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Rootstock on production and quality of 'Niagara Rosada' grapevine

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Abtract- In Brazil, the producers have changed used rootstocks to get more vigor to scion. Rootstocks change the distribution of bud fruitfulness over grapevine shoots and the expression of the bud fruitfulness into fruit yield. Hence, these modification could alter ideal pruning length. In this way, it was evaluated bud fruitfulness, fruit yield and quality of 'Niagara Rosada' grapevine grafted onto rootstocks: 'IAC 766', 'IAC 572', 'IAC 313', 'IAC 571-6', and 'Riparia do Traviu', which 'IAC 766' is the most used rootstock in São Paulo State, nowadays. The evaluations were performed over three crop seasons, in a vineyard located in Louveira, SP. Two evaluations were performed in Brazilian traditional season, and one crop pruning was performed in Brazilian summer, called "off-season". In traditional seasons, the bud fruitfulness was evaluated from the first to fourth bud in 2014 and to the fifth in 2015. In the off-season, bud fruitfulness was evaluated from the fifth to eighth bud. Fruit yield and quality were also evaluated over the three production cycles. Bud fruitfulness of 'Niagara Rosada' grafted onto the evaluated rootstocks showed that this characteristic was more affected by the environmental conditions, confirmed due to alteration of bud fruitfulness through production cycles. Additionally, no effect of rootstock was observed on fruit yield, and quality of 'Niagara Rosada'. Only isolated variations were detected, and these are not enough to confirm the influence of rootstocks on scion of 'Niagara Rosada'. Although no effect of rootstocks on bud fruitfulness, fruit yield and quality has been observed in the evaluated conditions, all rootstocks are recommended to be used in combination with 'Niagara Rosada'.

Index terms: *Vitis labrusca* L., grape, bud fruitfulness.

Porta-enxertos na produção e qualidade de frutos da videira 'Niagara Rosada'

Resumo - No Brasil, os viticultores têm trocado os porta-enxertos tradicionalmente utilizados por aqueles que conferem maior vigor à copa. O porta-enxeto altera a distribuição da fertilidade de gemas distribuídas nos ramos de videira e a expressão da mesma em produtividade. Portanto, essa alteração pode alterar o comprimento ideal de ramo no momento da poda. Diante disso, neste estudo, foram avaliadas a fertilidade de gemas, a produtividade e a qualidade da uva 'Niagara Rosada' enxertada em porta-enxertos: 'IAC 766', 'IAC 572', 'IAC 313', 'IAC 571-6' e 'Riparia do Traviu', sendo o porta-enxerto 'IAC 766' o mais utilizado no Estado de São Paulo, atualmente . As avaliações foram realizadas ao longo de três safras. Duas avaliações foram realizadas na temporada tradicional brasileira, e uma poda foi realizada no verão brasileiro, denominada "temporã" ou safrinha. Nos ciclos de produção tradicionais, a fertilidade de gemas foi avaliada da primeira à quarta gema, em 2014, e à quinta em 2015. No ciclo de produção de segunda safra ou temporã, a fertilidade de gemas foi avaliada a partir da quinta até a oitava gema. A produtividade e a qualidade dos frutos também foram avaliados ao longo dos três ciclos de produção. A elevada variabilidade dos resultados de fertilidade de gema de 'Niagara Rosada', combinada com estes porta-enxertos, mostraram que esta característica foi mais afetada pelas condições ambientais e características genéticas da variedade copa do que pelos porta-enxertos estudados. Não se observou efeito de porta-enxertos na produtividade e na qualidade de 'Niagara Rosada'. Foram detectadas variações isoladas, e estas não são suficientes para confirmar a influência de porta-enxertos na variedade copa Niagara Rosada. Embora não tenha sido observado qualquer efeito dos porta-enxertos na fertilidade de gemas, na produtividade e na qualidade dos frutos, nas condições estudadas, todos os porta-enxertos são recomendados para cultivo de 'Niagara Rosada'.

Termos para indexação: *Vitis labrusca* L.; uva; fertilidade de gemas.

