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EVALUATION OF YIELD AND STABILITY IN EARLY GENERATIONS OF FLAX HYBRIS. I. STRAW YIELD AND ITS COMPONENTS

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Abstract

Combining ability and stability performance for straw yield/plant and its component traits viz., plant height, technical stem length and no.of basal branches were studied in the F_3 and F_4 generations of 36 diallel crosses involving nine flax parents (P_1=Giza-7P_2=Giza-8,P_3 =S.2419/1, P_4 =S.2656/1, P_5= S.148/6/1 , P_6=S.237/1, P_7 =S.110/3, P_8=Gawhar-552 and P_9=Ariane-R_3)testing was made over three diverse environments.

The data revealed predominance of additive gene effects in the genetic control of the traits straw yield/plant, plant height and technical stem length. Specific(SCA) combining ability and SCA x environment interactions were much larger than general (GCA) combining ability and GCA x environment interactions. Indicating that non- additive gene effects were stable over environments, whereas additive effects were much influenced by environments. Hence testing for specific combining ability for these traits at few selected environments would may provide useful results. P1and P_3 showed high general combining ability for straw yield/plant and technical stem length in the F_3 and F_4 generations across environments. Also, P5 and P6 showed positive GCA effects for plant height and technical stem length over environments and generations. P_2 showed positive GCA effects for straw yield / plant only. Out of the 36 crosses included in this study 17 crosses for each of straw yield/plant and technical stem length were identified to be superior over generations by measuring for yield and stability criterion (YS_i). Ten out of these crosses ($P_1 \times P_2$, $P_1 \times P_3$, $P_1 \times P_4$, $P_3 \times P_5$, $P_3 \times P_6$, $P_3 \times P_7$, $P_3 \times P_9$, $P_5 \times P_6$, $P_5 \times P_9$ and $P_6 \times P_7$) revealed consistency for straw yield/plant and its two important components viz., plant height and technical stem length in both generations. Out of these ten crosses, which showed consistent superiority in integrating yield and stability criterion (Ys_i) in both F_3 and F_4 generations, four crosses ($P_1 \times P_2$, $P_1 \times P_3$, $P_5 \times$ P9, and P6 $\times$ P7) exhibited significant positive SCA effects for straw yield/plant, plant height and technical stem length. Moreover, the integrating yield and stability performance (Ys_i) may be used as predictive criteria for selection of crosses before pure line derivation.

INTRODUCTION

The diallel cross technique proposed by Griffing (1956) has been widely used for evaluation of general combining ability (GCA) which is due to additive gene action and specific combining ability (SCA) which is due to non-additive gene effects .The difficulty in producing enough F1 hybrid seeds in some self pollinated crops have limited the use of diallel analysis, and in such cases, F2 diallels may be more appropriate. However F2 diallels estimate dominance with only half the efficiency of F1 diallels(Allard 1956).

Genotype x environment interaction continues to be a challenging issue for plant breeders. A significant GE interaction for a quantitative trait reduces the usefulness of genotype means over all environments for selecting and advancing superior genotypes to the next stage of selection and has been shown to reduce progress from selection (Comstock and Moll, 1963; Kang and Martin, 1987). A yield-stability statistic (YSi) was developed by Kang (1993)and Kang and Magari (1995) for the simultaneous selection for yield and stability. The main objectives for this study were: (1) to evaluate possibility of selection in F3 and F4 generations for high yield performance with satisfactory yield . and (2) to estimate general and specific combining ability as well as their interactions with environment.

MATERIALS AND METHODS

The materials used for the present investigation consisted of 36 possible diallel crosses among nine flax genotypes (the full details of these crosses in both F_1 and F_2 generations were reported by Abo-Kaied 1999). The parents included two standard cultivars (P_1=Giza 7 and P_2=Giza 8), five advanced experimental strains (P_3=S.2419/1, P_4=S.2656/1, P_5=S.148/6/1, P_6=S.237/1 and P_7=S.110/3) and two introductions (P_8=Gawhar-552 and P_9=Ariane-R_3) . In 1999/2000 season, a part of the F_2 seed bulks of the 36 diallel crosses was used to evaluate their F_3 progenies at Giza, Gemmiza, Zarzoora experiment stations of the Agricultural. Research Center; located at Giza, Gharbia and El-Beheira Governorates, respectively. In 2000/2001season,the remaining part of the seed bulks of the 36 diallel crosses besides quantities of their correspondingF$_3$ seed bulks, resulted from 1999/2000 season, were used to evaluation the F_3 and F_4 generations at the three previous experiment stations .The evaluation experiments had a randomized complete block design with 3 replications and a restricted randomization where each plot consisted of two rows for each cross in F_3 and F_4 generations.

Rows were 2m long, and 20 cm apart. Single seeds were evenly drilled by hand in 5 cm spacing along the row. Normal recommended agronomic practices were applied. Ten guarded plants from each plot were measured for plant height, technical stem length , number of basal branches/plant and straw yield per plant.

Plot means were used for statistical analysis. Data from each macro environment (combinations of years and locations) were analyzed and Barteltt's test was used to test for heterogeneity of error variances across environments before combined analysis. In the combined analysis, environmental effect was assumed to be fixed. General (GCA) and specific (SCA) combining abilities were calculated according to Griffing's method 4, model 1 (fixed effects). Forms of analysis for individual environments as given by Griffing (1956) and for combined analysis as suggested by Singh (1973) were used. Data were subjected to yield - stability (Ys_i) analysis as outlined by Kang (1993) using the computer program " interactive program for calculating Shukla's stability variance and Kang's yield - stability (Ys_i) statistics" developed by Kang and Magari (1995).

RESULTS AND DISCUSSION

Combining ability:

General and specific combining ability variances for straw yield and its component traits, viz., plant height, technical stem length and no.of basal branches per plant were significant in both F_3 and F_4 generations for all environments and combined over environments, with the exception of the GCA and SCA variances in E_2 and E_3 for no. of basal branches in F_4 generation, and SCA variances for the same character in E_2 for F_3 in both seasons. Also the SCA variances of straw yield in E_2 for F_4 and plant height in E_2 and E_3 for F_4 generation did not reach the level of significance (Table1).

The ratio of general to specific combining ability variances for each environment and across environments was significant for straw yield and its components, plant height and technical stem length, indicating the predominance of additive gene effects in the genetic control of these traits. These results agree with published research (Murty and Anand 1966; Murty et al., 1967; Mourad, 1977; Mourad and Hella, 1987 : El-Farouk et al., 1998; and Abo-El-Zahab and Abo-Kaied,2000).

Although SCA mean squares were significant for all characters in F_3 and most characters in F_4, the magnitude of GCA mean squares were several times greater than SCA mean squares for straw yield, plant height and technical stem length. Therefore, the magnitude of additive genetic effects, must be of considerable value for each character. Consequently, effective selection should be possible within these F_3 and subsequent populations for straw yield/plant, plant height and technical stem length. Similar results were reported by Abo-El-Zahab and Abo-Kaied (2000).

