ACTA SOCIETATIS
BOTANICORUM POLONIAE
Vol. XLIV, nr 4
1975

Development of ovules on the stamens in flowers of *Solanum tuberosum* variety Flisak

ELŻBIETA PUŁŁO AND AURELIA ŚLUSARKIEWICZ

Institute of Plant Genetics, Polish Academy of Sciences, Poznań

(Received: April 17, 1975)

Abstract

The flowers were investigated morphologically and embryologically in the Flisak variety of *Solanum tuberosum*. The changes observed consisted in the formation of naked ovules on the stamens.

INTRODUCTION

In *Solanum tuberosum*, variety Flisak in 40 per cent of the flowers ovules were found on the stamens in the form of clavate excrescences at the site of junction of the head and the filament.

In the family *Solanaceae* so far several cases of carpeloid stamens have been described, specially in *Nicotiana* (Bhat and Krishnamurty 1956; Krishnamurty and Rao, 1960) and in interspecific *Solanum tuberosum* hybrids (Sirohi, Kishore and Khanna, 1964). In all these cases transformation of the stamen tissue, mainly the filament to ovule tissue was described. The present paper reports some interesting details concerning the morphology and embryology of the modified stamens in *Solanum tuberosum*, variety Flisak.

MATERIAL AND METHODS

Flower buds of *Solanum tuberosum*, variety Flisak were collected from July to September in 1974 from plants cultivated on crop fields of the State Farm Rokietnica near Poznań. The material represented all developmental stages of stamens and pistils.

For fixation of the material FAA (70% ethanol, glacial acetic acid, formalin — 90 : 5 : 5) or AA (100% ethanol glacial acetic acid — 3 : 1) were applied for 24 h. The material was stored in 70 per cent ethanol. The standard paraffin method was used. Microtome sections 10—12 μ thick were stained by Feulgen's method and with iron hematoxylin after Heindenhain and counterstained with fast green. For checking the number of normally developed pollen grains, crushed preparations were stained with acetocarmine.

RESULTS

I. Morphological observations

Normally developed *Solanum tuberosum* flowers correspond to the formula K (5) [C (5) A5] G (2). The modification observed in 35—40 per cent of the flowers concerned the morphology of two or sometimes three of the five stamens. In the changed, somewhat bent in the shape of the letter C stamens, at the junction of the head with the filament clavate excrescences were found in the number of several to several score on one stamen (Figs 1, 2, 3). In some cases these excrescences were surrounded

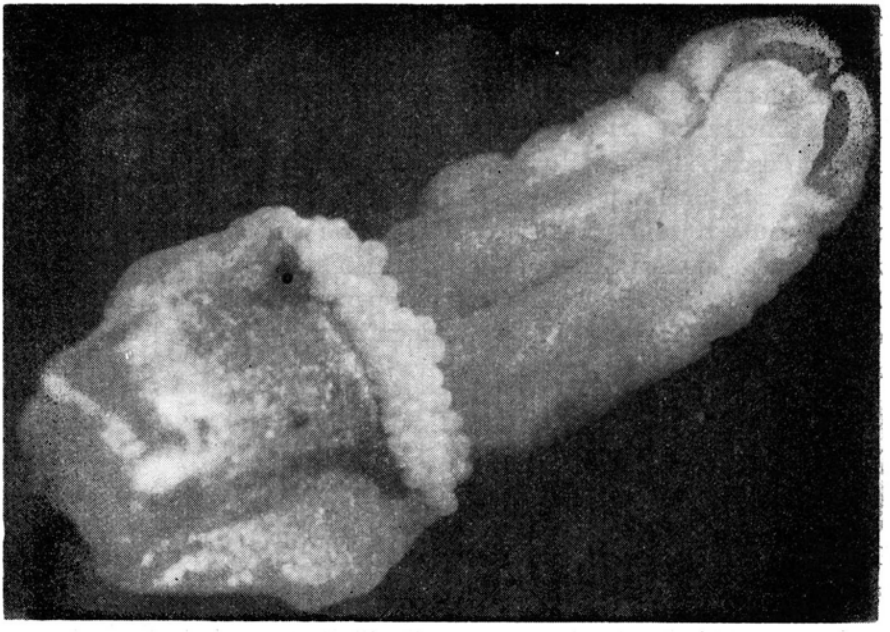

Fig. 1. Stamen with ovules at the junction of the head with the filament (× 20)

