GROSS MORPHOLOGY AND DIFFERENTIATION OF BUDS OF THE FRENCH HYBRID GRAPE VARIETY SEIBEL 2653

by

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INTRODUCTION

During the past few years in the United States of America, there has been considerable interest evinced in the French hybrid grape varieties. The first of this large group of hybrids owes its origin to a pastry baker Eugene Cantossot living in the town of Aubenos, France. This amateur grape grower in 1880 obtained a seedling grape variety from an American Herman Jaegar of Neosho, Missouri who was also interested in grape breeding. Cantossot was greatly impressed by the robust nature of the vine and the relatively large sized fruit of the seedling Jaegar 70. He saved the seeds from the berries and gave them to two of his neighbours Georges Couderc and Albert Seibel. Couderc and Seibel began their selection and breeding work with the seedlings grown from the seeds given to them by Cantossot.

The primary object of this selection and hybridization had been to develop outstanding wine varieties which could flourish under varied climatic conditions. Further, these breeders had sought in their hybrids, resistance to both insects and diseases as well as adaptability to a wide range of soils. The Vitis vinifera or the Old World species and several American species furnished the parents for these hybrids. The hardiness, vigor and disease and phylloxera resistance of the American species were combined with the high quality fruit characteristics of V. vinifera. The efforts of these breeders followed by others led to the development of the present day French hybrid varieties.

The French hybrids vary in vine and fruit characters.

Generally, they are vigorous, hardy, precocious, productive and resistant to diseases. Their fruit vary in color, size and shape of cluster and berry, flesh characteristics, flavor and time of ripening. The presence of these and other valuable characteristics have more than justified their recent popularity. Some of these new hybrid varieties show considerable promise. A number of state experiment stations are testing and selecting the French hybrids to find those varieties best suited to their area. About one hundred French hybrids are being grown at the Kansas State College Horticultural Farm, Manhattan, Kansas. The realization of the potentialities of these new introductions can be judged from the ever increasing number of private nurseries and individual growers in Kansas and elsewhere who are specializing in propagating and testing the French hybrids. Some eastern wineries are also growing these varieties. There is also an increasing demand from private growers and commercial firms for more information on these hybrids.

Little has been done in studying the comparative morphology and anatomy of these hybrids. With special reference to bud formation and differentiation, no information was found to be available in the literature. Although some work has been reported on Concord and some other type grapes, much remains to be done in studying the inherent differences of the promising French hybrids in the transformation of vegetative apical meristem to reproductive meristem.

The flowering phase of reproductive growth is a relatively

transitory one and is stated by Meyer and Anderson (10) to be controlled predominantly by a hormonal mechanism rather than by nutritive conditions within the plant. However, it is generally conceded that some effects of the nutritional status of the plant are exerted even in this phase of growth. The carbohydrate and nitrogen metabolism in the vegetative and reproductive phase clearly indicates the necessity for an adequate supply of these foods at appropriate periods in the life of the plant.

The object of this research was to study the differences in the flower bud differentiation occurring in buds situated at different positions on the shoots arising from overwintering buds. This investigation was planned not only to reveal the exact period when the buds of the selected variety changes from the vegetative to the reproductive stage but also to compare the growth and development of the various buds. Specifically, this study was planned to determine:-

1. The gross morphology and the sequence of development of the axillary buds on the current years shoot.
2. The time at which fruit bud differentiation occurs in the variety Seibel 2653.

The practical importance of this investigation lies in the fact that on the determination of the exact period of flower bud differentiation will depend the judicious manipulation of various factors which are conducive to optimum development. Cultural operations such as irrigation, fertilization, cultivation, pruning and spraying might possibly be so timed or adjusted as to

affect the change over from the vegetative to the reproductive state of certain buds.

MATERIALS AND METHODS

The French hybrid grape variety Seibel 2653 was used in these studies. The berries of this variety are gold in color ripening in mid-season. The vines were growing at the Kansas State College Horticultural Farm near Manhattan. This variety received the same cultural treatments as the other vines. A cover crop of winter vetch was sown in August 1955 and disked under in the early part of May 1956. The soil was regularly disked throughout the summer months as a moisture conservation measure. The vines were pruned in February 1956.

Collection of Material.

With the break of dormancy, each of the over-wintered canes pruned in February 1956, gave rise to young shoots bearing leaves and inflorescences. In the axils of these leaves were situated the axillary buds (Plate I)[1]. These buds were numbered beginning at the base of the shoot and moving towards its apex. For this study, the axillary buds from the third, fifth and tenth nodes of the current year's shoot were collected at weekly intervals commencing June 25, 1956. The last collection was made on August 13, 1956 making a total of seven sets. Buds were collected

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1 All Plates in the Appendix

from the same positions on the shoots throughout the entire sampling period so that the development of the various buds in the different positions could be compared. The position of the buds and fruit bearing habit of this variety may be seen in Plate I.

Buds were severed from the shoots with a safety razor blade. Beginning just above the bud, an oblique downward cut was made at an acute angle meeting the first cut at its basal end. In this manner, a wedge of wood was removed with the bud, in order to facilitate handling of the bud.

Killing and Fixing.

