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A study on the differentiation and the development of floral parts in grapes (Vitis vinifera L. var.)

by

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Introduction

Generative development in grape vines begins by fruit bud differentiation. Since MARTELLI (1892), MÜLLER-THURGAU (1892) and BEHRENS (1897) these differentiation stages were studied many times (BARNARD 1932, BARNARD and THOMAS 1933 and 1937, SNYDER 1933, WINKLER and SHEMSETTIN 1937, EGUCHI *et al.* 1952, BREVIGLIERI 1956, HUGLIN 1958, ALLEWELDT 1958, 1966, KHALIL 1961, RANIERI e SCARASCIA VENEZIAN 1964, MAY and ANTCLIFF 1964, RAJARAM 1964, MAY 1964, ALLEWELDT und BALKEMA 1965, DANIEL 1965, COSMO *et al.* 1966, NANAYA 1966, FIDAN 1966, LAVEE *et al.* 1967, ILTER 1968, AGAOGLU 1969 a, 1969 b and 1970, ALLEWELDT und ILTER 1969, ORAMAN and AGAOGLU 1970 a and 1970 b, MADHAVA RAO and MUKHERJEE 1970). Reports exist that the differentiation of floral parts initiated with budburst in spring, but this is contrary to the results of ALLEWELDT and his collaborators. They observed that the first calyx primordia appeared in the cluster primordia of the winter buds at the end of summer (ALLEWELDT und BALKEMA 1965, ALLEWELDT 1966, ILTER 1968, ALLEWELDT und ILTER 1969). The initiation of flower primordia continued during quiescence and dormancy of the buds, but was retarded in the cold season (compare also FIDAN 1966). The differentiation of the inflorescence is completed after budburst in the following spring.

Normally developed grape flowers have the following parts; pedicel, receptacle, calyx, corolla, stamen, pistil and nectary (DORSEY 1914, BABO und MACH 1923, PEROLD 1927, WINKLER 1962, ORAMAN 1965, 1970, FIDAN 1966, VOGT 1967, AGAOGLU 1969 a). They differentiate in the order named above.

As there is no report so far on differentiation and development of floral parts for any variety of grapes growing in Turkey, three cultivars of *Vitis vinifera* were examined under Ankara conditions, and the results are published in this paper.

Materials and Methods

Investigations were made between 1967 and 1968 with eight years old vines trained by goblet and planted 1,50 × 3,00 m in the vineyard of the Ankara Agricultural Research Institute. The materials were taken out of the *Vitis vinifera* varieties Hasandede, Kalecik karasi and Papaz karasi which were grafted on Chasselas × *V. berlandieri* 41 B rootstocks. Hasandede is one of the most important white grape varieties of Turkey and ripens in September under Ankara conditions, as does Kalecik karasi. The ripening time of Papaz karasi is the second half of October. The latter two varieties have purplish-black grapes.

For studying the ontogeny of floral parts, fruit buds and young inflorescences were collected in March 1967 at intervals of 3 days. Collections were continued until the buds burst. To observe the calyx development, the fruit bud collection began in August again. Materials were fixed in F.A.A. solution (JOHANSEN 1940) and then stored in 70% ethyl alcohol for a long time. After paraffin embedding, as ex-

plained by SASS (1951), longitudinal and transversal sections were taken by Spencer microtome (about 10μ thick) and then stained in 5% haematoxylin.

Results

The differentiation of the floral parts did not occur at the same time, due to variety. But in a variety, the flowers did not reach the same stage of development at one time. When there was more than one inflorescence on the same shoot, the differentiation took place first in the basal inflorescence. Also the flowers of an inflorescence near the pedicel primordia differentiated first, and differentiation gradually decreased towards the terminal points. The flowers did not bloom immediately after the differentiation was completed, because the temperature was too low at this time (AGAOGLU 1969 c). Resulting from low temperature in spring 1967 the complete development of flowers was retarded, and they were ready to bloom on June 6, 7 and 12 in Hasandede, Kalecik karasi and Papaz karasi varieties, respectively. But in 1968 it was May 20 in Hasandede and Kalecik karasi, and May 26 in Papaz karasi.

