Horticulture Research Journal, 3 (7)76 : 90 , September 2025, ISSN 2974/4474

# Determine Timing and Differentiation Stages of Grapevine Buds (*Vitis vinifera*, L.) cv. Superior Seedless

**Nesma M. Alam El-Deen[1] A.T. Salem[1], M.A. Abdel-Mohsen[1] and A. Sabbour[2]**
[1]Department of Pomology, Faculty of Agriculture, Cairo University, Giza, Egypt
[2]Department of Botany, Faculty of Agriculture, Cairo University, Giza, Egypt

## ABSTRACT

This experiment was conducted during 2018, 2019 and 2020 seasons to determine the timing of the differentiation stages of grapevine cv. Superior Seedless planted in a commercial vineyard Alexandria Road, Giza, Egypt, by defining the developmental phase of initiation and differentiation relative to the time of year and the phenological stages through a histology study on the latent compound bud (N+2). The results obtained showed that on the first week of May (during fruit set stage) - after 10 weeks from bud break (BB), the first changing from vegetative to fruitful bud was recorded which distinguished by formation of anlagen (An) indicating to the initiation phase. The differentiation phase started in the middle of May (during veraison stage) by division of anlagen to form the first bract (B) subtending the main axis of inflorescence primordial (IP). On the second week of August observation showed a primary bud (N+2) with a full differentiated inflorescence (IP). The second (IP) completed its differentiation in the first week of September. The second IP differentiation needs three weeks after the first, no change in number of inflorescences until January. Which means, primary bud (N+2) needs about (120 days) to complete its differentiation starting from the initiation phase, and (195 days) from (BB). Grape grower should take these results in consideration when planning to agriculture practices for Superior Seedless according to its differentiation time. We suggest carrying out bud dissection as a common procedure for grapevine cultivars which have an economic importance.

**Keywords**: Grapevine- Anlagen- Initiation- Differentiation- Inflorescence primordial.

## INTRODUCTION

Grapevine (*Vitis vinifera* L.) is the most widely cultivated, popular and economically important fruit crops in the world, and has been the concern of both researchers and vine growers for many years. Grapevine reproductive development is a long and complex process that extends over two growing seasons, it comprises a sequence of morphological, biochemical, and physiological events (Monteiro et al., 2022), it was known that cluster formation unfolds in two seasons: (season 1 involve initiation and differentiation of IP), while season 2: formation of flower primordia on cluster). It have been reached that season 1 explain 60% seasonal variation. Due to climatic conditions, a seasonal variation in vineyard yield can disrupt the annual harvest in numbers of the main region of production (Li-Mallet et al., 2016), moreover, a cultivar characterized by low fertility may maximize this variation and lead to shortened vine longevity and affect negatively the sustainability of this sector. One of the starting points to minimize yield irregularities is the prior knowledge of bud fruitfulness during dormancy by histological analysis or bud dissections to define the time of developmental stages of differentiation, identifying and quantifying the number of inflorescences on the axil of the primary bud (Monteiro et al., 2021). Besides that, it is an effective tool for viticulturists to take into account detrimental impacts that may occur by incorrect culture practice, disease or environmental conditions. The first and most comprehensive description of the primordium stages is the pioneering work of Srinivasan and Mullins (1981) on the Shiraz cultivar, they described the developmental

code of various stages of (IP) from 0 to 11 related to the changes in the latent compound bud (N+2), and showed that stages from 0 to 7 occurred in first season before dormancy, while stages from 8 to 11 occurred in second season. Watt et al. (2008) describe the IP stages corresponding to the phenological stages of Modified E-L system growth stages (Coombe, 1995).

The process of initiation and differentiation of (IP) in some details in grape buds was described extensively by many researchers most of them agreed that initiation and differentiation occurred early around bud burst and flowering. An early work by Madhava and Srinivasan (1971) found that the initiation of (IP) occurs about 45 days after bud burst and the differentiation of vines of Anab-e-Shahi is completed after 90 days. Pioneer work of Srinivasan et al. (1972) was concerned with identifying the timing and stages of floral initiation and differentiation and how it influenced by the application time of nutrients. The first and most comprehensive description of IP differentiation stages are those of Srinivasan and Mullins (1981) on Shiraz cultivar using SEM described a developmental code of differentiation IP from 0 to 11 which have been followed by all subsequent authors. Lavee et al. (1967) in their study on two ungrafted grapevine cultivars Sultana and Alphones in a purpose of determine time interval between induction and visible differentiation, estimated as 18 days in Sultana whereas, 14 days in Alphones from induction to differentiation. Kamel (1984) conducted an experiment to determine the time of bud change from vegetative to fruitful and revealed the developmental stages of the flower bud of Thompson seedless grapevine growing in Egypt, the first initiation of cluster was visible on the first week of May at the same time of the beginning of anthesis of the flower of the current year, about seven weeks after bud burst, same trend obtained from Carroll (2000) in Thompson Seedless grapevine mentioned that differentiation in the first 15 nodes is determined around the middle of June. Whereas Jogaiah et al. (2013) assessed the Phenological variation in Thompson Seedless grapevines grafted on different rootstocks and own-rooted vines and found that fruit bud differentiation takes place on the canes at about 45 to 60 days after back pruning, hence the biochemical composition during that stage correlates with fruitfulness. Swanepoel and Archer (1988) worked on Chenin blanc grapevine cultivar and linked the pathway of inflorescence to the visual phonological stages, observed that commencement of anlagen initiation in basal buds was 12-15 days before start of bloom, after 7 days initiation were completed at (beginning of bloom stage), after 14 days from initiation, beginning of differentiation was observed at (full bloom stage), the initiation and differentiation of the first and second (IP) on the two basal nodes was completed at 25 days after full bloom. Resembling, Bennett (2002) reported that the initiation process signaled by anlagen formation in Chenin blanc vines began 15 days before anthesis then the differentiation of anlagen into inflorescence primordial occurs 14 to 21 days after the anlagen first appears and coincides with current anthesis, once the first (IP) has been initiated the second begins to develop and once complete the third and the fourth may develop. From another point of view, Watt et al. (2008) found that starting time and continuity of differentiation may be related not only to the cultivar only, but also temperature has a significant effect on the timing and extent of (IP) initiation and differentiation (branching) when examined primary latent buds of Chardonnay vines grown in a hot 22.3° C and cool 18.1°C, they recorded that initiation of anlagen (uncommitted

