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ESTIMATES OF SOME GENETIC PARAMETERS IN FORAGE PEARL MILLET

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ABSTRACT

Fifteen hybrids were produced by crossing three male sterile-lines i.e., Tift 23A (L_1), Tift 23 E (L_2) and ICMA 89111 (L_3) and five pollinators of pearl millet i.e. Sudan-2 (T_1), ICMV 87101 (T_2), ICMV 155 (T_3), ICMV 87107 (T_4) and ICMV 87111 (T_5) according to line x tester mating system in 1998. Crosses with their pollinators and two check varieties were evaluated in a randomized complete block design with four replications at four locations, Sakha, Gemmeiza, Ismailia and Sids Agricultural Research Stations during 1999 season. The aim of this study is to evaluate forage yield of pearl millet under different environments and estimates of heterosis, combining ability and some other genetic parameters of forage yield and some related components.

Results revealed that, Sids location gave the highest total fresh and dry forage yield (2670.5 and 346.1 g/plant, respectively) overall entries with significant differences than other locations. Cross (L_2 x T_1) produced the highest total fresh forage yield (1678 g/plant), while cross (L_2 x T_4) gave the highest total dry forage yield (278.3 g/plant) overall locations. The best crosses for fresh forage yield were cross (L_3 x T_1) at Sakha, cross (L_1 x T_2) at Gemmeiza and Ismailia and cross (L_1 x T_4) at Sids. This is the same trend for dry forage yield, approximately.

High heritability values in broad sense (more than 80%) were obtained for number of tillers, leaf/stem ratio and forage yield. Number of tillers was the main trait affected forage yield. Significant positive correlation values between the two traits were obtained (0.756 and 0.768 for total fresh and dry forage yield, respectively were computed).

Heterosis values expressed as a percentage of constant parent (male parent) ranged from negative to positive significant values. Cross (L_1 x T_2) had the highest heterosis values for most studied characters (55.35, 16.85, 30.81, 56.70 and 43.31% for number of tillers, fresh leaf/stem ratio, dry leaf/stem ratio, total fresh yield and total dry yield, respectively.

The magnitude of general combining ability variance was generally more than specific combining ability variance for plant height, number of tillers, fresh and dry leaf/stem ratio, while, specific combining ability variance was more than general combining ability variance for stem diameter, total fresh yield and total dry yield.

General combining ability effects indicated that male sterile-line 23A (L_1) proved to be the best combiner for stem diameter, number of tillers, and fresh and dry leaf/stem ratio, while male sterile-line 23E (L_2) could be consider a good combiner for fresh and dry forage yield, then male sterile-line ICMA 89111 (L_3) was the best combiner for plant height. Sudan-2 variety (T_2) may be consider the best combiner fore all studied characters except plant height which ICMV 87107 (T_4) was the best one for this trait. These parents (lines and testers) can therefore be used successfully in cross-combinations for the improvement of their respective traits. Cross (L_1 x T_3) had positive significant specific combining ability values for most studied characters, while, cross (L_3 x T_3) had negative significant values for the same traits.

INTRODUCTION

Pearl millet [*Pennisetum americanum* (L.) Leeke] is a dual-purpose crop. It provides grain for human consumption and fodder for cattle. In Egypt, it is considered an important fodder crop together with forage sorghum, where it has a quick growing habit, thick and succulent stem before flowering, heavy tillering, leafiness, drought and heat tolerance, high photosynthetic efficiency and high dry matter production. Also, it is the most suitable crop for the dry farming areas and it grows better than any annual grass in sandy and light clay soil.

Breeders have mostly been concerned with increasing its grain yield. Few genetic work was done for improvement fodder yield. The need for development of hybrids possessing high fodder yield is being felt owing to the manifestation of heterosis for forage yield (Verma and Katiyar, 1977). Forage yield can be increased by capitalizing heterosis of good hybrids (Sleper, 1987). High percentages heterosis of forage pearl millet were reported by Burton *et al.*, 1980 and Patil *et al.*, 1992. Further, there is a need to study the combining ability of parental lines for identifying prepotent parents and potential hybrids. The rapid advances made, mainly due to the development of hybrids through the use of cytoplasmic male sterile lines. Such studies have, however, been mainly confined to the improvement of grain yield and evaluation of plant characters related to fodder properties has been a secondary feature.

