

INFLUENCE OF SOME SOIL HERBICIDES ON THE VEGETATIVE MANIFESTATIONS OF GRAFTED CUTTINGS OF SIYANA VINE VARIETY

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Abstract

The article shows the results of the influence of three soil herbicides: pendimethalin (Stomp New 330EK), s-metolachlor (Dual Gold 960EK) and pendimethalin and clomazone (Alcans Sync Tech) on the vegetative manifestations of the grafted vine cuttings. The study was carried out during the period 2018-2021, in the experimental vine rooting nursery of IASS "Obraztsov Chiflik", with Siyana dessert variety. Dual Gold 960EK and Stomp New 330EK were found to have high selectivity, provide good control of annual weeds, do not suppress budding and do not reduce the vigor of the main shoot growth. The tested herbicides did not negatively affect the synthesis of photosynthetic pigments. Alcans Sync Tech caused a moderate to moderately strong phytotoxic effect, expressed in a chlorotic halo of the first leaves of the cuttings, which was overcome at a later stage and did not affect their development. Despite slight fluctuations in the values of the ratio of chlorophylls to carotenoids, there was no evidence of premature aging due to stress factors.

Key words: weeds, herbicides, efficacy, phytotoxicity, vine rootstock.

INTRODUCTION

The essence of modern concepts for the development of sustainable agriculture consists in finding the appropriate, optimal productive level for each crop, by applying such systems, that guarantee obtaining stable yield for a long period of time and preserving natural resources, including the main means of production – the soil.

For the successful rooting of vine cuttings, soil preparation is important. The expected high and quality yield, from standard grafted vines, can be obtained only if all the requirements in the technologies for their cultivation are observed - control of weeds, diseases and enemies. One of the most dangerous competitors of vine cuttings are weeds, and it is very important to control them in the early phases of the crop's development (immediately after planting the cuttings in the rooting nursery) to avoid competition for water, light and nutrients substances (Correia et al., 2012; Gitti et al., 2012; Nosratti et al., 2020).

Weeds are the vine's main competitor for the absorption of the main biotic factors. Boychev (1980) and Prodanova-Marinova & Staneva (2018) found that the multiplication of weeds in

a vine rooting nursery transpired much more intensively than the vine and extract larger amounts of nutrients from the soil. According to Dimitrov & Prodanova-Marinova (2019) and Staneva & Rankova (2017), in addition to the fact that weeds are good accumulators of nutrients, their percentage content of nitrogen, phosphorus, potassium and magnesium in the leaf mass is higher, compared to the crops. The high degree of weed infestation usually leads to less developed shoots and a decrease in the quantity and quality of vine planting material.

There are studies that show that oxyfluorfen, pendimethalin, s-metolachlor, etc. can be used. Flumioxazin shows high efficacy against tilling-type weed associations (typical for the rooting nursery) and selective action in the production of grapevine planting material (Ivanova & Rankova, 2014; Rankova & Tityanov, 2014; 2017; Tsvetanov et al., 2014). A number of authors also report high efficacy and good selectivity of some soil herbicides (fluroxypyr, glyphosate, flumioxazin, isoproturon) used immediately after planting the grafted cuttings (Lange et al., 1970; Chelebiev & Encheva, 2002; Marble et al., 2016). The influence of trifluralin, napropamide, oxyfluorfen, pendimethalin and other active substances on the rooting process

and vegetative manifestations of young vines also was studied (Leonie et al., 2014). The production of vine planting material is a process that is influenced by a number of factors of a biological, ecological and technological nature (Risina, 2007; Schildberger et al., 2007).

Herbicides are an excellent assistant to the farmer in the weed control, but not infrequently they can also be a double-edged sword. If herbicides are not well known and the technology of their use is not observed, the crop can suffer significant losses, which naturally has direct economic consequences for farmers. Regardless of the selectivity of herbicides, they have a stressful effect on crop plants, which directly affects yield (Christopher et al., 2021; Ionescu and Popescu, 2024; Matei et al., 2024). The objective of the study was to determine the influence of some soil herbicides on the growth and development of grafted vine cuttings of Siyana variety in a vine rooting nursery.

