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ANATOMICAL CHANGES IN FLOWER BUDS OF LETTUCE (LACTUCA SATIVA L.) TREATED WITH A GA_3-SOLUTION FOR INDUCTION OF MALE STERILITY

A. H. EENINK and A. L. J. VEREIJKEN*

Instituut voor de Veredeling van Tuinbouwgewassen (IVT), Wageningen

SUMMARY

GA_3 spraying of lettuce induces male sterility. Different types of male sterile flowers developed: flowers with anthers containing some pollen grains which were not liberated (MS1) and flowers with only rudimentary anthers or with no anthers at all (MS2). From anatomical studies it appeared that great differences occurred for the effect of GA_3 between flower buds, within buds between florets and within florets. Besides the developmental phase also the type of tissue has a certain influence.

The lock-up of pollen grains by remnants of tapetum possibly hampered nutrition and prevented liberation of pollen accounting for the occurrence of MS1 flowers. Buds without sporogenous tissue or with tumors instead might develop into MS2 flowers.

1. INTRODUCTION

In lettuce (*Lactuca sativa* L.) male sterility is induced by GA_3-application providing good possibilities for large scale artificial crossing. Female fertility often remains practically normal after this treatment (EENINK 1977; EENINK & VEREIJKEN, 1978).

After GA_3-treatment different types of male sterile (ms) flowers were found:

1) Flowers with anthers containing some pollen grains which are not liberated (MS1).
2) Flowers with only rudimentary anthers or with no anthers at all (MS2).

In this paper results of anatomical studies on the above two male sterile forms are given.

2. MATERIALS AND METHODS

Plants of *Lactuca sativa* L. cv. Suzan with flower buds 1–3 mm long and grown at a constant temperature of 20°C in a glasshouse of the IVT-phytotron were sprayed once with a 100 ppm GA_3-solution in water with a wetting agent. At a varying number of days after spraying buds were collected and fixed in Carnoy-solution. They were embedded in paraffin and subsequently microtome sections (20 μm) were cut (see also EENINK 1975). These sections were stained with safranin and fast green and microscopically investigated.

* Student at the Agricultural University, Wageningen.

3. RESULTS AND DISCUSSION

Normal development. Microtome sections of untreated buds showed that differences in development occurred between the florets within a bud. Peripheral florets developed earlier than central florets as is demonstrated in *fig. 1.*

Premeiotic divisions of subepidermal anther cells resulted in the development of tapetum and sporogenous tissue with pollen mother cells. Then anthers fused (*fig. 2*) and between tapetum (b) and exothecium (c) endothecium developed (d).

Development after GA_3-application. Application of GA_3 induced great changes in the internal development of flower buds. Usually anthers did not fuse with each other after GA_3-application but they often did with style or petals (*fig. 3*).

It is noticeable that between and within buds and even within florets great differences occurred for reaction to GA_3. As we found earlier that sensitivity to GA_3 depended on the developmental stage of the buds (EENINK 1977) these differences may partly be due to the different developmental phases of the florets as mentioned above, at the time of GA_3-application.

The developmental phase effect is demonstrated in *fig. 3* in which peripheral florets were less disturbed by GA_3-application than central florets.

However, the effect of GA_3 on different tissues of one floret also differs. For instance *fig 4* shows that in certain places of an anther some sporogenous tissue was present after GA_3-application while in rather comparable places of the same anther tumors sometimes occurred. *Fig. 5* shows a floret of the same age in which both tapetum and sporogenous tissue were completely absent after GA_3-treatment and were replaced by tumors resulting in the formation of pollen-free anthers. Differences in sensitivity to GA_3 between floret tissues are also demonstrated in *fig. 6* where styles have not changed after GA_3-treatment in contrast with anthers.

From the sporogenous tissue present in malformed anthers more or less rudimentary pollen grains sometimes developed which were surrounded by remnants of tapetum and were separated from endothecium. This lock-up of pollen grains may hamper nutrition and will prevent release at anthesis.

4. CONCLUSIONS

Morphological changes of plants after GA_3-application as reported earlier (EENINK 1977) and anatomical changes mentioned in this paper both indicate an increase of cell elongation and of cell division.

