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Ovule and embryo-sac development in almond

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SUMMARY – In some varieties, degenerations occurring in relation to development of embryo sac and ovule at different stages might be a cause of fruitlessness. In fruit growing, to understand problems about this matter, knowledge is needed about embryo sac and ovule development. For this purpose, this study was designed. Tuono almond variety was used in this experiment. Sections from fixed samples were prepared by using the paraffin method. It was observed that ovule and integuments did not develop during the dormancy period. In the balloon stage, megaspore differentation began. At bloom, the embryo sac elongated and expanded. Embryo sac degeneration occurred probably on the fifth day on un-pollinated flowers.

Key words: Almond, Tuono, ovule, embryo sac.

RESUME – *"Développement de l'ovule et de l'enveloppe embryonnaire chez l'amandier". Chez certaines variétés, la dégénérescence survenant en liaison avec le développement de l'enveloppe embryonnaire et de l'ovule à différents stades peut être la cause de l'absence fruit. En arboriculture fruitière, pour comprendre les problèmes dans ce domaine, il est nécessaire d'avoir des connaissances concernant le développement de l'enveloppe embryonnaire et de l'ovule. Cette étude a été conçue dans cet objectif. La variété d'amandier Tuono a été utilisée dans cette expérience. Des sections d'échantillons fixés ont été préparées en utilisant la méthode de la paraffine. On a observé que l'ovule et les téguments intérieurs ne se développaient pas durant la période de dormance. Au stade ballon, a commencé la différenciation des mégaspores. A la floraison, l'enveloppe embryonnaire s'est allongée et expansée. La dégénérescence de l'enveloppe embryonnaire a probablement eu lieu au cinquième jour sur les fleurs non pollinisées.*

Mots-clés : *Amandier, Tuono, ovule, enveloppe embryonnaire.*

Introduction

In fruit trees, it is necessary that the ovule and the embryo sac normally develop and fertilization take place so that flower can be transformed into a fruit, in general. This condition is valid in all fruits except the parthenocarpic ones.

However, in some varieties, degeneration of the embryo sac and ovule development at different stages might cause fruitlessness (Rallo *et al.*, 1981). Also, the short life of embryo sac and ovule limit fruit set especially in self sterile varieties (Westwood, 1978).

In fruit growing, to understand problems related to this matter and to propose a solution, information on embryo sac and ovule development is needed with this purpose, this study was planned on almond variety Tuono.

Material and method

Tuono almond variety was used in the study. To investigate embryo sac and ovule development, samples were collected from onset of bud swell to full bloom every 2 days. In non-pollinated flowers, after full bloom to investigate the development, emasculated flowers were picked every 2 days for another 10 days. Sections from fixed samples were prepared by using paraffin method (Vardar, 1962; A_kın, 1989). Slides were stained with hematoxylin and examined by using transmission light and stereo microscope.

Results and discussion

It was observed that ovules in bud samples at the end of dormant period did not completely fill in the ovary (Fig. 1). A_kın (1989), found similar results in apricot at the start of the dormant period. Thus, it can be put forward that ovules did not develop during dormancy period. Integument growth in the longitidunal sections of the buds during the same period was not observed (Fig. 2).

Fig. 1. An appearance of flower bud at the end of dormant period on stereo microscope (5 x 1.6).

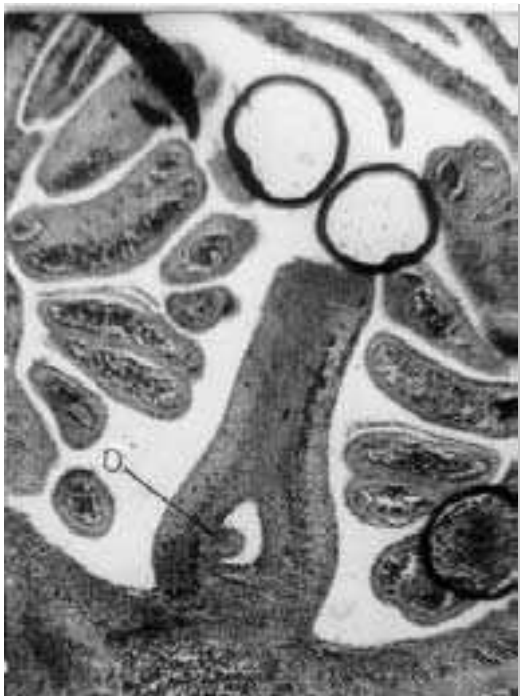

Fig. 2. A view of flower bud at the end of dormant period on transmission light microscope (5 x 6.3). O: Ovule.

