TEN GRAPEVINE ROOTSTOCKS: EFFECTS ON VEGETATIVE DEVELOPMENT, PRODUCTION AND GRAPE QUALITY OF cv. MENCIA IN THE D.O. BIERZO (SPAIN)

Jesús YUSTE[1], Ramón YUSTE[2], María V. ALBURQUERQUE[2]

[1] Instituto Tecnológico Agrario de Castilla y León
Ctra. Burgos km 119. 47071 Valladolid, Spain
[2] At present: external viticulture activity
**Corresponding author: Yuste. E-mail: yusbomje@itacyl.es*

Abstract

Grapevine rootstock is basic to achieve good adaptation of the vine to ground and environment. Given the low knowledge of the effects of different rootstocks in the agronomic behavior of cv. Mencia, an experimental trial was developed in the D.O. Bierzo during the period of 2009-2012, on a vineyard planted in 2002 in Pieros (Leon).

The vines were trained with vertical trellis, by means of bilateral Royat cordon pruning, to 3 two-bud spurs per arm, for a total of 12 buds per vine. Vine distances were of 3.0 m x 1.0 m (3,333 vines/ha) and row orientation is East-NE to West-SW. The rootstocks to study are: 110R, 140Ru, 1103P, 101-14M, 420A, 5BB, 41B, 161-49C, 333EM, SO4. The experimental design consisted of 4 randomized blocks, with an elemental plot of 30 vines.

The results showed a tendency of rootstocks SO4 and 420A to increase grape yield, and 101-14M and 5BB to reduce it, through the variation of number of clusters per vine and cluster weight. The vegetative development was clearly favored by rootstocks 5BB and 1103P, and reduced by 101-14M and 110R, which became the weakest rootstocks, mainly due to the variation of individual shoot vigor. The Ravaz index was higher in 110R, 41B and SO4 and lower in 5BB and 1103P.

The influence of the rootstock varied on several parameters of grape quality, which was partially dependent on the level of vegetative growth and grape yield achieved by each rootstock. Thus, 5BB, 101-14M and 1103P, the less productive rootstocks, increased the sugar concentration, whereas 41B and 110R reduced it. The acidity increased with 110R and 1103P, and was reduced with 333EM and 101-14M, whereas the pH value of 5BB, of highest sugar concentration, stood out from the rest. The tartaric acid in 41B and SO4 was the highest, and decreased in 333EM and 140Ru, whereas the malic acid got the highest values in 5BB and 1103P, the rootstocks of highest vegetative growth, and decreased in 101-14 M, as well as in 41B and 110R, the rootstocks of lower sugar concentration. The potassium concentration clearly increased in 5BB, a rootstock of very low production and high sugar content, and decreased in 41B, the rootstock of lowest sugar concentration, and 101-14M, whereas the total phenols index did not shown statistically significant differences between rootstocks.

***Keywords**: acidity, berry, grape yield, pruning weight, sugar.*

1 INTRODUCTION

The use of rootstocks in the cultivation of grapevine had an immediate and primary objective: the fight against phylloxera. For this reason, the first vines used as rootstock were selections of wild vines, which mostly belonged to natural pure species or hybrids. Most of them were discarded for commercial use in grafting the vines, except a few varieties of *Vitis riparia* and *V. rupestris*, as Riparia Gloire and Rupestris St. George (du Lot), or *V. berlandieri*, which were considered more appropriate (Winkler *et al*., 1974). However, currently the rootstock is mainly used to improve the adaptation of the vine to the ground on which it is planted, such as in calcareous soils, and to control certain soil pests besides the phylloxera, like the nematodes (May, 1994).

The research works related to the adaptation and improvement of rootstocks, which initially were more developed in countries like France and Germany, or in areas such as California (USA) or South Australia, many years ago, were usually aimed at achieving rootstocks resistant to phylloxera and limestone, considering the frequency of this type of soil and the severity of the problem when this bug can infect the vineyard. These objectives were not always perfectly achieved, but in the process there have been obtained some rootstocks that also have other possible qualities. These qualities represent added criteria to consider when to proceed to the choice of rootstock, such as the effect that it gives the variety, the ease of cuttings and grafting, the adaptation to local conditions (drought, humidity, salinity, etc…), the influence on the growth cycle of graft and the grape quality (Galet, 1998).