The differentiation of the organs of the flower begins with the calyx. In examining the cross sections one could easily recognize the calyx ring as symmetrical bubble on the flattened side of the mass of meristematic tissue of the flower primordia. The calyx was observed at the beginning of August in Hasandede and Kalecik karasi varieties, but only at the end of August or the beginning of September in Papaz karasi. The inflorescence primordia which continued their development in the bud up to the spring season showed appearance of new calyces, but no further organ differentiation was observed up to this time.

After dormancy and before leafing, the number of calyxes was increased. Then the corolla appeared. Before its development was completed, the stamen primordia were observed (Fig. 1). This took place before the buds burst. First filament and anther differentiation was noticed just after the petals interlocked (Fig. 2). Initiation of the pistil also happened at this time. It appeared as a mass of meristematic tissue. The primordia of the carpels formed just after the interlocking of the petals from the tip of this meristematic mass. The ovary, style and stigma differentiation was observed first during the complete appearance of the filaments (Fig. 3).

The number of carpels in the *Vitis vinifera* flower is 2, sometimes 3. Their margins form septa which do not subdivide the ovary entirely, but they are firmly united at the tip. Two ovules which are connected to the placenta with the funiculus arise in each carpel (Figs. 4—10). When ovule primordia were observed first, the egg cells were formed, and their development was completed when the egg cells matured. In Hasandede, Kalecik karasi and Papaz karasi, the inner integuments of the ovules were of normal length; so the abnormal elongation of inner integuments in the mature megasporangium (WINKLER 1962) was not observed in these three varieties. While there was differentiation of integuments in the carpels, the pollen was formed in the anthers (Figs. 4, 6, 9). So the anthers developed more rapidly than the carpels.

Discussion

As mentioned in the beginning, there is no other report about the differentiation and development of flower parts of grape varieties under Ankara conditions. So it will be convenient to compare the results of this study with the findings of investigations carried out in other countries. The observations on the development order of the flower organs were similar to the results of WINKLER and SHEMSETTIN