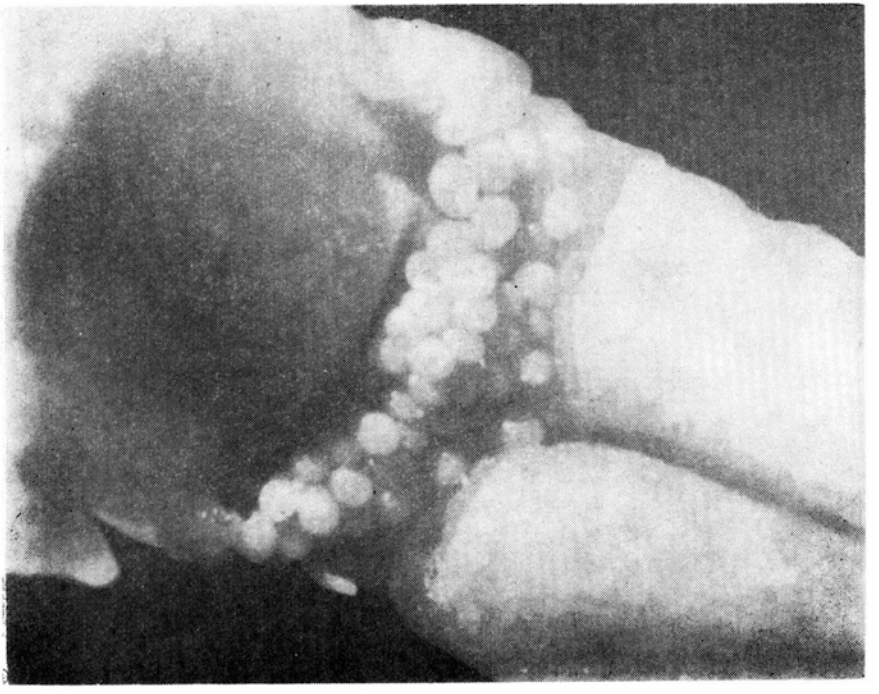

Fig. 2. Enlargment of a portion of figure 1 (× 40)

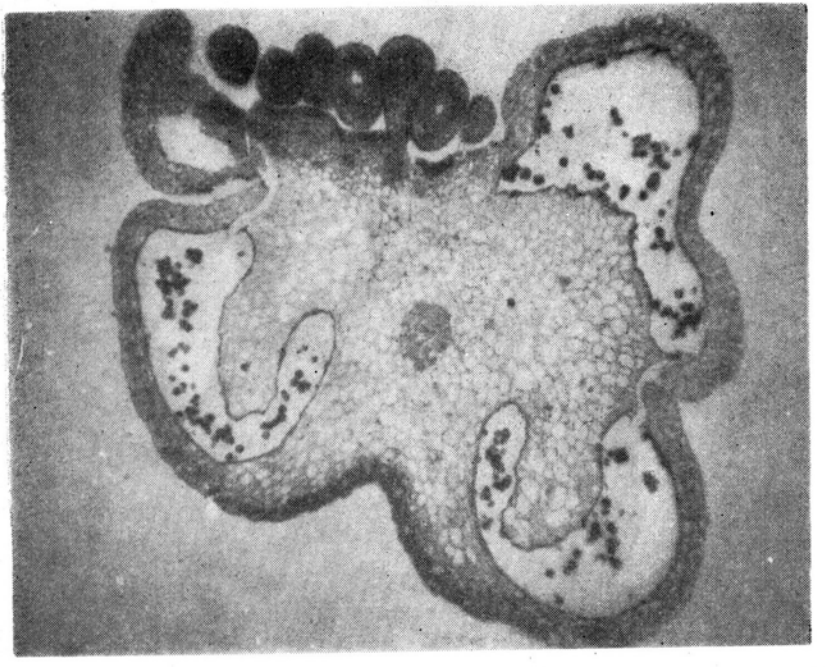

Fig. 3. Cross-section through the stamen in the site of growing out of ovules (× 120)