MATERIALS AND METHODS

During the period 2018-2021, in the experimental vine rooting nursery of the Institute, on soil type leached chernozem, the influence of three soil herbicides Stomp New 330EK (330 g l⁻¹ pendimethalin), Dual Gold 960EK (960 g l⁻¹ s-metolachlor) and Alcans Sync Tech (298 g l⁻¹ pendimethalin; 43 g l⁻¹ clomazone) on the vegetative manifestations of the grafted cuttings of Siyana vine cultivar was studied. The active soil fertility is characterized with a good potassium (33.17 mg 100g⁻¹ soil), insufficient nitrogen (16.84 mg 100g⁻¹ soil), poor phosphorus (6.15 mg 100g⁻¹ soil) nutritional regime and slightly acidic soil reaction pH (in KCL 5.6-6.7, degree of saturation with bases 89-92%) (Sabev & Stanev, 1963; Dimitrov, 1990). The experiment was carried out with Siyana dessert vine variety, grafted on SO4 rootstock (Berlandieri x Riparia). Before rooting, the stratified grafted cuttings were waxed up to 2/3 of their length, then rooted to a depth of 15-17 cm (up to the non-waxed part). The vines were planted in the spring, when the soil temperature at a depth of 10-15 cm reached 11-12°C (for the region of Obratzov chiflik, it was in the third ten days of May). Paraffinized grafted cuttings were rooted according to the technology of open cultivation, adopted by IASS "Obratzov

Chiflik", with drip irrigation and micro-jet misting in the first month after planting for rooting (Todorov, 2005). The planting scheme was in two-row beds with a distance between rows of 50 cm, and in rows - 7-8 cm. Variants included 264 pcs grafted vines planted in four replications of 66 each, with an experimental plot area of 2.31 m² and compared with a control (untreated) variant with grafted vines of the same variety. The following variants were tested during the experiment: control (untreated); Stomp New 330EK (1.98 kg ha⁻¹ a.c.); Dual Gold 960EK (1.44 kg ha⁻¹ a.c.) and Alcans Sync Tech (0.85 kg ha⁻¹ a.c.). A sprayer was used for the treatment with the herbicides, at a working solution consumption of 400 l ha⁻¹, applied at doses indicated in Table 1, and the control variant was kept clean of weeds by manual weeding. The selectivity by the 9 score scale of EWRS was evaluated on the 7-th and the 14-th day after the herbicide application (at score 0 there were not damages on the crop, and at score 9 the crop was completely destroyed).

The grafted cuttings of all variants were fertilized equally with nitrogen, phosphorus and potassium fertilizers.

Table 1. Herbicides and doses of treatment

Variants	Active substance, g l ⁻¹	Doses - commercial product, l ha ⁻¹	Dose - a.c., kg ha ⁻¹
Control		-	-
Stomp New 330EK	330 g l ⁻¹ pendimethalin	6.00	1.98
Dual Gold 960EK	960 g l ⁻¹ s-metolachlor	1.50	1.44
Alcans Sync Tech	298 g l ⁻¹ pendimethalin; 43 g l ⁻¹ clomazone	2.50	0.85

To clarify the influence of the tested soil herbicides on the grafted vine cuttings, the following parameters were traced:

- ✓ Emergence in dynamics - counting the emerging cuttings at the end of the first, second, third, fourth and fifth ten days, after planting them in the rooting nursery. The percentage of emergence was calculated based on the total number of cuttings planted.
- ✓ Length of the main shoot - the length of the main shoot (cm) was measured at the end of each ten-day period from the thirtieth day after planting to the beginning of wood maturation.

✓ Growth speed of the main shoot in dynamics - the growth speed of the main shoot was calculated in mm/day for each ten-day period. 10 vines per replication were measured.

