Investigations on structure of flowers and inflorescences of the *Anthurium andreanum* hort., non Linden

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(Received: September 26, 1972)

Abstract:

The aim of the present study was to determine the structure of the flowers and inflorescences of *Anthurium andreanum* hort. because of some controversial statements which have been made on this subject. It was stated that the spadix is an inflorescence made of fleshy and hermaphroditic flowers which are situated on the rachis forming a spiral. The flowers are two-sided symmetrical.

Close morphological analysis confirmed by the enclosed photos showed fourfold structure of the protogynic flower: the perianth consisting of four fleshy sepals situated conjugately, four stamens and one upper and fleshy pistil.

The family of *Araceae* is not represented very often in the Polish native flora. The flowers of plants belonging to the family *Araceae* are not pretty and are gathered in fleshy, straight or bent spadixes. Their rachis is thickened and not branched. The spadix is frequently surrounded by a colorful bract (spatha).

Among the plants belonging to *Araceae* there are species with hermaphroditic flowers for example *Calla palustris* L., *Acorus calamus* L. and entirely unisexual ones occurring in the same spadix (in the lower part of the spadix — female flowers; in the upper part — male ones). An example is *Arum maculatum* L.

The aim of the present study is to determine more closely the structure of the flowers and inflorescences of the species — Anthurium andreanum hort., non Linden (syn. Anthurium × cultorum Birdsey).

Anthurium andreanum hort. belonging to the family of Araceae, is a florid plant, coming from the tropical woods of Columbia. Primarily it is cultivated by gardeners because of its lustrous and vividly colored

spatha (Grunert 1966; Hahn and Otto 1967; Miessner 1968), (Fig. 1).

The literature dealing with the structure of the flowers of Anthurium gives controversial statements. Encke (1958) and Podbielkowski (1966) state that the individual flowers forming the spadix in the Anthurium genus are hermaphroditic. Wóycicki (1965), regarding the florid Araceae and all species belonging to Anthurium genus, and Pindel (1971), in reference to Anthurium scherzerianum Schott., state that the flowers occurring in the inflorescence are divided into female and male form. Podbielkowski (1966) states that the flower of Anthurium genus is made of six sepals, six stamens and one pistil, while Encke (1958) distinguishes four sepals, four stamens and one pistil.

Comparatively small flowers of the *Anthurium andreanu*m hort., (3-5 mm in diameter) white, yellow or pink colour, are situated tightly on the rachis, forming a spiral. A single flower has the appearance of a convexity, the shape of which resembles a rhomb with a hilly pistil raised more cleary above the sepals (Figs. 2, 3, 4).

Two planes of symmetry (two-sided symmetrical flowers) can be distinguished in the flower. The perianth consists of four fleshy and peltate sepals, situated conjugately two on each side. The smaller, inner sepals are parallel to the longitudinal rachis, while two bigger ones perpendicular to them are situated transverely (Figs. 3, 4, 5, 6, 7).

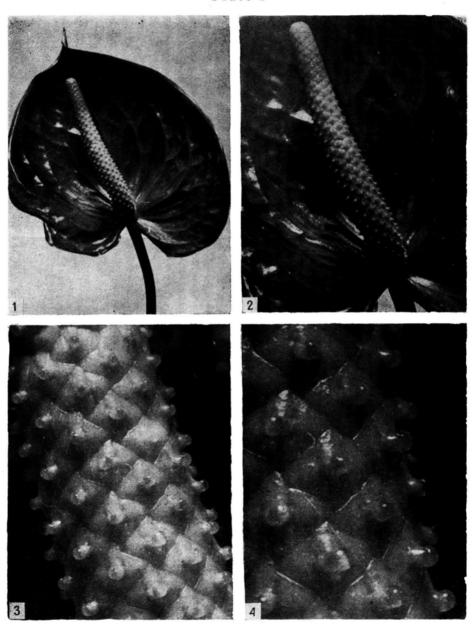
The pistil is upper, cylindrical or narrowing in the direction of stigma and in the basal part (Fig. 8). The stigma is situated on the ovary. On the transverse sections the pistil is circular or slightly square. This phenomenon is connected with a close setting of flowers on the rachis.