The aim of this study was to evaluate forage yield of pearl millet under different environments and estimates of heterosis, combining ability and some other genetic parameters of forage yield and some related components.

MATERIAL AND METHOD

Three male sterile lines of pearl millet i.e. Tift 23A (L_1), Tift 23 E (L_2) and ICMA 89111 (L_3) were used as female parents (lines). Five varieties i.e. Sudan-2 (T_1)(, ICMV 87101 (T_3), ICMV 155 (T_3), ICMV 87107 (T_4) and ICMV 87111 (T_5) were used as male parents (testers). Fifteen top crosses were produced from crossing females and males according to line x tester mating system at Sakha Agricultural Research Station in 1998 season.

During 1998, the 15 crosses, their parents and two local populations (Sids and Shandaweel-1) as a checks were grown at four locations i.e. Sakha, Gemmeiza, Ismailia and Sids. The locations were chosen based on their different environmental conditions specially soil type, drought and temperature. The material was sown in a randomized complete-block design with four replications at each location on the first half of June. Plot size was three ridges 3.0 m long spaced 60 cm apart. Seeds were drilled handle in hills 30 cm a part and thinned to one plant per hill, 3 weeks after planting. At all sites, the plots were fertilized with 20 kg P_2O_5/fed. at soil preparation, and 30 kg N./fed. added after thinning and after each cut. Normal recommended cultural practices were followed. Three cuts were taken throughout the growing season. Data were recorded on the plants of center ridge and calculated as an average for the individual plant. The studied characters were fresh and dry forage yields (g/plant) at all locations, in addition, some agronomic characters were recorded at Sakha location such as, plant height, stem diameter, number of tillers and fresh and dry leaf/stem ratios. Fresh and dry forage yield calculated as total yield at each location and their combined were done, meanwhile; the agronomic characters were calculated as average overall cuts. Heterosis was determined as amount versus one parent (male parent). The combining ability analysis was done according to Kempthorne (1957). In addition some genotypic parameters such as genotypic and phenotypic variances (σ^2g and σ^2p), genotypic and phenotypic coefficients of variabilities (P.C.V. and G.C.V.), heritability in broadsense (H_b^2), genetic advance (G.A.) and phenotypic correlation were estimated.

RESULTS AND DISCUSSIONS

I.Performance of forage yield:

Total fresh and dry forage yields of entries at different locations and their combined are presented in Table (1). Results indicated that, highly significant differences between entries for total fresh and dry forage yields at each location and their combined. Also, there are significant differences between locations overall entries.

Sids location gave the highest total fresh and dry forage yields (2670.5 and 346.1 g/plant, respectively) followed by Ismailia and Gemmeiza, then Sakha location as fresh forage yield. While Sids followed by Ismailia., Sakha, then Gemmeiza as dry forage yield.

The difference between locations production could be due to the differences between them in their environmental condition, meanwhile, the different ranking of fresh and dry forage yields may be due to the differences between them in dry matter percentage.

Most of the crosses were higher yielders than the male parents. Mean of crosses was higher than mean of testers and/or mean of checks for fresh and dry forage yields at each location and their combined except fresh forage yield at Ismailia where the mean of testers was more than the mean of crosses and checks (Table 1). Cross No. 2 (L_2 x T_1) gave the highest fresh yield followed by cross No. 11 (L_2 x T_4) which produced 1678 and 1654 g/plant, respectively, overall locations without significant difference between them, while, they were alternative ranking as dry forage yield (270.8 and 278.3 g/plant, respectively). This may be due to differences in dry matter percentage between them.

The best crosses for fresh forage yield were cross NO. 3 (L_3 x T_1) at Sakha, No. 4 (L_1 x T_2) at Gemmeiza and Isamilia and No. 10 (L_1 x T_4) at Sids. For dry forage yield, these crosses behaved the same ranking, approximately.