primordial) in dormant buds at node 4 commenced 4 weeks after bud burst (BB) in the hot climate and 6 weeks in the cool climate followed by subsequent differentiation, first anlagen observed at 6 and 9 weeks after (BB) in the hot and cool climate respectively during berry formation stages. Adding to that Noyce (2016) examined dissected samples of (N+2) of Chardonnay grapevine and determined the basal IP development stage and the full content of the bud growing point. He found that at 54 days post (BB) both growing points contained a single IP with leaf primordium (LP). Jones (2009) used a scanning electron microscopy in combination with a dissecting microscope to quantitatively asses timing and stages of differentiation of structure of latent bud of Pinot Noir, the investigation revealed that the first visible sign of initiation in latent buds was observed 7 weeks after bud burst (approximately 3 weeks before anthesis) and primary branch primordium was first observed after 11 weeks after bud burst which is the signaling of differentiation. Whereas, Vilar et al. (2017) found that the differentiation of inflorescence primordial of Italia grapevine occurred between 45 and 75 days after sprouting coinciding between the phonological stages of flowering and pea pod as cultural practices started. Nan et al. (2019) observed the initiation time of flower bud differentiation of Miguang and Baoguang and Summer black cultivars, and found the peak period of flower bud differentiation of the three cultivars occurred between early June and early August ( need about 60 days). Superior cv. is recognized as an important commercial in the Egyptian market, which has several positive characteristics such as, early ripening, good appearance, excellent flavor with medium brix ratio at harvest and crispy texture (Salem et al., 2021)., all make it a good cultivar for export, it represents about 15% from the certified planted area for grape exports (Central Administration of Plant Quarantine –Statistics). But it was known for its decreasing fertility with the increase of age. Science we know little of the timing of critical events for the most important grapevine cultivars in Egypt (Moawad et al., 2015).

The aim of the study is to determine the timing of the differentiation stages of Superior grapevine by defining the developmental phase of initiation and differentiation stages of the latent compound bud N+2 (the bud of interest in reproductive growth in grapevine) relative to the time of year and to the phenological stages under the condition of new land areas as a useful formation for viticulturist when applying culture practices program in purpose of improving its fertility.

## MATERIALS AND METHODS

**1-Plant material and growing conditions:**

The experiment was conducted during 2018,2019 and 2020 seasons in a commercial vineyard of Superior grapevine located at kilo 56, Alexandria Road, on three years old vines of Superior cultivar grafted on Freedom rootstock, spaced at 2 x3m grown in a sandy loam soil under a drip irrigation system with a density about 700 vines per feddan and grown in a sandy loam soil under drip irrigation system (two lateral lines per row and two pair of emitters per vine every 30 cm with rate 4 L/h). The Spanish Baron tiller is the supported system used and covered with plastic sheets.

Twenty-four vines that have normal growth and uniform vigor were selected for the experiment. Pruning was done each season during the second week of December each year by leaving about 12 canes per vine and 10-12 buds per cane. In addition, vines received standard cultured practices that are common among all table grapevine cultivars.

At the beginning of this experiment, soil samples were taken from two layers at (0-30 cm) and (30-60cm) in sites around the vines representing major portion of the root zone, sample was taken for physical and chemical analysis, the obtained results are represented in **(Table. 1).**

**Table (1).** The main physical and chemical analysis of vineyard soil experiment

| Properties | Particles size distribution | | | Soli texture | pH 1:2.5 | EC $dsm^{-1}$ | Soluble cations ($meq^{-1}$) | | | | Soluble anions ($meq^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sand (%) | Silt (%) | Clay (%) | | | | $Na^{+}$ | $K^{+}$ | $Ca^{++}$ | $Mg^{++}$ | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{-2}$ |
| | 62.15 | 22.95 | 14.90 | Sandy loam | 7.70 | 1.34 | 8.98 | 0.46 | 2.33 | 1.63 | 2.61 | 9.11 | 1.7 |

**2- The Bud histology study:**

To determine the time of initiation and differentiation stage of Superior grapevine and clarify it in successive steps, samples of compound buds were collected from node position 5 to 8 starting from 4 weeks post bud break (BB). The random sample of the compound bud on node 5-8 was taken every two to four weeks from the selected grapevine, every 2 weeks till the end of August, then samples were taken monthly until (BB), buds were separated carefully from the canes, killed and fixed at once by F.A.A. then transferred to alcohol 70% until dissection and for softening after that samples were washed carefully using tap water then dehydration according to N-butyl alcohol method (Johanson, 1940) and filtration in paraffin wax proceeded. The eyes of each considered dates were sectioned longitudinal as possible at 15 -20 µ thick were cut with a rotary microtome, then stained with saffranine and fast green pigments (Sharman, 1943), mounted with Canada balsam and dried in an electric oven at 55°C for 48 h. slides were microscopically examined, and the thickness of scale layers was measured using a micrometric lens. Images of dissections were taken using the LEICA ICC50 HD Microscope equipped with a camera connected to the computer for image capture.

**3-Determine timing and differentiation stages:**

Dates of the phenology stage were recorded starting from the bud break (BB) of 2019 until before the bud break (BB) of 2020. The histological description of the initiation and differentiation stages of latent compound bud (N+2) was related to the date of the year and the phonological stages in the vineyard according to the modified E-L system stage (Coombe, 1995).

## RESULTS AND DISCUSSION

**Determine timing and differentiation stages of grapevine buds (*Vitis vinifera*, L.) cv. Superior Seedless.**

The study focused on the most important changing event in the development stage of development floral primordial, which is illustrated with figures, only sections that bisect the latent bud (N+2) apex along and pass through the plane of leaf and (IP) will be displayed and other samples were lost during preparing, dissection even staining. This agreed with most histological studies which face difficulties in quantifying bud fruitfulness such as; (1) the mixed nature of grapevine buds that both leaves and clusters develop from the same bud, and the loss of the true leaves and extreme shortening of internodes in the most basal portion of shoots. May (2000); (2) it requires the use of specific laboratory techniques and procedures to observe the internal bud organogenesis; (3)

obtaining (IP) from longitudinal sections of cut from blocks with different orientations is often exceedingly difficult Srinivasan and Mullins (1981). Sequentially some samples were lost during dissection and in histological preparation (Monteiro et al., 2022).