The buds were immediately transferred into clean vials containing a two per cent solution of formaldehyde and taken to the laboratory. The next day the buds were transferred into a killing solution familiarly known as FAA(Formalin-Acetic acid-Alcohol) prepared according to Johansen (9) as follows:-

70% Ethyl alcohol	90cc
Glacial acetic acid	5cc
Formalin	5cc

The penetration of the reagents and the sectioning of the buds were greatly facilitated by pricking the buds carefully with a fine needle. The outer scales and excess basal portions of the bud were removed. The air bubbles in the buds were cleared by subjecting them to vacuum pressure of 25 inches of mercury for three hours. The buds were then immersed for three hours in a solution containing one part of ethyl alcohol to two parts of hydroflouric acid in order to dissolve the silica from the pu-

bescence of the buds. This treatment facilitated the sectioning and resulted in clear sections.

Dehydration.

The buds were run through a series of mixtures for specific periods of time. This schedule modified from Johansen's (9) was followed in dehydrating.

1.	In 50% alcohol	2 hours
2.	In 70% "	Overnight
3.	In 85%, 95% and 100% alcohol	1 hour each
4.	In 100% TBA(Tertiary butyl alcohol	2-3 hours
5.	In 100% fresh TBA	2-3 hours
6.	Another change to fresh TBA	Overnight
7.	In 50% paraffin and 50% TBA	1 hour
8.	In melted paraffin	2 hours
9.	In pure melted paraffin, twice for	2-3 hours
10.	Tissuemat (melting point 50-53°C)	2-3 hours
11.	Change to fresh tissuemat	Overnight
12.	Imbedding	Morning

Imbedding.

On the morning following dehydration, the buds were imbedded in tissuemat (melting point 50-53°C) in small paper trays. Immediately after pouring the contents into the tray, each of the buds were arranged carefully in correct positions with the help of a warm dissecting needle. This was done by placing the buds at right angles to the width of the tray. A correct imbedding position was found to be essential in order to get a longitudinal section through the center of the bud which was necessary to show the different stages of its development. After the proper alignment of the buds, the tray was floated on ice cold water so that the tissuemat solidified uniformly. The imbedded material was

labeled and kept in a refrigerator until required for sectioning.

Microtoming.

The imbedded material was cut carefully into rectangular blocks and mounted on wooden blocks 2 cm X 2 cm. Sections were cut with a rotary microtome at 12 microns thickness.

Staining Procedure.

The sections were mounted on slides smeared with Haupt's adhesive and flooded with water. A careful warming of the slide straightened out any crinkled ribbons. The following schedule also slightly modified from Johansen's (9) was followed in the staining procedure:-

1.	Xylol	4 minutes
2.	"	2 "
3.	Absolute alcohol	2 "
4.	95% alcohol	2 "
5.	70% alcohol	2 "
6.	1% Safranin in 50% alcohol	10-20 seconds
7.	Rinse in water	
8.	70% alcohol	30 seconds
9.	95% alcohol	30 seconds
10.	Absolute alcohol	less than 30 seconds
11.	Mixture of 40% absolute alcohol and 60% xylol-rinse	
12.	Fast green and clove oil	5-15 seconds
13.	Clear in clove oil(50%) + 25% absolute alcohol mixture	
14.	40% absolute alcohol + 60% xylol mixture	rinse
15.	Xylol	5 minutes at least
16.	Mount in balsam.	

REVIEW OF LITERATURE

As early as 1901, Goff (6) reported as a result of his

investigations of flower buds that embryo flowers were discernible in the grape bud during the previous season.

Dorsey (3) studied embryonic grape clusters in the buds before opening and suggested that each secondary division of the embryonic cluster occupied a position axillary to a bract.

The gross morphology of the grape bud was described by Gladwin(5). He referred to the group of two to five buds present at each node as an 'eye'. The eye as well as the individual buds that formed an eye were enclosed by scales. The eye consisted of a primary bud which was the principal fruit bearing organ, a secondary bud which produced very little or no fruit and the tertiary bud which developed into a vegetative shoot. Antcliff and Webster (1) stated that the accessory shoots arising as a result of the death of primary shoots or buds were very rarely fruitful.

From the anatomical stand point, Esau (4) stated that the floral meristem was usually found to be different in varying degrees from the vegetative meristem in the manner of its growth as well as in the differences in its cytological and histological characteristics. She cited Gregoire 1938, Foster 1939a and Philipson 1949 to substantiate her view. She stated that it appeared plausible to assume that the vegetative apex becomes reorganized more or less abruptly into the floral apex and that the two were merely different growth forms of the same meristems. The change could be detected by the changes in the growth pattern, shape of the apex and by the morphology of the lateral organs. She also cited Boke

1947; Lawalree 1948; Philipson 1947b, 1949; Reeve 1943; Satina and Blakeslee 1941 and Schessep 1942 who believed that the differences were not fundamental.

Holman and Robbin (8) categorically stated that there were two distinct points of difference in the primordia of foliage leaves and primordia of flower parts. The leaf primordia according to them were always produced on the sides of a growing point which continued to elongate at the tip. They suggested that the promeristem of the shoot could continue indefinitely to produce leaf primordia whereas the growing point of a developing flower does not continue to grow after the rudiments of flower parts had been formed as carpels at the main growing point. Further, in the development of the primordia of foliage leaves, those nearest the end of the growing point were always the smallest but this may not be true in the case of flower parts.

Hayward (7) tracing the floral ontogeny stated that the growing point of meristematic tissue first becomes rounded, signifying the beginning of the change.

Meyer and Anderson (10) indicated that the first visible change in the transformation of a vegetative into a reproductive meristem was in its configuration. They stated that the top of the growing point becomes flattened and small protuberances developed from this modified meristem in a regular spiral or whorled arrangement. The marked difference in the development of the two meristems according to them was that there was no elongation of the axis between successive floral primordia such as

usually occurs between successive leaf primordia.

