



# BIOLOGY OF FLOWERING OF HETEROGENOMIC COTTON SPECIES

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## ABSTRACT

It has given the results of studying of biological features of flowering of wild-growing Australian species (*G.sturtianum* J.H.Willis, *G.australe* F.Muell, *G.nelsonii* Fryx, *G.bickii* Prokh.) and intraspecific diversity of Indo-Chinese cotton (*G.arboreum* L.). It was determined for the Australian species is characteristic two types of flowering: cleistogamous and chasmogamous, and for Indochina species only chasmogamous flowering type. Discrepancy of cycles of the reproductive period, and also a dormant period of plants at the studied species and forms was revealed. Discrepancy of cycles of flowering complicates works on hybridization heterogenomic species and to their involving to genetic and breeding process.

**KEYWORDS:** biological features, cotton, species, comparative morphology, cleistogamous, chasmogamous.

## INTRODUCTION

The genus *Gossypium* L. has a pantropical range covering the steppe and semi-desert provinces of the Paleotropic, Neotropical and Australian floristic regions of the Globe. Representatives of this genus are inhabitants of lowlands and do not occur above 200-500 m above sea level. Only some cultural forms in the mountainous regions of tropical countries rise higher. All of them are heat-loving plants, more or less xerophytic. Australian and Indochinese wild cotton species belong to subtropical and tropical xerophytes, are more moisture-loving [1]. These species are light-loving and develop better in conditions of a large number of sunny days, especially during the flowering and maturation of the boxes. One of the factors geographically limiting its cultivation in Uzbekistan is the temperature. The optimal temperature for the growth and development of cotton plants is 25-30°C. Until recently, it was believed that temperatures above 36-37°C cause overheating of fabrics, and above 40°C strongly depresses cotton. At high temperatures, the viability of pollen decreases, which leads to a decrease in the degree of fertilization, increases the fall of the ovaries. However, more recent studies by physiologists have shown that an increase in temperature to 36°C accelerates the development of pods, seeds and fiber. High temperature somewhat reduces the yield of fiber, but favourably contributes

to some increase and improvement of its quality [2].

## MATERIAL AND METHODS

The aim of the research was to study the peculiarities of the flowering biology of wild Australian species (*G.sturtianum* var. *sturtianum*, *G.sturtianum* var. *nandewareense*, *G.australe* F.Muell, *G.nelsonii* Fryx, *G.bickii* Prokh.) and intraspecific varieties of Indo-Chinese cotton *G.arboreum* L. (ssp. *obtusifolium* (Roxb.) Mauer, ssp. *obtusifolium* var. *indicum*, ssp. *perenne* (Blanco) Mauer, ssp. *neglectum* (Tod.) f. *sanguineum*, ssp. *nanking* (Meyen) Mauer).

Long-term observations and morphological descriptions of the phases of the development of cotton flowering, allowed us to identify the features of the reproductive period of plants grown in conditions of natural daylight and photoperiod (10 hour daylight) in the greenhouse and vegetative area.

## RESULTS

It has been established that the Australian species *G.australe* F.Muell, *G.nelsonii* Fryx, *G.bickii* Prokh. sections of *Hibiscoidea* enter the reproductive phase of development at the age of 3-3.5 months.

The flowers of the species *G.australe* and *G.nelsonii* are medium-sized, wide-opening, the petals are lilac-lilac, lilac with a dark cherry anthocyanin spot at the base. Staminate filaments of



medium length (1.5-3.0 mm), anthers lilac, orange, cream pollen. The stigma is protruding. Out-of-flower nectaries 3, purple. Bracts 2-8 mm long, xiphoid and pubescent. The cup is notched with 5 teeth, 1.0-1.2 cm long with typical fluting.

In the species *G.bickii*, the flowers are medium-sized, the corolla is wide-ringed, the petals are light lilac, there is an anthocyanin spot at the base. Staminate filaments are short (1.5 mm), anthers and stigmas are cream. The stigma is protruding. Outwardly, there are 3 flower nectaries. The calyxes of *G.bickii* and *G.australe* species are morphologically similar. The bracts are xiphoid. A characteristic feature is the presence and alternation in the process of two types of flowering: kleistogamous and hazmogamous. The reproductive period usually begins with the formation of kleistogamous flowers. In plants of the first year of life, 20-25 flowers are formed on one plant in the species *G.australe*, and up to 20 in the species *G.bickii* and *G.nelsonii*. Hazmogamous flowers are formed later on the upper nodes, at the same time there is a process of maturation of the ovaries of kleistogamous flowers.

The plants bloom and bear fruit from June to October - November. The reproductive period of adult perennial individuals is longer (March - November), fruiting is abundant. For a short time (2-3 months), the plants go into a state of relative rest, dropping the bulk of the leaves. During this duration, the growth of lateral shoots and the main stem slows down or stops.

The peak of kleistogamous flowering occurs, as a rule, in April - May, and the peak of hazmogamous in July - August, when up to 40-50 flowers are formed on plants. During the entire period of hazmogamous flowering, up to 100-115 flowers are formed on individual plants in the species *G.australe* and *G.nelsonii* and 60-80 in the species *G.bickii*. The duration and intensity of flowering of both types varies and depends on the climatic conditions of the year.

The kleistogamous type is characteristic of cool and humid conditions, although extreme factors such as high temperature and dry air can also cause the formation of kleistogamous flowers.