Combining ability × environment interactions:

The interaction effects of GCA with environments were highly significant in the F_3 and F_4 generations for straw yield and its components with the exception of no.of basal branches per plant and staw yield in F_4 only. However, GCA and SCA mean squares were much larger than their interaction components (GCA × environment and SCA × environment) for these traits in F_3 and F_4 generations (Table1). But, the relatives between SCA and SCA x environment interactions were much larger than GCA and GCA x environment interactions. These results reveal that non- additive gene effects were stable over environments, whereas additive effects were more influenced by environment. Hence information on SCA for these traits can be obtained from a limited at a

Table1. Mean squares of individual and combined analyses of variance for 36 flax crosses in F3 and F4 generations evaluated at environments (E)for straw yield and its component traits,during1999/2000 and 2000/2001seasons.

s.o.v.	Straw yield/plant (g)										
	F3							F4			
	1999/2000			2000/2001			C.	2000/2001			C.
	E1	E2	E3	E1	E2	E3		E1	E2	E3	
Rep./E	2.623	2.393	7.301	1.216	1.138	2.861	2.922	3.485	0.990	2.315	2.260
Environments(E)							126.835 **				98.060 **
Crosses (C)	23.632 **	13.251 **	20.515 **	22.725 **	12.481 **	16.606 **	72.924 **	19.659 **	11.357 **	20.358 **	40.050 **
C * E							7.258 **				5.660 **
Heterogeneity							18.522 **				9.109 **
Residual							4.442 **				2.230 *
GCA	19.24 **	12.567 **	20.431 **	17.807 **	11.543 **	11.079 **	44.277 **	13.809 **	11.418 **	17.84 **	40.000 **
SCA	4.511 **	2.002 *	2.811 **	4.543 **	1.973 **	3.893 **	18.392 **	4.403 **	1.524	3.51 **	5.450 **
GCA*E							9.678 **				1.530
SCA*E							0.268 **				1.990 *
Pooled erorr	0.976	1.093	1.179	1.022	0.599	1.168	1.006	1.282	1.275	1.450	1.340
GCA/SCA	4.265 **	6.277 **	7.268 **	3.920 **	5.850 **	2.846 *	2.407 *	3.136 *	7.490 **	5.083 **	7.339 **
	No. of basel branches/plant										
Rep./E	0.096	0.017	0.231	0.041	0.123	0.216	0.121	0.015	0.005	0.150	0.060
Environments(E)							3.333 **				6.600 **
Crosses (C)	0.727 **	0.26 **	0.582 **	0.655 **	0.286 **	0.553 **	1.363 **	0.499 **	0.277 **	0.477 **	0.830 **
C*E							0.339 **				0.210 **
Heterogeneity							1.162 **				0.410 **
Residual							0.133 **				0.007
GCA	0.259 *	0.232 *	0.237 **	0.242 **	0.243 **	0.243 *	0.243 **	0.24 *	0.088	0.145	0.320 **
SCA	0.234 **	0.082	0.193 **	0.212 **	0.086	0.194 *	0.539 **	0.145	0.094	0.163	0.270 **
GCA*E							0.185 **				0.080
SCA*E							0.092				0.070
Pooled erorr	0.111	0.097	0.086	0.095	0.098	0.100	0.098	0.125	0.129	0.108	0.120
GCA/SCA	1.109	1.259	1.020	1.141	1.305	0.997	0.336	1.657	0.934	0.890	1.185

Table1. Continued

s.o.v.	F3 1999/2000 E1	F3 1999/2000 E2	F3 1999/2000 E3	F3 2000/2001 E1	F3 2000/2001 E2	F3 2000/2001 E3	F3 C.	F4 2000/2001 E1	F4 2000/2001 E2	F4 2000/2001 E3	F4 C.
plant height (cm)											
Rep./E	10.620	15.215	52.990	9.805	16.605	28.950	22.360	33.835	29.215	31.080	31.377
Environments(E)							11032.24 **				12243.89 **
Crosses (C)	431.346 **	217.596 **	423.757 **	414.257 **	217.171 **	422.627 **	1671.740 **	374.816 **	270.857	100.100 **	838.591 **
C*E							91.08 **				119.166 **
Heterogeneity							385.159 **				231.986 **
Residual							17.528 **				6.343
GCA	329.834 **	255.934 **	469.685 **	311.196 **	258.299 **	468.911 **	1448.44 **	208.315 **	261.569 **	415.349 **	571.478 **
SCA	88.656 **	18.191 **	43.939 **	86.794 **	18.379 **	43.68 **	293.56 **	100.235 **	39.540	63.292	193.027 **
GCA*E							129.08 **				156.878 **
SCA*E							1.210				5.019
Pooled erorr	10.823	10.799	11.532	5.651	10.570	11.337	10.120	35.985	33.243	40.981	36.736
GCA/SCA	3.720 **	14.069 **	10.689 **	3.585 **	14.054 **	10.735 **	4.934 **	2.078	6.615 **	6.562 **	2.961 *
Technical stem length (cm)											
Rep./E	5.454	29.448	14.422	5.594	30.061	12.316	16.216	13.590	12.670	6.260	10.840
Environments(E)							4128.96 **				3870.980 **
Crosses (C)	339.978 **	186.815 **	366.561 **	334.695 **	187.578 **	362.994 **	1298.03 **	298.549 **	219.668 **	390.902 **	668.100 **
C*E							95.96 **				120.580 **
Heterogeneity							373.773 **				237.150 **
Residual							26.505 **				3.993
GCA	261.084 **	217.503 **	334.488 **	251.929 **	219.778 **	330.705 **	1187.6 **	181.779 **	192.02 **	301.085 **	370.890 **
SCA	69.546 **	16.277 *	59.283 **	69.976 **	15.603 *	58.863 **	209.09 **	75.143 **	38.007 **	79.698 **	178.790 **
GCA*E							85.576 **				152.020 **
SCA*E							16.091 **				7.030
Pooled erorr	7.130	9.250	9.536	5.248	9.287	9.856	8.385	21.006	17.812	22.849	20.560
GCA/SCA	3.754 **	13.362 **	5.642 **	3.600 **	14.085 **	5.618 **	5.680 **	2.419 **	5.052 **	3.778 **	2.074

*,** indicating significant and highly significant ,respectively.
E1,E2 andE3=Giza,Gemmiza and Zarzoora,respectively
C.= combined over environments .

few number of environments compared to GCA. Patil and Chapde ,1981 reported similar results in flax .

GCA effects:

The estimates of GCA effects are presented in (Table 2). P_1(Giza7) and P_3 (S.2419 /1) showed high general combining ability for straw yield and technical length in F_3 and F_4 generations for individual environments and combined over environments . Also, P5 (S.148/6 /1) and P6 (S.237/1) showed positive GCA effects for plant height and technical length over environments and generations. P_2 (Giza 8) showed positive GCA effects for straw yield only. The GCA estimates of the parents were consistent over generations, indicating that the F_3 data may give reliable indication of combining ability for straw yield. However, GCA effects for no. of basal branches per plant for all parents were unstable over generations and environments except P_4 (S.2656 /1) which showed negative GCA effects for all environments and generations. Therefore, this trait seemed to be influenced by environmental conditions and selection for this trait will be misleading.

SCA effects:

Out of the 36 F_3 and F_4 crosses, only three crosses: $P_1 \times P_2$, $P_5 \times P_9$ and P6¥ P7 showed highly significant positive SCA effects for straw yield in individual environments and over environments in both F_3 and F_4 generations (Table3). It could be noticed that the cross $P_1 \times P_2$ involved high × high general combiners for straw yield, which represented additive × additive type of interactions. Hence, this cross may yield transgressive segregates in later generations (Bhatade and Bhale 1983).