II.Variability study:

The mean ($\overline{X}$) of five agronomic characters and total fresh and dry forage yields, genotypic and phenotypic variances (σ^2g and σ^2P), genotypic and phenotypic coefficient of variability (P.C.V. and G.C.V.), heritability in broad sense (H_b^2) and genetic advance from selecting the superior 5% of population (G.A) are presented in Table (2).

Table (1): Total fresh and dry forage yield (g/plant) of entries at different locations and their combined.

Entries		Total fresh forage yield (g/plant)					Total dry forage yield (g/plant)				
No.	Crosses (L. x T.)	Sakha	Gem-meiza	Ismailia	Sids	Combined	Sakha	Gemmeiza	Ismailia	Sids	Combined
1	$L_1 \times T_1$	1271	779	1204	2433	1418	238.1	113.2	274.5	316.8	235.3
2	$L_2 \times T_1$	1301	1300	1010	3063	1678	264.6	197.5	243.9	372.4	270.8
3	$L_3 \times T_1$	1313	1332	1129	2642	1597	264.8	213.0	250.2	301.0	255.8
4	$L_1 \times T_2$	1111	1470	1311	2573	1620	203.5	223.9	288.8	338.6	264.1
5	$L_2 \times T_2$	1031	1314	1138	2835	1580	216.2	198.9	269.5	327.1	253.1
6	$L_3 \times T_2$	827	1274	985	2695	1450	179.5	192.7	216.0	371.1	240.3
7	$L_1 \times T_3$	1092	952	1107	2695	1462	214.5	154.8	244.7	352.0	241.5
8	$L_2 \times T_3$	1090	880	1054	2958	1494	218.5	145.3	235.2	399.5	249.3
9	$L_3 \times T_3$	734	1120	1031	2450	1336	150.8	177.5	238.5	320.1	222.3
10	$L_1 \times T_4$	762	1125	1071	3185	1538	148.3	190.6	237.6	421.6	250.0
11	$L_2 \times T_4$	1078	1444	1120	2993	1654	220.7	237.7	269.5	389.2	278.3
12	$L_3 \times T_4$	891	1080	1022	2293	1318	183.5	167.9	225.6	318.1	223.4
13	$L_1 \times T_5$	920	1414	903	2800	1511	191.0	201.8	208.1	370.8	243.4
14	$L_2 \times T_5$	1049	1157	985	2660	1465	216.8	182.8	207.0	350.0	239.8
15	$L_3 \times T_5$	999	973	1012	2678	1414	204.3	156.1	211.2	350.8	230.1
Mean		1031.3	1174.3	1072.1	2730.2	1502.3	207.6	183.6	241.4	353.3	246.5
	Testers (T)										
16	T_1	945	891	1288	2363	1370	191.4	138.5	253.7	301.7	221.1
17	T_2	709	1080	1022	2748	1388	142.0	167.8	239.8	351.3	225.0
18	T_3	987	714	968	2608	1322	187.8	111.1	204.2	346.9	213.0
19	T_4	754	1181	1292	2573	1450	141.3	177.9	267.8	332.3	229.8
20	T_5	869	1120	1087	2730	1447	175.9	170.6	221.9	339.9	226.3
Mean		852.8	997.2	1131.4	2604.4	1395.4	167.7	153.2	237.5	334.4	223.0
	Check										
21	1	831	684	991	2432	1237	158.1	109.1	214.4	326.0	202.4
22	2	913	1034	833	2345	1287	163.7	174.6	182.7	315.1	210.0
Mean		872.0	859.0	912.0	2388.5	1262.0	160.9	141.9	198.6	320.6	206.2
Grand mean		976.2 c	1105.4 b	1071.0 b	2670.5 a	1456.2	194.3 c	172.9 d	236.7 b	346.1 a	237.5
L.S.D. 0.05		104	70	90	410	146	21.3	11.9	19.5	53.6	24.5

Table (2): Estimates of some genetic parameters of studied characters overall cuts at Sakha location.

