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BREEDING MILLET (*Pearel millet*) FOR FORAGE YIELD UNDER DROUGHT CONDITIONS: 1- COMBINING ABILITY IN DIALLEL CROSSES AMONG FIVE GENOTYPES.

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ABSTRACT

Pearl millet (*Pennisetum glaucum* (L) R.Br.) is a stable grain crop in the arid and semi-arid regions of Africa and India, and a new forage and grain crop in Egypt. A two year field experiments was conducted at El-Maghara Research Station (Middle Sinai), Desert Research Center, in summer growing seasons 2001 and 2002 . Half-diallel crossing system was established in summer 2001 season among five genetically diverse varieties and /or promising lines of five –rowed pearl millet to obtain a total of ten crosses. The first parent was the commercial cultivar Shandaweel-1 (P_1) and P_2 (ICMV88130), P_3 (ICMV88904) and P_4 (ICMV88908), these three lines introduced from Indian by Dr. Ebrahim Eisa (*Agric.Research Center*) and the fifth parent (P_5) was landrace grown by the farmers at the desert of Red Sea (Shlatein and Halayeb). The objective was to determine the influence of hybrid and three systems of water regimes (non stress and stress generated by irrigation at 30, 45 and 60 % available soil moisture depletion, respectively) on fresh and dry forage yield and drought susceptibility index. Significant differences among the five parents and their crosses were detected for fresh and dry forage yield at the three cuts and yield accumulates under the three different water regimes. The two crosses $P_1 \times P_5$ and $P_4 \times P_5$ and the fifth parent (P_5) gave the highest mean values for total fresh weight under the first level of soil moisture ($Irri._1$), these out yielded the third level of soil moisture ($Irri._3$) by 28.31, 34.29 and 25.01%, respectively. Whereas the two crosses $P_4 \times P_5$ and $P_1 \times P_5$ as well as the third parent (P_3) gave the highest mean values for total fresh forage yield under the second level of soil moisture ($Irri._2$) and out yielded by 16.81, 19.82 and 4.68% respectively.

The magnitudes of gca/sca ratios revealed that additive and additive by additive type gene action were more important for fresh and dry forage yield.

The mean square, due to general and specific combining ability, was highly significant for the three traits under different water regimes. Moreover, the mean squares, due to g.c.a. effects, were larger than those due to s.c.a. effects for fresh weight, drought index and dry weight except the third water regime for the same character.

Keywords: Pearl millet, drought tolerant, drought susceptibility index, combining ability and forage yield.

INTRODUCTION

In the desert region of Egypt (Shaletin and Halayep) farmers mainly grow pearl millet landraces. The adoption of modern cultivars is generally low because of their poor adaptation to extreme drought stress. Forages play a vital role in meet and milk production all over the world and also in Egypt. So, the total productions from livestock are still short to meet the requirements. This could be mainly due to shortage of forages particularly during the summer time.

The newly cultivated sandy soil is considered, as hopeful to increase green production .It is necessary to improve the yield capacity and quality of the summer forage crops as well as introduce new crops with high nutritive values to offset, the acute deficit in forage production in summer period such as pearl millet.

Studies in pearl millet indicate a preponderance of non-additive gene effects involved in forage yield (Burton, 1968, Gupta and Phul, 1981and Jauhar, 1981). Most research the subject shows that production of f_1 hybrids would be the most rapid way to improve dry forage yields in this species.

A forage-breeding program may have to consider several desirable traits of genetic improvement. In this investigation we will discuss three major traits: (1) fresh forage yield, dry forage yield and drought susceptibility index. These traits were selected because they appear to provide the greatest opportunity for improving the forage of *Pennisetum* species

MATERIALS AND METHODS

This investigation was carried out at the Experimental Station of El-Maghara (Meddle Sinai), Desert Research Center (*DRC*), Egypt, during the two successive growing seasons 2001and 2002.