Winkler and Shamsettin (15) working on Sultanina grape stated that cluster primordia began to be initiated during the first week of June and that they appeared as blunt, rather broad outgrowths of the growing point whereas the leaf primordia appeared as pointed outgrowths. They also stated that the cluster primordium was always opposite a leaf. They believed that there was unequal division of the growing apex to form the cluster and the leaf primordium and suggested that the cluster may be a lateral rather than a terminal initiation. Discussing the development of a primordial cluster they stated that division of the primordial cluster was first indicated by the appearance of bracts subtending the cluster branches. According to them, the first bracts were discernible a week to ten days after cluster initiation.

Snyder (13) working on Concord grape found that the initiation of the cluster primordia occurred in the buds of the young shoots and that the differentiation occurred during the first week of June and continued in the newly forming buds throughout the growing season. However, he stated that leaf and cluster primordia are alike in the initial stages but soon acquired different shapes, one becoming pointed which is characteristic of leaf primordia and the other obovate to form the cluster primordia. He also stated that while differentiation from leaf to cluster primordia was taking place, axillary buds were laid down in the axils of the previously formed primordial leaves. Describing the development of primordial cluster, he stated that the growing

point flattened as a result of extensive cell division near one side of the bud axis and that this was the first suggestion of cluster initiation. He stated that a week after this initiation, the cluster bore a bract immediately after which the main part of the cluster underwent rapid sub-division forming secondary and tertiary clusters.

Bradley (2) found that buds of the Concord grape at Manhattan, Kansas collected between the last week of June and last week of July showed the first stages of floral development. He stated that leaf and flower primordia at their initiation are formed from the same kind of tissue and early in their development it was difficult to distinguish one from the other. He found that opposite each inflorescence there was a leaf and that the first two nodes did not produce inflorescences. According to him, the axillary bud was formed about the middle of June shortly before the primordia for the following year's crop were initiated. He stated that there was very little difference in the stage of differentiation observed among the buds located between the second and twelfth nodes on a cane.

Working on the same variety in Michigan, Partridge (11) placed the time of flower bud initiation at midsummer.

Perold (12) quoting from Müller-Thurgen, pointed out that in Europe as a rule the first cluster is initiated about the middle of June, the second cluster about the first of July and that no further initiation occured in the buds after the beginning of August.

Factors which are believed to influence differentiation, may

include the inherent genetic character of the species or variety, environmental aspects such as soil and climate and cultural operations including cultivation, fertilization, pruning and spraying.

Esau (4) stated that the change from the vegetative to reproductive state is not irreversible and may be interrupted or prevented by subjecting the plant to influences that favor vegetative growth.

Bradley (2) stated that the fertility and balance of nutrients in a vineyard soil should be such as to produce medium cane growth at the time of bud differentiation.

Winkler (14) working on Muscat of Alexandria and Molinera stated that the position of the bud does not influence the development of clusters of Muscat and Molinera and that the improvement in the fruiting was the result of better nutrition of the flower parts at and just prior to blooming.

OBSERVATIONS AND RESULTS

The Bud.

With the break of dormancy, young shoots bearing leaves and inflorescences emerged from the over-wintered canes. These young shoots are referred to as the current year's shoots in this study. The buds located in the axils of these leaves are shown in Plate I. The buds are numbered beginning at the base of the shoot and moving towards its apex. For this study, the axillary buds at the third, fifth and tenth nodes on the current year's

shoot were collected at weekly intervals commencing June 25, 1956.

Examination, with the aid of a microscope, of longitudinal sections of early formed axillary buds showed each of them to possess a main conical growing point made up of small closely developed apical meristems (Plate V). Further examination of the buds revealed that flanked on either side of this main growing axis were similar but smaller growing points ranging in number from two to three. The one described earlier which was more or less centrally situated was bigger and structurally more advanced than the others. This was found to be the primary bud (Plate II). The buds found to be progressively less developed are referred to as the secondary, tertiary and quaternary buds respectively. All these buds were always enclosed by thick, hard scales full of pubescent hair providing protection to the tender growing point (Plate II). These scales developed on the sides of the growing apex before the initiation of leaf and cluster primordia and so were situated at its basal end. These scales were as large as the leaf primordia or sometimes even larger. A set of two to four buds were found to be completely enclosed in layers of scales, thus forming a compound bud or an 'eye'.

As the apical meristem of each primary bud developed, its configuration was noted to change. The growing point began to develop unevenly. The cells on one side of the point divided resulting in a pointed protuberance. This was the beginning or initiation of a leaf primordium. A longitudinal section through leaf primordia is shown in Plate III. In the initial stages, two

to four leaf primordia developed alternately from either side of the apical meristem devoid of any cluster primordia. It was only at a later stage when the first two or three leaf primordia were already formed that the first sign of cluster initiation was visible. The growing point appeared to become bilobed. These were distinguishable as either a leaf or cluster primordium by the fact that the former was narrow and pointed whereas the latter was broad and blunt. The remaining lobe continued to be the growing point. These differences were evident even in the very early stage of their development. (Plate III). The division of the growing apex was not equal. The cluster and leaf primordia appeared to be initiated on either side of the apex and hence may be said to have initiated laterally rather than terminally. Thus the lateral differentiation of the apex resulted in the development of leaf primordia and cluster primordia opposite each other on the sides of the growing axis (Plate III). As leaf and cluster primordia developed, axillary buds were laid down in the axils of the leaf primordia (Plate III). The largest leaf primordia were found at the base and the progressively smaller ones towards the apex with the smallest ones at the tip. Buds are shown in the axil of each leaf and the progressively smaller sized leaves towards the growing end of the shoot can be noted in Plate I.