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Introduction

In 2014 São Paulo State, Brazil, produced 158.781 tons of grapes in an area of 8.092 ha, making it the third highest producer of grapes in Brazil and a major producer of table grapes (AGRIANUAL, 2015). American table grapes, mainly represented by 'Niagara Rosada' (*Vitis Labrusca* L. x *V. vinifera* L.), account for almost 75% of table grapes produced in São Paulo (IEA, 2017). In recent decades, the traditional São Paulo State region of table grapes migrated to tropical regions. In this context, the production system of American table grapes was altered in São Paulo State, in which a trellis system and use of rootstocks adapted to this location were needed (CAMARGO; TONIETTO; HOFFMANN, 2011). Then, the common used rootstocks had to be changed to someone to get more vigor to scion. In fact, 'Riparia do Traviu' was changed to 'IAC 766', in most cases (CAMARGO; TONIETTO; HOFFMANN, 2011) . Rootstocks change the distribution of bud fruitfulness over grapevine shoots and the expression of the bud fruitfulness into fruit yield. Hence, these modification could alter ideal pruning length (VASCONCELOS et al., 2009).

In viticulture, grafting was primarily used to allow grapevine growth in soils infected with phylloxera (*Daktulosphaira vitifoliae* Fitch [Hemiptera: Phylloxeridae]), a soil-dwelling insect pest. However, nowadays, rootstocks are used in phylloxera-free region to prevent dissemination (COOKSON et al., 2012). Grapevine rootstocks are known to alter the scions' vegetative and reproductive development by altering various physiological processes (COOKSON; OLLAT, 2013). Therefore, grafting is widely used in grapevines to regulate a broad range of characteristics, such as to improve productivity and fruit quality, in addition to provide resistance to soil-borne pests and disease (JONES et al., 2009).

Bud fruitfulness is a term to describe the presence of one or more inflorescence primordial in latent buds that is estimated before or after budbreak, and it is used as an indicative of the potential production (DRY, 2000; SOMMER et al., 2000). Rootstocks and viticultural practices are known to influence on bud fruitfulness, fruit yield, and quality. In the 'Shiraz' grapevine , rootstocks influenced the bud fruitfulness and the incidence of primary bud necrosis (PBN) (COX et al., 2012). Additionally, rootstock can confer morphological alterations on the scion. The 'Cabernet Sauvignon' grapevine grafted and non-grafted showed that rootstocks can modify scin rate growth, weight, and diameter of shoots, depending on the rootstock vigor (COOKSON et al., 2012). Moreover, rootstocks with different vigor can affect the distribution of fruitfulness over the shoot and the expression of this fruitfulness in fruit yield, as fruitfulness indicates the potential fruit yield of each shoot (DRY, 2000; SOMMER; ISLAM; CLINGELEFFER, 2001).

In Brazil, 'Niagara Rosada' is most grafting in 'Riparia do Traviu', 'IAC 766', 'IAC 572', 'IAC 313', 'IAC 571-6'. Considering these rootstocks, 'Riparia do Traviu' has low vigor, 'IAC 766' intermediate vigour, and the other are vigorous (HERNANDES; MARTINS, 2010). However, there is no information about the bud fruitfulness of 'Niagara Rosada' grafted onto the rootstocks commonly used in Brazil, such as 'Riparia do Traviu', 'IAC 766', 'IAC 572', 'IAC 313' and 'IAC 571-6'. Therefore, in this study it was evaluated the influence of these rootstocks on the bud fruitfulness of 'Niagara Rosada' grapevine and this expression in fruit yield and quality in Louveira (SP).

Materials and Methods

Experimental site

The trial was conducted in an experimental area in Louveira, São Paulo State, Brazil (23º06'S and 46º55'W; 745 m above sea level). The average rainfall is 1400 mm, and the average temperature is 19.5°C with 70% relative humidity, classified by Köppen as Cwa climate. The vineyard trellis-training system was an espalier, with three wire strands, located 1.0, 1.3 and 1.6 above soil level. The grapevines were spaced 2.0 m between rows and 1.0 m between plants. The planting orientation was East-West, in a CAMBISSOLO Vermelho Distrófico (SANTOS et al. 2006) with 5% of declivity.

Plant material

Five years old vines of 'Niagara Rosada' grapevine were grafted onto rootstocks 'IAC 766', 'IAC 572', 'IAC 313', 'IAC 571-6', and 'Riparia do Traviu' (Table 1).

Table 1. Description of rootstocks according to Hernandes and Martins (2010).