✓ Content of photosynthetic pigments in the leaves (chlorophyll a, chlorophyll b and carotenoids c) - was determined by the spectrophotometric method (mg 100 g⁻¹) described by Delvin et al. (1981), by extracting pigments with an 85% acetone extract. An average sample was used for a variant of maximally developed leaves (6th - 8th leaf from the shoot tip to the base) on the 30th day after the treatment with the herbicides.

The data on the average daily temperature, during the study period, were taken from the stationary meteorological cell in IASS "Obratzov Chiflik", located near the Experimental Vineyard.

The mathematical processing of the results was carried out by two-factor analysis of variance (ANOVA), with the statistical program SPSS 19.0 (Ganeva, 2016). The significance of the assessment and the strength of the influence of the factors was determined, as a part of the intergroup variation in the total variation, and calculated after the method of Plohinsky (Lakin, 1990).

RESULTS AND DISCUSSIONS

Evaluating the impact of average monthly temperatures during the vegetation of the vines set for rooting, the studied years were relatively favorable for their development (Table 2). The average monthly air temperature according to the multi-year norm (over a 109-year period) was 15.8°C. The data showed that the studied years had air temperatures above the multi-year norm. July (2018) and June (2021) were exceptions, with average monthly temperatures below the multi-year average temperature, with a deviation of -0.21°C and -0.22°C. The annual variation of the temperatures showed that the years of the study could be considered as hot and differed with significantly higher average monthly air temperatures compared to the multi-year period. The period of active vegetation of the vines for rooting (from May to November), during the years of the study, had a clear trend of higher temperature deviations, compared to the multi-year norm (+0.04°C to +8.0°C), which

did not have an influence on the development of rooting vine cuttings. Venkataraman & Krishnan (1992) found that the phenology of a crop is largely dependent on genetic and environmental factors, including temperature and sunshine.

Table 2. Average monthly air temperature (°C), for the period 2018-2021

Period		Vegetation period							Average V - XI
		V	VI	VII	VIII	IX	X	XI	
Average for MP		16.4	20.2	22.5	23.9	17.9	7.2	2.7	15.8
Deviation, ± °C from MP	2018	5.00	1.68	-0.21	0.04	1.30	6.30	2.80	2.40
	2019	0.60	2.18	0.49	0.54	1.70	6.60	8.20	2.90
	2020	0.10	0.38	1.59	1.44	2.70	7.50	3.10	2.40
	2021	0.40	-0.22	2.09	0.04	-0.20	8.00	4.20	2.00

Legend: MP (multi-year period); The period from 1896 to 2006 was used for a multi-year period, as climate norm, since that period included decades with differences in the meteorological factors.

In the area of the vine rooting nursery, 2 groups of weeds which formed tilling-type associations were determined: late spring - *Setaria viridis* Beauv., *Echinochloa crus-galli* L., *Digitaria sanguinalis* L., *Solanum nigrum* L., *Chenopodium album* L., *Polygonum aviculare* L., *Tribulus terrestris* L., *Portulaca oleracea* L., *Xanthium strumarium* L., *Amaranthus retroflexus* L., *Persicaria lapathifolia* L., *Anthemis arvensis* L.; perennial rhizomes - *Convolvulus arvensis* L., *Cirsium arvense* Scop. и *Sonchus arvensis* L. Table 3 shows the average weed density, averaged over the study period, by species, 30 and 60 days after the fertilization with Stomp New 330EK, Dual Gold 960EK and Alcans Sync Tech. The perennial species *Convolvulus arvensis* L., *Cirsium arvense* Scop. and *Sonchus arvensis* L. were very little affected by the soil herbicides.

When double counting was done in the density of the weed associations, the applied soil herbicides had a significant long-lasting effect. The preservation of the total density of the weeds until the 60th day after the treatment, was due to the efficient action of the soil herbicides. The smallest density of weeds and accordingly the most significant herbicidal effect throughout the entire period of study were reported by the variants with Alcans Sync Tech and Stomp New 330EK (Table 3).