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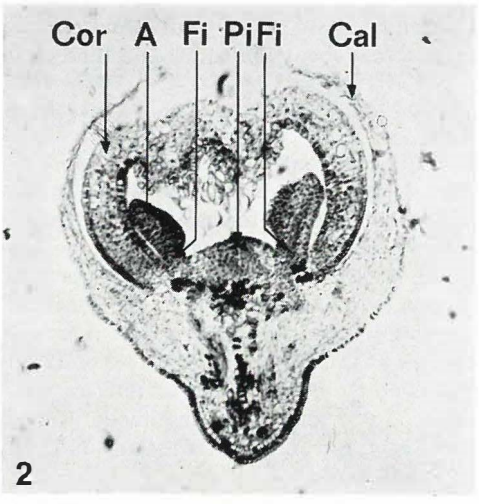
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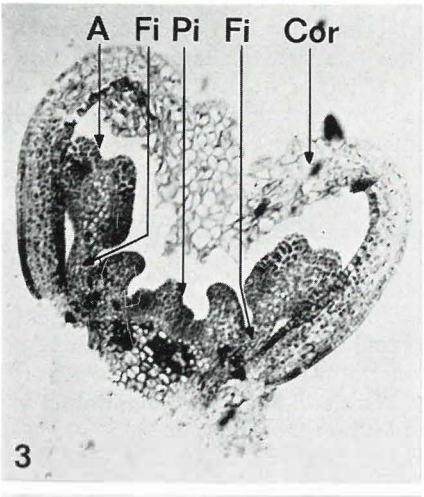
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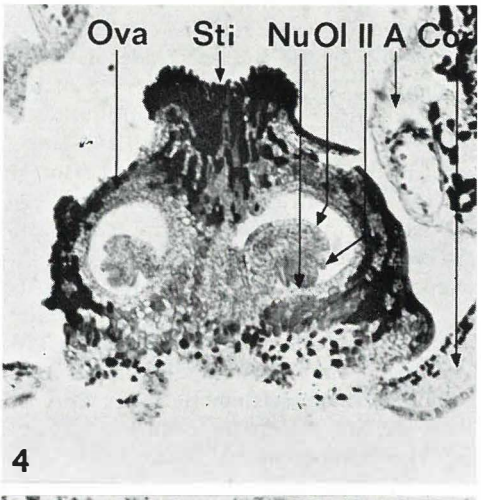
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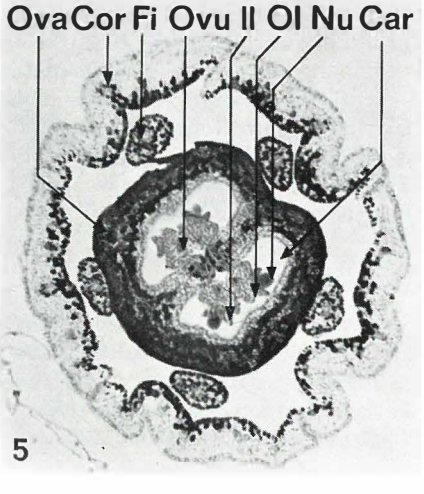
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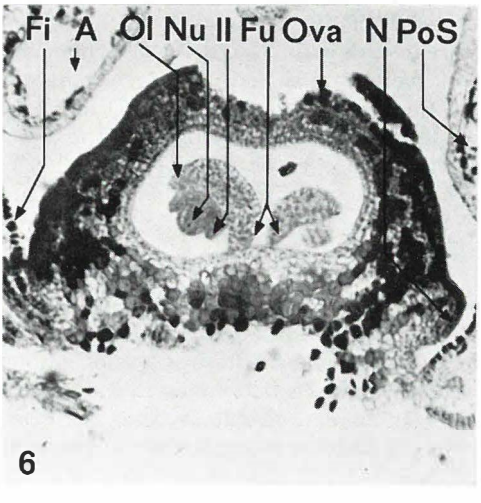
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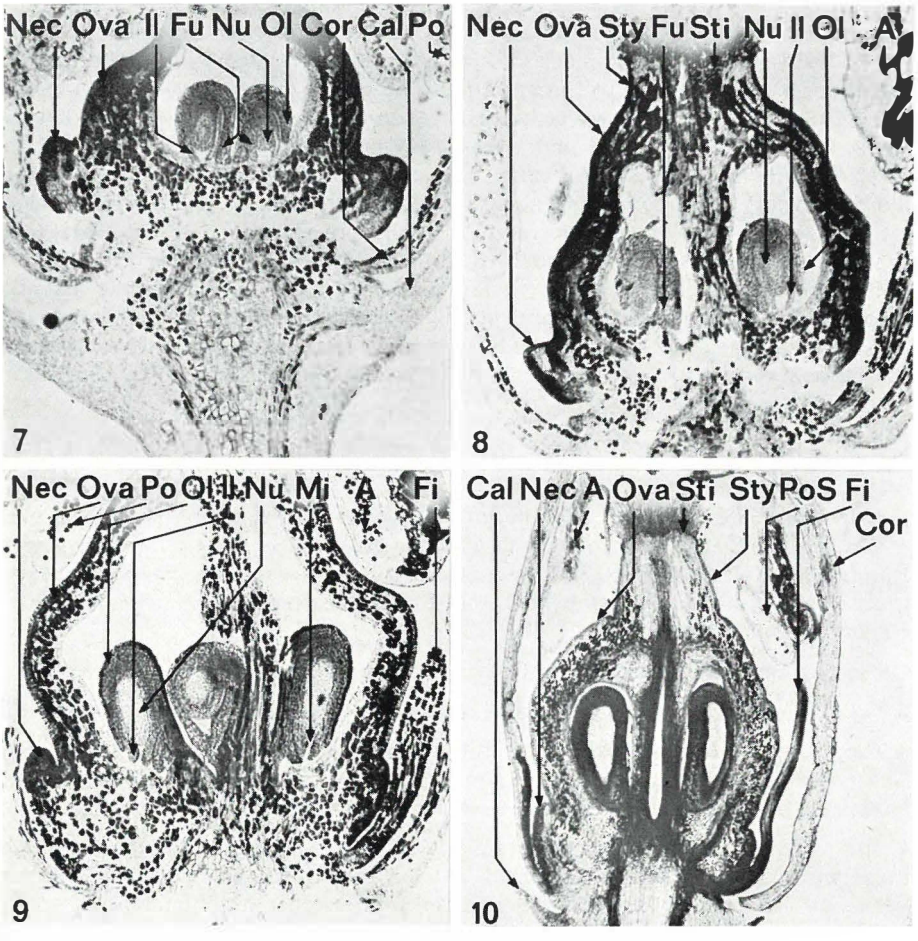

