A study on therhymics and reciprocity between the set and growth of almond fruit and bud differentiation

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A study on the rhythmics and reciprocity between the set and growth of Almond fruit and bud differentiation

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ABSTRACT-RESUME

In order to evolve purposeful management of almond orchard a study on the rhythmics of beginning and development of fruit and seed, in reciprocity with the bud differentiation was carried out. It is shown that the main phases of yield formation are closely subsequent and do not coincide by time in the same plant but correlate by terms with the blossom-and-maturing time characters of the cultivars.
The microscopically visible morphological changes of apical bud meristem begin by about the first half of July.

Les principales phases de développement des fruits se succèdent sans interruption mais ne sont pas simultanées pour toutes les variétés.
Elles sont plutôt en corrélation avec les dates de floraison et de maturité des diverses variétés. Les début de la différenciation florale s'observe à partir de la mi-juillet dans nos conditions de culture (Pomorie, Bulgarie).

INTRODUCTION

In orchards as well as in individual trees, the almond almost always occupies poor if not the poorest dry, slopy and more or less stony areas.

If we are going to realize the potential almond bioefficiency in such edaphic conditions a high agrotechnical level should be constantly maintained. For efficient planning the cultivation should be considered in relation to biological features of the almond, to its age, ontogenetic and annual stages and phases.

One of the basic factors of bearing is bud differentiation-peculiarities, time and conditions of developing. Acquaintance with these elements may show the optimum rates for orchard floor management, pruning, nutrition and irrigation. A very significant condition for developing the object is the study of the rhythmics and terms of set and formation of the fruit parts and starting time of the embryonic bud differentiation in connection with blossoming and ripening phases.

There are many studies on the bud differentiation regularities (1, 3, 4, 6, 7, 9, 10, 11, 13) but only some of them touch the rhythm of semen growth and this is for juicy-fruit species (2, 10).

Most of the authors consider that the start of the bud differentiation comes with spring-growth abatement when the formation of terminal leaf buds of the stone-fruit species is completed (1, 4, 10).

Baldini[1] considers that there is a period of "previous induction" and "predifferentiation" ("jar" phase) — this one taking place in July.

Vasilev and Baev[13] assert that "embryonic phase of flower buds may be seen in the leaf axil as early as in early May".

Strotchkova[12] also reckons that the discernible phase ("jar" phase) is not the real start of embryonic initiation of flower buds: it really begins earlier through physiological changes when the period of abundant watery assimilation substances (vigorous growth) goes into a period of decreased growth.

In fact, with this conclusion, Strotchkova also submits bud differentiation (embryonic or physiologic) to the time (condition) of abated growth. According to our and other case studies the first growth impulse of the almond ends between May 15-25 (depending on meteorological factors), and the second at mid-June.

The second growth is observed only at terminal and rarely at some lateral twigs. The growth of May-flower spurs and the short flower twigs is very short and it ends at the beginning of May. As the potentially-generative nature of the May-spur buds is a generic character of the almond, an early beginning of embryonic stage (before the end of May spur-growth) may be accepted a priori. But no objective evidence is known.

The enlargement of almond fruits as well as that of peaches[10] continues to nearly the end of June[9] when the growth of semen (kernel) begins.

MATERIAL AND METHODS

We studied some features of the problem of rhythmics and the reciprocity of start and the enlarging of the fruit as well as bud differentiation under the conditions of the seaside areas of the Pomorie region. A number of cultivars, hybrid-elites and species were used considering the early blossoming ones (Avgustovski, Nessebar), late blossoming (Reams, Primorski, éliles 4-3 N, 11-6aN, the species *Amygdalus Kuramica* Korsh, *A. vavilovii* M. Pop., *A. bucharica* Korsh, spontaneous hybrid 9L, 3-6 (F_2 *Amygdalus* × *andarobii* Seraf.), *A. webii* (?) — an endemic of South Western Bulgaria, *A. ledebouriana* Schlecht and certain interspecious hybrids), *Persica mira* (Koehne) Kov. et Kost. and its hybrids with almond included.

