Scientia Agraria Paranaensis – Sci. Agrar. Parana.
ISSN: 1983-1471 – Online

ROOTSTOCKS IN DEVELOPING RUSTIC GRAPEVINE IN TWO COUNTIES IN WEST OF PARANÁ STATE, BRAZIL

Fabíola Villa[1*], Paulo Antonio Dall'Oglio[2], Célio Potrich[2], Luciana Alves Fogaça[3]

SAP 19664 Data de envio: 08/06/2018 Data de aceite: 18/07/2018
Sci. Agrar. Parana., Marechal Cândido Rondon, v. 18, n. 2, abr./jun., p. 160-167, 2019

ABSTRACT - The vine, when studied in different places and years, allow extensive conclusion on cultural adaptation in a specific region. The objective of this research was to evaluate two rootstocks and three cultivars of rustic grapes under bench grafting at Toledo and Ouro Verde do Oeste (Paraná State, Brazil). Both researches were conducted in a private property, evaluating forming and plant development and of this plants in field. Bench grafting was used for plant forming, by saddle graft. After 90 days grafting root percentage and graft union were evaluated. Then, plants were conducted in field and after 15 days the average sprouting height and number of surviving plants was analyzed. Past 120 days the second phase that consisted of: diameter of horizontal cordon, number of grow plants, number of gems and number of branches than reach the second, and third line of the support system was evaluated. The experiment design was of randomized blocks with factorial arrangement 2x3x2. When the arrangement wasn't significant for triple and double interaction, each experiment was analyzed alone in factorial arrangement 2x3. All parameters did not show influence concerning local. In the first phase only height of sprouting was significantly at Ouro Verde do Oeste. The IAC-766 Campinas rootstock was better than 420-A to Bordô variety. In the second phase, the IAC-766 Campinas rootstock was more vigorous than 420-A to form a vineyard. Both rootstocks and cultivars are indicated to both counties.
Keywords: *Vitis* spp., american grapes, saddle graft, compatibility.

PORTA-ENXERTOS NO DESENVOLVIMENTO DE VIDEIRAS RÚSTICAS EM DOIS MUNICÍPIOS DO OESTE PARANAENSE

RESUMO - A videira, quando estudada em diferentes locais e anos, permite conclusões mais abrangentes sobre a adaptação da cultura em uma região específica. Objetivou-se com este trabalho avaliar dois porta-enxertos e três cultivares de uva rústica submetidas à enxertia em Toledo e Ouro Verde do Oeste (Paraná, Brasil). Ambas os experimentos foram realizados em uma propriedade privada, avaliando-se a formação e desenvolvimento incial de plantas e de plantas a campo. Na formação das plantas utilizou-se a enxertia de mesa por garfagem simples. Após 90 dias, foram avaliados o percentual de pegamento de enxertia e enraizamento. Em seguida, as plantas foram conduzidas em campo e após 15 dias a altura média de brotação e o pegamento de plantas foram analisados. Passados 120 dias realizou a segunda fase, avaliando-se o diâmetro do cordão esporonado, número de plantas de crescimento, número de gemas e número de ramos que atingem o segundo e terceira fio do sistema de condução. O delineamento experimental utilizado foi blocos casualizados, em arranjo fatorial 2x3x2. Quando o arranjo não foi significativo para interação tripla e dupla, cada experimento foi analisado isoladamente em arranjo fatorial 2x3. Todos os parâmetros avaliados não mostraram influência sobre o local dos experimentos. Na primeira fase, apenas a altura de brotação foi significativa em Ouro Verde do Oeste. O porta-enxerto IAC-766 Campinas foi superior ao 420-A para a cultivar Bordô. Na segunda fase, o porta-enxerto IAC-766 de Campinas foi mais vigoroso que o 420-A na formação do vinhedo. Ambos os porta-enxertos e cultivares são indicados para os dois municípios.
Palavras-chave: *Vitis* spp., uvas americanas, garfagem simples, compatibilidade.

INTRODUCTION

There is a great variability in vine cultivation in the state of Paraná, Brazil, comprising various places and crops (BOTELHO et al., 2014). Thus, repeating the present research became a necessity, assessing distinctive places, through many years, seeking to find a larger range of conclusions.

The adaptation of rustic vines in regions of subtropical climate, specifically South of Brazil, is described in the literature as a factor of success in the formation of vines. Another factor that influences in this choice is flexibility in commercialization, which comprises fresh consumption or processing (RICCE et al., 2014).

