ANATOMICAL EFFECTS OF INDOLEBUTYRIC ACID ON PEDICEL ABSCISSION OF *CORCHORUS*

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Abstract

Abscission of pedicel of Corchorus trilocularis *after its pollination with* C. olitorius *is completely suppressed by the application of IBA* (300 *PPM*) *around the pedicel of the pollinated flower. Longisections of the pedicels of self-pollinated flowers, when compared with those of the treated ones showed no difference in the shape and size of their cells in the abscission zone.*

In the crosses without IBA abscission zone was found to be differentiated 42 *hrs after pollination by the concurrent occurrence of cell division and initiation of lysis.*

Introduction

Abscission of one or the other organ has been studied in many plant species (Addicott 1956), but investigations on pedicel abscission following interspecific hybridization have not been many. This paper reports the results of the study of pedicel abscission of *trilocularis* after its pollination with *olitorius*. While crossing these two species, Islam and Ali (1966), noted that the cross-pollinated flowers drop within 48 hrs from the time of pollination. They further noted that if indolebutyric acid (IBA) is smeared around the pedicel, the pollinated flower stays on to the mother plant for a month or so and develops into a small empty fruit. These observations indicated that possibly an abscission layer is formed following interspecific cross in this combination and that the application of IBA suppresses its formation. Anatomical studies of the abscission zone were undertaken with a view to understanding the mechanism of abscission development and the effect of IBA on the suppression of this zone.

Materials and Methods

The following species of *Corchorus* were used in the present investigation.

C. olitorius L. (2n = 14), cultivated var. C. G., Ex-Dacca.

C. trilocularis L. (2n = 14), wild, local.

Crosses were made in August when the highest temperature range was between 35-42 C.

Conventional method of crossing was followed and all the necessary precautions were taken. Mature buds of *trilocularis* were emasculated before anthesis in the morning (six hrs before pollination). At approximately 3-0 p.m. the emasculated flowers were pollinated with the pollens of *olitorius* previously kept in a refrigerator. In the IBA applied crosses, the concentration was 300 PPM: the pedicel was smeared with it immediately after pollination. Explants were fixed in formalin-acetic-alcohol (90 ml of 50% alcohol + 5 ml of commercial formalin + 5 ml of glacial acetic acid). Sections were cut at 12½ μ and stained in safranine (1%) in 50% alcohol and light green (1%) in absolute alcohol.

Results

Experiment 1. *Determination of the exact time of flower drop and the location of abscission zone*

Since the pollinated flowers in the cross, *trilocularis* x *olitorius* were found to fall off, it was considered necessary to know exactly at what time after pollination the flower gets detached from the plant and to locate the abscission zone in the pedicel. Accordingly some 30 crosses were made in the above combination.

Observations: It was observed that almost all the flowers dropped after 48 hrs following pollination. Only a few were found to drop on the third day. Actual fall of the flower was due to the formation of an abscission layer, 4-5 cell layers above the point where bracts are found attached to the pedicel (Fig. 1).

Experiment 2. *Study of abscission layer development*

The flowers were fixed in 4 lots with 9 to 10 flowers in each at 24, 42, 48 and 72 hrs interval from the time of pollination. Fixation at longer time interval was not possible since 72 hrs was the maximum time that a flower stayed on to the mother plant after pollination. The flowers were fixed and stained according to the procedure earlier described.

Observations:

(*i*) **24 hrs.** In the first lot the cells found in the abscission zone showed no sign either of division or of any other change and were more or less equal in size.

(*ii*) **42 hrs.** While in the abscission zone the cells were half their size, in other portions of the pedicel their size was normal (Fig. 1). Besides the cells in the abscission zone were seen to have larger nuclei. Reduction in size of the cells and the presence of larger nuclei in only two layers of cells indicated that one complete mitotic division had taken place in this zone. Almost simultaneously with completion of division breakdown

of the newly arisen cells (lysis) was seen to be initiated from the periphery and to proceed towards the centre (centripetal). The cells in the area of lysis soon became empty because of the disintegration of their walls.

