# PROTOGYNOUS INTERVAL IN ELEPHANTGRASS (*PENNISETUM PURPUREUM* SCHUM.)

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**ABSTRACT**
A study was carried out to examine the protogyny duration in elephantgrass inflorescences. Nine accessions were selected, divided into three groups, according to early, intermediate or late flowering. From each cultivar, 10 panicles were sampled for evaluation. The criterion for estimating the duration of protogyny was the time interval (number of days) from the first visual detection of exserted stigmas up to the first visual appearance of open anthers (±5%). Duration of protogyny averaged 7.43±1.37 d, confirming that the species is protoginous. Late flowering accessions exhibited an average of 8.97 d for the duration of protogyny, which was significantly higher than the values observed for the intermediate and early flowering accessions. Data also indicate that the duration of protogyny in elephantgrass is efficient to prevent panicle selfcrossing.

**KEYWORDS**
protogyny, elephantgrass, time of flowering, breeding

**INTRODUCTION**
Elephantgrass is one of the most important fodders, being outstanding with regard to quality and production potential of dry matter, yielding up to 95 tons per hectare per year (Ruiz et al., 1992; Jacques, 1994). The majority of cultivars are collected in the wild with very few resulting from breeding programs.

When compared with other crops, the level of the genetic knowledge about elephantgrass is still extremely limited. The species is allogamous, highly heterozygous, has a strong inbreeding and is well adapted to vegetative propagation (Diz, 1994; Pereira, 1994; Hanna, 1994; Bogdan, 1977). The majority of cultivars are made up of clones propagated by stem cuttings, the seeds normally being produced by intercrossing of inflorescences of the same genotype. These seeds have a low germination rate, and produce plants which are not very vigorous. The inflorescences are of the panicle type, densely flowered, with spikelets which have plumose stigmas and three stamens. Flowering occurs, initially, caused by the differentiation of the apical meristem. The node meristems may also develop aerial buds and produce inflorescences. The flowering period, the production potential, and the viability of the seeds exhibit a wide variation between the ecotypes (Pereira, 1992; Xavier et al., 1993). According to these same authors, with regard to the flowering period, the elephantgrass ecotypes at Brazilian Germplasm Bank can be divided into three groups: early (flowering from February to March), intermediate (flowering from April to May) and late (flowering after June). There is a relationship between the ecotype or morphological group of elephantgrass and the flowering period (Pereira, 1992).

In the cross-pollinated species which have hermaphrodite and/or monoic flowers, the existence of genetic and physical mechanisms responsible for avoiding self-pollination is common. Protogyny is one of the mechanisms to prevent self-crossing, in which the maturing of the stigmas occurs before the opening of the anthers. Elephantgrass displays this protogynous flowering habit; however this does not prevent self-crossing between inflorescences of the same plant. The rate of cross-pollination depends on the flowering period, as well as the physical arrangement of the genotypes. Others morphological or genetic mechanisms of self-incompatibility or to prevent self-crossing have not yet been found in the elephantgrass germplasm.

In breeding programs where the artificial control of pollination is adopted, information about the interval between the male and female flowers maturing can ensure cross-pollinating free from contamination by self-crossing. This study was conducted with the objective to estimate this interval in elephantgrass.

**METHODS**
The experiment was carried out at **Embrapa**, National Dairy Cattle Research Center, located in Coronel Pacheco, State of Minas Gerais, Brazil. For the study, nine accessions of elephantgrass belonging to the Germplasm Bank were selected (Table 1), three within each group classified according to the flowering period - early, intermediate and late (Pereira, 1992; Xavier et al., 1993).

In each accession 10 inflorescences were chosen to evaluate the protogyny duration; these were identified before the exserted panicle. The criterion used was to estimate the protogyny duration between genotypes by measuring the time, in days, between the appearance of the stigmas and the opening of the first anthers (± 5%).

The experimental design was a completely randomized block, with 10 replicates, with the flowering groups mentioned above considered as treatments.

**RESULTS AND DISCUSSION**
The results obtained showed that there was a significant difference between the number of days from the beginning of the growth of the stigmas to the opening of the anthers for the accessions evaluated (Table 2). The mean and standard deviation of the protogyny duration for the 90 observed panicles was 7.43 ± 1.37 d, and for the accessions of the groups of early, intermediate and late flowering, a protogyny duration for 6.70 ± 0.59, 6.63 ± 0.61 and 8.97 ± 1.18 d, respectively (Table 3). These results confirm the protogynous nature of the flowering of the elephantgrass.