Among the most produced rustic grapevines in the West part of Paraná State, Bordô, Isabel Precoce and Niagara Rosada can be highlighted (VILLA et al., 2018a, VILLA et al., 2018b). Niagara Rosada is designed to *in natura* consumption and production of juices and wines, it

[1]Professora Adjunto, Dra., Universidade Estadual do Oeste do Paraná (Unioeste), *Campus* Marechal Cândido Rondon, Paraná, Brasil. CEP.: 85960-000. E-mail: fvilla2003@hotmail.com. *Autora para correspondência.
[2]Mestre em Agronomia, Universidade Estadual do Oeste do Paraná (Unioeste), *Campus* Marechal Cândido Rondon, Paraná, Brasil. CEP.: 85960-000. E-mail: paulodalloglio@hotmail.com.
[3]Professora Dra., Pontifícia Universidade Católica (PUC), Campus Toledo, Paraná, Brasil. E-mail: luciana.f@pucpr.br.

is also characterized by foxed aroma and a great acceptance in the internal market as a table grape (KUHN et al., 2007).

Isabel Precoce is used for production of juices, wines, and as an alternative for table since its production is early due to its premature maturation. Bordeaux is used as a complement to the production of juice, wines, and derivatives by reason of the strong colorant concentration, providing an excellent coloration and aroma (EMATER, 2013).

It is recommended, in vine formation of rustic cultivars, some compatible rootstocks. Rootstocks are commonly characterized according to the force offered to the graft (CORTELL et al., 2008). Due to its large amount, information about its natural habitat and their genetic makeup is used to help determine the most adequate for each particular vine. But characterizing a rootstock only by its parental species is an useful generalization. Only through experiments or testing, the assigned value to a rootstock relative soil, disease resistance and other agronomic conditions can be proven (RENOUF et al., 2010).

The use of 420-A and IAC-766 Campinas rootstocks for the West of Parana State represents 90% of used rootstocks (BORGES et al., 2014). The 420-A's (*V. berlandieri* x *V. riparia*) vigor is from little to medium; it is considered of low rooting and has a restricted use in Brazil (CAMARGO, 2014). The IAC-766 Campinas originates from the crossing of Riparia do Traviú (*V. riparia* x (*V. rupestris* x *V. cordifolia*) x *V. caribaea*, differing from the others due to its adaptation to hot regions. It is more vigorous than 420-A, it presents good roots formation and adaptation to sandy, clay, and acid soils, and plenty affinity with Niagara Rosada and Vênus variety (MOURA et al., 2011).

An alternative technique that has been used in the spread of vine seedlings is bench-grafting table. It consists of rootstocks and cup radicular system development, at the same time, accelerating the plant's formation, allowing, this way, a first production on the following year after seeding plantation in field (KUHN et al., 2007; REGINA et al., 2012).

In order to accomplish a satisfactory result, it is necessary a great affinity between rootstocks and cups, use of plant growth regulator (auxins, especially the indole butyric acid or IBA), and aptitude of rootstocks for rooting (REGINA et al., 2012). The present work aimed at evaluating the development of cultivars rustic vines spread by bench grafting table under two rootstocks in distinct locations on the South of Paraná State, Brazil.

MATERIAL E METHODS

The first plant material experiment was obtained in the Fruticulture Demonstrative Unit (UDF)/EMATER, located in the city of Quatro Pontes, Paraná State, Brazil. For the second experiment, the used plant material was extracted from the place of the first experiment, city of Toledo, state of Paraná, Brazil.

Experiments were done in two private areas. The first happened in Toledo, in the Ventura property, located in São Valentin line, under latitude geographic coordinate 24º43'04" S, longitude 53º43'58" W and altitude of 562 m, between July/2011 and August/2012.

The second occurred in the city of Ouro Verde do Oeste, Xamã's farm, line district João Gomes, under the geographic coordinates of latitude 24º 48' 48" S, longitude 53º 56' 01" W and altitude of 451 m, between July/2013 and August/2014.

According to Köppen's classification, the climate of these two experimental areas is *Cfa* type (subtropical humid zone), with an average temperature on the coldest month beneath 18ºC (mesothermal), with average temperature on the hottest month below 22ºC, with hot summers, infrequent frosts and tendency to rain concentration in summer months, with no defined dry season. The soil where mother plants are installed is oxisol type.

Both experiments followed the same propagation methodology and vine formation. The used experimental design in both was randomized block, in factorial scheme 2 x 3 x 2 (rootstocks x grafts x sites), comprising 4 repetitions of 20 cutting for each treatment on the first experiment and 4 repetitions of 8 plants for each treatment in the second experiment.

