



Nutrition and Physiology

## Primary bud necrosis in vine propagation material

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**Abstract.** *The study was carried out in the period 2019-2021 in the vine nursery of the Institute of Viticulture and Enology, Pleven (43.42°N 24.62°E and 140 m altitude) with Muscat Plevenski and Bolgar varieties, grafted to Berlandieri x Riparia SO4 rootstock. The cuttings were rooted in two-row beds without mulching with polyethylene foil. The planting depth was 0.15 m, at 0.07-0.08 m intra-row distance and 0.5 m between the rows in the bed. The distance between the beds was 2 m. The experiment was conducted in four replicates. The buds from the first to the fifth eye were examined twice – in the second half of October (15-20 October) and after the removal of the vines from the nursery (01-08 November). The proportion of necrotic buds was determined from samples of 10 shoots per replicate. The manifestations of primary bud necrosis in Muscat Plevenski and Bolgar were observed without exception during the three years of the experiment. Damage was found, regardless of the bud's location along the examined length of the shoot, with no specific trend of a particular node being affected.*

**Keywords:** vine, propagation material, primary bud necrosis

### Introduction

The setting and differentiation of buds in the winter eyes during the growing season is a process that depends on many factors – the variety biology, agricultural techniques, climatic conditions, etc. There have been studies in fruit-bearing vines, according to which some of the main buds died during the growing season without being exposed to low temperatures. Braikov et al. (1976) studied the winter eyes condition at the end of the vegetation period in the Bolgar, Cabernet Sauvignon, Rkatsiteli, Drebno without seeds and Beledi masri varieties, grown on different training systems. The analysis of the results showed that bud rotting without being exposed to low temperatures was found in all varieties included in the study. The highest

ratio of dead main buds was reported in the Bolgar variety in the section from the first to the seventh eye (from 5 to 60%). The damage to the low-lying winter eyes (first – third node) began in the second half of June, and those in the middle part of the shoots – in July (Babrikov et al., 1977).

As a probable reason, the authors pointed out, on the one hand, the peculiarities of the meteorological complex during the period of the winter eyes formation of the respective section, and on the other – some omissions in the implementation of the plant protection measures. One of the hypotheses of Bindra and Chohan (1976), who conducted a study in the vineyards of Punjab, India, was similar. They had analyzed samples of shoots from a number of vineyards fertilized with different but

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known fertilizer rates and different levels of agricultural technology. It was found that extreme growth vigor and a higher number of shoots, potentially due to excessive fertilization or other factors, increased bud decay.

Thus, according to them, a second hypothesis was formed about the causes of bud necrosis – the improper nutrition of vines. Similar results for the Bolgar variety were obtained in a study carried out simultaneously in Bulgaria and Algeria. It was found that the onset of death and the number of dead buds varied per years and were in direct correlation with the shoot growth specifics (Alishev, 1978). Wolf and Warren (1995) proved that the growth rate and the number of shoots significantly affected the primary bud necrosis. It had been found that a period of 15 days shading of individual buds or whole shoots at photosynthetic photon flux density (PPFD) of less than 1% to 2% of full sunlight was sufficient to significantly increase bud necrosis compared to the non-shaded control vines. Improving the light penetration reduced the necrotic buds and increased the vine fruiting (Perez and Kliever, 1990). There have been data that the rootstock affected the incidence of primary bud necrosis (Cox et al., 2012). Primary bud necrosis has been defined as a physiological disorder leading to their death and has been associated with a number of factors, including high growth strength, water stress, shading, redundant plant growth regulators (Dry and Coombe, 1994). A study conducted in Australia showed that primary bud necrosis continued to increase throughout the growing season until the leaves fell off.

Investigations are still going on in a number of different wine varieties. Appropriate management strategies, such as adjusting pruning levels, are being explored to minimize the incidence of primary necrosis in susceptible vineyards (Collins and Rawnsley, 2005).

There have also been a significant number of similar studies explaining the phenomenon of primary bud necrosis and presented the probable reasons for the manifestation of this physiological phenomenon in the fruiting vines (Dry, 1986; Aito et al., 1986; Vasudevan et al., 1998; Collins et al., 2006; Wohlfahrt et al., 2019; Wang et al., 2020, etc.), but there have been no published data on bud decay in the vine nurseries. The primary bud necrosis in the earliest stages of the grafted vines development – the rooting of the grafted cuttings and the formation of vine propagation material has not yet been studied.

The objective of the present study was to ascertain the presence and frequency of primary bud necrosis during the earliest stages of grafted vine development.

## **Material and methods**

The experimental work was carried out in the period 2019 – 2021 in the vine nursery of the Institute of Viticulture and Enology, Pleven (43.42°N 24.62°E and 140 m altitude). The soil type was clay loess-derived leached chernozem. The soil was predominantly sandy clay in composition, exhibiting good water-physical properties, thereby fully satisfying the biological requirements of the vine (Krastanov and Dilkova, 1963).

