

**IMPACT OF GLOBALISATION ON SUGARCANE PESTS,
BIODIVERSITY AND THE ENVIRONMENT:
A REVIEW OF THE 2009 ENTOMOLOGY WORKSHOP**

By

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Abstract

THE 7th International Society of Sugar Cane Technologists (ISSCT) Entomology Workshop was held from 20 to 24 April 2009 in San Miguel de Tucumán, Argentina under the theme: 'Impact of Globalisation on Sugar Cane Pests, Biodiversity and the Environment'. Technical sessions held over three days were grouped into five subject headings: biological control of sugarcane pests; pest management; insect-plant interactions; losses due to sugarcane pests; and biological studies of sugarcane pests. Following the technical sessions, field trips allowed delegates to view important insect pests of the Argentine sugarcane industry in the field and visit the Estación Experimental Agroindustrial Obispo Colombres, as well as cultural sites in the region surrounding San Miguel de Tucumán. The Entomology section concluded that globalisation will most likely continue to impact on the world's sugarcane industries. The ISSCT Entomology Workshops will therefore become increasingly important as a venue for entomologists to stay abreast of impending insect threats to their industries and to keep current with new technologies that will be vital for managing potential new invaders as well as maintaining sustainability.

Introduction

The 7th ISSCT Entomology Workshop was held from 20 to 24 April 2009 in San Miguel de Tucumán, Argentina. The Estación Experimental Agroindustrial Obispo Colombres hosted the workshop that enabled entomologists from 11 countries to share research findings under the theme: 'Impact of Globalisation on Sugar Cane Pests, Biodiversity and the Environment'. Seventeen technical presentations were made during the first three days of the workshop. The presentations covered the topics of biological control of sugarcane pests, pest management, insect-plant interactions, losses due to sugarcane pests, and biological studies of sugarcane pests. As always, an active discussion period was held at the end of each session.

A series of field trips was provided to complement the technical sessions. One day was set aside to visit selected field sites. One stop highlighted the clean seed program that provided micro-propagated seed to participating growers. At other sites, delegates were able to view damage caused by the stem borer *Elasmopalpus lignosellus* and, at another, the stem borer *Diatraea saccharalis*.

The final stop was at a commercial field where delegates were able to view damage by the weevil *Acrotomopus actropunctellus*. Lunch was provided by a local mill. The mill manager spoke to the group about processing and also enlightened the group about a consortium of mills planning to venture into the area of ethanol production. The following day the delegates were given a tour of Estación Experimental Agroindustrial Obispo Colombres. This experiment station is one of the oldest in the world and coincidentally is celebrating its centenary year in 2009. During the field tours, the delegates visited the region around San Miguel de Tucumán that included a visit to an archaeological site once inhabited by the indigenous people of this region of Argentina.

Opening

Dr Daniel L. Ploper, Head of the Estación Experimental Agroindustrial Obispo Colombres, opened the meeting by stressing the importance of the ISSCT workshops as venues for scientific exchange and the establishment of scientific contacts. Eng. Carlos Mirande, ISSCT Councillor from Argentina [Sociedad Argentina de Tecnico de la Caña de Azucar (S.A.T.C.A.)] and Mr Juan José Budeguer, president of the Board of Estación Experimental Agroindustrial Obispo Colombres also welcomed the attendees to the workshop and expressed their desire for a successful meeting. Dr Silverio Flores Cáceres, Honorary President of the 2010 ISSCT Congress, also welcomed delegates and encouraged all to come to Veracruz, Mexico in 2010. Dr William White, Entomology Section Committee Chairman, presented a historical review of the Entomology Workshops beginning with the first workshop held in 1991. He encouraged everyone to actively participate in the discussions as all could contribute to the workshop and their participation was important to group synergy.

Biological control of sugarcane pests

Biological control continues to be an important component of pest management by the world's sugarcane industries. Even an industry like Louisiana that relies heavily on insecticides to control its key insect, *Diatraea saccharalis*, has found that the use of green chemistry can have a profound positive impact on beneficial insects inhabiting sugarcane fields. Researchers in Louisiana found that, following the labelling and wide-spread use of the insect growth regulator (IGR) tebufenozide, the carabid beetle *Leptotrachelus dorsalis* is now able to successfully exploit sugarcane fields once denied it by broad spectrum contact insecticides. This beneficial insect appears to be a good candidate for future research in biological control in Louisiana.