Half-diallel crossing system was established in summer 2001 season among five genetically diverse varieties and /or promising lines of five –rowed pearl millet to obtain a total of ten crosses. The first parent was the commercial cultivar Shandaweel-1 (P_1) and P_2 (ICMV88130), P_3 (ICMV88904) and P_4 (ICMV88908), these three lines introduced from Indian by Dr. Ebrahim Eisa (*Agric.Research Center*) and the fifth parent (P_5) was landrace grown by the farmer at the desert of Red Sea (Shlatein and Halayeb). In summers 2002 season, the five parents and their hybrids were grown under three system of water regimes (non-stress and two stress generated by irrigation at 30, 45 and 60 % available soil moisture depletion, respectively) . The properties of the soil of the experimental field were the follows: sand 50%, silt 12%, clay 16%, organic matter 21%, Ec.09 dsm^{-1}, Ph=7.4 and soil type is sand. On the other hand, the salinity of irrigation water was 2000ppm. In each experiment entries were grown using a randomized complete block design with three replications. Each plot consisted of 3 rows for each parent or each F_1. Rows were 4m long; the seed were individually planted in 20cm a part and 50 cm between rows. Other cultural practices were followed as usual for the ordinary pearl millet field in the area except irrigation at treatments. Three cuts were taken consequently all 55 days from sowing to estimate fresh and dry forage yield depending on the yield of meter square.

Statistical analysis:

The data of experiment was subjected to proper statistical analysis according to Snedecor and Cochran (1967). General and specific combining ability estimates were obtained by employing the Griffing (1956) diallel cross analysis method-2 model-1.

Drought susceptibility index (*DSI*) was calculated according to Saulescu *et al.* (1995) as follows:

DSI=S/NS where; *S* and *NS* yield with stress conditions and non-stress.

In this study *DSI* was calculated for dry forage yield as follows:

DSI_1= irrigation no.-1/irrigation no.2, DSI_2 = irrigation no.1/irrigation no.3 and the DSI_3 = irrigation no. 2/irrigation no.3.

RESULTS AND DISCUSSION

Mean performance of different soil moisture regime:

A comparative summary of means performance for fresh and dry forage yields and accumulate for the three cuts of parental lines and their hybrids subjected to three soil moisture regimes is presented in Table 1. For any giving character, the value under stress as a percentage of that under control may be consider as a simple expression of the relative drought resistance the tested levels of stress. In this sense, mean forage yield at the three cuts and accumulate forage yield were significantly reduced by soil moisture stress.

The two crosses $P_1 \times P_5$ and $P_4 \times P_5$ and the fifth parent (P_5) gave the highest mean values for total fresh weight under the first level of soil moisture (Irri.$_1$), these out yielded compared with the third level of soil moisture (Irri.$_3$) by 28.31,34.29 and 25.01%, respectively. Whereas the two crosses $P_4 \times P_5$ and $P_1 \times P_5$ and P_3 gave the highest mean values for total fresh forage yield under the second level of soil moisture (Irri.$_2$) and out yielded by 16.81, 19.82 and 4.68% respectively.

Consequently, the accumulate total dry weight for the crosses $P_4 \times P_5$ and $P_1 \times P_5$ followed by the fifth parent (Landrace) surpassed significantly and out yielded by 45.69 and 19.09, 36.21 and 21.0 and 29.95 and 11.42% compared with the irrigation levels No.$_1$ and No.$_2$ with No.3 (control), respectively. Zeidan *et al.* (2000) found that hybrid cultivar of Napier grass and its hybrid with pearl millet surpassed the local variety in average of total green yield/fed. El-Naggar *et al.* (1999) fond that drought at both stages caused significant reduction grain yield. Singh and Singh (1995). Found that dry matter yield did not differ significantly among sorghum, maize and pearl millet under wet conditions but sorghum was superior to maize under all levels of water deficit.

The data presented in Table (2) indicated that the ordinary analysis of variance at F_1 generation for the studied traits. Significant differences among genotypes were detected for all traits in the F_1 generation and accounted for a major portion of the phenotypic variation. Mean squares related to parental varieties were found to reach the significant level in fresh and dry weight and

