Uluslararası Tarım Araştırmalarında Yenilikçi Yaklaşımlar Dergisi
International Journal of Innovative Approaches in Agricultural Research 2023, Vol. 7 (1), 126-134
https://doi.org/10.29329/ijiaar.2023.536.9


Original article

# Chemical Defoliation in the Vine Nursery

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**Abstract**

The trial was carried out in the period 2017-2020 in a vine nursery located on slightly leached chernozem. The objective of the study was to investigate the opportunities of applying the contact foliar herbicides Basta 15 SL (*150 g/l glufosinate-ammonium*) and Diqua 20 SL (*200 g/l diquat*) as defoliants, immediately before removing the vines from the nursery (the second half of October). Their effect on the above-ground vegetative mass of the grafted rooted vines of the varieties Muscat Plevenski, Bolgar, Naslada and Storgozia was established. The herbicides were applied in different doses, once and twice at the end of the growing season with work solution of 50 l/da. The strongest defoliating effect in all varieties was reported after treatment with Diqua 20 SL at a dose of 0.6 l/da and the combination of Basta + Diqua (0.3 + 0.33 l/da) with two applications, but in case it was not possible the second treatment to be performed, a satisfactory result might be achieved with a single application of the herbicides no later than 15 days before removing the vines from the nursery. To prove the vines' capacity for development during the next growing season, the status of their buds after the treatment with the tested herbicides was determined. No negative vines' response caused by this type of defoliation was found.

**Keywords:** Vines, Propagating Material, Nursery, Defoliation, Herbicides.

**Received:** 30 September 2022 * **Accepted:** 19 February 2023 * **DOI:** https://doi.org/10.29329/ijiaar.2023.536.9

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## INTRODUCTION

In many crops, especially in seed ones, the leaf mass of the plants at the end of the growing season caused difficulties in harvesting the produce. The use of chemical means for defoliation was a method that had been studied and applied efficiently in cotton, rape seed, alfalfa, soy, etc. (Monks et al., 1999; Barone & Frank, 1999; Booker et al., 2000; Crawford et al., 2000; Karademir et al., 2007; Teixeira et al., 2007; Teixeira et al., 2007*; Deol et al., 2011; McCormick et al., 2013, Ward & Jacobs., 2013).

A great number of fruit and vine planting material producers had been restricted in taking out the deciduous species they grew by the natural defoliation processes. To speed up this process, chemical defoliation might be applied, which was more cost-efficient compared to the manual defoliation. The reduction of manual labor cut down the costs and decreased the prime cost of the produced planting material. Alanap (200 mg/$l^{-1}$, a.i.), Depeg (0.5%) and Ethrel (150 mg/$l^{-1}$, a.i.), applied in combination, had been effective in similar application for some apple and pear varieties (Larsen & Higgins, 1999). The effects of foliar application of CuEDTA (Cu), ZnSO4 (Zn) and urea on defoliation rate and nitrogen reserves of trees were studied. Both products (CuEDTA and ZnSO4) promoted the early defoliation of almond trees, while the addition of urea facilitated the maintenance of their nitrogen reserves (Bi et al., 2005).

In viticulture, the use of defoliation had been recommended in fruit-bearing vineyards to prepare them for the mechanized harvesting, in mother plantations to facilitate the preparation of cuttings and in the production of grapevine propagation material for removing the leaves before taking out the vines from the nursery. Defoliation helped the flow of nutrients from the leaves to the other plant parts. The defoliated vines were easier to be removed, easier to be stored and the risk of developing fungal diseases during storage had been reduced. A good defoliating effect was found with magnesium chlorate. It had been recommended the defoliation to be carried out in the morning, ten to fifteen days before harvesting or removing the vines from the nursery (Gromakovsky, 1968; Mishurenko, 1997). The application of urea increased the yield, and the nitrogen supplied in this way played a very important role in the growth and development of the vines in the following year (Cheng & Xia, 2004). Early defoliation of the grafted rooted vines (August or September) reduced the total carbohydrate content in the roots and the mature wood (Vršič et. al, 2009).