It has been shown in various circumstances, over the time, that the use of different rootstocks carries variable responses of different grapevine varieties in many wine producing regions and areas of the world (Reynier, 2002), depending on soil and climatic conditions of each growing location. Thus, in those situations where the rootstock has shown adequate adaptation to growing location, its reasonable use should not have negative effects on the quality of the grapes. Furthermore, the appropriate choice of rootstock may allow increased production efficiency in the vineyard, and therefore increasing grower profitability (Dry, 2007), depending on soil and climate conditions of the place of cultivation and production goals. The study of rootstocks and the analysis of the factors and criteria for selection should be considered very interesting for the progress of the wine sector. Therefore, these aspects should be given to the corresponding preference for experimentation and research, giving as much importance as other lines or alternative techniques that look for the increase of profitability of the vineyard, such as the improving vine water use and physiological efficiency (Sampaio and Vasconcelos, 2005), the techniques of underground irrigation, RDI (regulated deficit irrigation) or PRD (partial root-zone drying) systems, the integral vineyard mechanization or other grapegrowing alternatives. Such possible techniques are often alternatives focused on mitigate the excess of vigor and several training problems of the vineyard. In this sense, rootstocks can provide permanent answers to help solve such problems, especially those related to the scarcity of available water and its quality or to control vegetative growth of vineyard (Alburquerque *et al*., 2010).

In Spain, despite being the country with the largest acreage of vineyards for wine in the world, close to a million of hectares, a small number of rootstocks is mostly used, most of which belong to species of the genus of American origin *Vitis*, which come from crosses between the following species, *V. riparia, V. rupestris* and *V. berlandieri*, and from the crossing of these species with *V. vinifera*. Among them, the rootstocks 110 Richter, mainly, and 41B, used more specifically in areas with calcareous soils, highlight over the rest (Yuste and Albuquerque, 2011). However, the existence of growing areas with different soil and climate characteristics suggests the desirability of knowing the behavior of alternative rootstocks that can better accommodate the vineyard depending on the conditions of the crop area (Yuste and Albuquerque, 2013). This situation is also contemplated in the region of Castilla y Leon, where there have already been done some works with rootstocks, among which there have been included some trials done with cv. Tempranillo in the A.O. Rueda (Yuste and Albuquerque, 2011), the A.O. Toro (Alburquerque *et al.*, 2010; Yuste and Albuquerque, 2013) and the A.O. Cigales (Yuste and Alburquerque, 2014), with Sauvignon blanc in the A.O. Rueda (Yuste *et al*., 2013) and with Verdejo in the A.O. Rueda (Yuste and Alburquerque, 2015).

Therefore, it is considered appropriate a more intense study of rootstocks, among which should be included, in addition to the aforementioned 110R and 41B, other of different features such as 140Ru, 1103P, 101-14M, 420A, 5BB, 161-49C, 333EM and SO4, to understand their influence in different areas of Castilla y Leon.

With the aim of determining the influence of rootstock on the agronomic performance of the vineyard, it has been carried out an experimental trial with a group of 10 vine rootstocks, aimed to evaluate the influence of all of them on cv. Mencia, through the quantification of vegetative, productive and quality parameters of grapes in the D.O. Bierzo, which is located in the Norht-East part of Castilla y Leon and Spain.

2 MATERIAL AND METHODS

The field trial was carried out during the period 2009-2012 in Pieros, Cacabelos (Leon), in a vineyard owned by grapegrower Victor Arroyo, located on the D.O. Bierzo, in the Northwest of Castilla y Leon. The geographical coordinates of the trial are 42º 36' N and 6º 45' W. The vines, of red cv. Mencia, were planted in 2002 (May 27), grafted onto different rootstocks to be studied.

The vines were trellis trained with bilateral Royat cordon and vertical shoot positioning (VSP), row orientated East-NE to West-SW. Vine distances are 3.0 m x 1.0 m (3,333 vines/ha). The pruning load has been 12 buds per vine, that is per row linear meter, on 3 two-bud spurs per arm. A green pruning operation was applied each year, after the period of spring frost risk, in order to adjust the load of shoots to 12 per vine.