Characters	$\overline{X}$	σ^2g	σ^2P	G.C.V.	P.C.V.	H_b^2	G.A	$\frac{G.A}{\overline{X}}$x100
Plant height (cm)	106.1	43.06	71.36	6.19	7.97	60.35	10.501	9.90
Stem diameter (cm)	0.91	0.003	0.005	6.02	7.77	60.00	0.087	9.56
No. of tillers	9.50	2.95	3.21	18.10	18.88	91.94	3.395	35.75
Fresh L/S ratio (%)	21.36	108.09	112.80	48.66	49.72	95.82	20.964	98.13
Dry L/S ratio (%)	50.57	231.94	237.35	30.12	30.47	97.72	31.013	61.33
Total fresh yield (g/plant)	967.2	30316.7	35755.2	17.84	19.37	84.79	330.28	33.83
Total dry yield (g/plant)	194.3	1236.4	1463.4	18.10	19.69	84.49	66.58	34.27

Results indicated that σ^2g, σ^2P, P.C.V. and G.C.V. for plant height and stem diameter traits were more affected by environmental factor and less affected by genetic factor. P.C.V. values were higher than G.C.V. values with having narrow range between them, suggesting some effects of environment on these characters. The highest values of G.C.V. and P.C.V. were 48.66 and 49.72, respectively, for fresh leaf/stem ratio.

High heritability values in broad sense (more than 80%) were obtained for all studied characters except plant height and stem diameter. Heritability values ranged from 60.00% for stem diameter to 97.72% for dry leaf/stem ratio. High heritability estimates were obtained when the difference between P.C.V. and G.C.V. was very narrow.

The highest values of the expected genetic advance (expressed as percent of the mean) was 98.13% for dry leaf/stem ratio, while, plant height and stem diameter had the lowest values of genetic advance 9.90 and 9.56%, respectively. Results indicated the possibility of improving forage yield through selection for number of tillers and leaf/stem ratio (because of their high heritabilities and genetic advance values) than plant height and stem diameter characters.

III.Phenotypic correlation:

Phenotypic correlation among all pairs of seven studied characters are given in Table (3). Plant height was significantly negatively correlated with other traits and insignificantly with fresh and dry forage yield. Stem diameter was significantly negatively correlated with number of tillers and dry forage yield. Similar results were obtained by Patil and Jadhav (1992) who found significant negative correlation between stem girth and both number of tillers and green forage yield in pearl millet x napier grass hybrids. While, stem diameter had significant positive correlation with fresh and dry leaf/stem ratio. Number of tillers was the main character affected forage yield which had significant positive correlation between them (0.756 and 0.768 for total fresh and dry forage yield, respectively). These results are in agreement with those obtained by Kunjir and Patil (1986) who reported highly significant positive correlation between number of tillers and forage yield of pearl millet. This suggested that, selection based on number of tillers lead to a greater change in fodder yield. Total dry forage yield showed a positive and significant association with total dry forage yield (0.968). This suggested true genetic relationship between these traits. Similar results were obtained by Tyagi *et al*. (1980).

Table (3): Phenotypic correlation values among the pairs of studied characters overall cuts at Sakha location.

Characters	Stem diameter	No. of tillers	Fresh leaf/ stem ratio	Dry leaf/ stem ratio	Total fresh yield	Total dry yield
Plant height	-0.252*	-0.504**	-0.440**	-0.497**	-0.165	-0.098
Stem diameter		-0.406**	0.516**	0.658**	-0.227	-0.344*
No. of tillers			0.092	0.003	0.756**	0.768**
Fresh leaf/stem ratio				0.906**	0.324**	0.174
Dry leaf/stem ratio					0.214	0.052
Total fresh yield						0.968**

***, ** significant at 0.05 and 0.01 levels of probability, respectively.**

IV.Heterosis:

Heterosis values expressed as a percentage of constant parent (male parent) for studied characters overall cuts are presented in Table (4). Results revealed that most crosses had insignificant heterosis values for both plant height and stem diameter traits, which tended to be shorter and thinner than their male parents. All crosses involved T_1 (Sudan-2) or T_2 (ICMV 87101) had significant negative heterosis values.

Table (4): Heterosis of crosses relative to constant parent for studied characters overall cuts at Sakha location.