In the first phase plant formation was studied, and in the second, initial development of the vine. Vine cultivars branches were collected through winter pruning of 30-35 cm length, 1.0-1.5 cm diameter and 4-5 gems, grafted one day after stake collection. Posteriorly, seedlings were submitted to IBA plant growth regulator treatment (1000 mg L^{-1} IBA) for 10 s and afterwards emerged in water for seven days. Next, they were laid in plastic bags (18 x 30 cm), added on high clay level oxisol and identified according to the treatments.

Cuttings were kept in a masonry construction built on a plain surface up to plant formation, 1,0 x 10,0 m length, and shade 18% to 2,0 m of soil. Irrigations were twice a week, in a way to always maintain the substrate humid. The percentage of grafting gripping and rooted plants was evaluated after 90 days. Grafting gripping was considered when the plant presented shoot formation in gems above point of the graft. For the rooting percentage roots formation in plants extremity was verified.

The trellising system (double cordon) was built in field during the period of formation of seedlings, and it is constituted by three wire strands, being the first 1,00 m from the soil, the second 1,30 m from the soil, and the third one 2,00 m from the soil. In the first experiment pit and surface liming was done in order to raise base saturation to 80% and posteriorly basic fertilization, according to soil analysis (Table 1) and Emater's orientation (2013). In the second experiment only maintenance fertilization was performed, since soil analysis did not show the necessity for liming or correction fertilization (Table 2).

After evaluating the grip percentage of grafts and rooted plants, the seedlings were taken to the field and planted with a spacing of 1,25 m between the plants and

2,00 m between lines. After the transplant, the survival percentage of the plants was analyzed (by counting the surviving plants 15 days after planting) and also budding length, through the measure of the lowest extremity of the budding gem until the last output of new leaves.

TABLE 1 - Chemical analysis of soil before 1st experiment implantation.

Depth	pH	P	K^+	Ca^{2+}	Mg^{2+}	Al^{3+}	H^+Al^{3+}	T	V
cm		mg dm^{-3}	----------$cmol_c.dm^{-3}$----------						%
0-20	4,60	45,90	0,39	3,41	1,14	0,58	8,36	13,30	37,14

TABLE 2 - Soil chemical analysis of the area before 2nd experiment implantation.

Depth	pH	P	K^+	Ca^{2+}	Mg^{2+}	Al^{3+}	H^+Al^{3+}	T	V
cm		mg dm^{-3}	---------- $cmol_c.dm^{-3}$ ----------						%
0-20	5,70	15,20	1,14	12,9	3,84	0,00	3,18	21,14	84,6

In the second stage budding graft was conducted up to the first strand of the sustentation system, being blunted in order to promote the break of the apical dominance and induction of side buds to form spore cord. From this period until vine dormancy once a week all-cultural treats inherent to vine formation were done, such as thinning budding rootstocks, branches disconnection, tutoring, branches tying, among others.

During the past 60 days after seedlings plantation in field, the use of fungicides, three times a week, was performed, with rotation of the following active ingredients: Tiofanato Metil, Mancozeb, Metiran + Riraclostrobina, Femoxadone + Mancozeb, Azoxystrobin, Difenoconazole, Cymoxanil + Mancozeb and copper oxychloride. After this period, agrochemicals use was reduced and its necessity was based according to climate conditions of precipitation and humidity presented until plants dormancy.

Around August 2011 and 2014, before the achievement of the first production pruning, the number of formed plants was evaluated. By using digital caliper, plants considered formed were the ones that presented spore cord with diameter higher than 5 mm for both sides, according to Abreu et al. (2016) methodology. The number of productive gems of each plant (by counting) and the number of branches that reached the second and third strands of sustentation system were also measured.

When neither triple nor double occurred (rootstock x variety), the counties were evaluated separately. Collected data were analyzed though Sisvar software (FERREIRA, 2011), using Tukey's test for average comparing, under a 5% probability of error.

RESULTS AND DISCUSSION

Since the mean square relation of individual analysis shows a proportion inferior to 4:1, a combined analysis of the places in which researches were performed was possible. According to combined analysis of variance, the first phase did not show triple interaction (rootstocks x variety x place) nor double (rootstocks x variety). This way, the analysis of each county was performed separately (Tables 3 and 4). Table 4 shows the non-significance budding length in vines cultivated in Toledo.

Only for the budding length in Ouro Verde do Oeste (Table 5) interaction between rootstock and Bordô cultivar (25,97 to IAC-766 Campinas e 24,49 to 420-A, respectively) was verified, probably due to high temperature in August 2014 in Ouro Verde do Oeste, attesting the better adaptation of IAC-766 Campinas to higher temperatures.

