Australian Journal of Crop Science AJCS

AJCS 10(2):216-219 (2016) ISSN:1835-2707

Application of natural garlic extract to overcome bud dormancy of grapevines 'BRS Rúbea' and 'BRS Cora'

Jullyanna Nair de Carvalho[1]*, Letícia Silva Pereira[2], Pollyanna Aparecida de Carvalho[3], Antônio Decarlos Neto[2]

[1]Agrônoma, Universidade Federal do Vale do São Francisco, Petrolina, Pernambuco, Brasil
[2]Agricultura , Departamento de Biologia, Universidade Federal de Lavras, Lavras, Minas Gerais, Brasil
[3]Fisiologia Vegetal , Departamento de Biologia, Universidade Federal de Lavras, Lavras, Minas Gerais, Brasil

***Corresponding author: jullyannacarvalho@gmail.com; pollycarvalhoufla@yahoo.com.br**

Abstract

The dormancy is an important physiological behavior in temperate fruit trees. Currently, there are chemicals being used for breaking dormancy of these plants, allowing their production. However, it is important to restrict the need of those products in the management of orchards, defending sustainable fruit production systems. In this context, the present study aimed to evaluate the effect of different doses of natural garlic extract (NGE) with or without addition of mineral oil, for overcoming the dormancy of vine buttons of cultivars of *Vitis Labrusca L.* 'BRS Rúbea' and 'BRS BRS Cora'. The treatments (dormancy handlers) applied were: (1) Control (water); (2) NGE 5%; (3) NGE 10%; (4) NGE 15%; (5) NGE 20%; (6) NGE 5% + MO 2% (Assist®, 750 mL L^{-1} mineral oil, Basf S.A.); (7) NGE 10% + MO 2%; (8) NGE 15% + MO 2%; (9) NGE 20% + MO 2%; (10) hydrogenated cyanamide 2% (Dormex ®, 520 g L^{-1} H_2CN_2, Basf S.A.); (11) MO 2%. The experimental design was completely randomized, in factorial scheme 2×11 (cultivars × dormancy handlers). For comparison of means, the Scott-knott test was applied at 5% level of significance. Furthermore, regression analysis was conducted. The results of this study showed that there is natural garlic extract action in dormancy breaking. The treatments with NGE 10%, NGE 15% and NGE 15% + MO 2% presented significantly higher results than other treatment and these results were statistically equal when compared to the product Dormex® in the induction of shoots of both cultivars.

Keywords: Dormancy of Vine Buttons; Garlic Extract; Mineral Oil; Natural Sprouting; *Vitis Labrusca* L.
Abbreviations: MG_Minas Gerais, MO_Mineral Oil, NGE_Natural Garlic Extract.

Introduction

The fruit trees of temperate climate have a mechanism of protection that allows their survival in adverse weather conditions, known as dormancy (Campoy et al., 2011; Jones et al., 2013). According to Perez and Lira, (2005) temperature is the most important environmental variable in the induction processes and overcoming of dormancy of these fruit trees. Low temperatures lead these plants to a state of physiological inactivity. To overcome the dormancy and start a new cycle of vegetation, without delay and within uniformity to the shoots, they need to be exposed to a cold period, variable according to each cultivar (Ben Mohamed et al., 2010). Hawerroth et al. (2013) claim that the dormancy is one of the main factors that influence the production of temperate fruit trees in tropical regions. Therefore, the use of chemicals to overcome dormancy is a key factor of higher production in these regions (Botelho and Müller, 2007). In vines, which is one of the main temperate climate fruit tree in the world, the necessary period of cold climate to the uniformity of budding and overcome dormancy can range from 50 to 400 hours, at the temperature of 7 ºC (Vasconcelos et al., 2007). When the number of hours of chilling during the winter is insufficient, the breaking of dormancy and sprouting of buds tend to be reduced and/or uneven, reflecting on low productivity (Bonhomme et al., 2005). Currently, the hydrogenated cyanamide (H_2CN_2) has been the most used compound to induce sprouting of temperate fruit trees (Hawerroth et al., 2013), mainly in vines (Botelho et al., 2007), providing a uniform budding and allowing production in tropical regions (Reddy and Shikhamany, 1989). However, despite the efficiency of such product, its use has been questioned, because H_2CN_2 is a product considered as toxic. It has been classified by the Environmental Protection Agency of the United States in the category of highest toxicity (Category I) and II health hazard potential, negatively impacting the health of the producer and the environment (Settimi et al., 2005). Thus, aiming to reduce the use of synthetic substances in the management of orchards, advocating sustainable fruit production systems, there is a necessity of news agents for dormancy break that are easily available, effective, low toxic and effective in low concentrations. In search for new agents that can be used in budbreaking, the garlic extract was employed as an alternative substance, providing promising results. Oliveira et al. (2009) observed that the garlic extract initiated the break dormancy of the pear buds, treatment with 5% GE + 4% MO anticipated bud burst, presented similar results to those obtained with 0.52% HC + 4% of MO. Botelho et al. (2010) verified that the highest dose of garlic extract (70 ml L^{-1}) showed a great potential for budbreaking in organic production, presenting similar effects such as

