Bioscience Research Communications
Vol. 14, No. 3, June 30, 2002
Printed in Nigeria

0795-8072/2002 $3.00 + 0.00

BRC 2001051/14302

Qualitative and Quantitative assessment of Genetic gain in Pearl Millet (*Pennisetum glacum* (L.) R. Br) through hybridization methods.

*S.E. Aladele[1], I.E. Ezeaku[1] and I. Angarawai[2]

[1]International Crops Research Institute for the Semi-Arid Tropics, P.M.B. 3491, Kano.

[2]Lake Chad Research Institute, P.M.B. 1293, Maiduguri, Nigeria.

(Received April 6, 2001)

ABSTRACT: Three varieties of pearl millet (ICMV 88908, RCB-IC 911 and GB 8735) were crossed together to developed a new variety. Comparison was made between the new variety designated LCIC 9702 and GB 8735 which has the highest grain yield in 1996 preliminary Pearl millet trial. The experiment was conducted in two locations using RCBD with 10 replication and 30 m^2 per net plot. The study was carried out to quantify the progress made over the best parent LCIC 9702 performed bettern than GB 8735 in terms of grain yield (7%), panicle length (11%) and less downy mildew (-4%). GB 8735 was only better in terms of grain size. There was no significant difference in terms of plant height and days to bloom between both varieties. The study confirms the superiority of LCIC 9702 over GB 8735.

Keywords: Genetic gain, Hybridization, *Pennisetum glacum*, Randomate.

Introduction

Pearl millet (*Pennisetum glacum* (L.) R. Br) is a cross-pollinated cereal crop, which is extensively grown in the sudanian and sahelian continents of Africa and Asia. It is estimated that pearl millet is grown on over 15 million ha in Africa and 13 million in India (Andrew, 1987). It is an important forage crop in USA, South America and Australia. However its importance as gain is growing in USA (Hanna, 1995). Nigeria is the largest producer of Pearl millet and second most populous country in Africa (FAO, 1992). There are limitations to the progress in crop improvement a breeder can make through selection. Although some gains could be achieved over a period of time (Aladele et al, 2000), the gains would not be able to match the population growth and the increasing need of cereal grain. Particularly pearl millet, which is a major food of over 75% population of the resource poor farmers of Africa.

*To whom correspondence should be addressed.

One of the essetial aspect of plant breeding is the utilization of the selected materials for the creation of new populations to be employed either as potential new commercial varieties or as the basis for new cycle of selection (Comstock and Robinson, 1952). It is not surprising that variability existing in land varieties at the beginning of the last century was rapidly exhausted in many crops and that returns from pure line selection progressively became smaller and smaller. As this happened, the emphasis in plant breeding gradually shifted to planned hybridization between carefully selected parents (Allard, 1960).

Development of commercial hybrid millet is still at a preliminary in Africa. No stable parental lines have been developed or identified in West Africa and in Nigeria in particular. The only option for immediate result that will satisfy the growing demand for millet with limited land area is Hybridization. We embarked on combining three varieties of pearl millet (ICMV 88908, RCB-IC 911 and GB 8735) to produce one variety through hybridisation.

This study shows the level of total improvement (quantitative and qualitative) the new variety has over the best of the three varieties used in the hybridization.

Materials and Methods

During the rainy season of 1996. three varieties of pearl millet (ICMV 88908, RCB-IC911 and GB 8735) were identified from the preliminary pearl millet trial conducted in Bagauda (Kano state) and Maiduguri (Borno state) (ICRISAT Annual Report, 1996). The three varieties were crossed artificially by bagging the heads at flowering stage. The crossing was done among each other by crossing ICMV 88908 with RCB-IC 911 and GB 8735. RCB-IC 911 was also crossed with GB 8735. Crosses were done between 9-11 am when stigma are usually ready to receive pollen (Mustapha, 1999). The F1 from the three crosses were threshed separately and equal quantity of 100g from each cross was mixed together thoroughly. The bulk of the mixture was planted on 0.2 hectare in isolation (Time isolation) to randomate at Bagauda on August 15, 1997 when all the millet on the farmers field were already at maturity stage. The field was monitored to remove ant plant that was not the true cross or resemble any of the parental lines. Any plant that shows symptoms of downy mildew were also rogued. For identification purposes the new millet variety was named LCIC 9702.

