

Indole butyric acid and substrates influence on multiplication of blackberry 'Xavante'

Influência do ácido indol butírico e substratos na propagação de amoreira-preta 'Xavante'

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ABSTRACT

Blackberry is a shrubby plant specie which has a high economic importance among agriculture crops. Brazil is the major country of Latin America with the highest future scope for blackberries. For availability of good quality and maximum quantity of seedlings, the present study was carried out at the Universidade Estadual de Londrina, PR from January to March in 2013. The aim of the study was to evaluate the multiplication of blackberry 'Xavante' cuttings under different type of substrates treated with different levels of indole butyric acid (IBA). The experiment was laid out in randomized complete block design with 2 factors, i.e., substrate (rice husk, vermiculite and coconut fiber) and IBA (0; 1,000; 2,000 and 3,000mg L⁻¹), with 5 replications. Each replicate consisted of 10 cuttings. The variables studied were: cutting rooting, cutting survival, leaf retention, cuttings with new leaves, number of major roots, length of major roots and roots dry weight. Most of the variables were significantly affected by both substrate and IBA. Rice husk and vermiculite performed better than coconut fiber and provided the same results for most of the variables, while coconut fiber showed lower performance for all of the variables studied. IBA significantly affected the rooting and the number of major roots. It is concluded that for multiplication of blackberry 'Xavante', both rice husk and vermiculite can be used along 2,000mg L⁻¹ of IBA.

Key words: indole butyric acid, vermiculite, coconut fiber.

RESUMO

A amoreira-preta é uma espécie vegetal arbustiva que apresenta relevante importância econômica entre as culturas frutíferas. O Brasil é o maior produtor da América Latina. Para disponibilidade de boa qualidade e alta quantidade de mudas, o presente estudo foi realizado na Universidade Estadual de Londrina, PR, de janeiro a março, em 2013. O objetivo foi avaliar a multiplicação de amoreira-preta 'Xavante' em vários tipos de

substratos sob diferentes níveis de ácido indol butírico (AIB). O delineamento experimental foi em blocos casualizados com dois fatores: substrato (casca de arroz carbonizada, vermiculita e fibra de coco) e AIB (0, 1.000, 2.000 e 3.000mg L⁻¹), com cinco repetições, sendo cada repetição constituída por 10 estacas. As variáveis avaliadas foram: estacas enraizadas, sobrevivência das estacas, retenção de folhas, estacas com folhas novas, número de raízes, comprimento de raízes e massa seca dos raízes. A maioria das variáveis foi significativamente afetada pelos substratos e AIB. A casca de arroz e vermiculita apresentaram melhor desempenho quanto à maioria das variáveis, enquanto a fibra de coco apresentou desempenho inferior. O AIB afetou significativamente a porcentagem de enraizamento e o número de principais raízes. Conclui-se que, para a otimizar a multiplicação de mudas de amoreira-preta 'Xavante', tanto a casca de arroz carbonizada como a vermiculita podem ser usadas, associadas a 2.000mg L⁻¹ de AIB.

Palavras-chave: ácido indol butírico, vermiculita, fibra de coco.

INTRODUCTION

The blackberry (*Rubus* spp.), a shrubby plant specie of the family *Rosaceae*, is considered a good cultivation option for small scale growers because of low cost of development and maintenance of orchards, minimum level of insect and disease damage and higher nutritional value (ANTUNES et al., 2000; 2002). Mexico is the largest producer in the world with about 56,800 tons harvested in 2011, mainly for export (FAOSTAT, 2013). In Brazil, the main producing area is Rio Grande do Sul but other

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regions with favorable microclimate, such as Minas Gerais, São Paulo, Santa Catarina and Paraná, have high potential for growing this specie (ANTUNES, 2002; VILLA et al., 2003).

Among the cultivars of blackberry, 'Xavante' has strong, erect and thornless stem, therefore needs no support, which facilitates the process of cultivation and harvesting (RASEIRA et al., 2004). It can be propagated by softwood cuttings, from woody roots, shoots and by tissue culture, which enables the achievement of large quantity seedlings in a short time (ANTUNES et al., 2004).

According FACHINELLO et al. (2005), the success of vegetative propagation through cuttings depends on the genetic potential of rooting, physiological conditions of the mother plant, season of year, hormonal balance, temperature, light and humidity.

The substrate varies for the germination process due to the factors such as structure, aeration capacity, water retention and degree of infestation of pathogens (POPINIGIS, 1977). Therefore, some techniques have been induced in order to provide increased emission of roots, and one of them is the use of plant growth regulators, such as indole butyric acid (IBA), a synthetic auxin enhancing root initiation which increases the percentage of rooting, number and quality of roots formed and uniform rooting (HAN et al., 2009).

KAMPF et al. (2006) reported that the process of root initiation of plant cuttings is related to the substrate, which influences the quality of roots formed and the percentage of rooting. It also prevents desiccation of the base of cuttings and possesses pore space which facilitates the availability of oxygen to the roots and doesn't have any phytotoxic substances for the plants (ANTUNES et al., 2004; FACHINELLO et al., 2005). Among the substrates commonly used for fruit plants propagation, some can be listed, such as vermiculite, rice husk and coconut fiber (ZIETEMANN & ROBERTO, 2007).