The Cluster.

The cluster primordium was found to develop as a shoulder near one side of the growing axis as a lateral protuberance (Plate VII). This was the primary cluster. Short and pointed bract

were found to develop at the basal end of the cluster (Plate IX). About this time, it was noted that the cluster primordium began to develop successive lobes. These lobes were the secondary, tertiary and quaternary clusters (not to be confused with the buds) according to their stage of development. This situation is well illustrated in Plate IV. Each division of the cluster was subtended by a bract.

Sequence of Development of the Bud.

In order to show representative development the sequence of differentiation of buds at given positions throughout the season were compared.

Although the soil and vines were fairly uniform, there was some variation in the size and length of individual canes on each vine. These variations in cane size were reflected in the differences in size of the primordial leaf and cluster.

As stated earlier, the third, fifth and tenth buds in the leaf axils of the current year's shoot were collected (Plate I). The buds were numbered beginning at the base of the shoot and moving towards its apex. For the purpose of determining the progressive development and differentiation of a bud at a given position, photomicrographs were made of the buds collected at weekly intervals from the fifth node beginning the third week of June and continuing through the middle of August. Examination of longitudinal sections of buds collected at the fifth node on June 25, revealed that four to five bud scales had developed. The

apical meristem had flattened and a leaf primordium had been initiated but there was still no sign of any cluster initiation (Plate V).

The initiation of a cluster primordium was clearly visible as a blunt protuberance in the form of a raised shoulder in the bud collected on June 30 (Plate VII). The development of a tertiary bud was also noticed.

The bract subtending the cluster primordium was discernible on July 6, seven days after the initiation of the cluster primordium was first observed, suggesting rapid development (Plate IX). The cluster primordium was found to be situated opposite the third leaf primordium and the development of the first axillary bud in the axil of the first leaf primordium was also evident at this time (Plate IX).

The growing apex began to show the initiation of another cluster primordium and two leaf primordia on July 14. The two types of primordia could be clearly distinguished from each other as the cluster primordia were blunt protuberances while the leaf primordia were pointed (Plate XI). Axillary buds were present in the three early developed leaf primordia. The early stages of a quaternary bud was also observed at this time.

By July 20, the cluster primordium had divided considerably giving it a branched appearance. This was the beginning of the development of secondary clusters as branches on the lateral surface of the primary cluster. At this stage, a bract was present at the base of each of the three secondary clusters (Plate XII).

Sections through buds collected on July 27, showed the beginning of further division of the first cluster primordium into three more secondary clusters and further development of the second cluster primordium. The leaf primordia and the buds in their axils were in a more advanced stage of development as evidenced by the increase in their number and size (Plate XIV).

The final collection made on August 13, 1956 showed that the first cluster primordium continued to branch, resulting finally in six well lobed secondary clusters, each subtended by a bract. The initiation of more leaf and cluster primordia was evident from the fact that blunt and pointed protuberances continued to develop from the growing apex (Plate XV).

Photomicrographs of longitudinal sections through buds collected from the third and tenth nodes were studied to compare the stage of development of the cluster primordia of these buds with the primordia observed in the buds from the fifth node collected on the same dates.

A comparison of Plates VI and VII showed that the bud at the third node was in a more advanced stage of development than the bud at the fifth node both with regard to the number of leaf primordia as well as the size of cluster primordia. The lower bud on the shoot appeared to have developed earlier.

Similarly, a comparative study of the buds at the third, fifth and tenth nodes collected July6, confirmed the previous observations that differentiation of the buds occurred progressively later from the base toward the apex of the shoot (Plates VIII, IX and X).

The tenth buds which were the terminal buds collected, were latest in development in all respects. The buds located on the basal part of the shoot at the third node developed before those at the fifth node, apparently due to their earlier formation. The buds collected at the tenth node were showing first signs of cluster initiation when buds at the fifth node had well developed cluster primordia subtended by bracts. Bud from the third nodes at this time had cluster primordia showing visible signs of branching into secondary clusters.

The buds from the fifth node collected on June 30 (Plate VII) and the buds from the tenth node collected a week later on July 6 (Plate VIII) appeared to be in the same stage of development, both showing the first signs of cluster initiation. This progressive development from the base toward the tip for each position of the bud was observed throughout the entire collection period.

A study of the buds collected from the various positions on the shoot revealed that the number of differentiated buds increased as the season proceeded as evidenced by the appearance of more initials of cluster and leaf primorida.

It was also of interest to note that the buds did not initiate the first cluster primordium till the leaves subtending the buds had ceased to increase in size. These observations tend to indicate that the stage of maturity of the leaf subtending the axillary bud may have an influence on the time of differentiation.

The first cluster primordia appeared after the basal, first

and second leaf primordia as well as the first few bud scales were formed on the primary bud (Plate VI). Moreover, the first axillary bud was observed in the basal leaf primordium only after two more leaf primordia were formed (Plate IX).