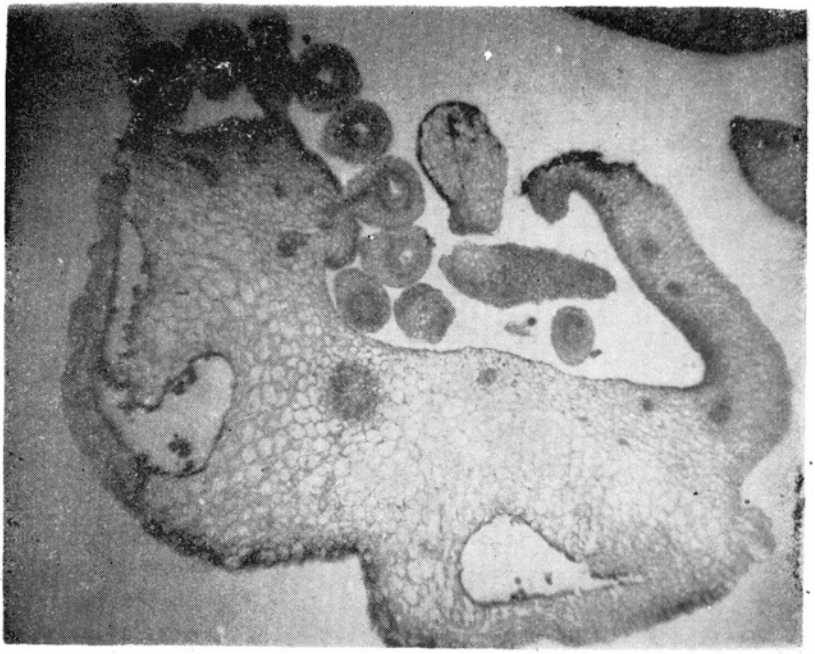

Fig. 4. Cross-section through the stamen with one fold surrounding the ovules (× 120)

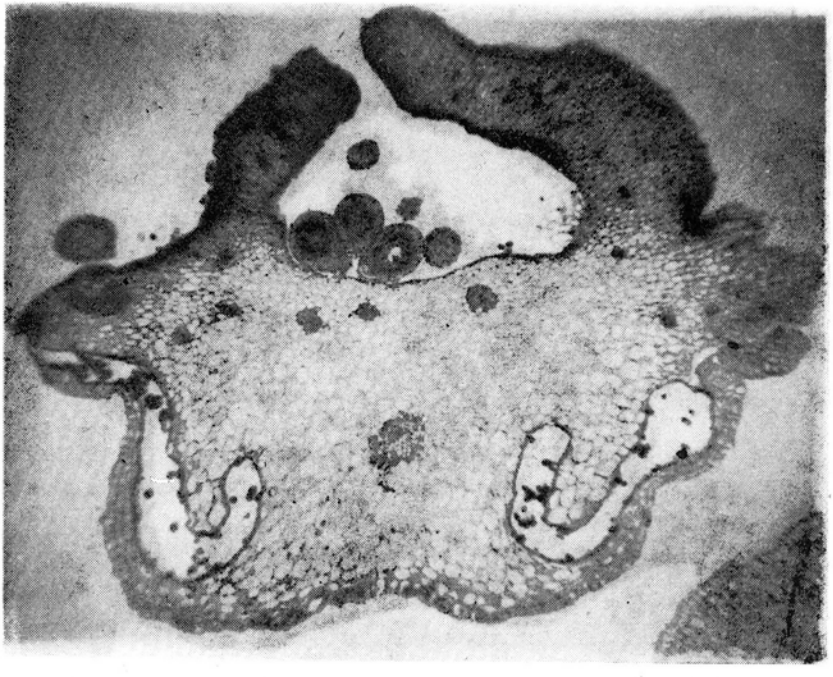

Fig. 5. Cross-section through the stamen with two folds (× 120)