The objective of this study was to determine the opportunities of optimizing the harvesting and the propagation material sorting out by applying contact herbicides for defoliation of the grafted rooted vines.

## MATERIALS and METHODS

The trial was carried out during the period 2017 – 2020 in the vine nursery of the Institute of Viticulture and Enology, Pleven (43.42°N 24.62°E and 140 m altitude). The study included grafted rooted vines of four varieties common on the territory of the Republic of Bulgaria. Two of them, Bolgar (white,

table grapes variety) and Storgozia (red, wine) had been characterized by strong growth, and the other two, Muscat Plevenski (red, table grapes) and Naslada (white, wine) – with moderate growth (Ivanov et al., 2004). They were grafted on Berlandieri x Riparia SO4 rootstock.

The defoliating effect of Diqua 20 SL (*200 g/l diquat*) and Basta 15 SL (*150 g/l glufosinate-ammonium*) was studied. The trial variants were determined by the application doses of the herbicide products:

**V1** – defoliation with Basta 15 SL (0.5 l/da)

**V2** – defoliation with Diqua 20 SL (0.5 l/da)

**V3** – defoliation with Diqua 20 SL (0.6 l/da)

**V4** – defoliation with Basta 15 SL (0.3 l/da) + Diqua 20 SL (0.33 l/da)

The spraying of the vines' vegetative mass was carried out with a backpack sprayer at a solution consumption rate of 50 l/da. The herbicide effect was monitored with single and twice treatments of each variant. The first treatment was carried out 15 days before the vines were removed from the nursery, and the second one ten days later (5 – 6 days before the vines were taken out from the nursery). Each variant included four repetitions of 50 cuttings.

To determine the herbicide efficiency, the degree of damage from the applied solutions (on the leaves) was recorded – the EWRS scale (Table 1).

**Table 1**. EWRS scale (after Tonev et al., 2002).

| **Herbicide damage to the crop** | **%** |
|---|---|
| none | 0 |
| very weak | 1 |
| weak | 2 |
| weak, moderate | 5 |
| moderate | 10 |
| severe | 25 |
| very severe | 50 |
| highly severe | 75 |
| complete (crop destruction) | 100 |

To establish the viability of the vine propagation material after removing the grafted vines from the nursery, it was determined:

- ratio of damaged buds along the length of the mature part of the main shoot (up to the $5^{th}$ eye inclusive) - %;

- the condition of the second eye (ratio of damaged buds) - %;

The ratio of damaged buds was counted in samples of 10 main shoots per replicate. Their condition was determined by cutting according to the method used to detect primary bud necrosis (PBN) induced by physiological causes (Dry, 2000). The estimation was done by sight, using Cooling Tech digital microscope. The results were compared with two non-defoliated controls – K for the once-treated plots and K1 for the twice-treated plots.

## RESULTS and DISCUSSION

The applied herbicides were contact and their action was limited only to the places of direct contact of the solution on the vegetative mass. The degrees of damage "highly severe" and "complete" were of practical importance, i.e. more than 75% damage to the crop, in this case - to the vine leaves. They were reported as follows in Table 2:

**Table 2.** Herbicidice severity degree on grapevine leaves (EWRS scale)

| Herbicides | Muscat Plevenski | | Bolgar | | Naslada | | Storgozia | |
|---|---|---|---|---|---|---|---|---|
| | **Single treatment** | **Twice treatment** | **Single treatment** | **Twice treatment** | **Single treatment** | **Twice treatment** | **Single treatment** | **Twice treatment** |
| **Basta – 0.5 l/da** | Moderate | Severe | Moderate | Severe | Severe | Very severe | Very severe | Very severe |
| **Diqua – 0.5 l/da** | Very severe | Very severe | Very severe | Very severe | Very severe to highly severe | Complete | Highly severe | Complete |
| **Diqua – 0.6 l/da** | Very severe to highly severe | Highly severe to complete | Highly severe | Complete | Highly severe to complete | Complete | Complete | Complete |
| **Basta + Diqua – 0.3 l/da + 0.33 l/da** | Highly severe to complete | Complete | Complete | Complete | Complete | Complete | Complete | Complete |