The treatments established consist of 10 grapevine rootstocks, which are: 110R, 140Ru, 1103P, 101-14M, 420A, 5BB, 41B, 161-49C, 333EM and SO4. The experimental design has been of randomized blocks, with 4 replications of 30 vines and elemental plot of 10 control vines.

The soil of the vineyard is deep enough for adequate development of vineyard, and homogeneous on surface. It does not show remarkable stony elements, but there is good drainage as a whole. The vineyard has orographic disposition with certain slope, homogeneous and increasing in the east to west direction. The water regime of the vineyard has been rainfed, without irrigation throughout the study period.

The statistical analysis of the results has been done through variance analysis (ANOVA), taking as repetition the average value of each of 4 years of study, by means of the STATISTICA program, and applying the Duncan test to separate means when necessary.

Monthly average data of temperature and rainfall in the area of the field trial, for the period 2009-2012, are detailed in tables 1 to 4.

Table 1. Temperature and rainfall (precipitation) average values of the season 2009 (October-2009 / September-2010), registered in Carracedelo (Leon). Tm: average temperature (ºC), Tmax: maximum temperature (ºC), Tmin: minimum temperature (ºC), P: rainfall (mm).

2008-2009	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	*Year*
Tm	10.9	4.9	3.6	4.6	5.8	9.5	9.8	15.5	19.3	19.2	20.4	17.0	*11.7*
Tmax	25.4	18.9	13.6	15.3	22.4	26.7	27.3	32.7	33.9	33.7	35.0	34.9	*26.7*
Tmin	-2.3	-6.7	-6.0	-8.6	-4.9	-3.5	-3.3	-0.7	6.1	4.8	6.8	2.0	*-1.4*
P	8.6	3.8	10.0	91.8	11.2	3.2	4.6	29.0	12.6	2.0	0.6	6.2	*184*

Table 2. Temperature and rainfall average values of the season 2010 (October-2009 / September-2010).

2009-2010	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	*Year*
Tm	13.3	9.4	4.2	4.2	5.2	7.6	12.6	14.0	18.0	22.0	20.7	16.8	*12.3*
Tmax	28.3	20.5	16.3	14.3	18.5	21.4	29.2	32.5	33.6	36.7	36.1	33.3	*26.7*
Tmin	-1.5	0.3	-10.3	-7.1	-7.5	-6.0	-1.5	-1.3	2.3	6.4	5.9	1.8	*-1.5*
P	44.8	135.0	210.2	119.2	138.0	81.0	38.2	52.8	51.4	4.8	0.0	20.4	*896*

Table 3. Temperature and rainfall average values of the season 2011 (October-2010 / September-2011).

2010-2011	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	*Year*
Tm	11.5	6.9	3.6	4.9	4.9	8.4	13.9	16.2	17.8	18.9	19.9	17.4	*12.0*
Tmax	24.0	19.0	17.7	14.1	19.4	24.1	31.5	30.3	37.2	33.2	35.5	33.6	*26.6*
Tmin	-0.8	-6.3	-7.1	-7.7	-6.7	-4.4	0.3	0.3	0.0	6.0	3.5	1.4	*-1.8*
P	144.2	103.2	117.0	111.4	66.4	59.6	43.4	22.4	5.4	8.4	34.6	9.6	*726*

Table 4. Temperature and rainfall average values of the season 2012 (October-2011 / September-2012).

2011-2012	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	*Year*
Tm	11.7	8.0	4.8	2.2	3.8	9.9	9.0	15.5	17.8	19.6	19.9	17.7	*11.7*
Tmax	30.7	20.7	15.3	14.9	22.8	25.7	24.8	33.8	37.6	36.9	37.4	23.9	*27.0*
Tmin	-2.4	-2.6	-5.6	-6.9	-10.3	-4.7	-0.2	3.4	0.0	3.8	4.0	2.9	*-1.6*
P	43.0	73.8	28.6	15.8	0.4	10.0	72.4	50.0	29.7	5.8	15.1	20.7	*365*

3 RESULTS AND DISCUSSION

3.1 Vegetative development

The total number of shoots per vine showed slight differences between treatments, favorable to rootstocks 420A and 333EM and unfavorable to 110R and SO4, mainly due to the number of watershoots, since the number of count shoots did not show noticeable differences between rootstocks (Table 5). The absence of differences in the number of count shoots is related to the adjustment of shoot load carried by early green pruning each year, which resulted in an average of just over 11 count shoots per vine, whereas the average number of total shoots was lightly higher than 12.5 per vine.