(*iii*) **48 hrs.** Lysis was complete (Fig. 2) but the separating parts lay close to each other. As the cells resulting from cell division were immediately involved in lysis, no protective layer was found to develop during the period abscission was completed.

(*iv*) **72 hrs.** Abscission was in a very advanced stage: aided by mechanical stress the pedicel and peduncle were seen completely separated from each other (Fig. 3). Further it was observed that the intact cell walls away from line of separation were thickened (Fig. 2). It is difficult to arrive at any definite conclusion whether the thickening is due to deposition of wall material or it is the result of a collapse of cells. Possibly there is something of each involved.

Experiment 3. *Effect of IBA on the suppression of abscission layer*

The pollinated flowers were smeared around their pedicels in a thin layer with 300 PPM of IBA in lanolin paste. After the application of IBA, the flowers were fixed in 4 lots, at intervals of 24, 42, 48 and 72 hrs from the time of pollination.

Observation: No cell division or initiation of abscission was observed after 24, 42, 48 and 72 hrs (Figs. 4 & 5) and there was no difference in the type of tissues of IBA treated pedicel and those of the non-treated ones. It was also observed that there is no marked difference in the tissues of treated pedicel and that of a self-pollinated flower (cf. Fig. 5 with Fig. 6).

Many of the IBA-treated flowers persisted on to the mother plant and a few developed into mature although somewhat stunted fruits. Thus IBA, when applied in the conc. of 300 PPM around the pollinated flower of the cross, completely suppressed the abscission development.

Experiment 4. *Anatomical studies of explants from self-pollinated flowers of trilocularis*

The pedicels of 20 self-pollinated flowers were fixed in order to study whether the pedicel of IBA treated crossed flower has the same kind of tissues as that found in the pedicel of a self-pollinated flower. Study was made with the materials collected 42 and 48 hrs after pollination; this was because abscission layer starts developing 42 hrs after pollination and is almost complete within 48 hrs.

Observation: Longisections of the pedicels fixed at 42 hrs time interval from pollination when compared with those of IBA-treated explants, showed no

difference in the type of their tissue. The cells were more or less similar in shape and size at each site (Fig. 6). This indicates that possibly IBA supplies the same kind of necessary growth supporting substances which are available for the uninterrupted growth of the pedicel of a self-pollinated flower.

Discussion

Most of the previous reports are on leaf abscission either on its formation or induction of it by means of chemicals *e.g.*, ammonium thiocyanate, carbon tetrachloride, ethylene chlorohydrin (Gawadi and Avery 1950), gibberellin (Bornman 1968). The results reported here are essentially similar to those obtained from the application of auxin type regulators to leaves.

In studying the mechanism of abscission in *Poinsettia*, pepper, cotton, *Impatiens* and tobacco, Gawadi and Avery (1950), reported that the process leading to leaf-fall is different in different species. For instance, they found that in *Poinsettia*, as a result of cell division, a multilayered abscission zone is formed leading to leaf-fall, while in *Impatiens* abscission occurs without any cell division. In contrast to *Poinsettia*, the latter affords a clear case of abscission without secondary cell division taking place prior to leaf-fall.

Pathan (1968), observed the *Poinsettia* type of abscission development in the pedicel of *Gossypium armourianum* following pollination with *G. hirsutum*. She observed that on the 5th day following pollination, two to three abscission layers develop as a result of secondary cell division. Abscission in this case is of the type in which lysis is not initiated until the cell division is completed.

In the present investigation the mode of abscission development seems to be intermediate between what has been observed in the leaves of *Poinsettia* and those of *Impatiens*. Here the cell division as well as separation seems to take place simultaneously involving only two layers of cells. The latter, the product of a single cell division are immediately involved in lysis. It is probably on account of this that one cannot distinguish here the protective layer from the rest of the tissues at the time when the development of abscission is completed.

Explaining the reasons of the persistence of IBA-treated flower one may assume that in a self-pollinated flower some kind of auxin type regulator is made available presumably from the developing seeds to the ovary for its development into a fruit. On the other hand, when incompatible species are crossed there is short supply of such regulator not enough to support fruit development or to suppress the abscission formation.