The same trend has been proven by other authors, who noted that the use of soil herbicide

products has a positive effect on the density of weed associations in a vine rooting nursery (Prodanova, 2012; 2015). Sarpe et al. (2007) and

Andr et al. (2014) also reported a similar effect on *Amaranthus retroflexus* L., *Setaria viridis* Beauv. and *Solanum nigrum* L.

Table 3. Weed density by species, 30 and 60 days after treatment with soil herbicides (pcs. m⁻²), average for the period 2018-2021

Types of weeds	30 days				60 days			
	Control	Stomp New 330EK	Dual Gold 960EK	Alcans Sync Tech	Control	Stomp New 330EK	Dual Gold 960EK	Alcans Sync Tech
<i>Late spring weeds</i>								
<i>Setaria viridis</i> Beauv.	53	-	-	-	72	-	-	-
<i>Echinochloa crus galli</i> L.	28	-	-	-	40	-	-	-
<i>Digitaria sanguinalis</i> L.	14	-	-	-	20	-	-	-
<i>Solanum nigrum</i> L.	4	-	-	-	12	-	-	-
<i>Chenopodium album</i> L.	2	-	-	-	10	-	-	-
<i>Persicaria lapathifolia</i> L.	26	-	-	-	10	-	-	-
<i>Portulaca oleracea</i> L.	14	4	2	-	43	4	2	-
<i>Xanthium strumarium</i> L.	8	6	9	7	12	6	9	7
<i>Amaranthus retroflexus</i> L.	2	-	-	-	20	-	-	-
<i>Anthemis arvensis</i> L.	-	-	-	-	6	-	-	-
<i>Polygonum aviculare</i> L.	2	-	-	-	15	1	-	3
<i>Tribulus terrestris</i> L.	3	-	-	-	6	2	1	-
Total weeds	156	10	11	7	266	10	11	7
<i>Perennial rhizomes</i>								
<i>Convolvulus arvensis</i> L.	15	-	1	1	17	-	1	-
<i>Cirsium arvense</i> Scop.	2	-	-	-	2	-	-	-
<i>Sonchus arvensis</i> L.	-	-	1	1	6	-	4	5
Total weeds	17	-	2	2	25	-	5	5
Total number of weeds	173	10	13	9	291	21	26	21

In addition to the good herbicidal activity against weeds, the tested soil herbicides also showed good selectivity towards emerging grafted cuttings. In the counts made, the number of the emerging grafted cuttings in the treated variants was greater, compared to that in the control variant. Table 4 shows the data about the dynamics of the emerging grafted vine cuttings, average over the period of the experiment, recorded from the 30th to the 70th day after planting and their treatment with herbicides in the vine rooting nursery.

The percentage of emerging of the grafted cuttings, from the 30th to the 70th day after the treatment with Stomp New 330EK, Dual Gold 960EK and Alcans Sync Tech, was higher than that of the control variant. Statistical differences were found, at the level of significance $\alpha=0.05$,

for the variants Stomp New 330EK, Dual Gold 960EK (on the 50th day of treatment) and Alcans Sync Tech (on the 70th day of treatment). Good statistical significance ($\alpha=0.01$) was found on the 30th (Stomp New 330EK and Dual Gold 960EK) and 70th (Dual Gold 960EK) days of variant treatment. Very good significant differences, at $\alpha=0.001$, had the variants treated with Alcans Sync Tech on the 30th day and Stomp New 330EK 330EK on the 70th day of the use of the products.

In Table 5, the analysis of variance showed that, on average over the study period, the use of herbicides (factor B) had a significant effect ($\alpha=0.01$) on the emerging of grafted cuttings and with a power of impact of 34.29%. The unexplained influence due to random factors was 29.87%.

Table 4. Vine germination dynamics (%) of grafted cuttings in vine rooting nursery, on average for the period 2018-2021.

