RESEARCHES REGARDING GLYPHOSATE EFFECTIVENESS ON THE DEGREE OF WEED CONTROL IN GRAPE PLANTATION

Monica NEGREA*, Gheorghe CARCIU*, Ersilia ALEXA*, Aurel LAZUREANU*, Andreea SFETCU*

*Banat's University of Agriculture Sciences and Veterinary Medicine, Timisoara, Romania
Corresponding author: Ersilia Alexa, Banat's University of Agriculture Sciences and Veterinary Medicine Timisoara, 119 Calea Aradului, 300645 Timisoara, Romania, phone: 0040256277303, e-mail: ersilia_alexa@yahoo.com

Abstract. In this paper was determined the control degree of weeds in grape plantation, Burgund variety, when is using chemical treatments with herbicides and agro-technique measures. Herbicide used was Roundup 3 l/ha and 4l/ha (glyphosate isopropyl amine salt 360 g/l) applied in 4 experimental variants. It was determined the weed presence degree, the type of weeds destroyed and the degree of their participation. Predominant weed species in studied grape plantation, were: *Agropyron repens* (20.15%), *Geranium dissectum* (17.91%), *Capsella bursa pastoris* (15.67%) and *Avena fatua* (13.43%). *Ephemeral weeds Veronica hederifolia* and *Stellaria media* had a participation rate of 8.96%. Perennial weeds represented 40.30% while annual weeds are 59.70% . The herbicide Roundup provides most effective control in a dose of 3 or 4 l/ha, combined with mechanical weeding + 1 manual weeding, control rates being over 90%.

Keywords: glyphosate, grape plantation, weed control degree

INTRODUCTION

Glyphosate (N-methyl-glycine fosfono) is a full-action herbicide, post emergent, systemic, non selective, universal, with potential uses in all agricultural crops, is basically an agro-technique tool, whose active substance is glyphosate, which is presented as glyphosate acid form, isopropylamine salt or trimethylsulfonium salt. Glyphosate is used against monocotyledonous and dicotyledonous weeds, annual and perennial, including the *Sorghum halepense* rhizomes. Glyphosate is the active ingredient in 53 of herbicides formulation and is used to kill a variety of broadleaf weeds and grasses [20].

Glyphosate is sold in more than 100 countries being made in technical preparation as isopropyl-amine salt in aqueous solution, representing the active substance of commercial preparations Roundup (Montsanto Company), Rodeo (Dow Agrosciences), Aquamaster (Montsanto Company) [6].

Glyphosate is part of organic phosphorus compounds and has systemic action. Glyphosate is absorbed through the leaves and is transported to the end of the roots and rhizomes. Symptoms of the glyphosate action appear during of 5-10 days, the total effect is obtained after 30 days (depending on weather conditions and weed type). Symptoms of the action are manifested by yellowing, and then drying of the leaves. Glyphosate have no effect on the weed seeds [8, 21].

Glyphosate is resistant to hydrolytic and photolytic degradation. In plants, glyphosate is metabolized to amino-methyl phosphonic acid (AMPA). The half-life of glyphosate in plant products is between 10.4 to 26.6 days and the amount of residues in fruit becomes negligible after 20 days for blueberry and 13 days for raspberries [12].

Addition of inorganic substratum (ammonium nitrate in different doses), lead to a slow decrease of bio-degradation capacity of glyphosate as a result of micro-organisms attack over the available nitrogen source [2].

Studies regarding the structure and activity of edaphically microorganism community when glyphosate is added indicate a glyphosate biodegradation to Chernozem soil type, which is assured by the actinomycetes and micromycetes populations of *Pseudomonas lemonierii* and *Pseudomonas aurantiaca* [17]. A high concentration of glyphosate (4 ppm) has negative influence on the biological activity of soil [18]. Weather conditions, especially temperature variations between day and night, influences the soil microorganisms activity which affect biodegraded glyphosate percentage [4].

Glyphosate has a better efficiency on weed in intensive growth phase, in conditions of high soil moisture. Is not recommended glyphosate application in drought conditions. Avoid the use of glyphosate if rainfall is expected within 5-6 hours after application, or when is heavy dew, because it dilutes the preparation concentration on leaf surface, so is diminished its effectiveness [19].

Because glyphosate has no action to soil, for weeds control after the appearance of first crop plants, is recommended to apply a selective herbicide [10]

MATERIALS AND METHODS

The experience was set up in the experimental field of Didactic Station of Banat's University Timisoara, situated in the west side of Romania, in a 20 years old wine grape plantation with Burgund variety. The plots are close to each other, in the same environmental conditions. The plantation has a open culture system, on half grape vines, planting distance 2 m between rows and 1.2 m between plants on the row, resulting a density of 4166 grape vines to ha.

