Paclobutrazol decreases dry weight gain in pansy

Paclobutrazol diminui o ganho de massa seca em plantas de amor-perfeito

Adalberto Di Benedetto[1]
[1]Cátedra de Floricultura, Facultad de Agronomía, Universidad de Buenos Aires,
Av. San Martín, 4453 (1417), Buenos Aires, Argentina.
(e-mail: dibenede@agro.uba.ar)

Abstract

The aim of this study was to show the effects of growth retardant paclobutrazol at the plug stages on the post transplant pot dry weight accumulation for *Viola wittrockiana* bedding plants grown under a range of growing media quality. Changes in media physical properties, such as a decrease in total porosity, resulted in a lowering of dry weight gain. Although it has been indicated that triazoles may indirectly influence photosynthetic activity in several ways, our results showed that a decrease in dry weight gain would be associated to the height plant regulation through paclobutrazol retardant; total dry weight was negatively affected by both total porosity and paclobutrazol rate. The use of paclobutrazol during nursery production and its effects on plant productivity after transplant are discussed.

Additional keywords: ornamental plant; growing media; nursery; plant growth retardant; *Viola wittrockiana*.

Resumo

O objetivo deste trabalho foi mostrar os efeitos do retardante de crescimento paclobutrazol, aplicado no estágio de plântula, sobre a acumulação de massa seca na planta ornamental *Viola wittrockiana* em pós-transplantio, cultivada em vazos com substratos de diferentes qualidades. Variações nas propriedades físicas dos substratos, como o decréscimo na porosidade total, produziram diminuição no ganho de massa seca. Apezar da indicação de que triazóis podem influenciar indiretamente, de várias maneiras, na atividade fotossintética, nossos resultados evidenciaram que o decréscimo no ganho de massa seca estaria associado à regulação da altura da planta pelo retardante paclobutrazol; a massa seca total foi afetada negativamente tanto pela porosidade total quanto pela taxa de aplicação de paclobutrazol. O uso de paclobutrazol durante a produção de mudas em viveiro e seus efeitos na produtividade das plantas após o transplante são discutidos.

Palavras-chave adicionais: planta ornamental; meio de crescimento; viveiro; retardante de crescimento; *Viola wittrockiana.*

Introduction

The marketability of bedding plants is greatly influenced by the quality of the plants produced. High quality potted plants should be compact. Bedding plant producers progressively adopted containers of reduced size, leading to a limited soil volume available for the root system (MUGNAI et al., 2000; DI BENEDETTO & KLASMAN, 2004; 2007). Plastic seedling trays, with individual small cell sizes permit short plant-raising periods and have reduced costs. Ornamental and vegetable seedlings growing at high population densities under conditions of adequate moisture and mineral nutrients become increasingly tall and etiolated as a direct result of reduced photon absorption (STYER & KORANSKI, 1997). It is a common practice in horticultural potted-plant production to use chemical growth regulators to control shoot elongation. Ideally a growth retardant should reduce plant height without adversely affecting aesthetic quality or dry weight gain. Paclobutrazol is an effective inhibitor of stem elongation (BARRETT & NELL, 1992), but obtaining consistent results without excessive stunting or adversely affecting flowering has been a problem (WILKERSON, 1990).

Many plug producers use growth retarding chemicals for obtaining a rapidly developing seedling that is short and stocky; but if a mistake (rate, no uniform application and vol-

ume) is made, plants may be overly stunted. BARRETT (1990) has indicated that there have been several cases of plugs being treated with paclobutrazol and then being shipped to another grower who could not get them to grow; this failures had contributed to a reluctance by some growers to use paclobutrazol.

Species vary in responsiveness to plant growth retardants and optimum rates may vary with cultivar or growing conditions (LATIMER, 1991). Residual effects may be more important with the use of the new triazole compounds, such as paclobutrazol, which appear to be active in plants for longer than the former growth retardants (LEVER, 1986). Media components affect the efficacy of growth retardant drenches too (MILLION et al., 1998; 1999).

The aim of this study was to show the effects of paclobutrazol use at the plug stages on the post transplant pot dry weight accumulation for *Viola wittrockiana* bedding plants grown under a range of growing media quality.

Materials and methods

Viola wittrockiana 'Banner' seeds were germinated and growth on 288 plug trays and twenty plants for each media tested during plug growth and paclobutrazol level were transplanted into 1,000 cm^3 pot^{-1} when 3rd true leave pair were developed.

