Indian J. Genet., **58**(1): 107-112 (1998)

VARIABILITY IN FLORAL STRUCTURE AND FLORAL BIOLOGY OF FINGER MILLET (*ELEUSINE CORACANA* (L.) GAERTN.)

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(Received: June 18, 1996; accepted: March 22, 1997)

ABSTRACT

The variability in floral structure and floral biology was studied in 24 strains of finger millet. The inflorescence consisted of a cluster of variable number of spikes called fingers. Each finger has two opposite rows of spikelets. A spikelet contains variable number of florets. The florets are hermaphrodite, perfect except for the terminal florets. The floret is covered by two large glumes, enclosed between a pair of palea. The florets are in the axil of lemma. The androecium consists of three stamens. The gynoecium is bicarpellary, unilocular with superior ovary. Near the base of ovary two lodicules are present. There was a wide range of variation in the length of anther, filament, stigma and style. Anthesis occurred between 1.00 a.m. to 6.00 a.m., the peak period of anthesis being between 3.00 to 5.00 a.m. The pollen viability at the time of dehiscence of anthers ranged from 76.92 to 100 per cent. The pollen remained viable for 20 minutes.

Key words: Finger millet, variability, floral structure, floral biology

The hybridization method of breeding has produced spectacular results in various crops. However, in finger millet, hybridization is difficult due to the small size of florets. Finger millet flower is poorly understood taxonomically. The knowledge of floral structure and floral biology which is a pre- requisite for developing crossing techniques is largely lacking in finger millet. The present investigation was, therefore, undertaken to study the floral structure and floral biology of finger millet.

MATERIALS AND METHODS

The experimental material for the study consisted of 24 strains of finger millet (*Eleusine coracana* (L.) Gaertn.) randomly selected from the All India Co-ordinated Millets Improvement Project and from local and improved cultures. Five seedlings

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of each of the strains were planted in earthen pots. Five florets from each strain were dissected before dehiscence to measure the length of different floral attributes under ocular micrometer in mm. Pollen grains were stained with 0.25 per cent acetocarmine and mounted pollen grains were examined under low as well as high power of microscope. The time of dehiscence and anthesis was recorded on tagged plants through continuous observations. The data were analysed according to Panse and Sukhatme (1).

RESULTS AND DISCUSSION

The detailed investigation on the inflorescence of finger millet (Table 1) revealed that, the number of inflorescence per plant ranged from 1.53 in TNAU 896 to 4.60 in HR 374. The inflorescence of finger millet was a cluster of spikes called fingers which varied from 3.13 in RAU 13 to 10.13 in PPR 2614 and white ragi. The general mean for this character was 7.36. Ayyanger and Rao (2), Ayyangar and Warriar (3), and Tyagi and Koranne (4) observed maximum variability for fingers per head. The length of finger varied from 4.43 to 12.36. The GN 3 had the longest fingers, while RAU 13 had the shortest fingers among the strains studied. Each finger was made of two opposite rows of secured spikelets closely arranged on the two sides of the rachis. There was considerable variability observed for number of spikelets per main head which ranged from 226.68 in RAU 13 to 939.17 in GN 3. The general mean for this character was 472.60. The variation in spikelets per finger is also reported by Ayyangar and Rao (2) and Ayyangar and Warriar (3). A spikelet contained variable number of florets which varied from 4.47 in VL 281 to 6.67 in GPU 32. Variation in florets per spikelet was also reported by Ayyangar and Warriar (3). The detailed investigation on the floret structure revealed that, the finger millet florets were perfect except for the terminal florets which were either staminate or pistillate. The flowers usually were hermaphrodite and hypogynous.

The floret is covered by two large barren leaves known as glumes, each being enclosed between a pair of scale known as palea. The florets are in the axil of lower flowering glume known as lemma, which had a small appendage. Near base of the ovary, two little scales the lodicules were present. The androecium consisted of three hypogynous stamens. Gynoecium was bicarpellary, unilocular with superior ovary and single ovule.