Stability measurement:

Mean squares from the individual and combined analyses of variance over environments for 36 crosses in F_3 and F_4 generations for straw yield and its components are presented in Table 1. Highly significant variance due to crosses revealed the presence of genetic variability in the material under investigation for all traits. The crosses x environment interactions (C x E) were highly significant for these characters indicating differential expression of crosses over environments. Therefore, it is important to give much consideration to C x E while breeding flax to improve straw yield. Environments differed significantly for straw yield and its components, indicating a wide range of variation among the environments studied.

The variances due to C x E (linear), i.e, heterogeneity was statistically significant for straw yield/plant and its components in both F_3 and F_4 generations, indicating that these crosses differed genetically in their response to different environments when tested with pooled deviation. The variances due to the pooled deviation from re-

Table2.Estimates of GCA effects for straw yield /plant and its components in individual environments (E) and combined (C.) over environments for 9- parents diallel cross in flax.

Parents	Straw yieldlplant (g)										
	F3							F4			
	1999/2000			2000/2001			C.	2000/2001			C.
	E1	E2	E3	E1	E2	E3		E1	E2	E3	
P1 #	0.710 **	0.481 **	1.420 **	0.970 **	0.593 **	0.970 **	0.857 **	1.014 **	0.581 *	1.240 **	0.945 *
P2	1.060 **	1.297 **	1.130 **	1.110 **	1.194 **	0.980 **	1.129 **	1.261 **	1.398 **	1.440 **	1.366 **
P3	3.510 **	2.023 **	2.250 **	3.290 **	2.125 **	1.600 **	2.466 **	2.692 **	1.962 **	2.180 **	2.278 **
P4	-1.440 **	-0.934 **	-0.540 *	-1.270 **	-0.794 **	0.610 *	-0.728 **	-0.526 *	0.029	-0.490 *	-0.329
P5	-0.360 **	0.995 **	0.100	-0.580 **	0.582 **	0.300	0.173	-0.386	0.043	0.520 *	0.059
P6	0.520 **	0.137	-1.010 **	0.400 **	0.105	-1.130 **	-0.163	-0.058	-0.048	-0.100	-0.069
P7	-0.950 **	-0.741 **	0.460 *	-1.090 **	-0.954 **	-0.370	-0.608 **	-1.005 **	-0.925 **	-0.790 **	-0.907 *
P8	-1.310 **	-2.185 **	-3.670 **	-1.380 **	-2.112 **	-2.470 **	-2.188 **	-1.476 **	-2.364 **	-3.190 **	-2.343 **
P9	-1.730 **	-1.072 **	-0.120	-1.460 **	-0.741 **	-0.480 *	-0.934 **	-1.517 **	-0.677 *	-0.820 **	-1.005 *
LSD 5%	0.587	0.398	0.697	0.587	0.438	0.678	0.564	0.475	0.458	0.484	0.472
(Sij-Sik)1%	0.903	0.612	1.072	0.903	0.674	1.044	0.868	0.731	0.705	0.745	0.727
	Plant heigh/plant (cm)										
P1	5.350 **	4.608 **	8.680 **	5.040 **	5.608 **	8.740 **	6.338 **	5.445 **	7.537 **	9.120 **	7.367 **
P2	-0.060	-3.574 **	-2.240 *	0.020	-2.574 **	-2.450 **	-1.813 **	-0.618	-1.210	-1.730	-1.186
P3	10.880 **	3.703 **	3.790 **	10.640 **	3.703 **	3.860 **	6.096 **	4.233 **	3.020 *	4.000 *	3.751 *
P4	-2.390 **	-2.090 **	-3.480 **	-2.560 **	-2.990 **	-3.420 **	-2.822 **	1.923	-0.226	-2.080	-0.128
P5	3.490 **	2.142 **	3.070 **	3.460 **	2.356 **	3.140 **	2.943 **	4.235 **	3.610 **	3.580 *	3.808 *
P6	1.110	4.044 **	4.410 **	1.090 *	3.829 **	4.470 **	3.159 **	1.761	4.061 **	4.530 **	3.451 *
P7	-0.340	2.836 **	1.150 *	0.090	2.836 **	1.210	1.297 **	0.290	-1.301	-2.080	-1.030
P8	-13.93 **	-15.07 **	-19.55 **	-13.33 **	-14.17 **	-19.49 **	-15.923 **	-11.479 **	-14.082 **	-17.990 **	-14.517 **
P9	-4.110 **	1.402 **	4.160 **	-4.460 **	1.402 *	3.950 **	0.391 **	-5.790 **	-1.409	2.640	-1.520
LSD 5%	1.888	1.677	2.080	1.375	1.677	2.132	1.805	1.958	2.174	2.693	2.275
(Sij-Sik)1%	2.906	2.581	3.202	2.116	2.581	3.281	2.778	3.013	3.346	4.144	3.501

Table2. Continued

Parents	F3							F4			
	1999/2000			2000/2001			C.	2000/2001			C.
	E1	E2	E3	E1	E2	E3		E1	E2	E3	
Technical stem length /plant (cm)											
P1 #	3.230 **	4.505 **	3.600 **	3.070 **	4.705 **	3.700 **	3.802 **	3.654 **	3.752 **	3.330 **	3.579 *
P2	0.190	-2.134 **	-1.360 *	0.260	-2.134 **	-1.490 *	-1.111 *	-0.541	-1.156	-1.700	-1.132
P3	8.370 **	2.803 **	2.820 **	8.160 **	2.603 **	2.700 **	4.576 **	4.134 **	2.905 **	3.330 **	3.456 *
P4	-1.030 *	-1.530 *	-3.000 **	-1.030 *	-1.550 *	-2.900 **	-1.840 **	1.234	-0.303	-1.700	-0.256
P5	3.850 **	1.812 **	1.840 *	3.850 **	1.446 *	1.710 *	2.418 **	3.813 **	2.911 **	2.460 *	3.061 *
P6	1.720 **	5.002 **	5.840 **	1.760 **	5.368 **	5.930 **	4.270 **	2.658 *	4.732 **	5.240 **	4.210 **
P7	1.190 **	2.283 **	-0.200	1.420 **	2.282 **	-0.110	1.144 *	1.620	-0.359	-1.470	-0.070
P8	-13.46 **	-13.41 **	-16.33 **	-13.10 **	-13.37 **	-16.23 **	-14.317 **	-10.927 **	-12.824 **	-15.590 **	-13.114 **
P9	-4.070 **	0.648	6.810 **	-4.390 **	0.650	6.690 **	1.056	-5.645 **	0.341	6.110 **	0.269
LSD 5%	1.521	1.721	1.837	1.045	1.721	1.864	1.618	1.745	1.591	1.802	1.713
(Sij-Sik)1%	2.341	2.649	2.827	1.608	2.649	2.869	2.491	2.686	2.449	2.773	2.636
No.of basel branches/plant											
P1	-0.080	-0.034	-0.211 **	-0.040	-0.024	-0.220 **	-0.102	-0.028	-0.034	-0.080	-0.047
P2	0.140	0.224 **	0.101	0.090	0.234 **	0.100	0.148 *	0.152	0.166 **	0.240 **	0.186 **
P3	0.180 *	0.118 *	-0.100	0.180 *	0.128 *	-0.110 *	0.066	0.270 **	0.077	-0.120 *	0.076
P4	-0.220 *	-0.106 *	-0.210 **	-0.210 *	-0.136 *	-0.200 **	-0.180 **	-0.206 *	-0.176 **	-0.180 **	-0.187 **
P5	-0.270 **	0.076	0.110 *	-0.280 **	0.046	0.110 *	-0.035	-0.254 *	-0.056	0.140 *	-0.057
P6	-0.040	-0.120 *	-0.150 *	0.000	-0.110 *	-0.140 *	-0.093	-0.113	-0.104	-0.120 *	-0.112
P7	0.050	-0.114 *	0.177 **	0.000	-0.114 *	0.180 **	0.030	-0.020	-0.054	-0.030	-0.035
P8	0.320 **	-0.021	0.053	0.330 **	-0.011	0.050	0.120 *	0.235 *	0.111 **	-0.010	0.112 *
P9	-0.100	-0.004	0.224 **	-0.070	-0.014	0.220 **	0.043	-0.037	0.071	0.150 *	0.061
LSD 5%	0.257	0.136	0.165	0.183	0.136	0.165	0.174	0.167	0.106	0.112	0.128
(Sij-Sik)1%	0.395	0.209	0.254	0.282	0.209	0.254	0.267	0.257	0.164	0.172	0.198

For expanation see Table (1) .