Every other 5-6 days, starting from May 15, longitudinal cuts of 10 buds, taken similarly from 5 May-flower spurs and 5 flower shoots from the south side of the tree, are made. One of the cuts of the fruit which has the most developed phase of growth (of pericarp, endocarp and embryo) is stamped on millimeter paper. Both the weights of the fruit and the kernal are registered separately.

Parallel anathomomorphological study[8] of the buds gives information about the apical development up to formation of flower parts.

RESULTS AND INTERPRETATION

Because of the great number of elements observed and the great quantity of data received, we consider herewith only the more important part of it. Fig. 1 shows, under the 1976 conditions, and influence of the blossoming time on the time of growth of both fruit and semen.

The latest blossoming elite— 4-3N has the longest period of growth of pericarp (up to June 28) followed by Reams and elite 11-6aN. The fruit of mid-blossoming elite 16-4aN grows up to June 14 and that of relatively early-blossoming cultivar Avgustovski— up to June 4. The reciprocity is not the same with 91 3-6. This plant shows domination of the characters of *Amygdalus Spinosissima* Bunge: xerophity, late blooming, but very early fruit maturing -the fruit ripen by the end of July. This short period of growth to full maturity of the fruit correlates positively with the quick formation and growth of the semen.

Similar correlation is a feature of the cultivar Avgustovski, whose fruit mature the earliest of all cultivars (about 15-25 August) and breeding elites grown at our Research Station (over 6000). The semen of the other studied elites and that of Reams begin enlarging in the same sequence. So a visible growth of the semen of 4 —3N begins no earlier than June 25.

Fig. 2 presents data for a number of wild species and spontaneous hybrids, the cultivar Reams included, one wild peach and its hybrids with almond —for 1976 too. Evidently the majority of the taxons of g. *Amygdalus* also end the enlarging of pericarp by June 12-14 and the growth of the embryo begins at the same time. The semen of the nature hybrid *Amygdalus bucharica* { *A. communis* begins to grow a bit later. The formation of the semen of Persica mira and its hybrids with almond as well as the semen of *Amygdalus ledebouriana* and of Reams begins about 7-8 days later.

