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REPRODUCTIVE AND BREEDING BEHAVIOUR OF PALMAROSA (*CYMBOPOGON MARTINII* WATS)

H. K. SRIVASTAVA* AND G. N. SRIVASTAVA

Central Institute of Medicinal and Aromatic plants, Lucknow 226016

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ABSTRACT

Breeding behaviour of palmarosa (*Cymbopogon martinii*) studied in self, cross and open pollinations. The hermaphrodite flowers constituted only 25 to 35% of the florets in an inflorescence and the rest were staminate florets. Pollen fertility varied from 84 to 96% in staminate and hermaphrodite florets. The seed set was 15% in self, 50% in cross, and 64% in open pollinations. Few pollen tubes were noticed to traverse inside stigma and penetrate through the stylar region under self-pollination. Low seed set on selfing may be due to some self-incompatibility system in palmarosa.

Key words: *Cymbopogon martinii*, palmarosa, essential oil, geraniol, floral biology, reproductive and breeding behaviour.

Palmarosa (*Cymbopogon martinii* Wats) is an important aromatic grass yielding palmarosa oil which is the major source of geraniol. India is one of the major producers of palmarosa oil in the world. The present paper is a report on breeding behaviour of this species.

MATERIALS AND METHODS

Motia, the palmarosa cultivar since 1924, served as experimental material. Three plants were selected and tagged before anthesis for each of the following three sets of experiment:

(i) Selfed: bagging the whole inflorescence of randomly selected individual tillers in each plant separately for selfing with the pollen of the same panicle; (ii) crossed: bagging the whole inflorescences of two tillers of two different plants together for crossing with the pollen of two different panicles; and (iii) open pollination: leaving the randomly selected inflorescence of tillers unbagged for open pollination. The panicles were throughly examined in order to ensure that the anthesis has not taken place. The inflorescence was bagged 3-4 days before anthesis for selfing and crossing. Selfing and crossing were facilitated by occasional shaking of the bagged inflorescence(s).

Pollen germination on stigma and the path of pollen tubes down the style were studied in pistils stained and squashed in safranin–aniline blue in 45% hot acetic acid. The

*Present address: Department of Biotechnology, Ministry of Science and Technology, Block II (8th floor), CGO Complex, Lodi Road, New Delhi 110003.

male and hermaphrodite florets were counted in one panicle each of the three sets under dissecting microscope. The remaining panicles of sets were allowed to set seeds. Seeds were classified as well-filled and not well-filled (shrivelled and empty), and their total number per panicle was recorded. Pollen fertility was estimated by iodine–potassium iodide method with squashing of undehisced mature anthers from the main tiller.

RESULTS AND DISCUSSION

A palmarosa plant possessing enormous number of tillers per hill is shown in Fig. 1a. The separated panicles from inflorescence are exhibited in Fig. 1b. Spikelets with florets exhibiting emergence of anthers and stigmas are seen in Fig. 1c. Staminate (69%) and hermaphrodite (31%) flowers are generally observed in the entire inflorescence. Figure 1d illustrates anthers of a staminate flower. The anthers of staminate flowers emerge out of the perianth lobe after the post-fertilization stage of hermaphrodite flowers. These anthers may be used to fertilize the remaining unfertilized flowers. Figure 1e shows two hermaphrodite flowers. Feathery type stigma and anther lobes of the older hermaphrodite floret have just protruded out. There is no shedding of pollen grains over the stigma. Anther lobes of the younger floret of the same spikelet in Fig. 1e remain intact. Figure 1f exhibits anthers of hermaphrodite flower after having shedded their pollen grain on the same receptive feathery stigma, and Fig. 1g shows several germinating pollen grains. Long germinating pollen tube is seen travelling all the way inside stigma. More pollen tubes were noted descending inside stigma and penetrating through the stylar region in case of natural open pollination.

