GRUBPLAN: A TRAINING PROGRAM TO HELP GROWERS MANAGE GREYBACK CANEGRUB (DERMOLEPIDA ALBOHIRTUM) IN AUSTRALIA

By

P.R. SAMSON1, W.D. HUNT2, K.J. CHANDLER3, A. HORSFIELD4, R. COCCO1, R. MATTHEWS5 and P.J. SGARBOSSA6

1BSES Limited, PMB 57, Mackay Mail Centre 4741, Australia
2Formerly BSES Limited; currently North Queensland Area Consultative Committee, PO Box 500, Townsville 4810, Australia
3BSES Limited, Private Bag 4, Bundaberg DC 4670, Australia
4Formerly BSES Limited; currently Crop Care Australasia
5BSES Limited, PO Box 117, Ayr 4807, Australia
6Chairman, Sugar Industry Canegrub Steering Committee and grower psamson@bses.org.au

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Abstract

ALTHOUGH sugarcane growers in Queensland, Australia, have diverse options for managing greyback canegrub—controlled-release granular insecticides such as suCon® Blue (chlorpyrifos), the liquid insecticide Confidor® (imidacloprid), the biological control product BioCane™ (Metarhizium anisopliae), tolerant varieties, trap cropping, and tillage practices—preventative use of suCon® Blue has been the most common and often the only control measure employed on many farms. In 2001, a severe outbreak of greyback canegrub in northern Queensland created an urgent need to design and deliver a formal training program for greyback grub management to encourage the appropriate use of the full range of management strategies. The program, GrubPlan, used group extension methods with a high trainer:participant ratio of about 1:5. Workshops had an education component, as well as an interactive component in which participants mapped management strategies for individual fields on their own farms. The program in 2001 involved more than 900 growers and industry professionals in 70 workshops. Success of the program was judged by surveys of participants' responses to the workshops and their use of grub-management tactics, and by the subsequent level of grub damage. About 80% of growers indicated that GrubPlan had caused them to reconsider greyback management strategies on their farms. Greyback canegrub damage in 2002 was about 80% lower than in 2001. Workshops were run again in 2002 and 2003, but participation was much lower than in 2001. The GrubPlan program will continue on a needs basis, and will be upgraded as new information comes available. Improved systems for predicting the risk of future grub infestation are currently a high priority.

Introduction

White grubs, the larvae of melolonthine scarabs (Coleoptera: Scarabaeidae) are the most serious insect pests of sugarcane in Australia. The 19 species occurring in canefields are known locally as canegrubs, with the greyback canegrub, Dermolepida albohirtum (Waterhouse), being the most problematic. The product suCon® Blue, controlled-release granules containing chlorpyrifos, is the most commonly used control method for greyback canegrub and has the longest history of use, having been introduced to the industry in 1986. During the 1990s, control failures with suCon® Blue in the Burdekin region stimulated a period of intensive research into greyback management. Several new insecticidal and crop management options became available to farmers, but their use and integration were poorly understood, and many farmers were not using suCon® Blue to best advantage. Concurrently, an integrated pest management program evolved with input from researchers, extension specialists and grower champions. Management information was relayed to cane farmers through a variety of traditional extension techniques, such as shed meetings and fact sheets. However, there was no concerted industry-wide effort to encourage adoption of the full range of control options until 2001.

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In 2001, there was a severe outbreak of greyback cane grub in northern Queensland. Canegrub losses (almost all due to greyback with a minor contribution from some Lepidioota species) amounted to 746 000 t of cane, a huge increase over the 2000 figure of 350 000 t (see later data). However, the 2000 figure was itself substantially greater than the 255 000 t lost in 1999, indicating a rising trend. These yield losses were a severe loss of revenue on their own, but farmers also suffered the additional burden of having to replant severely damaged fields. Many ratoon crops were unprotected by susCon® Blue, either because plant crops had not been treated or the period of protection (1–2 years) had expired, so there was a risk of high damage continuing into 2002 and beyond.

Thus, there was an urgent need to deliver information on grub management to a large number to farmers within a short time period. The result was GrubPlan, a coordinated approach to training growers and advisory staff in the management of greyback cane grub by integrating all control options (Hunt et al., 2002, 2003). Its components, delivery and outcomes are described here.

