Growth Evaluation of Blueberry Minicuttings under Different Growth Regulators

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Abstract

The work aimed to evaluate the growth of blueberry minicuttings 'O'Neal' using benzylaminopurine (BAP) and gibberellins (GA_3). A completely random experimental design was used in a 3×5 factorial arrangement, three treatment (control, 250 mg/L of BAP, 250 mg/L of BAP + 250 mg/L of GA_3) and five evaluations (0, 30, 60, 90 and 120 days). Biweekly applications were done during this period. The experiment was carried out in greenhouse and after 60 days plants were transferred to a low tunnel. Minicuttings height, number of leaves, number and mean length of lateral shoots were measured. There was interaction between treatment and time for the number of leaves. There were differences between the 60 and 90 days, and the latter and 120 day, for minicutting height for all treatments. The same occurred for the number and mean length of shoots. Control treatment and the use of 250 mg/L BAP + 250 mg/L GA_3 responded in the same way regarding mean length of shoots, being superior to the use of 250 mg/L of BAP. In the control treatment and the use of 250 mg/L of BAP + 250 mg/L of GA_3 the number of leaves linearly increased depending on evaluation period. Using 250 mg/L of BAP the number of leaves decreased from 0 up to 60 days. Then, from the 60 to the 120 days, the leaves increased. The phytoregulators BAP + GA_3 show similar behavior to the control treatment regarding mean length of shoot and number of leaves. The growth in height and shoot number of the blueberry minicuttings 'O'Neal' increases by time and are independent of the use of phytoregulator.

INTRODUCTION

The minicutting technique comprises the formation of new plants from mother plants propagated by conventional cutting. The minicuttings are 3 to 5cm long and have 1 to 3 pairs of leaves (Xavier and Wendling, 1998).

The minicutting technique is very promising in the clonal plants production and has been successfully used mainly for forest species rooting (Wendling et al., 2000; Xavier et al., 2003), fruit crops (Ritzinger and Grazziotti, 2005; Tonietto et al., 2001), and recently, in the blueberry culture (Fischer, 2006; Trevisan et al., 2008).

Plant propagation by minicuttings and using rejuvenated material allows the obtaining of better quality plants, with high rates and quality of rooting associated with time reduction for plant formation (Wendling and Xavier, 2001; Titon et al., 2002).

The phytohormones are organic compounds, which in small amounts qualitatively promote, inhibit or change plant growth and development (Rodrigues and Leite, 2004), and has been intensively used in the horticulture with several purposes.

Cytokinins belong to this class of components and there are responsible to induce cell division and elongation (Metivier, 1979), to promote the breaking of apical dominance and the induction and proliferation of the axillary buds. Gibberellins act on growth and promote increase in cell size and number, stimulating cell elongation and division (Taiz and Zeiger, 2004).

However, there is a need on further research regarding use of minicuttings associated to phytoregulators, especially to species for commercial production. Therefore,

the objective of this work was to evaluate the growth of blueberry minicuttings 'O'Neal' under different concentrations of benzylaminopurine and gibberellin.

MATERIAL AND METHODS

This work was carried out in nethouse and plastic low tunnel at Universidade Federal de Pelotas (UFPEL/FAEM), State of Rio Grande do Sul, Brazil, during July to November 2008. Minicuttings of blueberry 'O'Neal' with approximately 3 cm height It were used. Different concentrations of cytokinin and gibberellin on plants were sprayed.