Crosses		Plant	Stem	No. of	Fresh leaf/	Dry leaf/	Total fresh	Total dry
No.	(L. x T.)	height	diameter	tillers	stem ratio	stem ratio	yield	yield
1	1 x 1	-12.46**	-8.44*	43.68**	16.60**	2.82	34.50**	24.40**
2	2 x 1	-1.31	-13.53**	46.96**	-27.32**	-32.80**	37.67**	38.25**
3	3 x 1	-2.25	-6.63*	22.48**	-11.29**	-6.88**	38.94**	38.09**
4	1 x 2	0.69	-10.26**	55.35**	16.85**	30.81**	56.70**	43.31**
5	2 x 2	4.65	-7.69*	42.76**	-14.53**	-10.84*	45.42**	52.25**
6	3 x 2	4.65	-16.21**	28.28**	6.94	1.49	16.64*	26.41**
7	1 x 3	-14.26**	3.60	63.75**	3.96	17.22**	10.64*	14.22*
8	2 x 3	-2.73	-4.45	44.41**	-29.39**	-37.89**	10.44*	16.35**
9	3 x 3	-1.28	-6.43	-2.15	-29.34**	-42.26**	-25.63**	-19.70**
10	1 x 4	-14.73**	3.70	29.46**	21.46**	23.14**	1.06	4.95
11	2 x 4	-4.27	0.00	39.33**	1.69	-3.86	42.97**	56.19**
12	3 x 4	0.73	-3.81	12.48**	10.75*	-5.43	18.17*	29.87**
13	1 x5	-10.11**	-5.41	16.59**	14.43**	43.55**	5.87	8.58
14	2 x 5	-11.78**	-4.54	28.21**	1.81	4.35	20.71**	23.25**
15	3 x 5	6.15	-3.57	8.11	15.67**	-15.58**	14.96*	16.15**

***, ** significant at 0.05 and 0.01 levels of probability, respectively.**

In respect of number of tillers, all crosses had significant positive heterosis except crosses No. 9 (L_3 x T_3) and No. 15 (L_3 x T_3) which had -2.15 and 8.11%, respectively. The significant positive heterosis values among crosses for number of tillers is an indication of usefulness of these populations. The large heterosis values of certain crosses indicates that male parents are genetically diversed. The highest heterosis value for number of tillers was obtained from cross No. 7 (L_1 x T_3) followed by cross No. 4 (L_1 x T_2) which had 63.75% and 55.35%, respectively.

Fresh and dry leaf/stem ratio took the same trend approximately. Heterosis values ranged from significant negative values to significant positive values. Most crosses involved L_1 had positive heterosis, while most crosses involved L_2 or L_3 had negative heterosis.

Regarding total fresh and dry forge yield, all crosses had significant positive heterosis values for both characters except, crosses No. 10 (L_1 x T_4) and No. 13 (L_1 x T_5) which had insignificant values, while, cross No. 9 (L_3 x T_3) had significant negative values which gave -25.63% and -19.70% for fresh and dry forge yield, respectively. The highest values of heterosis for fresh forage yield were obtained from cross No. 4 (L_1 x T_2) followed by cross No 5 (L_2 x T_2) which had 56.70% and 45.42%, respectively, and alternated their ranking for the heterosis values of dry forage yield which gave 52.25% and 43.31 for the crosses No. 5 and No. 4, respectively. Quendeba *et al*. (1993) found high significant positive heterosis values up to 80.8% among grain African pearl millet landraces.

V.Combining ability:

a.Combining ability variance:

The partitioning of crosses sum squares indicated that general combining (g.c.a) of lines and testers were significant for all studied characters except stem diameter of tester which had insignificant differences. Gupta and Choubey (1988) found insignificant g.c.a. variances of male and female parents of stem thickness. Line x tester interaction or specific combining ability was significant for all studied characters as shown in Table (5). The estimates of general and specific combining variances (σ^2g and σ^2s) and their ratio for plant height, number of tillers, fresh and dry leaf/stem ratio showed that g.c.a. variance were found to be of larger magnitudes than corresponding s.c.a. ones, therefore, σ^2g/σ^2s ratios exceeded the unity. This indicates that, both additive and non-additive types of gene action were involved in the inheritance of these traits with additive portion of a greater role. These results agreed with the finding of Quendeba *et al*. (1993). Alternatively, the component of specific combining ability was larger than that due to general combining ability for stem diameter, both fresh and dry forage yields, therefore, σ^2g/σ^2s ratios were less than unity, this indicates that s.c.a was more important than g.c.a. variance and that non-additive variance was predominant variance component controlling the inheritance of these characters. Similar results were obtained by Gupta and Gupta (1971).

