DOES IMIDACLOPRID PROVIDE ABIOTIC BENEFITS TO SUGARCANE IN THE ABSENCE OF CANEGRUBS?

By

GR TUCKER[1], KJ CHANDLER[2], JK STRINGER[2], L DERBY[2], A EATON[2], J JENNINGS[2], N MATTHEWS[1]

[1]Nufarm Australia Ltd, [2]SRA Limited
Glenville.Tucker@cropcare.com.au

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Abstract

SRA AND CROP CARE AUSTRALASIA sampled 16 field-trials in sugarcane, commencing in 2012 to examine any positive abiotic (non-insecticidal) effects that the imidacloprid products suSCon maxi® and Senator® WG might have on crop growth in the absence of canegrubs or other insect pests. Plant crops from the first set of trials established in 2012, and the second set established in 2013, have shown no positive growth responses in the absence of canegrub infestation. Plots re-treated with Senator WG as coulter applications into the young first ratoon crop gave some inconsistent effects in terms of increased cane yield or ratoon shoot growth in some of the trials, but in all cases these could have been due to low-level presence of canegrubs in the first ratoon crops.

Introduction

Numerous insecticides based on the active ingredient imidacloprid are registered for application in plant and ratoon crops of sugarcane for control of a range of canegrub pests. Imidacloprid insecticides are the only products being used by most sugarcane growers for control of canegrubs in Australian sugarcane.

In recent years, data have been published that support abiotic benefits to crop growth in various crops from the application of the insecticide imidacloprid in the absence of pests (Elbert *et al.*, 2008; Gonias *et al.*, 2008; Jeschke *et al.*, 2011).

However, no data are available in the public domain to substantiate such claims in Australian sugarcane; however imidacloprid is being widely used, based on unsupported (in sugarcane) recommendations in advertisements and verbal communication promoting positive abiotic effects.

In order to further investigate these claims in sugarcane, Crop Care, in co-operation with Sugar Research Australia, established replicated trial work in sugarcane with the imidacloprid products suSCon maxi (50 g/kg imidacloprid) and Senator WG (700 g/kg imidacloprid).

Relevance of such tests to the Australian sugarcane industry is that widespread use of imidacloprid to obtain unproven crop growth benefits increases risks of accelerated biodegradation and environmental load, which could lead to the industry losing the availability of imidacloprid-based insecticides.

Preliminary results from the 2012 trials in the plant crop were reported previously (Tucker *et al.*, 2014).

This paper now reports full results for plant crops of seven trials established in 2012 and nine trials established in 2013; also results from first ratoon crops of the 2012 trials that were retreated with Senator WG as coulter applications after the plant crop harvest.

Methods

Seven replicated small plot trials were established in 2012 in plant crops at Bundaberg (three) Mackay (two) and Gordonvale (two) districts. A further nine trials were established in plant crops at Bundaberg (three), Mackay (two), Burdekin (two) and Gordonvale (two) in 2013. All treatments were established into the open planting furrow before a fill-in cultivation. suSCon maxi granules were applied by hand shaker in a band 150–200 mm wide in the bottom of the furrow. Senator WG was sprayed as a liquid suspension with a small, calibrated hand sprayer to form a band 150 mm wide in the bottom of the furrow.

In all cases, at least 50 mm of soil was brought in over the granule band soon after application. Final soil cover over treatment bands varied between 80 and 200 mm and in most cases was in the range of 100–170 mm

Selected plots in the seven trials established in 2012 were retreated with the registered rates of Senator WG as coulter applications in the young first ratoons. Retreatment was according to registered commercial practice where a suspension in water of the product is applied under pressure through single nozzles running behind twin or single coulters running at a depth of at least 100 mm in each row of cane. A summary of the location and timing of application in these sixteen trials is shown in Table 1.

suSCon maxi was applied at 0.5 and 0.75 kg a.i./ha (10 and 15 kg/ha of product). Senator WG was applied in both the plant and first ratoon crops at 367.5 and 504 g a.i./ha (525 and 720 g product/ha) in the northern, Burdekin and central trials, which are the application rates registered for greyback canegrub *Dermolepida albohirtum* (Waterhouse) control.

In southern district trials, Senator WG was applied in both plant and ratoon crops at 252 and 367.5 g a.i/ha (360 and 525 g product/ha), which are the rates registered for control of southern canegrub species.

Duplicate untreated plots were established in most trials. Plots were four rows wide by 15 m long in the case of suSCon maxi treatments and four rows wide by 30 m long in the case of Senator WG treatments to facilitate mechanical application in the first ratoon crops. All trials had four replications of treatments.

All trials were monitored for canegrub infestation during plant and first ratoon (2012 trials only) crops. Between February and March and/or October and November (in southern trials) of each year of the trials, untreated plots were investigated for the presence of second and third instar canegrubs in the cane row.

If an average of 0.5 or more grubs/stool sample (60x40x30 cm soil and stubble) was found in these exploratory samplings, the trial was fully sampled (four samples/plot) for canegrubs in all plots.

With the exception of some trials for logistic reasons, crop yield was sampled at harvest in each year. Millable cane was weighed from the two central rows of each plot, using a truck-mounted weighing device fitted with load cells (± 2 kg).