This is probably because in incompatible species crosses, ovules are not fertilized and if ovules remain unfertilized, as in the present case, there is no seed development.

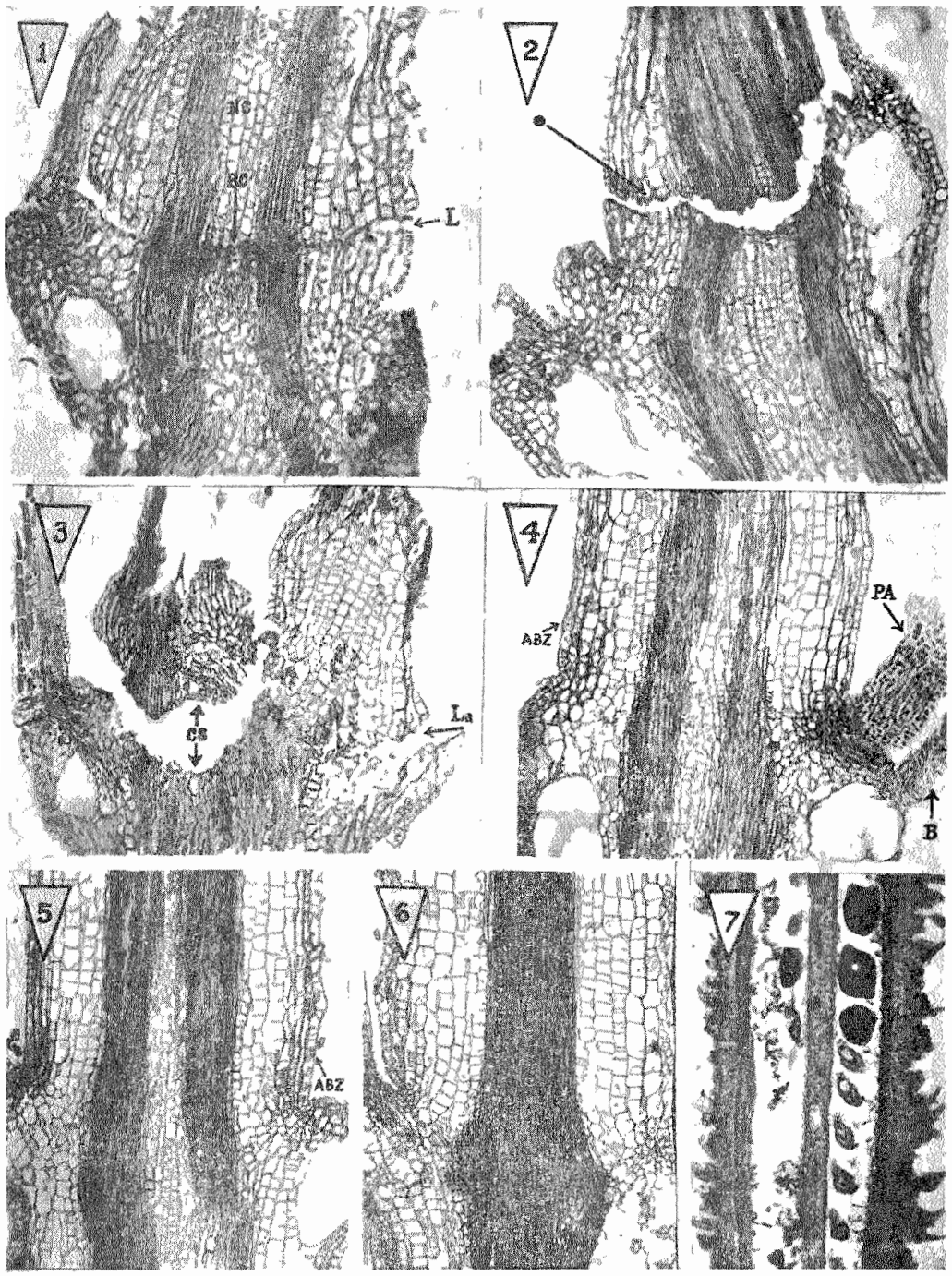
1
MC
SC
L
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Fig. 1. Abscission zone of pedicel, 42 hrs after pollination, RC, reduced cells; NC, cells of normal size: and L, lysis.

