوى، فأن الصفات ذات التأثير المباشر علي محصول العلف الجاف للموسم هي بترتيب قوة التأثير : محصول العلف الأخضر للموسم ونسبة المادة الجافة.