Table 1. Percentage of sprouted buds per plant of BRS Rúbea and BRS Cora cultivars depending on the application of dormancy handlers - after 30 days of application, Lavras, UFLA, MG.

Dormancy handlers	Sprouted bud (%)		
	BRS Rúbea	BRS Cora	Mean
Control	73.6	54.6	64.2^{C}
NGE 5%	75.3	69.3	72.3^{C}
NGE 10%	80.0	93.0	86.5^{A}
NGE 15%	85.6	93.3	89.5^{A}
NGE 20%	50.3	59.3	54.8^{D}
NGE 5%+MO 2%	74.6	85.0	79.8^{B}
NGE 10%+MO 2%	73.3	82.3	77.8^{B}
NGE 15%+MO 2%	89.3	100.0	94.6^{A}
NGE 20%+MO 2%	46.3	59.6	53.0^{D}
DORMEX	90.3	89.3	89.8^{A}
MO 2%	73.0	67.3	70.2^{C}
Mean	73.8	77.6	

Means followed by same uppercase letter in the column and the same lowercase letter on the line, do not differ by Scott-Knott test ($p \leq 0.05$).

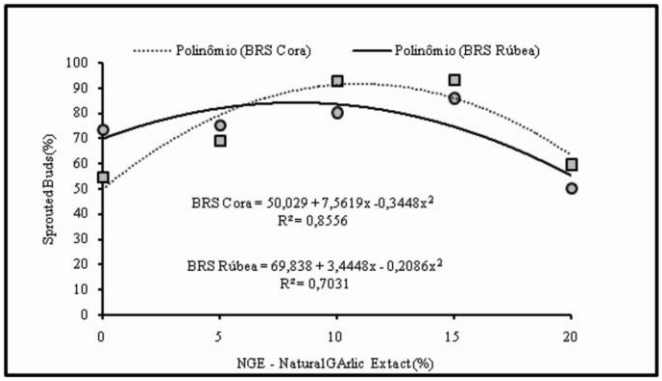

Fig 1. Percentage of sprouted buds of BRS Rúbea and BRS Cora, depending on the different natural garlic extract doses (NGE).

cyanamides. Besides, satisfactory results were also obtained with 20% garlic oil in 'Pione' and 'Thompson Seedless' grapevines (Kubota et al., 2000).

The present study aimed to evaluate the effect of different doses of natural garlic extract (NGE) mixed (or not) with mineral oil (MO), in overcoming the dormancy of vine buttons of the cultivars of *Vitis Labrusca* L. 'BRS Rúbea' and 'BRS Cora'.

