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The Biology Of Flowering In *Pennisetum americanum* (L.) Leeke.

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Floral biology of six varieties of *Pennisetum americanum* (L)LEEKE has been studied. The six varieties included two hybrids, two inbreds, and two synthetics. A wide range of differences in floral features and biology has been observed among the varieties. The process of flowering was mainly influenced by meteorological conditions and varietal status. The significant variations in floral features may be attributed to wide genetic diversity of their ancestors.

Floral biology provides useful information about the period of anthesis, dehiscence of anthers and receptivity of stigma etc. of plants that are to be used as parents in the hybridization programme. In pearl millet *(Pennisetum americanum* (L.) Leeke, however, no systematic work has been carried out towards the improvement of the crop. Only very little work on floral biology has been done by Tewari *et al.*, (1971). In the present paper, therefore, an attempt has been made to describe the details of the different floral phenomena.

MATERIALS & METHODS Six varieties of pearl millet including two inbreds (PIB 155, PIB 228, two hybrids(PHB 10, PHB 47) and two synthetics (PCB 380, PSB 15) were used. The characters studied were: 1.Panicle emergence, 2. Number of spikelets per panicle, 3. Number of florets per spikelet, 4. colour and number of subtending bristles, 5. Opening angle of floret, 6. Colour and size of anther, 7. Extrusion of anther, 8. Dehiscence of anther, 9. colour and size of stigma, 10. Extrusion of stigma, 11.Overlapsing period between the styles and anthers, 12. Pollen morphology, 13. Pollen viability and 14. Sign of grain formation.

Seed of the six varieties were sown in randomized block design with three replicates. The experimental material consisted of ten plants of each variety. Five plants of each treatment from each plot were selected for recording the observations. Number of pollen grains per anther was counted by the method given by Beri & Anand (1971). The pollen preparations were made by acetolysis method as described by Nair (1960). The terminology used for pollen morphological characters was that of Erdtman (1952,1964). The various aspects were studied under local conditions of relative humidity and temperature ranging from 80 - 85% and 28.5-33.2°C, respectively (lat 30° 56'N,long.75° 52'E).

RESULTS & DISCUSSION The data on mean values of 14 floral characters recorded on different varieties are presented in Table 1. The florets in all the varieties started opening from 5.00 P.M., and by 7.00 P.M. all the florets were opened.

1. **Panicle emergence** - Considerable variations were recorded in the complete panicle emergence . The time taken in different varieties varied from 150. to 232.7 h. Tewari *et al.*, (1971) observed that the time of complete panicle emergence was less in the F_1 hybrids. However, the present results do not correspond with the findings of Tewari *et al*

(1971) since the hybrids and synthetics took more time than their parents (Table 1). The probable reason might be the larger size of the panicle.

2. **Number of spikelets per panicle** - The number of spikelets per panicle was mainly influenced by the size of panicle and its compactness. The number of spikelets in different varieties varied from 1937 to 3271. Godbole (1925) and Tewari *et al.* (1971) reported a much lower number of spikelets than what was observed in the present studies (Table 1). The higher number of spikelets in the hybrids and synthetics might be due to the hybrid vigour for this character.

3. **Number of florets per spikelets** There was no difference in the number of florets per spikelet in inbreds, hybrids and synthetics. In each case, there were two florets, upper hermaphrodite and the lower antheriferous.

4. **Colour and number of subtending bristles** - In different varieties of *P. americanum* the colour of bristles ranged from pale-yellow to brownish to dark-pink and the number varied from 53 to 78 surrounding the spikelet group. They were of two types. Large-sized bristles were hairy at the base, while the small - sized ones were smooth throughout their length.

5. **Opening angle of floret** - The angle of separation of broad lemma and thin palea ranged from 5.8 to 8.3°. It was noticed that tightness of panicle influenced the opening angle of floret.

6. **Colour and size of anther** - In different varieties, the colour of anther varied from pale -yellow to yellow to dark- pink. The length and width of the versatile anthers ranged from 3 to 3.5 mm and 1090 to 1246 µm, respectively.

7. **Extrusion of anther** - The extrusion process was very slow in the beginning at about 6.00 P.M. However, it gradually became rapid around 10.00 P.M. and subsequently slowed down gradually around 4.00 A.M. The extrusion process was completely arrested by exposing the panicle surface to the bulb light in night. The length of the filament in different varieties ranged from 9.00 to 11.0 mm. Moreover, in general, all the three anthers were found extruding from the floret.