The four varieties used in the trial showed different susceptibility to the applied herbicides. The strongest effect was reported for Storgozia variety, and the weakest – for Muscat Plevenski. A degree of "highly severe" in the least affected Muscat Plevenski variety was recorded after a single treatment with Basta + Diqua and after twice treatment of Diqua – 0.6 l/da. In the other varieties, a "highly severe" degree was found with a single treatment with Diqua - 0.6 l/da for Bolgar and Naslada and with Diqua - 0.5 l/da for Storgozia. The greatest efficiency was guaranteed by the "complete" degree of affecting. It was reported for all varieties after treatment with the combination of Basta + Diqua - for Muscat Plevenski after two treatments, and for the rest varieties after single treatment. That degree was also found for twice treatment of Bolgar, Naslada and Storgozia with Diqua - 0.6 l/da, as well as for Naslada and Storgozia after two applications of Diqua - 0.5 l/da.

The results showed that the most significant effect in the tested varieties was observed after treatment with the combination of Basta + Diqua (0.3 l/da + 0.33 l/da) and Diqua at a dose of 0.6 l/da (photo 1) .

**Photo 1**. Plot treated with Diqua - 0.6 l/da (Naslada variety).

To prove the possibility of the vines development during the next growing season, the state of their buds before and after treatment with the tested herbicides was determined.

Before the treatment, damages were found in the three varieties – Bolgar, Muscat Plevenski and Naslada (Table 3). The damage was manifested by bud necrosis, which turns brown under the integument and was consistent with that described for PBN by Dry and Coombe, 1994.

**Table 3.** Bud damage on vines of the varieties included in the experiment – from the first to the fifth eye, inclusive, before herbicide treatment (%)

| **Varieties** | **Average** | | **Second eye** | |
|---|---|---|---|---|
| | Main bud | Substituting bud | Main bud | Substituting bud |
| Muscat Plevenski | 2.67 | 0.00 | 0.00 | 0.00 |
| Bolgar | 1.33 | 0.00 | 0.00 | 0.00 |
| Naslada | 1.33 | 0.00 | 0.00 | 0.00 |

After the treatment, damage was reported in all varieties, both in the treated variants and in the untreated controls (Table 4). The highest ratio of damaged buds in the single-treated variants was reported for Muscat Plevenski (11.59% main + replacing buds). The most significant rate of damage in the untreated control was found in the Storgozia variety (23.86% main + replacing buds). In the treated variants, the vines defoliated with Basta 15 SL (0.5 l/da) were the most affected, which contrasted with the lowest degrees of the EWRS scale - from “moderate” to “highly severe” found in the action of this herbicide.

**Table 4.** Damage to the buds of the vines treated once and twice – from the first to the fifth eye inclusive, average for the period (%)