Table (5): Analysis of variances of crosses and their components and estimates of combining ability variance overall cuts at Sakha location.

S.O.V.	d.F	Plant height	Stem diameter	No. of tillers	Fresh leaf/ stem ratio	Dry leaf/ stem ratio	Total fresh yield	Total dry yield
Crosses (C)	14	227.2**	0.0042*	8.364**	369.3**	633.8**	131796.8**	4659.2**
Line (L.)	2	870.9**	0.0077*	28.551**	759.4**	2311.3**	123245.0**	5867.0**
Tester (T)	4	154.1**	0.0016	9.761**	739.4**	715.5**	273544.9**	9309.4**
(L. x T.)	8	102.8**	0.0046*	2.619**	86.8**	173.6**	63060.8**	2032.2**
Error	63	28.3	0.002	0.259	4.8	5.4	5438.5	226.96
σ^2g		25.61	0.000001	1.03	41.41	83.74	8458.4	347.3
σ^2s		18.62	0.000658	0.59	20.51	42.05	14405.6	451.3
σ^2g/σ^2s		1.38	0.00152	1.75	2.02	1.99	0.587	0.770

***, ** significant at 0.05 and 0.01 levels of probability, respectively.**

b) Combining ability effects:

i) General combining ability effects:

Estimates of g.c.a. effects as given in Table (6) indicated that, L_1 showed negative insignificant values for plant height and total dry yield, while, it had positive significant values for the rest of agronomic characters. On the other hand, L_2 had significantly negative values for fresh and dry leaf/stem ratio and significantly positive values for total fresh and dry forage yields. In respect to L_3, it was poor combiner which had only positive significant value for plant height, while it had negative; with and/or without significant values; for all other characters. These results revealed that, L_1 may be consider as a good combiner for stem diameter, number of tillers and fresh and dry leaf/stem ratio, L_2 is a good combiner for fresh and dry forage yield and L_3 is a good combiner only for plant height.

Regarding to testers, results revealed that, T_1 was found to be the best combiner for all studied characters except plant height and stem diameter, while T_3 behaved the opposite trend for the same characters, approximately. The rest of testers had most significant and/or insignificant negative values. Generally it is evident that general combining ability of yield is related to the general combining ability for most of the yield components. The best combiner T_1 could be extensively used for getting combinations.

Table (6): General combining ability effects of lines and testers for studied characters overall cuts at Sakha location.

Parents	Plant height	Stem diameter	No. of tillers	Fresh leaf/ stem ratio	Dry leaf/ stem ratio	Total fresh Yield	Total dry yield
Lines (L.)							
L_1	-7.0**	0.022*	0.72**	6.50**	12.34**	-0.1	-8.56*
L_2	0.8	-0.005	0.67**	-5.71**	-7.36**	78.5**	19.72**
L_3	6.2**	-0.017	-1.38**	-0.82	-4.97**	-78.5**	-11.16**
L.S.D. (g_i-g_j) 0.05	3.4	0.028	0.32	1.37	1.47	46.63	9.53
L.S.D. (g_i-g_j) 0.01	4.5	0.038	0.43	1.83	1.96	62.02	12.67
Testers (T)							
T_1	-4.3**	0.003	1.44**	13.65**	13.59**	263.7**	48.03**
T_2	-0.8	-0.019	0.18	-4.04**	-4.74**	-41.6	-7.91
T_3	4.7**	0.008	-0.87**	-5.83**	-3.91**	-59.3**	-13.04**
T_4	-2.0	0.008	-0.14	-0.77	-1.08**	-121.0**	-23.47**
T_5	2.5	0.000	-0.60**	-3.06**	-3.85**	-42.0	-3.64
L.S.D. (g_i-g_j) 0.05	4.3	0.037	0.42	1.77	1.90	60.21	12.30
L.S.D. (g_i-g_j) 0.01	5.8	0.048	0.55	2.36	2.53	80.07	16.36