Growing media tested were formulated with an inverse proportion of light Canadian *Sphagnun* peat moss and field soil (v/v) to generate a significant total porosity range. A soil from the field organic horizon of Pilar City (Argentine)(Organic Matter: 4.7%; pH: 7.4; Electric Conductivity: 0.15 dS m^{-1}; Cation Exchange Capacity: 25.3 me/100 g) was used.

Plants were irrigated as needed, using intermittent overhead mist and a weekly soil fertilization according to STYER & KORANSKI (1997)(Stage 2: 50 ppm N; Stage 3-4: 100 ppm N; pot: 150 ppm N) was included.

The triazol growth retardant paclobutrazol (β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol) was added to the media during pansy plug growth (2 L m^{-2} of bench area from a solution of 0.5; 1.0; 2.5 and 5.0 ppm) when the 1st true leave pair was developed.

Plants were harvested at the commercial sale stage (85 days from sowing); they were dried at 80 °C for 48 hours and weighed.

Samples of each growing medium were collected at the beginning of the study and total porosity was determined, according to the methodology and equation suggested by FONTENO (1996). The procedure required to fill a container of known volume with the medium. The standard pot used had holes in the bottom that were taped closed and covered on the inside by a nylon screen. The volume of medium used was recorded and water was added slowly until the medium was saturated to the surface and the volumes of water added were registered. The tape from the bottom of the container was removed and the draining water collected for 60 minutes. The wet sample was weighed, then dried and reweighed.

The values from the above procedures were used to calculate total porosity using the following equation:

$$\mathbf{TP(\%\ v/v)} = \{[(WW - DW) + DV]/MV\}\ 100 \qquad (1)$$

where: WW - wet weight; DW - dry weight; DV - drained volume; MV - media volume.

The experiment design was a split plot, with growing media as main plots and paclobutrazol concentration as subplots. Experiment was repeated twice.

Results and discussion

There was a decrease in *Viola wittrockiana* total dry weight (Figure 1) related to total porosity; high correlation coefficient for the control (0 ppm) was found; this result is in agreement with petunia previous report (DI BENEDETTO & MOLINARI, 2007). On the other hand, dry weight gain was affected by paclobutrazol solution rate added to the substrate during nursery production; dry weight accumulation decreased with increased paclobutrazol rates. Highly significant correlation coefficients between dry weight and porosity for all paclobutrazol rates were found too.

Applications in excess of growth retardants to sensitive crops, such as *Viola wittrockiana*, may have long-term effects that prevent proper performance after transplanting (BARRETT & ERWIN, 1994). At a recommended shoot:root ratio less than 1.0 (STYER & KORANSKI, 1997), the reserves available are invested to expand new leaves, which through an increasing export of photoassimilates let to higher rates of growth; when dry weight are limited by the biomass developed at the transplant stage it would be reach a limiting growth factor (Figure 1). The influence of triazoles on assimilate transport and partitioning is only beginning to be understood; paclobutrazol has been shown to suppress shoot growth although it has been shown to promote root growth (UPADHYAYA et al., 1986), but it would not be the case of *Viola wittrockiana* (data not shown).