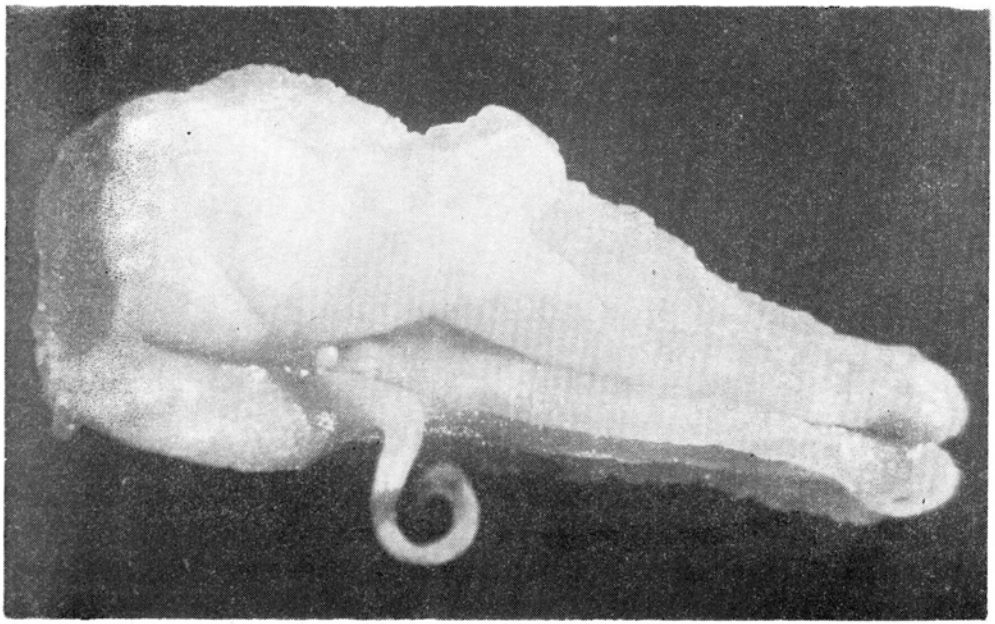

Fig. 6. Excrescence resembling in shape a pistil (× 20)

by folds growing marginally out of the stamen wall (Figs 4, 5). Sometimes at the site of these excrescences structures resembling in shape a minute style with a pistil ending in a two-lobed stigma were visible (Fig. 6).

II. Embryological observations

The clavate excrescences are ovules deprived of integument, naked with a thick nucellus. They appear in the form of meristematic eminences at the moment when some tetrads are formed in the modified anthers. In the ovule primordium two megasporocytes arise, one of which produces a megaspore tetrad arranged linearly (Figs. 7, 8, 9). From the chalazal megaspore a megagametophyte develops according to the *Polygonum* type. As a result of this the mature ovary consists of the egg apparatus, a secondary nucleus and three ephemeric antipodes (Fig. 10). At the two-, four- and eight-cell stage of the ovary different variants of nuclear degeneration were observed.

For comparative purposes the development of ovules was also studied in the pistil ovary. No major differences were noted in it with the exception of one integument. *Megasporogenesis and megagametogenesis had a* similar course in both types of ovules and was synchronous. The cell dimensions, their nature and number were identical in both types of ovules.