The timing of anlagen initiation and differentiation in latent buds is firstly defined for economically important cultivars in a range of environments as we inferred previously (Srinivasan and Mullins ,1981, Swanepoel and Archer ,1988, Carroll, 2000, Bennett ,2002, Watt et al., 2008, Jones , 2009, Jogaiah et al., 2013, Eltom et al. , 2015, Vilar et al., 2017, Noyce , 2016 and Nan et al., 2019).

For instance, the recorded observation from our Superior Seedless vineyard phenology according to the modified E-L system stage (Coombe , 1995) revealed that stage 4-bud break (BB) was recorded at the beginning of the second week of Feb. Full bloom (stage 25) was on last week of March ( 80 % caps off) after 5 weeks of (BB). Berry setting (stage 27) was on the second week of April after 8 weeks from (BB). The beginning of the harvest period (stage 38) was on the first of June, after 14 weeks from (BB).

Science we know little of the timing of critical events for our more important grapevine cultivars in Egypt (Moawad et al., 2015). In the histological study, the examination of serial longitudinal sections of Superior Seedless compound latent buds (N+2) to determine the time of changing from vegetative to a fruitful one showed that samples taken in the flowering stage, stage 25, (last week of March, after 5 weeks of BB) showed the prompt bud of Superior Seedless *Vitis vinifera* L. which formed first in the 1st season of growth, it was surrounded by the first leaf primordial which modified to scale leaves, and the latent bud located in the axil of the first leaf primordial, revealed the early stage of latent bud formation **(Fig. 1)**.

The prompt bud will develop forming summer lateral, while the latent bud steal in a vegetative stage which could be easily distinguished by apical meristem are often less and plump and more pointed than floral buds **(Fig. 2)**.

Sample taken in the setting stage (young berries enlarging >2mm) showed undeveloped bud created in the year (n) represent the primary or latent bud and we prefer (N+2) according to the names of different types of grapevine buds suggested by (May, 2000) as indicated in **(Fig. 1)**. **(Fig. 2)** showed that buds steal in the vegetative status with a dome-shaped and a layer of tunica which consist of two layers and below the tunica there was a group of irregularly arranged cells represents the corpus. The same description was reported by (Kamel, 1984) in the developmental buds of the Thompson Seedless cultivar**.** Tunica refers to the peripheral meristem, its cells are small and rapid with small vacuoles, surround the central zone of the apical meristem, and produce the outer shoot tissues and the lateral meristems (Keller, 2015).

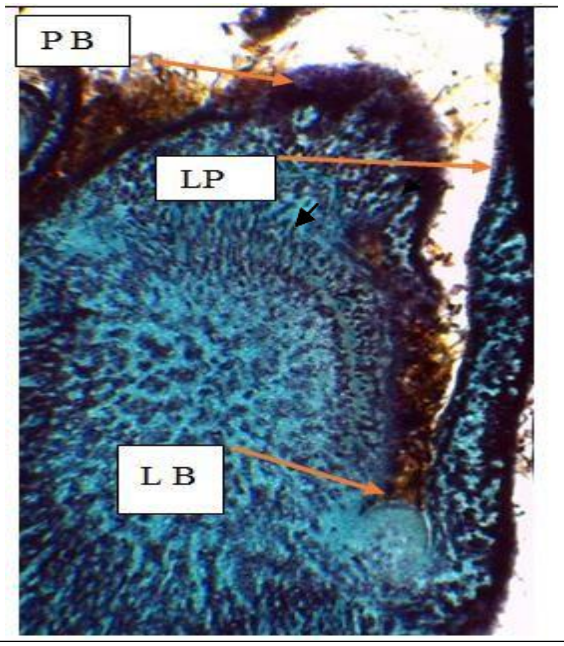


**Fig. (1).** Transverse section through a prompt bud (PB ) of Superior Seedless surrounded by the first leaf primordial (LP) which modified to scale leaves, and the latent bud (N+2) located in the axil of the first leaf primordial at the beginning of vegetative growth.

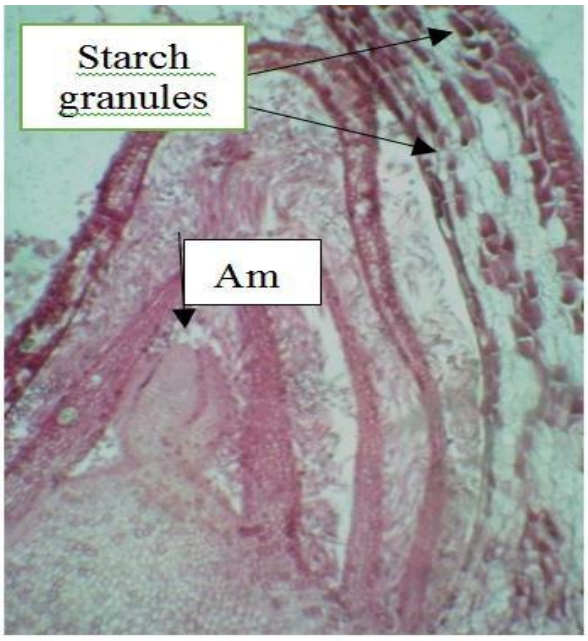


**Fig. (2).** A vegetative bud of Superior Seedless *Vitis vinifera* L., note the apical meristem (AM) are often less and plump and more pointed than floral buds in the last week of March. Note the starch granules in the old leaf primordial.