Table (1): the genotypes mean performance for fresh and dry forage

G	1 st cut			2 nd Cut			3rd cut			Total fresh weight (Ton/fed.)		
	Irri. 1	Irri. 2	Irri. 3	Irri. 1	Irri. 2	*Irri. 3*	Irri. 1	Irri. 2	Irri. 3	Irri. 1	Irri. 2	Irri. 3
P_1	4.475 i	8.901 e	10.202 j	11.022 g	14.15 g	17.49 d	2.973g	4.920f	5.919g	18.470l	27.976g	33.612ef
P_2	5.169h	7.506 g	8.732 m	9.337 j	11.73 j	14.35 h	1.685k	4.564g	4.807l	16.191j	23.798j	27.886j
P_3	8.333a	9.268 d	8.376 n	11.21 fg	14.81 f	16.32 f	5.348c	8.051a	9.015c	24.889e	32.131c	33.709ef
P_4	3.812 j	5.566 l	12.656 d	9.934 l	11.45 k	15.42 g	2.582l	4.193l	5.790gh	16.228j	21.213k	33.867de
P_5	5.060h	6.237 k	9.207 l	17.97 b	20.46 b	21.40 b	4.730e	5.633d	6.403f	27.755c	32.333c	37.011c
$P_1 \times P_2$	5.510g	9.925 b	11.410 g	8.345 l	12.73 l	13.55 l	3.542f	4.370h	4.667l	16.063j	28.515f	28.110j
$P_1 \times P_3$	6.727c	9.631b	13.520 b	11.39 f	13.72 h	14.26 h	3.641f	4.480gh	5.639h	21.876g	27.832g	33.417fg
$P_1 \times P_4$	5.213h	6.609 j	11.840 f	9.794 l	13.71 h	15.49 g	4.935d	5.065f	6.350f	19.942h	25.389h	33.686ef
$P_1 \times P_5$	5.506g	7.135 l	13.370 c	20.18 a	21.43 a	22.52 a	6.044b	6.922c	8.337d	31.731a	35.489b	44.263a
$P_2 \times P_3$	6.725c	8.864 e	11.310 g	10.51 h	11.66 jk	12.64 j	2.523l	7.345b	7.814e	19.760h	27.873g	31.814h
$P_2 \times P_4$	5.895f	6.673j	10.74 h	9.076 k	10.95 l	12.73 j	5.038d	8.042a	9.749a	20.008h	25.663h	33.226g
$P_2 \times P_5$	6.064e	9.018e	12.26 e	14.21 e	16.10 e	16.43 f	2.603l	3.746j	4.742l	22.880f	28.860e	33.438fg
$P_3 \times P_4$	6.416d	7.326h	10.53 l	11.05 g	12.69 l	14.23 h	2.283j	4.600g	6.226f	19.931h	24.608l	30.993l
$P_3 \times P_5$	6.958b	9.474 c	10.86 h	15.830 d	17.11 d	16.87 e	2.786h	5.333e	6.394f	25.572d	31.587d	34.117d
$P_4 \times P_5$	6.401d	8.342 f	13.91 a	17.058 c	19.86 c	20.78 c	6.946a	8.193a	9.222b	28.747b	36.392a	43.747b

-Values followed by the same letter (s) is not different at $P < 0.05$ Duncan's multiple range test.

Table (1): continuos

Genotype	1 st cut			2 nd Cut			3rd cut			Total dry weight (Ton/fed.)		
	Irri. 1	Irri. 2	Irri. 3	Irri. 1	Irri. 2	Irri. 3	Irri. 1	Irri. 2	Irri. 3	Irri. 1	Irri. 2	Irri. 3
P_1	0.883 l	1.873 d	1.835 i	1.943 l	2.861 g	2.881 l	1.014d	1.208 h	1.830 d	3.839 h	5.941 f	6.546 l
P_2	0.963 gh	1.847 def	2.158 h	2.068 h	2.948 g	3.233 g	0.383j	0.992 j	1.485 g	3.421 l	5.787 g	7.209 fg
P_3	1.619 a	1.965 c	1.832 l	2.213 g	3.082 f	3.284fg	1.308a	2.125 a	1.974 c	5.141 e	7.172 c	7.090 g
P_4	0.776 j	1.307 i	2.155 h	2.462 f	1.927 j	2.975hi	0.576h	1.144 l	1.252 l	3.814 h	4.378 l	6.382 l
P_5	1.011 g	1.286 l	2.450 f	3.786 a	4.357 b	4.022 c	0.953e	1.381 f	1.737 e	5.750 c	7.024 d	8.208 d
$P_1 \times P_2$	1.184 de	1.980 c	2.331 g	2.653 e	3.617 d	3.064 h	0.909ef	1.268 g	0.953 k	4.746 g	5.997 f	7.216 fg
$P_1 \times P_3$	1.549 b	2.075 b	2.938 b	2.638 e	3.416 e	3.877 d	0.780 g	0.802 k	1.635 f	4.968 f	6.293 e	8.451 c
$P_1 \times P_4$	1.102 f	1.658 g	2.369 g	2.400 f	2.491 l	3.409ef	1.094 c	1.254 gh	1.435 gh	4.596 g	5.402 h	6.847 h
$P_1 \times P_5$	1.147 ef	1.796 ef	3.265 a	3.614 b	3.879 c	4.325 b	1.281ab	1.845 c	1.881 d	6.042 b	7.520 b	9.471 a
$P_2 \times P_3$	0.924 hi	2.119 b	2.721 c	2.367 f	3.366 e	3.290fg	0.497 l	1.705 d	1.676 f	3.788 h	7.190 c	8.020 e
$P_2 \times P_4$	1.228 d	1.418 h	2.688 c	2.633 e	2.547 l	3.345efg	1.239 b	1.953 b	2.618 a	5.100 ef	5.918 f	8.718 b
$P_2 \times P_5$	1.099 f	1.778 f	2.597 d	3.339 c	4.636 a	3.434 e	0.864 f	0.602 l	1.175 j	5.392 d	7.016 d	7.206 fg
$P_3 \times P_4$	1.390 c	1.855 de	2.516 ef	2.730 de	2.681 h	3.097h	0.520 i	0.827 k	1.756 e	4.673 g	5.363 h	7.368 f
$P_3 \times P_5$	1.396 c	2.322 a	2.568 de	2.835 d	3.771 c	3.386ef	0.789 g	1.513 e	1.410 h	5.021 ef	6.940 d	7.364 f
$P_4 \times P_5$	1.503 b	1.942c	2.710 c	3.764 a	4.687 a	4.630 a	1.321 a	1.796 c	2.249 b	6.582 a	7.758 a	9.589 a