Options for greyback management in 2001

susCon® Blue (140 g/kg chlorpyrifos) was developed in the 1980s to replace the persistent organochlorines, benzene hexachloride and heptachlor, that had been used up until that time. susCon® Blue is applied to plant crops either at or after planting. susCon® Blue requires more precise application than the organochlorines, and its efficacy can be compromised by high soil pH (Robertson et al., 1998). In 2001, many farmers, particularly those that had not had a history of grub infestations, were not aware of all requirements for its effective use.

BioCane®, a biological control product containing spores of the fungal pathogen Metarhizium anisopliae (2 x 10⁶ spores/g), was registered for greyback management in 2000 (Samson et al., 2001). Like susCon®, Blue, it is a preventative product for plant cane but must be applied after planting. Being a new product, many farmers were not aware of what this product could and could not do, and of its fairly exacting storage and application requirements.

Efficacy data for Confidor® 200 SC (200 g/L imidacloprid) were collected in 1999–2001 for its use as a ratoon treatment (Chandler, 2003). An Emergency Use Permit was obtained in 2001 to allow Confidor® use over large areas. A new formulation, Confidor® Guard (350 g/L) had replaced the 200 SC by 2003, but use was still under a permit system. Farmers in 2001 were keen to obtain details of this new product, as it was the only treatment available for application to unprotected ratoons.

Trap cropping was a new concept to most growers in 2001. Studies in the Burdekin region showed a strong relationship between time of planting or harvesting and subsequent grub populations, with taller cane attracting more ovipositing beetles (Ward, 2003). With the availability of Confidor®, strips could be cut early and treated with insecticide, aiming to avoid the need to treat whole fields (Horsfield et al., 2002).

Other developments from the recent RD&E push included sulfur-coated controlled-release chlorpyrifos granules, susCon® Plus, to provide grub control in alkaline soil (Chandler et al., 1998), minimum tillage to foster soil-borne grub pathogens (Robertson et al., 1997), and grass weed control which may help to reduce both crop attractiveness to beetles (Robertson and Walker, 1996) and establishment and survival of young grubs which require living plant roots for optimum survival and growth (Logan and Kettle, 2002).

In both plant and ratoon cane, grub control products had to be applied in advance of grub infestations, so forecasting and risk assessment was required. Growers were encouraged to monitor for grub infestations throughout their farms, and to judge the risk of future infestations according to current infestation status, infestation trends, proximity to other infestations, and the time of planting or harvesting of fields. Integration of options into management plans for each farm was quite a complex undertaking, with no recipe and no single answer.

GrubPlan workshops

We chose a workshop structure to deliver GrubPlan to industry. Workshops are valuable when immediate action is required, participants are receptive to learning, and there are management options available to remedy problems.

Workshops were conducted in four parts: situation assessment, education, application of knowledge, and evaluation, with a total duration of about 3 hours (Hunt et al., 2002):

- Situation assessment: Growers were supplied maps of their farms showing field boundaries and crop ages. They then mapped in known grub infestations, fields currently protected by insecticide, and fields intended for falling or planting, using a simple technique with coloured pens.
Education: Information on greyback biology, control options and risk assessment was delivered by specialists. A *GrubPlan* booklet summarising pertinent information was given to all participants.

Application of knowledge: Growers returned to their farm maps and developed whole-of-farm plans, while workshop staff circulated and discussed options with participants. Growers retained these farm plans for subsequent implementation.

Evaluation: Survey forms were distributed to identify subjects of most interest and the success of the workshop process.

This process was structured to have participants actively involved in the workshop from the outset, through the initial hands-on situation assessment. We did not want people to be passive onlookers in the workshops, and the situation assessment was also intended to make the following education component more meaningful to individuals. The application of knowledge component allowed participants to immediately apply and reinforce their knowledge, and also gave valuable feedback to workshop staff on the complexity of farm situations. Attendance at each workshop was restricted to 20 participants, with a high staff to participant ratio of 1:5, to maximise interaction and learning opportunities.

Workshops were run over a 16-week period in 2001, in grub-affected areas from Sarina north to near Cairns.

