DOES *LOLIUM PERENNE* GR COMPETITION AFFECTS GRAPE YIELD AND WINE QUALITY OF DOURO

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Summary: To assess the efficacy of post-emergence herbicide programs in *Lolium perenne* L. populations glyphosate resistant (GR), a field experiment was carried out in a Douro vineyard (North Portugal) in 2014. A random block design (RBD) experiment with 11 treatments and three replicates was implemented. Fruit size, cluster number and grape weight were determined. Quality parameters (pH, total polyphenols anthocyanin content and color intensity) were also analysed. Analyses of variance (ANOVAs) were used to test the effects of weed cover on grape yield and quality. Tukey test was used to determine the differences among group means. The results show that weed cover affects crop productivity but it does not affect fruit composition, and therefore to wine quality.

Keywords: Vineyards, cluster weight, color intensity, total polyphenols, pH.

Resumen: ***La competencia de Lolium perenne RG afecta el rendimiento de uva y la calidad del vino de la región del Duero.*** En 2014 se llevó a cabo un ensayo en un viñedo del Douro (Norte de Portugal) para evaluar la eficacia de diferentes herbicidas en post-emergencia sobre *L. perenne* GR. Se evaluó los efectos de la infestación en la productividad y calidad de la uva. La productividad se determinó midiendo el tamaño, peso y número de frutos y racimos. Los parámetros de calidad analizados fueron: pH, contenido de antocianinas, polifenoles totales e intensidad de color. El ensayo se dispuso en un diseño de bloques al azar con 11 tratamientos y 3 repeticiones. Se realizó el análisis de varianza (ANOVA) y la prueba de Tukey para observar las diferencias significativas

entre la media de la eficacia, la productividad y la calidad. Los resultados obtenidos mostraron que la producción se vio afectada por la cobertura de *L. perenne*. Sin embargo, la composición del fruto, y por lo tanto la calidad del vino no se vio alterada.

Palabras clave: Viñedo, racimo, intensidad de color, polifenoles totales, pH.

INTRODUCTION

Vineyards are the most important crop in Portugal, both in area and economically (IVV, 2015). Demarcated in 1756, Douro is the world's oldest regulated wine region where one of the world's best wines is produced. In Douro region, glyphosate-resistant populations of *Lolium perenne* were confirmed in 2012.

It is important to have in mind that vineyard cover-cropping with weeds is a soil management practice widely used between the rows. However, if the weeds are improperly managed, they may induce a strong competition with vines for water as it was shown in Portugal and in the United States (Centinari et al., 2011; Lopes et al., 2011). In order to achieve the best weed control strategy it is necessary to know the weed biology and ecology.

The additional water consumption caused by the weed can have positive or negative effects in the vineyards depending on soil, weather conditions of the year and the age and vigour of the vine. Moderate water stress in spring can be beneficial for varieties with high vegetative development potential, since it reduces vine vigour that benefits grape quality and the health of clusters (Frazão & Moreira, 1990; Pacheco et al., 1991; Maigre & Aerny, 2001; Lopes et al., 2008).

In Douro wine region, where most of the vineyards are not irrigated, summers are dry and soils have low water storage capacity. In these environmental conditions, water stress can easily occur with negative effects on physiology, growth, production of the vine and on grape quality (Monteiro et al., 2012). Having these in mind and also that GR *Lolium perenne* is present in 30% of Douro vineyards (*circa* 10 000ha), a field experiment was carried out to assess the efficacy of post-emergence herbicide programs in GR populations.

MATERIAL AND METHODS

A field trial was carried out in 2014 in a Douro vineyard (North Portugal) with *a random block design* (RBD) experiment with 11 treatments

and three replicates, each plot with $10m^{-2}$ (2x10m). Trials included herbicide treatments with early POST-only (glyphosate); 1 –pass Post (mixed herbicides with glyphosate) and 2-pass - POST (sequence of application with glyphosate followed by ACCAse- or ALS-inhibiting herbicides) – Table 1.

Table 1. Efficacy of herbicide strategies on *Lolium perenne*, expressed as percentage of control in Douro vineyard, Peso da Régua, Portugal - 2014.