A factor that can explain the lack of significance of the places is the similarity of edaphoclimatic conditions of the counties. Both areas are in similar altitudes (562 m Toledo and 451 m Ouro Verde), in a soil with high proportion of clay (74% Toledo and 78% Ouro Verde), also with similar climate conditions. In addition, during seedling formation the substrate humidity was controlled and plants were covered when temperature was above 10ºC, at night. The qualities of the collected material and environmental control conditions during grafting performing (humidity, temperature, cleaning of the place and the used tools) corroborate these results.

TABLE 3 - Budding length (cm) on three grafted cup cultivars in two vine rootstocks, after 120 days, in Ouro Verde do oeste (Paraná State).

Vine rootstocks	Vine variety		
	Isabel Precoce	Niagara Rosada	Bordô
420-A	26,52 a*	23,98 a	24,49 b
IAC-766 Campinas	25,97 a	23,62 a	25,97 a
CV (%)		2,96	

*Averages followed by the same letter in the column are not different from one another by the Tukey's test, $p<0,05$.

TABLE 4 - Budding length (cm) on grafted cup cultivars in vine rootstocks in Toledo (Paraná state).

Vine rootstocks	Budding length (cm)
420-A	25,58^{ns}*
IAC-766 Campinas	25,39^{ns}
Vine variety	
Isabel Precoce	24,8^{ns}
Niagara Rosada	24,61^{ns}
Bordô	25,04^{ns}
CV (%)	8,61

*ns = not significant.

Table 5 describes the results found for grafting gripping, rooting and seedlings survival after planting in the field. It is clear by the high values of graft gripping that incompatibility between the rootstocks and cup cultivar did not occur, since one of the main symptoms of incompatibilities is the complete or low percentage of bonding between the parts (HARTMANN and KESTER, 2011).

TABLE 5 - Graft gripping (GG), rooting percentage (RP) and field survival of rootstocks (SR) and vine variety.

Vine rootstocks	GG (%)		RP (%)		SR (%)	
	Too	O.V	Too	O.V	Too	O.V
420-A	87,92 a*	85,41^{ns}	98,58^{ns}	97,66^{ns}	100^{ns}	98,96^{ns}
IAC-766	76,66 b	85,33^{ns}	90.03^{ns}	92,4^{ns}	98,95^{ns}	100^{ns}
Vine variety	GG (%)		RP (%)		SR (%)	
	Too	O.V	Too	O.V	Too	O.V
Isabel Precoce	85,62^{ns}	93,50 a	99,06^{ns}	93,25 b	100^{ns}	100^{ns}
Niagara Rosada	81,24^{ns}	81,0 b	97,62^{ns}	97,38 a	98,43^{ns}	100^{ns}
Bordô	78,00^{ns}	81,62 b	98,68^{ns}	94,5 a b	100^{ns}	98,44^{ns}
CV (%)	5,86	6,79	1,83	2,86	2,56	3,0

*Averages followed by the same letter in the column are not different from one another by the Tukey's test, $p<0,05$. Too = Toledo e O.V = Ouro Verde do Oeste. *ns = not significant.

Table grape grafting allows the union of the rootstock to the cup cultivar without climatic interferences and without soil contact, making the material free of fungi contamination. During the process of grafting, verifications on the rootstock and cup cultivar changes were carefully done, making sure that they presented the biggest region of contact possible seeking to promote good formation for a new shift and later a new xylem and phloem between the parts (KUHN et al., 2007).

The analysis of each county separately, shows that in Toledo, the 420-A presented a higher average of gripping (87,92%) than the IAC-766 Campinas, (76,66%), however, in Ouro Verde do Oeste there was no difference from IAC-766 Campinas. The higher percentage measured in 420-A in Toledo can be explained by the source relation, rootstock drain and cup cultivar. The lower vigor of 420-A makes sap circulation between the rootstock (source) and graft (drain) slower, facilitating scar and tissue formation, a process known as vine welding (REZENDE and PEREIRA, 2001).

Hartmann and Kester (2011) complement this explanation proposing that grafted vigorous cup cultivar in a rootstock of low to medium vigor (such in the case of 420-A rootstock) stimulates plant growth, making this one greater than the ones that were not grafted. Also according to the authors, the inversion is also true, a vigorous rootstock with less vigorous cultivar, will have a lower plant and root system growth.

Non-significance in Ouro Verde do Oeste derives from the difference of temperature within the years the experiments were performed. Figure 1 shows that in Ouro Verde winter temperatures were not as low as in Toledo, making plants leave dormancy stage earlier, and influencing result similarity.