The buds section in **(Fig.3)** on the second week of April shows the condensation of starch granules in the apical meristem in the diaphragm cells. The developmental stage of the bud in **(Fig 2 and 3)** illustrate the state of bud readiness for initiation. In this regard, Botti and Sandoval (1990) take a sample of latent bud of Thompson seedless grapevine in spring and fall to determine the time of floral initiation based on cytological traits of the apical meristem. They found that starch content seems to be a highly important indicator for induction process since the latent buds presenting more starch were also those exhibiting an increase in cell nucleus, nucleolus diameters. This cytological change pointed to how important the presence of carbohydrates for floral initiation.

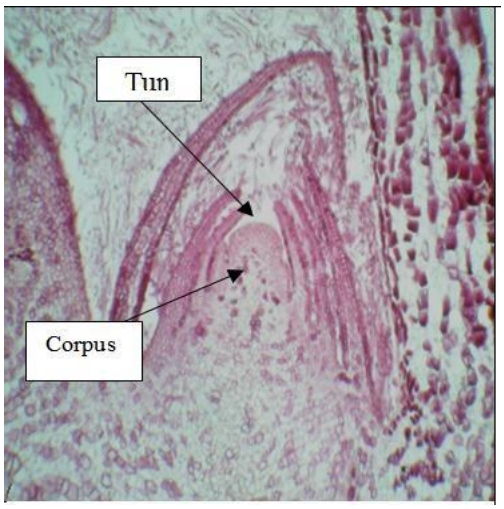


**Fig. 3.a.** Undeveloped bud (vegetative bud) of Superior Seedless *Vitis vinifera* L. (14 April, coincides with the fruit set, after 8 weeks from (BB) Tun = Tunica, Cor = corpus.

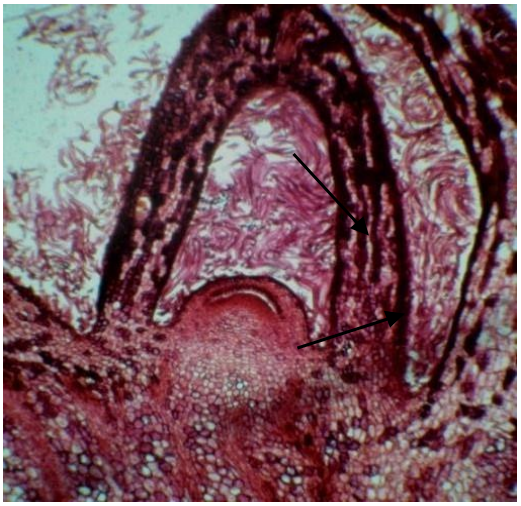

**Fig. 3.b.** Undeveloped bud (vegetative bud) of Superior Seedless *Vitis vinifera* L., with more starch granules as arrow refereed (10x magnified).

The bud section in **(Fig. 4)** showed a formation of the uncommitted primordial (UM) or anlagen (An) formation indicated the start of the initiation phase on the 1st week of May during (berries pea size 7mm). The initiation phase means the beginning of bud change from vegetative to fruitful which represents the first step in the reproductive cycle in grapevine.

Bud section in (Fig. 4) displays that Anlagen forming in the left part of the apical meristem which could be distinguished by the dark pigmentation due to the extensive division of the meristematic cells, while the right part indicates the meristematic cell starts to form a leaf primordial (L). Anlage or anlagen arises like club-shaped meristematic protuberance from the apics of the primary buds. Generally, the initiation phase could be distinguished by a continuous increase of starch granules condensation in the apex of anlagen. The longitudinal section of (N+2) in **(Fig. 4)** showed that anlagen is opposite to the youngest (LP) and has separated from the apex and developed to blunt board abovate structure. Noyce et al. (2016) defined the change from a vegetative apex to a reproductive apex state by the ability to produce IP on the SAM. The first developmental change in the reproductive apex is marked by the formation of anlagen in the SAM. This developmental growth is an irreversible start of the floral axis, ultimately leading to the form of the (IP) in the year (N) and completed differentiation of individual flowers in the next season (n+2) (Srinivasan and Mullins, 1981 and Monteiro et al*.,* 2021).

Concerning the phenology stage facing the initiation stage, it coincided with (berries pea size 7mm) after 10 weeks from (BB). This agreed with the finding of (Srinivasan and Muthukrshnan (1972) ; Srinivasan, C. and Mullins (1980) who found that the fruit set was the phenology stage which faced the initiation phase**.** This result also agreed with (Kamel, 1984) in the identifying the initiation time of Thompson Seedless. On the other hand, other authors such as Swanepoel and Archer (1988); Jones (2009), and Noyce et al. (2019) supported that the initiation phase occurring early before or at flowering. We suggested that initiation time may differ according to cultivars and climate conditions.

In the middle of May (veraison stage) a more advanced stage of development of anlagen (An) as in **(Fig. 5)** indicates the start of the second phase which is the differentiation of anlagen. This phase is marked by the start division of anlagen (An) to form the first bract (B) subtending the main axis of inflorescence (IP). Srinivasan and Mullins (1981) observed when discussing the developmental stages of the primordial in the latent bud of *Vitis vinifera* that bract originate as depression in the distal ends of the anlagen, later these depressions appear to move to the periphery and form a collar-like structure.

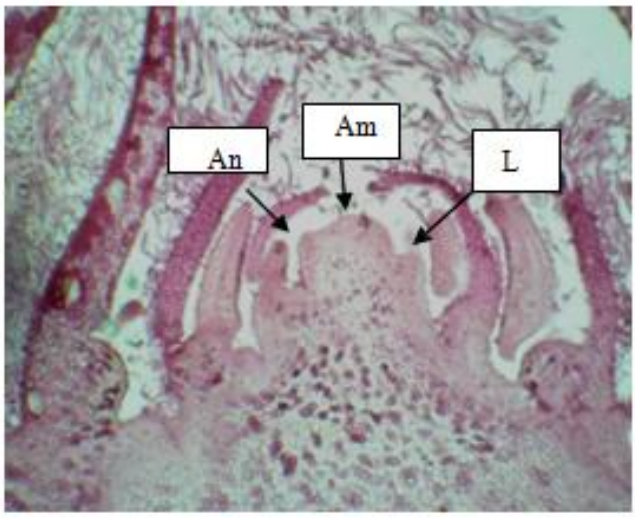


**Fig. (4).** Formation of anlagen indicating to initiation phase, the first step in the reproductive cycle of Superior Seedless on first week of May, during the fruit set stage. An= anlagen, Am= apical meristem, L=leaf primordial.