The experiment was carried out in the production of propagation material from the Muscat Plevenski and Bolgar varieties, grafted on Berlandieri X Riparia SO4 rootstock. The Bolgar variety, belonging to the oriental ecological-geographical group, is a medium-ripening white table grape variety. The vines were strongly growing with good fertility. The Muscat Plevenski variety, bred by crossing the Muscat Hamburgski and Pearl of Csaba, is a very early maturing red table grape variety. The vines had moderate to strong growth. The cuttings were planted in two-row beds without the use of polyethylene foil mulch. The planting depth was 0.15 m, at 0.07 - 0.08 m intra-row distance and 0.5 m between the rows in the bed. The distance between the beds was 2 m. The experiment was set in four repetitions.

The buds condition from the first to the fifth eye was examined twice – in the second half of October (15-20 Oct) and after the removal of the vines from the nursery (01-08 Nov). The proportion of necrotic buds was determined from samples of 10 shoots per replicate. Primary bud necrosis (PBN) was identified upon dissecting the buds (Dry, 2000). The observations were made visually and with the aid of a Cooling Tech digital microscope (China).

## **Results and discussion**

The results of the experimental work conducted during the three years (2019 - 2021) showed manifestations of primary bud necrosis in both varieties included in the study. When the buds were cut, browning of the inside was observed due to necrosis of the tissues, which might include the main, base, or both types of buds (Figures 1, 2 and 3). The present work was focused on the manifestations of PBN in the main buds.



**Figure 1.** Section of bud without necrosis



**Figure 2.** Section of buds with and without necrosis



**Figure 3.** Section of necrotic buds

The mortality rate of main buds varied over the years, significantly more so in the Muscat Plevenski variety – from 20.41% in 2020 to 0.75% in 2021 (Table 1). In the case of the Bolgar variety, the lowest ratio of necrotic buds was reported in 2019, and the difference between the results found in 2020 and 2021 was insignificant (only 0.19%). The differentiation of the results by accounting final terms had not revealed a definite trend to increase or decrease the ratio of affected buds depending on the calendar terms and the degree of development of the shoots for which they referred. From October 15<sup>th</sup> to November 8<sup>th</sup>, maturation of the wood in the young vines was completed, preparing for leaf fall and subsequent entrance into relative dormancy. (Bulgarian Ampelography, 1990). In the Muscat Plevenski variety the most significant ratio of necrotic buds was reported in the period 01-08 Nov in 2020 – 17.74% of all main buds along the shoot length from the first to the fifth eye. In the Bolgar variety the highest ratio of buds with primary necrosis was found in the period 15-20 Oct 2021 – 5.67%.

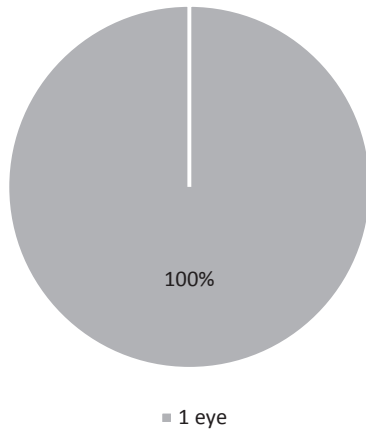
**Table 1.** Decayed main buds from the first to the fifth eye inclusive (%)

Year	Muscat Plevenski			Bolgar		
	15-20 Oct	01-08 Nov	Total for the year	15-20 Oct	01-08 Nov	Total for the year
2019	5.00	2.94	7.94	1.70	1.61	3.31
2020	2.67	17.74	20.41	1.33	5.13	6.36
2021	0.50	0.25	0.75	5.67	0.50	6.17
Average for the period	2.73	6.98	9.70	2.90	2.41	5.31

Figures 4, 5, and 6 present the distribution of dead buds along the shoot length from the first to the fifth node in the Bolgar variety, following the second count. Across the studied years, the distribution was highly uneven, showing no discernible development trend. In 2019, the damage was entirely in the first eye (Figure 4). In 2020,

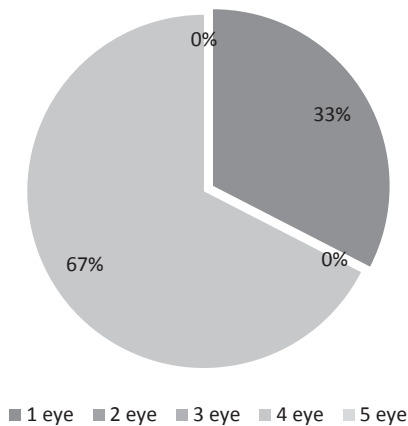
decayed buds from primary necrosis were reported in the first and fourth eyes, with a significantly higher ratio in the fourth eye (Figure 5). In 2021, again, there was no damage to the second eye, but all others were affected, with the most pronounced effect being found in the fifth eye (Figure 6).