Territorial unit of soil is Cambic Chernozem, silty clay, on fine loess deposits. Morphological properties indicate a moderate stage of development, characteristic to a relatively young soil, in transition to a ground with a certain degree of maturity. The fractions composition is given by fine sand fractions (28-36%) and clay (40 to 42.0%). Heavy sand fractions (0.3 to 0.7%) is found in a small proportion and dusty fractions in a normal proportion (27-30%) [13].

The soil characteristics influence the degradation capacity of glyphosate in the presence of microorganisms. The soil sampled from the vine

plantation (Burgundy grape variety) shows a high degradation capacity, of over 85% of total glyphosate after 44 days from the treatment application [3, 5].

Burgund wine grape variety is characteristic for the Banat region, being a sort of mid-growing season (165-175 days), representing the high growth and high productivity. Biological resistance to frost is low (-20 ... -22 ^{0}C), good drought tolerance and is more resistant to grey rottenness. Sugar content accumulation is lower 185-195 g/l, has ripening over capacity, instead the content in phenol compounds is higher 2.7, and total acidity slightly increased from 5.5 to 6.3 g / l, production is high, on average of 12.14 t/ha and can reach to 20 t/ha [7].

Used herbicide was Roundup 3 l/ha and 4 l/ha (glyphosate isopropyl amine salt 360 g/l) and are based on chemical application on weeds, on the grape plantation rows. Herbicide application was performed to 1-2 days after the weed mapping, when most of them were in the stage of seedlings or plants without reproductive organs, or depending on the species, the plant with blossoms (grass) [11].

Experience is a single factorial type and studied experimental variants were:

V_1 – without herbicide and hoeing application
V_2 – Roundup (3 l/ha) + 1 mechanical hoeing
V_3 – Roundup (4l/ha) + 1 mechanical hoeing
V_4 – 2 mechanical hoeing + 2 manual hoeing
V_5 – Roundup (3 l/ha) + 1 mechanical hoeing + 1 manual hoeing
V_6 – Roundup (4 l/ha) + 1 mechanical hoeing + 1 manual hoeing

Weed mapping was done to determine the quantity and quality of weeding degree of studied plots before and after herbicide application. Data were obtained using quantitative numerical method, which represent the counting of the weeds species in the studied area (0.33 m^2), is an expeditious and sufficiently accurate method [9].

Besides the actual number of weed species found within the metric frame, was noted the weed development phase that was found to each species using the following scale of assessment: A – seedlings or plant without reproductive organs, B - plant with blossoms or in the case of grass plants, the skin stage, C – plant with flower, D – plant with fruit, E - plant with seeds or fruits which were spread.

Data processing phase consisted in primary data processing and obtain of weed sheet. Statistical data was performed according to method described by Saulescu [16].

It was established that the differences which have a probability over 5% to be found in the differences distribution, if real difference is 0, are considered *insignificant.* In this case, can be accepted the validity of the zero difference hypothesis. Differences with a probability of less than 5% of the appearance, if there are no real differences between variants, are considered *significant,* and those whose appearance, when the real difference is zero, has a probability of less than 1% are considered *distinct significant.* Significance limit of 0.1% (significant differences), usually, this classification does not give more information. If the difference obtained experimentally will be less than DL 5% we accept difference hypothesis zero and we will consider the difference as insignificant. But if the observed difference will exceed DL 5% we reject the zero hypothesis, saying, with the risk of error in 5 cases out of 100, than there is a real difference between variants [16].

RESULTS

The experimental results regarding the glyphosate effectiveness regarding degree of weed control to Burgund grape variety are presented in Tables 1-2 and Fig. 1.

Table 1. Floristic composition of weed species in control variant, without hoeing, in the Burgund vineyard culture, 2010.

No.	Weed species	Vegetation phase	Botanical class
1	*Agropyron repens*	A-C	M.p.*
2	*Geranium dissectum*	A-C	D.a.*
3	*Capsella bursa pastoris*	A-C	D.p.*
4	*Avena fatua*	A-B	M.a.*
5	*Cirsium arvense*	A-C	D.p.*
6	*Convolvulus arvensis*	B-C	D.p.*
7	*Veronica hederifolia*	A-C	D.a.*
8	*Stellaria media*	A-C	D.a.*

Species rapport number (D.a./D.p./M.a./M.p.): 3/3/1/1=8;
*D.a. - Dicotyledonous annual; D.p. - Dicotyledonous perennial; M.a. - Annual monocotyledon; M.p. - Monocotyledonous perennial.

Experience set up in the grapevine plantation, is stationary, the number of weeds/m^2 in 2010 was lower only 134 weeds/m^2 compared with year 2009.

Predominant weeds were: *Agropyron repens* (20.15%), *Geranium dissectum* (17.91%), Capsella bursa pastoris (15.67%) and *Avena fatua* (13.43%). Ephemeral weeds *Veronica hederifolia* and *Stellaria media* had a participation rate of 8.96%. Perennial weeds represented 40.30% while annual weeds were 59.70% (Table 1, Fig. 1).

