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Short Communication

SELECTION CRITERIA FOR GRAIN YIELD IMPROVEMENT IN FINGER MILLET AT HIGH ALTITUTDE

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Higher elevations of hills pose a regular problem for genotype - environment interactions due to short growing season. More often, temperature stress affects the physiological processes of cultivar that determine growth and yield [1]. The cultivars of finger millet show late emergence of panicles when exposed to sub-optimum temperatures during vegetative growth inspite of having favourable day length to initiate flowering [2]. Duration of grain filling or grain growth is prolonged as a consequence of low atmospheric temperature at post floral growth [3-6]. As a result, grain production of finger millet is not fully realized at higher elevations in hills of north India.

In this study, effective selection criteria for improving grain yield of finger millet were investigated among 22 genotypes by studying eight characters viz. plant height, days to 50% head emergence, number of productive tiller per plant, number of fingers per ear, ear length, total biological yield, grain yield and harvest index. The genotypes considered for this study were DM 1, HR 374, KM 208, KM 228, KM 229, KM 230, Local, PES 400, PPR 2679, PR 202, PRM 3, RAU 13, TNAU 533, VL 149, VL 207, VL 209, VL 279, VL 280, VL 281, VL 282, VL 704 and VR 708. The seeds were sown in June. The experiment was conducted at an altitude of 2100 m above mean sea level for three consecutive years during 1994, 1995 and 1996 and was laid out in randomized block design with three replications. Recommended agronomic practices were adopted to promote normal growth and development of plant. Analysis of variance [7] and correlation coefficients [8] were computed on pooled data over three year trials. Test of significance was determined as per the statistical procedure. Mean values of maximum and minimum temperature (°C) were recorded during three experimental years on May (19.35, 20.89, 19.14), June (21.80, 22.25, 19.60), July (20.40, 19.75, 19.10), August (19.35, 19.00, 18.50), September (19.05, 18.10, 17.45), October (15.55, 15.35, 14.30) and November (11.60, 11.40, 11.90). Maximum day and night temperature were registered for June (34.2, 20.5), July (25.6, 19.4) and August (26.8, 18.8) respectively on 1995, 1994 and 1994.

Table 1. Analysis of variance for yield components in finger millet

Source	df	Mean squares							
		Plant height	No. of productive tiller per plant	Days to 50% head emergence	No. of finger per ear	Ear length	Harvest index	Total biological yield	Grain yield
Genotype	21	580.5**	6.0**	206.7**	31.6**	14.7**	3.5**	23622.2**	29805.6**
Year	2	675.4*	8.7*	390.6**	11.6	9.7	2.4*	45170.1*	6583.9*
Genotype × year	42	185.3**	2.1**	67.8	5.0	3.2	0.6**	10270.5*	1762.3**
Error	126	92.7	0.9	36.6	3.9	2.4	0.1	6224.5	802.3

*, ** Significant at 5 and 1% level of probability

Table 2. Estimates of phenotypic correlation coefficients among eight characters of finger millet grown under cool climatic condition at high altitude

	1	2	3	4	5	6	7	8
1. Biological yield	1.000	–0.703**	0.676**	–0.096	0.319**	0.513**	0.526**	0.051
2. Harvest index		1.000	–0.353*	0.015	–0.367*	–0.090	–0.423**	0.563**
3. Plant height			1.000	–0.464**	0.614**	0.715**	0.255	0.226
4. Productive tiller/plot				1.000	–0.382*	–0.347*	0.330*	0.042
5. Ear length					1.000	0.455**	0.015	–0.141
6. No. of fingers/ear						1.000	0.350*	0.247
7. Days to 50% emergence							1.000	– 0.001
8. Grain yield								1.000