(P1 = Giza7 and P2=Giza8,P3=S.2419/1,P4=S.2656/1,P5=S.148/6/1,P6=S.237/1,P7=S.110/3, P8=Gawhar-552 and P9=Ariane-R3)

Table3. Estimates of SCA effects for straw yield /plant and its components in individual environments (E) and combined (C.) over environments for 36 flax crosses.

Crosses	Straw yield/plant (g)										
	F3							F4			
	1999/2000			2000/2001			C.	2000/2001			C.
	E1	E2	E3	E1	E2	E3		E1	E2	E3	
1x2	3.140 **	2.902 **	3.170 **	2.600 **	3.081 **	3.160 **	3.009 **	2.617 **	2.041 **	1.799 **	2.152 **
1x3	2.140 **	0.515	-0.640	1.810 **	0.763 *	1.110	0.950 *	0.756	0.460	0.528	0.581
1x4	0.740	-0.294	0.510	0.210	-0.358	0.620	0.238	1.151 *	-0.227	-0.823	0.034
1x5	-1.000 *	-2.050 **	-2.410 **	-1.160 *	-1.560 **	-2.770 **	-1.825 **	-1.619 **	-1.390	-3.324 **	-2.111 **
1x6	-1.100 *	-0.005	-2.460 **	-1.350 **	0.104	-2.500 **	-1.219 *	-1.904 **	-1.277 *	-2.375 **	-1.852 **
1x7	0.280	-1.720 **	1.790 **	0.050	-1.431 **	1.500 *	0.078	-0.013	-0.969	1.689 **	0.236
1x8	-2.980 **	1.297 **	2.550 **	-3.190 **	0.300	1.190	-0.139	-2.569 **	0.080	3.312 **	0.274
1x9	-1.210 *	-0.646	-2.510 **	1.030 *	-0.900 *	-2.310 **	-1.091 *	1.582 **	1.282 *	-0.806	0.686
2x3	4.180 **	0.320	0.320	4.260 **	-0.744 *	-3.340 **	0.833	3.479 **	0.214	0.352	1.348 *
2x4	-2.040 **	0.783 *	-0.740 *	-0.610	0.769 *	3.140 **	0.217	1.897 **	0.673	0.265	0.945
2x5	-2.460 **	0.275	0.030	-2.530 **	0.166	-0.620	-0.857	-1.587 **	0.113	-0.477	-0.650
2x6	-0.660	-0.467	-0.850 *	-0.640	-0.143	-1.190	-0.658	-1.818 **	-0.933	-0.738	-1.163 *
2x7	0.160	-0.569	-1.360 **	-0.260	-0.065	-0.980	-0.512	-0.587	-0.219	-0.044	-0.283
2x8	-2.110	-1.889 **	-1.600 **	-2.160 **	-1.670 **	-3.260 **	-2.115 **	-2.453 **	-2.493 **	-2.977 **	-2.641 **
2x9	-0.200	-1.355 **	1.030 **	-0.660	-1.394 **	3.080 **	0.084	-1.549 **	0.603	1.821 **	0.292
3x4	-2.170 **	-2.703 **	-0.840 *	-2.320 **	-2.756 **	-1.950 **	-2.123 **	-2.821 **	0.195	-0.173	-0.933
3x5	1.600 **	-0.235	0.170	1.860 **	0.708 *	2.910 **	1.169 **	2.116 **	0.659	-0.221	0.851
3x6	0.040	0.676	-0.040	0.150	-0.275	0.120	0.112	0.548	-1.251 *	-0.219	-0.307
3x7	-2.350 **	-0.119	-0.700 *	-2.160 **	0.180	0.170	-0.830	-0.921	-0.437	-1.577 *	-0.978
3x8	-1.060 *	1.445 **	2.250 **	-0.990 *	1.459 **	1.090	0.699	-1.174 *	1.159 *	1.865 **	0.617
3x9	-2.380 **	0.102	-0.520	-2.610 **	0.664 *	-0.120	-0.811	-1.983 **	-0.999	-0.556	-1.179 *
4x5	-0.880 *	2.619 **	1.230 **	-1.030 *	2.714 **	-0.730	0.654	-1.460 *	0.021	1.582 *	0.048
4x6	-1.690 **	-0.933 **	0.780 *	-1.920 **	-0.852	-0.860	-0.913 *	-2.221 **	-1.455 *	-0.246	-1.307 *
4x7	0.500	-0.405	1.400 **	0.270	-0.144	0.480	0.350	-0.574	0.460	1.835 **	0.574
4x8	3.260 **	0.112	-2.870 **	3.310 **	0.088	0.180	0.680	2.643 **	-0.309	-3.275 **	-0.314
4x9	2.290 **	0.822 *	0.530	2.090 **	0.540	-0.870	0.900 *	1.384 *	0.641	0.836	0.954
5x6	-0.050	-0.829 *	1.360 **	0.020	-0.861 *	0.670	0.052	0.272	1.182 *	1.499 *	0.984
5x7	-1.280 **	0.933 **	0.800 *	-1.160 *	-1.253 **	0.830	-0.188	-1.454 *	-0.447	-0.193	-0.698
5x8	0.950 *	-1.297 **	-1.540 **	1.090 *	-0.768 *	-0.370	-0.323	0.970	-0.505	1.103 *	0.523
5x9	3.140 **	0.584	0.360	2.920 **	0.854 *	0.080	1.323 **	2.761 **	0.368	0.031	1.053 *
6x7	1.780 **	2.361 **	-0.020	2.430 **	2.794 **	0.320	1.611 **	2.785 **	2.027 **	1.289 *	2.034 **
6x8	1.490 **	-0.302	0.040	1.580 **	-0.154	2.390 **	0.841 *	2.116 **	0.939	-1.008	0.682
6x9	0.190	-0.501	1.180 **	-0.280	-0.612	1.050	0.171	0.220	0.768	1.800 **	0.929
7x8	1.610 **	-0.420	-0.330	1.840 **	-0.092	-1.310 *	0.216	1.823 **	1.690 **	0.553	1.355 *
7x9	-0.690	-0.060	-1.580 **	-1.010 *	0.010	-0.990	-0.720	-1.059 *	-2.104 **	-3.552 **	-2.238 **
8x9	-1.140 *	1.054 **	1.510 **	-1.480 **	0.838 *	0.070	0.142	-1.356 *	-0.559	0.427	-0.496
LSD 5%	1.297	0.894	1.549	1.314	0.985	1.549	1.265	1.601	1.546	1.635	1.594
(Sij-Sik)1%	1.866	1.287	2.229	1.890	1.417	2.229	1.820	2.304	2.224	2.353	2.294

