广 西 植 物 Guihaia 26(4):392 — 394 2006 年 7 月

Seasonal variability of facultative apomixis in *Apluda mutica*

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Abstract: Variability in incidence of apomictic and sexual embryo sacs was detected in *Apluda mutica* at Guangzhou City during different seasons in a wild population for two years. Statistical analysis of incidence of apomictic and sexual embryo sacs indicated significant difference in seasons. Frequencies of apomictic embryo sacs were the highest in winter and summer respectively in two years.

Key words: *Apluda mutica* L.; facultative apomixis; seasonal variability

CLC number: Q942.5 **Document code**: A **Article ID**: 1000-3142(2006)04-0392-03

The monotypic genus *Apluda* belongs to the sub-family Andropogoninae of Gramineae. *A. mutica* L. is a perennial grass. It usually blooms for three times in June, September, and December respectively during one year in Guangzhou of China. However, it tend to bloom rather sporadically in December. It can stay in bloom for about one month. It can set seeds twice a year, in July and October respectively. It set no-seed in December.

Murty(1973)and Ma *et al.* (2002) did the embryological study in *A. mutica* and found it could perform facultative apomixis. In facultative apomixis, sexual reproduction promotes genetic variation, whereas apomixis preserves gene heterozygosity. The production of new genotypes by sexual reproduction could be followed by fecund production of the best genotypes by apomixis. Theoretically facultative apomixis and sexual reproduction form a well-balanced genetic system. Such a balanced genetic system should enable *A. mutica* to live in a variety of environments. Facultative apomixis could benefit *A. mutica* in the long run. But our knowledge on the occurring frequency of apomictic frequency in this species is still very limited. The present study was undertaken to fill up a part of the large gap in its variability of apomictic frequency.

1 Material and methods

Inflorescences of *A. mutica* was collected from more than 10 plants at each of five sites in South China Botanical Garden in June, September and December respectively. Inflorescences were fixed in formalin-glacial acetic acid-ethanol(FAA)solution, and then transferred to 70% alcohol at 4℃ for storage. The ovaries were excised from the flowers with a pair of very fine tip needles, stained in ehrliched hematoxylin, dehydrated through an ethanol gradient series, and embedded in paraffin. Serial sections which were 5-8μm in thickness were cut and observed under a microscope. The amount of ovules observed for each sample varied from 100 to 150. The embryo sacs were classified as sexual or apomictic according to earlier criteria (Ma *et al.*, 2002).

Received date: 2005-03-07 **Accepted date**: 2005-09-25

Foundation item: Supported by the National Natural Science Foundation of China(3970086); Ph. D. Programs Foundation of Jinan University(692016, 692017)

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Proportion of apomictic embryo sac was studied by using analysis of variance.

2 Results

A total 1 140 embryo sacs were collected from field-growing plants over a 2-year period. Apomictic frequency was 60.74%, 63.92% and 79.89% respectively in June, September and December for the year 1999, and where the apomictic frequency in winter was significantly higher than those in the other two seasons(Table 1). For the year 2000, the frequency was 75.36%, 40.00% and 35.39% respectively in summer, autumn and winter, where the apomictic frequency in summer was significantly the highest (Table 1). Mean percentages of 68.19% and 50.25% were classified as being apomictic for all the ovules examined in 1999 and 2000, respectively. There were significantly more apomictic pistils in the sample collected in June than those in September and December in 2000.

Statistical analysis of the incidence of apomictic and sexual embryo sacs indicated there were significant differences in apomictic frequency in different seasons(Table 1). The dramatic increase in the proportion of apomictic embryo sac was found in *A. mutica* during the winter in 1999 and summer in 2000. These data suggested that apomictic frequency was not stable in different seasons.

3 Discussion

The percentage of apomictic embryo sac was significantly different in different seasons. The lowest temperature and total precipitation were 2.3℃ and 58 mm respectively in Guangzhou in December of 1999. It was found that the frequency of apomixis was the highest at this time. But the lowest temperature and total precipitation were 6.9℃ and 110.5 mm respectively in December of 2000 (Table 1), the frequency of apomixis was the lowest at this time. It indicated that the temperature and precipitation showed no clear association with the degree of apomixes.

Photoperiod influenced the ratio of apomictic to sexual sacs in some grasses (Knox, 1967). It was found that the frequency of apomictic embryo sac showed the difference in different season in facultative apomixis *Dichanthium aristatum* (Knox 1967). The frequency of apomixes is 59.58% when the photoperiods are over 14 hours, while the photoperiods are less than 14 hours, it is 90.84%. Temperature and precipitation showed no influence to apomictic frequency in *Dichanthium aristatum*(Knox 1967).

Table 1 Comparision of frequency of apomictic embryo sac in different times

Time	Precipitation (mm)	Temperature	Percentage of apomictic embryo sac	Significance level of difference 5%	1%
1999 June	337	20.1～34.0	60.74%	b	B
1999 September	291	20.7～31.8	63.92%	b	B
1999 December	58	2.3～17.9	79.89%	a	A
2000 June	299	18.9～36.8	75.36%	a	A
2000 September	300	14.9～35.7	40.00%	c	C
2000 December	110.5	6.9～28.1	35.39%	c	C

Note: Capital letter indicating significance at 1% level; Small letter indicating significance at 5% level. Precipitation and temperature data obtained from Guangzhou Weather Station.

Flowering and seed setting were retarded greatly as photoperiod was greater natural photoperiod during inflorescence development (Ma *et al.*, 2003). It indicated that *A. mutica* is one of the short-day plants. Most short-day plants bloom in early spring or fall, often requiring fewer than fourteen hours of light each day. This is also the case in *A. mutica*. The frequency of apomixis was the highest in winter of 1999 and in summer of 2000 respectively in our study. Inflorescence sampled in December of 1999 when effective daylengths were less than 12 h, had a significant higher percentage of apomictic pistils than inflorescences sampled earlier; However, this was not found in inflorescence taken in December of 2000. Thus, some factor other than daylength probably was responsible for the increased proportion of apomictic pistils in December 1999. For *A. mutica* used in this research, the frequency of apomictic embryo sacs was not related to changes in temperature,

photoperiods and rainfall when grown in the field. Otherwise, Hussey *et al*. (1991)also found that the frequency of apomixis was not affected by the photoperiods in *Pennisetum ciliare*.

The frequency of apomixis had been not easy to predict, since the photoperiod, temperature, and rainfall seem no relationship with the apomixis respectively in Guangzhou. Due to the highly irregular frequency of apomixis that are occasionally observed in field-growing *A. mutica*, it appears that environmental factors other than temperature, photoperiods and precipitation or some of them together influence the facultative apomixes in *A. mutica*. The frequency of apomixis is like the yield of crop, many environmental cues affected the yield of crop together, not only one of the environmental cues can determine the frequency of apomixis in *A. mutica*.

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水蔗草兼性无融合生殖的季节变化

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摘 要：对广州地区水蔗草在不同季节的无融合生殖胚囊和有性生殖胚囊频率进行了研究。结果表明：无融合生殖胚囊和有性生殖胚囊的频率在不同季节差异十分显著。两年中，无融合生殖胚囊出现的频率分别在冬季和夏季最高。

关键词：水蔗草；兼性无融合生殖；季节变化

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