Days \ Variants	30-th day	Difference	40-th day	Difference	50-th day	Difference	60-th day	Difference	70-th day	Difference
Control	85.95	-	91.32	-	90.85	-	92.35	-	93.62	-
Stomp New 330 EC	90.12**	4.17	92.15n.s.	2.00	92.45*	1.60	93.90n.s.	1.55	95.37***	1.75
Dual Gold 960 EC	90.35**	4.40	92.77n.s.	1.45	92.45*	1.60	93.45n.s.	1.10	94.9**	1.27
Alcans Sync Tech	91.07***	5.12	93.32n.s.	0.82	91.80n.s.	0.95	93.82n.s.	1.47	94.72*	1.10
LSD										
$\alpha=0.05$	2.45	-	3.00	-	1.05	-	1.73	-	0.86	-
$\alpha=0.01$	3.44	-	4.12	-	1.48	-	2.43	-	1.20	-
$\alpha=0.001$	4.86	-	5.95	-	2.09	-	3.44	-	1.70	-

***, **, * - significant at $\alpha=0.001$, $\alpha=0.01$ and $\alpha=0.05$; n.s. - non-significant

Table 5. Vine germination dynamics (%) of grafted cuttings - impact of the factors

Source of variance	Significance	Impact of the factors (%)
Year (A)	n.s.	1.29
Herbicide (B)	**	34.29
Interaction of the factors (A x B)	n.s.	3.55
Error	-.	29.87

***, **, * - significant at $\alpha=0.001$, $\alpha=0.01$ and $\alpha=0.05$; n.s. - non-significant.

The tolerance of each plant species to a particular herbicide is within certain limits. When the dose exceeds the recommended limits and especially when the herbicide treatment is applied under unfavorable weather conditions, negative effects may occur. The results of the visual readings in points of phytotoxicity on EWRS scale, thirty days after the treatment of the experimental plots, in the variant with Alcans Sync Tech soil herbicide, a chlorotic halo was observed on the first leaves of the grafted vine cuttings (Figure 1).

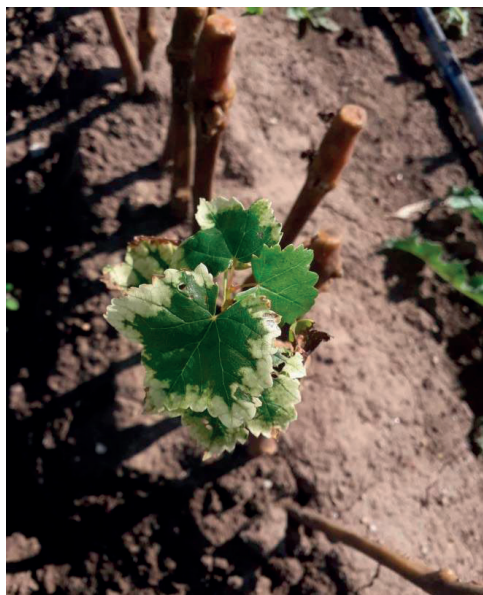


Figure 1. Phytotoxicity of Alcans Sync Tech soil herbicide, 30 days after the treatment

The observed symptoms subsided after the 60th day of treatment with the herbicide and did not affect the further development of the vine cuttings (Figure 2). The observed chlorotic halo was due to the action of clomazone - the active substance, which under certain environmental

stress conditions, inhibited the biosynthesis of photosynthetic pigments.

Dual Gold 960EK and Stomp New 330EK soil herbicides did not cause phytotoxicity during the entire growing season of the cuttings.

The grafted cuttings were planted under the same conditions in the vine rooting nursery (soil, climate, agrotechnical), but the differences in the preliminary emerging determined to a large extent the changes in the growth of the shoots and the effect of herbicides on them.