The nectareous tissue occurs on the surface of the pistil and sepals. At first it secretes very small droplets of nectar, which then flow together onto the lamina, almost uniformly covering the exposed parts of sepals. This nectar gathers most abundantly in the hollows formed by the places of contact of flowers placed side by side.

The maximum secretion of the nectar takes place in the period of puberty in the pistil. In this period the visible drop of liquid containing a considerable amount of sugar occurs on the surface of the stigma (Figs. 3, 4). The capillary method used in the investigations of the composition of the nectar was applied here to determine the kind of liquid secreted. Then, the sugar content was determined by means of an Abbe (Zeiss) refractometer. The presence of sugar, in amount of about 6%, was ascertained in the sample cultivated under greenhouse conditions, with a temperature of $19-21^{\circ}$ C and a relative humidity of 80%. This fact leads to the conclusion that the liquid secreted is a nectar.

On the basis of similar investigations conducted on the other species of *Anthurium (Anthurium digitatum)* Kulijev (1960) shows that typi-

Plate I

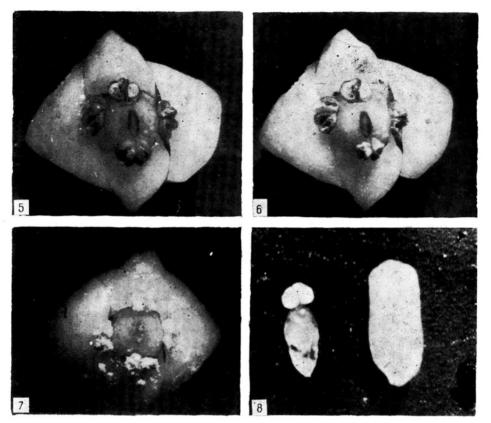


The structure of the inflorescence of Anthurium andreanum hort.

Figs. 1 and 2. The spadix seen against the beckground of the spatha Figs. 3 and 4. Part of the spadix: the ripening pistils of tightly and spirally situated flowers secrete the drops of nectar (fig. $3-\times 3$, fig. $4-\times 5$)

Phot. E. Weryszko

Plate II



The structure of the flower of Anthurium anreanum hort.

Figs. 5, 6 and 7. The flowers isolated from the spadix with 4 sepals, 4 stamens and 1 pistil, in the following stages of ripening of anthers (ca × 10)

Fig. 7—the ripe anther dust gets out of the breaking anthers on the sepals
Fig. 8. The stamen (on the left side) and the cylindrical pistil (on the right side) isolated from the flower (× 11)

Phot. E. Weryszko

cal nectar is secreted by papillae situated on the stigma of the pistil in these plants. The secretion of the nectar decreases and subsequently disappears as the pistil grows.

Within the flower, the pistil grows earlier than stamens. The phenomenon of protogyny occurring here indicates on the allogamy of the flowers *Anthurium andreanum* hort.

Four stamens having flattened, slightly convex filaments on the side of the perianth appear overlayingly to the sepals. The length of the flattened filaments in proportion to the size of the anther is in the ratio of three to one (Fig. 8).

The stamens develop after 3-4 weeks from the moment of full growth of the pistil (this period can be shortened, depending on the temperature and the humidity of the environment). At the beginning they can not be seen because they are at the base of fleshy, rather closely contiguous sepals. The two anthers conjugate to the ovary, situated close to the outer, larger sepals, appear first, and after a few days they are followed by two remaining anthers (situated near the smaller sepals). The filaments remain hidden between the fleshy sepals and the wall of the ovary, during the whole period of blooming (Figs. 5, 6).