Rootstock	Parents	Vigour	Disease Resistance	Affinity
‘Riparia do Traviu’	*Vitis riparia* x (*V. rupestris* x *V. cordifolia*)	Low	Antracnose: suscetível; Phylloxera: high	Niagara Rosada
‘IAC 313’ or ‘Tropical’	‘Golia’ [(*Vitis vinifera* L. x *V. riparia*) x *V. rupestris*] x *Vitis cinerea*	High	Phylloxera: high; Nematodes: high	Italia and mutations, RedGlobe, Centenial Seedless, Niagara Rosada, Isabel
‘IAC 572’ or ‘Jales’	*Vitis caribaea* x ‘101-14’ (*V. riparia* x *V. rupestris*)	High	Antracnose: baixa; Mildew: high Phylloxera: high; Nematode: high	Italia and mutations, RedGlobe,Centenial Seedless, Niagara Rosada
‘IAC 571-6’ or ‘Jundiaí’	*Vitis caribaea* x ‘Pirovano 57’ [‘Bicane’ x ‘Poeta Matabon’]	High	Nematode: high; Earth-pearl: tolerant; phylloxera: high	Niagara Rosada e Patricia
‘IAC 766’ or ‘Campinas’	‘Riparia do Traviu’ x *Vitis caribaea*	Medium	Antracnose: media; Mildew: high; phylloxera: high; Nematode: high	Italia and mutations, RedGlobe, Centenial Seedless, Niagara Rosada, Isabel, Festival, Sultanina

Pruning seasons

The experiment was carried out for three production cycles. Two prunings were performed in winter in the southern hemisphere on July 25, 2014, and August 12, 2015, and the harvest was performed in summer (December). These prunings were performed during the plant reserve mobilization phase. This is called dry or spur pruning because only one bud is left per spur (SCARPARE et al., 2012). And, one production cycle was performed by pruning the vines on February 9, 2015, and the harvest occurred in winter, June, 2015. This pruning is called green or cane pruning because it is done during reserves accumulation and at least four buds are left on each cane (SCARPARE et al., 2012).

Bud fruitfulness

Bud fruitfulness was determined by collecting 20 canes of the ‘Niagara Rosada’ grapevine during pruning. In the production cycle of July 2014, the fruitfulness was analyzed from the second to the fifth bud from the pruning cut. In the production cycle of February 2015, fruitfulness was analyzed from the fifth to the eighth bud. In the production cycle of August 2015, fruitfulness was analyzed from the second to the fourth bud. The buds were cross-sectioned and observed using the binocular microscope LABOMED Luxeo 4Z at 35× magnification. Bud fruitfulness was determined with the observation of the total number of buds on the compound bud (NCB) and the number of inflorescence primordia on the primary (N+2) bud (NIP); however, when the primary bud was necrotic, the largest secondary (N+3) bud was scored for the number of inflorescence primordia. PBN was also assessed at each node, and the incidence was expressed as a proportion, as described by Kidman et al. (2013).

Fruit yield and quality traits

The ‘Niagara Rosada’ grapevine yield was obtained based on the weight of all bunches per plot and its conversion into kg plant^{-1}. The number of bunches per shoot was determined by relation of the total number of bunches and total number of shoots at harvest. The fruit quality analysis was performed with 10 bunch samples from each plot. These bunches were weighted for determination of the individual fresh mass of the bunch (g). Then, all berries were removed from the bunch, and the mass of the peduncle (g) and number of berries per bunch were measured. The soluble solids (°Brix) were measured by extraction of juice from berries of five clusters per plot. Three measures were performed with deposition of one drop with a digital refractometer Atago, Palete 101.

Statistical analysis

The experimental design was a completely randomized block with four replicates in a split-plot system, in which principal plots were represented by rootstocks, and subplots by the bud node position on shoots, in evaluation of bud fruitfulness. However, the experimental design for quality parameters was a completely randomized block with four replicates. For all experiment each plot was composed for four central plants. Statistical analysis data was performed using SAS 9.2 software (SAS Institute, Cary, NC, USA). The data were subjected to analysis of variance and the means were compared by the Tukey’s test at 5% significance. PBN was transformed by $(x + 0.5)^{0.5}$, because the distribution of the data did not accord to the basic requirements necessary to do analysis of variance.