Changes in the frequency of cell divisions do not occur in all floret parts to the same amount. For instance pistil tissue appears almost insensitive to additional GA_3 resulting in normal and fertile pistils. Anthers or sporogenous tissue within anthers hardly or not develop after GA_3-application and sometimes instead certain tumors do, resulting in "empty" anthers or in anthers without fully grown pollen grains. Developing buds with such pollen grains will account for the occurrence of MS1 flowers (see Introduction) and buds with "empty" anthers or without anthers at all develop into MS2 flowers.

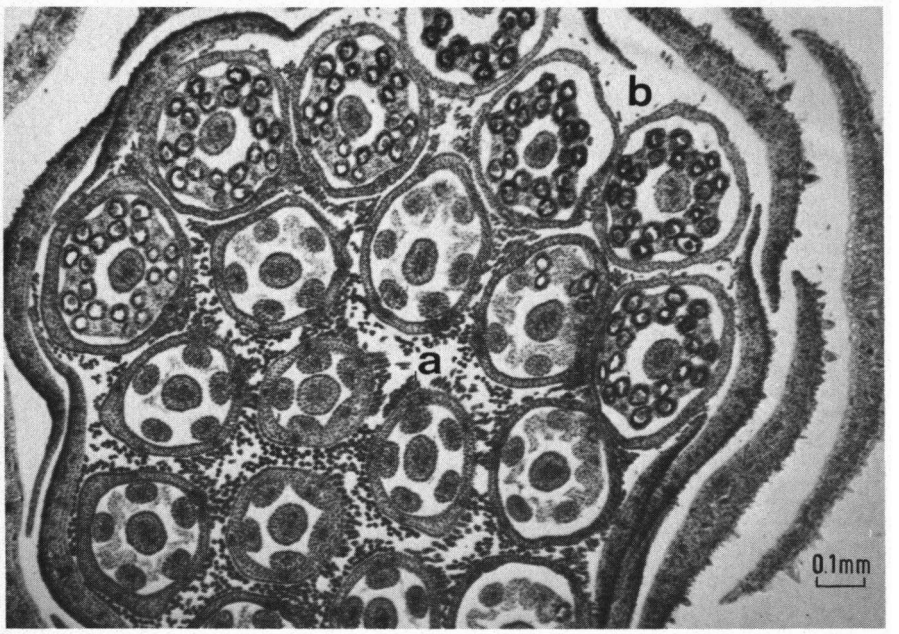

Fig. 1. Differences in development of central (a) and peripheral florets (b) within an untreated bud.

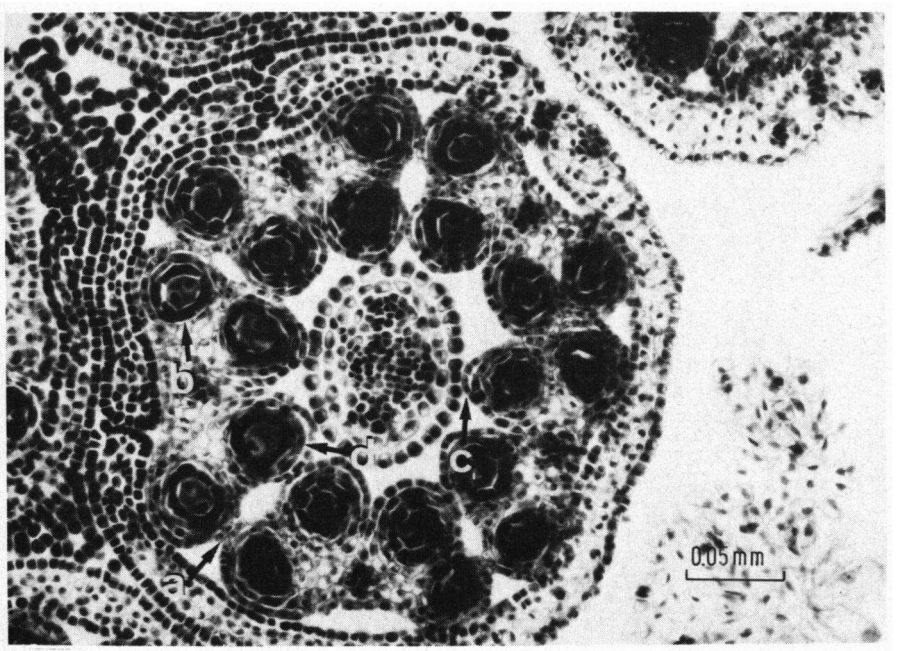

Fig. 2. Anthers fuse (a) and between tapetum (b) and exothecium (c) endothecium (d) develops (untreated bud).