| Herbicides | Muscat Plevenski | | | | Bolgar | | | | Naslada | | | | Storgozia | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Once | | Twice | | Once | | Twice | | Once | | Twice | | Once | | Twice | |
| | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds |
| Basta – 0.5 l/da | 8.06 | 0.90 | 4.33 | 2.24 | 5.62 | 2.44 | 15.26 | 7.8 | 7.83 | 0.32 | 14.15 | 0.39 | - | - | 24.32 | 1.88 |
| Diqua – 0.5 l/da | 6.20 | 1.00 | 1.89 | 0.75 | 4.29 | 0.32 | 4.52 | 1.57 | 6.14 | 1.14 | 7.22 | 0.56 | - | - | 7.00 | 0.00 |
| Diqua – 0.6 l/da | 1.75 | 0.36 | 1.33 | 0.45 | 0.88 | 0.00 | 4.20 | 1.67 | 3.06 | 0.95 | 3.28 | 0.00 | - | - | 4.94 | 1.73 |
| Basta + Diqua – 0.3 l/da + 0.33 l/da | 4.69 | 0.00 | 4.44 | 0.82 | 0.77 | 0.00 | 5.95 | 2.16 | 6.66 | 0.00 | 2.48 | 0.87 | - | - | 10.36 | 1.57 |
| Not treated control | 10.34 | 1.25 | 4.28 | 0.82 | 3.37 | 0.86 | 5.66 | 0.36 | 6.05 | 0.56 | 6.27 | 5.09 | - | - | 19.24 | 4.62 |

**Table 5.** Damage to the buds of the vines treated once and twice – second eye, average for the period (%)

| Herbicides | Muscat Plevenski | | | | Bolgar | | | | Naslada | | | | Storgozia | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Once | | Twice | | Once | | Twice | | Once | | Twice | | Once | | Twice | |
| | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds | Main bud | Substituting buds |
| Basta – 0.5 l/da | 3.65 | 0.00 | 4.17 | 0.00 | 6.67 | 2.50 | 5.66 | 3.87 | 1.57 | 0.00 | 0.00 | 0.00 | - | - | 1.79 | 1.79 |
| Diqua – 0.5 l/da | 4.17 | 0.00 | 0.00 | 0.00 | 4.69 | 1.57 | 7.74 | 3.57 | 12.36 | 2.50 | 0.13 | 0.00 | - | - | 1.79 | 0.00 |
| Diqua – 0.6 l/da | 0.00 | 0.00 | 0.00 | 0.00 | 2.09 | 0.00 | 4.59 | 0.00 | 0.00 | 0.00 | 7.09 | 0.00 | - | - | 4.17 | 2.09 |
| Basta + Diqua – 0.3 l/da + 0.33 l/da | 0.00 | 0.00 | 6.37 | 0.00 | 1.25 | 0.00 | 8.75 | 4.59 | 2.78 | 0.00 | 2.09 | 0.00 | - | - | 0.00 | 0.00 |
| Not treated control | 10.61 | 1.52 | 1.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.45 | 0.00 | 4.59 | 0.00 | - | - | 2.09 | 0.00 |

When reporting the condition of the second eye, damage was found with a different frequency in the individual varieties (Table 5). The most affected were the vines from K of Muscat Plevenski (12.13% main + replacing buds) and the once-treated with Diqua - 0.5 l/da vines of the Naslada variety (14.86% main + replacing buds). In the plots defoliated with Diqua – 0.6 l/da (once and twice) of Muscat Plevenski variety, no damage was observed. In the case of the Bolgar variety, no damage to the second eye was detected in the controls.

The presence of a high ratio of affected buds before the treatment and in the controls was indicative of the influence of causes unrelated to the tested herbicides. The damages found in the research process were characteristic of primary bud necrosis (PBN), the manifestation of which in vine nursery had not been sufficiently studied.

**Conclusion**

The herbicide Diqua at a dose of 0.6 l/da and the combination of Basta + Diqua (0.3 + 0.33 l/da) had the greatest potential to be used as chemical defoliant.

The two-time treatment resulted in a stronger defoliation effect, but if it was impossible to carry out the second treatment, the single application of Diqua at a dose of 0.6 l/da or the combination of Basta + Diqua (0.3 + 0.33 l/da) not later than 15 days before removing the planting material from the nursery, might cause defoliation sufficient for the needs of the technology.

The chemical defoliation carried out by the herbicides Basta 15 SL and Diqua 20 SL did not negatively affect the vine buds of the varieties Muscat Plevenski, Bolgar, Naslada and Storgozia.

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