Table 5. Number of count shoots, Number of watershoots and Total number of shoots per vine, Pruning wood weight (kg/vine), Shoot weight (g) and Ravaz index, for rootstocks: 110R, 140Ru, 1103P, 101-14M, 420A, 5BB, 41B, 161-49C, 333EM and SO4. Average values of period 2009-2012. Levels of statistical significance (Sig.): - = non significative; * = p< 5%; ** = p< 1%.

Rootstock	Count shoots	Watershoots	Total shoots	Pruning w.	Shoot w.	Ravaz
110R	10.8	1.5 bc	12.3 b	0.630 c	51.5 c	8.65 a
140Ru	10.9	1.7 bc	12.7 ab	0.756 b	60.2 b	7.55 b
1103P	11.1	1.6 bc	12.7 ab	0.816 a	64.7 a	6.56 bc
101-14M	11.2	1.3 c	12.6 ab	0.630 c	50.0 c	7.48 b
420A	11.2	2.0 ab	13.3 a	0.795 ab	60.1 b	7.47 b
5BB	11.0	1.7 bc	12.7 ab	0.878 a	69.6 a	5.47 c
41B	11.1	2.6 a	12.8 ab	0.700 bc	55.3 bc	8.24 a
161-49C	11.0	1.7 bc	12.7 ab	0.743 b	59.0 b	7.37 b
333EM	11.2	2.1 ab	13.3 a	0.755 b	56.9 bc	7.29 b
SO4	11.0	1.5 bc	12.5 b	0.789 ab	63.2 ab	8.21 a
Sig.	-	*	*	**	**	**

The pruning wood weight was clearly higher in 5BB and 1103P, with an average value over 800 g/vine, than in most rootstocks, with statistically significant differences except with respect to 420A and SO4. The rootstocks that showed significant lower vegetative development were 110R and 101-14M, with average values of 630 g/vine. The rest of rootstocks showed average values between 700 and 755 g/vine. The rootstock 5BB showed an average increase in pruning weight of 39% with respect to 101-14M in average of all the years of study. The trend observed in shoot vigor was similar to the weight of pruning wood, also being the rootstocks 5BB and 1103P, with more than 64 g, of heaviest shoot weight, and resulting significantly more vigorous than most rootstocks, especially in comparison with 101-14M and 110R, which showed values around 51 g.

The Ravaz index showed statistically significant differences favorable to rootstocks 110R, 41B and SO4, with average values greater than 8, and unfavorable to 5BB, especially, with an average value lower than 5.5, and to 1103P, with an average value of 6.6. The rest of rootstocks showed intermediate values, between 7.3 and 7.5.

Based on the results obtained, the rootstocks that generally showed greater vegetative development were 5BB and 1103P, and those that showed less vegetative development were 101-14M and 110R, mainly due to the differences observed in the shoot vigor.

3.2 Grape production

The use of various rootstocks caused statistically significant differences in grape yield of cv. Mencia favorable to rootstocks SO4 and 420A, with average values of 6.3 and 5.9 kg/vine respectively, followed by 140Ru, with 5.7 kg/vine. The statistically significant differences have been unfavorable to 101-14M, with 4.6 kg/vine, and to 5BB, with 4.7 kg/vine (Table 6). The rest of rootstocks showed intermediate values, between 5.3 and 5.4 kg/vine. The rootstock SO4 showed an average increase in grape yield of 38% with respect to 101-14M in average of all the years of study.

The grape yield differences observed among treatments were partially due to the number of clusters per vine, with significant differences clearly favorable to rootstock SO4, which showed an average value of 22.0 clusters per vine, as well as to 420A, with 20.7 clusters per vine, and highly unfavorable to 101-14M, with 18.1 clusters per vine. The rest of rootstocks showed average values between 19.0 and 20.4 clusters per vine. Logically, the fertility, expressed through the number of clusters per shoot, showed a similar trend as the number of clusters per vine, with statistically significant differences remarkably favorable to SO4 and noticeable unfavorable to 101-14M.