**Results**

**Initial evaluation by participants**

A total of 906 people attended *GrubPlan* workshops in 2001. Of the survey forms handed to participants, 400 (44%) were returned completed. The mean rating for worth of the workshops was 4.4 out of 5, indicating that respondents were highly satisfied with the outcomes. Participants rated the workshop process as 4.3, indicating that we achieved the interactivity that we were seeking. 98% of respondents were comfortable with the workshop environment. No preference was shown for any of the mapping or educational components of the workshop.

As for the future, 97% of participants stated that they intended to employ strategies developed in farm plans, and 97% indicated that they would be interested in future training and management planning in *GrubPlan*.

**Subsequent evaluation by participants**

The response of participants to the 2001 workshops was evaluated again early in 2002. Evaluations in 2002 were separated for two regions, the Burdekin and all others combined. This separation was done due to major differences in sugarcane agronomy and history of greyback problems. The Burdekin is dominated by farms with conventional tillage practices and cane burning, whereas in other regions there is much greater use of reduced tillage, green-cane harvesting and trash blanketing. Greyback losses during the 1990s had been consistently high in the Burdekin due to pH-induced problems with suSCon® Blue, so the increase in losses in 2001 was not nearly as marked (Figure 1). These ongoing problems with suSCon® Blue also meant that Burdekin growers were very receptive to new control options.

Of 400 Burdekin growers who attended 2001 workshops, 101 (25%) responded to the survey in February 2002. Of these, 25% had fully complied with the plans they developed at the workshops, while 79% had at least 60% compliance. Growers used a wide range of management tools, including two methods of targeting adults, carbaryl and light-trapping (Table 1).

**Table 1—Practices used by Burdekin growers for greyback canegrub management in 2001.**

<table>
<thead>
<tr>
<th>Management practice</th>
<th>% growers using practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>suSCon® Blue + acidifiers</td>
<td>47</td>
</tr>
<tr>
<td>suSCon® Plus</td>
<td>74</td>
</tr>
<tr>
<td>BioCane®</td>
<td>35</td>
</tr>
<tr>
<td>Confidor®</td>
<td>52</td>
</tr>
<tr>
<td>Carbaryl</td>
<td>68</td>
</tr>
<tr>
<td>Ploughing</td>
<td>36</td>
</tr>
<tr>
<td>Trap cropping</td>
<td>51</td>
</tr>
<tr>
<td>Late planting</td>
<td>78</td>
</tr>
<tr>
<td>Reduced-tillage planting</td>
<td>18</td>
</tr>
<tr>
<td>Light trapping</td>
<td>29</td>
</tr>
</tbody>
</table>
These adult control methods were not recommended at the workshops, as there was no evidence of their effectiveness for reducing grub damage, but they had been in use in the region for several years. The emergency use permit for carbaryl has since lapsed, while most local proponents of light traps have abandoned their use. 75% of the Burdekin respondents thought that *GrubPlan* had helped them improve their management plans.

In non-Burdekin regions, 140 (28%) of *GrubPlan* participants responded to the survey in April 2002. 23% recorded that they had fully complied with their plans while 75% recorded at least 60% compliance. There were considerable differences in the range of management practices used by non-Burdekin and Burdekin growers. Non-Burdekin growers did not use adult control options (carbaryl and light trapping), presumably because the main control option, suSCon® Blue, had remained effective over the preceding years and the same level of desperation to try anything had not developed. suSCon® Plus and BioCane™ were also little used. suSCon® Plus is useful in high-pH soils, which are common in the Burdekin but less common elsewhere. There is also less incentive for farmers to use BioCane™ in areas outside the Burdekin, where suSCon® Blue is still effective and where there has been less promotion of the product. 88% of respondents stated that *GrubPlan* had made them reconsider their greyback management. 84% indicated that they would continue in the *GrubPlan* program by attending follow-up workshops.

