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Cientific Paper

Plant regulators effect on germination of seeds of tabasco pepper

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Abstract

The germination of pepper seeds, even under favorable conditions, is slow and disuniform, requiring the use of techniques which help to speed up the germination and uniform emergence in the field. The study aimed to evaluate the effect of different plant growth regulators on seed germination tabasco pepper (*Capsicum frutescens* L.) The experimental design was completely randomized in factorial scheme 2 (pre-soaking) x 5 (plant growth regulators). There were four replicates of 50 seeds for each treatment. The plant regulators used were (1) Stimulate®, Stoller; (2) Sett®, Stoller; (3) CaB®, Stoller; (4) Progibb®, Valent Biosciences; (5) distilled water, which was used a volume of 13 ml of solution for all treatments. The seeds were pre-soaked for 24 hours or germinated directly in solutions with plant growth regulators. The seeds were submitted to germination test in gerbox in germinators at 25 °C for 19 days. The pre-soaked tabasco pepper seeds had higher percentage of germination, of normal seedlings and seedling growth, regardless of the pre-soaking solution. The growth regulators Progibb® and Stimulate® improved seed germination and early growth of seedlings of tabasco pepper. The use of any one of the bioregulators evaluated stimulated the development of roots.

Key words: *Capsicum frutescens;* imbibition; growth regulators

Reguladores del crecimiento de plantas en la germinación de semillas de pimienta tabasco

Resumen

La germinación de semillas de pimienta, incluso en condiciones favorables es lento y desigual, o que requiere el uso de técnicas que contribuyen para acelerar el proceso de germinación y uniformizar la emergencia de campo. El objetivo del estudio fue evaluar el efecto de diferentes reguladores del crecimiento vegetal en la germinación de semillas de pimienta tabasco (*Capsicum frutescens L.*). El diseño experimental fue completamente al azar en factorial 2 x 5 (pre-imbibición y reguladores de crecimiento de las plantas), con cuatro réplicas de 50 semillas para cada tratamiento. Los reguladores del crecimiento utilizados fueron (1) Stimulate®, (2) Sett®, (3) Cab®, (4) Progibb®, y (5) el agua destilada, cuja las semillas fueron pre-embebidas durante 24 horas o puestas para germinar directamente en las soluciones con los reguladores del crecimiento de plantas. La pre-imbibición promovió mayor porcentaje de germinación, de plántulas normales y el crecimiento de plántulas de pimienta tabasco, independiente de la solución. El uso de reguladores de crecimiento de plantas Progibb® y Stimulate® estimula la germinación de semillas y el crecimiento inicial de las plántulas de pimienta de Tabasco y el uso de cualquiera de los reguladores evaluados estimuló el desarrollo de las raíces.

Palabras clave: *Capsicum frutescens*; reguladores del crecimiento; imbibición

Reguladores vegetais na germinação de sementes de pimenta-tabasco

Resumo

A germinação de sementes de pimenta, mesmo em condições favoráveis é lenta e desuniforme, sendo necessário o uso de técnicas que contribuam para acelerar o processo de germinação e uniformizar a emergência em campo. O trabalho teve como objetivo avaliar o efeito de diferentes reguladores vegetais na germinação de sementes de pimenta-tabasco (*Capsicum frutescens L.*). O delineamento experimental utilizado foi inteiramente casualizado em esquema fatorial 2 x 5 (pré-embebição

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e reguladores vegetais), em quatro repetições de 50 sementes para cada tratamento. Os reguladores vegetais utilizados foram (1) Stimulate®; (2) Sett®; (3) CaB®; (4) Progibb®, y (5) água destilada, cujas sementes foram pré-embebidas por 24 horas ou postas para germinar diretamente em soluções com os reguladores vegetais. A pré-embebição promoveu maior percentual de germinação, de plântulas normais e crescimento de plântulas de pimenta tabasco, independente da solução. O uso dos reguladores vegetais Progibb® e Stimulate® estimula a germinação de sementes e crescimento inicial de plântulas de pimenta-tabasco e a utilização de qualquer um dos biorreguladores avaliados estimulou o desenvolvimento de raízes.