Results and Discussion

The effect of dormancy handlers was significant ($P \leq 0.01$), when the percentage of sprouted buds of the cultivars 'BRS Rúbea' and 'BRS Cora' were assessed (Table 1). However, the effect of the dormancy handlers was independent of the cultivar studied, since the interaction between the factors was not significant. Vines which received the treatments of NGE 10%; NGE 15%; NGE 15% + MO 2%, showed respectively 87%, 90% and 95% of sprouted buds, respectively, 30 days after the application of the treatments. These treatments provide greater efficiency in overcoming dormancy of gems of the vines, not statistically different from the conventional treatment with H_2CN_2 who obtained 90% of buds sprouted. The NGE 20 % and NGE 20% + MO 2% treatments were the ones that showed worse results, in this experiment (Table 1). Generally speaking, it turns out that the doses of NGE in concentrations of 10% and 15%, with or without the addition of MO 2%, have provided better results in overcoming dormancy and sprouting induction of cultivars of grapevines BRS Rúbea and BRS Cora. When compared to the means of the cultivars in each dose of the dormancy handler, it was observed that there were no significant differences in percentage of sprouted buds. The percentage of shoots shows that the control treatment causes 74% and 55% of sprouting in BRS Rúbea and BRS Cora cultivars, respectively. Rady and Seif El-Yazal (2014) identified that the use of garlic extract increased the yield of apple trees, in addition to the anticipated sprouting buds. Botelho et al. (2010) found that garlic extract revealed itself as a great potential in stimulation of sprouting in organic production of vine 'Niagara Rosada ', showing similar effects to those treated with H_2CN_2. Botelho et al. (2009), observed that the mixture of vegetable oil to the garlic extract has provided the best results in the sprouting buds of Isabel Precoce. Botelho and Muller (2007), also analyzed the effect of garlic extract on the sprouting of apple and concluded that this showed a similar result and even superior to those treated with H_2CN_2. Kubota et al. (2000) verified that fresh garlic paste, commercial garlic oil and diallyl sulfide stimulated the breaking of dormancy of the vine buds without causing phytotoxicity in seedlings and rods. Through the first regression analysis, which was considered the percentage of sprouted buds of BRS Rúbea and BRS Cora cultivars depending on the doses of NGE, it is observed that the increase in NGE dose until 15% promotes increase the percentage of sprouted buds on both cultivars and concentrations above this may cause reduction in the percentage of sprouted buds (Fig 1). In the second regression, the percentage of sprouted buds of BRS Rúbea and BRS Cora cultivars depended on the application of doses of NGE + MO 2%. The results show that the increase in doses of NGE +

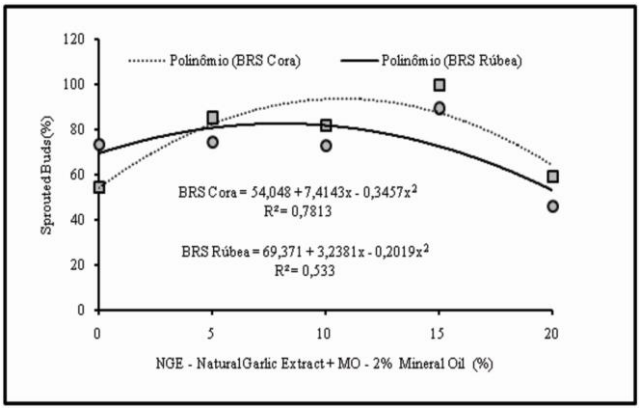

Fig 2. Percentage of sprouted buds of BRS Rúbea and BRS Cora, depending on the different natural garlic extract doses (NGE) + 2% mineral oil (MO).

Fig 3. Obtaining the Natural Garlic Extract (NGE) with removal of the bark of garlic cloves (Fig 4A); grinding of garlic cloves; (Fig 4B); pressing and filtering of the dough (Fig 4 C, 4 D, 4E) and extraction of GNE (Fig 4F).