The different stages of the development of stamens: the gradual breaking of anthers and emptying of anther dust from them is shown in Figs. 5, 6, 7.

The ripening of the flowers begins from the lower part of the spadix and flowers situated at the top of inflorescence develop latest of all. At an earlier stage of development, when the pistils of the spadix's flowers situated in the lowest part ripen, the flowers on the top are still shaped.

During the period of nectar-secretion, the flowers of *Anthurium* andreanum hort. emit a delicate fragrance. They are pollinated by insects and humming birds (Szafer 1969). It is also possible that they can be pollinated by snails.

Our observations confirm the observations by Encke concerning the structure of *Anthurium* flowers and inflorescences. We behave that all flowers constituting the inflorescence in the case of *Anthurium andreanum* hort, are hermaphroditic. The individual flowers are made up of four sepals, four stamens and one pistil.

Regarding to other species of this genus, we have not found any data concerning the division of the flowers within the inflorescence other than those quoted in the literature.

REFERENCES

Bonnier G., 1879, Les Nectaries, Ann. Sci. Natur. Bot., 8 (6): 5 - 212.

Encke F., 1958, Pareys Blumengärtnerei. Beschreibung Kultur und Verwendung der Gesamten Gärtnerischen Schmuckpflanzen, Paul Parey in Berlin und Hamburg, I Band: 168 - 171.

Grunert Ch., 1966, Zimmerblumen, Veb Deutscher Landwirtschaftsverlag, Berlin, pp. 90 - 91.

Hahn E., Otto A., 1967, Spezielle Schnittblumen, Verlag Paul Parey, Berlin und Hamburg: 9-11.

Kulijev A. M., 1960, Morfologicheskaya ewolucya nektarnikov u pokrytosiemiannikh rastienii, Kirovabad, p. 22.

Miessner E., 1968, Zierpflanzen, Veb Deutscher Landwirtschaftsverlag, 104 Berlin, pp. 300 - 307.

Pindel Z., 1971, Uprawa anturium Szercera, Hasło Ogrodnicze 2: 14-15.

Podbielkowski Z., 1966, Słownik roślin użytkowych, PWRiL, Warszawa, p. 18.

Scheithauer W., 1966, Kolibris, Fliegende Edelsteine, München, Bayr. Landw. Verlag.

Szafer W., 1969, Kwiaty i zwierzęta, PWN, Warszawa, p. 263.

Wóycicki S., 1965, Uprawa roślin ozdobnych, Warszawa, PWRiL, pp. 476-478.

Badania nad budową i rozwojem kwiatów i kwiatostanów *Anthurium* andreanum hort., non Linden

Streszczenie

Praca niniejsza míała na celu bliższe określenie budowy kwiatów i kwiatostanów Anthurium andreanum hort., non Linden (syn. $Anthurium \times cultorum$ Birdsey). W literaturze można znaleźć kontrowersyjne stwierdzenia na temat budowy kwiatów tego gatunku.

W kwiecie można wyróżnić dwie płaszczyzny symetrii (kwiaty dwubocznie symetryczne). W obrębie kwiatu słupek dojrzewa wcześniej niż pręciki. Występujące tu zjawisko przedsłupności (protogynia) wskazuje na obcopylność kwiatów Anthurium andreanum hort.

Przeprowadzone obserwacje potwierdzają doniesienia Enckego (1958) dotyczące budowy kwiatów i kwiatostanów Anthurium. Stwierdzono, że wszystkie kwiaty składające się na kwiatostan u Anthurium andreanum hort. są obupłciowe. Poszczególne kwiaty zbudowane są z 4 elementów okwiatu, 4 pręcików i 1 słupka.

Dojrzewanie kwiatów rozpoczyna się od dolnje części kolby, a najpóźniej rozwijają się kwiaty położone na szczycie kwiatostanu. W okresie gdy dojrzewają słupki najniżej położonych kwiatów kolby, kwiaty na jej wierzchołku są jeszcze słabo wykształcone.