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Parental Affinities for grain size in Sorghum type, Periamanjal-Irungu

by

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Introduction: *Periamanjal-Irungu* is an extracted type of Sorghum from a cross between *Periamanjal (Sorghum durra)* of Coimbatore; and *Irungu (Sorghum dochna)* of Tirunelveli. This strain of hybrid origin is a fodder-cum-grain type and is being introduced in the *Irungu* tracts of the Southern districts i. e. Madurai, Ramanathapuram and Tirunelveli of the Madras State. *Periamanjal-Irungu* has recorded 50 percent more grain yield over local in Madurai, where *Irungu* types are grown for grain and 14 percent more fodder than local in Ramanathapuram and Tirunelveli where *Irungu* is cultivated exclusively for fodder. The grain of the fodder variety of *Irungu* is unfit for human use as it is bitter. The dual purpose *Periamajal-Irungu* has the potential of completely replacing the fodder Irungu. Trials with *Periamanjal-Irungu* are in progress for assessing its suitability in other districts of the Madras State. A few of the reports that have been received are indicative of the plastic nature of *Periamanjal-Irungu.*

The *Periamanjal-Irungu* was found to have an inherent defect, perhaps derived from the parents that went into the cross from which it was isolated. The grain lacked in uniformity of size showing variations from the tiny grains of *Irungu* to *that* of bold grains of *Periamanjal.* Inducing uniformity of grain size was expected to increase its economic worth as well, as this might step up its grain yield. It is gratifying that the results have not proved otherwise. Further it was noted that bold and well exposed grains are preferred for food purposes.

Materials and Methods: Single plants collected from seed multiplication plots of *Periamanjal-Irungu* were used to determine the grain weight variations and also to fix bold grained types. The grain weights of the parental strains, *Cholam Co. I (Periamanjal)* and *Cholam K. 1 (Irungu)* were recorded. The *Periamanjal-Irungu* and *Irungu* were grown under rainfed conditions in the Black soil Block of the Agricultural Research Station, Kovilpatti. As *Co. 1* does not set seeds in Kovilpatti, earheads of *Co. 1* grown at the Millets Breeding Station, Coimbatore, were obtained from the Millets and Pulses Specialist. The weight of 100 grains collected from

individual panicles was taken as index of grain weight. The grains in each case were collected from the middle outer periphery of the panicle so as to avoid chance variations, if any in the weight of the grain due to its position on the earhead.

A cement balance was used to weigh the grains and the weight is expressed in Grams. The grain yield of the selected lines is given in pound.

The weight of hundred grains also proved a good index ef grain size, for bigger grains, assessed by visual observations weighed more and smaller grains fixed by the same method weighed lese. Hence selection by eye judgement was a reliable method for fixing bold grained types. This was however confirmed by weighment. From the single plant selections of *Periamanjal-Irungu,* the grain weights of which were noted, selections that showed a 100 grain-weight of 2·4 grams and over (more than the average of Periamanjal-Irungu) were advanced for further screening and selection. Selections that were put through five years of rigorous selection and confirmed for uniformity of grain wieght, as assessed from the grain weight of of progenies, were advanced to yield tests with unselected *Periamanjal-Irungu.*

The grain weight of *Cholam K. 1* and *Cholam Co. 1* were not recorded every year as the latter does not set seeds at Kovilpatti and was not considered essential for establishing the uniformity of grain size of progenies of *Periamanjal-Irungu.* Bold grain selection work was initiated in 1951. From more than 1530 single plant selections that were analysed and studied for grain weight during the succeeding years, nine selections that have uniformity of grain weight were fixed by 1956 (Table III and IV). Data to show the trend of improvement effected in *Periamanjal-Irungu* are presented in the article.

Experimental Data: Initially the grain weight of *Irungu, Periamanjal* and *Perimanjal-Irungu* as expressed by that of 100 grains were ascertained. As *Periamanjal* does not set seed under Kovilpatti conditions its grain weight was determined from earheads obtained from the Millets and Pulses Specialist, Coimbatore. Owing to this fact the records for grain weight were limited to 10 observations. This was however found ample to reveal the uniformity of grain size of strains *Cholam K. 1 and Cholam Co. 1* and the diversity in grain weight of *Periamanjal-Irungu.* The recorded grain weights of *Cholam K. 1, Cholam Co. 1* and *Periamanjal-Irungu* are given in table I.

TABLE I.

(100 grain weight of *Cholam Co. 1, K. 1* and *Periamanjal-Irungu*).