While the impact of biological control in the field is often reported, the socio-economic impact of biological control is often under-publicised. In one documented case in Thailand, total benefits of US\$224-473 per hectare were realised with cost:benefit ratios of 0.12 and 0.33. The additional benefits to the environment and human health have not yet been taken into account.

Cotesia flavipes remains an important biological control agent of stem borers around the world. However, advances in mass rearing are needed to reduce the time and financial investment required to produce this parasitoid. Researchers in Argentina have found that production of cocoons was 8% higher following one inoculation rather than two. They also found that stinging 18 and 19 day-old larvae produce the most adults and female moths, while the ratio of males:females decreased from larvae 17 days old to 21 days.

Thailand has five important species of lepidopterous stem borers: *Chilo tumidicostalis*, *C. infuscatellus*, *C. sacchariphagus*, *Sesamia inferens*, and *Scripophaga excerptalis*, as well as a longhorn beetle stem borer, *Dorystenes buqueti*. Fortunately, a number of beneficial insects are present for biological control. These beneficial insects plus the stage of growth and nutritional condition of the cane plants play an important role in determining the level of damage incurred by Thai cane growers.

French researchers from INRA, FDGDON and CIRAD have developed an effective program for controlling the stem borer *C. sacchariphagus* on Réunion Island with the egg parasitoid, *Trichogramma chilonis*. However, they too are searching for ways to improve efficiency

of mass propagation of the parasitoid so that overall costs associated with the program can be lowered. Their approach is to develop cold-storage technology. Initial results have already defined biotic and abiotic parameters required for successful storage for up to two months.

Pest management

The main sugarcane pests in Mauritius are the stem borer *Chilo sacchariphagus*, the armoured scale *Aulacaspis tegalensis*, the soft scale *Pulvinaria iceryi*, the white grub *Heteronychus licas*, and armyworms *Mythimna* spp. Mauritius has a long history of successful biological control of these pests. However, with increased mechanisation of field operations to reduce production costs, major changes are occurring in the sugarcane landscape, causing a shift from a diverse habitat to one where sugarcane monoculture predominates. Researchers are investigating ways of creating conservation areas and undisturbed areas that would enhance the natural enemy populations and thus control incipient outbreaks of the pests.

The sugarcane leafhopper *Perkinsiella saccharicida* continues to be an important pest in Ecuador. While researchers continue to look for new and more effective biological control agents, an integrated pest management (IPM) approach that includes use of insecticides appears to be the approach most likely to succeed. However, insecticide application must be done in such a way as to minimise the risks to natural enemies.

Entomologists in South Africa are also focusing on an IPM approach with combinations of varietal resistance, cultural (planting date manipulation) and insecticide options to manage sugarcane thrips, *Fulmekiola serrata*. Research continues to be conducted to determine just how much yield loss is associated with thrips feeding.

White grubs continue to be the most important pests of sugarcane in Australia. Many growers in Australia are adopting new farming practices, i.e. legume rotations, controlled traffic and minimum tillage for economic and agronomic reasons and this may have positive or negative effects on white grub populations and damage. Existing insecticide recommendations may also be affected. Results of field trials are being included in guidelines for growers to manage white grubs in these systems.

Insect-plant interactions

Sugarcane is attacked by a complex of insect pests including stalk borers and leaf-sucking insects. In the U.S., two of these insect pests, the Mexican stem borer *Eoreuma loftini* and the sugarcane aphid *Melanaphis sacchari*, conform in their herbivore-plant interactions to the plant stress hypothesis.

The plant stress hypothesis predicts that environmental stresses on plants decrease plant resistance to insect herbivory by altering biochemical source-sink relationships and foliar chemistry, leading to more palatable food.

High-performance liquid chromatography analysis of whole leaf tissues indicates that several essential free amino acids increased in sugarcane leaves under drought stress. This increase was also associated with enhanced Mexican rice borer oviposition and injury.