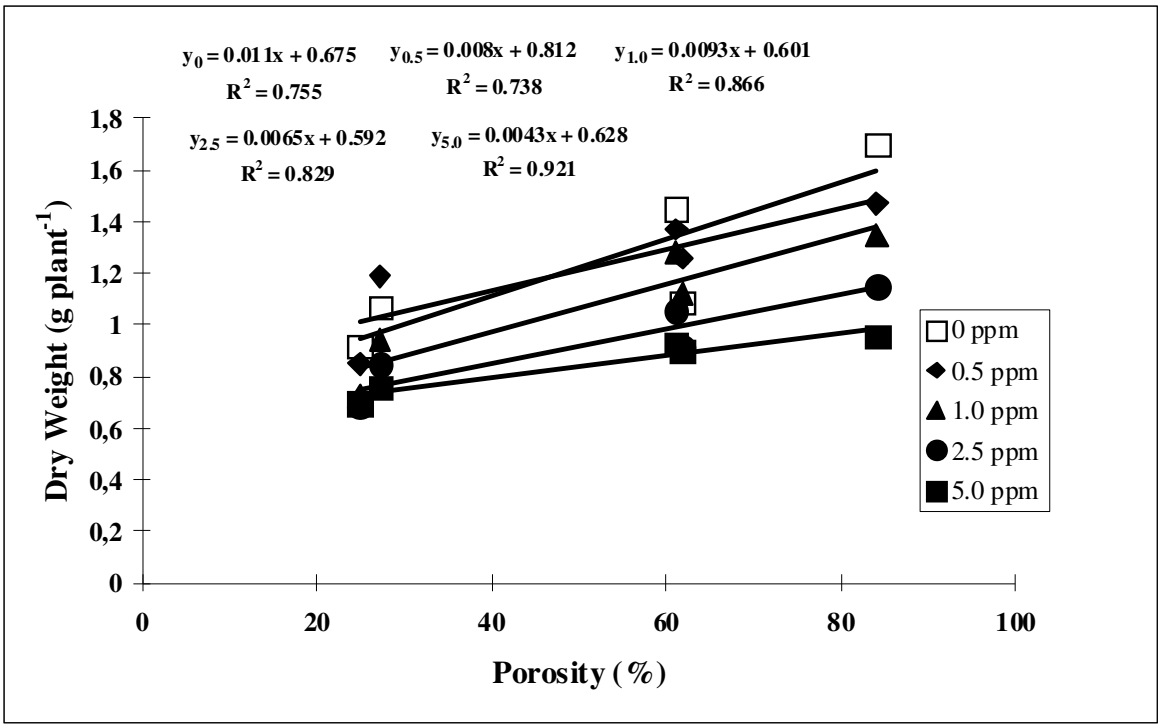

Figure 1 - Total dry weight related to total porosity for paclobutrazol (0.5, 1.0, 2.5 and 5.0 ppm) *Viola wittrockiana* treated-plants. Each point is a mean of twenty replicates.

There are several important factors that determine whether use of any given compound will be commercially feasible for floricultural crops. First, the compound must be easily applied and the response properly estimated. Results from *Viola wittrockiana* underscore the fact that triazole-induced alterations in plant growth and development are not necessarily due strictly to gibberellins biosynthesis inhibition related to internodes elongation. Second, the range of acceptable application dosage should both be too narrow or the probability of over- or underdosage may be unacceptably high for the user. It is also important that a growth retardant provided consistent results across a reasonable range of environmental and cultural conditions that might be encountered during production. A compound whose efficacy is highly sensitive to environmental conditions may be too risky for commercial application. For *Viola wittrockiana* there was a high possibility of obtaining stunted plants or a decrease in growth rate after transplant. Third, ideally a growth retardant should reduce plant height without adversely affecting aesthetic quality or productivity. This would not be true for *Viola wittrockiana*.

Although plant growth retardants, in many cases, are essential for the production of high-quality bedding plants, chemicals may not subsequently improve plant quality in the landscape. LATIMER (1991) has shown for impatiens and marigold that plant height of treated plants approximated that of the untreated control after 5 to 7 weeks in the field, and there was a reduction in plant quality relative to that of the untreated plants. Results from *Viola wittrockiana* are in agreement with LATIMER's report.

LAFE & STYER (1990) showed that paclobutrazol (1 to 3 ppm) affect pansy plug height compared to untreated plugs. Besides plug height, paclobutrazol affect leaf color and growth habit, restrict leaf expansion compared to untreated plugs, but enhance green color and root development and did not cause stunting. On the other hand, BARRET & ERWIN (1994) suggested a paclobutrazol optimum rate range from 5 to 15 ppm. Results plotted in Figure 1 showed that paclobutrazol significantly deleted dry gain in *Viola wittrockiana* at recommended rate of 5 ppm and even at 0.5 ppm under the highest medium porosity.

The use of chemicals that inhibit gibberellins biosynthetic pathway, such as paclobutrazol may be expensive, it is increasingly restricted and is perceived by some as environmentally unfriendly (RUNKLE & HEINS, 2002). A frequently overlooked aspect of growth retardant use in potted plants is that of post-production performance. It is important to

understand how growth retardant application during nursery production influences subsequent shelf-life, and productivity.

Conclusion

This results showed that the deleterious effect of paclobutrazol on dry weight gain was misleading when a low quality media was used. On the other hand, recommendations which claimed for a pot plant high quality media would be an additional argument towards the increasing efforts to growth regulators replacement and *Viola wittrockiana* productivity improvement.

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