Sl. No. of Single plant Selection	Cholam Co. 1 (Periamanjal)	Cholam K. 1. (Irungu)	Periamanjal-Irungu
1.	2·78 Grams.	1·21 Grams.	1·60 Grams.
2.	2·86 ,,	1·00 ,,	1·30 ,,
3.	3·02 ,,	0·99 ,,	2·72 ,,
4.	2·89 ,,	1·05 ,,	1·23 ,,
5.	2·66 ,,	1·04 ,,	2·69 ,,
6.	2·50 ,,	1·07 ,,	2·97 ,,
7.	2·70 ,,	1·12 ,,	2·73 ,,
8.	2·78 ,,	1·06 ,,	2·80 ,,
9.	2·70 ,,	1·00 ,,	2·78 ,,
10.	3·00 ,,	1·00 ,,	2·99 ,,
Total	27·89	10·54	23·81
Mean.	2·79 ± 0·050	1·05 ± 0·021	2·38 ± 0·223

The differences in grain weight between *Cholam K. 1* and *Cholam Co. 1,* and *Cholam K. 1* and *Periamanjal-Irungu* were statistically significant whilst *Cholam Co. 1* and *Periamanjal-Irungu* did not show significant difference.

To ascertain the range of variation in grain weight of *Periamanjal-Irungu* 223 single plant selections were taken from the bulk crop and their 100 grain weights determined. It was found to vary from 1·29 grams to 2·9 grams per 100 grains, which is roughly between the grain weight of the parents. The grain weights showed a bimodal distribution with the largest frequencies in the proximity of the parental classes (Figure 1).

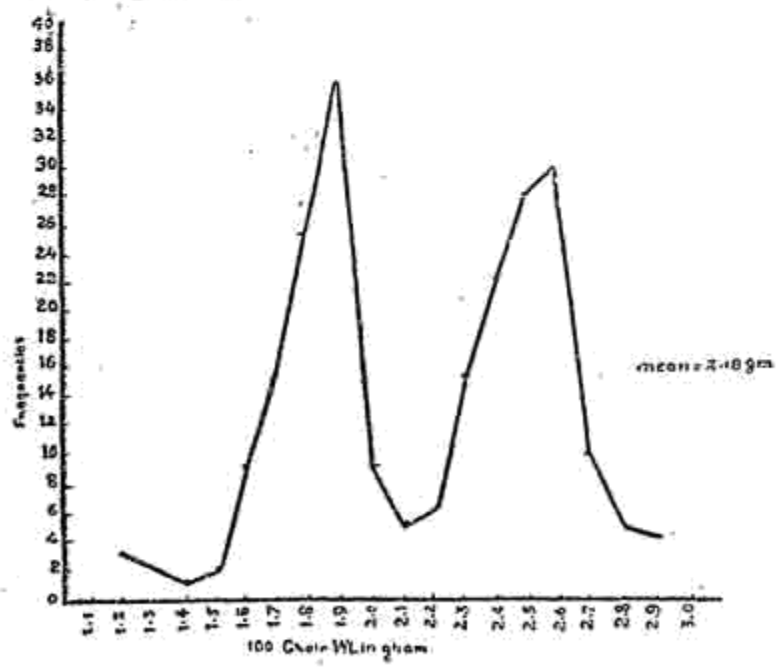

FIG. 1.

Frequency curve: Periamanjal - Irungu grain weight.

From the 223 single plant grain weights that were analysed, selections with well exposed grains and a hundred grain weight of 2·4 grams and above were subjected to further selection to induce uniformity of grain size and the small grained selections were rejected. As revealed in table II below, the progenies in the first year of selection were not uniform for grain weight.

TABLE II

100 grain weight of bold grained selections of *Periamanjal-Irungu* and their progenies in the I year of selection.

100 grain weight in gram of six progenies from each of the selections at top right.	100 grain weight in gram of eight selections							
S. No.	1	2	3	4	5	6	7	8
1.	2·50	2·80	2·86	2·64	2·70	2·51	2·91	2·67
1.	2·40	1·70	2·00	2·42	2·25	2·40	2·30	2·14
2.	1·12	2·20	2·20	2·12	1·95	2·38	3·00	2·05
3.	2·02	1·88	1·95	1·63	1·80	2·75	2·20	1·15
4.	2·00	1 81	1·80	1·81	1·88	1·88	2·20	1·80
5.	1·50	1·90	1·70	1·85	1·75	2·90	1·23	1·66
6.	1·80	2·35	2·60	1·86	1·76	2·27	1·23	1·94
Mean of progenies.	1·81 ∓ 0·157	1·95 ± 0·080	2·04 ± 0·115	1·95 ± 0·119	1·85 ± 0·067	2·43 ± 0·128	2·02 ± 0·244	1·79 ± 0·227

Again single plant selections with bold and well exposed grains alone were advanced to further selection. It was also observed that seasonal factors influenced the grain weight to a very great extent. A selection that recorded higher grain weight in good season was found to record a poor weight during adverse season and vice versa. Hence, the boldness of the grain having been fixed, more importance was attached to uniformity in grain among the progenies in a particular season. Careful selection over six years was found to induce a fair amount of uniformity among the progenies. A comparative statement of grain weight of parental selections and progenies in the sixth year of selection is given in table III.