Table 6. Grape yield (kg/vine), Number of clusters / vine, Weight of cluster (g), Weight of berry (g), Number of berries per cluster and Real fertility (clusters / shoot), for rootstocks: 110R, 140Ru, 1103P, 101-14M, 420A, 5BB, 41B, 161-49C, 333EM and SO4. Average values of period 2009-2012. Levels of statistical significance (Sig.): - = non significative; * = p< 5%; ** = p< 1%.

Rootstock	**Grape yield**	**Clusters**	**Cluster w.**	**Berry w.**	**Berries/ cluster**	**Fertility**
110R	5.35 bc	19.8 b	270 ab	1.89 ab	144 ab	1.65 b
140Ru	5.66 b	20.4 b	276 ab	1.94 a	143 ab	1.70 b
1103P	5.25 bc	19.6 b	266 b	1.96 a	136 b	1.64 b
101-14M	4.59 c	18.1 c	250 bc	1.86 b	135 b	1.51 c
420A	5.90 a	20.7 ab	283 a	1.90 ab	150 a	1.73 ab
5BB	4.74 c	19.5 b	235 c	1.66 c	142 ab	1.63 bc
41B	5.41 bc	20.4 b	261 b	1.85 b	144 ab	1.70 b
161-49C	5.31 bc	19.0 bc	276 ab	1.93 a	144 ab	1.59 bc
333EM	5.42 bc	20.4 b	264 b	1.93 a	137 b	1.70 b
SO4	6.33 a	22.0 a	284 a	1.91 ab	150 a	1.84 a
Sig.	**	*	**	*	*	*

Cluster weight was a yield component decisive for the variations in grape yield, with significantly higher values of rootstocks SO4 and 420A, with average values of about 284 g, followed by 140Ru, 161-49C and 110R, with values of 270 to 276 g. The rootstock 5BB showed a significantly lower cluster weight than the other rootstocks, with a value of 235 g. The berry weight partially contributed to the trend observed in cluster weight, with significantly higher values of 1103P, 140Ru, 161-49C and 333EM, between 1.93 and 1.96 g. The rootstock 5BB showed a significantly lower average value of berry weight than the other rootstocks, of 1.66 g. The number of berries per cluster also significantly contributed to the differences in the weight of cluster, in such a way that rootstocks SO4 and 420A, with 150 berries per cluster, led to significantly higher values than most other rootstocks, while 101-14M, 1103P and 333EM generated the lowest average values, of about 136 berries per cluster. The rest of rootstocks, 110R, 140Ru, 5BB, 41B and 161-49C, showed intermediate average values of around 143 berries per cluster.

In summary, the different rootstocks caused clear differences in grape yield, highlighting as more productive the rootstocks SO4 and 420A, and as less productive the rootstocks 101-14M and 5BB.

3.3 Grape composition

The concentration of sugars or soluble solids showed an increasing tendency of the less productive rootstocks, 5BB especially, with an average value of 23.3 ºbrix, and 101-14M and 1103P, with values around 22.7 ºbrix, being the observed differences statistically significant with respect to most other rootstocks (Table 7). On the contrary, the rootstock 41B, with an average value of 21.4 ºbrix, and 110R, with a value of 21.8 ºbrix, showed the lowest average values of sugar concentration.

The titratable acidity hardly showed significant differences between some rootstocks, although the value of 110R, 4.43 g/L, and the value of 1103P, 4.40 g/L, were significantly higher than those of rootstocks with the lowest values, 333EM and 101-14M, of about 4.12 g/L. Logically, the pH of must did not show many remarkable differences between rootstocks, although the highest value of 5BB, the rootstock of higher sugar concentration, 3.67, and the lowest values of 110R, 41B and SO4, between 3.53 and 3.56, were noticeable.

The tartaric acid showed significant differences especially favorable to the rootstocks 41B and SO4, with values of 5.50 g/L, and significantly unfavorable to 333EM and 140Ru, with values of 5.17 g/L. The malic acid showed significant differences favorable to the rootstocks 5BB and 1103P, the rootstocks of higher vegetative growth, with values of 1.84 g/L and 1.78 g/L respectively, whereas 101-14M, with 1.48 g/L, as well as 41B and 110R, the rootstocks of lower sugar concentration, showed average values of malic acid significantly lower, 1.51 and 1.55 g/L respectively, than the rest of rootstocks.