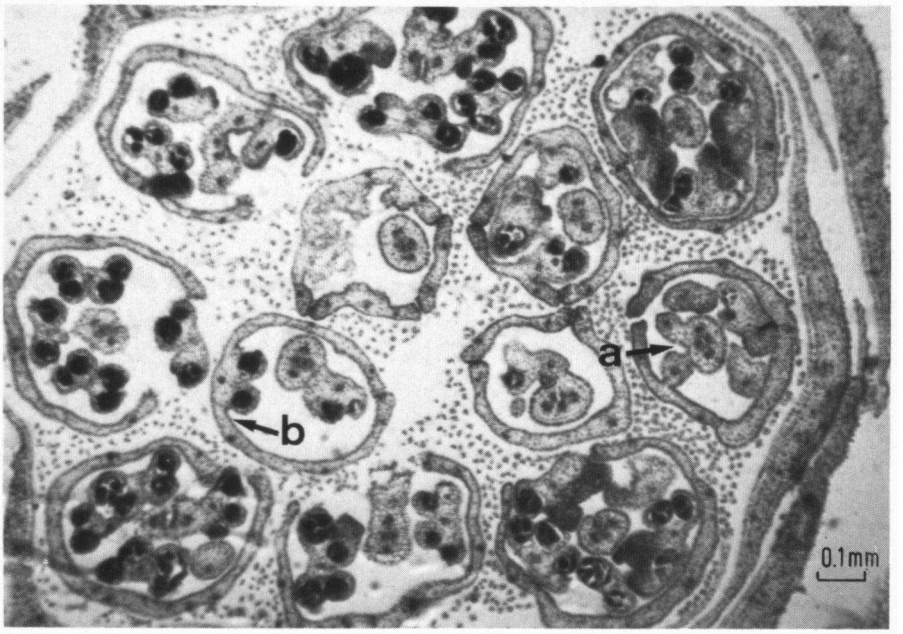

Fig. 3. Anthers fusing with style (a) or petals (b) after GA_3-application.

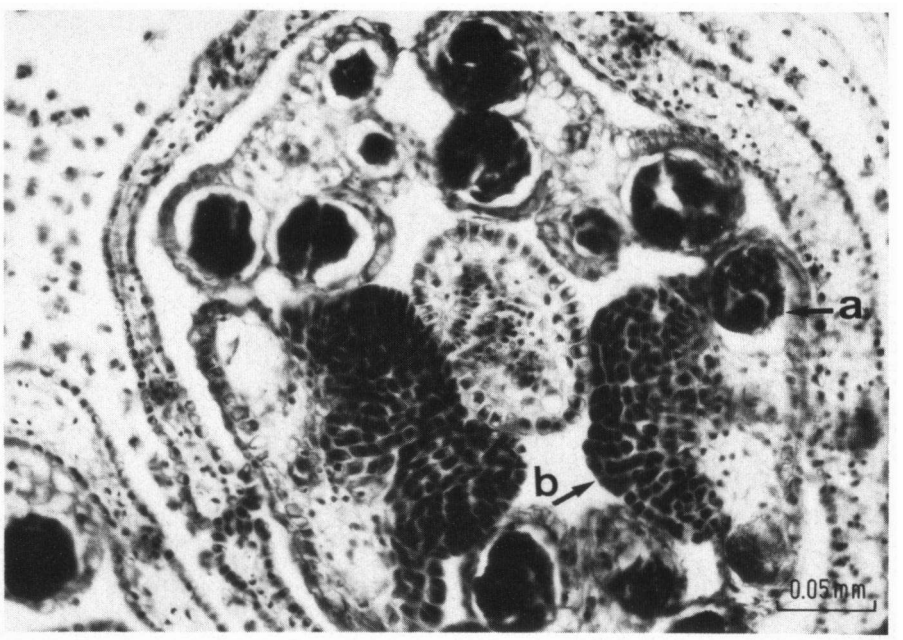

Fig. 4. Both sporogenous tissue (a) and tumors (b) occurring within an anther after GA_3-application.