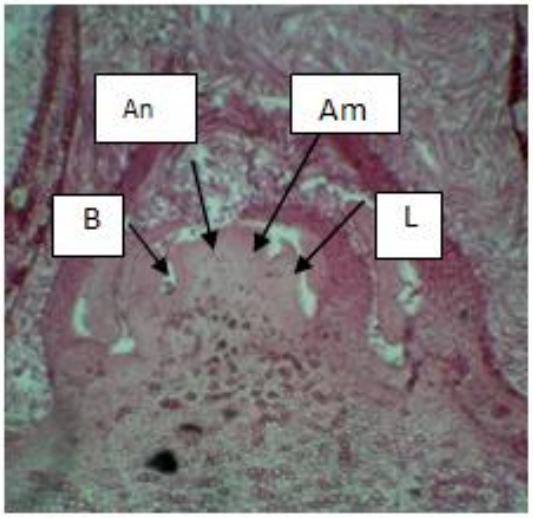


**Fig. (5).** More advanced stage of anlagen development of Superior Seedless on second week of May where the division of anlagen (An) started to form the first bract (B) subtending the main axis of inflorescence primordia (IP).

On the first of June, after 15 days from the differentiation phase (coincides with the beginning of the harvest period) the bud section showed that a subtended bract (B) became clear, besides the split of anlagen into two unequal parts which is the inner and outer arm as a two-lobed apical dome, both arms have the potential to produce (IP) or tendril primordial (TP) **(Fig. 6, 7 and 8).**

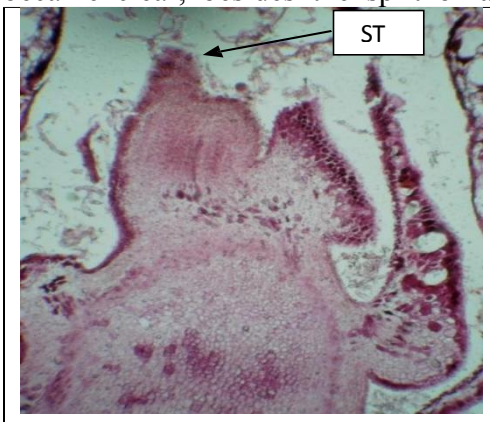


**Fig. (6).** An anlagen differentiates to shoot primordial (ST) of Superior Seedless at (first week of June).

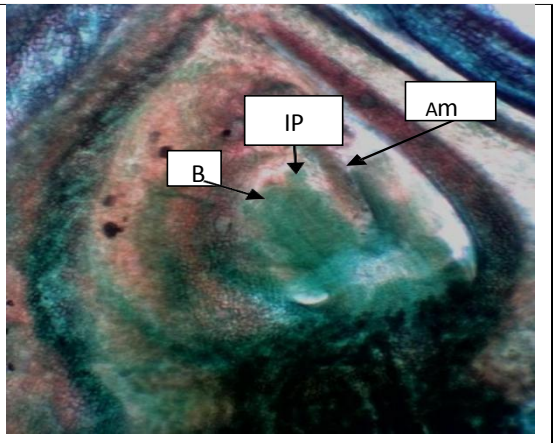


**Fig. (7).** Division of anlagen into two portions (bract (B) and anlagen (An) in the center and apical meristem (Am) on the opposite side on (the first week of June June) during berry ripening of Superior Seedless.

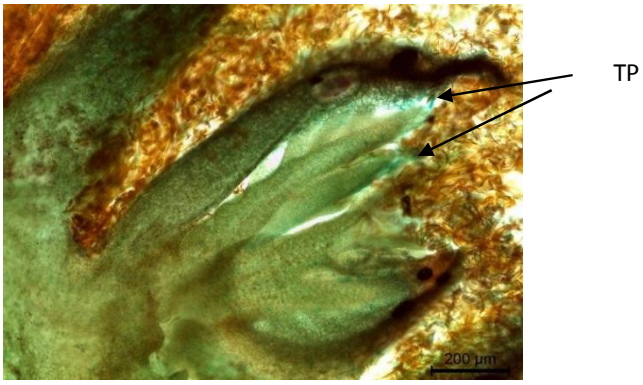


**Fig. (8).** The Longitudinal section of the latent bud showed more advanced stages of anlagen differentiation to a tendril (in July) of Superior Seedless (4x magnified), arrows indicated to the arms of the developing tendrils primordia (TP).

These results agree with many researchers suggesting that differentiation occurred around fruit sets. Lavee et al. (1967) determined the time interval between induction and visible differentiation for two cultivars Sultana and Alphones was 18 days in Sultana whereas, 14 days in Alphones which would represent the time required for the development of primordial. Similar results obtained from Watt et al. (2008) on Chardonnay vines reported that subsequent differentiation of anlagen was first observed at berry formation stages. Also, Eltom et al. (2015) reported in Sauvignon Blanc that initiation at nodes six and eight occurred at 0 and 4 weeks post-fruit set. Same observation obtained by Noyce et al. (2016) they provided a detailed description of the development stage of compound primary bud relative to the date of the year and the phonological stages of Chardonay grapevine, and found that first undifferentiated IP observed early just before flowering began followed by a very fast growth finally became a more mature differentiated primordia at berry setting which takes about 15-21 days. In addition to Vilar et al. (2017) found that the differentiation of (IP) of Italia grapevine occurred between 45 and 75 days after sprouting coincided between the phonological stages of flowering and pea pod as cultural practices started.