Crosses	No.of basel branches/plant											
	F3							F4				
	1999/2000			2000/2001			C.	2000/2001			C.
	E1	E2	E3	E1	E2	E3		E1	E2	E3	
1x2	-0.500 *	-0.103	0.436 **	-0.460 **	-0.103	0.436 **	-0.049	-0.45 **	-0.145	0.135	-0.153
1x3	0.040	-0.073	0.174	0.000	-0.073	0.187	0.043	-0.301 *	-0.044	0.183	-0.054
1x4	0.330	-0.129	0.579 **	0.280 *	-0.129	0.566 **	0.250	0.421	0.32 *	0.381 **	0.374 *
1x5	-0.170	-0.132	-0.879 **	-0.210	-0.132	-0.879 **	-0.400 **	0.05	-0.257 *	-0.597 **	-0.268
1x6	-0.370 *	-0.305 **	-0.637 **	-0.450 *	-0.305 **	-0.637 **	-0.451 **	-0.472	-0.56 **	-0.545 **	-0.526 **
1x7	-0.040	0.298 **	-0.017	-0.010	0.298 **	-0.017	0.085	-0.121	-0.092	-0.064	-0.092
1x8	-0.280	0.366 **	0.563 **	-0.260	0.366 **	0.563 **	0.220	0.017	0.249 *	0.461 **	0.242
1x9	0.990 **	0.078	-0.219	1.110 **	0.078	-0.219	0.303 *	0.856 **	0.529 **	0.047	0.477 **
2x3	-0.640 **	-0.408 **	0.038	-0.600	-0.408 **	-0.039	-0.343 *	-0.418 *	-0.267 *	-0.143	-0.276
2x4	-0.010	-0.097	0.056	0.120	-0.097	0.133	0.018	0.041	0.287 *	0.349 *	0.226
2x5	-0.360	-0.283 *	-0.292 *	-0.330 *	-0.283 **	-0.292 *	-0.307	-0.234	-0.161	-0.105	-0.167
2x6	0.020	0.063	-0.413 **	0.070	0.063	-0.413 **	0.102	-0.062	-0.12	-0.27 *	-0.151
2x7	1.210 **	0.244 *	0.040	0.820 **	0.244 *	0.040	0.433	0.683 **	0.151	0.054	0.296 *
2x8	0.120	0.401 **	0.107	0.200	0.401 **	0.107	0.223	0.17	0.163	0.092	0.142
2x9	0.160	0.184	0.028	0.180	0.184	0.028	0.127	0.269	0.092	-0.111	0.083
3x4	0.280	0.433 **	-0.410 **	0.280	0.433 **	-0.410 **	0.101	0.32	0.038	-0.337 *	0.007
3x5	0.420 *	-0.090	-0.394 **	0.430 **	-0.090	-0.381 **	-0.018	0.289	-0.63	-0.364 **	0.046
3x6	0.620 *	0.266 *	-0.221	0.490 **	0.266 *	-0.209	0.185	0.381 *	0.032	-0.233	0.060
3x7	-0.490	0.054	0.388 **	-0.440 **	0.054	0.401 **	-0.006	-0.115	0.149	0.318 *	0.117
3x8	0.570 **	0.158	0.335 *	0.560 **	0.158	0.348 **	0.355 *	0.106	0.244 *	0.436 **	0.262
3x9	-0.700 **	-0.340 **	0.090	-0.730 **	-0.340 **	0.102	-0.320 *	-0.262	-0.09	0.14	-0.071
4x5	0.150	0.251 *	0.277 *	0.120	0.251 *	0.264 *	0.219	0.091	0.211	0.341 *	0.214
4x6	-0.040	-0.080	-0.170	-0.070	-0.080	-0.183	-0.104	-0.03	-0.178	-0.291 *	-0.166
4x7	-0.230	-0.413 **	-0.424 **	-0.200	-0.413 **	-0.437 **	-0.353 *	-0.249	-0.237 *	-0.244	-0.243
4x8	-0.300	-0.198	-0.481 **	-0.320	-0.198	-0.494 **	-0.332 *	-0.292	-0.579 **	-0.842 **	-0.571 **
4x9	-0.160	0.234 *	0.574 **	-0.200	0.234 *	0.561 **	0.207	-0.303	0.138	0.644 **	0.160
5x6	-0.220	0.281 *	0.869 **	-0.200	0.281 *	0.869 **	0.313 *	-0.182	0.188	0.532 **	0.179
5x7	-0.100	0.235 *	0.291 *	-0.050	0.235 *	0.291 *	0.150	-0.121	0.093	0.256 *	0.076
5x8	0.160	-0.301 **	0.171	0.090	-0.301 **	0.171	-0.002	0.094	0.044	0.054	0.064
5x9	0.140	0.038	-0.044	0.140	0.038	-0.044	0.045	0.013	-0.056	-0.116	-0.053
6x7	-0.040	0.068	0.297 *	0.110	0.068	0.297 *	0.133	0.178	0.35 **	0.351 *	0.293 *
6x8	-0.300	0.002	0.064	-0.340	0.002	0.064	-0.085	-0.208	-0.045	0.142	-0.037
6x9	0.440 *	-0.295 **	0.212	0.390 *	-0.295 **	0.212	0.111	0.395 *	0.331 *	0.316 *	0.347 *
7x8	0.290	-0.507	-0.347 *	0.360	-0.507 **	-0.347 *	-0.176	0.413 *	0.226	-0.047	0.197
7x9	-0.600	0.022	-0.229	-0.590 **	0.022	-0.229	-0.267 *	-0.668 **	-0.641 **	-0.624 **	-0.644 **
8x9	-0.260	0.079	-0.412 **	-0.290 *	0.079	-0.412 **	-0.203	-0.3	-0.303 *	-0.296 *	-0.300 *
LSD 5%	0.556	0.303	0.374	0.387	0.303	0.374	0.383	0.562	0.357	0.377	0.432
(Sij-Sik)1%	0.800	0.436	0.538	0.557	0.436	0.538	0.551	0.809	0.514	0.543	0.622