Fig. 1: Inflorescence with bracts, calyx, corolla and stamen primordia (Hasandede variety).
Fig. 2: First appearance of filaments (Hasandede variety).
Fig. 3: Clearly differentiated pistil (Kalecik karasi variety).
Fig. 4: Formation of ovules (Hasandede variety).
Fig. 5: Transversal section through a flower (Hasandede variety).
Fig. 6: Initiation of funiculus bending (Papaz karasi variety).
Figs. 7, 8: Advanced stages in developement of ovule (Papaz karasi variety).
Fig. 9: Appearence of carpels in a completely developed flower (Hasandede variety).
Fig. 10: Longitudinal section through completely developed flower (Papaz karasi variety).

Abbreviations:

anthers	A	outer integument	OI
bracts	B	ovary	Ova
calyx (sepals)	Cal	ovule	Ovu
carpel	Car	pistil	Pi
corolla (petals)	Cor	pollen	Po
filament	Fi	pollen sac	PoS
inner integument	II	stamen	Sta
micropyle	M	stigma	Sti
nectary	Nec	style	Sty
nucellus	Nu		

(1937), BREVIGLIERI (1956), WINKLER (1962), ALLEWELDT und BALKEMA (1965), FIDAN (1966), ALLEWELDT (1966), ILTER (1968), ALLEWELDT und ILTER (1969), MADHAVA RAO and MUKHERJEE (1970). The sepals, petals, stamens and pistil are differentiated in the order named. But there is a contrast about the initiation time of the calyx between the workers. Our results are similar to those reported by ALLEWELDT und BALKEMA (1965), ALLEWELDT (1966), ILTER (1968), ALLEWELDT und ILTER (1969), but different from those of all the other authors. In this study the calyx appeared in August and September, respectively. Contrary to BARNARD and THOMAS (1933), who reported a synchronous development for all flowers of an inflorescence, in the present study different stages of flower development were noticed in the same inflorescence at one time. This is similar to observations of MADHAVA RAO and MUKHERJEE (1970). All the essential organs (calyx, corolla, stamens and pistil) of the flower were formed within the 10—15 days of the appearance of the inflorescence after budburst. This result is also similar to MADHAVA RAO and MUKHERJEE (1970) but contrary to WINKLER and SHEMSETTIN (1937) and WINKLER (1962).

Summary

Investigations on differentiation and development of floral parts in *Vitis vinifera* were conducted in 1967 and 1968 under Ankara conditions. Materials were Hasandede, Kalecik karasi and Papaz karasi varieties, which were grafted on Chasselas × *V. berlandieri* 41 B M.G. rootstocks. The results obtained can be summarized as follows:

1. The differentiation time of floral parts is different in the three varieties.

2. Not all flowers of one inflorescence have the same stages of development.

3. The differentiation of floral parts initiated with the calyx in cluster primordia. The calyx can be noticed at the beginning of August in Hasandede and Kalecik karasi, at the end of August or the beginning of September in Papaz karasi.

4. The differentiation and development of the sepals (calyx), petals (corolla), stamens and pistil is in the order named. All the essential flower parts were formed within 10—15 days of the appearance of the inflorescence after budburst.

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