Table 1. Variation in floral attributes in finger millet

Strains	No. of inflores-cences/ plant	No. of fingrs/ head	Length of inflor-escence (cm)	No. of spikelets/ head	No. of florets/ spikelet	Length of filament (mm)	Length of anther (mm)	Length of style (mm)	Length of stigma (mm)
Dapoli 1	4.00	8.47	8.44	793.6	5.70	0.79	0.88	0.64	1.07
DM 1	2.53	6.87	5.85	334.8	4.60	0.78	0.96	0.61	0.83
Gave Local	3.40	9.00	6.65	528.9	5.47	0.68	1.02	0.63	1.00
GN 3	2.27	8.53	12.36	939.1	5.53	0.82	1.04	0.51	1.22
GPU 32	1.73	7.20	7.54	526.0	6.67	0.80	1.02	0.61	1.07
HR 374	4.60	7.27	5.99	477.3	6.07	0.79	1.02	0.58	1.15
KM 228	4.53	6.93	5.01	414.0	5.33	0.62	0.98	0.55	1.04
KM 229	3.47	6.27	5.21	351.0	4.80	0.66	1.01	0.58	1.28
MR 16	2.47	6.73	7.58	565.7	6.33	0.85	1.08	0.81	1.04
PES 400	3.93	6.63	5.58	326.2	5.20	0.63	0.90	0.83	1.28
PPR 2614	2.87	10.13	6.32	445.7	5.27	0.55	0.95	0.48	0.99
RAU 8	4.07	8.93	6.69	576.3	5.33	0.67	1.05	0.70	0.98
RAU 13	4.00	3.13	4.43	226.6	6.20	0.65	0.97	0.57	0.94
SRS 2	1.73	7.80	7.36	531.4	6.40	0.63	0.94	0.51	1.12
TNAU 533	4.00	7.00	5.33	382.5	5.27	0.53	0.97	0.58	1.22
TNAU 896	1.53	9.73	7.65	614.9	5.67	0.69	1.02	0.60	0.92
VL 149	2.33	8.73	7.90	565.2	5.63	0.72	0.88	0.51	0.92
VL 235	2.33	6.73	6.29	340.1	5.07	0.57	0.89	0.44	0.97
VL 281	3.27	5.00	5.93	244.0	4.47	0.57	0.89	0.38	0.96
VR 696	2.40	7.00	5.91	436.0	5.87	0.83	1.04	0.60	1.09
VR 704	3.20	5.53	5.42	210.0	4.87	0.72	1.02	0.64	1.34
VR 708	3.33	5.93	4.83	258.2	5.27	0.84	1.03	0.66	1.12
Vengurla-1	3.27	7.13	7.05	480.9	6.13	0.83	0.93	0.65	1.25
White ragi	2.53	10.13	6.73	773.2	6.13	0.78	1.03	0.51	1.23
Mean	3.08	7.36	6.58	472.60	5.56	0.70	0.98	0.57	1.09
S.E. ±	0.77	0.58	0.31	31.12	0.36	0.04	0.02	0.05	0.08

There are reports on the florets structure in finger millet by Gokhale *et al.* (5), Hilu and De Wet (6), Ganesshaiah and Umashankar (7). The androecium almost surrounded the stigma, which ensured self-pollination. The filaments were very short and ranged from 0.48 mm in VL 281 to 0.85 mm in MR 16. The general mean for this character was 0.70 mm. Anthers were smaller and their length varied from 0.86 to 1.06 mm. The minimum length of anthers was in Dapoli-1, and maximum in MR 16. Thus, the androecium could apparently pose a problem for emasculation.

The gynoecium is bicarpellary having feathery branched stigma. The variation in length of style ranged from 0.36 to 0.70 mm. The longest style was observed in RAU 8 and the shortest in VL 281. The length of feathery stigma ranged from 0.83 mm in VR 704 to 1.34 mm in DM 1 before dehiscence of anthers which indicates that, it would be worthwhile to select strains which facilitate easy emasculation. The variation in length of stigma after dehiscence of anthers in finger millet is reported by Ganeshaiah and Umashankar (7).

The flowering behaviour in finger millet is very abrupt. The study revealed that, stigma came out of the lemma, covered by thick cloud of pollen dust. Apparently, the longation of style and filaments were closely associated with the anthers bursting on the stigma as soon as it emerged. That gave very little chance for cross pollination. The anthers dehisced when still inside, hence, not much pollen was lost. Soon after the dehiscence of anthers, the flower was closed with no traces of stigma, only empty and dehisced anthers hanging out at low humidity and high temperature but when there was high humidity and low temperature, it was interesting to note that, both the stigma and anthers were outside, when flower closed. These behavioural sequences in finger millet predispose the species into chasmogamous and cleistogamous reproduction. There are earlier reports on flowering behaviour in finger millet [7,8].