The obtained results found that anlagen may be differentiated early to a shoot primordial (SP) **(Fig. 6)**, or to (IP) as showed in **(Fig. 7)**, or (TP) **(Fig. 8)**. Noting that, in **(Fig .7)** we cannot provide early prediction that anlagen will differentiate to (IP). This was previously discussed by Carmona et al. (2008) whose reported that both inflorescence and tendril are modified shoots with a common origin, and supported this hypothesis with different observations, first; they are derived from the same meristem, second; each organ can be a substitute for each other by environmental conditions or hormonal treatments, third; intermediate organ between tendril and inflorescence are frequently formed. Whereas, in the longitudinal section of **(Fig. 6)** the anlagen finally differentiates to a tendril, and we can observe the arms of the developing tendril as pointed. According to Mullins (1979) and Srinivasan and Mullins (1979) anlagen that produce two or three branches grow into tendrils and grapevine tendrils may be interpreted as weakly differentiated inflorescences. From the point of view of Bennett (2002) low temperature stimulates tendril initiation rather than inflorescence and vice versa. While, Noyce et al. (2016) suggested that IP must reach a certain size in the first season to continue to develop into a full IP after bud burst in the second season, and those IP that do not reach the size, likely form a tendril in the next season.

Through the season proceeding in the favor condition of primordia cluster growth, the longitudinal section of buds showed that

IP passed through growth stages from June to July. Examined samples showed that IP increased in size and divided several times to give rise to secondary and tertiary branches forming the main axis of (IP) **(Fig. 9 and 10)**. Monteiro et al. (2022) described (IP) as a branched structure with small protuberances that correspond to the meristems which will form a cluster of flowers in the following spring. A sample taken on the second week of August in **(Fig. 11)** showed a primary bud (N+2) with more progress revealing a fully differentiated inflorescence (IP) with globular ends of branch primordia. This support the observed structure of IP with several branching compared with the limited branching structure of tendril primordia (TP) **(Fig. 9 and 10)**.

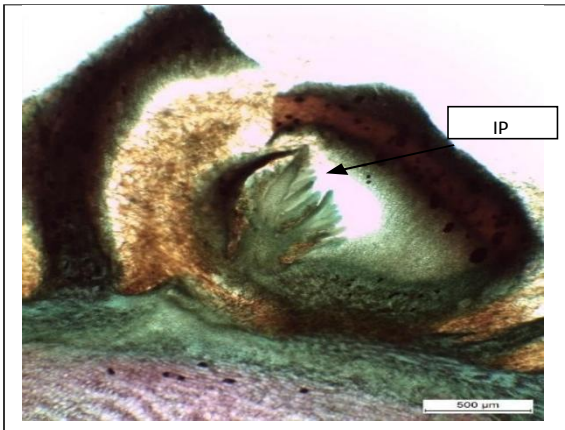


**Fig. (9).** Longitudinal section of latent bud showed more advanced stages of anlagen differentiation to IP (last week of July) of Superior Seedless (4 x magnified). IB= inflorescence branches primordial.

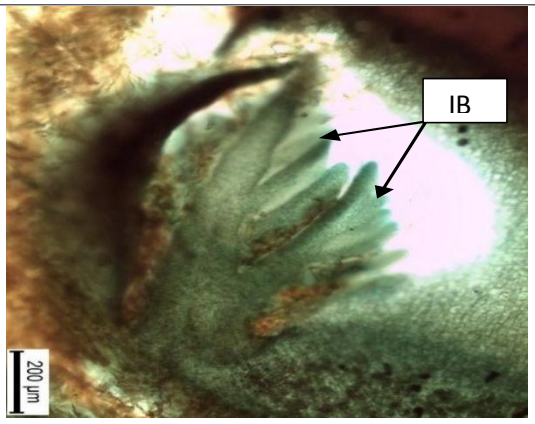


**Fig. (10).** Arrow indicated to secondary and tertiary branches -inflorescence branch primordial- (IB) of the developing inflorescence primordia (IP) on the last week of July of Superior Seedless (10 x magnified).

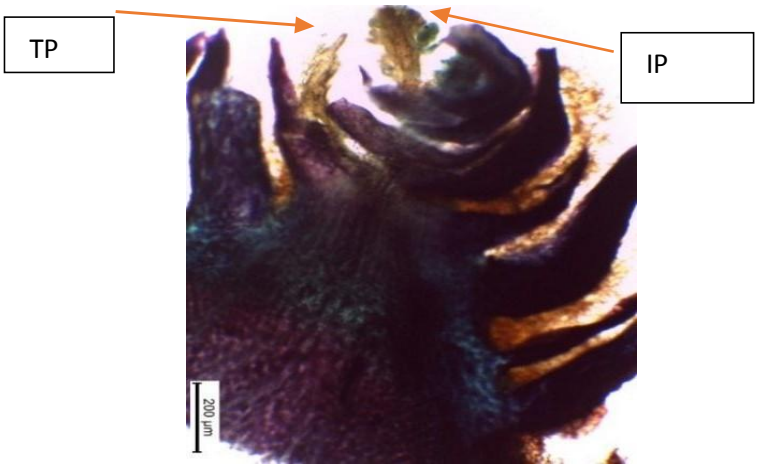


**Fig. 11.** A fully differentiated inflorescence primordial (IP) on the second week of August of primary bud (N+2) of Superior Seedless. Note the globular terminal end of IP, the little branching of tendril primordial (TP) with (4x) magnified.

Our histological observation showed that during the first season the second (IP) completed differentiation in the first week of September **(Fig. 12 and 13)**. It means that the second IP differentiation needs two to three weeks after the first differentiated IP,

and about (120 days) for primary bud (N+2) to complete its differentiation starting from the initiation phase on the first of May and needs (195 days) from (BB) at the second week of Feb as mentioned above.

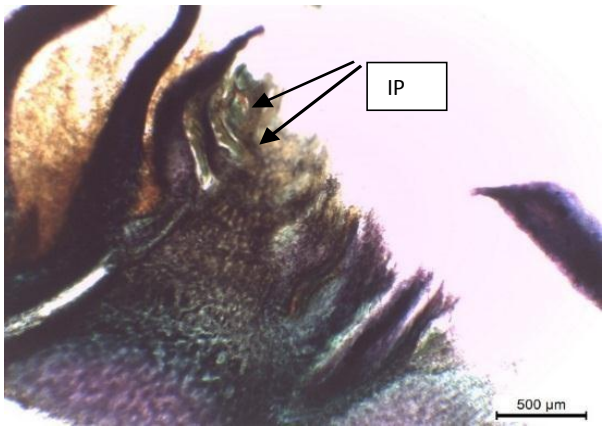


**Fig. (12).** Two complete differentiated inflorescence primordial (IP) (4x magnified) on the first week of September at latent bud in the terminal portion of the cane at (8 position) of primary bud (N+2) of Superior Seedless.