Another research, performed near Toledo and Ouro Verde do Oeste, Silva et al. (2010) verified that rootstock 420-A promoted a better grafting number in cultivar BRS Violeta comparing to IAC-766 Campinas rootstock. Regina et al. (2012) observed greater percentages of grafting gripping in camp between cup cultivar Syrah and IAC-766 Campinas rootstock (67,6%) when compared to 420-A (5,13%). Concerning the high percentage of rooting, vine rootstocks did not show great difficulties of rooting when propagated through woody cuttings (MAYER et al., 2006).

High rooting percentage (over 90%), can be

explained by the fact that rootstocks cultivars has been selected over time to easily root. Another important fact is that both 420-A and IAC-766 Campinas have *Vitis riparia*, *V. caribaea* ou *V. rupestris* species in its development. These species make rootstocks easily root when coming from dormancy stakes. *Vitis caribea* species has its origin center around Central and South America (Colombia and Ecuador), making its rootstocks well adapted to tropical and subtropical climate (FARIA et al., 2007). The use of IBA also contributes to a high level of rooting, since this regulator is a form of synthetic auxin. According to Hartman and Kester (2011), auxins induce root formation and induces xylem's wound healing and phloem's repair in the callus formation in the graft.

Researches in the state of Paraná bring contrasting results, such as in Gasparotto et al. (2009), that did not find rooting differences in the rootstockings 420-A and IAC-766 Campinas, in the North of Paraná. However, Silva et al. (2010) assessed higher values for BRS Rúbea variety grafted over rootstock IAC-766 Campinas (42,28 cm), before 420-A (26,3cm), in the city of Marechal Cândido Rondon, Paraná. Survival similarity in field after 15 days is mainly related to the high percentage of root formation, which provided conditions for the seedlings to develop in the field after 90 days of grafting.

Beyond this high percentage of rooting found before plantation, chemical, physical and environmental barriers that could hinder the survival of the plants were prevented, such as correction, fertilization (Tables 1 and 2) and uncompressing (50 cm deep). When the seedlings went to the field (beginning of November, 2015), soil humidity was close to the field capacity and average temperature stayed almost completely between 20 and 30º, a great temperature response for photosynthesis on vine leaves (HOCHBERG et al., 2015).

Aguiar et al. (2006) demonstrate that, in general, vine rootstocks transplanted on rainy days or soils with high grade of humidity show better results in field. It can be also considered the influence of seedling formation time (90 days). The same authors verified that the same period of seedling formation used in experiments (90 days after cutting) is the best phase for IAC-766 Campinas rootstocks transplant in black plastic bags of 20 x 30 cm. Second phase results (grapevine formation) are shown in Tables 6 to 9. There was no triple interaction between rootstock, cup cultivars and studied counties in Paraná.

TABLE 6 - Spore cord diameter (mm) of three-cup cultivars grafted over two vine rootstocks, after 120 of grafting.

	Spore cord diameter (mm)		
Vine rootstocks	Vine variety		
	Isabel Precoce	Niagara Rosada	Bordô
420-A	5,15 b*	5,09 a	4,22 b
IAC-766 Campinas	7,19 a	5,44 a	4,96 b
CV (%)		10,69	

*Averages followed by the same letter in the column are not different from one another by the Tukey's test, $p<0,05$.

TABLE 7 - Number of buds (NB) of three-cup cultivars grafted over two vine rootstocks after 120 days of grafting.

Vine rootstocks	NB	
	Too	O.V.
420-A	$14,51^{ns*}$	$14,40^{ns}$
IAC-766 Campinas	$14,22^{ns}$	$13,54^{ns}$
Grafts		
Isabel Precoce	$14,70^{ns}$	$14,62^{ns}$
Niagara Rosada	$14,51^{ns}$	$15,36^{ns}$
Bordô	$13,90^{ns}$	$13,21^{ns}$
CV (%)		15,37

*ns = not significant.

Conjoint analysis of the experiments indicated double interaction between rootstocks and cultivars for the spore cord diameter, formed plant and branches percentage reached the 2nd and 3rd strand conducting system, and such parameters were conjointly analyzed. Only the number of gems was not significant between the rootstocks and cultivars together, and was evaluated by county.