Buds collected from the third, fifth and tenth nodes on June 25, did not show any sign of differentiation. The first signs of cluster initiation was observed in the buds at the third and the fifth node on June 30 (Plate VI and VII). All the buds at the third, fifth and tenth nodes had differentiated on July 6 (Plates VII, IX and X). As stated previously, it was observed that the buds differentiated progressively from the base toward the tip of the shoot and also chronologically. Hence, it is safe to assume that the first cluster initiation in the French hybrid grape variety Seibel 2653 took place in the buds at the third and fifth nodes sometime during the last week of June 1956.

Moreover, it was observed that at least two cluster primordia were initiated during the period of this study in buds collected from the third, fifth and tenth nodes and that the differentiation of these buds began with the development of the third leaf primordium in each bud.

SUMMARY AND CONCLUSIONS

The gross morphology and sequence of development of the axillary buds of the French hybrid grape variety Seibel 2653 growing in the field was studied. Determinations of the time at which fruit bud differentiation occurred in this variety were

also made.

For this purpose, axillary buds from the third, fifth and tenth nodes were collected at weekly intervals commencing June 25, 1956. The last collection of buds was made on August 13, 1956 making a total of seven sets of buds representing seven weeks' development. The buds were numbered beginning at the base of the shoot and moving towards its apex. Photomicrographs of the longitudinal sections of the buds collected at the fifth node were made at weekly intervals. Some sections were prepared from the buds collected from the third and tenth nodes.

The buds were severed from the axils with a safety razor blade and placed in a formalin-acetic acid-alcohol killing solution. A modified form of the paraffin method of infiltration as recommended by Johansen (9) was followed. Buds were pricked with a fine needle and subjected to vacuum pressure which facilitated proper penetration of the reagents. Hydroflouric acid was used effectively to dissolve the silica in the pubescence. After dehydration with tertiary butyl alcohol, the material was imbedded in tissuemat and mounted on wooden blocks. Sections were cut with a rotary microtome at a thickness of 12 microns. Safranin and fast green were used in the staining process and the sections were mounted in balsam.

The axillary bud of the grape was found to consist of a main growing axis which was structurally more advanced than similar but smaller growing points flanking it. The main growing axis was the primary bud and the progressively less developed ones

are referred to as secondary, tertiary and quaternary buds. All these buds were found to be enclosed by three to four scales providing protection to the tender growing points. The axillary bud of a grape is thus a compound bud or an 'eye'.

Examination of the longitudinal section of the primary bud under the microscope revealed that it was enclosed in two to four layers of pubescent scales. In the initiation of the buds, scales were noted to be formed before the leaf primordia.

After the formation of two to four scales, the leaf primordia were initiated and developed alternately as pointed protuberances on either side of the apical meristem. The largest leaf primordia were found at the base and the progressively smaller ones toward the apex.

The initiation of the first cluster primordium as broad and blunt outgrowths was the next stage observed in the development of the bud. The initiation of the first cluster primordium appeared to be delayed until the first three leaf primordia had developed. The cluster primordia were always found opposite leaf primordium. The leaf primordia were narrow and pointed thus readily distinguishable from the broad and blunt cluster primordia. Their initiation at the growing apex appeared to be lateral rather than terminal.

The first bract subtending the primordial cluster was observed on July 6, a week after the initiation of the cluster. The cluster primordium showed signs of branching into secondary clusters on this date; the first axillary bud was also observed.

By July 14, the apical meristem had initiated another cluster primordium and two more leaf primordia. Two more axillary buds and a quaternary bud had also developed.

The first cluster primordium showed rapid division of its lateral surface resulting in three secondary clusters, each subtended by a bract on July 20. The buds had developed three more secondary clusters making a total of six secondary clusters present on July 27. By August 13, the secondary clusters were more pronounced and initiation of more leaf and cluster primordia had been accomplished.

A comparison of the development of the buds at the third, fifth and tenth nodes on the same shoot on a given date as well as at weekly intervals showed that the morphological development was progressively more advanced from the base toward the tip. The number of differentiated buds increased as the season proceeded.

Buds collected from the third, fifth and tenth nodes on June 25 did not show any differentiation. The first cluster initiation was observed in the buds from the third and the fifth nodes on June 30. The buds collected from the tenth nodes had differentiated on July 6. It was observed that the buds differentiated progressively from the base toward the tip of the shoot and also chronologically.

The first cluster primordium did not develop until after the basal as well as the first and second leaf primordia and the first few bud scales were formed.

The initiation and development of the axillary bud appeared to be related to the stage of maturity of the primordial leaf subtending it. Differentiation of the buds did not occur until the adjacent leaves had nearly reached their full size.

The initiation and differentiation of the leaf and the cluster primordia appeared to occur in the same type of meristematic cells at the growing apex. The buds in all the three positions studied at the third, fifth and tenth nodes, were all found to be fruitful in view of the presence of one or more cluster primordia.