MO 2% also promotes an increase in the percentage of sprouted buds of BRS Rúbea and BRS Cora cultivars. Therefore, the concentration of NGE + MO 2% (15%) provided maximum buds but concentrations greater than this may cause reduction in percentage of sprouted buds (Fig 2). There is strong evidence that one of the principal mechanisms that involves in the dormancy and bud breaking of temperate climate fruit plants is associated with the induction of an oxidative stress (Pinto et al., 2007). According to Kubota et al. (1999) the active substances in garlic, responsible for breaking bud dormancy in grapevines are sulfur-containing compounds with an allyl group ($CH_2\backslash CH\backslash CH_2$), particularly diallyl mono-, di-, tri- and tetra-sulfides. However, only trace amounts of dimethyl mono- and disulfides were present. Probably, these compounds would act by the same mechanism as proposed by Pinto et al. (2007), in breaking of the dormancy temperate climate fruit trees, in other words, by oxidative stress, through the accumulation of H_2O_2. However, the physiological role of these compounds on the breaking bud dormancy in no chilled grapevines was not established (Kubota et al., 2000). Nevertheless, many previous studies are in parallel with the result of this study and reported that the action mechanism of sulfur compounds in garlic extract caused dormancy-breaking (Hosoki, et al., 1985). So, the NGE product, characterized by the relative ease of extraction and production, in addition to low toxicity, appeared to be effective in stimulation of shoots, and may be a potential replacement of H_2CN_2 on handling dormancy of grapevines. In spite of the promising results showed by the treatment with NGE and NGE + OM 2% in field conditions, the results are still preliminary and needs new researches, which may contribute to increasing the use of garlic extract in the breaking of the dormancy, mainly, like a natural product recommended for organic production systems. Additionally, the toxicity of NGE and NGE+OM in sprouted buds also should be examined, as toxicity has been a major problem with the use of H_2CN_2 when the dormancy break is delayed.

Materials and Methods

The experiment was conducted in the Orcharding Sector, in the Department of Agriculture at the Universidade Federal de Lavras, in Lavras, MG (21° 14' 06" S, 45° 00' 00" W, and altitude 918 meters). Environmental conditions were: mean air temperature between 14 °C (minimum) and 36 °C (maximum) with an average temperature of 25 °C; average air relative humidity around 75%.

Plant materials

The vegetative material used in this experiment corresponds to 3-year-old vine plants of cultivars 'BRS Rúbea' and 'BRS Cora', grafted on rootstock 'Paulsen 1103', by the method of Omega type grafting. The seedlings were planted in September 2010 and conducted in manger system, in the form of 'Y', with 1.0 m spacing between plants and 3.0 m between rows. Fruiting vines pruning was performed in August 2014, leaving 4 to 6 buttons by branch.

Products and treatments

The NGE product was extracted from *Allium sativum* L. cultivar 'Chonan roxo'. First, the shell was removed and subsequently the cloves were grinded in a blender (Wallita ®). After the grinding, the dough was simultaneously pressed and filtered with a potato masher and a cotton cloth to filter (Fig 3). The extract obtained from the pressing and filtering.
The treatments (dormancy handlers) applied were: (1) Control (water); (2) NGE 5%; (3) NGE 10%; (4) NGE 15%; (5) NGE 20%; (6) NGE 5% + MO 2% (Assist®, 750 mL L^{-1} mineral oil, Basf S.A.); (7) NGE 10% + MO 2%; (8) NGE 15% + MO 2%; (9) NGE 20% + MO 2%; (10) hydrogenated cyanamide 2% (Dormex ®, 520 g L^{-1} H_2CN_2, Basf S.A.); (11) MO 2%.

The treatments were applied on the same day, through direct brush stroke on the dormant buttons. We applied brush stroke to avoid drift effects, which could be occurred in a spray application. We also used the surrounded plants, ensuring that there is no influence or combination of treatments of adjacent plants. Thirty days after application of the treatments, the sprouted buds per plant were counted and the percentage of sprouted buds calculated.

Statistical analysis

The experimental design was completely randomized, considering the homogeneous area by virtue of its small size, in factorial scheme 2×11 (cultivars × dormancy handlers) with three replications and experimental portion consisting of a plant. The results were submitted to analysis of variance, F test, studying the interaction between the factors. For comparison of means, the Scott-knott test was applied at 5% level of significance. Furthermore, regression analysis was conducted. Statistical analyses were performed using the SISVAR version 5.3 (Build 77).