Results

There was no interaction between rootstocks and node bud position, except to NIP in July 2014. There was no influence of rootstocks in the NIP of buds of node 1 and node 3 of 'Niagara Rosada' shoots in July 2014. The NIP of the bud positioned on the second node was lower for 'Niagara Rosada' grafted onto 'IAC 571-6'. The NIP of the bud located on the fourth node was higher for 'Niagara Rosada' grafted onto 'IAC 766' than 'IAC 313'. The bud located on the fifth node showed higher NIP for the scion/ rootstock combination 'IAC 313' than 'IAC 766' (Table 2). The bud fruitfulness of 'Niagara Rosada' grape over fruitful shoots, except for Niagara Rosada grafted on 'IAC 571-6', was higher on basal buds than apical buds for all scion/rootstock combinations studied (Table 2).

Considering the rootstock effect isolated on the NIP, the rootstock 'Riparia do Traviu' conferred higher NIP on 'Niagara Rosada' scion than the rootstock 'IAC 571-6' (Table 3). On the other hand, considering only the effect of the bud node position, the inflorescence primordia number was higher on buds located in nodes 1 and 2, independent of the rootstock (Table 4). However, the rootstock and bud node position had no effect on the NCB and the incidence of PBN (Table 3 and Table 4).

In February 2015, no interference of the rootstock and bud node position on the bud fruitfulness of 'Niagara Rosada' was observed (Tables 2 and 3). However, the incidence of PBN was lower in 'Niagara Rosada' grafted onto 'Riparia do Traviu', 'IAC 313' and 'IAC 571-6' in relation to 'IAC 572' (Table 3). Additionally, the cane pruning allowed analysis of the apical buds (nodes 5, 6, 7, and 8) complementing the July 2014 evaluation. NIP were stabilized from the fifth node bud to the end of the cane. On the other hand, the incidence of PBN increased from basal buds to the end of the cane. Neverthless, NCB of 'Niagara Rosada' grape were not affected by rootstocks in February 2015 (Table 3).

In August 2015, there were no significant different of NIP, NCB, and PBN of 'Niagara Rosada' grafted onto the rootstocks studied (Table 3). However, the bud node position affected NIP, and it was higher in buds located on node 3 than those located on nodes 1 and 4 (Table 4). There was no effect of bud node position on PBN and NCB (Table 4).

There was no effect of rootstocks on fruit yield and quality in the February 2015 production cycle (Table 5). On the other hand, although rootstock had no effect on the bunch number per shoot, fruit yield, bunch mass, peduncle mass, or number of berries per cluster, the opposite was found for soluble solids in July 2014. 'Niagara Rosada' grape grafted onto 'Riparia do Traviu' had significantly higher soluble solids in berries in relation to 'IAC 313' and 'IAC 572' (Table 5). Nevertheless, the fruit yield in the August 2015 production cycle was higher for 'Niagara Rosada' grape grafted onto 'Riparia do Traviu', 'IAC 313', and 'IAC 766' than onto 'IAC 572'. Additionally, rootstock had no effect on the bunch number per shoot, bunch mass, peduncle mass, number of berries per cluster and soluble solids.

Discussion

The highly randomized node position of fruitful buds over 'Niagara Rosada' shoots grafted onto the evaluated rootstocks showed that bud fruitfulness was more affected by the environmental conditions than by the rootstocks studied. Bruna and Back (2015) observed similar results duration of phenologic cycle, in a ten year study. Moreover, the difference in results between the July 2014 and August 2015 experiments showed that the NIP variations observed in July 2014 occurred due to changes in environmental conditions, and it had no relation to the rootstocks. Temperature and majority rainfall season (Figure 1) were different in 2014 and 2015. The more intensity drought at winter/2014 influence the expression of fruitfulness in yiel, as well, the diferenciation of buds of 2015 production cycle. According to Li-Malett et al. (2016) water status, especially water stress, is also a major factor that has an impact on the grapevine flowering process, in particular on latent bud fruitfulness. Aditionally, Kavoosi et al. (2013) concluded that temperature interfere in the differentiation of grapevine inflorescence primordia in latent buds. Sugesting a synergic effect of temperature and light intensity on bud differentiation. Other studies showed that water status could influence the number of inflorescence primordia due to an effect on hormonal balance, once that water stress cause a decrease of citokinin content in the xylem sap and an increase of abcsic acid in leaves and stems (LI-MALLET, 2016; GUILPART et al. 2014).

