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Short communication. Effects of the plant growth stimulant SBPI on *Bemisia tabaci* Genn. (Homoptera: Aleyrodidae)

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Abstract

The environmentally friendly plant growth stimulant and pesticide SB Plant Invigorator (SBPI, Stan Brouard Group) helps the plant to produce quality fruit. Three days after tomato plants were sprayed for the first time with SBPI (2 mL L^{-1} solution), this product seemed to be ineffective against *Bemisia tabaci* adults, as the numbers of dead females were practically equal on control and treated plants. After 3 days oviposition values on control plants did not differ significantly from those on treated plants. However, 31 days after the first treatment with weekly repeated treatments, new adult whiteflies started to emerge from pupae on control plants, but no L_3, L_4 or new adults were found on SBPI-treated plants. However, differences in the number of $1^{st} + 2^{nd}$ instar larvae were not statistically significant. From these findings it can be concluded that, under these conditions, SBPI is an effective alternative product for the control of *B. tabaci* on tomato plants, as foliar application inhibits larval development decreasing the risk of a new whitefly generation.

Additional key words: development, horticultural crops, reproduction, sweet potato whitefly, tomato.

Resumen

Comunicación corta. Efectos del estimulante del desarrollo vegetal (SBPI) sobre *Bemisia tabaci* Genn. (Homoptera: Aleyrodidae)

El estimulante del crecimiento vegetal y plaguicida respetuoso con el medio ambiente llamado SB Plant Invigorator (SBPI, Grupo Stan Brouard) incrementa la calidad de los frutos. Tres días después de que plantas de tomate fueron pulverizadas por vez primera con SBPI (2 mL L^{-1}), este producto pareció ser no efectivo frente a los adultos de *Bemisia tabaci,* puesto que el número de hembras muertas fue prácticamente igual en las plantas control y en las tratadas. Después de un periodo de 3 días, los valores de oviposición en las plantas control no difirieron significativamente de los obtenidos en las tratadas, aunque el valor medio de huevos puestos en las hojas tratadas con SBPI fue ligeramente mayor que el observado en las control. Sin embargo, 31 días después del primer tratamiento con tratamientos semanales, se inició la emergencia de nuevos adultos en las plantas control, mientras que no se obtuvieron L_3, L_4 ni nuevos adultos en las plantas tratadas con SBPI. El número de $L_1 + L_2$ fue mayor en estas plantas, pero las diferencias respecto a las controles no fueron estadísticamente significativas. De estos resultados concluimos que, bajo las condiciones experimentales utilizadas, el producto SBPI es efectivo para controlar *B. tabaci* en plantas de tomate, ya que su aplicación foliar inhibe el desarrollo larvario del insecto, disminuyendo el riesgo de aparición de una nueva generación de esta plaga.

Palabras clave adicionales: cultivos hortícolas, desarrollo, moscas blancas, reproducción, tomate.

The sweet potato whitefly, *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae), is a pest affecting a number of horticultural crops in tropical and subtropical regions worldwide (Carnero *et al*., 1990; Brown and Bird, 1992; Bedford *et al*., 1994a). This pest is represented in Spain by three biotypes, B, Q and S (Guirao *et al*., 1997; Banks *et al*., 1999) but only the B and Q-biotypes cause serious damage to commercial tomato (*Lycopersicon esculentum* Mill) crops and have a negative influence on the commercial success of this crop which is one of the most profitable and widely distributed crops in Spain (MAPA, 2004). Damage is the result of direct feeding by the insects, deposition of large quantities of honeydew and transmission of plant viruses (Moriones *et al*., 1993; Bedford *et al*., 1994b; Markham *et al*., 1996; Jiang *et al*., 1999).

Bemisia tabaci can develop resistance to many insecticides, and high levels of resistance have been

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reported in different agricultural systems worldwide (Denholm *et al*., 1998; Dennehy *et al*., 1999; Nauen and Denholm, 2005). Moreover, many of these products are toxic to the environment if they are not properly used. These disadvantages make necessary to carry out investigations on alternative strategies for the control of this species in the framework of IPM programmes. Utilization of new products, which fight pest physically but not chemically, are some of the alternative methods currently being investigated.