-Values followed by the same letter (s) is not different at $P < 0.05$ Duncan's multiple range test.

drought susceptibility index revealing overall differences between these parents.

Accordingly, the variations among entries were partitioned into general and specific combining abilities. It is clear that the mean squares, due to general and specific combining ability, were highly significant for the three traits under different water regimes. Moreover, the mean squares, due to g.c.a. effects, were larger than those due to s.c.a. effects for fresh weight, drought index and dry weight except the third water regime for the same character.

Table (2): Analysis of variance of forage yield and drought susceptibility index in 5x5 diallel pearl millet crosses.

Sources	d.f	Mean squares								
		dry weight			Fresh weight			Drought susceptibility index		
		$Irri._1$	$Irri._2$	$Irri._3$	$Irri._1$	$Irri._2$	$Irri._3$	$Dsi._1$	$Dsi._2$	$Dsi._3$
Entries	14	2.38 **	2.68 **	2.95 **	70.10 **	55.19 **	63.57 **	0.04 **	0.02 **	0.03 **
G.C.A.	4	4.45 **	6.01 **	1.92 **	178.0 **	121.3 **	127.9 **	0.07 **	0.03 **	0.06 **
S.C.A.	10	1.55 **	1.36 **	3.36 **	26.24 **	28.74 **	37.82 **	0.02 **	0.02 **	0.02 **
Error	28	0.13	0.07	0.15	1.51	0.51	0.40	0.01	0.01	0.01
GCA/SCA		2.88	4.43	0.57	6.61	4.22	3.38	18.30	1.94	2.62

* *: Significant at .01 levels of probability.

The g.c.a. to. / s.c.a. ratio for fresh weight were 6.61, 4.22 and 3.38% under the three water regime and for dry weight were 2.88 and 4.43% under the first and second water regime and drought susceptibility index were 18.25, and 2.62 % under the first and the third water regime respectively. This result indicates that the observed genetic variation, among F_1 crosses for these traits, could be attributing mostly to the additive and the additive × additive epistatic gene effects. However, the variance due to the general and specific combining ability seemed to be either equally affected by both abilities or by g.c.a., to a marginally greater extent, for drought susceptibility index under the second water regime. The gca/sca ratio for this respective character was 1.94%. This finding indicated the importance of both additive and non-additive types of gene action for this character. On the other hand, gca / sca ratio for dry weight under the third water regime was 0.57 indicating that the non- additive genetic variance was more important than the additive one in the inheritance of such traits. These findings were supported by Burton, (1968); Gupta and Phul, (1981) and Jauhar, (1981). They found that the studies in pearl millet indicate a preponderance of non-additive gene effects involved in forage yield and the most research on the subject shows that production of F_1 hybrids would be the most rapid way to improve dry matter (DM) yield in these species.

Research by Solanki and Hooda (1979), and Verma and Ramanujam (1975) showed that pearl millet breeders should exploit the non-additive genetic variation by developing hybrids. The greatest opportunity for increasing forage productivity of pearl millet is through the development of hybrids.