Meanwhile GB 8735, which has been included in the Pearl Millet Trial in 1997 (Table 2), was replaced with LCIC 9702 after the second random mating was completed in 1998 main season. When LCIC 9702 was included in the Pearl Millet Trial in 1999 to assess its performance, the result shows that LCIC 9702 was better than GB 8735 (Table 3).

Before the completion of the process of hybridization in 1998, GB 8735 has become popular among farmers in drier areas of Northern Nigeria. Hence there was need for justification to replace GB 8735 with the newly bred variety LCIC 9702.

Experiment was designed for these two varieties on Randomised Complete Block Design with 10 replications. Each plot was 10 rows of 5 m long and 0.75m between rows. Data collected includes plant height, days to 50% flowering, paniclelength and grain yield. Thousand-grain mass was also considered after proper drying. All these data werecollected from the 8 inner rows and analysed on location basis as well as combined using Genstat 5 release 3.2.

Table 1: Performance data of three Pearl Millet entries for six traits in Bagauda and Maiduguri, 1996 main season.

Entry	Grain yield (tha-1)	Downy mildew (%)	Time to 50% bloom (days)	Plant height (cm)	Panicle length (cm)	Grain mass g/1000
GB 8735	1.35	26.2	52	185	21.7	11.70
ICMV 88908	1.03	2.3	53	216	24.3	13.20
RCB-IC 911	1.05	14.5	46	210	27.5	11.20
Mean	1.14	14.3	50	189	24.5	12.00

Table 2: Performance data of ten Pearl Millet entries for six traits in Bagauda and Maiduguri, 1997 main season.

Entry	Grain yield (tha-1)	Downy mildew (%)	Time to 50% bloom (days)	Plant height (cm)	Panicle length (cm)	Grain mass g/1000
ICMV-IS 89305	1.69	5.3	58.3	263	47.2	9.09
SOSAT-C88	1.68	2.3	56.0	244	25.2	9.85
IKMV 8201	1.52	4.8	52.5	235	32.0	9.42
***GB 8735**	**1.42**	**22.5**	**44.3**	**194**	**21.3**	**11.35**
INMV 83	1.25	8.8	54.8	239	27.5	9.01
ExBorno	1.21	7.8	63.5	282	23.2	8.46
LOCAL	1.20	32.9	56.3	258	55.2	9.91
ICMV-IS 86330	1.18	5.8	55.5	242	36.8	9.60
Gwagwa	1.17	6.6	62.2	267	26.0	9.24
Buduma	1.09	33.4	47.5	195	18.2	8.15
SE±	0.203	2.59	0.61	8.8	2.57	0.155
Mean	1.21	6.58	51.3	243	35.0	9.25
CV %	29	68	2	6	13	5

Table 3: Performance data of ten Pearl Millet entries for six traits in Bagauda and Maiduguri, 1999 main season.

Entry	Grain yield (tha-1)	Time to 50% bloom (days)	Downy mildew (%)	Plant height (cm)	Panicle length (cm)	Grain mass g/1000
SOSAT	3.47	54.3	1.6	297	22.7	11.17
EMC (C1)	2.96	55.0	11.3	270	41.7	9.60
LCIC 9703	2.91	54.3	134.4	216	38.3	8.87
LCIC 9702	2.71	44.0	13.3	216	30.3	11.37
MMC (C1)	2.59	57.0	8.8	267	30.0	9.77
LOCAL	2.47	53.3	18.7	284	44.0	9.90
DC (C1)	2.05	55.0	14.7	228	28.3	10.13
ExBorno	1.76	59.0	5.6	261	21.3	9.17
ZATIB	1.75	58.3	13.7	259	43.3	9.30
Dangombe –1	1.64	58.7	23.4	254	42.7	9.33
SE ±	0.224	1.45	3.26	21.6	3.16	0.279
Mean	2.43	54.9	12.4	255	34.3	9.86
CV %	16	5	45	15	16	5

Results and Discussions

The Analysis of Variance (ANOVA) shows that days to maturity and plant height are statistically the same across the two locations (Table 4). The response of both varieties to downy mildew is found to be the same in each location but different from one location to the other. There is more incidence of downy mildew in Babura than Minjibir (Table 2). LCIC 9702 is statistically better than GB 8735 for grain yield and panicle length. There was no significant difference for plant height in both varieties at different location. However GB 8735 has significantly higher thousand grain mass than LCIC 9702 which is an index of bigger grain size (Budak and Yildirim, 1999). It is therefore clear that LCIC 9702 yielded 7% more than GB 8735 with its panicle length 11% longer. Though there was no significant difference in the downy mildew incidence on the two varieties, LCIC 9702 has 4% less downy mildew when compared with GB 8735 (Table 5).