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APPENDIX

EXPLANATION OF PLATE I

Current year's growth showing relative positions of inflorescences, leaves and buds. 1956.

a. Cane
b. Current year's shoot
c. Axillary buds

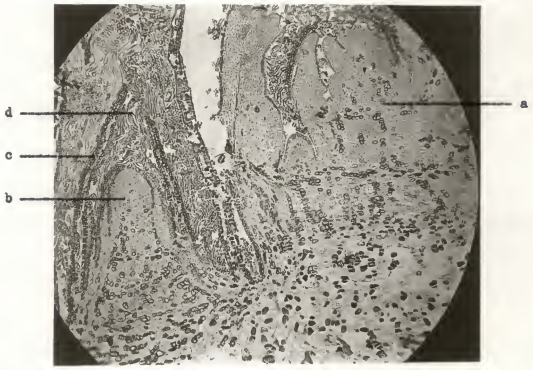
Plate I

EXPLANATION OF PLATE II

Longitudinal section through a bud at the fifth node collected August 13, 1956. X 120

a. Primary bud
b. Secondary bud
c. Scales
d. Pubescent hair

Plate II

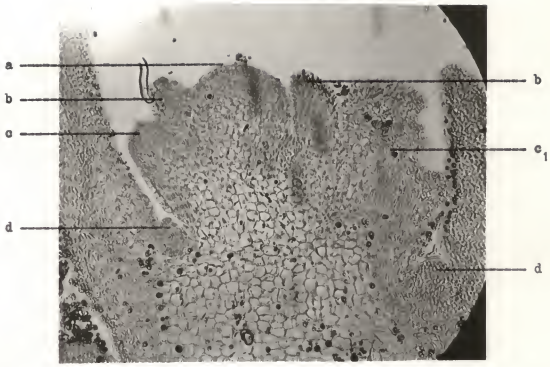


EXPLANATION OF PLATE III

Longitudinal section through a bud from the fifth node collected July 14, 1956. X 224

a. Growing point apical meristem
b. Leaf primordia - lateral initiation
c. Cluster primordia initiation
c_1 Cluster primordia in an advanced stage (slightly damaged in sectioning)
d. Axillary buds in the axils of leaf primordia

Plate III

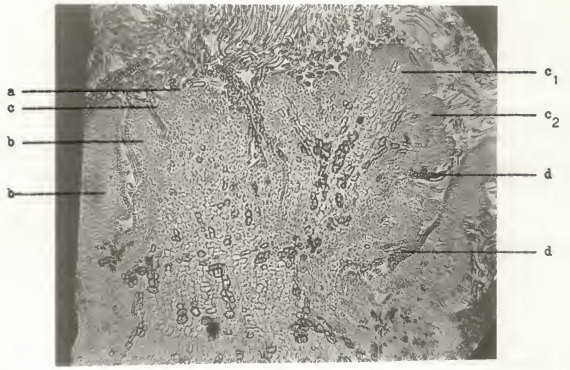


EXPLANATION OF PLATE IV

Longitudinal section through bud at the fifth node collected August 13, 1956.
X 120

a. Apical growing point
b. Leaf primordia
c. Cluster primordia
c_1 Primary cluster
c_2 Secondary clusters
d. Scales subtending secondary clusters

Plate IV

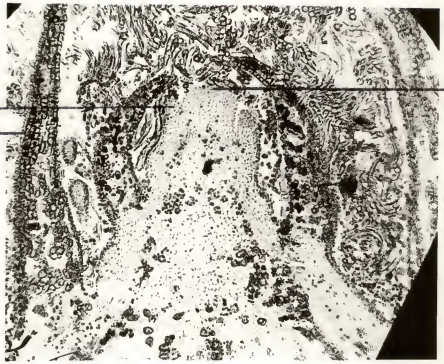


EXPLANATION OF PLATE V

Longitudinal section through bud at fifth node collected June 25, 1956. X 64

a. Apical meristem
b. Leaf primordium
c. Bud scale

Plate V

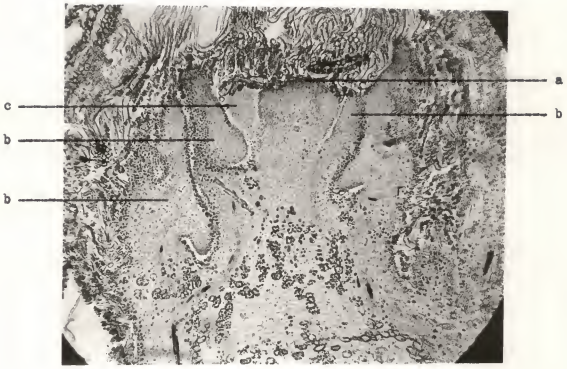


EXPLANATION OF PLATE VI

Longitudinal section through bud at third node collected June 30, 1956. X 64

a. Apical meristem
b. Leaf primordia
c. Cluster primordia - more advanced.

Plate VI

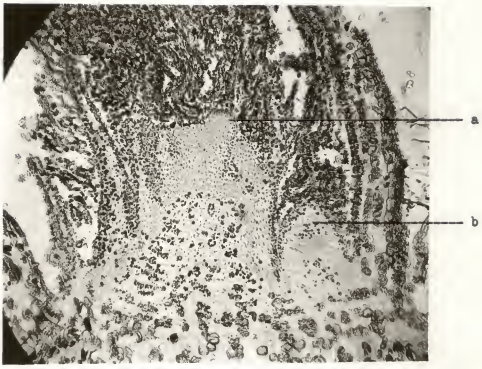


EXPLANATION OF PLATE VII

Longitudinal section through bud at fifth node collected June 30, 1956. X 64

a. Initiation of cluster primordium seen as a blunt protuberance.
b. Tertiary bud initiation