Treatment (Nº)	Early postemergence-early tillering of *Lolium* (BBCH 13-18)	Tillering stage of *Lolium* (late February–early March)	Efficacy (%) 60 DAT	Interval
1	untreated		0	0
2	glyphosate 1800 g/ha		24.5	20-30
3	glyphosate 1800 g/ha	cletodim 100 g/ha	49.2	40-50
4		cletodim 100 g/ha + glyphosate 1800 g/ha	62.5	60-70
5	glyphosate 1800 g/ha	cycloxidim 250 g/ha	70	60-70
6		cycloxidim 250 g/ha + glyphosate 1800 g/ha	74.2	
7	flazasulfuron 50 g/ha + glyphosate 1800 g/ha		95.2	90-100
8	glyphosate 1800 g/ha	flazasulfuron 50 g/ha	70.8	
9		flazasulfuron 50 g/ha + glyphosate 1800 g/ha	65.7	60-70
10	glyphosate 1800 g/ha	quizalofop-ethyl 125 g/ha	62.3	60-70
11		quizalofop-ethyl 125 g/ha + glyphosate 1800 g/ha	75	

Yield assessment

Results of visual estimation at 60 days after treatment (DAT), were classified into five categories of herbicide efficacy: 0% (control); 20-30%; 40-50%; 60-70% and 90-100% (Table 1). Grape weight and cluster number were determined by individual harvest of 5 vines per subplot (25 clusters per treatment).

Grape quality

Prior to harvest a 100-grapes sample was collected from each subplot for berry weight and fruit composition. The quality parameters analysed were: pH, total acidity, total polyphenols, anthocyanin content, and color intensity. They were measured according to the International Organization of Vine and Wine (OIV) in 2014.

Statistical analysis

Data were analysed with an ANOVA using R (R Development Team, 2014). Differences among the treatment means were determined by Tukey's test at a significant level of 0.05.

RESULTS AND DISCUSSION

Yield assessment

There are significant differences in the weight of clusters that is correlated with herbicide efficacy – Table 2. The grape weight increased with herbicide efficacy. A difference of 99.7 g on mean values, between class 1 and class 5 (90 and 100% efficacy), correspond to a loss of about 19% of production between untreated and acceptable efficacy plots.

Table 2. Effect of *Lolium perenne* coverage on vineyard yield.

Class	Herbicide efficacy (%)	Bunches weight (g)	Bunches length (cm)	Weight of 100 grapes (g)
1	0	307.2 a	15.77 a	229 a
2	20-30	314.4 a	15.3 a	225.2 a
3	40-50	323.4 a	15.2 a	236.9 a
4	60-70	364.2 ab	16.4ab	244.8 a
5	90-100	406.87 b	16.7 b	241.5 a

The values are percentages and those in parenthesis are SE.
Values in a column with different letters are significantly different from each other ($\alpha < 0.05$) (Tukey's test).

Reduction of vine yield could be attributed to lower grape weight of bunches (Table 2).

Grape quality

Table 3 shows that the five quality parameters are not statistically different among herbicide efficacy classes. The effects of vineyards cover cropping on grape quality are usually indirect; the reduction of vine vigour affects positively grape health and maturity. However, these results are not in accordance with those of Lopes et al. (2011) which showed a decline in total acidity or Agulhon (1998) and Lopes et al. (2008) who found that the presence of natural groundcover vegetation lead to increase anthocyanins and color intensity.

Table 3. Effect of *Lolium perenne* coverage on grape quality.

Class	Herbicide efficacy (%)	pH	Total acidity	Anthocyanin content	Total Polyphenols	Color intensity
1	0	3.2a	3.9a	554.2a	31.9a	16.9a
2	20-30	3.2a	3.4a	550.4a	36.8a	17.4a
3	40-50	3.2a	4.0a	584.5a	35.8a	17.5a
4	60-70	3.2a	4.1a	468.7a	32.3a	15.9a
5	90-100	3.2a	3.9a	538.4a	38.4a	18.6a

Values in a column with different letters are significantly different from each other ($\alpha < 0.05$) (Tukey's test).

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