*, ** Significant at 5 and 1 per cent level of probability

Meteorological data on temperature indicated that the climatic condition in June was relatively warm. A subsequent decrease in atmospheric temperature was observed in July and August during vegetative growth of experimental cultivars; while a steep decline in temperature was noticed during post floral growth of cultivars from September onwards. The results revealed that genotype × year interaction effect registered significant variation in plant height, tiller number, total biological yield, grain yield and harvest index (Table 1). This offered opportunity to identify suitable genotypes for higher altitudes. Grain yield registered significant positive correlation with harvest index (Table 2) and non-significant association with other characters. Earlier studies on the association of these characters, except days to heading, have reported significant correlation with grain yield at low altitude [9, 10]. It was, therefore, attributed that ecophysiological constraint particularly associated with low atmospheric temperature perhaps impeded the establishment of desired correlation at high altitudes. Late emergence of head, prolonged duration of grain filling or grain growth and short growing season at high altitude perhaps had exerted its influence on reducing the effect of inter character correlation between heading date and grain yield of cultivars. The present study, therefore, suggests that an effective partitioning of photosynthates into growth of structural compounds of vegetative organ and non structural compound in reproductive state [11] was more important towards enhancing the productivity of grain yield at high altitude. At non-freezing cold stress, an improvement of harvest index indicated that temperature dependent enzymes remain active within the living cell of plant and carried out normal physiological and biochemical function associated with transduction and utilization process of photosynthesis [12]. Cultivar is able to produce more grain through accumulating non- structural carbohydrates to the grains [13] or through enhancing the rate of photosynthesis at latter part of crop development [14]. It appears from this investigation, that harvest index is the most efficient selection criterion for improving grain yield of finger miller at higher elevations of hills in north India.

REFERENCES

1. Y. Murata. 1964. On the influence of solar radiation and air temperature upon the local differences in the productivity of paddy rice in Japan. Proc. Crop. Sci. Soc., Japan. **33**: 59-63.
2. M. D. Kernick. 1961. Ecology. In: Agricultural and Horticultural Seeds : Their Production, Control and DIstribution. FAO Rome,. pp. 32-61.
3. I. Sofield, L. T. Evans, M. G. Cook and I. F. Wardlaw. 1977. Factors influencing the rate and duration of grain filling in wheat. Aust. J. Plant Physiol., **4**: 785-797.
4. S. I. Chowdhury and I. F. Wardlaw. 1978. The effect of temperature on kernel development in cereals. Aust. J. Agric. Res., **29**: 205-223.
5. C. L. Wiegand and J. A. Cuellar. 1981. Duration of grain filling and kernel weight of wheat as affected by temperature. Crop Sci., **21**: 95-101.
6. J. Vos. 1985. Aspects of modelling post-floral growth of wheat and calculations of the effects of temperature radiation. *In*: Wheat Growth and Modelling (Eds. W. Day and R. K. Atkin). Plenum Press, New York. pp. 143-148.
7. R. K. Singh and B. D. Chaudhary. 1985. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi, Ludhiana.
8. H. A. Al Jibouri, P. A. Millar and H. P. Robinson. 1958. Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. Agron. J., **50**: 633-636.

9. R. B. Sarvaiya, K. B. Desai and M. U. Kukadia. 1983. Correlation and path analysis in finger millet in Sikkim. Indian J. Agric. Sci., **53**: 15-18.

10. C. Lal, T. Dawa, P. Plaha and S. K. Sharma. 1996. Studies on genetic variability and component analysis in ragi (*Eleusine coracana* Gaertn.), Indian J. Genet., **56(2)**: 162-168.

11. T. Ishikawa, T. Hoshina, K. Nagata, I. Nakamura, S. Akita and N. Kabaki. 1994. Effect of temperature during reproductive period on spikelet number in rice (*Oryza sativa* (L). Japan J. Crop Sci., **63** (Extra issue) **1**: 152-153.

12. J. P. Palta. 1993. Mechanism for obtaining freezing stress resistance in harbacious plant. In: Plant Breeding in 1990s. (Eds. H. T. Stalker and J.P. Murphy), CAB International, pp. 219-251.

13. S. Akita. 1980. Studies on the differences in photosynthesis and photorespiration among crops. Nat. Inst. Agric. Sci., **31**: 1-94.

14. S. Akita. 1995. Ecophysiological aspects of increasing the biological and commercial yield potential of rice (*Oryza sativa* L.). International Rice Commission Newsletter., FAO, **44**: 21-32.