Figure 2. Phytotoxicity of Alcans Sync Tech soil herbicide, 60 days after the treatment

Table 6 shows the data about the length of the shoots, during the different ten days, which were a reflection of the dynamics in the growth speed of the grafted vine cuttings. In all variants, an increase in speed was observed, from mid - July to the beginning of August, as with the approaching of the phase of wood maturation, the growth of the shoots stopped. The increase in the speed with which the shoots grew in the middle of the growing season was determined by the development of the root system of the cuttings and the larger leaf area. The length of the main shoot remained close to that of the control variant until early August, after which their fast growth was observed, as in the variant with Dual Gold 960EK, the main shoot had the smallest length, compared to the other variants. Thirty days after the use of the herbicide products, the length of the main shoot in the treated variants varied from 6.07 cm (Stomp New 330EK) to 7.75 cm (Alcans Sync Tech). A

minimal increase in length, reported for the variants compared to the control was found on the 50th day of the treatment with Alcans Sync Tech herbicide. At the end of the vegetation period all the treated variants had almost the same length of the main shoot, which was

greater than that of the control. The last readings of that parameter were on the 70th day after the planting and treatment the vine cuttings, the values of which showed that growth had been already stopped at the end of September.

Table 6. Growth dynamics of the main shoot (cm), on average for the period 2018-2021

Days Variants	30-th day	Difference	40-th day	Difference	50-th day	Difference	60-th day	Difference	70-th day	Difference
Control	6.37	-	14.65	-	23.53	-	26.98	-	40.31	-
Stomp New 330 EC	6.07n.s.	0.30	14.76n.s.	0.11	25.34n.s.	1.81	31.15n.s.	4.17	45.40n.s.	5.08
Dual Gold 960 EC	7.40n.s.	1.02	14.85n.s.	0.20	24.72n.s.	1.19	28.64n.s.	1.66	42.73n.s.	2.41
Alcans Sync Tech	7.75n.s.	1.37	14.89n.s.	0.24	24.43n.s.	0.91	30.97n.s.	3.99	44.03n.s.	3.71
LSD										
α=0.05	2.98	-	7.48	-	13.07	-	27.60	-	31.21	-
α=0.01	4.18	-	10.49	-	18.34	-	38.69	-	43.76	-
α=0.001	5.91	-	14.89	-	25.93	-	54.70	-	61.86	-

***, **, * - significant at $\alpha=0.001$, $\alpha=0.01$ and $\alpha=0.05$; n.s. - non-significant.

The dispersion analysis of the data about the both indicators (year, herbicide), determined the influence of the herbicide (factor B) on the length of the main shoot, where the power of impact was 35.68%. During the period of study, the year (factor A) and the interaction between the two factors (A x B) showed an insignificant effect on the length. The unexplained influence due to random factors was 25.67% (Table 7).

Table 7. Growth dynamics (cm) of the main shoot - impact of the factors

Source of variance	Significance	Impact of the factors (%)
Year (A)	n.s.	1.39
Herbicide (B)	n.s.	35.68
Interaction of the factors (A x B)	n.s.	4.38
Error	-	25.67

***, **, * - significant at $\alpha=0.001$, $\alpha=0.01$ and $\alpha=0.05$; n.s. - non-significant.

For the entire period of the experiment, the herbicide (factor B) had an effect on the dynamics of emergence and the growth of the main shoot of the grafted vine cuttings, while the year (factor A) and the interaction of the factors (A x B) did not have a significant effect on their speed of development. The growth and development of vine cuttings to a large extent were connected with the similarity of the main active substances (pendimethalin, s-metolachlor and clomazone) in the three tested products. The obtained results confirmed the study of Prodanova-Marinova & Staneva, 2019; Prodanova-Marinova et al., 2021), who reported

that pendimethalin and s-metolachlor did not suppress the emerging and growth of the main shoot of grafted vine cuttings. Similar results were also reported by Chelebiev (1981) and Prodanova (2013) regarding the effectiveness of the herbicide products on the weeds in vineyards.