***, ** significant at 0.05 and 0.01 levels of probability, respectively.**

ii) Specific combining ability effects:

Results indicated that, most of the crosses had insignificant values of s.c.a. effects for most studied traits as shown in Table (7). The highest value of s.c.a. effects for plant height was 6.82 for cross No. 15 (L_3 x T_5) which involved high g.c.a. of female parent and medium g.c.a. for male parent. For stem diameter, all crosses had insignificant values of s.c.a. effects. In respect to number of tillers, cross No. 7 (L_1 x T_3) which involved highest g.c.a. effect of female parent had the highest s.c.a. effect (1.26), while cross No. 9 (L_3 x T_3) which involved the lowest values of g.c.a. effects for both their parents had the lowest value of s.c.a effect (-1.24). Crosses No. 1 (L_1 x T_1) and NO. 3 (L_3 x T_1) had the highest s.c.a. values for fresh and dry leaf/stem ratio, respectively, which involved the highest g.c.a. effects of both parents for the cross No. 1 and the highest g.c.a. effect of male parent for the cross No. 3. In respect of fresh and dry forage yields, the highest values of s.c.a. effects were obtained from cross No. 7 (L_1 x T_3) which had 120.1 and 28.46, respectively. This hybrid which showed favorable s.c.a. effects for total fresh and dry forage yields was posses favorable s.c.a. effects for most agronomic characters contributing yield such as stem diameter, number of tillers and fresh and dry leaf/stem ratio as shown in Table (7).

Table (7): Specific combining ability effects of crosses for studied characters overall cuts at Sakha location.

Crosses No.	(L. x T.)	Plant height	Stem diameter	No. of tillers	Fresh leaf/ stem ratio	Dry leaf/ stem ratio	Total fresh yield	Total dry yield
1	1 x 1	-0.63	-0.005	-0.21	7.27**	1.88	-23.9	-9.02
2	2 x 1	3.47	-0.031	0.12	-5.81**	-6.84**	-72.5	-10.79
3	3 x 1	-2.85	0.039	0.08	-1.47	8.72**	96.5*	19.79*
4	1 x 2	4.31	-0.011	0.26	-1.75	-2.98*	121.4**	12.33
5	2 x 2	0.51	0.041	-0.62*	-0.40	0.24	-37.2	-3.25
6	3 x 2	-4.81	-0.030	0.36	2.14	2.73*	-84.2*	-9.07
7	1 x 3	-2.59	0.037	1.26**	2.70*	8.56**	120.1**	28.46**
8	2 x 3	3.11	-0.019	-0.04	1.09	-1.89	39.5	4.18
9	3 x 3	-0.51	-0.016	-1.24**	-3.78**	-6.67**	-159.5**	-32.64**
10	1 x 4	-2.53	0.012	-0.53*	-2.95**	-4.18**	-148.2**	-27.31**
11	2 x 4	1.17	0.006	0.31	2.34*	3.63**	89.2*	16.81*
12	3 x 4	1.35	-0.016	0.21	0.62	0.55	59.2	10.49
13	1 x5	1.44	-0.030	-.81**	-5.25**	0.47	-69.2	-4.44
14	2 x 5	-8.26**	0.005	0.20	2.78*	4.85**	-18.8	-6.92
15	3 x 5	6.82*	0.026	0.59*	2.48*	-5.33**	88.2*	11.46
L.S.D. (S_{ij}-S_{kl}) 0.05		7.52	0.063	0.72	3.07	3.29	104.3	21.31
L.S.D. (S_{ij}-S_{kl}) 0.01		10.01	0.084	0.96	4.09	4.37	138.7	28.34

***, ** significant at 0.05 and 0.01 levels of probability, respectively.**

An examination of the performance of hybrids as estimated by specific combining ability effects indicated that the crosses between two good general combiners were not always good for specific combining ability (Phul *et al.,* 1973).

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تقدير بعض الثوابت الوراثية فى دخن العلف

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قسم بحوث محاصيل العلف - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية.