Crosses	Plant height (cm)										
	F3							F4			
	1999/2000			2000/2001			C.	2000/2001			C.
	E1	E2	E3	E1	E2	E3		E1	E2	E3	
1x2	23.970 **	8.393 **	7.376 **	22.970 **	8.393 **	7.580 **	13.114 **	22.374 **	13.206 **	3.686	13.089 **
1x3	12.180 **	4.346 **	-0.805	11.550 **	4.346 **	-0.875	5.124 **	16.569 **	8.046 **	-0.976	7.880 **
1x4	-1.710	-1.378	1.818	-1.650	-1.378	1.751	-0.425	-4.567	-2.674	-0.689	-2.643
1x5	-4.810 *	-2.893 *	2.018	-4.250 **	-3.107 *	1.948	-1.849	-6.879 **	-2.144	2.238	-2.262
1x6	-1.470	0.232	-6.317 **	-1.350	0.446	-6.384 **	-2.474	-3.425	-5.357 *	-6.072 *	-4.951
1x7	0.190	-0.794	-0.651	0.240	-0.794	-0.718	-0.421	-0.464	1.197	1.566	0.766
1x8	-9.330 **	2.177	4.915 **	-9.400 **	2.177	4.848 **	-0.769	-6.078 *	-0.145	7.112 *	0.296
1x9	-19.020 **	-10.083 **	-8.355 **	-18.110 **	-10.083 **	-8.150	-12.300 **	-17.530 **	-12.131 **	-6.865 *	-12.175 **
2x3	11.300 **	-1.483	-0.387	12.250 **	-1.483	-0.186	3.335 *	-17.485 **	-7.710 **	-0.642	-8.612 **
2x4	-6.360 **	-0.423	-0.468	-6.470 **	-0.423	-0.263	-2.401	18.855 **	6.206 *	0.088	8.383 **
2x5	-8.030 **	-0.381	0.029	-8.090 **	-0.596	0.230	-2.806 *	-1.260	0.360	-0.331	-0.410
2x6	-6.450 **	-2.704 *	1.867	-6.630 **	-2.489	2.071	-2.389	-7.336	-3.654	1.309	-3.227
2x7	-5.390 **	-2.765 *	-5.294 **	-5.640 **	-2.765 *	-5.089 *	-4.491 **	-6.241 *	-3.616	-2.833	-4.230
2x8	-5.350 **	-0.778	-5.704 **	-4.870 **	-0.778	-5.499 *	-3.830	-2.832	-4.165 **	-6.383 *	-4.460
2x9	-3.690 *	0.142	2.580	-3.510 **	0.142	1.156	-0.530	-6.075 *	-0.627	5.106	-0.532
3x4	-8.570 **	-5.833 **	-11.098 **	-8.120 **	-5.833 **	-11.169 **	-8.437 **	-9.216 **	-8.710 **	-11.993 **	-9.973 **
3x5	5.530 **	-1.025	2.042	5.580 **	0.264	1.992	2.397	7.893 **	1.460	2.165	3.839
3x6	-7.770 **	-1.424	-7.154 **	-7.790 **	-2.712 *	-7.224 **	-5.679 **	1.976	1.843	-6.053 *	-0.745
3x7	-9.640 **	-2.522 *	5.076 **	-10.260 **	-2.522 *	5.006 **	-2.477	-3.842	-5.896	3.022	-2.239
3x8	-5.510 **	3.595 **	15.313 **	-5.780 **	3.595 **	15.242 **	4.469 **	0.567	8.372 **	15.208 **	8.046 **
3x9	2.120	4.345 **	-2.987	2.570 *	4.345 **	-2.786	1.268	3.548	2.596	-0.733	1.804
4x5	3.320 **	6.368 **	0.318	3.160 **	6.154 **	0.247	3.261 *	-0.727	1.836	2.508	1.206
4x6	-1.700	0.513	4.152 *	-1.830	0.727	4.085 *	0.991	-6.514 **	-2.584	2.541	-2.186
4x7	2.480	0.681	5.552 **	1.940	0.681	5.485 **	2.803 *	-2.269	3.384	7.536	2.884
4x8	0.790	-2.635 *	-3.305 *	1.030	-2.635 *	-3.372 *	-1.688	-4.830 *	-4.818	-5.135	-4.928
4x9	11.750 **	2.708 *	3.032	11.950 **	2.708 *	3.236 *	5.897 **	9.268 **	7.359 **	5.144	7.257 *
5x6	4.060 **	-2.035	1.966	3.550 **	-2.035	1.896	1.234	2.575	-0.147	-1.762 *	0.222
5x7	-6.960 **	-1.574	-6.161 **	-7.720 **	-1.789	-6.232 **	-5.073 **	-8.234 **	-5.273 *	-4.033	-5.847 *
5x8	4.360 **	-4.187 **	-4.805 **	5.310 **	-4.402 **	-4.875 **	-1.433	3.155	-1.468	-7.594 *	-1.969
5x9	2.550	5.726 **	4.592 **	2.460 *	5.512 **	4.793 **	4.272 **	3.476	5.376 *	6.808 *	5.220 *
6x7	1.460	5.194 **	10.076 **	4.190 **	5.408 **	10.009 **	6.056 **	3.790	9.717 **	12.853 **	8.787 **
6x8	11.280 **	-1.973	-10.050 **	10.700 **	-1.758	-10.117 **	-0.320	8.649 **	-2.092	-10.368 **	-1.270
6x9	0.580	2.197	5.460 **	-0.840	2.412	5.664 **	2.579	0.284	2.275	7.551 *	3.370
7x8	7.780 **	5.309 **	-0.321	7.390 **	5.309 **	-0.388	4.180 **	5.804 *	4.826	3.030	4.553
7x9	10.080 **	-3.528 *	-8.277 **	9.860 **	-3.528 *	-8.073 **	-0.578	11.456 **	-4.340	-21.141 **	-4.675
8x9	-4.380 **	-1.507	3.956 *	-4.370	-1.507	4.160 *	-0.608	-4.426 *	-0.609	4.129	-0.269
LSD 5%	4.244	3.776	4.683	3.099	3.776	4.796	4.062	6.608	7.339	9.089	7.679
(Sij-Sik)1%	6.106	5.432	6.738	4.458	5.432	6.901	5.845	9.508	2.224314	13.077	11.048