**Table 2—Practices used by non-Burdekin growers for greyback cane grub management in 2001.**

<table>
<thead>
<tr>
<th>Management practice</th>
<th>% growers using practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>suSCon® Blue</td>
<td>88</td>
</tr>
<tr>
<td>BioCane®</td>
<td>9</td>
</tr>
<tr>
<td>Confidor®</td>
<td>49</td>
</tr>
<tr>
<td>Trap cropping</td>
<td>37</td>
</tr>
<tr>
<td>Late planting</td>
<td>34</td>
</tr>
<tr>
<td>Reduced-tillage planting</td>
<td>45</td>
</tr>
</tbody>
</table>

**Subsequent cane losses (2002)**

In the Burdekin, cane losses fell from 258 000 t in 2001 to 45 000 t in 2002. The real significance of this fall is that the 2002 losses were the lowest that had been recorded in the Burdekin since 1995 (Figure 1). In non-Burdekin regions, losses fell from 488 000 t of cane in 2001 to 110 000 t in 2002 (Figure 1).

![Fig. 1—Canegrub losses in northern Queensland over a 9-year period](data supplied by Cane Protection and Productivity Boards).
On-going grower participation in GrubPlan

Our hope was that growers who participated in 2001 would return in 2002 and 2003 for further rounds of workshops, where they would reflect on and draw meaning from the success of actions they had taken in the previous year, before embarking on a new round of management actions. The group process would allow individuals to benefit from the experiences of others.

GrubPlan workshops were advertised again in 2002. However, attendance was well down on 2001, despite the interest initially expressed by participants at the 2001 workshops and in the follow-up survey early in 2002. In the Burdekin, only 100 growers participated, compared with 400 the previous year, and in non-Burdekin areas the corresponding figures were 164 growers compared with 506. Some reasons given by growers for non-attendance included ‘Grubs are no longer a problem, they have gone away’, ‘I can’t afford to apply treatments with the current low sugar price’, and ‘I now know what to do, I don’t need to attend follow-up workshops’ (Hunt et al., 2003). The workshop format was changed in 2003, as many farmers had become jaded with the original workshop structure, and more emphasis was placed on farm walks and less formal activities. 103 growers participated in greyback-focused activities outside the Burdekin in 2003; no dedicated GrubPlan activities were run in the Burdekin.

Discussion

The high participation in GrubPlan workshops in 2001 can be attributed to several factors; first, a need on the part of growers; second, a concerted response to the greyback grub problem by canegrowing organisations, and their support of the process; and third, the coincidence of the workshops with several new products or concepts for canegrub management—susCon®, Plus, BioCane™, Confidor® and trap cropping. There was particularly a novelty factor with the availability under permit of Confidor®, this being the first time that growers had access to a treatment for greybacks that could be applied to ratoon cane.

It can be inferred that the concerted industry response to greyback canegrub, with GrubPlan in the frontline, had a definite impact on grub losses in the next year. We can rule out an outbreak of canegrub pathogens as a plausible reason for the precipitous decline in losses from 2001 to 2002, as this decline was synchronous across most canegrowing regions, including the Burdekin where canegrub diseases are rare (Sallam et al., 2003). It is possible that unidentified weather events across northern Queensland may have played a role in both the increase in losses in 2000 and 2001 and the fall in 2002. This is being investigated, although a previous attempt to correlate greyback canegrub outbreaks with rainfall was unsuccessful (Robertson et al., 1997).

The sugar industry in Australia has a history of being reactive in pest management, and a paradigm shift is required by growers and staff to manage risk in a pro-active manner. Already there are signs that, now that canegrub pressure has eased, the attention of much of the industry has moved on. Our current aim is to establish forecasting systems and risk assessment procedures that will allow the industry to restrict outbreaks as occurred in 2001, by increasing management inputs during periods of pest population build-up; the converse benefit will be not wasting money on grub management inputs when the risk of grub attack is low.

Acknowledgements

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**GRUBPLAN: UN PROGRAMME DE FORMATION POUR AIDER LES AGRICULTEURS À GÉRER LE VER BLANC *DERMOLEPIDA ALBOHIRTUM* EN AUSTRALIE**

P.R. SAMSON1, W.D. HUNT2, K.J. CHANDLER3, A. HORSFIELD4, R. COCCO1, R. MATTHEWS5 et P.J. SGARBOSSA6

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6Chairman, Sugar Industry Canegrub Steering Committee and grower psamson@bses.org.au

**MOTS CLÉS: Canne a Sucre, Vers Blancs de la Canne a Sucre, Scarabeidae, *Dermolepida Albohirtum*, Vulgarisation, Gestion du Ravageur.**