The dehiscence of anthers occurred prior to opening of florets. Moreover the sticky stigma and anthers were at the same height inside the flower at the time of deiscence, thus, it is evident that these two factors largely contributed to self-pollination. Regarding the time of dehiscence of anthers, it was observed that, the dehiscence occurred mainly 40 to 50 minutes before anthesis which indicated the need to collect fresh pollen grains. It was interesting to note that, in all the strains studied the dehiscence occurred before 6.00 a.m. It appears that it would be worthwhile to create such requisite environmental conditions artificially which might help in easy emasculation prior to the stage of receptivity of the stigma due to induced protandry.

Table 2. Variation in time of anthesis in finger millet

Strains	12.00 to 1 a.m.	1 a.m. to 2 a.m.	2 a.m. to 3 a.m	3 a.m. to 4 a.m.	4 a.m. to 5 a.m.	5 a.m. to 6 a.m.	6 a.m. to 7 a.m.
Dapoli 1	0.00	2.37	20.77	30.00	33.78	13.08	0.00
DM 1	0.00	9.17	26.64	21.25	32.17	10.77	0.00
Gave local	0.00	4.46	15.23	33.22	37.00	10.09	0.00
GN 3	0.00	5.76	19.37	33.18	38.03	3.66	0.00
GPU 32	0.00	4.08	16.65	35.05	37.23	7.99	0.00
HR 374	0.00	7.24	19.51	31.17	37.82	4.26	0.00
KM 228	0.00	4.34	17.52	38.83	35.21	4.10	0.00
KM 229	0.00	2.95	21.24	30.19	29.43	16.19	0.00
MR 16	0.00	3.48	20.45	32.41	38.14	5.52	0.00
PES 400	0.00	8.12	19.15	28.03	30.63	14.07	0.00
PPR 2614	0.00	5.06	18.43	34.59	29.42	12.50	0.00
RAU 8	0.00	3.84	18.47	20.29	36.53	10.87	0.00
RAU 13	0.00	5.12	20.86	34.18	26.11	13.73	0.00
SRS 2	0.00	4.58	11.16	26.67	40.31	17.28	0.00
TNAU 533	0.00	5.56	10.81	25.67	42.88	15.08	0.00
TNAU 896	0.00	7.43	20.72	30.92	28.32	12.61	0.00
VL 149	0.00	5.04	14.43	27.73	39.06	13.74	0.00
VL 235	0.00	3.13	13.48	21.30	45.37	16.72	0.00
VL 281	0.00	5.87	9.17	24.94	39.49	20.53	0.00
VR 696	0.00	4.75	11.28	26.54	41.87	15.56	0.00
VR 704	0.00	12.53	23.65	21.51	31.24	10.97	0.00
VR 708	0.00	4.72	12.14	25.29	47.23	10.62	0.00
Vengurla 1	0.00	2.88	18.35	27.92	34.05	16.80	0.00
White ragi	0.00	7.23	21.11	32.18	31.07	8.41	0.00
Mean	0.00	5.40	17.53	29.16	35.93	11.88	0.00

There are reports on dehiscence of anthers in finger millet by Gokhale *et al.* (6) and Ganeshaiah and Umashankar (7). The opening of flowers commenced between 1.00 a.m. to 2.00 a.m. (Table 2). More than 65 per cent anthesis opened after 6.00 a.m. in any of the strains studied. Gokhale *et al.* (6) observed anthesis between 4.30 a.m. to 7.30 a.m Ayyangar and Warriar (3) between 2.00 a.m. to 7.00 and Chavan *et al.* (8) between 6.00 a.m. to 10.00 a.m.

Pollen viability is another important character in the case of cultivated crops. For getting success in hybridization, one has to use viable pollen grains and more the viability more would be the chances of making a successful hybridization programme. In the present investigation, the pollen viability ranged from 76.92 % in var. DM 1 to 100.00 % in var. VL 281 and VR 696 at the time of dehiscence of anthers. The mean pollen viability at the time of dehiscence was high (90.48%). However, the pollen viability lasted only for 20 minutes after dehiscence of anthers in all the strains studied.

Thus, it is evident that a wide range of genetic variability exists for floral structure and floral biology which could be utilized for systematic exploitation in finger millet improvement programme through hybridization.

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