Table 3. Continued

Crosses	Technical stem length (cm)										
	F3							F4			
	1999/2000			2000/2001			C.	2000/2001			C.
	E1	E2	E3	E1	E2	E3		E1	E2	E3	
1x2	20.6 **	4.084 **	3.615 *	20.96 **	4.084 **	3.725 *	9.511 **	21.308 **	12.46 **	3.428	12.3987 **
1x3	15.55 **	3.994 **	2.753 *	15.16 **	3.994 **	2.862 *	7.386 **	16.983 **	10.566 **	2.625	10.058 **
1x4	-2.54 *	-0.299	5.068 **	-2.5 *	-0.299	4.959 **	0.732	-3.371	0.585	4.837 *	0.684
1x5	-5.77 **	-2.568 *	-4.512 **	-5.5 **	-2.202 *	-4.403 **	-4.159 **	-5.659 *	-4.7 *	-4.072	-4.810
1x6	-4.39 **	-2.151	-8.806 **	-4.68 **	-2.517	-8.916 **	-5.243 **	-6.837 **	-9.154 **	-9.871 **	-8.62067 **
1x7	-0.06	-0.552	-2.087	-0.22	-0.552	-2.196	-0.945	-3.147	-1.336	-0.605	-1.696
1x8	-7.02 **	3.221 *	6.991 **	-7.22 **	3.221 *	6.881 **	1.012	-3.466	1.008	6.632 **	1.398
1x9	-16.37 **	-5.729 **	-3.022	-15.99 **	-5.729 **	-2.912 *	-8.292 **	-15.831 **	-9.429 **	-2.973	-9.411 **
2x3	2.46 *	-3.533	-0.537	3.13 **	-3.533 *	-0.209	-0.370	-13.622 **	-5.846 **	-0.153	-6.540 **
2x4	-3.5 **	-0.827	-2.562	-3.66 **	-0.827	-2.452	-2.305	9.941 **	1.186	-3.341	2.595
2x5	-6.8 **	-0.969	-1.716	-6.77 **	-0.603	-1.387	-3.041 *	-2.931	-1.352	-1.55	-1.94433
2x6	-3.92 **	-1.062	2.784 *	-4.21 **	-1.428	2.894 *	-0.824	-4.569 *	-2.556	0.121	-2.33467
2x7	-4.3	-0.016	-0.017	-5 **	-0.016	0.093	-1.543	-4.575 *	-1.151	1.147	-1.52633
2x8	-4.4	0.983	-4.149 **	-4.35 **	0.983	-4.04 **	-2.496 *	-2.128	-2.8	-3.617	-2.84833
2x9	-0.15	1.34	2.582	-0.1	1.34	1.374	1.064	-3.426	0.059	3.966	0.200
3x4	-6.84 **	-3.82 **	-11.888 **	-6.57 **	-3.82 **	-11.779 **	-7.453 **	-7.021 **	-9.212 **	-13.948 **	-10.060 **
3x5	7.25 **	3.844 **	2.322	7.16 **	1.65	1.117	3.891 **	6.557 *	1.36	1.387	3.101
3x6	-5.04 **	-1.906	-7.752 **	-5.12 **	0.289	-7.643 **	-4.529 **	2.409	0.829	-6.756 **	-1.17267
3x7	-9.53 **	-0.59	6.701 **	-9.94 **	-0.59	6.81 **	-1.19	-5.214	-3.825	7.141 **	-0.63267
3x8	-4.47 **	1.783	11.971 **	-4.88 **	1.783	12.08 **	3.045 *	-0.733	6.026 **	11.961 **	5.751 **
3x9	0.61	0.227	-3.568 *	1.06	0.227	-3.239 *	-0.781	0.642	0.101	-2.257	-0.50467
4x5	3.01	2.078	3.394 *	3.06 **	2.443	3.503 *	2.915 *	-0.4	2.906	5.195 *	2.567
4x6	1.37	0.621	2	1.03	0.255	1.89	1.194	-1.568	0.028	2.833	0.431
4x7	2.8	-1.03	-0.85	2.35 *	-1.03	-0.96	0.213	0.443	1.373	1	0.939
4x8	-6.04 **	-1.947	-1.84	-5.5 **	-1.947	-1.95	-3.204 *	-9.38 **	-6.003 **	-3.304	-6.229 **
4x9	11.74 **	5.223 **	6.678 **	11.8 **	5.223 **	6.788 *	7.909 **	11.355 **	9.137 **	6.728 **	9.073 **
5x6	3.62 **	-0.625	1.056	3.47 **	-0.625	1.166	1.344	3.177	0.83	-0.806	1.067
5x7	-3.93 **	-2.825 *	-2.971 *	-4.57 **	-2.46	-2.861 *	-3.27 *	-4.173 *	-2.455	-2.153	-2.927
5x8	4.67 **	-3.119 *	-3.944 **	5.17 **	-2.753 *	-3.834 *	-0.635	3.588	-0.607	-5.753 *	-0.924
5x9	-2.04	4.184 **	6.371 **	-2.01	4.55 **	6.7 **	2.959 *	-0.16	4.018 *	7.753 **	3.870 *
6x7	-0.66	1.601	14.895 **	1.84	1.236	14.786 **	5.616 **	1.306	9.778 **	15.665 **	8.916 **
6x8	10.41 **	-3.539 *	-12.814 **	9.96 **	-3.905 **	-12.924 **	-2.135	7.447 **	-3.518 *	-12.522 **	-2.86433
6x9	-1.39	7.061 **	8.637 **	-2.29 *	6.695 **	8.747 **	4.577 **	-1.365	3.764 *	11.337 **	4.579 *
7x8	7.46 **	9.167 **	2.895 *	7.43 **	9.167 **	2.786 *	6.484 **	5.614 **	5.68 **	4.481 *	5.225 *
7x9	8.21 **	-5.756 **	-18.567 **	8.13 **	-5.756 **	-18.457 **	-5.366 **	9.746 **	-7.964	-26.677 **	-8.29833 **
8x9	-0.6	-6.55 **	0.89	-0.6	-6.55 **	1	-2.068	-0.961	0.314	2.123	0.492
LSD 5%	3.435	3.872	4.133	2.358	3.872	4.195	3.644	5.887	5.372	6.084	5.781
(Sij-Sik)1%	4.943	5.57	5.946	0.557	5.57	6.036	5.243	8.471	7.729	8.754	8.318

gression (residual) was significant for only straw yield/plant in both generations. A portion of CE interaction sum of squares was non linear, indicating that crosses differed with respect to their stability. This suggests that the prediction would be difficult, which means that selection of cross combinations on the basis of mean performance alone (mean yield) would not be appropriate. In such situations, methods that combine yield and stability of performance are useful (Bachireddy *et al.*, 1992).

Data presented in Table 4 show that, out of 36 crosses included in this study 17 crosses for each of straw yield/plant and technical stem length were identified to be superior over generations by measuring for yield and stability criterion (YS_i). Ten out of these crosses ($P_1 \times P_2$, $P_1 \times P_3$, $P_1 \times P_4$, $P_3 \times P_5$, $P_3 \times P_6$, P3 × P_7, $P_3 \times P_9$, P5× P6, $P_5 \times P_9$ and $P_6 \times P_7$) revealed consistency for straw yield/plant and its two important components *viz.*, plant height and technical stem length in both generations. Hence these 10 crosses could be identified as more adapted crosses and may be useful as potential breeding material for developing crosses with stable straw yield/plant and its two components *viz.*, plant height and technical stem length. Out of these ten crosses four ($P_1 \times P_2$, $P_1 \times P_3$, $P_5 \times P_9$, and $P_6 \times P_7$)crosses exhibited significant positive SCA effects for high straw yield, plant height and technical stem length. Results of the present work suggest that integrating yield and stability performance (expressed in terms of Ys_i) may be of value for the selection of crosses with a high breeding potential before pure line derivation

Table 4. Mean yield and yield stability statistic (Ysi) for 36 flax crosses evaluated at 6 environmemts in F3 and 3 environments in F4, for straw yield and its component variables.