The measure of the spore cord is an indicator of productive potential for the next crop, since it is from this structure that productive branches occur. A well-formed cord (above 5mm) allows pruning the end of the next winter (GUILPART et al., 2014). The biggest assessed diameter to IAC-766 Campinas is due to the fact that this is more vigorous than 420-A and more adapted to subtropical conditions because of the center of its origin. In addition, one of its greatest characteristics is good compatibility with american cultivars (MOTA et al., 2009; PEDRO Jr. et al., 2006).

Table 7 shows the number of buds on the spore cord and formed plant percentage. Even with no statistical difference when the counties were analysed separately, plants showed buds in all cord internodes. This parameter is important since the buds determine the kind of pruning that will be adopted in the next crop and the quantity of productive branches in the following cycles (POTRICH et al., 2007).

Non-influence of rootstocks possibly occurred due to the uniformity of the experimental areas. Nuzzo;

Matthews (2006) verified that even when some rootstocks varieties influenced in cultivars grip, the correct manner of the soil, the correct time of planting and cultural techniques tend to overcome rootstock effect concerning plants vigor. Similarity of buds numbers between plants in Toledo and Ouro Preto suggests that internodes of cordons presented a growth and normal length, consequently showed a good concentration of reserves.

This is a positive result because branches that come from spore cord on the first crop are responsible for a good fructification in the following years. Many American vine cultivars, in case there is no food buds formation close to the base of the spore cord, cultivar tend not to sprout in the following years, such effect is due to apical dominance, production and translocation of plant growth regulator (VIEIRA et al., 2006). That occurs because grafting initiate by the stick tip of spore cord and posteriorly by median and basal gems, as a consequence of good fit hormones concentration in apical growth proximity (LEÃO et al., 2011).

Relating to Table 8, significance between rootstocks and cup cultivar in plants formation could be observed. Thus, IAC-766 Campinas rootstock was 84,75% of Isabel Precoce's plants, and 84,79% of Bordeaux plants. 420-A was around 10% less, such characteristic was attributed to the highest vigor and IAC-766 Campinas.

TABLE 8 - Plant formation (%) of three cultivars grafted on two grapevine rootstocks, after 120 days of grafting.

	Plant Formation (%)		
Vine rootstocks	Vine variety		
	Isabel Precoce	Niagara Rosada	Bordô
420-A	72,33 b*	84,09 a	73,33 b
IAC-766 Campinas	84,75 a	83,28 a	84,79 a
CV (%)	12,90		

*Averages followed by the same letter in the column are not different from one another by the Tukey's test, p<0,05.

The high percentage of formed plants (over 60%) in Paraná's counties, using table grafting, shows that the majority of plants will not need to go through another formation pruning, corroborating thus to Kuhn et al. (2007) and Regina et al. (2012), who affirm that table grafting can anticipate the first vine production in one year. This allows farmers to recuperate their investments on the vine installation right in the first productive year.

Table 9 shows the number of branches that reached the 2nd and 3rd supporting system strand, where it is possible to assess the influence of rootstock in the final process of vine formation, confirming thus a bigger assessed vigor in the IAC-766 Campinas rootstock. The conjoint analysis of these research places shows that between the branches that reach the 2nd supporting system strand, the 420-A rootstock was superior only when cultivating Niagara Rosada. However, when checking the number of branches that reached the 3rd supporting system strand, the IAC-766 Campinas rootstock was widely superior in all cultivars.

TABLE 9 - Number of branches that reached the 2nd and 3rd supporting system strand of three grafted cultivars over two vine rootstocks, after 120 days of grafting.

	Number of branches that reached the 2nd and 3nd supporting system strand					
	2nd supporting system strand			3rd supporting system strand		
Vine rootstocks	Vine variety					
	IP	NR	Bordô	IP	NR	Bordô
420-A	1,85 b*	2,91 a	0,82 a	0,41 b	1,69 b	0,47 b
IAC-766 Campinas	3,72 a	1,36 b	0,89 a	8,18 a	3,78 a	1,22 a
CV (%)	32,48			23,89		

*Averages followed by the same letter in the column are not different from one another by the Tukey's test, p<0,05. IP = Isabel Precoce, NR = Niagara Rosada.

These results are explained by the greater vigor presented in IAC-766 Campinas rootstock, which, according to Botelho et al. (2006) are related to the branches thickness, internodes length and/or vine leaf area. Mota et al. (2009), also find a greater vigor in the studied American cultivars, on cup cultivar of Isabel Precoce and Niagara Rosada grafted over IAC-766 Campinas rootstock, compared to 420-A. In general, the rootstock choice depends on edaphoclimatic conditions of each productive area, and, within a given region, there could be many variations being thus necessary that research is repeated in each cultivation place (SATO et al., 2009).