The extrusion of anthers started in two distinct phases. During the first phase, they emerged from the hermaphrodite florets and in the second phase from the antheriferous ones. The extrusion of anthers started from the apex of the panicle and gradually proceeded downwards. The second stage of extrusion started when the first phase of extrusion reached the base of the panicle. The time taken for complete extrusion of the antheres ranged from 33 to 85 h.

8. **Dehiscence of anther** - The dehiscence process was influenced by two factors viz. elongation of the filament and the number of the pollen grains. In all the varieties, the number of pollen grains per anther ranged from 853 to 1175. The dehiscence process occurred from 11.00 P.M. to 6.45 A.M.

9. **Colour and size of stigma** - The colour of stigma varied from pale-yellow to yellowish green to dark pink. In different varieties, the total length of style and stigma ranged from 4.95 to 6.57 mm with 374 to 489 delicate stigmatic hairs which were 370 to 490 µm in length.

10. **Extrusion of stigma** - The style emergence started from the panicle apex and gradually proceeded towards the base. In most of the varieties, the stigma tended to grow and slightly protruded out from the lips of the lemma and palea. The time taken in complete extrusion of the styles varied from 28 to 48 h. The receptivity of stigma ranged from 29.6 to 36.3 h. Tewari *et al.* (1971) reported more time for this process than what was observed by us.

Table 1 Floral biological data of different varieties of *Pennisetum americanum* (L)Leeke.

Variety	Full panicle emergence (h)	No.of spikelets/ panicle	No.of subtending bristles	Floret opening angle (°)	Anther length (mm)	Anther width (µm)	No.of pollen grains/ anther	Total length of style and stigma (mm)	No.of stigmatic hairs	Length of stig matic hairs (µm)	Stigma receptivity (h)	Pollen grain diameter (µm)	Pore diameter (µm)	Pollen grain viability (h)
PIB 155*	168.8	1937	53	5.8	3	1091	853	5	374	380	32.4	39	4	7
PIB 228*	158.3	2044	53	6.1	3	1100	918	5	391	370	29.6	39	4	7
PHB 10**	221.8	3094	59	7.5	3	1181	1087	6	437	481	34.1	42	4	8
PHB 47**	232.7	3271	78	8.3	4	1246	1175	7	489	490	36.3	43	4	8
PCB 380***	171.2	2519	59	7.2	3	1149	946	5	426	421	34.0	41	4	8
PSB 15***	196.4	268.4	59	6.9	3	1180	987	6	430	430	35.0	41	4	8

(* Inbred, ** Hybrid, *** Synthetic)

Godbole (1925) observed that styles required 34 to 38 h, for complete emergence and then begin to dry up. He emphasised that in hybrids, a much higher period of style extrusion was due to the hybrid vigour.

11. **Overlapping period between the extrusion of styles and anthers** - Usually styles begin to extrude earlier than the anthers. But in some cases, there was certain degree of overlapping period between the extrusion of styles and anthers which afforded excellent opportunity for self- pollination. This time varied from 10 to 28 h.

12. **Pollen-morphology** - The mature pollen grains were generally three-celled monoporate, but rarely bi-or triporate, spherical or slightly ovoid in shape, exine usually 2.2 - 2.5 µm thick, smooth, granular cytoplasm, with a raised rim (diameter from 8.4 to 12.6 µm) around the circular pore. The pore diameter ranged from 3.7 to 4.17 µm. The average diameter of pollen grains in different varieties ranged from 38.6 to 43.1 µm.

13. **Pollen viability** - The pollen grains collected at 11.00 P.M. showed maximum germination. The pollen viability decreased with the delay in the time of pollen collection from 11.00 P.M. onward. The pollen grains remain viable from 7 to 8 h (Table 1), when stored at room temperature (30°C) and in a relative humidity of 80-85%. The period of maximum physiological development in pollen grains was between 11 to 4 A.M.

14. **Sign of grain formation** - After 24 h of pollination, the stigma withered and gradually lost its erectness. Their stigmatic hairs were shrunk, curled and dried gradually. Their yellowish brown colour showed the sign of grain formation.

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