Additionally, the rootstock effect on grapevine bud fruitfulness could be related to genetic characteristics of the scion cultivar. Several researchers have studied the bud fruitfulness of *Vitis vinifera*, showing the rootstock effect on the bud fruitfulness (COOKSON et al., 2012; COX et al., 2012; KIDMAN et al., 2013). However, the Niagara Rosada grapevine did not show the same results in this study (Table 2). As well, the data showed a tendency toward decrease in bud fruitfulness from basal buds until the bud located on nodes at the end of canes. This tendency is also contrary of some *V. vinifera* buds fruitfulness distribution, such higher bud fruitfulness were observed in the buds located in the end of the canes (COX et al., 2012; KIDMAN et al., 2013). The shoots vigor is the main factor of the tendency toward increase in bud fruitfulness from basal buds in *V. vinifera* (DRY, 2000).

'Niagara Rosada' showed low incidence of PBN (Tables 2 and 3). The effect of the rootstock on scion PBN incidence is controversial. According to Dry (2000), there is no effect of rootstocks on PBN. In contrast, Collins et al. (2006) showed the rootstock effect on PBN of 'Shiraz' and 'Cabernet Sauvignon' grapevines. Therefore, the incidence of PBN is variable among different scion cultivars. Furthermore, according to Kidman et al. (2013), a significant impact on bud fruitfulness and, therefore, final yield has been observed in grapevines with incidence of PBN higher than 20%. In general, Niagara Rosada had a low incidence of PBN. High levels of PBN have been associated with high shoot vigor (DRY; COOMBE, 1994). Vigorous shoots have shown higher incidence of PBN due to excessive shading during bud reproductive differentiation (DRY, 2000). PBN for the cultivar Niagara Rosada was about 1.5%, in this study. This incidence of PBN had no influence on bud fruitfulness and final yield, according to Kidman et al. (2013). Additionally, no significant changes to NCB were observed in this study; however, the incidence of PBN was low, and NCB was a main factor only in the case of a high level of PBN.

Rootstocks have the ability to influence scion fruit yield and quality. The key point of this influence is translocation of water and nutrients (SERRA et al., 2014; IBACACHE; ALBORNOZ; ZURITA-SILVA, 2016). Generally, no significant effect of rootstocks on fruit yield and quality was observed for 'Niagara Rosada' in this study, except for the difference on soluble solids and fruit yield in July 2014 and August 2015. However, the climatic conditions over these production cycles explain the differences found. According to Ibacache et al. (2016), different scion cultivars have differential responses to the influence of the rootstocks. Some cultivars with white-colored fruits, such as Thompson Seedless, have shown a greater effect of rootstocks on scion than red-fruit cultivars. Hence, the climatic changes through the production cycles showed higher influence on fruit yield and quality (KAVOOSI et al., 2013).

Table 2. Number of inflorescence primordia per compound bud (NIP) for different node positions (1st to 5th bud) on canes of 'Niagara Rosada' grapevines grafted onto rootstocks five rootstocks at pruning performed in July 2014 in Louveira-SP.

Rootstock	NIP				
	1st	2nd	3rd	4th	5th
Ripária do Traviú	1.58 a A	1.52 ab A	1.23 bc A	1.13 c AB	1.02 c AB
IAC 313	1.42 a A	1.40 a A	1.12 ab A	0.96 b B	1.23 ab A
IAC 572	1.52 a A	1.25 ab AB	1.13 b A	1.24 ab AB	1.14 b AB
IAC 571-6	1.33 a A	1.04 a B	1.22 a A	1.21 a AB	1.12 a AB
IAC 766	1.38 a A	1.35 a A	1.11ab A	1.33 a A	0.87 b B

Means followed by the different lowercase in row and uppercase in column, differ significantly at $P \leq 0.05$ by Tukey's multiple range test.

Table 3. Number of inflorescence primordia per compound bud (NPI), primary bud necrosis (%) (PBN), and buds per compound bud (NCB) of the 'Niagara Rosada' grapevine on different rootstocks over three production cycles: July 2014, February 2015, and August 2015 in Louveira-SP.