Table 4: Comparison of GB 8735 with LCIC 9702 at Babura and Minijibir, main season, 2000.

Traits	Minjibir		Babura		Combined		S. E.
	LCIC 9702	GB 8735	LCIC 9702	GB 8735	LCIC 9702	GB 8735	
Grain yield t/ha	2.55	2.44	1.70	1.54	2.13*	1.99	0.86
Days to 50% flowering (days	45	45	41	39	43	42	0.4
Downy mildew count	5.2^{ns}	5.5^{ns}	12.7*	13.3*	9.0	9.4	1.08
Plant height (cm)	193	185	199	195	196	190	3.4
Panicle length (cm)	25.1	22.7	26.4	23.6	25.8*	23.2	0.62
Grain mass (g/1000)	10.1	11.4	10.3	11.4	10.2	11.4*	0.19

*Significant at 0.001 level of probability
ns = non-significant.

Table 5: Genetic Gains of LCIC 9702 over GB 8735

Traits	Mean performance		Hybridization Differential	Percentage Gain (%)
	LCIC 9702	GB 8735		
Grain yield t/ha	2.13*	1.99	0.14	7.0
Downy mildew count	9.0	9.4	(-0.4)	4.0
Panicle length (cm)	25.8*	23.2	2.6	11.0
Grain mass g/1000)	10.2	11.4*	(-0.8)	8.0

The grain yield in Babura was much lower than that of Minijibir for both varieties. This is probably due to less rainfall at Babura during the year 2000. However, the percentage difference between the two varieties at Babura was higher in Babura than at Minijibir (Babura – 10.7%; Minijibir – 4.5%). This is suggests that the dried the environment, the more advantage LCIC 9702 has over GB 8735.

The two varieties matured earlier in Babura than at Minjibir, this may be due to early cessation of rainfall at Babura. Though the differences between the incidence of downy mildew at both locations are minimal, LCIC 9702 has lower downy mildew at both locations and statistically significant at Babura. This is probably due to rogueing carried out during the random mating. LCIC 9702 has longer panicles at both locations, an indication that it is superior to GB 8735over a wide range of environment.

The result of this study suggests that there is rapid improvement through hybridization in varietal improvement than any other breeding methods of crop improvement.

References

Andrew, D.J. (1987). Breeding pearl millet grain hybrids. Pages 83-109 in Hybrid Seed Production of Selected Cereal oil and vegetable crops, FAO Plant Production, paper 82 (Feister, W.A. and Kelly, A.F. (eds.), Rome, Italy; Food and Agricultural Organization of United Nations.

Aladele, S.E.; Mustapha, O.T. and Gupta, S.C. (2000). Genetic Variability in Pearl millet variety of ExBorno and selection for downy mildew, and long panicles. Bioscience Research Communication 12(1): 31-36.

Allard, R.W. (1960). Principles of Plant Breeding. John and Wiley and Sons, Inc., New York and London.

Budak, N. and Yildirim, M.B. (1999). Correlations among the yield and yield components at segregating populations derived from selection based on Harvest Index in Bread Wheat. Cereal Research Communication 27(3): 267 – 272.

Comstock, R.E. and Robinson, H.F. (1952). Genetic parameters, their estimation and significance. Proceedings of Sixth International Grassland Congress, 284-291.

FAO (1992). Food and Agriculture Organization of United Nations Production Year Book, 1991. FAO Basic Data Unit, Statistical Division, Rome, Italy.

Genstat 5 committee of the Statistics Department, Rothamsted Experimental Station. Genstat 5 release 3.2 Reference Manual 1993. Oxford University Press, New York.

Hanna, W.W. and Lowell, G. (1995). Germplasm Collection: Status and Utilization International Sorghum and Millet Newsletter 36: 1-3.

ICRISAT Annual Report (1996). International Crops Research Institute for the Semi-Arid Tropics. Pearl Millet and Sorghum Breeding Programme, Kano, page 16-18.

Mustapha, O.T. (1999). Hybridization studies in the *Urginea indica* (ROXB) Kunth Complex. African Journal of Material and natural Sciences 1(2): 10-13.