Plate VII

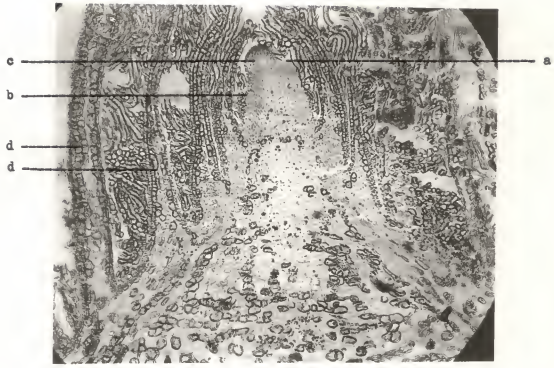


EXPLANATION OF PLATE VIII

Longitudinal section through bud at the tenth node collected July 6, 1956. X 64

a. Apical meristem
b. Leaf primordium
c. Cluster primordium
d. Scales

Plate VIII

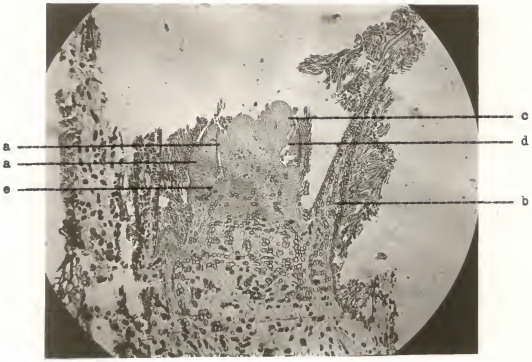


EXPLANATION OF PLATE IX

Longitudinal section through bud at the fifth node collected July 6, 1956. X 64

a. Leaf primordia
b. Scale
c. Cluster primordia opposite the third leaf primordium
d. First signs of bract
e. Axillary bud in the axil of a leaf primordium

Plate IX

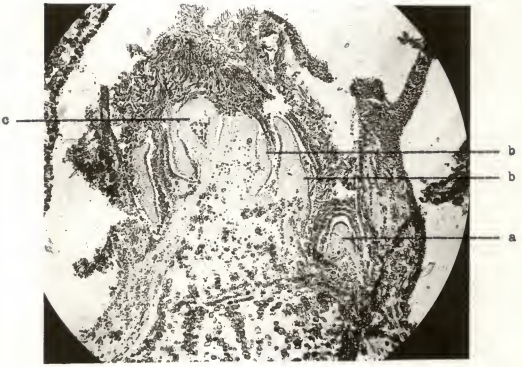


EXPLANATION OF PLATE X

Longitudinal section through bud at the third node collected July 6, 1956. X 64

a. Tertiary bud
b. Leaf primordia
c. Cluster primordia

Plate X

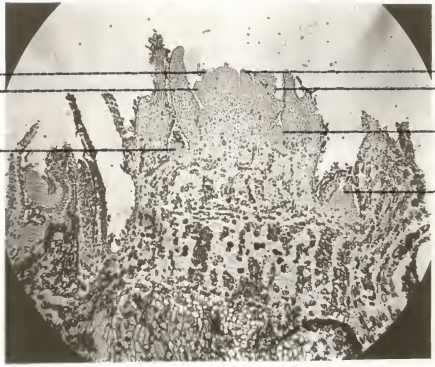


EXPLANATION OF PLATE XI

Longitudinal section through bud at the fifth node collected July 14, 1956. X 64

a. Axillary bud
b. Initials of leaf primordia
c. Initials of cluster primordia
c_1 Cluster primordium
d. Quaternary bud

Plate XI

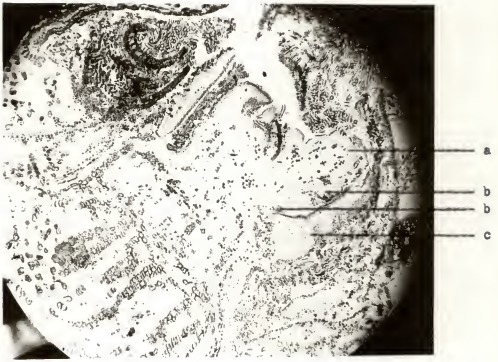


EXPLANATION OF PLATE XII

Longitudinal section through bud at the fifth node collected July 20, 1956. X 64

a. Primary cluster branching into secondary clusters
b. Bract subtending each secondary cluster
c. Leaf primordia

Plate XII

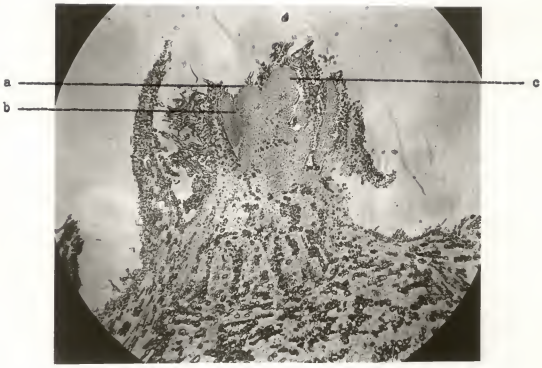


EXPLANATION OF PLATE XIII

Longitudinal section through bud at the third node collected July 20, 1956. X 64

a. Growing apex
b. Leaf primordia
c. Cluster primordium not yet branched into secondary clusters