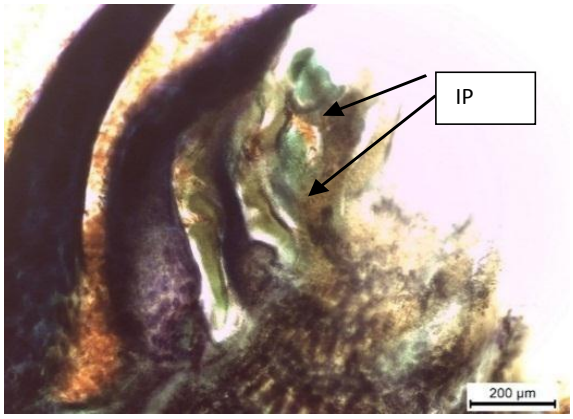


**Fig. ( 13).** Two magnified (10 x magnified) inflorescence primordial (IP) on the first week of September at latent bud in the terminal portion of the cane at (8 positions) of primary bud (N + 2) of Superior Seedless.

These observations were in the same line with Noyce et al. (2016) they found that the time interval between the first and second IP differentiation of the Chardonnay cultivar takes from 2 to 3 weeks. Similarly, Nan et al. (2019) when considering the time interval between development stages of differentiation for three cultivars (Miguang and Baoguang and Summer black), the three cultivars exhibited an early initiation of inflorescence started from 17/5, time of inflorescence anlagen appearance recorded from 7/6 to 26/6, while, formation of the main axis of (IP) was completed after anlagen appearance from 26/6 and continue to 18/7, whereas, most of the second branching (IP) accomplished from 7/8 to 28/8, finally they determined the peak period of flower bud differentiation of the three cultivars occurred between the early June and the early August ( about 60 days). Analogous to the findings of Madhava and Srinivasan (1971) whose observed that the differentiation of vines of Anab-e-Shahi was completed after (90 days). Similarly, Mullins *et al.* (2008) pointed out that the bud differentiation process starts in the first weeks after the node separates from the apex and continues for (59-84 days). Noyce et al. (2016) in Chardonnay Grapevine, noted that by the end of the season, the two differentiated IP required about (111 days) after BB, facing the berry formation stage corresponding to Modified E-L system stage (Coombe. 1995).

As the season proceeded, it was noticeable that there were no changes in the number of cluster primordia until winter pruning **Fig (14 and 15)** in the first season. N+2 buds samples taken in January before BB as indicated in **(Fig. 16 and 17 )** showed two IP with bigger size ready to differentiate individual floral primordial (stages from 8 to 11) and a highly starch granules content in axes and leaf primordial of the primary bud. Examination of bud dissection samples showed that a cross-section of compound latent buds (N+2)

found two IPs observed as a maximum. It means that the potential bud fruitfulness for Superior Seedless doesn't exceed two clusters.

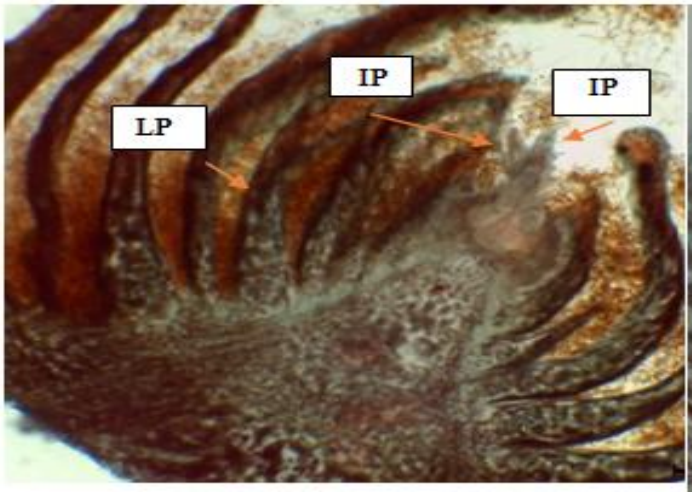


**Fig. (14).** Longitudinal section of the primary bud (N+2) of Superior seedless showed two differentiated (IP) on the first week of December and the leaf primordial (LP) (4x magnified).

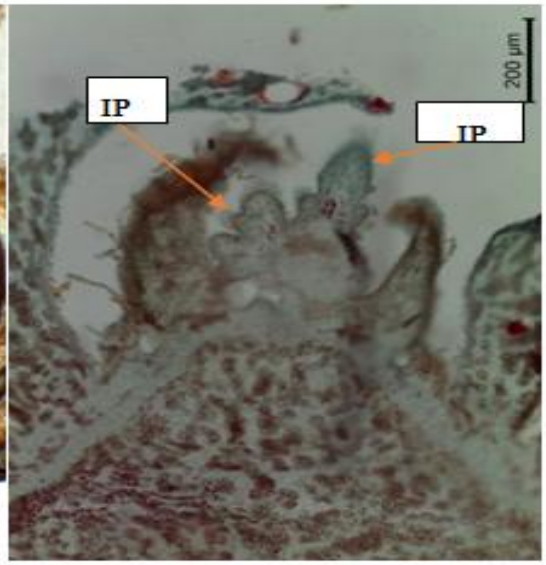


**Fig. (15).** Two differentiated (IP) of Superior seedless on the first week of December (10x magnified).

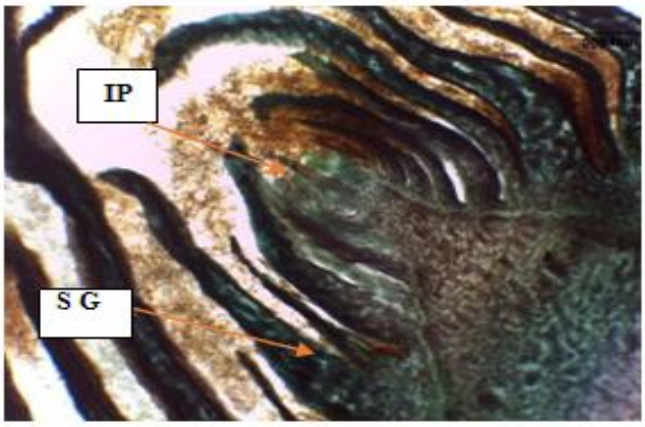


**Fig. (16).** Longitudinal section of latent bud (N+2) of Superior Seedless before bud burst (BB), showed two IP before BB. Note the starch granules (SG) in the leaf primordial and the bud axis, magnified with (4x).