Greater difference is observed among years (shown at

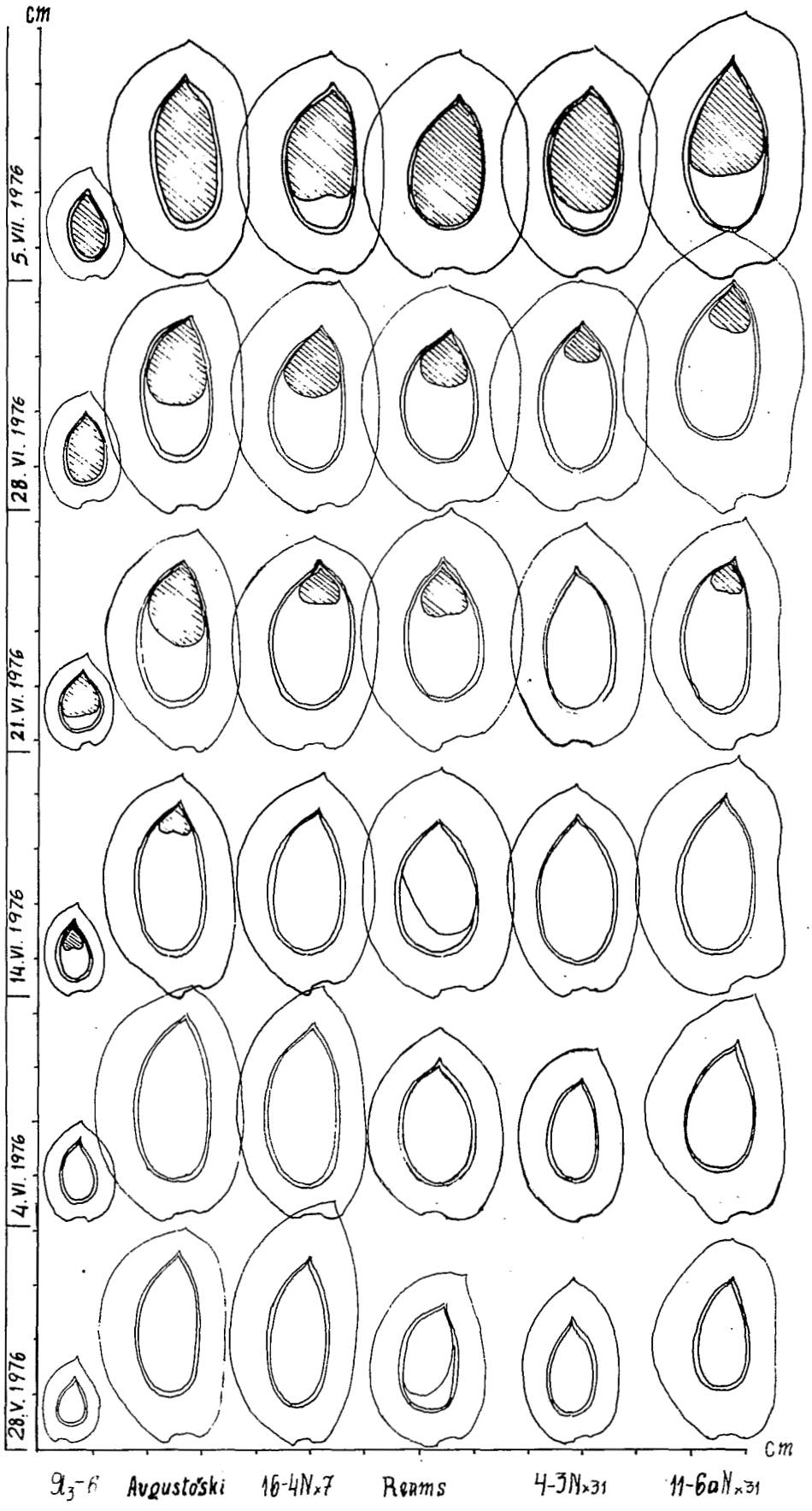


Fig. 1. Formation of semen of several almond cultivars and elites.