Crosses	Straw yield/plant(g)				No. of basel branches/plant				plant height (cm)				Technical stem length (cm)			
	F3		F4		F3		F4		F3		F4		F3		F4	
	Mean	Ysi	Mean	Ysi	Mean	Ysi	Mean	Ysi	Mean	Ysi	Mean	Ysi	Mean	Ysi	Mean	Ysi
1x2	15.62	39 #	15.59	38 #	2.03	11	2.07	15	119.12	31 #	119.70	31 #	78.26	30 #	81.23	30 #
1x3	14.89	29 #	14.93	37 #	2.05	21 #	2.06	13	118.87	30 #	119.43	34 #	81.79	31 #	83.48	31 #
1x4	10.99	17 #	11.77	24 #	2.00	12	2.23	26 #	104.26	18 #	105.03	23 #	68.75	18 #	70.39	27 #
1x5	9.83	11	10.01	9	1.50	-9	1.72	4	108.74	24 #	109.35	30 #	68.12	20 #	68.21	23 #
1x6	10.10	7	10.15	10	1.40	-6	1.40	-2	108.34	29 #	106.30	28 #	68.89	15 #	65.55	13
1x7	10.95	16 #	11.40	14	2.05	22 #	1.92	6	108.53	31 #	107.54	31 #	70.06	28 #	68.19	22 #
1x8	9.15	-2	10.00	0	2.28	33 #	2.40	33 #	91.11	-4	93.58	4	56.56	-5	58.24	3
1x9	9.45	3	11.75	23 #	2.28	26 #	2.58	34 #	95.74	-2	94.10	1	62.63	0	60.82	0
2x3	15.05	30 #	16.12	31 #	1.91	8	2.07	16	108.93	27 #	94.39	2	69.09	16 #	62.16	1
2x4	11.24	21 #	13.10	35 #	2.02	15 #	2.31	29 #	94.13	5	107.50	22 #	60.77	6	67.59	13
2x5	11.07	18 #	11.90	24 #	1.84	3	2.05	9	99.64	13	102.65	21 #	64.29	11	66.36	15
2x6	10.93	15 #	11.26	20 #	1.99	3	2.01	9	100.27	6	99.47	13	68.37	13	67.12	20 #
2x7	10.63	19 #	11.30	21 #	2.65	31 #	2.53	34 #	96.31	9	93.99	7	64.52	13	63.65	12
2x8	7.44	-10	7.50	-2	2.53	37 #	2.53	35 #	79.90	-10	80.27	-4	48.11	-9	49.28	-3
2x9	10.90	14 #	11.77	19 #	2.35	35 #	2.42	34 #	99.37	3	97.20	4	67.04	10	65.71	6
3x4	10.24	12	12.14	27 #	2.02	6	1.99	0	95.83	-1	94.08	8	61.27	-1	59.52	3
3x5	14.43	28 #	14.31	34 #	2.04	12	2.06	11	112.58	29 #	111.83	35 #	76.88	28 #	76.00	34 #
3x6	13.04	27 #	13.02	29 #	2.20	22 #	2.11	14	104.72	26 #	106.89	29 #	70.31	25 #	72.87	28 #
3x7	11.65	31 #	11.52	23 #	2.13	20 #	2.25	28 #	106.06	19 #	100.92	16 #	70.53	22 #	69.13	20 #
3x8	11.60	32 #	11.67	24 #	2.58	30 #	2.54	37 #	95.94	0	97.71	14	59.30	-4	62.47	8
3x9	11.34	22 #	11.22	18 #	1.82	-4	2.16	24 #	108.90	34 #	104.47	22 #	70.84	31 #	69.60	23 #
4x5	10.72	13 #	10.90	6	2.03	12	2.06	11	104.38	23 #	105.32	25 #	69.52	26 #	71.75	29 #
4x6	8.82	2	9.41	4	1.66	2	1.63	3	102.33	12	101.57	19 #	69.65	27 #	70.76	28 #
4x7	9.64	1	10.46	8	1.53	0	1.62	2	102.28	19 #	102.16	20 #	65.55	6	66.99	19 #
4x8	8.39	-5	8.13	-7	1.64	1	1.44	-5	80.71	-9	80.86	-3	46.67	-2	46.78	-2
4x9	9.86	12	10.74	13	2.10	17 #	2.12	15	104.47	24 #	106.04	27 #	73.15	29 #	75.47	35 #
5x6	10.68	20 #	12.09	28 #	2.22	24 #	2.10	13	108.48	30 #	107.92	32 #	74.06	34 #	74.72	33 #
5x7	10.00	5	9.57	5	2.18	21 #	2.07	13	100.31	7	97.37	13	66.33	17 #	66.44	18 #
5x8	8.28	-7	9.36	2	2.12	23 #	2.21	25 #	86.88	-7	87.76	-7	53.50	-7	55.40	-6
5x9	11.18	28 #	11.23	19 #	2.08	21 #	2.04	8	108.75	25 #	107.94	31 #	72.46	24 #	73.57	24 #
6x7	11.46	23 #	12.18	32 #	2.11	24 #	2.23	27 #	111.66	28 #	111.64	34 #	77.06	29 #	79.43	29 #
6x8	9.11	-3	9.39	-3	1.98	9	2.05	12	88.22	-6	88.10	-6	53.86	-6	54.61	-7
6x9	9.69	10	10.98	13	2.09	16 #	2.39	32 #	107.28	20 #	105.73	18 #	75.94	27 #	75.43	26 #
7x8	8.04	-8	9.23	-1	2.01	5	2.36	27 #	90.85	-5	89.44	1	59.35	-3	58.42	3
7x9	8.36	-2	6.97	-4	1.84	-3	1.47	0	102.26	10	93.21	-3	62.86	2	58.28	-4
8x9	7.64	-9	7.28	-1	1.99	10	1.96	7	85.16	-8	84.13	-2	50.70	-8	54.02	-4
Mean	10.62	12.8	11.12	15.9	2.03	14.2	2.09	16.6	101.15	13.3	100.43	15.8	66.03	13.7	66.38	15.3
LSD 5%	0.550		0.962		0.169		0.269		1.761		4.700		1.587		3.516	

= Stable crosses on basis of Ysi

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تقييم المحصول وثبات السلوك الوراثي في الأجيال المبكرة في الكتان

١- محصول القش ومكوناته

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معهد المحاصيل الحقلية-مركز البحوث الزراعية-الجيزة

تم دراسة ٣٦ هجينا في كل من الجيلين الثالث والرابع ناتجة من التهجين مابين٩ أباء(١= جـــــــــــ٧ . ٢=جـــــــــــ٨ ، ٣=س٢٤١٩/ ١ ٤=س٢٦٥٦/١،٥=س١٤٨/٦/١ ، ٦=س٢٣٧/١ ،٧=س١١٠/٣ ،٨=جوهر،٩=إريانا) من الكتان عبر ثلاث بيئات مختلفة(الجيزة-الجميزة-زرزورة)في موسمي١٩٩٩/٢٠٠٠و٢٠٠١/٢٠٠٠ ,وكان التصميم التجريبي المستخدم هو قطاعات كاملة العشوائية ذات الاربعة مكررات وذلك لتقدير القيمة التربوية وثبات السلوك الوراثي ، وتشير النتائج إلي تحكم العوامل المضيفة في توريث محصول القش والطول الكلي والطول الفعال، كما تشير النتائج إلى أن النسبة بين تباين القدرة الخاصة علي الائتلاف(العوامل غير المضيفة) وتباين التفاعل الخاص بها مع البيئة أكبر بكثير من النسبة بين تباين القدرة العامة علي الائتلاف(العوامل المضيفة) وتفاعلها مع البيئة ، كما تشير النتائج إلى أن الأباء جيزة ٧، جيزة ٨ أظهرا قدرة عالية علي الائتلاف لصفة محصول القش والطول الفعال للساق في كل من الجيلين الثالث والرابع وعبر كل البيئات ، أيضا الأب ٥ ، الاب٦ أظهرا قدرة عالية علي الائتلاف لصفة الطول الكلي/ نبات والطول الفعال للساق عبر كل البيئات والأجيال كما أظهر الاب٢ قدرة عالية علي الائتلاف لصفة محصول القش نبات فقط ، كما تشير النتائج الخاصة بتقديرات ثبات السلوك الوراثي أن هناك ١٧هجين أظهرت ثباتا في سلوكها الوراثي وفقاً لمقياس كانج١٩٩٥ م (والذي يقوم بقياس ثبات السلوك الوراثي مع المحصول المرتفع) لمحصول القش ومكوناته ،وأن ١٠هجن منها فقط اظهرة ثباتا عبر صفات محصول القش مكونيه(الطول الكلي- الطول الفعال) ،كما تشير النتائج إلى أن ٤هجن (١ X ٢- ١X ٣ -٥ X ٩ -٦X ٧) منها فقط بالإضافة إلي كونها ثابتة كانت أيضاً متفوقة في تقديرات تأثيرات القدرة الخاصة علي الائتلاف لإنتاج محصول عالي من القش بالإضافة إلي الطول الكلي والطول الفعال ،وتشير الدراسة الي امكانية استخدام القيمة التربوية وكذلك ثبات السلوك الوراثي لاختيار الهجن الواعدة في الأجيال المبكرة قبل بداية عملية انتخاب السلالات النقية.