ORGANOGENESIS CYCLE IN APRICOT

G. Đurić, N. Mićić and R. Cerović,
ARI "SERBIA", Fruit and
Grape Research Centre,
32000 Čačak, Kralja Petra I/9, Yugoslavia

S. Jevtić
ARI "SERBIA"
Zeleni venac 2/III
11000 Beograd, Yugoslavia

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Abstract

In fruit growing practise the knowledge of organogenesis cycle at the level of morphogenetic processes, i.e. the dynamic of various phenophases and microphenophases in the development of certain organs and the whole plant, represents a basis for defining procedures in biological control of growth and development. Organogenesis cycle in apricot is presented by determination of typical and in analytical sense, complete processes in organ and tissue differentiation in the annual cycle of growth and development.

1. Introduction

Organogenesis cycle of woody plants was divided into 12 stages by Kuperman (1968), while Isaeva (1977), according to the division and due to specific nature of organogenesis process in fruit trees, divided some stages into a number of substages. The basis for defining stages in the organogenesis cycle of fruit trees species is the determination of typical and complete processes in organ and tissue differentiation in the annual cycle (Lancashire, 1991; Mićić and Đurić, 1994).

2. Materials and methods

The process of organ and tissue differentiation and the course of their growth and development were analysed in cvs Hungarian Best, Cehin, Melitopol'skaya Ranyaya and Frühe Kittze in 1994-1996 through morphological and histological analyses. Morphological analyses were done visually and using stereoscopic microscope, whereas histological analyses were carried out by preparing histological preparations by paraffin technique with sample fixation according to Nawaschin and staining with Delafield's hematoxylin. The samples (mixed bearing branches) were taken in 7-10 days depending on phenophase during the whole year. Then all buds from bearing branches were analysed in all moments of sample taking.

3. Results

The organogenesis cycle in apricot, taken integrally as a definite number of irreversible steps in the organ and tissue differentiation, occurs in the following stages and substages:

Stage I – formation of new undifferentiated meristematic domes of the tree and seed.

This stage has the following substages:

Ia_0 – formation of meristematic dome of the seed plumule;
Ia_1 – formation of primary meristematic dome in the leaf axil of new vegetative tree growths;

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Ia$_1$' – division of primary meristematic dome and formation of lateral meristematic domes of the nodes (the basis of collateral and serial buds).

Stage II – formation, differentiation, growth and development of vegetative tree organs.

This stage has the following substages:

IIa$_0$ – differentiation of vegetative buds (differentiation of scales)
IIb$_0$ – differentiation of meristematic dome after dormancy break – formation of nodes with leaf primordia;
IIb$_1$ – growth and development of shoots and leaf rosettes;
IIc$_1$ – termination of shoot growth by shoot tip abortion.

Stage III – change in meristem character: transition from vegetative to generative differentiation phase – the onset of differentiation of generative buds. A certain number of meristematic domes from IIa$_0$ stages passes into this stage of organogenesis.

This stage occurs in two substages:

IIIa – programme phase of the transition of meristem character from vegetative into generative stage of differentiation – the process of genetic programming of the transition of meristematic dome into meristematic apex of the generative bud;
IIIb – the onset of morphological changes on the meristematic apex of generative buds.

3.4. Stage IV – differentiation of flower axes.

3.5. Stage V – differentiation of floral primordia.

This stage has the following substages:

Va – differentiation of the receptacle tissues (formation of the initial recesson the top of flower axis primordia);
Vb – formation of sepal primordia ;
Vc – formation of petal primordia;
Vd – formation of anther primordia;
Ve – formation of carpel primordia;
Vf – growth and development of the formed floral primordia until a certain degree of differentiation, necessary for the normal passing of dormancy period, has been reached .

Stage VI – differentiation of anther tissue, male archaesporial tissue and the process of microsporogenesis.

This stage has the following substages:

VIa – differentiation of archaeosporial tissue;
VIb – meiosis;
VIc –cytological constitution of pollen;
VId – pollen development up to anther shedding.

Stage VII – differentiation of ovules, female archaeosporial tissue and the process of macrosporogenesis.

This stage has the following substages:

VIIa – formation of ovule primordia in the ovary locule;
VIIb – differentiation of pronucellar tissue and the integuments;
VIIc – differentiation of archaeosporial tissue and macrosporogenesis.

Stage VIII – macrogametogenesis and cytological forming of the egg apparatus ready for fertilization.

This stage occurs in the following substages:

VIIIa – first mitosis of the macrospore nucleus – binucleate stage of the embryo sac;
VIIIb – second mitotic cycle – 4-nucleate stage of the embryo sac;
VIIIc – third mitotic cycle – 8-nucleate stage of the embryo sac;
VIIId – cytological constitution of the embryo sac elements: the egg cell with synergids in the micropyle region, the three antipodal cells in the chalaza region and polar nuclei in the central part of the embryo sac.

Stage IX – flowering and fertilization

This stage has two substages:

IXa – flowering and pollination;
IXb – the progamic phase of fertilization and fertilization.

Stage X – zygote and early embryogenesis

Stage XI – embryogenesis (seed formation)

This stage has the following substages:

XIa – the globular embryo;
XIb – the heart-shaped embryo;
XIc – the torpedo-shaped embryo;
XId – young embryo (the formed primordia of the major organs and cotyledon);
XIe – development of embryo to the full mature (process of endosperm resorpcion)

Stage XII – formation of physiologically mature fruit and its ripening

This stage has two substages:

XIIa – physiologically mature fruit with formed cotyledons (resorbed endosperm, the change of colour of the seed-coat).
XIIb0 – development of mesocarp tissue in the function of seed dispersal - fruit ripening.

Graphic analyses of onset, relationship and dynamics, as well as of duration of defined stages and substages, show that all 12 stages of organogenesis occur on the tree during a year (Fig. 1). However, one final cycle in differentiation and development of meristematic dome from the first to the twelfth stage, occurs during two-year time (Fig. 2). Each stage and substage defined in the process of organs and tissues differentiation may be classified in a larger number of individual phases which may be observed both in relation one to another and in relation to a plant development as a whole (Fig. 3).

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Figure 1. The relation between individual stages and substages apricot organogenesis in annual cycle

Figure 2. The relation between individual stages and substages apricot organogenesis from 1st to 12th stage

Figure 3. Each stage and substage defined in the process of organs and tissues differentiation may be classified in a larger number of individual phases which may be observed both in relation one to another and in relation to a plant development as a whole