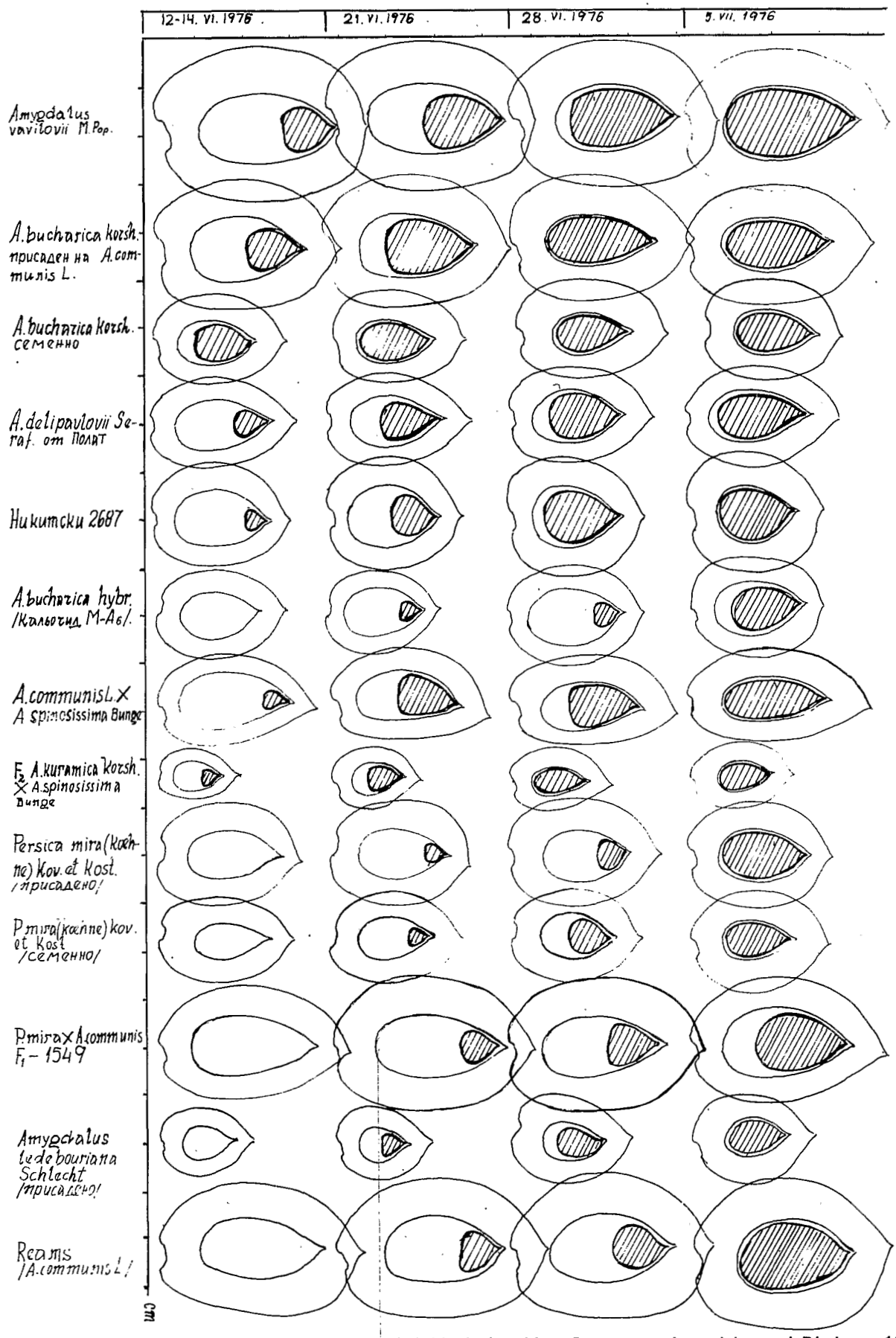


Fig. 2. Formation of semen of several species and hybrids, incl. cultivar Reams —g. Amygdalus and Pérsica.— 1976.

Fig. 3, with dat for 1963, 1964 and 1975). The enlarging of the fruit of Avgustovski and Primorski end entirely by about June 17. Reams shows some slower growth. The speed of the enlarging of the seeds is different not only in the relatively early in blossoming Avgustovski, but in the lateblossoming Reams also, While in 1963 and 1964 the growth coincides with the data for 1976, in 1975, we observe considerably earlier terms — by June 17 the semen of Avgustovski reached 4/5 of its full dimensions and Reams only 2/3.

The individual differences in the semen enlarging go to nearly same-time termination —by July 5-7. There are some plus-minus variations in terms of time in the group of the late-blossom cultivars (which are late-maturing too) and elites as well as at F_1-1549 *(Persica mira* × *Amygdalus communis)*. Only the semen enlarging of Avgustovski and of the hybrid $9l^{3\,6}$ end on June 28 and in 1975, on June 23.

According to the data obtained in the course of our investigations, which are not illustrated here, a quick hardening of the endocarp in the course of the last 10-12 days of the active growth of pericarp is proved. The growth of the embryo begins closely after this, as shown above.

Fig. 4 shows that the microscopically visible changes of buds in form and size begin soon after the end of the active growth of seed. By about July 10-11, the apex rises into cone. Sepal Primordium appears on August 5, 1974; August 11, 1976.