Therefore, keeping in view the importance of both growth plant growth regulator and substrate for the propagation and development of new and healthy plants, the present study was conducted aiming to evaluate the use of different concentrations of IBA and substrates on cutting multiplication of blackberry 'Xavante' in order to optimize its nursery plant system.

MATERIAL AND METHODS

The experiment was carried out from January to March 2013 at Universidade Estadual de

Londrina - PR (altitude 23°23 S, longitude 51°11 W and elevation of 566m). According to Köppen, the local climate is Cfa (subtropical humid). The genetic material of blackberry 'Xavante' was obtained from stock trees of EMBRAPA Clima Temperado, Pelotas, RS in 2011.

The experimental was laid out in randomized complete block design with five replications of ten cuttings per plot, in a 3x4 factorial arrangement. The factors were: three substrates (rice husk, vermiculite of medium granules and coconut fiber) and four concentrations of IBA (0; 1,000; 2,000 and 3,000mg L⁻¹).

Before preparing the cuttings, a hydroalcoholic solution of IBA was obtained by weighting 0.1g, 0.2g and 0.3g of IBA and dissolved into 50mL of ethanol. After completely dissolved, the volume was raised to 100mL with distilled water to obtain the concentrations of 1,000; 2,000 and 3,000mg L⁻¹ IBA, respectively (FACHINELLO et al., 2005).

Healthy shoots were selected and softwood cutting were prepared from middle portion of each shoot. The size of each cutting was of 10-12cm. The cuttings consisted of a cut just below a node, and the leaves near to the basal portion were removed, leaving a pair of leaves at the top. During preparation, the cuttings were placed in a water recipient to avoid dehydration. After preparation of cuttings, IBA was applied by dipping the base of the cuttings for 10 seconds. Then, the cuttings were disposed in perforate plastic boxes (44x30x7cm) containing the different substrates.

The experiment was performed in a mist chamber with controlled intermittent timer and solenoid valve. The valve was programmed to mist during 10 seconds every three minutes. The nozzle nebulizer employed (Model DanSprinklers Mist, Israel) presents flow 35L h⁻¹. The mist chamber was maintained in greenhouse covered with transparent polyethylene film and 30% shading. During the experiment, the mean maximum and minimum temperatures inside the greenhouse were of 32.1°C and 18.3°C respectively.

After 90 days, the following variables were evaluated: cutting rooting (% of cutting which issued at least one major root), cutting survival (% of alive cuttings); leaves retention (% of cuttings that did not lose their leaves), number of roots per cutting, length of major roots per cutting (cm) and dry weight of roots per cutting (g). The root dry mass was obtained by drying in an oven with forced air at 78°C for 48h. After the completion of experiment,

pH in water in a 1:1 ratio, the electrical conductivity (EC) (mS cm^{-1}) the density (kg m^{-3}) and the water retention capacity (WRC) (mL L^{-1}) of the substrates were evaluated according to KÄMPF et al. (2006).

The data were submitted to analysis of variance and means were compared by Tukey test at 5% probability (BANZATTO & KRONKA, 2006). The pH, Electrical Conductivity (EC), density and Water holding capacity (WHC) of rice husk were 6.81, 149.40 ($\mu\text{S cm}^{-1}$), 161.20 (kgm^{-3}) and 466.80 (mL L^{-1}) respectively. The vermiculite and coconut fiber had pH 7.17 and 6.53, EC 118.80 and 170.60 ($\mu\text{S cm}^{-1}$), density 261.20 and 144 (kg m^{-3}), WHC 396.40 and 790.40 (mL L^{-1}) respectively.

RESULTS AND DISCUSSION

Several variables were significantly affected by both IBA and substrates. Cutting survival was significantly affected by substrate with maximum recorded in rice husk, followed by the vermiculite with minimum obtained by coconut fiber (Table 1). The lower survival in coconut fiber may be due to its higher water holding capacity which may cause the suffocation of cutting. The results are in line with CORRÊA & BIASI (2003), which stated that substrates with the improper aeration had higher percentage of dead cuttings and according to KAMPF (2000) that porosity of substrate has direct relation with cutting survival. However, IBA was not significant on the survival of the blackberry

cuttings. BASTOS et al. (2006) reported that IBA increased the cutting rooting but had no significant affect on the cutting survival. YAMAMOTO et al. (2013) argued that IBA has no role in the survival of blackberry cuttings 'Xavante' when rice husk or vermiculite used as substrate when propagated in spring.

Leaves retention was significantly affected by both IBA and substrates tested. The impact of leaves retention had positive impact on the rooting and also on the new sprouts emergence, which in turn caused higher percentage of success. The leaves prepare carbohydrate through photosynthesis and also a small quantity of natural auxins present in the leaves helps in the rooting and sprouting of cuttings (HARTMANN et al., 1990).