At the end of the dormant period, buds started swelling and ovule development was accelerated. At this stage, integuments started to envelope nucellus (Fig. 3). In buds before the balloon stage, megaspore differentation began (Fig. 4). Pimienta and Polito (1983), reported that cell differentation to constitute embryo sac took place later and was irregular in Nonpareil variety. This case occurred at an earlier stage in Tuono. This situation is important to show differences between varieties in the same species. The fact that megaspore differentation happened at this stage could be considered as a cultivar characteristic for Tuono. Also, Costa and Mackenzie (1990), obtained the same situation in some varieties of *M. pumila*.

At balloon stage, ovules filled in the ovary completely (Fig. 5) and possibly, embryo sac development reached to the two nuclei stage (Fig. 6).

At bloom, mature embryo sacs could be observed. Synergids and egg cell were in the micropylar pole, endosperm nuclei was in the centre (Figs 7 and 8). At this stage, embryo sac elongated and expanded and could be fertilized, but antipode cells were not observed. This situation may be due to degeneration after embryo sac matures. Confirming this, Costa and Mackenzie (1990), reported that antipode cells were malformed at blooming. It was impossible to know which one of the ovules would continue to develop (Fig. 9). Pimienta and Polito (1982) obtained parallel results from their investigations.

Abortive ovule was found in a sample taken at balloon stage. In this abortion, nucellus tissue could not develop, internal integuments combined with each other over the nucellus, but this process was not carried out in the external integuments. The cause of this condition may be the cessation of cell

division in the microphylar part. This idea is supported by the tip of nucellus which did not elongate and had a flat surface, because in healthy ovules, there is a continuous cell division in this part. Pimienta and Polito (1982), observed the same results in Nonpareil variety.

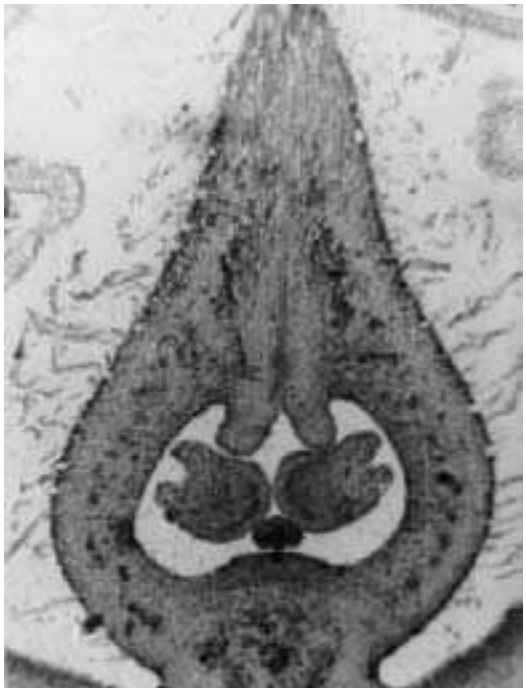

Fig. 3. Longitudinal section of swelling flower bud (5 x 6.3).

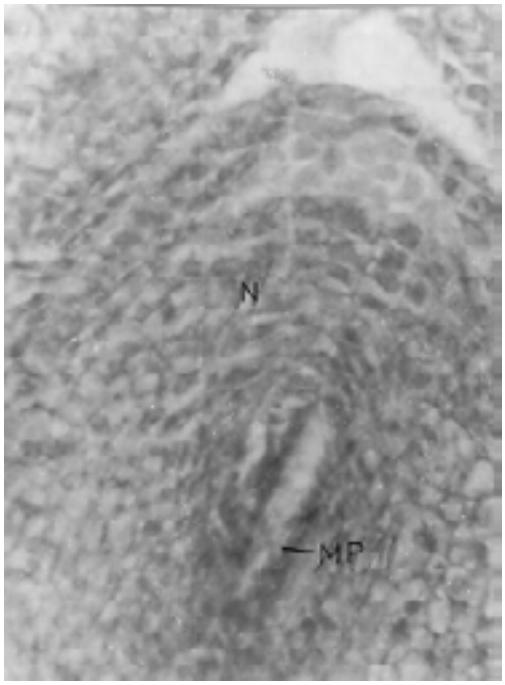

Fig. 4. An appearance of nucellus at the megaspore differantation stage (15 x 40). N: Nucellus; MP: Megaspore part.