*Bolgar 2019*



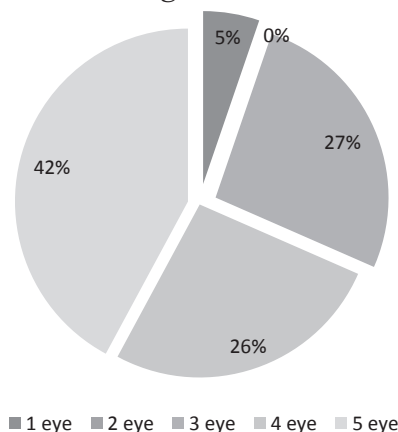
**Figure 4.** Distribution of dead buds along the shoot length from the first to the fifth eye after the second counting in the Bolgar variety for the year 2019

*Bolgar 2020*



**Figure 5.** Distribution of dead buds along the shoot length from the first to the fifth eye after the second counting in the Bolgar variety for the year 2020

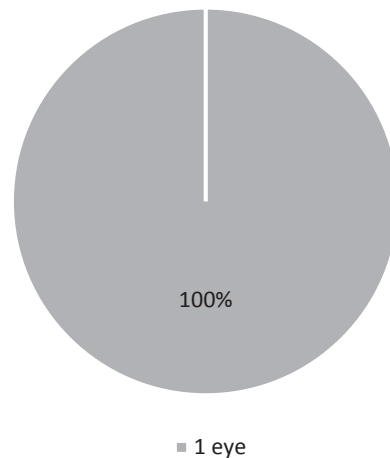
*Bolgar 2021*



**Figure 6.** Distribution of dead buds along the shoot length from the first to the fifth eye after the second counting in the Bolgar variety for the year 2021

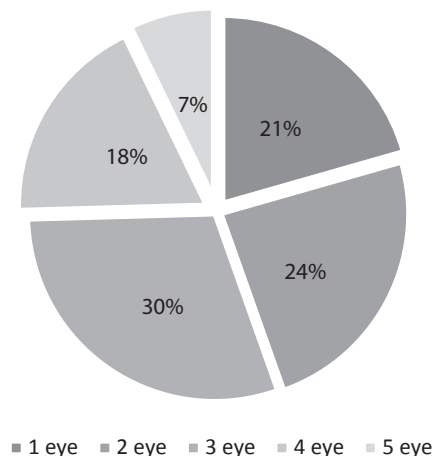
Similar to the Bolgar variety, the Muscat Plevenski variety also showed no discernible pattern or trend in the manifestation of primary bud necrosis along the vine shoot length. (Figures 7, 8 and 9). In 2019, a complete identity was recorded in the location of the affected buds in both varieties – 100% of the dead main buds were located in the first eye (Figure 7). In 2020, primary necrosis in Muscat Plevenski was counted with different frequency in all observed eyes, with the maximum being noted in the third eye (Figure 8). In 2021, a relatively even distribution of the dead main buds in the first, second and fourth eye was found. In the fifth one their number was twice smaller – 14%, and in the third eye there were no affected buds (Figure 9).

*Muscat Plevenski 2019*



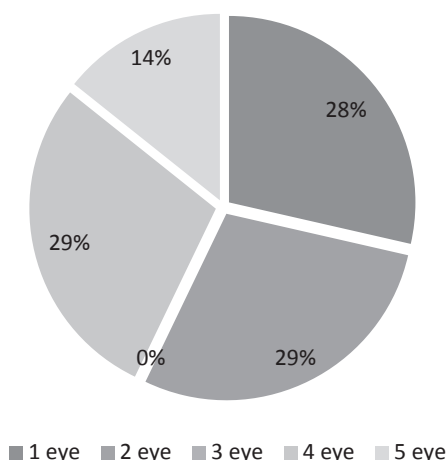
**Figure 7.** Distribution of dead buds along the shoot length from the first to the fifth eye after the second counting in the Muscat Plevenski variety for the year 2019

*Muscat Plevenski 2020*



**Figure 8.** Distribution of dead buds along the shoot length from the first to the fifth eye after the second counting in the Muscat Plevenski variety for the year 2020

## Muscat Plevenski 2021



**Figure 9.** Distribution of dead buds along the shoot length from the first to the fifth eye after the second counting in the Muscat Plevenski variety for the year 2021

The buds at the first and second nodes play a crucial role in the development of young vines after their transplantation to a permanent location. Their viability ensures a healthy start for the new vineyard, preventing potential economic losses. This requires a thorough study of the primary bud necrosis and clarifying the causes for its occurrence. The significant ratio of found decayed main buds in the Bolgar and Muscat Plevenski varieties have justified the work in this aspect to be continued so that methods to reduce or neutralize the effect of primary bud necrosis to be developed.

### Conclusion

This is the first instance of primary bud necrosis (PBN) being identified in young vines. Primary bud necrosis was manifested in the propagation material of the Bolgar and Muscat Plevenski varieties, grafted on Berlandieri X Riparia SO4 rootstock with different frequency. The damages affected the main and base buds, regardless of their location along the shoot length, without outlining a trend to affect a specific eye.

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