The present study further indicates that the best general parental combiners for fresh and dry forage yield and drought susceptibility index under the three-water regime were the landrace (P_5) followed by the millet strain (P_3) (Table.3) due to their higher of g.c.a. . It is worthy to note that these high combiners for fresh and dry forage yield also were high combiners for drought susceptibility index.

Table (3): Estimates of general combining effects of the parents 5x5 diallel pearl millet crosses for forage yield and drought susceptibility index.

Parents		Fresh weight			Dry weight			Drought susceptibility index		
		$Irri._1$	$Irri._2$	$Irri._3$	$Irri._1$	$Irri._2$	$Irri._3$	$Dsi._1$	$Dsi._2$	$Dsi._3$
P_1		-0.79 **	0.19 **	0.22 **	-0.16 *	-0.17	-0.17 **	-0.01 *	-0.01	-0.01 *
P_2		-2/.99 *	-1.91 *	-3.26 **	-0.47 *	-0.08 *	-0.10 **	-0.07 *	-0.05 *	-0.01
P_3		0.71	0.61 **	-1.06 **	-0.06 *	0.26 *	-0.13 *	-0.03	0.01	0.05 *
P_4		-1.55**	-2.48 **	0.61 **	-0.08 **	-0.73 **	-0.14 **	0.08	0.001	-0.08
P_5		4.63 **	3.59 **	3.49 **	0.77 **	0.72 **	0.54 **	0.03	0.05	0.04 *
LSD	0.05	0.49	0.28	0.25	0.14	0.11	0.16	0.03	0.03	0.02
gi-gj	0.01	0.69	0.39	0.34	0.20	0.15	0.21	0.04	0.04	0.04

***&**: Significant at 0.05 and 0.01 levels of probability.**

Considering the general combining ability effects for these traits, it was suggested that a pearl millet population, involving the above millet cultivars, could be developed in a multiple crossing program for selecting high yielding ability lines with good fodder yield under the drought environmental conditions. Consequently, the choice of parents for hybridization should base on the performance of the parents per se and they're combining ability effects. Burton (1962) released the first pearl millet forage hybrid, Gahi 1 that yielded 52% more dry matter than Common and 35% more than Starr.

Regarding Table 4, it was emphasized that the estimates of specific combining ability effects were significant for all affected crosses for accumulate fresh and dry forage yield and drought susceptibility index under the three-water regime.

Table (4): Estimate of specific combining ability effects in 5x5 diallel pearl millet crosses for fodder yield and drought susceptibility index.

Crosses	Fresh weight			Dry weight			Drought susceptibility index		
	$Irri._1$	$Irri._2$	$Irri._3$	$Irri._1$	$Irri._2$	$Irri._3$	$DSI._1$	DSI_2	DSI_3
$P_1 \times p_2$	-2.17**	1.59 **	-3.05 **	0.52 **	-0.13	-0.23	0.10 **	0.09 **	0.01
$P_1 \times p_3$	-0.05	-1.61 **	0.07	0.33	-0.18	1.04 **	0.08 *	-0.04	0.13 **
$P_1 \times p_4$	0.27	-0.96 *	-1.33 **	-0.02	-0.08	-0.55 **	0.01	0.05	0.04
$P_1 \times p_5$	5.88**	3.07 **	6.36 **	0.57 **	0.59 **	1.39 **	0.02	-0.04	-0.07 *
$P_2 \times p_3$	0.04	0.52	1.90 **	-0.54 **	0.63 **	0.53 *	-0.13 **	-0.11**	0.02
$P_2 \times p_4$	2.55**	1.41 **	1.69 **	0.79 *	0.35 *	1.25 **	0.08 *	0.01	-0.07 **
$P_2 \times p_5$	-0.76	-1.45 **	-0.98 *	0.23	0.01	-0.95 **	0.05	0.12 **	0.10 **
$P_3 \times p_4$	-1.14*	-2.17 **	-2.74 **	-0.04	-0.56 **	-0.08	0.06 *	-0.01	-0.07 *
$P_3 \times p_5$	-1.77**	-1.26 **	-2.51 **	-0.55 **	-0.42 **	-0.76 **	-0.35 **	-0.01	0.02
$P_4 \times p_5$	3.67**	6.64 **	5.46 **	1.04 **	1.39 **	1.48 **	-0.28 **	-0.00	0.75 **
L.S.D 0.05	1.90	1.10	0.99	0.56	0.41	0.61	0.04	0.10	0.11
0.01	2.99	1.50	1.33	0.76	0.56	0.83	0.13	0.14	0.12
SiJ-sik 0.05	1.74	1.00	0.89	0.51	0.37	.55	0.09	0.09	0.08
0.01	2.37	1.36	1.22	0.70	0.51	0.76	0.12	0.12	0.11