The SB Plant Invigorator (SBPI) developed by the Stan Brouard Group (Stan Brouard, 2005) has a physical mode of action that makes the product environmentally friendly. In 2005 the European Commission accepted SB Plant Invigorator as having a physical mode of action and it thus falls outside their pesticide directive 91/414/EEC (EWSN, 2005). Consequently SB Plant Invigorator is now available for use in many of the European member state countries without the requirement for registration. Due to its formulation, SBPI is a plant stimulant, and it has proved to be not toxic and environmentally safe. Therefore no harvest interval is required after it is used and special health and safety measures for users are not necessary. Further it does not cause residue problems in food (Stan Brouard, 2005). As its activity against insects is achieved by physical means, insects do not develop resistance to SBPI. This means that this product, even after long periods of application continues to be useful. The objective of this study was to analyze if SBPI was effective for the control of *B. tabaci* in commercial tomato plants.

Seeds of tomato (*Lycopersicon esculentum* Miller) cv. Marmande were germinated in a climate chamber maintained at 24ºC, 60% r.h. and a photoperiod of 16:8 (L:D). Plants were grown in red sand for the 10 first days and then in vermiculite. They were grown in 500 mL plastic pots and irrigated every other week with a nutrition complex at a concentration of 3 g L^{-1} (Nutrichem 60; Miller Chemical, Hanover, PA). Twenty 47-day-old plants were used for the assay.

Ten plants were sprayed using a small plastic spray with SBPI (2 mL L^{-1}) 12 times per plant, twice per six leaves. The rest of the plants were free water sprayed following the same proportions. To determine the effect of the product on different developmental stages of *B. tabaci*, and following the manufacturer's directions, the treatment was repeated weekly for the following 4 weeks (Stan Brouard, 2005). All treated and control plants were whitefly infested 1½ h after the first treatment with SBPI product or water. Five female adults of *B. tabaci* (B-biotype) were removed from a colony reared on tomato plants cv. Marmande, and placed into each of 10 clip-cages per assay (one cage per plant) attached to the under surface of one leaf (Nombela *et al*., 2001). Whiteflies were removed after 3 days, and eggs and dead individuals counted. First + second instar larvae, 3rd and 4th instar larvae and adults were recorded 31 days after initial treatment.

Data were analyzed with a one-way ANOVA followed by Tukey's HSD test (StatSoft, 1994).

The mean number of eggs and dead adults on control and treated plants did not differ significantly and this trend continued for 1st + 2nd instar larvae (Table 1). The lower number of 1st + 2nd instar larvae in control plants could be due to some immature insects developing to the next stage in the SBPI-treated plants but they died, and therefore, their development stopped at the 2nd instar stage, so no 3rd and 4th instar larvae or adults were recorded on these plants.

Recent studies on the mode of action of the product as a whitefly pesticide have shown that SBPI causes adult whitefly to stick to a wet layer that this product forms on the leaves where whiteflies land on them. Adult whiteflies produce a white wax powder that causes the white colour of their wings. Close examination showed that this wax powder becomes sticky when it is mixed with SBPI (Stan Brouard, 2005). This may explain why

Table 1. Mean (± SE) numbers of *B. tabaci* dead females and eggs after 3 days and different instar larvae and empty pupal cases after 31 days in control (water) and treated (SBPI) plants

Treatment	3 days after treatment		31 days after treatment				
	Dead females	Eggs	1st + 2nd instar larvae	3rd instar larvae	4th instar larvae	Empty pupal cases	Total
Water	3.00 ± 0.39 a	45.20 ± 8.31 a	18.50 ± 4.13 a	7.59 ± 1.57 a	5.10 ± 1.35 a	1.58 ± 0.52 a	32.79 ± 6.95 a
SBPI	2.89 ± 0.35 a	61.09 ± 11.29 a	37.78 ± 10.15 a	0 b	0 b	0 b	37.78 ± 10.15 a

Means followed by the same letter in the same clumn do not differ significantly ($P < 0.05$) by the Tukey's HSD test.

adult whiteflies are trapped by their wings after plant treatment and the insects remain stuck although the surface dries, and they die (Stan Brouard, 2005). However, there was no evidence of this in the present study as the number of dead adults was practically equal in both control and treated plants. The present results also showed that 3rd and 4th instar larvae were controlled by SBPI but in a different way to the adults. Whitefly larvae have a coating of wax that protects them form rainwater. The SBPI overcomes this protection and causes the larvae to suffocate. This physical mode of action does not allow *B. tabaci* to develop resistance and this makes the products useful for long term use.

From these findings it can be concluded that SBPI can reduce the use of toxic pesticides for the control of *B. tabaci* in commercial tomato plants.