خلال موسم 1998 وبمحطة البحوث الزراعية بسخا تم التهجين بين ثلاثة سلالات دخن عقيمة استخدمت كأمهات وهى 23A (L_1), 23E (L_2), ICMA 98111 (L_3) وخمسة أصناف دخن استخدمت كأباء ملقحة (كشافات) وهى Sudan-2 (T_1) , ICMV 87101 (T_2), ICMV 155 (T_3), ICMV 87107 (T_4), ICMV 87111 (T_5) بنظام التزاوج القمى (Line x Tester) ونتج عن ذلك 15 هجينا قميا. وخلال موسم 1999 تم تقييم الهجن القمية الناتجة مع الكشافات وصنفين للمقارنة هما عشيرة سدس وشندويل-1 فى تجربة حقلية فى قطاعات كاملة عشوائية ذات أربع مكررات فى أربع جهات مختلفة هى مزارع محطات بحوث سخا والجميزة والاسماعيلية وسدس. وتتلخص النتائج فى الآتى:

1- كانت هناك فروقا معنوية بين المواقع لمحصول العلف الكلى الاخضر والجاف وكان أفضلها إنتاجية هى سدس حيث أعطت 2670.5 ، 346.1 جم/نبات على الترتيب. وعلى مستوى المواقع فلقد أعطى الهجين ($L_2 \times T_1$) أعلى محصول علف أخضر (1678.0 جم/نبات) فى حين أعطى الهجين ($L_2 \times T_4$) أعلى محصول علف جاف (278.3 جم/نبات). وبالنسبة لكل موقع على حده فكان أفضل الهجن لمحصول العلف الاخضر هى ($L_1 \times T_4$), ($L_1 \times T_2$), ($L_1 \times T_2$), ($L_3 \times T_1$) لكل من جهات سخا والجميزة والاسماعيلية وسدس على الترتيب وكانت نفس الهجن تقريبا بالنسبة لمحصول العلف الجاف.

2- كانت درجة التوريث فى المدى الواسع عالية (أكبر من 80%) لمعظم الصفات المدروسة.

3- كانت صفة عدد الفروع للنبات هى العامل الاساسى المؤثر فى كمية محصول العلف الاخضر والجاف حيث كانت درجة التلازم بينهما 0.756 ، 0.768 على الترتيب.

4- تباينت قوة الهجين منسوبة إلى الآباء الذكور (الكشافات) كأب ثابت من قيم معنوية سالبة إلى قيم معنوية موجبة ولقد أعطى الهجين ($L_1 \times T_2$) أعلى قوة هجن لمعظم الصفات المدروسة (55.35 ، 16.85 ، 30.81 ، 56.70 ، 43.31% لكل من صفات عدد الفروع - نسبة الورق/السوق أخضر وجاف ، محصول العلف الكلى الاخضر والجاف على الترتيب).

5- -كان تباين القدرة العامة على الائتلاف أكبر من تباين القدرة الخاصة على الائتلاف لصفات ارتفاع النبات - عدد الفروع - نسبة الورق/السوق أخضر وجاف فى حين كان تباين القدرة الخاصة على الائتلاف أكبر من تباين القدرة العامة على الائتلاف لصفات سمك الساق ومحصول العلف الاخضر والجاف.

6- تعتبر سلالة الدخن العقيم 23A (L_1) أفضل السلالات للقدرة العامة على الائتلاف لصفات سمك السابق وعدد الفروع ونسبة الورق/السوق أخضر وجاف فى حين تعتبر السلالة العقيمة 23E (L_2) أفضل السلالات لصفتى محصول العلف الاخضر والجاف والسلالة ICMA 89111 (L_3)أفضلها لارتفاع النبات. ومن حيث الكشافات فيعتبر الصنف Sudan-2 (T_2) أفضل الكشافات للقدرة العامة على الائتلاف لجميع الصفات المدروسة فيما عدا صفة ارتفاع النبات حيث كان الصنف ICMBÿV 87107 (T_4) أفضل كشاف لهذه الصفة.

7- أظهر الهجين ($L_1 \times T_3$) أعلى قدرة خاصة على الائتلاف لمعظم الصفات المدروسة فى حين أعطى الهجين ($L_3 \times T_3$) أقل قدرة خاصة على الائتلاف لنفس الصفات.