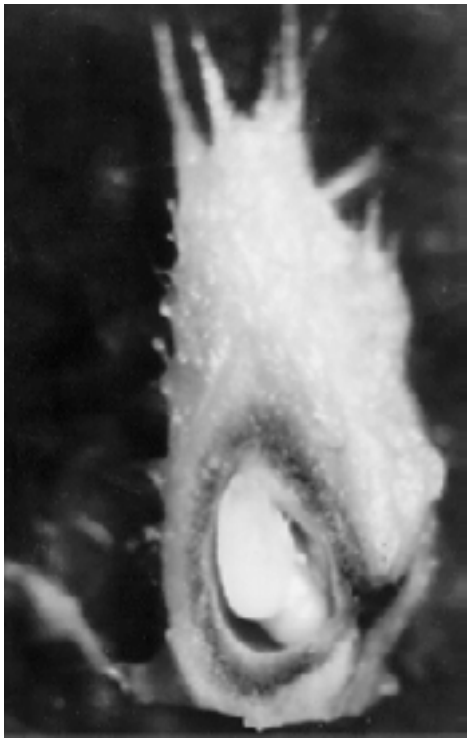

Fig. 5. General aspect of ovule at the balloon stage (5 x 1.6).

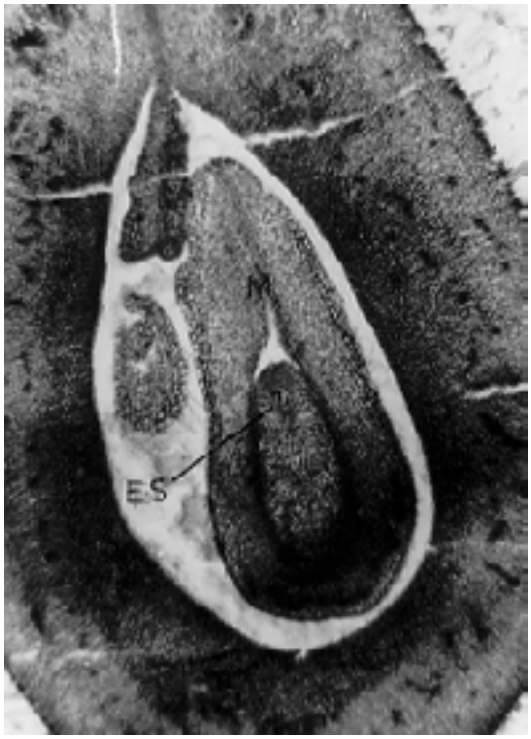

Fig. 6. Ovule at the balloon stage (5 x 6.3). ES: Embryo sac; M: Mycropyl.

Fig. 7. Mature embryo sac (5 x 6.3).

Fig. 8. Ovules in flower at blooming (5 x 1.6).

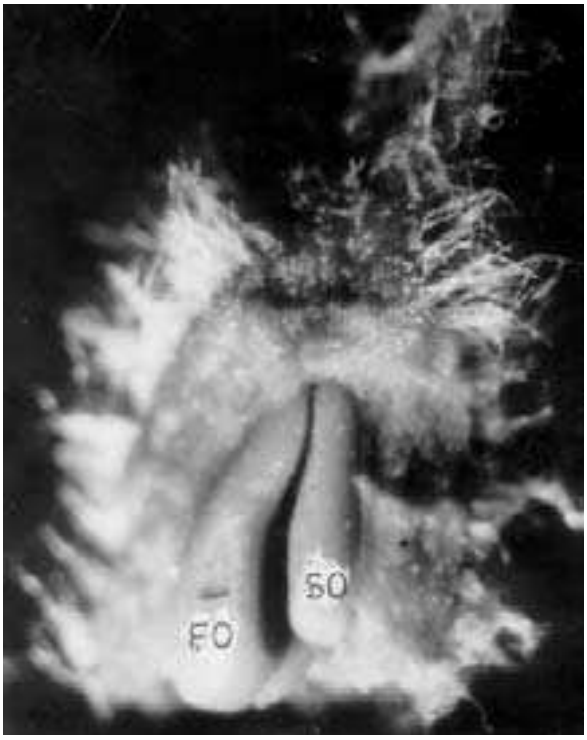

Fig. 9. The ovules on the fourth day after blooming (5 x 1.6). FO: First ovule; SO: Second ovule.

A second part of this study aimed at investigating embryo sac and ovule development in non-pollinated flowers. Endosperm nuclei was densely stained and nucellus degeneration did not start showing a functional embryo sac in these flowers. Only one of the ovules developed. Embryo sac

degeneration seemed to occur on the fifth day, because they have been observed as completely degenerated in the samples taken on the sixth and eighth days. After the embryo sac had lost its function in the primary ovules, the degeneration in nucellus cells covering the embryo sac also started. In non-pollinated flowers primary ovule is somewhat larger. The development of secondary ovule stopped and then the nucellus shrunk and departed from the integuments.

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