Plate XIII

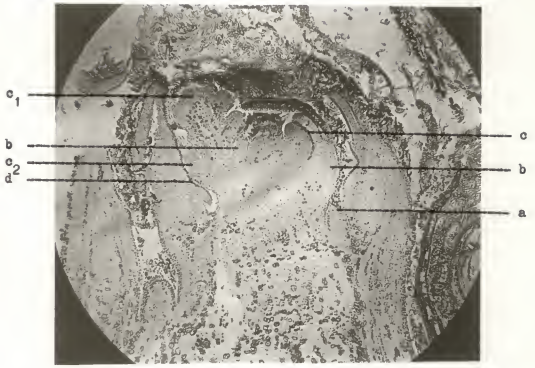


EXPLANATION OF PLATE XIV

Longitudinal section through bud collected at the fifth node collected July 27, 1956. X 120

a. Axillary bud
b. Leaf primordia
c. Cluster primordia
c_1 Primary cluster
c_2 Secondary cluster
d. Bract

Plate XIV

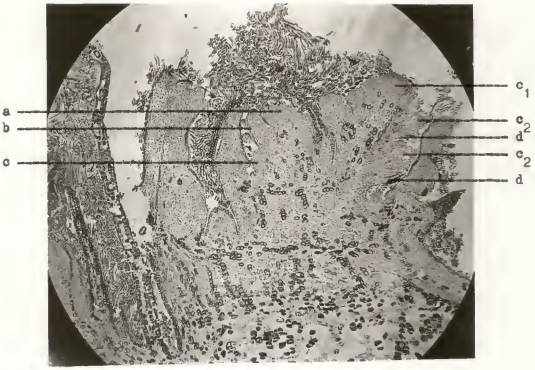


EXPLANATION OF PLATE XV

Longitudinal section through bud at the fifth node collected August 13, 1956. X 120

a. Growing point
b. Leaf primordium
c. Cluster primordium
c_1 Primary cluster
c_2 Branches on the cluster primordium
d. Bract subtending each branch primordium

Plate XV

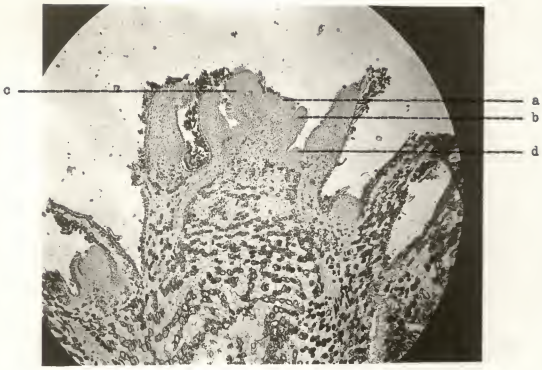


EXPLANATION OF PLATE XVI

Longitudinal section through bud at the tenth node collected August 13, 1956. X 64

a. Growing apex
b. Leaf primordia
c. Cluster primordia
d. Axillary bud

Plate XVI



GROSS MORPHOLOGY AND DIFFERENTIATION OF BUDS OF THE FRENCH HYBRID GRAPE VARIETY SEIBEL 2653

by

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B. Sc. Ag., University of Madras, India, 1942

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

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MASTER OF SCIENCE

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OF AGRICULTURE AND APPLIED SCIENCE

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ABSTRACT

During the past few years in this country, there has been considerable interest evinced in the French hybrid grape varieties. These hybrids were developed by combining the hardiness, vigor, disease and phylloxera resistance of the American species with the high quality fruit characteristics of the Vitis vinifera varieties. No information was available in the literature with regard to bud formation and differentiation of these hybrids.

This study was planned to determine the gross morphology and the sequence of development of the axillary buds on the current year's shoot and the time at which fruit bud differentiation occurs in the variety Seibel 2653.

The practical importance of this investigation lies in the fact that on the determination of the exact period of flower bud differentiation will depend the judicious manipulation of cultural operations which are conducive to optimum development of the vine.

For this purpose, axillary buds at the third, fifth and tenth nodes on the current year's shoot were collected at weekly intervals from June 25 to August 13, 1956. The buds were numbered beginning at the base of the shoot and moving towards its apex. Longitudinal sections of the buds were made following the procedure recommended by Johansen (9) with slight modification. Photomicrographs of the sections were taken.

Examination of the longitudinal section of the axillary bud under the microscope revealed that it consisted of two to four buds. The centrally situated one being structurally more

advanced is called the primary bud. The progressively less developed ones are referred to as secondary, tertiary and quaternary buds.

The main growing axis of the primary bud was found to be enclosed by two to four layers of pubescent scales. In the developing buds, initiation of the scales were noted to be formed first. After three leaf primordia had developed alternately the first cluster initiation was observed. The two types of primordia could be clearly distinguished from each other as the cluster primordia were broad and blunt protuberances while the leaf primordia were pointed. The cluster primordium was always found in a leaf opposed position. Leaf and cluster primordia were initiated in the main growing axis laterally rather than terminally.

The first sign of cluster initiation was observed in the buds at the third and fifth nodes on June 30. The first bract subtending the primordial cluster was noted on July 6. A second cluster primordia was initiated on July 14. By August 13, the first cluster primordium had divided into six secondary clusters each subtended by a bract.

A comparison of the development of the buds at the third, fifth and tenth nodes on the same shoot on a given date as well as at weekly intervals showed that the buds differentiated progressively from the base toward the tip and also chronologically. Differentiation did not occur until the adjacent leaves subtending the buds had nearly reached their maturity.

The first cluster primordium did not develop until after the basal as well as the first and second leaf primordia and the first few bud scales were formed. The buds in all the three positions studied at the third, fifth and tenth nodes were found to be fruitful in view of the presence of one or more cluster primordia. The number of differentiated buds increased as the season proceeded. The initiation and differentiation of the leaf and cluster primordia appeared to occur in the same type of meristematic cells at the growing apex.