The hazmogamous flowers of the studied representatives are bisexual, five-membered, heterochlamydic. Androceus fused into a staminate column, a guinea of 3-4, less often 5, carpels. The ovary is upper. The fruits are 3-4 leaf-shaped boxes, ripen in 30-35 days. Flowers, ovaries and fruits have a number of morphological differences characteristic of each species.

The flowers of the variety *G.sturtianum* var. *sturtianum* are medium-sized, wide-opening, the color of the corolla pads varies from purple to light

purple, with a dark red anthocyanin spot at the base. Staminate filaments 1-3 mm and anthers red, pollen cream. The stigma protrudes above the stamen column by 1.5 cm. The bracts are one-piece with a pointed tip, measuring 3.0 x 2.0 cm, and vary from egg-shaped to triangular in shape. The calyx is 5-toothed, light green. The out-of-flower outer nectaries are colorless.

In the variety *G.sturtianum* var. *nandewarensis* flowers are medium-sized, wide-opening, the petals of the corolla are slightly lighter than those of the variety *G.sturtianum* var. *sturtianum*. Staminate filaments 1-3 mm, anthers red, pollen cream. The stigma protrudes above the staminate column by 1.0-1.3 cm. Bracts 3.0 x 2.0 cm vary from oval to heart-shaped, with 3-5 small teeth. The calyx is 5-toothed, light green. The out-of-flower outer nectaries are colorless.

Plants of the varieties *G.sturtianum* var. *sturtianum* and *G.sturtianum* var. *nandewarensis*, as a rule, does not start flowering in the first year of life. The flowering of plants in the second year of life is more abundant in the variety *G.sturtianum* var. *nandewarensis*. Flowering plants in the variety *G.sturtianum* var. *nandewarensis* of the second and third years of life begins, as a rule, from mid-June and ends in August. From 45 to 90 flowers are formed on one plant for the entire period (for the entire flowering period). The boxes ripen in 30-35 days. The flowering period of the variety *G.sturtianum* var. *sturtianum* is somewhat shorter and lasts from mid-June to mid-July. The number of flowers on one plant varies by year, from 4 to 16-20 flowers are formed over the entire period.

It should be noted that the morphology of flowers and the biology of flowering of Indo-Chinese species is somewhat different from Australian cotton. Indo-Chinese species are characterized only by a hazmogamous type of flowering, as well as weak photoperiodicity. They enter the reproductive phase of development at the age of 4.5-5.0 months.

In wild forms of the subspecies *G.arboreum* ssp. *obtusifolium*, the flowers are medium-sized, medium-opening, the petals of the corolla are yellow, with an anthocyanin spot on the base. Staminate filaments of medium length, anthers and pollen are yellow. The stigma is protruding. Out-of-flower nectaries 3. Heart-shaped bracts with weakly pronounced teeth 0.1-0.3 cm long. The calyx is toothed, with 5 teeth. Flowering usually begins in the second decade of June and lasts until September. The peak of flowering occurs in July-August months and from 20 to 40 flowers are formed on one plant. The boxes are 3-fold, mature in 30-32 days.

The ruderal form has ssp. *perenne* flowers are small, medium-opening, the corolla petals are yellow with an anthocyanin spot on the base.



Staminate filaments of medium length, anthers and pollen are yellow. The stigma is protruding. Out-of-flower nectaries 3, Bracts- heart-shaped with 7-8 teeth, 0.2-0.3 cm long. The cup is notched with 5 teeth. The peak of flowering occurs in the month of July (05.VII-20.VII), 40 to 60 flowers are formed on one plant. The boxes are 3-4-fold, mature in 25-28 days.

In the culturally tropical form - ssp. *neglectum* f. *sanguineum*, the flowers are small, medium-opening, the petals of the corolla are yellow with an anthocyanin spot on the base. Staminate filaments are of medium length, anthers are light pink, pollen is yellow. The stigma is protruding. Out-of-flower nectaries 3, Bracts- 0.1-0.2 cm long, heart-shaped with 3-4 teeth. The cup is notched with 5 teeth. The peak of flowering occurs in the month of July (20.VII-30.VII), 40 to 60 flowers are formed on one plant. The boxes are 3-fold, mature in 28-30 days.

In the subtropical form of ssp. *nanking*, the reproductive period begins in June, and the flowers are small, medium-opening, the petals of the corolla are yellow, there are no gossypoly glands. Staminate filaments are of medium length, anthers are rare, pollen is yellow. The stigma is protruding. There are 3 out-of-flower nectaries, the bracts are heart-shaped with 7-8 teeth, 0.2-0.3 cm long. The cup is notched with 5 teeth. The peak of flowering occurs in the month of July. The boxes are 3-4-fold, mature in 35-40 days.

## CONCLUSIONS

Thus, the results of the conducted studies revealed some distinctive and similar signs of the biology of flowering of Australian and Indochinese cotton species.

It has been established that two types of flowering are characteristic for Australian species: kleistogamous and hazmagamous, and for Indochinese species only the hazmagamous type of flowering. If Australian species are strictly photoperiodic, then intraspecific varieties of Indochinese cotton *G.arboreum* L. are practically unpretentious to the length of daylight, only wild forms of this species are characterized by weak photoperiodicity. Also, in the condition of natural daylight, the discrepancy between the cycles of the reproductive period in the studied species and forms was revealed. Accordingly, they do not have the same periods of dormancy of plants. The mismatch of flowering cycles complicates the work on hybridization of heterogeneous species and their involvement in the genetic selection process.

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