The lack of influences of the cultivated places found in this work corroborates the recommendation for rootstocks and cups given by Emater to the West region of Paraná state. Thus, the confirmation that one cup cultivar is apt to a specific place brings more safety for those who deal directly with this cultivation; farmers, technical assistance or research.

CONCLUSIONS

Both rootstocks showed good development and are indicated for Toledo and Ouro Verde do Oeste, however IAC-766 Campinas rootstock was considered more vigorous in plant formation.

As a factor, place did not influence in the

rootstock values.

REFERENCES

ABREU, C.M.; CAMPOS, L.F.C.; ASCHERI, D.P.R.; SELEGUINI, A. Etefom e épocas de poda no crescimento de videira rústica. **Revista Ceres**, v.63, n.6, p.829-835, 2016.

AGUIAR, R.S.; NEVES, C.S.V.J.; ROBERTO, S.R.; SANTOS, C.E.; GENTA, W. Arquitetura do sistema radicular do porta-enxerto de videira 'IAC-766' na época de transplante do viveiro para o campo. **Revista Brasileira de Fruticultura**, v.28, n.3, p.402-405, 2006.

BORGES, R.S.; ROBERTO, S.R.; YAMASHITA, F.; ASSIS, A.M.; YAMAMOTO, L.Y. Produção e qualidade de frutos de clones de videira 'Concord' sobre diferentes porta-enxertos. **Pesquisa Agropecuária Tropical**, v.44, n.2, p.198-204, 2014.

BOTELHO, R.V.; PIRES, E.J.P.; TERRA, M.M. Fertilidade de gemas em videiras: fisiologia e fatores envolvidos. **Ambiência**, v.2, n.1, p.1-16, 2006.

CAMARGO, U.A.; TONIETTO, J.; HOFFMANN, A. Progressos na viticultura brasileira. **Revista Brasileira de Fruticultura**, v.33, n. especial, p.144-149, 2011.

CORTELL, J.M.; HALBLEIB, M.; GALLAGHER, A.V.; RIGHETTI, T.L.; KENNEDY, J.A. Influence of vine vigor on grape (*Vitis vinifera* L. cv. Pinot Noir) anthocyanins. 1. Anthocyanin concentration and composition in fruit. **Journal of Agriculture and Food Chemistry**, v.55, n.1, p.6575-6584, 2008.

FARIA, A.P.; ROBERTO, S.R.; SATO, A.J.; RODRIGUES, E.B.; SILVA, J.V.; SACHS, P.J.D.; CAMOLESI, M.R.; UNEMOTO, L.K. Enraizamento de estacas semilenhosas do porta-enxerto de videira 'IAC 572-Jales' tratadas com diferentes concentrações de ácido indolbutírico. **Semina:** Ciências Agrárias, v.28, n.1, p.393-398, 2007.

FERREIRA, D.F. Sisvar: a computer statistical analysis system. **Ciência e Agrotecnologia**, v.35, n.1, p.1039-1042, 2011.

GASPAROTTO, AC.; MESSIAS, S.S.; ALMAGRO, A.C.; CALDAS, R.G.; PIAN, L.B.; BIASE, R.; CADAMURO, R.B.; SENA, J.O.A. Avaliação da produção da videira (*Vitis labrusca*) 'Rúbea' sobre diferentes porta-enxertos cultivada em sistema de produção orgânico. **Revista Brasileira de Agroecologia**, v.4, p.3694-3697, 2009.

GUILPART, N.; METAY, A.; GARY, C. Grapevine bud fertility and number of berries per bunch are determined by water and nitrogen stress around flowering in the previous year. **European Journal of Agronomy**, v.54, n.1, p.9-20, 2014.

HARTMANN, H.T.; KESTER, D.E. **Plant propagation:** principles and practices. 8. ed., Englewoods Cliffs, Prentice Hall, 2011. 70p.

HOCHBERG U, BATUSHANSKY, A.; DEGU, A.; RACHMILEVITCH, S.; FAIT, A. Metabolic and Physiological responses of Shiraz and Cabernet Sauvignon (*Vitis vinifera* L.) to near optimal temperatures of 25 and 35°C. **International Journal of Molecular Sciences**, v.16, n.1, p.24276-24294, 2015.

KUHN, G.B.; REGLA, R.A.; MAZZAROLO, A. **Produção de mudas de videiras (*Vitis* spp.) por enxertia de mesa.** Embrapa Uva e Vinho: Bento Gonçalves, 2007. 12p. (Circular Técnica, 74). Disponível em: <http://ainfo.cnptia.embrapa.br/digital/bitstream/CNPUV/8822/1/cir074.pdf>. Acesso em: 23 out. 2018.

