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Are the embryos of apple tree, cv. Antonówka in the state of dermancy?

A critical note on the paper of Czerski and Jankowska "Growth of apple seedlings *(Malus domestica)* cv. Antonówka obtained from non-stratified embryos" (Acta Soc. Bot. Polon. 1977; 46: 649—668)

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The dormancy of seeds, conditions and mechanism of its onset, maintenance and removal, as well as the post-effects of dormancy on plant growth and development have attracted the attention of botanists for many years. However, our knowledge of the nature of dormancy is still far from being complete, so each attempt to learn more about this phenomenon should be useful.

In this connection, one could expect that a paper about the characteristics of growth of apple seedlings, grown from embryos isolated from non-stratified (dormant) and fully stratified (non-dormant) seeds, may substantially contribute to solve the problem of embryonal dormancy. However, the paper of Czerski and Jankowska (1977) do not fulfill this expectation. The final conclusion of the paper, the methodological approach leading to this conclusion and the interpretation of results rise so many doubts that an appraisal different from that of the authors seems necessary.

The final conclusion of Czerski and Jankowska is: "the seeds of the autumn apple 'Antonówka' do not pass the state of embryonal dormancy". It seem that such a surprising conclusion, contradictory to other autors' observations, ought to be carefully discussed and explained on the basis of literature data. On the other hand, it could be taken as a unawareness of the dormancy phenomenon itself.

The authors report two kinds of arguments to support their conclusion: 1 — they did not find any difference "between the germination of embryos isolated from non-stratified and stratified seeds" and 2 — they did not observe any difference "between the growth of plants obtained from non-stratified and stratified embryos".

It is commonly known, that embryonal dormancy, being a kind of plant adaptation to unfavorable climate conditions, is released by an appropriate treatment. For apple seeds, similarly as for many seeds of woody species, the treatment consists in cold stratification which substitutes the natural conditions in soil during winter. But the imitiation of natural conditions is not the only possibility to remove the embryonal dormancy. Instead of stratification, total anaerobiosis could be applied to remove the dormancy in apple embryos (Tissaoui and Côme, 1973). Dormancy of hazelnuts can be broken by a gibberellin treatment which is as effective as cold (Jarvis and Wilson, 1977). In cereals dormancy can be released either by dry storage or by treatment with azide, cyanide and other inhibitors (Roberts, 1969; Roberts and Smith, 1977). These examples indicate that the mechanism of dormancy and its removal are quite complex and need further investigations. Thus, the fact that Czerski and Jankowska, did not observe some of the symptoms of dormancy in their material could be explained in two ways: either the embryonal dormancy in apple seeds disappeared without chilling under experimental conditions applied or that they did not use the proper criterions in studies on seed dormancy.

The fundamental criterion of dormancy in seeds is their inability to germinate or slower germination as compared to non-dormant ones. Conditions for testing germinability ought to be carefully selected in order to determine not the viability of seeds but the energy of germination (vigor). There are two ways of proper experimentation: 1 — to investigate the germinability at a wide temperature range (Vegis, 1964), or 2 — to investigate the dynamics of germination (Thevenot and Côme, 1973).

Authors of the paper under discussion performed the investigation of germination of embryos isolated from stratified and dormant apple seeds simply by counting the germinated embryos after arbitrary chosen 10 day period of culture. They did not find any difference between both kinds of embryos. This observation is inconsistent with data obtained for the same cultivar (Antonówka) at the Institute of Pomology in Skierniewice (Kamiński and Pieniążek, 1968; Rudnicki, 1969), in Nikolaeva's laboratory in Leningrad (Nikolaeva and Jankelevich, 1976) in Côme's laboratory in Paris (Thevenot et al., 1977) in our laboratory (Lewak et al., 1975; Wyzińska and Lewak, 1978) and in all the seed-testing stations in our country. For other cultivars of apple tree the important differences in germinability of

dormant and stratified embryos were stated in different laboratories over the world (for example Visser, 1956a, b, Côme, 1970). This discordance between the results obtained by the authors of the discussed paper and the results of all the other investigators is dismissed by Czerski and Jankowska by the short statement that "the differences could have been caused by different germination conditions...". Such a statement, not supported by a detailed discussion is without value and does not entitle the authors to deny the occurence of dormancy in apple ambryos.

The major part of Czerski and Jankowska's paper is devoted to the observations of growth of young apple trees obtained from embryos excised from stratified and non-stratified seeds. In the opinion of the authors of the discussed paper these observations have given the crucial argument against the occurence of embryonal dormancy in apple (cv. Antonówka) seeds. They expected that trees grown from non-stratified, dormant embryos, would show dwarfy appearance. This expectation is based on the statement of Flemion (1934), Burton (1965), Crocker and Burton (1953), Nikolaeva (1967) and of other authors that among plants grown from dormant seeds (or isolated embryos) dwarfy plants occur. Czerski and Jankowska seem do not realize that physiological dwarfism may be, but not necessarily is one of the post--effects of seed dormancy. It has been never taken as a criterion of dormancy.

Many authors observing the development of plants from dormant or partly stratified seeds agree that physiological dwarfism occurs only in plants grown under stress conditions. Such conditions, which are easily overcome by plants grown from fully stratified seeds, provoke the occurence of developmental abnormalities in less resistant seedlings grown from partly dormant seeds. The best example of such a relation was presented by Pollock (1959) who demonstrated that the temperature during the first week of germination of dormant peach embryos determined the character of further development of seedlings. When germination was performed at 19°C all plants were normal, at 27°C almost all were dwarfed. Intermediate temperatures led to a population partly dwarfed and partly normal. The other stress-evoking factor (shortening of the day-length) was shown by Nikolaeva (1967) to induce dwarfism precisely in the apple seedlings grown from embryos non-stratified in cold.

As a matter of fact, the authors of the discussed paper did observe the shortening of internodes and dwarfism when plants were grown on quartz sand and suffered from water stress. However, they deny the significance of that observation by concluding that 'Antonówka' seeds do not show the embryonal dormancy. Moreover, they deny even the observation itself, without looking at the photograph no 3 (page 658)

because they state "no dwarf forms among non-stratified plants were observed". In such a situation should the arguments of Czerski and Jankowska be taken seriously?

Some other remarks of Czerski and Jankowska are also difficult to understand. For example the authors state "...the more dynamic growth of stratified seedlings. ... was caused by the fact that stratified seeds were physiologically older...". What does it mean — "physiologically older seeds"? Is such a seed more mature? If so, authors do not question the fact that some ripening processes did occur during stratification. Why not consider these processes as after-ripening (e.g. removal of dormancy).

The same concerns two last sentences of discussion. According to Czerski and Jankowska, differences in enzyme activities, hormonal balance and formation of the photosynthetic apparatus reported by other authors (for dormant and non-dormant apple embryos) are attributed to "long lasting low temperature treatment, but can not be connected with the embryonal dormancy". Why not? Are these differences not symptoms of physiological immaturity of seeds? Authors do not present any arguments to support their unwarranted statement.

Summarizing, the fact that Czerski and Jankowska did not find some of the symptoms of embryonal dormancy in seeds of apple cv. Antonówka is not sufficient to present a view, contradictory to the other investigators' opinion based on hundreds of experiments performed in different laboratories over the world, when more complete and objective approaches have been used. The discussed paper presents several interesting observations on the growth of apple seedlings obtained from dormant embryos which could be fully understood and interpreted only in result of further experiments.

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