Rootstock	NIP*	PBN^{ns}	NCB^{ns}
	July 2014		
Ripária do Traviú	1.30 a	1.29	1.9
IAC 313	1.23 ab	1.38	1.9
IAC 572	1.26 ab	2.70	1.9
IAC 571-6	1.19 b	1.23	1.8
IAC 766	1.21 ab	0.92	1.9
LSD	0.099	2.802	0.190
P value	0.0281	0.4756	0.3759
	February 2015 ^{ns}		
Ripária do Traviú	0.96	0.00 a	1.9
IAC 313	1.08	0.87 a	2.1
IAC 572	1.05	9.42 b	2.0
IAC 571-6	0.87	1.25 a	1.9
IAC 766	1.04	4.87 ab	2.0
LSD	0.370	7.338	0.164
P value	0.4302	0.0077	0.0728
	August 2015 ^{ns}		
Ripária do Traviú	1.00	1.52	1.64
IAC 313	1.12	1.54	1.77
IAC 572	0.94	1.43	1.58
IAC 571-6	1.08	1.26	1.70
IAC 766	1.22	0.53	1.64
LSD	0.282	2.33	0.337
P value	0.0621	0.5881	0.4850

*Means followed by the different letters in columns differ significantly at $P \leq 0.05$ by Tukey's multiple range test. ^{ns} not significant. LSD- least significant difference.

Table 4. Number of inflorescence primordia per compound bud (NPI), primary bud necrosis (%) (PBN), and buds per compound bud (NCB) of the 'Niagara Rosada' grapevine over different node positions.

Node position	NIP*	PBN[ns]	NCB[ns]
	July 2014		
1	1.45 a	-	-
2	1.32 a	1.92	1.83
3	1.16 b	1.46	1.93
4	1.18 b	1.17	1.86
5	1.08 b	1.46	1.88
LSD	0.034	1.613	1.136
P value	0.000	0.7892	0.2623
	February 2015		
5	0.99	-	-
6	1.04	1.87 a	1.97
7	0.99	2.48 ab	1.98
8	0.97	4.09 b	2.02
LSD	0.234	2.151	0.070
P value	0.8863	0.0546	0.2298
	August 2015		
1	0.90 b	-	-
2	1.15 ab	1.08	1.61
3	1.22 a	0.84	1.74
4	0.94 b	1.85	1.64
LSD	0.204	0.939	0.147
P value	0.0014	0.0503	0.0912

*Means followed by the different letters in columns differ significantly at $P \leq 0.05$ by Tukey's multiple range test. [ns] not significant. LSD- least significant difference.

Table 5. Bunch number per shoot (BN), fruit yield, bunch mass (BM), peduncle mass (PM), number of berries per cluster (BC), and soluble solids (SS) of the 'Niagara Rosada' grapevine grafted on different rootstocks over the July 2014, February 2015, and August 2015 production cycles in Louveira-SP.

Rootstock	BN [ns]	Fruit yield (kg plant^{-1}) [ns]	BM (g) [ns]	PM (g) [ns]	BC [ns]	SS*
			July 2014			
Ripária do Traviú	1.12	1.57	176.20	3.61	67.09	17.95 a
IAC 313	1.35	2.01	186.45	1.01	66.65	16.88 b
IAC 572	1.30	1.28	192.70	4.33	73.27	16.68 b
IAC 571-6	1.44	1.88	204.85	4.24	76.05	17.40 ab
IAC 766	1.22	1.24	204.50	4.15	75.56	17.20 ab
LSD	0.564	0.974	52.138	1.345	19.555	0.999
P value	0.4694	0.019	0.3930	0.4958	0.3991	0.0132
			February 2015			
Ripária do Traviú	0.88	0.90	202.10	13.13	40.00	14.26
IAC 313	1.17	0.95	193.56	13.80	43.50	14.54
IAC 572	0.99	0.67	182.83	13.04	42.80	11.93
IAC 571-6	1.35	0.68	170.65	12.11	38.60	13.90
IAC 766	0.93	0.79	178.40	12.26	36.70	14.55
LSD	0.699	0.579	70.795	5.372	16.917	3.581
P value	0.2335	0.4333	0.6520	0.8483	0.6876	0.1718
			August 2015			
Ripária do Traviú	0.96	1.66 a	226.14	6.24	45.35	13.49
IAC 313	0.87	1.63 a	205.44	6.00	43.55	13.53
IAC 572	0.80	0.83 b	186.68	5.25	42.51	13.67
IAC 571-6	1.11	1.16 ab	200.09	5.85	39.85	14.2
IAC 766	0.78	1.48 a	227.10	7.58	50.25	13.76
LSD	0.586	0.623	80.960	2.900	20.054	1.989
P value	0.3951	0.0050	0.4740	0.1962	0.5713	0.7988

*Means followed by the different letters in columns differ significantly at $P \leq 0.05$ by Tukey's multiple range test. [ns] not significant. LSD- least significant difference. LSD- least significant difference.