Analysis of phloem sap composition of susceptible and resistant varieties revealed that two essential free amino acids (histidine and arginine) were missing in the phloem sap of an aphid-resistant variety. This change in amino acid content may also be associated with plant stress.

While *E. loftini* is a pest of stressed sugarcane, the stem borer *Diatraea saccharalis* is a pest of vigorously growing cane. Work in Argentina was conducted to investigate if fertilisation rates were associated with *Diatraea saccharalis* infestations.

When plots were fertilised with half of the standard rate, no differences were found between treated and control plots with respect to infestation levels. The researchers concluded that the gains in yield from proper fertilisation are greater than any increase in damage by the sugarcane borer.

Losses due to sugarcane pests

Assessing the losses due to insect feeding is a critical component in pest research. Dispersion of scarce research funds, as well as establishing action thresholds and other IPM management decisions, all depend on evaluations of pest losses. The sugarcane borer, *Diatraea saccharalis*, is the most important insect pest in Tucumán. Researchers there evaluated three varieties and determined field and factory losses due to this stem borer. Losses of 0.42% in stalk weight and 0.20% in pol of sugarcane were observed for each 1% increase in bored internodes.

In general, foliar feeding by insects is not considered to cause economic losses. However, in Argentina, the grassworm looper, *Mocis latipes*, appears to be an exception to this rule, with results from two separate studies being reported at the workshop. One study measured reductions in stalk weight of 11.3 to 41.2%, height of 1.7 to 20.7%, sugar content of 0.8 to 4.2%, and sugar yields of 13.9 to 42.9% while, in the second study, the average reduction in sugar yield was 58.3%. These studies indicate that the grassworm looper is capable of producing significant losses in sugar production. The differences in yield losses can be explained by cane variety and age of cane at attack.

Biological studies of sugarcane pests

Ecology processes take place within a spatial context, and the distribution of habitat may strongly impact the distribution, dynamics and evolution of natural populations. Today, the effective management of major insect pests requires an understanding of ecological processes involved in agroecosystem-insect pest interactions including the surrounding landscapes. With the growing use of remote sensing and electronic- and computer-based technologies in pest management, there is a real opportunity to understand the temporal and spatial movements of the insect populations as never-before possible. In Australia, a joint project is underway between CIRAD and BSES using new tools such as radiotelemetry, GIS and simulation models to unravel the spatial ecology of the white grub *Dermolepida albohirtum*.

Three species of leafhoppers, *Tomaspis nonozulia*, *T. australis* and *Tapajosa rubromarginata*, infest sugarcane fields in the Province of Jujuy, Argentina. These insects appear to have become important as pests with the adoption of green harvest and drip irrigation systems. Research has shown that the environmental factor that has the greatest adverse effect on population development is low precipitation during December.

When new pests are discovered attacking the sugarcane crop, rapid identification of the species and elucidation of basic pest biology are important early considerations. In 2003, while monitoring infestations of *Diatraea saccharalis* in Tucumán, a coleopteran larva was found in stalks causing damage similar to that produced by the *D. saccharalis*. Specimens were sent to the Museo de Ciencias Naturales in La Plata, Buenos Aires for identification. Dr Analía Lanteri identified the beetle as *Acrotomopus actropuntellus* (Coleoptera: Curculionidae). This weevil was previously cited by Jaynes in 1929 as occurring in sugarcane fields in Tucumán and Jujuy. The larvae feed on basal internodes, building wide and tortuous galleries, and also weaken the rootstocks where they hibernate. The insects colonise new fields mainly by the movement of seed-cane. Research continues on this emerging pest as its damage is frequently confused with that of the sugarcane borer and has likely been underestimated.

Conclusions

Globalisation is the integration of economic, political, and cultural systems around the world. It can be a force for economic growth but can also have an adverse impact on local agriculture by facilitating the introduction of insect pests and reducing biodiversity, thus increasing the frequency of pest outbreaks. Sugarcane industries will require their entomologists to react to the negative effects of globalisation by maintaining sustainability of their home industries. The ISSCT Entomology Workshops continue to be ideal forums to obtain knowledge on the most recent control

strategies, emerging pest developments and threats, and new technologies useful in unravelling difficult pest, host, and environmental inter-relationships. The 7th ISSCT Entomology Workshop was successful in meeting its obligations to those delegates investing the time and money to attend. Maintaining a high level of knowledge transfer remains an important challenge for organisers of future workshops as travel budgets diminish. Organisers must work hard to attract entomologists from developing and emerging countries, as well as provide services to sugarcane entomologists beyond the workshops, e.g. updating pest compendiums and forming consortiums to provide services unattainable to research institutions working alone.