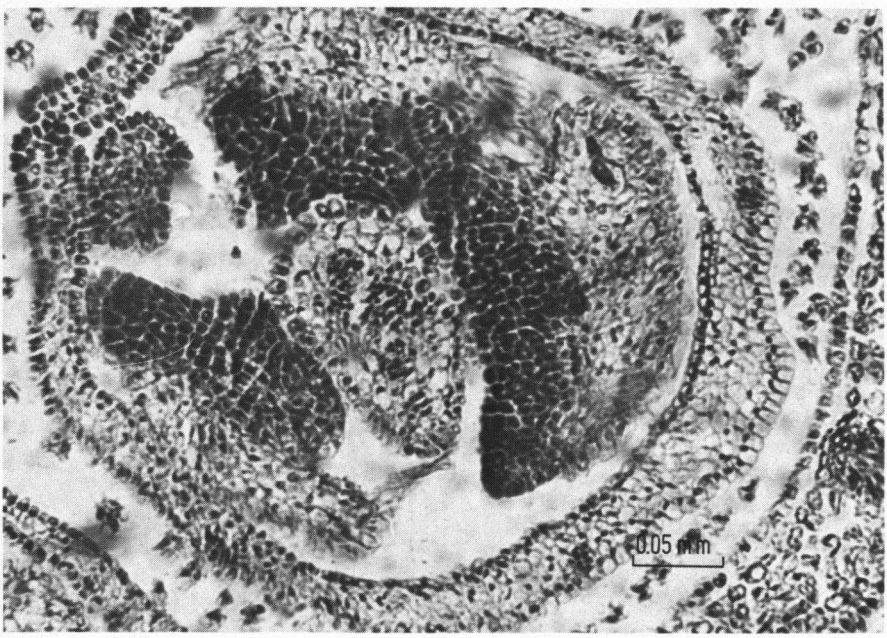

Fig. 5. The occurrence of tumors instead of sporogenous tissue after GA_3-application.

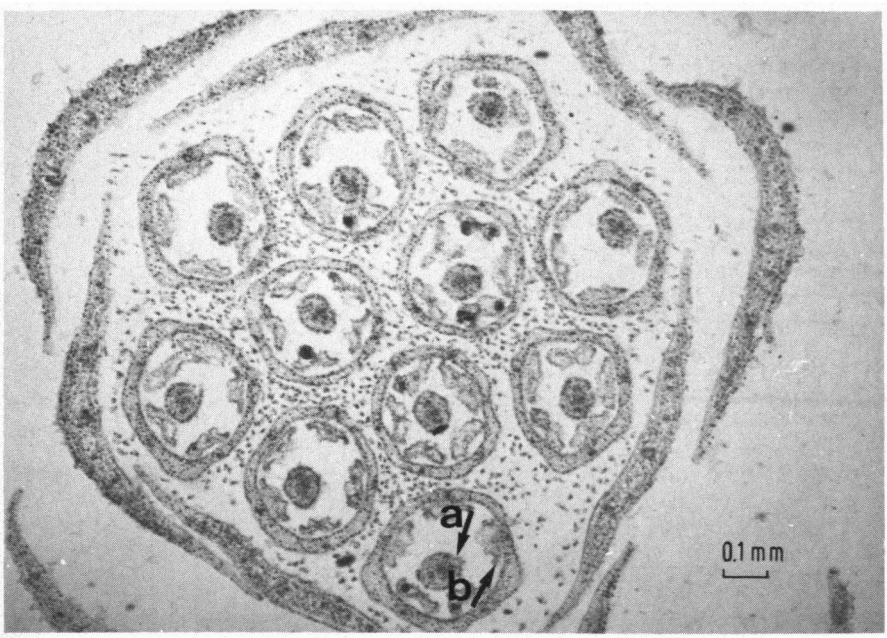

Fig. 6. Normal styles (a) after GA_3 treatment and malformed anthers (b).

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