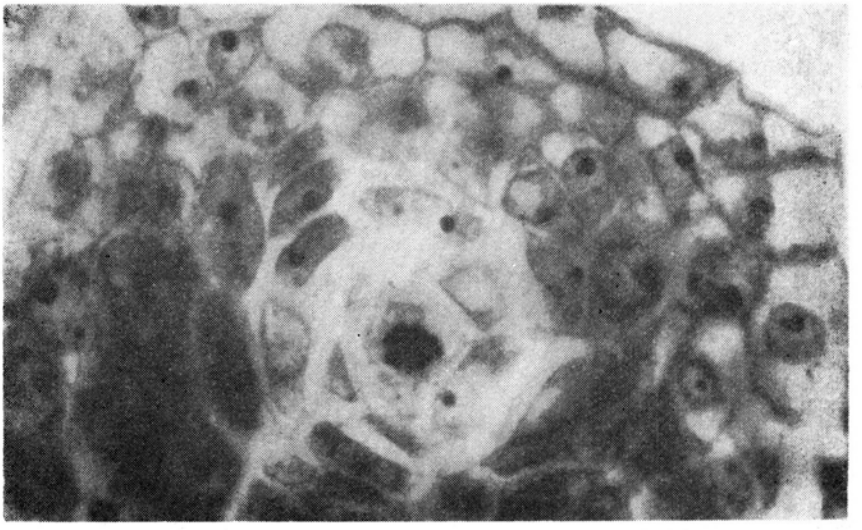

Fig. 7. Cross-section through the ovule with mother-cell (× 4000)

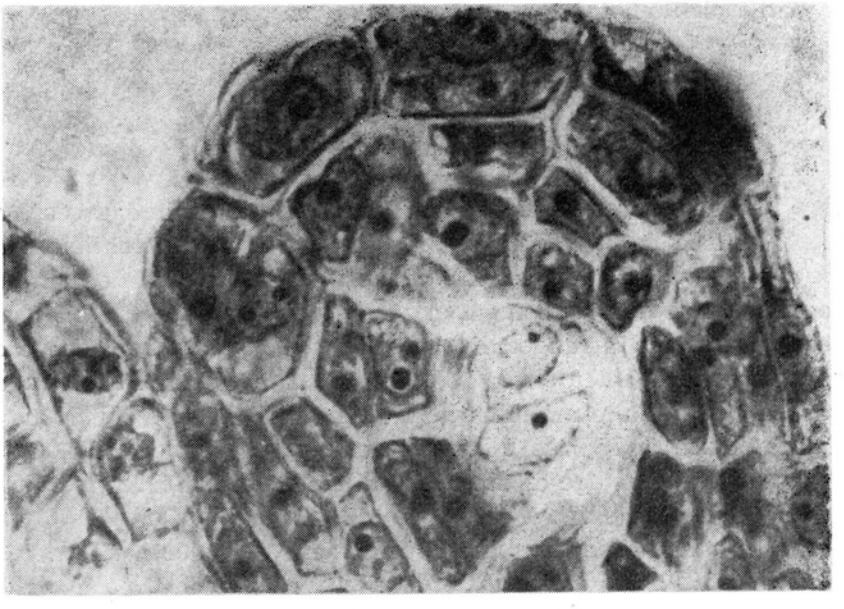

Fig. 8. Cross-section through the ovule with two-nucleate megagametophyte (× 4000)

Fig. 9. Megaspora tetrad arranged lineary (× 4000)

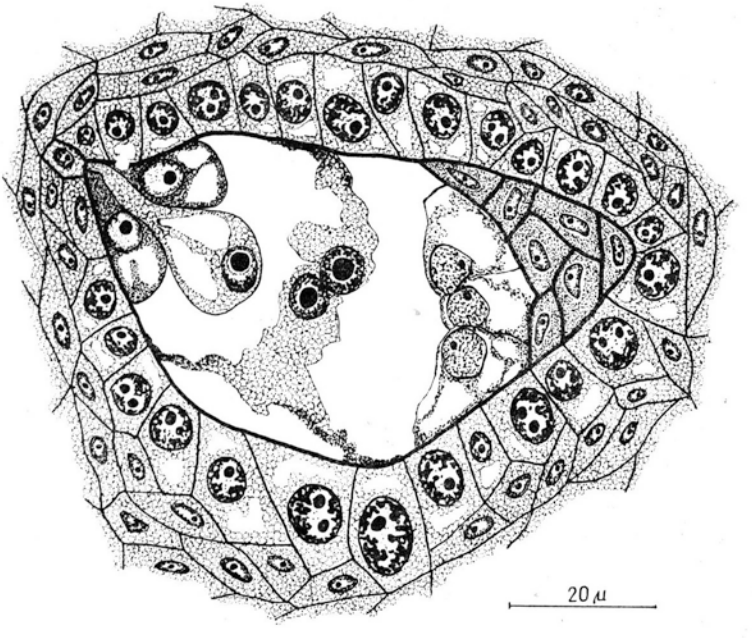

Fig. 10. Eight-cell stage of the ovary (× 2000)

In modified mature anthers a complete lack of endothecium was noted, there were only deformed pollen sacs with shrunken empty pollen grains. The flowers described did not set fruits.