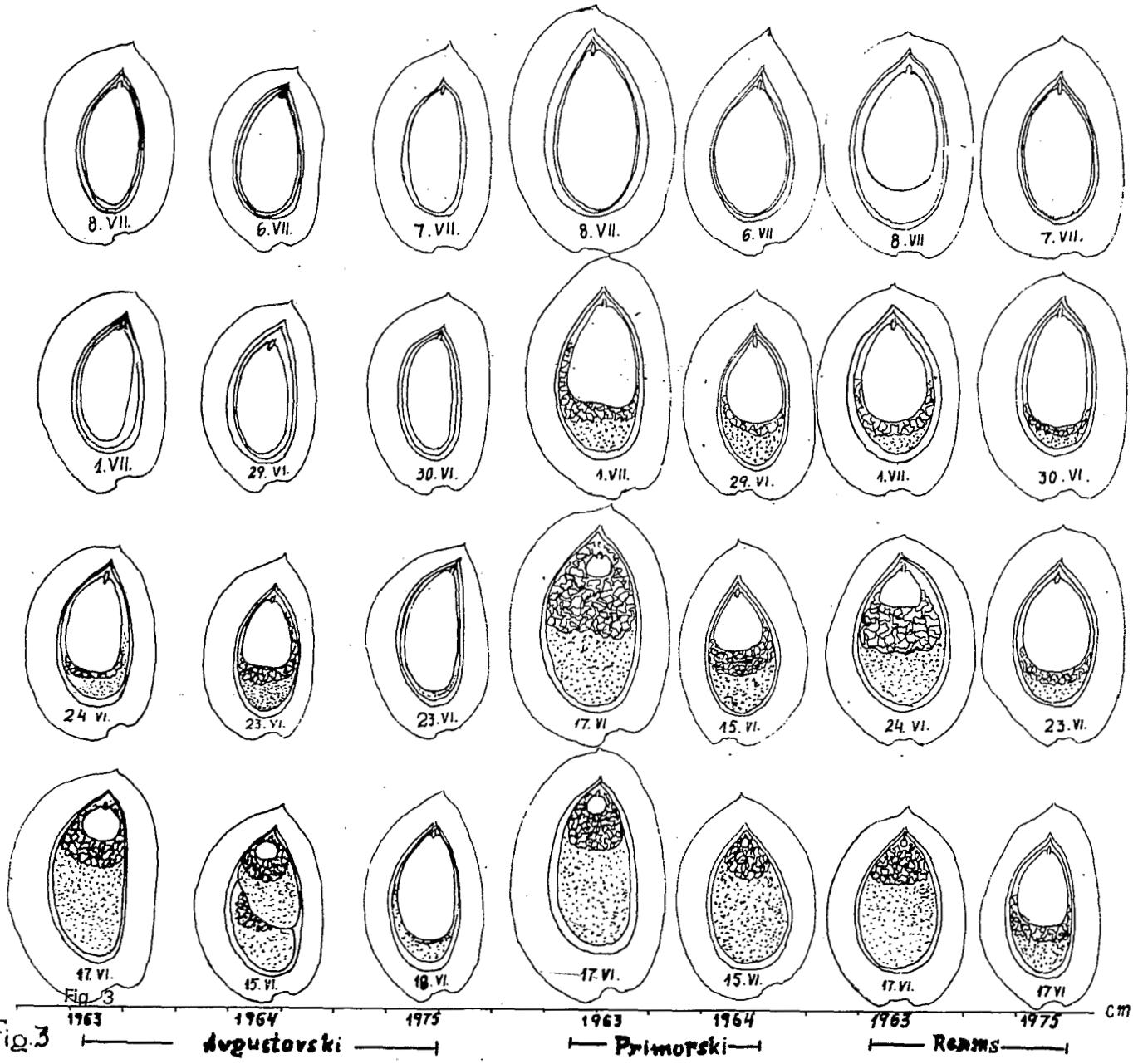


Fig. 3

We do not have to examine all the phases of bud formation and we should only show that the decisive phase (tetrads) of the winter dormancy for all cultivars and wild species ends in a short period - from December 10 to January 12. The earlier dates correspond to the earlyblosson cultivars and the later to the late-blossoming ones.

The data obtained do not confirm the a priori assertion[13] that the embryonic state of flower buds is seen in early May, even if this concerns the May-flower spurs. As Strotchkova (12) affirms, during the period when the most active vegetative growth is in action, the physiologic process eliminates any formation of potential inception of flower buds. In the course of this period buds develop at every leaf axil, the basic buds included, although their leaves are very small and short-livea (12). Through the whole period of active vegetative growth the buds seem the same anatomically and morphologically.