Cuttings with new leaves were significantly affected by the substrates, however IBA had non significant effect. TIBERTI et al. (2012) narrate that cuttings treated with IBA may unbalance the naturally existing plant growth regulators present in the buds and leaves of cuttings, which in turn may cause variation for various variables like rooting and sprouting. The results are in accordance with VILLA et al. (2003), which found that sprouting and rooting percentage was higher when blackberry cuttings treated with 2,000mg L^{-1} of IBA.

Rooted cuttings were significantly affected by both IBA and substrates (Table 1). RAMOS et al. (2003) reported that both indole butyric acid and substrate had significant effect on

Table 1 - Cutting survival, leaf retention, sprouted cuttings and rooted cuttings of 'Xavante' blackberry on different substrates and IBA doses.

Treatments	Cutting survival (%)	Leaves retention (%)	Cuttings with new leaves (%)	Rooted cutting (%)
IBA (I) (mg L^{-1})				
0	65.0	46.7 b	16.5	66.3 b
1,000	70.4	60.8 a	11.0	74.6 ab
2,000	71.3	65.4 a	15.6	83.7 a
3,000	65.0	57.1ab	19.2	72.1ab
F	0.874 ns	8.510**	0.763ns	2.951*
Substrates (S)				
Rice Husk	82.5 a	65.0 a	14.3 ab	84.7 a
Vermiculite	77.5 a	63.7 a	23.1 a	80.3 a
Coconut Fiber	43.7 b	43.7 b	9.3 b	57.5 b
F	45.192**	25.297**	4.230*	20.993**
F (I x S)	1.536ns	1.606ns	0.859ns	3.371*
CV(%)	18.47	16.49	87.28	16.60

Means followed by the same letter are not significantly different at 5% level of significance by Tukey test.

ns= non significant and * = Significant at 5% level of significance.

** = Significant at 1% level of significance.

the percentage of rooting, with a better performance of vermiculite in plum rootstock cv. 'Mirabolano'. YAMAMOTO et al. (2013) argued that vermiculite and the rice husk had the same positive affect for propagation of blackberry 'Xavante' on survival and rooting of cutting. The higher rooting in vermiculite and rice husk may be due to porosity which causes lower retention of water and higher air exchange than coconut fiber. SMARSI et al. (2008) argued that IBA and substrate had significant affect rooting and number of roots. MAIA & BOTELHO (2008) state that among various IBA doses tested for rooting of blackberry cuttings, 2,000mgL⁻¹ showed the best result.

It was observed significant difference using IBA in relation to the number of roots, however, the different substrates studied had no significant effect on the number of roots. PIO et al. (2005) stated that IBA influences the multiplication of blackberry, like number of roots and root length. MINAMI et al. (1994) reported that a good substrate is one that provides adequate conditions for roots development and growth.

The length of major roots was significantly affected by different substrate, with higher roots length was observed in vermiculite followed by rice husk with minimum in coconut fiber (Table 2). However, IBA was significant affected. FACHINELLO & PAULETTO (1994) found that the formation of roots and roots system vary with each substrate, and with vermiculite,

the performance is better than other substrates. HOFFMAN et al. (1995) studied various substrates and found that vermiculite has preference with other growth substrates. MARCO et al. (1998) stated that vermiculite is better than rice husk due to higher number of roots and rooting.

The dry weight of roots per cutting was significantly affected by different substrate, and the higher roots length was observed in vermiculite followed by rice husk, with minimum in coconut fiber. The results are in accordance with NICOLOSO et al. (1999), which stated that dry weight of roots has a direct relation with the substrate used for the propagation.

The results indicate that the development of rooting cutting, number and length of major roots were higher in vermiculite and rice husk and lower in coconut fiber. IBA 2,000mg L⁻¹, a root promoting plant growth regulator is considered a better option for enhancement of roots in blackberry cutting.

CONCLUSION

For blackberry 'Xavante' cutting rooting, both rice husk and vermiculite can be used along 2,000mg L⁻¹ of IBA.

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Table 2 - Number of roots per cutting, major length, and dry weight of roots per cutting of 'Xavante' blackberry on different IBA doses and substrates.

Treatments IBA (I) (mg L ⁻¹)	Number of roots per cutting	Length of major root (cm)	Dry weight of roots per cutting (g)
0	8.7 b	27.7	0.4
1,000	11.3 ab	27.3	0.5
2,000	13.5 a	27.1	0.5
3,000	11.1 ab	23.0	0.4
F	3.260*	1.599ns	0.691ns
Substrate (S)			
Rice Husk	11.1	30.4 a	0.4 ab
Vermiculite	12.2	32.1 a	0.5 a
Coconut Fiber	10.2	16.5 b	0.3 b
F	1.244ns	31.163**	6.828*
F (I x S)	0.732ns	0.395ns	1.772 ns
CV(%)	32.99	23.44	41.71

Means followed by the same letter are not significantly different at 5% level of significance by Tukey test.

ns = non significant and * = significant at 5% level of significance.

** = Significant at 1% level of significance.

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