Table 1. Seed set of representative plants under self, cross, and open pollinations of *Cymbopogon martinii*

Parameter	Selfed	Crossed	Open pollination
Total florets (hermaphrodite and staminate)/panicle	2175	2745	2781
Hermaphrodite flowers/panicle, %	13.0	31.0	31.0
Staminate florets/panicle, %	68.9	68.9	68.3
Pollen fertility (hermaphrodite flowers), %	93	90	92
Pollen fertility (staminate flowers), %	96	88	84
Total seeds/panicle	540	852	998
Well filled (viable) seeds/panicle, %	15	50	64

The data on seed set of selected plants under self, cross, and open pollinations as well as pollen fertility are summarized in Table 1. Pollen fertility in anthers of both staminate and hermaphrodite flowers was above 84%. The hermaphrodite flowers represented only 31% of total flowers, which was further reflected in low seed set as compared to cross-seed and selfed flowers. The see set in the selfed plants was only 15%. The highest pollen fertility with lowest seed setting in the selfed plants indicated that some self-incompatibility mechanism may be operational in palmarosa which under self-pollination results poor sed and selfed flowers. The seed set in the selfed plants was only 15%. The highest pollen

penetrated through the stylar region under artificial self-pollination points to the above contention. More pollen tubes, on the contrary, were found descending inside stigma and deeply penetrating through the stylar region under both cross and open pollinations. The high seed set both under cross and open pollinations suggests that palmarosa is endowed with natural cross-pollination, possibly due to self-incompatibility. However, the details of floral biology, especially the extent of protogyny, period of pollen viability, and duration of stigma receptivity must be investigated to confirm the contention of self-incompatibility.

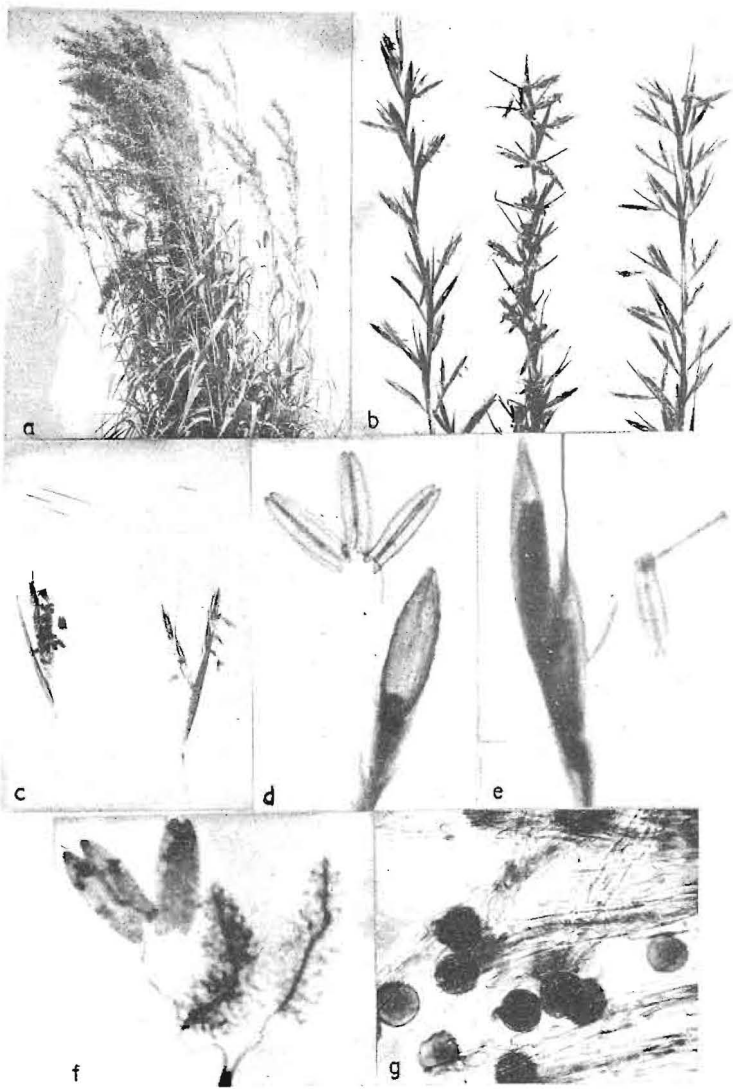

Fig. 1. General view of palmarosa plant (a), its panicles (b), spikelets (c), anthers of staminate flower (d), hermaphrodite flowers (e), self-pollination in a hermaphrodite flower (f), and germinating pollen grains (g).