Palavras-chave: *Capsicum frutescens*; embebição; reguladores de crescimento

Introduction

The *Capsicum* species are originated in the Americas and are now scattered all over the world (CARVALHO et al., 2006). They present a wide variety of types, shapes, sizes, colors, flavors and pungency and are grown all over the Brazilian territory, with production volume of around 40 000 tonnes in about 2000 ha (HENZ e COSTA, 2005). The states of Minas Gerais, São Paulo, Ceará and Rio Grande do Sul are the largest producers of pepper (CARVALHO et al., 2006).

The species *Capsicum frutescens L.* is represented by the type of pepper best known and consumed in Brazil, the cayenne pepper. It also belongs to this species the tabasco pepper, the cultivar more known in the United States and known worldwide for the hot pepper sauce that bears its name. These are extremely spicy peppers, have small fruits of elongated shape, measuring approximately 3 cm long and 0.3 to 0.5 cm in diameter, and reddish when mature (FILGUEIRA, 2003).

In Brazil, the tabasco pepper is grown in the state of Ceará, in order to export in paste form and therefore has great potential for cultivation in the entire northeastern Brazil (CARVALHO et al., 2006). Adding value to the product in the form of sauces, pickles, jams, dried pepper powder, among others, has contributed to increasing the sector. Moreover, the production of peppers is presented as a segment of great social importance, because it is a culture that uses high manpower, characterized typically as family farming (NASCIMENTO et al., 2006).

One of the problems that farmers face is the pepper seed germination that, even under favorable conditions, is slow and uneven, thus suggesting the existence of a certain type of dormancy in seeds of these species (Edwards & Sundstrom, 1987), which justifies the use of techniques which help to accelerate the process of germination and uniform emergence in the field.Among the chemicals that are used for rapid and uniform seed germination are the plant growth regulators and biostimulants that control metabolism and the responses of seeds to the environment (DAVIES, 1994). Currently there are several commercial products, that have plant growth regulators in its composition or bioregulator effect. Little is known about these biostimulants, wich are Stimulate®, Sett®, CaB®, among others, and their effect on vegetable seeds. It is believed that biostimulants, depending on the composition, concentration and proportion of substances, can increase plant growth, stimulating cell division, as well as increasing the absorption of water and nutrients for plants (VIEIRA e CASTRO, 2002). The pre-soaking in of plant growth regulators and biostimulants solutions can influence seed germination by accelerating the whole process, which starts by the absorption of water, ending with the embryonic axis elongation (BEWLEY et al., 2013). The availability of water during the germination process is decisive in enzymatic reactions, solubilization and transport of metabolites and as a reagent in hydrolytic digestion of seeds reserves (BEWLEY et al., 2013). Thus, imbibition is essential for germination because it allows the resumption of metabolic activity, contributing to the processes of assimilation and mobilization of reserves and subsequent growth (MARCOS FILHO, 2005).

Some studies were performed in order to increase the germination of seeds of peppers (FIALHO et al., 2010), testing the effect of priming in seeds of yellow-long-pepper-(*Capsicum annuum* L.) and various chemical treatments, including moistening of the substrate with gibberellic acid, aminociclopropene 1-carboxylic acid, polyethylene glycol, KNO_3 and pre-cooling for rapid and uniform germination of seeds of true-cumari-pepper (*Capsicum baccatum* var. *praetermissum* L.). Therefore, this study aimed to evaluate the effect of different plant growth regulators and presoaking on germination of the seeds of tabasco pepper (*Capsicum frutescens* L.).

Material and Methods

The study was conducted at the Laboratory of Vegetable Crops, Department of Technology and Social Sciences, State University of Bahia- UNEB in Juazeiro - BA in the period from August 23 to September 11, 2009, in a completely randomized design with treatments arranged in a factorial 2 x 5 (absorption and plant growth regulators), in four replications of 50 seeds for each treatment.

The seeds of tabasco pepper (*Capsicum frutescens* L.) were placed in plastic cups containing 50 mL of water and solutions of different plant growth regulators, such as 0.77 mL L^{-1} of Stimulate®, Stoller (0.009% kinetin + 0.005% indolilbutiric acid + 0.005% giberelic acid); 3.00 mL L^{-1} of Sett®, Stoller (5.0% nitrogen NH_4^+ + 10% de calcium+ 2% boron); 3.00 mL L^{-1} of CaB®, Sotller (6% calcium + 0.5% magnesium) 1g L^{-1} of Progibb®, Abbott (10% giberelic acid GA_3), incubated for five hours in a Biochemical Oxygen Demand (BOD) germination chamber type set at 25°C. After this period the seeds were distributed in gerbox (11 x 11 x 3.5 cm) on two sheets of germitest paper moistened with 13 mL of distilled water. The seeds which have not been previously soaked were sown in the same conditions described above, in germitest paper moistened with 13 mL of distilled water or the plant regulators solutions previously described.