There were significant differences for the protogyny duration between the accessions within the early and late flowering group, whereas these differences were not observed for the intermediate group. In the early group, the Taiwan A-26 accession has a shorter protogyny duration than the others. In the late group, Napier from Volta Grande and Purple has a longer protogyny duration than the Mott cultivar. Between groups, the late accessions had a greater protogyny duration than the other groups.

Between panicles of the same accession the variation of the period from the growth of the stigmas to the opening of the anthers was very small. This was to be expected since the reproductive characters normally have a strong genetic control, as well as the fact that the accessions studied, being clones, do not have an intrinsic genetic variation. Between accessions and between groups the variations were greater and can be explained by the fact that there are genetic differences, which are a result of adaptation which came about during the evolutive process of each ecotype. The two extra days in the protogyny duration of the late flowering group, shows the existence

of a more efficient genetic-adaptative mechanism to prevent self-crossing in this group.

The general mean of the protogyny duration for the accessions studied was 7.43 days. The time interval between the growth of the stigmas and the anthers is enough to prevent the occurrence of self-pollination within the same inflorescence and to allow safe crossing controls. There was no observed simultaneous maturation of stigmas and anthers in the same inflorescences. This is in agreement with Hanna (1994) who observed that in elephantgrass the stigmas grow from the top of a panicle, for a 3 to 4 d period, after which the anthers open and the pollen is liberated, in the same way and for a similar period of time. Considering the mean duration obtained and information from Hanna (1994), we have a real interval of 3 to 4 d in which there is no simultaneous maturing of the male and female reproductive structures in inflorescences of elephantgrass. The results of this study showed that the interval between the growth of the stigmas and the anthers can be considered enough to prevent the occurrence of self-pollination. This information is important for elephantgrass breeding programs, since within the species' germplasm, more efficient mechanisms for pollination control, such as male sterility and genetic self-incompatibility, have not yet been identified.

The results of the present study indicate that: a) within the same inflorescence of elephantgrass there is no simultaneous maturing of male and female flowers, the protogyny duration being from three to four days. This time interval is enough to prevent the occurrence of self-cross; b) within the inflorescences, the time interval, in days from the beginning of the maturing of the female flowers to that of male flowers varies from 6 to 9 days depending on the time at which each cultivar flowers; c) the protogyny duration of the late-flowering cultivars is greater than that of the early and intermediate flowering ones, and; d) the protogynous nature of the elephantgrass inflorescences has been confirmed.

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**Table 1**
Accessions of studied elephantgrass, grouped according to the time of flowering

| Groups | Accessions |
|---|---|
| Early | 1 - Elefante da Colômbia |
| | 2 - Taiwan A-26 |
| | 3 - Sem Pêlo |
| Intermediate | 1 - Híbrido Gigante da Colômbia |
| | 2 - Mineiro |
| | 3 - Cachoeiro do Itapemirim |
| Late | 1 - Napier de Volta Grande |
| | 2 - Purple |
| | 3 - Mott (dwarf) |

**Table 2**
Summary of the analysis variance of protogyny duration in days, of three groups of accessions of elephantgrass with early, intermediate and late flowering

| Source of Variation | DF | SM | F |
|---|---|---|---|
| **Treatment** | 8 | 15,0750 | 25,71** |
| Early Group | 2 | 2,7000 | 4,60** |
| Intermediate Group | 2 | 0,0333 | 0,06 |
| Late Group | 2 | 4,6333 | 7,90** |
| Between Groups | 2 | 52,9300 | 90,26** |
| Residual | 81 | 0,5804 | |
| Mean | 6,70 | | |
| CV % | 10,30 | | |

**Table 3**
Mean number of days of protogyny duration, in elephantgrass accessions with early, intermediate and late flowering.

| Groups | Accessions | | | Mean |
|---|---|---|---|---|
| | 1 | 2 | 3 | |
| Early | 7,0 a | 6,1 b | 7,0 a | 6,70±0,59 B |
| Intermediate | 6,7 a | 6,6 a | 6,6 a | 6,63±0,61 B |
| Late | 9,2 a | 9,5 a | 8,2 b | 8,97±1,18 A |

LSD (between means of the groups)= 0,8183
LSD (between means within groups)= 0,4724

Means followed by the same letter horizontally and capital letter vertically differ from each other, by Tuckey's test, by no more than 5%.