TABLE III

100 grain weight of bold grained selections of *Periamanjal Irungu* and their progenies in 6th year of selections.

100 Grain weight in gram of six progenies from each of the selections at top right.	100 grain weight in Gram of six selections					
S. No.	3·26	3·14	3·03	2 90	3·00	3 39
1.	2·10	2·07	2·07	2·09	2·13	2·12
2.	2·01	2·05	2·07	2·07	2·14	2·13
3.	2·12	2·07	2·04	2·07	2·18	2·15
4.	2·00	2·08	2·02	2·07	2·14	2·16
5.	2·01	2·07	2·04	2·07	2·16	2·13
6.	2·02	2·07	2·16	2·12	2·18	2·14
Mean of progenies.	2·04 ± 0 018	2·07 ± 0·011	2 07 ± 0 020	2·80 ± 0·007	2·16 ± 0·002	2·14 ± 0·005

The selections that have attained uniformity as revealed by progeny test (table III above) were found to yield better than unselected *Periamanjal Irungu.* The yield of the selections in table III as expressed by the aggregate yield of progenies, compared with unselected Periamanjal-Irungu is given in the table IV. The yield represents the produce from four rows of 25 links each.

TABLE IV

Grain yield of *Periamanjal-Irungu* bold grained selections compared with unselected *Periamanjal-Irungu* (6th year of selection).

Selection No.	K.1 758	K.1 758/3	K.1 758/1	K.1 758/4	K.1 759/1	760/1	Unselected Periamanjal-Irungu.
Grain yield in lb.	1·81	1·69	1·56	1·50	1.38	1·25	1·13
Percentage of increased yield over unselected Periamanjal-Irungu.	60·28	40·71	38·05	32·74	22·22	10·62	

It may be observed that the above selections gave a maximum increased grain yield of 60·28 percent over unselected *Periamanjal-Irungu* with an average increased grain yield of 34·10 percent. These selections have been advanced to regular yield trials with *Periamanjal-Irungu.*

Discussion : Analysis of grain weight of single plant selections of *Periamanjal-Irungu* revealed the necessity of screening to induce uniformity in grain wegiht. The grain weight of unselected *Periamanjal-Iruugu,* expressed in terms of weight of 100 grains was found to vary from 1·2 grams to 2·9 grams i. e. roughly between the grain weights of the parents that went into the cross from which *Periamanjal-Irungu* was extracted. The bimodal distribution of the grain weights, (fig. 1) with the highest frequencies centering round the parental classes and the lowest about the mean, illustrates the parental affinities of *Periamanjal-Irungu* in the matter of grain weight. A greater concentration towards the *Irungu* parents was also discernible. Though the original cross was effected in 1937, it was interesting to note occassionally plants similar to the *Periamanjal* and *Irungu* parents in single plants selection of *Periamanjal-Irungu.*

Seasonal factors during growth period were found to influence the grain weight considerably. Hence the variations through the seasons were not taken in to account, but simply observed. For ascertaining the range of variation in *Periamanjal-Irungu* all the 223 selections were taken from one field in the same season. It may be

seen from tables that selected lines do not show as much variation as unselected one. Selections, the progenies of which showed almost similar grain weight alone were considered to have attained uniformity.

Another interesting feature revealed during the investigations was the paucity of grain setting in *Periamanjal-Irungu*. During seasons of low or ill distributed rainfall it may be as low as 21 to 24 percent. This may perhaps be reminiscent of its *Periamanjal* parent which does not set seed in Kovilpatti. *Periamanjal-Irungu* does not exhibit poor setting when grown under irrigation, indicating that poor setting may be due to lack of moisture at the proper time Particular attention was paid to eliminate this defect in the bold grained selections. But it appears that this problem has to be tackled separately after fixing bold grained selections.

Selection was found to have definite influence in inducing uniformity of grain weight in *Periamanjal-Irungu*. As bold grains are preferred for a grain crop for which *Periamajal-Irungu* is well adapted, selection was directed to fix uniformly bold grained types with well exposed grains similar to the *Periamanjal* parent. The data in table II for the first year of selection and in table III for the sixth year of selection illustrate the results very clearly. Attaining of uniformity of grain weight was found to improve the grain yield as well, the increased yield over unselected *Periamanjal-Irungu* being 10 to 60 percent.

Summary: The grain size of *Periamanjal-Irungu* was found to vary between the grain size of its parents. Rigorous and continued selection was found to eliminate this deversity considerably. Bold grained selections in which this improvement was effected, gave a substantially better yield than unselected *Periamanjal-Irungu*. Together with this improvement, if the poor grain setting when grown under rainfed conditions were also eliminated, this fodder-cum-grain strain will be immensely benefited.

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