The seeds were submitted to germination test in BOD germinator in the dark (Brasil, 2009), with the first and second counts (% normal seedlings) performed on the seventh and fourteenth days after sowing. The evaluations of germinated seeds (% germination) were performed daily for 19 days. At the end of the germination test, we evaluated the length of the shoot and main root (cm) and fresh and dry biomass of whole seedlings (g). Moreover, from the daily evaluations were obtained germinated seeds percentage (%G), germination speed index – GSI, mean germination time and average germination speed –AGS (RANAL e SANTANA, 2006). The data were subjected to analysis of variance and means were compared by Tukey test at 5% probability.

Results and Discussion

In tabasco pepper seed, germination was approximately 100% for all treatments, except for the seeds that germinated without pre-soaking in Sett ® (Table 1). The same occurred with the percentage of normal seedlings in the final evaluation of the germination test (Table 1).

The germination speed index (GSI) of seeds

Table 1. Germination of tabasco pepper seeds, after pre-soaking or germinated in different plant regulators. Juazeiro, Uneb. 2010.

	Plant Regulator				
	H_2O	**Progibb®**	**Stimulate®**	**Sett®**	**CaB®**
	Germination (%)				
Soaked paper	98 aA	98 aA	99 aA	82 bB	97 aA
Pre-soaked seeds	97 aA	98 aA	100 aA	99 aA	99 aA
	Average germination speed (day^{-1})				
Soaked paper	0.1171 aB	0.1159 aB	0.1424 aA	0.1298 aAB	0.1103 aB
Pre-soaked seeds	0.1163 aA	0.1181 aA	0.1196 bA	0.1235 aA	0.1204 aA
	Germination speed index (seedlings day^{-1})				
Soaked paper	7.93bA	8.12 bA	6.84 bBC	6.26 bC	7.52 Bab
Pre-soaked seeds	9.49 aA	9.15 aA	9.09 aA	8.69 aA	8.58 aA
	First count (% normal seedlings)				
Soaked paper	74 aB	90 aA	48 bC	50 bC	70 aB
Pre-soaked seeds	85 aA	94 aA	91 aA	85 aA	86 aA
	Second count (% normal seedlings)				
Soaked paper	98 aA	98 aA	99 aA	80 bB	97 aA
Pre-soaked seeds	99 aA	97 aA	99 aA	97 aA	98 aA

Means followed by the same lower case letter in the column and the same capital letter in lines are not different (Tukey test, p>0.05).

submitted to pre-soak in water or plant growth regulators were similar and higher than those that were not pre-soaked. The average germination speed (AGS) was similar for seeds submitted or not to pre-soak. However, for the seeds that germinated in Stimulate® solution, AGS was higher than other treatments (Table 1). There was no treatment effect for the mean germination time (data not shown). Soaking tabasco pepper seeds in Progibb® provided higher percentage of normal seedlings at seven days after sowing and higher length of seedlings shoots at 14 days, compared to other treatments without pre-soaking (Tables 2 and 3).

Means followed by the same lower case letter in the column and the same capital letter in lines are not different (Tukey test, p>0.05). Médias seguidas pela mesma letra minúscula ou maiúscula nas colunas não diferem significativamente, pelo teste de Tukey, a 5%.

Seeds of sweet pepper (*Capsicum annum*) and of sweet corn (*Zea mays* L.) treated with gibberellic acid presented higher germination, as well (ARAGÃO et al., 2003; DINIZ et al., 2009). Such behavior may be explained by the fact that gibberellins promote growth by increasing the plasticity of the cell wall followed by hydrolysis of starch into sugar, which reduces the water potential in the cell, resulting in entry of water therein and promoting elongation (ARTECA, 1996).

Means followed by the same lower case letter in the column are not different (Tukey test, p>0.05). Médias seguidas pela mesma letra minúscula ou maiúscula nas colunas não diferem significativamente, pelo teste de Tukey, a 5%.