The rooted minicuttings were put into 20x30cm black polyethylene bags filled up with Plantmax® + fresh sawdust (1:1 – v/v). Manual irrigation was done according to culture requirement, with water pH adjusted to 5.0 by $SOLP_{30}$ addition. Nutritive solution (12% ammonium, 10% potassium and 10% magnesium sulfate; 35% urea; 10% phosphoric acid) was biweekly applied to the minicuttings. A completely random experimental design was used in a 3×5 factorial arrangement, three treatments (control, 250 mg/L of BAP, 250 mg/L of BAP + 250 mg/L of GA_3) and five evaluations (0, 30, 60, 90 and 120 days). It was used 3 replications of 10 plants each. The minicuttings canopy was biweekly sprayed with the treatments during the 120 days of trial. The trial was initially carried out in nethouse, and at 60 days the minicuttings were transferred to a low tunnel to provide higher solar radiation. At 0, 30, 60, 90 and 120 days after experiment installation minicuttings height, number of leaves, number and mean length of lateral shoots were measured. Data were submitted to ANOVA (analyses of variance F-test). The mean were compared with Tukey test ($p<0.05$). The statistical analyses were performed with the statistic program WinStat 2.0.

RESULTS AND DISCUSSION

There was interaction between phytoregulator and period for the variable mean number of leaves; whereas for mean height of minicuttings and number and mean length of lateral shoots the factor had effect separately.

Time of evaluation showed effect on mean height of minicuttings. The height of minicuttings was higher at 120 days, independently the use of phytoregulator (Fig. 1). There was no alteration on minicuttings growth up to 60 days. At 90 days and a month in the minigreenhouse it was possible to verify the increase in plant height. The beginning of October (90 days) the South region of Brazil is characterized by an increase in temperature and photoperiod that could have positively affected the growth of blueberry minicuttings. Solar radiation directly acts on plant growth and development. The global solar radiation observed for the region of Pelotas, comprising the period from July to November, is 367.09; 412.63; 425.64; 483.08; 606.37 $MJ.m^{-2}$, respectively (Böhmer, 2006). As it is possible to verify the global solar radiation increases during this period; so this factor could possibly have affected the results observed in this study. According to Pereira et al. (2002) the maximum duration of insulation (photoperiod) in hours, at the 15º of each month and latitude 30º (the region where the experiment was installed is located at latitude 31º 52'00''S), decreases from January with 13.7 h, to July (10.2 h) and from then on it starts to increased to 10.9; 11.8; 12.7; 135 h in the following months.

In regards to mean number of lateral shoots of the minicuttings the behavior was similar to height, where evaluation time was responsible for the effect on lateral shoots growth. The higher number of lateral shoots occurred at 120 days (Fig. 2) and from the increase of temperature and photoperiod. Possibly, during the 60 day-period minicuttings had gone through stress situation. The responses management of the plant stress is driven by plant hormones, resulting short or long term changes. In this period, represented for low temperatures months, the biomembrans are more rigid and the low temperature increase the activation energy required to execute the biochemical process. Depending on intensity and duration the low temperatures interfere on the metabolic activity, growth and plant viability (Larcher, 2006). As for as the mean length of the lateral shoots is concerning there was effect of the treatments and evaluation time, independently. Regarding evaluation time, it was observed increasing in length as time passed, just as

occurred for the mean height of the minicuttings and mean number of the lateral shoots. It seems there has been a potential response as using the combination BAP and GA_3 in relation to mean length of shoots; however this observation was statistically similar to control. The use of BAP itself caused lesser pronounced effect on shoot growth, even in comparison to control. Giampan et al. (2005) observed that isolated applications of lanolin paste and BAP 500 mg/L + GA 500 mg/L (Pro-Gibb®) promoted elongation of lateral shoots in papaya plants (Sunrise Solo) in comparison to control and to the complete treatment (spraying + application of lanolin paste + trunk injection of BAP (500 mg/L) and GA (500 mg/L). According to Ono et al. (2004), the use of 250 mg/L GA_3 + 250 mg L^{-1} BA on papaya showed better results as for lateral shoots development and shoot growth. They also concluded that gibberellin appears to be indispensable to promote shoot length growth through its activity on cell elongation; whereas cytokinin has importance on diameter growth due to its activity on cell division promotion.