Fig. 2. L.S. of a pedicel, 48 hrs after pollination showing a later stage in the development of abscission. Arrow indicates the outer thickened walls of the separating cells.

Fig. 3. An advanced stage in the development of abscission, 72 hrs after cross-pollination. SC, complete separation of the pedicel from the peduncle and La, lysis of the adjacent pedicel.

Fig. 4. L.S. of the IBA treated pedicel, 48 hrs after pollination showing normal growth of tissues in the abscission zone. ABZ, approximate abscission zone; and PA, pedicel of the adjacent flower.

Fig. 5. Healthy growth of the tissues in the treated pedicel, 48 hrs after pollination. ABZ, approximate abscission zone.

Fig. 6. L.S. of the pedicel of a self-pollinaed flower, 48 hrs after pollination.

Fig. 7. L.S. of the ovary of *trilocularis*, showing fertilized ovules in the upper region and unfertilized in the lower region.

The lack of seed formation leads to inadequate auxin supply to the regions where it is required in abundance *e.g.*, pedicel particularly in the abscission zone and ovarian wall. In the pedicel of the crossed flower, abscission layer develops 42 hrs after pollination. The question arises as to why there is no initiation of abscission layer until 42 hrs from the time of cross-pollination. The possible explanation may be that even in a self-pollinated ovary the octant stage of the embryo is not reached within 42 hrs. For this period the pedicel of a selfed flower is presumably to depend on its built-in reserve of auxin to prevent its shedding. It follows therefore that whether a flower is self or cross-pollinated, the internal supply of auxin is good enough to hold the flower in position for 42 hrs. From then onward, the attachment of the pedicel to the mother plant will depend upon the fresh supply of auxin-like growth regulators regardless of the fact whether the latter are provided by fertilized seeds or through external application of regulators as in case of the pedicel of a cross-pollinated flower.

The fruits obtained from the cross as a result of IBA treatment were much smaller of compared to normal ones. The explanation of the stunted growth of crossed fruit comes from the work of Baloch (1967) who found that only a few ovules lying in the first two rows of the uppermost portion of the ovary were fertilized (Fig. 7) and evidently only a few ovules (only about 16.7% of the total) could not supply enough regulators to stimulate the ovary to its full development. Moreover according to Baloch (l.c.) the growth of the hybrid embryos stopped beyond the octant stage with no division of endosperm nucleus. If this were so, the few fertilized ovules with undeveloped embryo could not supply the same quantity of auxin as would be supplied by the ovules containing fully developed embryos of a self-pollinated flower. It would be worthwhile to apply periodically different types of growth regulators including IBA on the ovarian wall of a cross-pollinated flower and see whether such application leads to its full growth.

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References

Addicott, F. T. 1965. Physiology of abscission. Encyclopaedia of Plant Physiology. W. Ruhland (ed.) **14:** (2) Springer-Verlag, Berlin pp. 1094-1126.

Bornman, C.H., F. T. Addicott, and J. L. Lyon. 1968. Anatomy of gibberellin induced stem abscission in cotton. Amer. J. Bot. **55:** 396-375.

Baloch, M. S. 1967. Further studies into the effect of indolebutyric acid in the cross, *Corchorus olitorius* x *C. trilocularis* L., M.Sc. thesis, Sind University.

Gawadi, A. G. and G. S. Avery. 1950. Leaf abscission and the so called "abscission layer". Amer. J. Bot. **37**: 172-180.

Islam, A. S. and S. A. Feroza, 1967. Investigation into the causes of failure of reciprocal crosses between *C. olitorius* L. var. C. G. and *C. trilocularis* L. Sind University Sci. Res. J. **2**: 209-214.

Pathan, S. 1968. Effect of indolebutyric acid on the anatomy of the abscission zone in the cross, *Gossypium armourianum* Kearney x *G. hirsutum* L. var. M4. M.,Sc. thesis, Sind University.