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References

BANKS G., BEDFORD J.D., BEITIA F., RODRÍGUEZ-CEREZO E., MARKHAM P.G., 1999. A novel geminivirus of *Ipomoea indica* (Convolvulacea) from Southern Spain. Plant Dis 83(5), 486.

BEDFORD I.D., PINNER M., LIU S., MARKHAM P.G., 1994a. *Bemisia tabaci*-potential infestation, phytotoxicity and virus transmission within European agriculture. Proc. Brighton Crop Protection Conference: Pest and Diseases 3. The British Crop Protection Council, Farnham, UK. pp. 911-916.

BEDFORD I.D., BROWN J.K., ROSELL R.C., MARKHAM P.G., 1994b. Geminivirus transmission and biological characterisation of *Bemisia tabac*i (Gennadius) biotypes from different geographic regions. Ann Appl Biol 125, 311-325.

BROWN J.K., BIRD J., 1992. Whitefly-transmitted geminiviruses and associated disorders in the Americas and the Caribbean basin. Plant Dis 76, 220-225.

CARNERO A., MONTESDEOCA M., PÉREZ F., SILVERIO A., RODRÍGUEZ P., 1990. Presencia de *Bemisia tabaci* (Genn.) en cultivos comerciales de hortícolas y ornamentales en la isla de Tenerife (Islas Canarias). Cuadernos de Fitoparasitología 25, 176-180. [In Spanish].

DENHOLM I., CAHILL M., DENNEHY T.J., HOROWITZ A.R., 1998. Challenges with managing insecticide resistance in agricultural pests, exemplified by the whitefly *Bemisia tabaci*. Philos T Roy Soc B 353, 1757-1767.

DENNEHY T.J., WIGERT M., LI X., WILLIAMS L., 1999. Arizona whitefly susceptibility to insect growth regulators and chloronicotinyl insecticides: 1998 season summary. 1999. University of Arizona Cotton Report. University of Arizona Cooperative Extension. pp. 376-391.

EWSN, 2005. SB Plant Invigorator. Available in: http://www.whitefly.org/Resources/News/absolutenm/templates/CropProtProducts.asp?articleid=16&zoneid=5. [25 September, 2007].

GUIRAO P., BEITIA F., CENIS J.L., 1997. Biotype determination of Spanish population of *Bemisia tabaci* (Homoptera: Aleyrodidae). Bull Entomol Res 87, 587-593.

JIANG Y.X., DE BLAS C., BARRIOS L., FERERES F., 1999. Correlation between whitefly (Homoptera: Aleyrodidae) feeding behavior and transmission of tomato yellow leaf curl virus. Ann Entomol Soc Am 93, 573-579.

MAPA, 2004. Tomate: Serie histórica de superficie, rendimiento, producción, precio, valor y comercio exterior. In: Anuario de Estadística Agroalimentaria. Ministerio de Agricultura, Pesca y Alimentación. Dirección General de Planificación Económica y Coordinación Institucional, Madrid, Spain. 387 pp. [In Spanish].

MARKHAM P.G., BEDFORD I.D., LIU S., FROLICH D.F., ROSELL R., BROWN J.K., 1996. The transmission of geminiviruses by biotypes of *Bemisia tabaci* (Gennadius). In: Bemisia 1995: taxonomy, biology, damage, control and management (Gerling D., Mayer T., eds). Intercept, Andover, Hants, UK. pp. 69-75.

MORIONES E., ARNO J., ACOTTO G.P., NORIS E., CAVALLARIN D.L., 1993. First report of tomato yellow leaf curl virus in Spain. Plant Dis 77, 953.

NAUEN R., DENHOLM D.I., 2005. Resistance of insect pests to neonicotinoid insecticides: Current status and future prospects. Arch Insect Biochem 58, 200-215.

NOMBELA G., BEITIA F., MUÑIZ M., 2001. A differential interaction study of *Bemisia tabaci* Q-biotype on commercial tomato varieties with or without the Mi resistance gene, and comparative host response with the B-biotype. Entomol Exp Appl 98, 339-344.

STAN BROUARD, 2005. Stan Brouard Limited Guernsey, Channels Islands, Great Britain. Available in: http://www.sbproducts.co.uk/. [25 September, 2007].

STATSOFT, 1994. Statistica Version 4.5 for the Windows Operating System. Reference for statistical procedures. StatSoft, Tulsa, OK, USA.