There was interaction between phytoregulator and period on the mean number of leaves of the blueberry minicuttings 'O'Neal'. The increase in number of leaves depending on evaluation time can be represented by second degree curves in all treatments (Fig. 4). Control treatment and 250 mg/L BAP + 250 mg/L GA_3 showed linear regression curves, while 250 mg/L BAP showed quadratic regression curve. Therefore, in this latter treatment the number of leaves decreased from 0 up to 60 days. Then, from the 60 to the 120 day, the leaves increased. The minimum point for this treatment is reached at 73 days. Environmental stimulation such as photoperiod and temperature affect gibberellins. In general, in long days there is more production of gibberellins in plants than in short days (Rodrigues and Leite, 2004), what can explain the higher number of leaves in minicuttings mainly from 60 days, being potentially expressed by exogenous applications of gibberellic acid.

According to Castro et al. (1991) plant regulators generally act on perennial plants after longer period, above 30 days, as observed in macadamia nuts tree; however the same was not verified in this work. The time was the main factor on the responses of the measured attributes, however it is believed that other factors has have effect on the blueberry minicuttings 'O'Neal', such as root quality, substrate, and so on. In general, minicuttings-derived plants show inferior performance in regards to rooting (length, number of roots, length of the larger root) than microcuttings-derived material (Titon et al., 2002). This allows to conclude that root quality of the material used in this experiment might have been a limiting for a positive response of the use of phytoregulators.

CONCLUSIONS

The BAP + GA_3 association promotes higher growth of lateral shoots of the blueberry minicuttings when compared to the isolated application of BAP. Regarding height and number of shoots the growth of 'O'Neal' minicuttings increased by time, independently treatment. The number of leaves linearly increased in control treatment and whether using BAP + GA_3. Lower doses of BAP and GA_3 must be tested for growth of the blueberry minicuttings 'O'Neal'.

ACKNOWLEDGEMENTS

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Figures

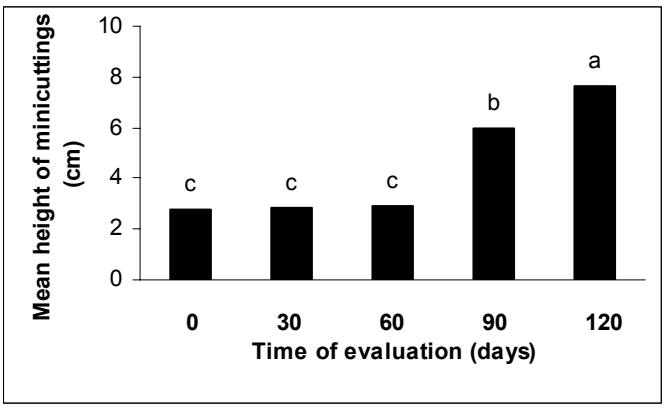


Fig. 1. Mean height of minicuttings of blueberry 'O'Neal' at 0, 30, 60, 90 and 120 days. UFPEL/Pelotas, Brazil, 2009.

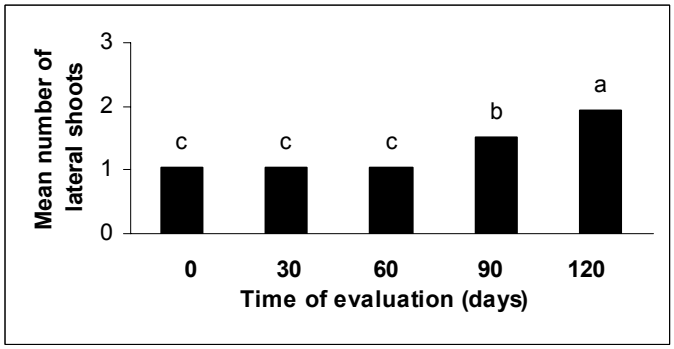


Fig. 2. Mean number of lateral shoots of minicuttings of blueberry 'O'Neal' at 0, 30, 60, 90 and 120 days. UFPEL/Pelotas, Brazil, 2009.