**Résumé**

Les agriculteurs canniers du Queensland en Australie disposent de plusieurs options pour gérer le ver blanc; parmi celles-ci, on note l’insecticide granulé SusCon® Bleu (chlorpyrifos) à émission lente, l’insecticide liquide Confidor® (imidacloprid), le produit de contrôle biologique BioCane® (*Metarhizium anisopliae*), les variétés tolérantes, les plantes pièges et les pratiques de labour. Toutefois, le SusCon® Bleu, utilisé en contrôle préventif, a toujours été le plus commun et souvent le seul moyen de lutte contre le ver blanc sur beaucoup d’exploitations. En 2001, une infestation sévère du ver blanc dans le nord du Queensland suscita un besoin urgent de développer et de vulgariser un programme soutenu de formation pour la gestion de ce ravageur de la canne à sucre, afin d’encourager l’utilisation appropriée de toute la panoplie de stratégies de lutte. Le programme *GrubPlan*, qui utilise les méthodes de vulgarisation de groupes, a été élaboré avec un ratio formateur: participant de l’ordre de 1:5. Au cours des ateliers de travail comportant l’aspect éducatif ainsi que l’élément d’interaction, les participants ont été invités à développer des stratégies de lutte pour les champs individuels de leurs propres exploitations. Plus de 900 agriculteurs et professionnels de l’industrie ont participé aux 70 ateliers de travail organisés en 2001. Le succès du programme a été évalué à travers des sondages auprès des participants quant à l’adoption des tactiques de
gestion et le niveau de dégâts causés par le ver blanc par la suite. Pour environ 80% des agriculteurs, le programme avait été une incitation à revoir leurs stratégies de lutte sur leurs exploitations. Les dégâts causés par le ver blanc étaient inférieurs de 80% à ceux enregistrés en 2001. Des ateliers ont aussi été organisés en 2002 et 2003, mais le taux de participation a été largement inférieur à celui de 2001. Le programme GrubPlan sera poursuivi selon les besoins et sera amélioré au fur et à mesure que de nouvelles informations seront disponibles. La priorité est actuellement accordée aux systèmes plus performants pour la prédiction des risques d’infestation du ver blanc.

**Resumen**

Palabra clave: Caña de Azúcar, Gusano Blanco, Gusano Gris, Scarabaeidae, Dermolepida albohirtum, Extensión, Manejo de Plagas.

Aún cuando los cultivadores de caña en Queensland, Australia, tienen varias opciones para el manejo del gusano de dorso gris de la caña – insecticidas granulares de liberación controlada, tales como el susCon® Blue (Chlorpyrifos), el insecticida líquido Confidor® (imidacloprid), el producto de control biológico BioCane™ (Metarhizium anisopliae), variedades tolerantes, cultivos trampa y prácticas de labranza – el uso preventivo de susCon® Blue ha sido la más común y frecuentemente, la única medida de control empleada por los cultivadores. En 2001, un brote severo de esta plaga en el norte de Queensland creó la necesidad urgente de diseñar y ofrecer un programa formal de adiestramiento para el manejo de este gusano para estimular el uso adecuado de una amplia gama de estrategias de manejo. El programa, GrubPlan, empleó varios métodos de extensión con una baja número (5) de participantes por instructor. Los talleres tuvieron un componente educacional, al igual que un componente interactivo en el cual los participantes mapearon las estrategias de manejo para campos individuales de sus propios predios. El programa en 2001 involucró más de 900 agricultores y profesionales de la industria en 70 talleres. Se juzgó el éxito del programa a través de encuestas de las respuestas de los participantes a los talleres y el uso dado de las tácticas de manejo del gusano, y por el daño resultante del gusano. Alrededor del 80% de los cultivadores afirmaron que el GrubPlan hizo que ellos replantearan las estrategias de manejo en sus granjas. Se realizaron de nuevo talleres en 2002 y 2003, pero la participación fue mucho menor que en 2001. El programa GrubPlan va a continuar con base en la necesidad, y será actualizado a medida que se disponga de información nueva. Los sistemas mejorados para predecir el riesgo de futuras Infestaciones del gusano son, en el presente, de alta prioridad.