The best results of germination and seedling growth were obtained with seeds pre-soaked in comparison with those who did not undergo pre-soak, regardless the solution used (Tables 2 and 3). The different solutions used for soaking the seeds did not induce an increase in germination and growth of seeds compared to those pre-soaked in water (Table 1). The imbibition allows the seeds to resume metabolic activity, contributing to the assimilation and mobilization of seed reserves and subsequent seedling growth (MARCOS FILHO, 2005). Therefore, treatments which enable a pre-soaking of seeds induced the fastest germination and greatest growth of seedlings (Tables 2 and 3).

The Stimulate® treatment induced 99% germination (Table 1), because auxins all have in common the ability to act in the division and cell elongation, root formation and growth (POZO et al., 2005). Cytokinin a component of the growth promoter Stimulate ®, plays an important role in the regulation of cell division and interacts with auxins in the control of many aspects of plant growth and development of plants (POZO et al., 2005).

The growth promoter Stimulate®, induced seed germination and seedling development of *Strelitzia reginae* Banks. (GARCIA et al., 2006)

Table 2. Shoot length (cm) of tabasco pepper seedlings, of wich seeds were pre-soaked or germinated in different plant regulators. Juazeiro, Uneb, 2010.

	Plant Regulator				
	H_2O	**Progibb®**	**Stimulate®**	**Sett®**	**CaB®**
Soaked paper	1.82 bBC	3.00 aA	2.60 bAB	0.84 bC	2.99 bA
Pre-soaked seeds	3.10 aA	3.29 aA	3.60 aA	3.43 aA	3.83 aA

Table 3. Root length, fresh and dry biomass of tabasco pepper seedlings, of wich seeds were pre-soaked or germinated in different plant regulators. Juazeiro, Uneb. 2010.

	Root Length (cm)	**Fresh Biomass (mg)**	**Dry Biomass (mg)**
Soaked paper	6.708 a	164.800 a	142.750 a
Pre-soaked seeds	5.485 b	166.950 a	139.200 a
H_2O	5.000 b	157.125 a	141.000 a
Progibb®	5.833 ab	155.375 a	141.125 a
Stimulate®	6.694 a	158.500 a	135.250 a
Sett®	6.606 a	185.750 a	141.125 a
CaB®	6.352 a	172.625 a	146.375 a

and passion fruit (FERREIRA et al., 2007) and accelerated the rate of emergence of tomato seedlings (ALBUQUERQUE et al., 2010), supporting this work. Seeds of *Genipa americana* L. (PRADO NETO et al., 2007) and of *Glycine max* (L.) Merrill (MORTELE et al., 2011), when treated with Stimulate® expressed higher germination and seedling growth. Treatment of seeds with CaB® led to 97% germination (Table 1). Calcium is required for cell division and growth, which are important for root growth. Magnesium has the function of a structural element, assisting in the membrane and cell walls stability, and acting as a bridge-like element, acting on the stability of the conformation of several enzymes and enzyme activation in phosphorylation reactions in photosynthesis (KERBAUY, 2004). It is observed that the highest length of shoots was obtained in seeds pre-soaked with CaB ®, Stimulate® and Progibb® which did not differ statistically (Table 2).

These and all other growth regulators tested, regardless of pre-soaking, induced greater root length in seedlings of tabasco pepper (Table 3). On the other hand, when evaluated in the fresh and dry biomass treatments with bioregulators not differ statistically (Table 3).

Biostimulants, mixture of two or more plant bioregulators or of plant bioregulators with other substances, can, according to their composition, concentration and proportion of substances, increase plant growth and development stimulating cell division, differentiation and cell elongation, but may also increase the absorption and utilization of water and nutrients for plants (STOLLER DO BRASIL, 1998).

The higher speed of germination, initial growth of seedlings and root development of seedlings seem to be the major effect of these substances (STOLLER DO BRASIL, 1998), as observed in this work.

Conclusions

Pre-soaking promotes highest percentages of germination and of normal seedlings, as well as highest seedling growth of tabasco pepper, regardless of the soaking solution;

The use of plant growth regulators Progibb ® and Stimulate ® improves seed germination and early growth of seedlings of tabasco pepper.

The use of any one of the bioregulators evaluated stimulated the development of roots.

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