Acknowledgments

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L'IMPACT DE LA GLOBALISATION SUR LES RAVAGEURS DE LA CANNE À SUCRE, LA BIODIVERSITÉ ET L'ENVIRONNEMENT : UNE REVUE DE L'ATELIER D'ENTOMOLOGIE EN 2009

Par

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MOTS-CLÉS: Lutte biologique, Gestion des Ravageurs, Interactions Insecte-Plante, Effets sur le Rendement, Études Biologiques.

Résumé

Le 7ème Atelier de Travail d'Entomologie de l'International Society of Sugar Cane Technologists (ISSCT) a eu lieu du 20 au 24 avril 2009 à San Miguel de Tucumán, en Argentine, ayant pour thème: «L'impact de la Globalisation sur les Ravageurs de la Canne à Sucre, la Biodiversité et l'Environnement». Les sessions techniques se sont déroulées pendant trois jours et étaient regroupées sous les thèmes suivants: la lutte biologique contre les ravageurs de la canne à sucre; la gestion des ravageurs; les interactions insecte-plante; les pertes occasionnées par les ravageurs; et les études biologiques des ravageurs de la canne. Après les sessions techniques, des visites aux champs ont permis aux délégués d'observer les ravageurs principaux de l'industrie sucrière d'Argentine et de visiter l'Estación Experimental Agroindustrial Obispo Colombres, aussi bien que

les sites culturels de la région de San Miguel de Tucumán. La Section d'Entomologie de l'ISSCT est arrivée à la conclusion que très probablement, la globalisation continuera à affecter l'industrie cannière dans le monde. Les ateliers d'Entomologie seront donc encore plus pertinents comme lieu de rencontre pour que les entomologistes puissent prendre connaissance des derniers développements, en particulier les menaces imminentes des ravageurs sur leurs industries. De plus, ils leur permettront de se familiariser avec de nouvelles technologies, essentielles pour gérer les envahisseurs potentiels et maintenir une lutte durable contre les ravageurs.

IMPACTO DE LA GLOBALIZACION SOBRE LAS PLAGAS DE LA CAÑA DE AZUCAR, BIODIVERSIDAD Y EL MEDIO AMBIENTE: UNA REVISION DEL TALLER DE ENTOMOLOGIA DE 2009

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PALABRAS CLAVE: Control Biológico, Manejo de Plagas, Interacciones Insectos Plantas, Pérdidas de Rendimiento, Estudios Biológicos.

Resumen

EL 7th Taller Internacional de Entomología de la Sociedad de Técnicos de la Caña de Azúcar se llevó a cabo entre el 20 y 24 de abril de 2009 en San Miguel de Tucumán, Argentina bajo el lema: "Impacto de la globalización sobre las plagas de la caña de azúcar, biodiversidad y ambiente". Se desarrollaron sesiones técnicas durante tres días agrupadas en cinco temáticas tituladas: control biológico de las plagas de la caña de azúcar, manejo de plagas, interacciones de insectos y plantas, pérdidas debidas a plagas de la caña de azúcar, y estudios biológicos de plagas de la caña de azúcar. A continuación de las sesiones técnicas, se programaron viajes de campo para permitir a los delegados ver insectos plagas importantes de la industria de la caña de azúcar de Argentina y visitar la Estación Experimental Agroindustrial Obispo Colombres, así como sitios culturales en la región cercana a San Miguel de Tucumán. La sección de Entomología concluyó que la globalización muy probablemente continuará impactando las industrias en el mundo de la caña de azúcar. El taller de ISSCT en Entomología seguirá incrementando su importancia como una herramienta para que los entomólogos se mantengan alertas e impidan las amenazas de los insectos a sus industrias y para mantenerse actualizado sobre nuevas tecnologías que serán vitales para manejar nuevos invasores potenciales así como para mantener la sostenibilidad.