The potassium concentration showed significant differences between some treatments, with highlighting average value of rootstock 5BB, very little productive, of 1.75 g/L, and clearly lower average values of 41B, the rootstock of lowest sugar concentration, 1.54 g/L, and 101-14M, 1.59 g/L.

The total phenols index failed to show statistically significant differences between treatments, with similar numeric average values between rootstocks, in spite of the differences observed in several vegetative and productive aspects between the rootstocks studied.

Table 7. Soluble solids content (ºbrix), pH, Titratable acidity (g of tartaric/L), Tartaric acid (g/L), Malic acid (g/L), Potassium (ppm) and Total phenols index (TPI), for rootstocks: 110R, 140Ru, 1103P, 101-14M, 420A, 5BB, 41B, 161-49C, 333EM and SO4. Average values of period 2009-2012. Levels of statistical significance (Sig.): - = non significative; * = p< 5%; ** = p< 1%.

Rootstock	**Soluble solids**	**pH**	**T. acidity**	**Tartaric A.**	**Malic A.**	**Potassium**	**TPI**
110R	21,8 bc	3,53	4,43 a	5,39 ab	1,55 b	1614 ab	14,9
140Ru	22,1 b	3,58	4,38 ab	5,18 b	1,69 ab	1607 ab	14,6
1103P	22,6 ab	3,61	4,40 a	5,24 ab	1,78 a	1680 ab	15,6
101-14M	22,7 ab	3,60	4,13 b	5,21 ab	1,48 b	1586 b	15,4
420A	22,2 b	3,60	4,36 ab	5,26 ab	1,73 ab	1654 ab	15,4
5BB	23,3 a	3,67	4,32 ab	5,38 ab	1,84 a	1749 a	15,5
41B	21,4 c	3,55	4,33 ab	5,51 a	1,51 b	1541 b	15,4
161-49C	22,3 b	3,58	4,33 ab	5,46 ab	1,67 ab	1709 ab	14,8
333EM	22,1 b	3,59	4,12 b	5,17 b	1,60 ab	1663 ab	15,0
SO4	22,2 b	3,56	4,36 ab	5,50 a	1,67 ab	1676 ab	15,6
Sig.	*	*	*	*	*	*	-

4 CONCLUSION

The use of different vine rootstocks caused some changes in vegetative growth and grape yield in cv. Mencia, which were more or less extensive depending on the rootstock. Overall, the rootstocks 5BB and 1103P caused greater vegetative growth, expressed through the increased pruning wood weight, closely correlated with the vigor of the shoot. On the other hand, the rootstocks 101-14M and 110R showed smaller vegetative growth than the rest of rootstocks. The increase of pruning weight of 5BB with respect to 101-14M and 110R has been of 39%.

The rootstocks SO4 and 420A were the most productive, whereas the less productive rootstocks were 101-14M and 5BB. The differences in grape yield were due to the variations in the number of clusters per vine, therefore due to fertility, as well as to the cluster weight. The average increase of grape yield of SO4 with respect to 101-14M has been of 38%.

The combination of vegetative performance and productive response resulted in higher values of the Ravaz index in 110R, 41B and SO4, higher than 8, and remarkably lower values in 5BB, especially, of about 5.5, and 1103P, of 6.6.

The influence of rootstock in grape quality was variable, having partly depended on the level of vegetative growth and grape yield achieved by each rootstock. The sugar concentration was higher in the less productive rootstocks, 5BB especially, and 101-14M and 1103P, and was lower in rootstocks 41B and 110R. The titratable acidity was higher in 110R and 1103P and lower in 333EM and 101-14M, whereas the higher pH level of 5BB, the rootstock of highest sugar concentration, highlighted over the rest. The tartaric acid highlighted in 41B and SO4 and decreased in 333EM and 140Ru, whereas the malic acid highlighted in 5BB and 1103P, the rootstocks of higher vegetative growth, and clearly decreased in 101-14 M, as well as in 41B and 110R, the rootstocks of lower sugar concentration.

The potassium concentration clearly increased in 5BB, a rootstock of very low production and high sugar concentration, and decreased in 41B, the rootstock of lowest sugar concentration, and 101-14M, whereas the total phenols index did not show statistically significant differences between rootstocks.

Consequently, the choice of a specific rootstock with cv. Mencia should be done according to the evaluation of its response to environmental conditions, and the intended productive and qualitative targets in each local grow situation.

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