Conclusion

The results of this study show the action of the NGE on the overcoming of dormancy of grapevines 'BRS Rúbea' and 'BRS Cora', particularly on the cultivar 'BRS Cora'. Thus, this natural product may be a potential substitute for synthetic growth regulators. The application of 15% NGE, with 2% MO (added or not) and 10% NGE encouraged the budding of the vines 'BRS Cora' and 'BRS Rúbea', showing similar effect like conventional treatment with H_2CN_2.

Acknowledgements

We thank the Universidade Federal de Lavras, CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) and Fapemig (Fundação de Amparo à Pesquisa do estado de Minas Gerais) for financial support.

References

Ben Mohamed H, Vadel AM, Geuns JMC, Khemira H (2010) Biochemical changes in dormant grapevine shoot tissues in response to chilling: Possible role in dormancy release. Scientia Hort. 124:440–447.

Bonhomme M, Regeau R, Lacointe A, Gendraud M (2005) Influences of cold deprivation during dormancy on carbohydrate contents of vegetative and floral primordia and nearby structures of peach buds (*Prunus persica* L. Batch). Scientia Hort. Amsterdam, V. 105:223-240.

Botelho RV, Müller MML (2007) Extrato de alho como alternativa na quebra de dormência de gemas em macieiras Cv. Fuji Kiku. Revis Brasil de Fruticul. 29 (1): 37-41.

Botelho RV, José Maia A, Pires EJP, Terra MM (2009) Efeito do extrato de alho na quebra de dormência de gemas de videiras e no controle in vitro do agente causal da antracnose (Elsinoe Ampelina Shear). Revis Brasil De Fruticul. 31(1): 96-102.

Botelho RV, Pires EJP, Moura MF, Terra MM, Tecchio MA (2010) Garlic extract improves budbreak oo the 'niagara rosada' grapevines on sub-tropical regions. Ciência Rural [Online]. 40(11): 2282-2287.

Campoy JA, Ruiz D, Egea J(2011) Dormancy in temperate fruit trees in a global warming context: a review. Scientia Horticulturae, Amsterdam. 30:357–372.

Hosoki TH, Hiura MH (1985) Breaking bud dormancy in corns, Tubers and trees with sulfur-containing compounds. Hort Sci. 20: 290-291.

Jones HG, Hillis RM, Gordon SL, Brennan RM (2013) An approach to the determination of winter chill requirements for different ribescultivars. Plant Biol. 15:18–27.

Kubota N, Matthews MA, TakahagiT (2000) Effects of garlic preparations and calcium and hydrogen cyanamides on budbreak of grapevines grown in greenhouses. Amer J Enolo Viticul. 51:409-414.

Kubota N, Yasushi Y, Koji T, Kazuyoshi K, Tesuo H, Shoji N (1999) Identification of active substances in garlic responsible for breaking bud dormancy in grapevines. J Jap Soc Hort Sci. 68: 1111–1117.

Mcartney SJ, Walker JTS (2004) Current situation and future challenges facing the production and marketing of organic fruit in oceania. Acta Hort. 638:387–396.

Mohamed AKA (2008) The effect of chilling, defoliation and hydrogen cyanamide on dormancy release, bud break and fruiting of anna apple cultivar. Scientia Hort. 118:25–32.

Oliveira B, Lipski B, Silva EDB, Biasi LA, Coelho SS (2009) Extrato de alho na superação da dormência de pereira 'housui'. Scientia Agraria. 10(4):283-288.

Pinto M, Lira V, Ugalde H, Perez F (2007) Fisiologia de la latencia de las yemas de vid: hipótesis actuales. Universidad de Chile, Santiago, 16.

Rady MM, Seif El-Yazal MA (2014) Garlic extract as a novel strategy to hasten dormancy release in buds of 'anna' apple tres. South Afr J Bot. 92:105–111.

Reddy NN, Shikhamany SD (1989) Effect of hydrogen cyanamide and thiourea on budbreak and bloom of thompson seedless grapevines under tropical conditions. Crop Research, Hisar. 2(2):163-168.

Vasconcelos R, Pozzobom A, Paioli E, Monteiro M, Lopes M (2007) Effects of chilling and garlic extract on bud dormancy release in cabernet sauvignon grapevine cuttings. Amer J Enolo Viti. 58(3):402-404.