Photosynthetic pigments are the most important component of the photosynthetic apparatus, through which the absorption of light quanta and the transformation of their energy into chemical energy is carried out. The ratio of *chlorophyll a* to *chlorophyll b* in the above-ground parts is widely used as an indicator of response to light intensity and also as an early indicator of aging. The ratio of chlorophylls to carotenoids is considered a sensitive marker that differentiates natural timely aging and aging due to environmental stress factors (Misra et al., 2012). The obtained results are presented in Table 8.

Average over the period of study, the herbicides had different effects on the synthesis of photosynthetic pigments during the growing season of the rooted vine cuttings. In the course of the treatment with Dual Gold 960EK and Alcans Sync Tech soil herbicides, a slight decrease in the content of *chlorophyll a* and *chlorophyll b*, compared to the control was found. The content of *chlorophyll a* and *b*, in the photosynthetic apparatus of the vine cuttings, in the variant with Stomp New 330EK was the same as in the control variant. The differences in the values were insignificant and did not show a clear trend of a negative effect of the herbicides.

According to Humbeck et al. (1996) and Miersch et al. (2000), changes in the content of chlorophyll pigments after exposure to soil herbicides is typical of abiotic stress, in which the content of *chlorophyll a* is initially much more reduced, compared to *chlorophyll b*. These changes in the chlorophyll content are related to the degradation of a greater part of the reaction centers of the both photosystems.

The content of *carotenoids c* in the leaves of vine cuttings varied from 0.09 mg g⁻¹ to 0.13 mg g⁻¹. All differences were insignificant and not statistically significant.

The highest value, according to the ratio of yellow to green pigments (*chlorophyll a+b* to *carotenoids c*), was reported by the variant with Stomp New 330EK – 3.09 mg g⁻¹, and the lowest by the variant with Dual Gold 960EK – 3.07 mg g⁻¹. Lower values in the ratio of green to yellow pigments are associated with increased protection against photooxidation of chlorophyll. According to Koyama (1991) and Demming-Adams & Adams (1996), one of the most important functions of *carotenoids c* in the xanthophyll cycle is the prevention of the destruction of chlorophyll molecules under the action of active oxygen forms, the amount of which increases in cells under adverse effects.

Table 8. Content of pigments (*chlorophyll a, b* and *carotenoids c*) in the leaves of grafted cuttings of Siyana vine variety, mg 100 g⁻¹, average for 2018-2021

Variants	Photosynthetic pigments				
	<i>a</i>	<i>b</i>	<i>c</i>	<i>a: b</i>	<i>(a+b): c</i>
Control	0.08 a	0.03	0.12 a	2.98 a	0.87 a
Stomp New 330EK	0.08 a	0.03	0.13 a	3.09 a	1.12 a
Dual Gold 960EK	0.07 a	0.02	0.09 a	3.07 a	0.80 a
Alcans Sync Tech	0.07 a	0.02	0.10 a	3.08 a	1.10 a
$\alpha < 0.05$	0.023	0.008	0.042	1.00	0.269

Means of the same letters are not significantly different at $\alpha < 0.05$.

CONCLUSIONS

Stomp New 330EK, Dual Gold 960EK and Alcans Sync Tech herbicides were effective against annual late-spring weeds, and less effective against *Convolvulus arvensis* L., *Cirsium arvense* Scop., and *Sonchus arvensis* L. Dual Gold 960EK and Stomp New 330EK herbicides did not cause the appearance of phytotoxicity during the growing season of the

vine cuttings. Alcans Sync Tech caused the appearance of a chlorotic halo on the first leaves of the grafted cuttings, which was overcome and did not affect their development.

Stomp New 330EK and Alcans Sync Tech provided good control of annual weeds in the vine rooting nursery, as the treated vine cuttings had the highest intensity of the main shoot growth.

The herbicides tested did not suppress bud formation and did not reduce the vigor of the main shoot. At the end of the growing season, the length of the main shoot of the treated variants exceeded that of the control.

The herbicides tested did not negatively affect the synthesis of photosynthetic pigments. Despite of the slight fluctuations in the values of the ratio chlorophylls to carotenoids, there was no evidence of premature aging due to stress factors.

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