Some authors, (2, 14) show that the apex of leaf-initial buds have a 4-layer tunic, and the flower —initial ones have a 2-layer one but with equivalent body structure. However Brooks (2) affirms the need of further studies of this significant problem.

From an agronomic point of view, the studied rhythmics and reciprocity of enlarging and formation of fruit, semen and transition into functional changes in big number of buds are of great degree production importance. These fundamental processes coincide with considerable changes of meteorologic factors, which in the major almond regions are not so advantageous for simultaneous formation of high yield and high number of flower buds.

This concerns mainly the early summer, in particular June, when as a rule the summer drought begins. Objectively, this starts at first place in the slopy almond terrains. It is evident that this problem brings the necessity to plan and provide soil management and nutrition in terms of permitting more uniform spending of soil water stock as well as normal vegetative growth in May and June. This growth should end by mid-June in order to prevent the concurrence with the active growth of semen and with the decisive moment of bud changes —end of June and early July.

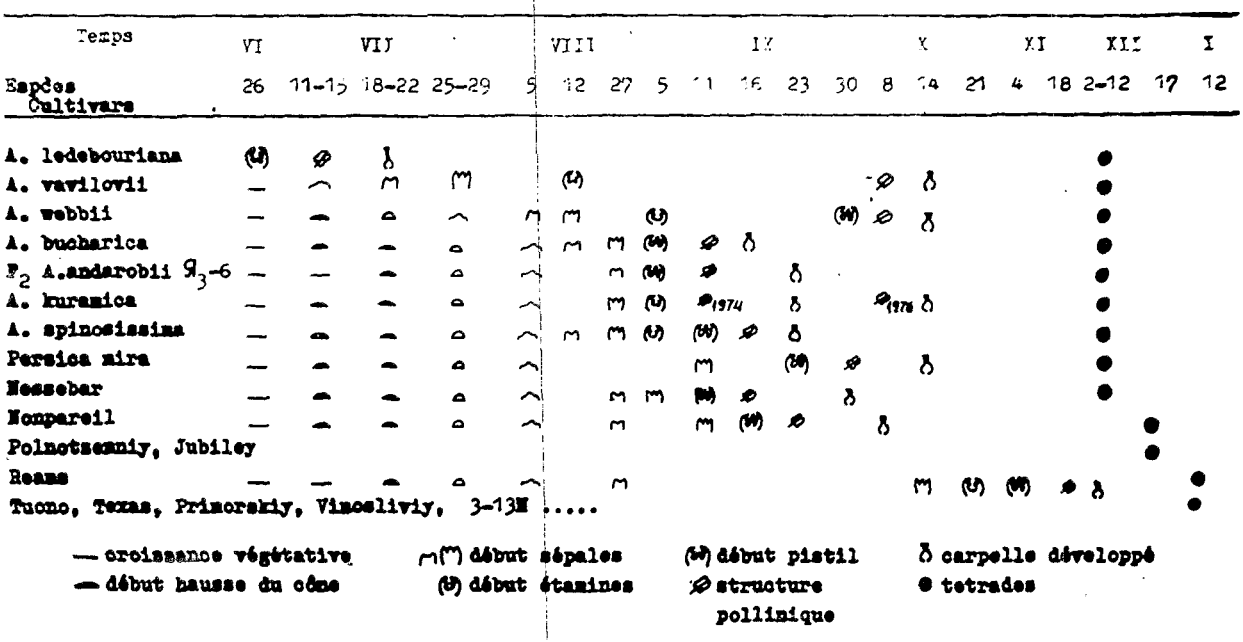
CONCLUSIONS

1. The growth period of almond pericarp and semen correlates to the terms of blossoming and maturing of fruit.

2. The enlarging of pericarp and semen ends by mid-June with some exceptions.

Fig. 4

Phases de différentiation des bourgeons de l'amandier (1974, 1975, 1976)



3. The vigorous development and shaping of semen begins immediately after the growth end of the pericarp (endocarp implied) and terminates by 5-7 July.

4. The microscopically visible beginning of bud differentiation relates to te end of the first decade of July.

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