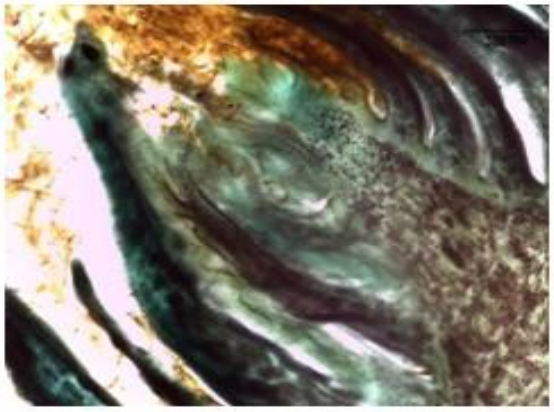

**Fig. (17).** Longitudinal section of latent bud (N + 2) of Superior Seedless before bud burst (BB), showed two differentiation inflorescence (IP) magnified with (10x).

These finding is in agreement with Kamel. (1984) who found no change in the configuration of the differentiated cluster primordia of the Thompson Seedless compound bud from October to December. The increase of starch granules existed in the old leaf primordia and the bud axes in bud samples taken on December **(Fig. 16 and 17)** agreed with the observation obtained by Koussa et al. (2001) in latent buds of *Vitis vinifera* L. (cv. Merlot) collected during their dormancy phase, its microscopical observations showed a gradient of starch content in different regions of bud in which the foliar primordia and scales were the starch richer. It may be one of the signs for preparing for BB for the next season as shown in **(Fig. 16 and 17)**.

Regarding potential bud fruitfulness which indicates the number of (IP) per bud before winter pruning, it recorded two IP as a maximum. However, it seems to vary between cultivars, for example; research of Srinivasan and Mullins (1981) found that in the Sultana grapevine, latent bud produces about one to three inflorescence primordial before entering into dormancy, Noyce et al. (2016) observed in Chardonnay usually two and rarely three fully differentiated IP observed and continued as clusters after dormancy.

## CONCLUSION

The results pointed out that the initiation and differentiation phase of the Superior seedless grapevine happened late, during the berry formation stage. This is different from what most research agrees on, that initiation happened early around bud burst and flowering. It should be taken into consideration when planning agriculture practices for Superior seedless according to its bud differentiation time with the aim of increasing the fruitfulness of the cultivar or predicting yield and avoid fluctuating in yield which make trouble to grapevine sector. It can be suggest carrying out bud dissection to determine differentiation process time as a common procedure for grapevine cultivars which have economic importance.

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## الملخص العربي

## تحديد مواعيد ومراحل التكشف لبراعم العنب صنف سوبيريور /(*Vitis vinifera* L.)

**نسمة محمد علم الدين[1]، أحمد توفيق سالم[1]، علي محمود صبور[2]، محمد عبد العزيز عبد المحسن[1]**

**[1]قسم الفاكهة، كلية الزراعة، جامعة القاهرة، الجيزة، مصر**

**[2] قسم النبات الزراعي، كلية الزراعة، جامعة القاهرة، الجيزة، مصر**

يعد صنف العنب سوبيريور واحداً من أصناف العنب الهامة والتجارية المزروعة في مصر من أجل الاستهلاك المحلي والتصدير ولكنه يتصف بانخفاض الخصوبة على مدار السنوات. أجريت هذه الدراسة خلال ثلاثة مواسم نمو على كرمات عنب صنف السوبيريور عمر 3 سنوات مزروعة على مسافة 2 * 3 م في تربة رملية ومرباه بنظام التكاعيب الاسبانية، وكان هدف الدراسة هو تحديد ميعاد ومراحل تكشف براعم صنف العنب سوبيريور من خلال اجراء دراسة هستولوجية عن طريق عمل قطاعات للبرعم المركب الساكن (N+2) على مدار الموسم. أوضحت الدراسة الهستولوجية على البراعم أنه في الأسبوع الأول من مايو (مرحلة عقد الحبات) يبدأ التحول من حالة البرعم الخضري إلى حالة البرعم الزهري والتي يمكن تمييزها بتكون ال anlagen مشيرة الى مرحلة التهيئة الزهرية، ثم تبدأ مرحلة التكشف الزهري في منتصف مايو (أثناء مرحلة ليونة الحبات) من خلال انقسام anlagen لتعطي أول مبدأ قنابة زهرية bract. ويستمر البرعم في النمو والتطور حتى تظهر أول مبدأ نورة Inflorescence primordia (IP) مكتملة التكشف ذات النهايات الملتفة في الأسبوع الثاني من أغسطس، ويكتمل تكشف مبدأ النورة الثانية في الأسبوع الأول من سبتمبر وبذلك فإن البرعم الرئيسي (N+2) يحتاج لحوالي 120 يوم لاكتمال تكشفه بداية من مرحلة التهيئة ونحو 195 يوم بداية من الخروج من السكون. ونوصي بمراعاة مواعيد التكشف للصنف سوبيريور عند التخطيط لاعداد برنامج ادارة المزرعة لمعظمة الاستفادة من المعاملات الزراعية أو حتى تجنب التذبذب في كمية المحصول كما نقترح عمل دراسات هستولوجية لبراعم أصناف العنب ذات الأهمية الاقتصادية لتحديد ميعاد تكشفها خاصة مع ملاحظة تأثير التغيرات المناخية على القطاع الزراعي.