After the application of agro-tehnique measures, the number of weeds is reduced from 134 weeds/m^2 (variant V_1 without herbicide application, without hoeing) to 10.51 weeds/m^2 (V_6 - Roundup (4 l/ha) + 1 hand hoeing + 1 mechanical hoeing). The control degree of weeds varies between 78.02% (V_4 - 2 hand hoeing + 2 mechanical hoeing) and 92.16% (V_6 - Roundup (4 l/ha) + 1 hand hoeing + 1 mechanical hoeing).

The herbicide Roundup provides most effective control in a dose of 3 or 4 l/ha, combined with mechanical hoeing + 1 manual hoeing, control rates being over 90%.

Variant with 2 mechanical hoeing + 2 manual hoeing, provides a control percentage of 78.02%, thanks to the large amount of precipitation fallen after the first two weed hoeing, which lead to a further reinfection with weeds, of vine experimental field (Table 2). Depending on the used control method, number of the controlled weeds range between 104.55 weeds/m^2 respectively 123.49 weeds/m^2, the difference between control variant and all other variants V_2 - V_6, are *very significant* .

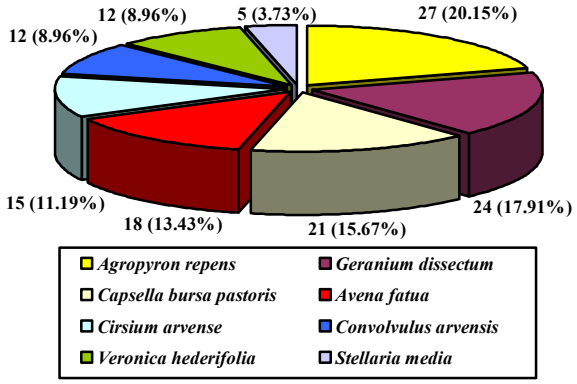

Figure 1. Number of weeds/m^2 and participation percentage (%) of weeds in the grape plantation, Burgund variety, 2010.

Table 2. Influence of agro-technique measures on the degree of weed participation, to Burgund variety, in 2010.

Experimental variant	Number of non controlled weeds/m^2	The control degree of weeds (%)	Number of controlled weeds /m^2	Difference significance*
V6	10.51	92.16	123.49	xxx
V5	13.35	90.04	120.65	xxx
V3	16.91	87.38	117.09	xxx
V2	18.40	86.27	115.60	xxx
V4	29.45	78.02	104.55	xxx
V1	**134.00**	0.00	Control	-

$DL_{5\%}$ = 4.12 weeds/m^2; $DL_{1\%}$ = 5.36 weeds/m^2; $DL_{0,1\%}$ = 7.2 weeds/m^2;
*DL - Difference Limit (number of individuals exceeds the number of existing variants); xxx - very significant; xx – distinct significant; x – significant; - Insignificant

DISCUSSIONS

The control variant for Burgund variety, Variant 1, without glyphosate application (Table 1) indicate the presence of five weeds species in studied grape plantation, with a participation percentage over 10%: *Agropyron repens, Geranium dissectum, Capsella bursa pastoris, Avena Fatua, Cirsium arvense* and 3 species with a participation rate lower than 10%: *Stelaria media, Convolvulus arvensis, Veronica hederifolia.*

The previous studies regarding control degree of weeds in grape plantation shown that, to the grape wine variety (Feteasca Regala) post emergence herbicides, Roundup (3 l / ha) and Basta (4 l / ha) associated with two hand hoeing, realized best weed control in year 1999, with a percent of 85, 57% and respectively 85.40% [10, 11].

Studies made by Nicoleta Daniela Olaru and Aurel Lazureanu, in 2002 and 2004 in the vineyard of Didactic Station of Banat's University Timisoara, showed that an effective weed control had post emergent herbicides Roundup (3 l / ha) and Touchdown (4 l / ha) in 2004 compared with 2002, the percentage being 92.08% and respectively 88.32% [14, 15].

The obtained experimental results complete previous studies made in fruit trees plantation of Banat`s University Timisoara regarding weed control in apple plantations, indicating a good efficiency of glyphosate for the Pioneer apple, both regarding weeds species and the weed combated number [1].

The results obtained by this paper come to complete previous research, made to grapevine culture regarding the glyphosate herbicide efficiency for weed control.

The originality of this scientific paper result from the study of *Glyphosate effectiveness on the degree of weed control in grape plantation,* Burgund variety, in agro-techniques conditions of Didactic Station of Banat`s University Timisoara and in climatic conditions of year 2010.

The herbicide Roundup provides most effective control in a dose of 3 or 4 l/ha, combined with mechanical hoeing + 1 manual hoeing, control rates being over 90%

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