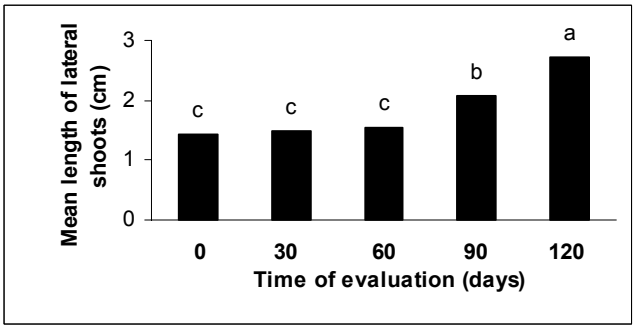


Fig. 3. Mean lenght of lateral shoot of minicuttings of blueberry 'O'Neal' at 0, 30, 60, 90 and 120 days. UFPEL/Pelotas, Brazil, 2009.

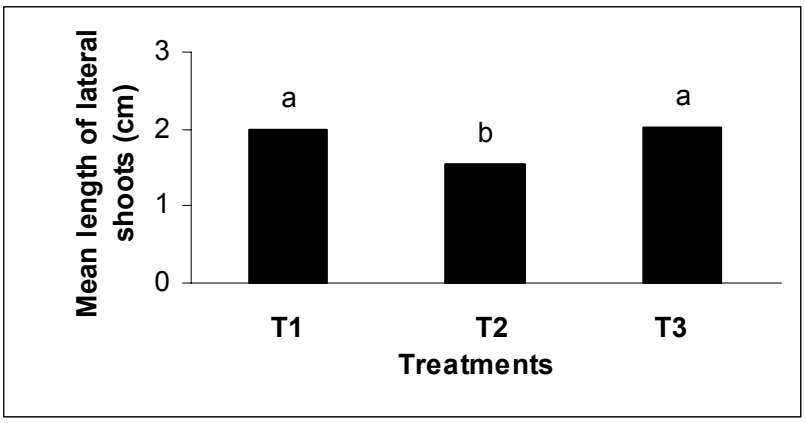
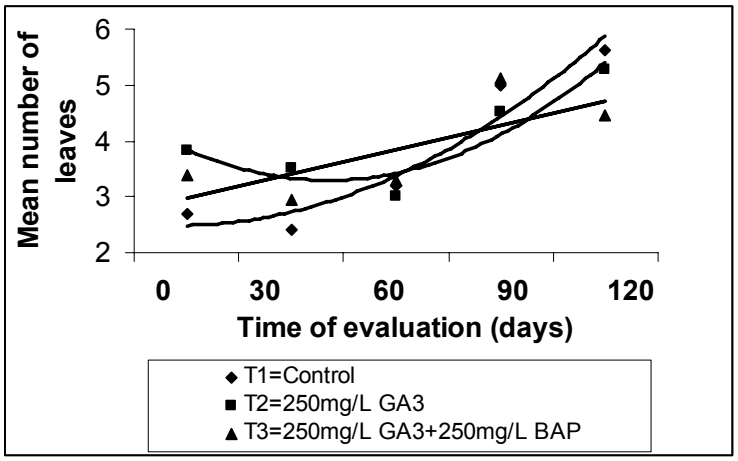


Fig. 4. Mean lenght of lateral shootings of minicuttings of blueberry 'O'Neal' with the use of growth regulators. Treatments: T1: Control; T2: 250 mg/L of BAP; T3: 250 mg/L of BAP + 250 mg/L of GA_3. UFPEL/Pelotas, Brazil, 2009.



$T1 = 0.848\ x^2 + 2.085$ $R2 = 86.41$
$T2 = 0.300\ x^2 - 0.814\ x + 3.84$ $R2 = 88.04$
$T3 = 0.432\ x^2 + 2.972$ $R2 = 55.54$

Fig. 5. Number of leaves of minicuttings of blueberry 'O'Neal' with the use of growth regulators. Treatments: T1: Control; T2: 250 mg/L of BAP; T3: 250 mg/L of BAP + 250mg/L of GA_3. UFPEL/Pelotas, Brazil, 2009.