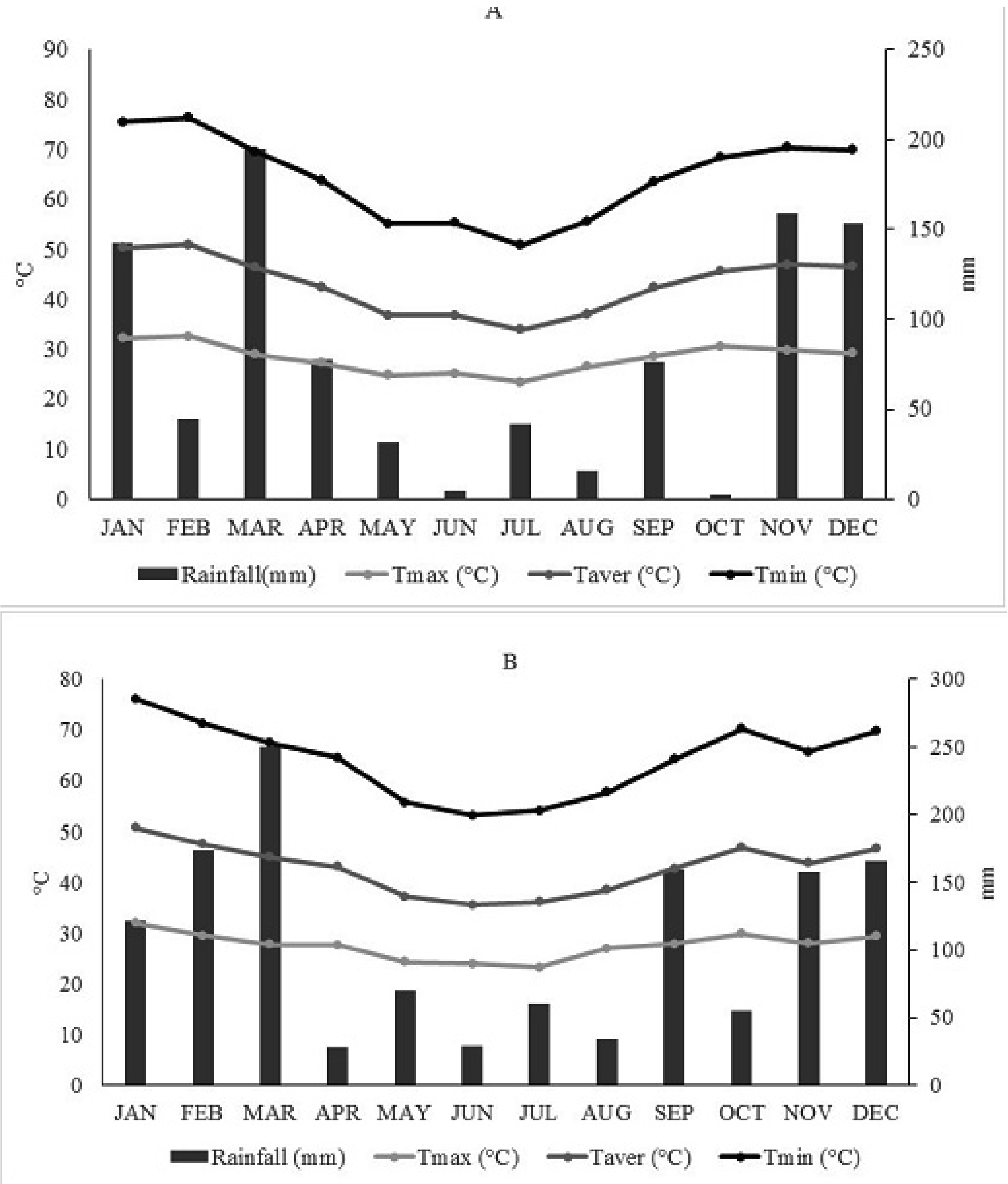

Figure 1. Rainfall (mm), temperature maximum (Tmax), average (Taver) and minimum (Tmin) (°C) of experimental site during 2014 (A) and 2015 (B).

Conclusion

Considering the results, it was concluded that there is no influence of these rootstocks on the bud fruitfulness of 'Niagara Rosada' grapevine and this expression in fruit yield and quality, in Louveira (SP).

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