DISCUSSION

The problem here presented concerning sex modification in hermaphroditic flowers is additional evidence supporting the phylogenetic concept of homology of the elements forming the flower.

The opinions claiming that the above described modifications are teratological and that as such they should not be taken into account in studies on the evolution of flower plants (Carlquist 1969) are contradicted by the fact that carpeloid stamens appear as a constant developmental trait (Shealy and Herr, 1973) independently of environmental changes (Bhat and Krishnamurty, 1956; Krishnamurty and Rao, 1960). Sirohi and Kishore (1964) claimed that the transformation of stamens observed by them occurred only in plants of a large F_1 population. This seems to indicate that this phenomenon occurs under control of genetic factors associated with sex. It is suggested by Storey (1953) that two coupled factors modifying "sex expression" are active here, one of them leads to the stamen and the other to the pistil. Cases equivalent to the ovules on stamens have been reported as "stamenoids" that is transformation of stamens into pistils. Biswas (1965) found such a deviation in *Crotolaria spectabilis* Roth. The presence of stamens and pistils inside the ovary of *Corchorus capsularis* L. has been described by Datta (1965). Lately Haccius (1974) reported secondary ovules arising in in vitro cultures from the walls of young ovaries in *Nicotiana tabacum* L. The mechanisms leading to the above discussed transformation are the object of further investigations.

Acknowledgment

The authors are deeply indebted to docent dr Maciej Zenkteler for valuable advice and guidance in the course of the present studies.

REFERENCES

Bhat N. R., Krishmamurty K. V., 1956. Fascination of stamens in interspecific *Nicotiana* hybrids. Sci. Cult. 21: 746—748.

Biswas K. C., 1956. Staminate pistil in *Crotolaria spectabilis* Roth. Sci. Cult. 21: 372—373.

Carlquist S., 1969. Evolutionary interpretations of floral anatomy. Phytomorphology 19: 332—362.

Datta R. M., 1965. Occurrence of stamens and carpels within the ovaries of *Corchorus capsularis* L., a cultivated Jute species. Sci. Cult. 31: 375.

Haccius B., Bhandari N. N., Hausner G., 1974. In vitro transformation of ovules into rudimentary pistil. in *Nicotiana tabacum* L. J. Exp. Bot. 25: 695—704.

Krishnamurty K. V., Rao K. A., 1960. A note on the ovule development in carpeloid stamens of a *Nicotiana* hybrid. Current Sci. 29: 23—24.

Shealy H. E., Herr J. M., 1973. Carpelloid stamens in *Rubus trivialis* Michx. Bot. Gaz. 134: 77—87.

Sirohi S. S., Kishore H., Khanna M. L., 1964. Ovole development in carpelloid stamens of *Solanum tuberosum* L. Experientia 20: 615—619.

Storey W. B., 1953. Genetics of the Papaya. J. Hered. 44: 70—78.

Author's address:
Mgr Elżbieta Pułło and
Mgr Aurelia Ślusarkiewicz
Institute of Plant Genetics
Polish Academy of Science
60-479 Poznań, Strzeszyńska 2/4, Poland

Rozwój zalążków na pręcikach w kwiatach Solanum tuberosum odmiany „Flisak"

Streszczenie

Badano zmodyfikowane kwiaty *Solanum tuberosum* odmiany „Flisak". Stwierdzono występowanie nagich zalążków na pręcikach, których pylniki nie wytwarzały żywotnych ziaren pyłku. Obserwowane nagie zalążki rozwijały się prawidłowo według typu Polygonum. Opisane wyżej zjawisko jest jednym z przykładów homologii elementów tworzących kwiat.