***&* *: Significant at 0.05 and 0.01 levels of probability.**

The desirable inter-and intra allelic interaction were represented in the F_1 generation by the three crosses P_1xP_5, P_2xP_4 and P_4xP_5 and one cross

P_2xP_3 for fresh forage yield under the three water regime and irrigation with 60% from the field capacity, respectively. Whereas, two crosses P_1xP_5 and P_2xP_5, P_2xP_3 and one cross P_2xP_4 for dry forage yield under the three water regime, second and third system of water field capacity, respectively. Also, four crosses P_1xP_2, P_2xP_3, P_2xP_4 and P_3xP_4 and two crosses P_1xP_2 and $P_2xP_5$and three crosses P_2xP_3, P_2xP_5 and $P_4xP_5$for drought susceptibility index under Erri.no. 1, 2 and 3, respectively.

These crosses might be of interest in breeding program towards pure line varieties as most of them involve at least one good combiners for the character in view. This finding agreed with Nouri Maman *et al.* (1999) and El-Nagger *et al.* (1999).

The results further indicted hat the crosses, P_1xP_5, P_2xP_4, P_4xP_5, P_2xP_3 and P_1xP_5, P_2xP_5, P_2xP_3, P_2xP_4 exhibited significant and positive estimates of s.c.a. for the studied traits. These finding lead to the conclusion that high estimates of specific combining ability, in any cross combination, might not necessarily be dependent upon the general combining ability effects in the involved parent for the different studied characters.

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تربية الدخن (الدخن اللؤلؤي) لمحصول العلف تحت ظروف الجفاف:
١-القدرة علي التآلف في التهجين بين خمسة تراكيب وراثية.

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***قسم المحاصيل -كلية العلوم الزراعية بمشتهر- جامعة الزقازيق-فرع بنها**
****قسم الأصول الوراثية-مركز بحوث الصحراء - المطرية -القاهرة**

اجري هذا البحث في محطة بحوث المغارة (بمنطقة وسط سيناء) التابعة لمركز بحوث الصحراء خلال موسمي ٢٠٠١ ,٢٠٠٢ حيث تم التهجين بين خمسة أباء من الدخن متباينة وراثيا بنظام الداياليل غيرالعكسى بطريقة جريفينج ١٩٥٦ الطريقة الثانية الموديل الأول وذلك بهدف تقدير القدرة علي التآلف لكل من الأباء والهجن الناتجة منها لمحصول العلف الغض والجاف التراكمي لثلاث حشات مختلفة تحت تأثير ثلاث مستويات مختلفة من الرطوبة الأرضية عند السعة الحقلية (٣٠-٤٥-٦٠%) . كما تم تقدير معامل الإجهاد البيني لتحمل الجفاف لمحصول العلف الجاف تحت تأثير مستويات الرطوبة السابقة .

هذا وقد أوضحت النتائج أن كانت كل من القدرة العامة والخاصة علي التآلف عالية المعنوية لجميع الصفات المدروسة

ومن ناحية أخري تم تقدير القدرة علي الائتلاف فكانت معنوية موجبة أو معنوية سالبة في بعض الهجن مثل: (الأب الأول × الأب الخامس ، الأب الثانى × الأب الرابع ، الأب الرابع × الأب الخامس ، الأب الثانى × الأب الثالث ، الأب الثانى × الأب الخامس) والتي يمكن اعتبارها كهجن مبشرة في تربية الدخن لمحصول العلف الغض والحاف في المناطق الجافة وشبة الجافة ، كما أظهرت تقديرات معامل الإجهاد البيني أن الهجن (الأب الأول × الأب الثانى ، والأب الثانى × الأب الثالث ، الأب الثانى × الأب الرابع ، الأب الثالث × الأب الرابع ،الأب الأول × الأب الثانى ، الأب الثانى × الأب الخامس ، الأب الرابع × الأب الخامس)كانت ذات قدرة غالية علي التآلف لمحصول العلف الجاف تحت ظروف المستويات المختلفة للرطوبة الأرضية من السعة الحقلية.

وعليه يمكن الاستفادة من هذه الهجن في برامج التربية لانتاج سلالات اكثر مقاومة للجفاف خاصة وأن معظم آبائه تمتلك قدرة عامة عالية علي التآلف بالنسبة للصفات تحت الدراسة.