LEÃO, P.C.S.; BRANDÃO, E.O.; GONCALVES, N.P.S. Produção e qualidade de uvas de mesa 'Sugraone' sobre diferentes porta-enxertos no Submédio do Vale do São Francisco. **Ciência Rural**, n.41, p.1526-1531, 2011.

MAYER, J.L.S.; BIASI, L.A.; BONA, C. Capacidade de enraizamento de estacas de quatro cultivares de *Vitis* L. (Vitaceae) relacionada com os aspectos anatômicos. **Acta Botânica Brasileira**, v.20, n.1, p.563-568, 2006.

MOTA, R.V.M.; SOUZA, C.R.; FÁVERO, A.C.; SILVA, C.P.C.; CARMO, E.L.; FONSECA, A.R.; REGINA, M.A. Produtividade e composição físico-química de bagas de cultivares de uvas em distintos porta-enxertos. **Pesquisa Agropecuária Brasileira**, v.44, n.1, p.576-582, 2009.

MOURA, M.F.; TECCHIO, M.A.; HERNANDES, J.L.; MOURA, N.F.; SELEGUINI, A. Comportamento produtivo da videira, cultivar Juliana, sobre três porta-enxertos em diferentes épocas de poda. **Revista Brasileira de Fruticultura**, v.33, n.spe1, p.625-631, 2011.

NUZZO, V.; MATTHEWS, M.A. Response of fruit an ripening to crop level in dry-farmer Cabernet Sauvignon on four rootstocks. **American Journal of Enology and Viticulture**, v.57, n.1, p.314-324, 2006.

PEDRO Jr., M.J.; HERNANDES, J.L.; ABRAMIDES, P.L.G.; POMMER, C.V.; PEZZOPANE, J.R.M. Fenologia e produção da cultivar tetraplóide de uva de mesa Niabell sobre diferentes porta-enxertos. **Bragantia**, v.65, n.1, p.109-114, 2006.

RENOUF, V.; TRÉGOAT, O.; ROBY, J.P.; van LEEUWEN, C. Soils, rootstocks and grapevine varieties in prestigious Bordeaux vineyards and their impact on yield and quality. **Journal of International Science of Vigne et Vin**, v.44, n.1, p.127-134, 2010.

REGINA, M.A.; SOUZA, C.R.; DIAS, F.A.N. Propagação de *Vitis* spp. pela enxertia de mesa utilizando diferentes porta-enxertos e auxinas. **Revista Brasileira de Fruticultura**, v.34, n.1, p.897-904, 2012.

RICCE, W.S.; CARVALHO, S.L.C.; CARAMORI, P.H.; ROBERTO, S.R.R. Zoneamento agroclimático da cultura da videira no Estado do Paraná. **Semina:** Ciências Agrárias, v.35, n.4, 2014, p.2327-2335, 2014.

SATO, A.J.; SILVA, B.J.; BERTOLUCCI, R.; CARIELO, M.; GUIRAU, M.C.; FONSECA, I.C.B.; ROBERTO, S.R. Evolução da maturação e características físico-químicas de uvas da cultivar Isabel sobre diferentes porta-enxertos na Região Norte do Paraná. **Ciências Agrárias**, v.30, n.1, p.11-20, 2009.

SILVA, T.P.; PIO, R.; SALIBE, A.B.; DALASTRA, I.M.; STANGARLIN, J.R.; KUHN, O.J. Avaliação de porta-enxertos de videira em condições subtropicais. **Bragantia**, v.69, n.3, p.144-149, 2010.

VIEIRA, C.R.Y.; PIRES, E.J.P.; TECCHIO, M.A.; OTSUBO, I.M.N.; VIEIRA, M.C.; YAMASAKI, A.Y.; KASUMI, A.; BORTOLONZA, O. Fertilidade de gemas de videiras 'Niagara Rosada' de acordo com o sistema de condução. **Revista Brasileira de Fruticultura**, v.28, n.1, p.136-138, 2006.

VILLA, F.; SILVA, D.F.; MARTELO, R.; RITTER, G. Comportamento agronômico de cultivares de videiras finas em diferentes épocas de poda. **Acta Iguazu**, v.7, n.3, p.17-26, 2018a.

VILLA, F.; DALL'OGLIO, P.A.; POTRICH, P. Formação de mudas de videiras labruscas através de enxertia de mesa em região subtropical de baixa atitude. **Scientia Agraria Paranaenses**, v.17, n.2, p.186-190, 2018b.