Following harvest, all trials were assessed for ratoon shoot growth and gaps between shoots, to provide a measure of ratooning vigour and stool damage. Shoot populations and number of gaps (>0.6 m) between ratoon shoots were counted in the middle two rows of each plot.

Grub numbers were subject to a $\times^{0.44}$ transformation prior to analysis of variance with means separated by LSD Test (P=0.05). Cane yield and shoot data were not transformed prior to analysis of variance. Shoot gap data were sometimes transformed by log (×+1) when required to normalise distribution.

Non-transformed means are presented in the tables. Mixed Model analysis of data combined from all trials in each crop-class for canegrubs (after a $\log_{10}$ grubs/4 samples transformation for canegrubs), sugarcane yield, shoots and gaps was conducted. Non-transformed or back transformed estimates are presented in the tables.

Table 1−Site and treatment details for 16 field trials established in sugarcane with suSCon Maxi and Senator WG applied into the planting furrow.

Trial no.	Trial reference and cane variety	Trial co-operator and location	Application timing in relation to crop stage and soil cover	Soil type	Date trial established and retreated in 1st ratoon
1	EN12-01 Q200ϕ / KQ228ϕ	W. Thomas, Sandy Creek Road, Gordonvale, NQ	Half open drill with 70 mm cover over sets. Final soil cover over the granules-100 mm	Thorpe Granitic sandy loam	20/12/2012 28/10/2013
2	EN12-02 Q208ϕ	J. Castini, Green Hill, Gordonvale, NQ	Half open drill with 60 mm cover over sets. Final soil cover over the granules-100 mm	Kirrama Granitic sandy loam	16/10/2012 25/10/2013
3	EC12-01 Q238ϕ	P&R Ribaldone, Turners Road, Homebush, CQ	Half open drill with 50–75 mm cover over sets. Final soil cover over granules 140 mm	Sandy loam	28/11/2012 24/10/2013
4	EC12-02 Q183ϕ	T. Reed, Bruce Hwy, Sarina	Half open drill with 50–75 mm cover over sets. Final soil cover over granules 200 mm	Loamy sand	1/11/2012 2/10/2013
5	ES12-01 Q232ϕ	Bundaberg Sugar Ltd, Church Rd, South Kolan, SQ	Half open drill with 60–75 mm with soil cover over sets. Final soil cover 170 mm over granules.	Red clay loam	20/09/2012 14/11/2013
6	ES12-02 Q208ϕ/ Q242ϕ	C. Francis, Moore Park Rd, Oakwood,SQ	Half open drill with 70–85 mm cover over sets. Final soil cover 110 mm over granules	Red clay loam	4/12/2012 1/11/2013
7	ES12-03 Q242ϕ	A, Chapman, Langbecker Road E. Woongarra.SQ	Half open drill with 70–85 mm cover over sets. Final soil cover over granules 125 mm	Yellow clay loam	17/12/12 6/11/2013
8	EN13-01 Q208ϕ	J. Downing, Peets Bridge, Gordonvale, NQ	Half open drill with 30 mm cover over sets. Final soil cover over granules 130 mm	Pin Gin red kraznozem	9/12/2013
9	EN13-02 Q208ϕ	D Thomas, Irvin Access Rd Highleigh, NQ	Half open drill with 30 mm soil cover over sets. Final soil cover over granules 200 mm	Virgil red earth	4/12/2013
10	EC13-01 Q238	G. Borg, Borg Access Rd. Mt Ossa, CQ	Half open drill with 50–75 mm cover over sets. Final soil cover 200 mm over granules	Clay soil	22/11/2013
11	EC13-02 Q208ϕ	G. Davies, Balnagowan, Mackay, CQ	Half open drill with 50–75 mm cover over sets. Final soil cover 160 mm over granules.	Sandy loam	21/11/2013
12	EA13-01 Q138	P. Marano, Jarvisfield, Ayr, Burdekin	Half open drill with 60 mm cover over sets. Final soil cover 240 mm over granules	Alluvial clay loam	29/08/2013
13	EA13-02 Q183ϕ	G. Lyon, Giru, Burdekin	Half open drill with 40 mm cover over sets. Final soil cover 170 mm over granules	Black clay	23/08/2013
14	ES13-01 Q208ϕ	G & M Fritz, Dahl's Rd,Calavos, SQ	Half open drill with 90 mm cover over sets. Final soil cover over granules was 100 mm	Grey sandy loam	11–12/11/2013
15	ES13-02 Q240ϕ	A & A LaRocca, LaRocca's Lane, Cordalba, SQ	Half open drill with 100 mm cover over sets. Final soil cover 80 mm over the granules	Red volcanic clay	25/11/2013
16	ES13-03 Q238ϕ /Q240ϕ	E. Zunker, Henricksen's Rd,Sharron, SQ	Half open drill with 140 mm cover over sets. Final soil cover over granules 85 mm	Red clay loam	17–18/12/2013

Results and discussion

Grub counts

Canegrub numbers found in untreated plots in exploratory sampling at each trial are provided in Table 2.

Table 2—Canegrub numbers in exploratory sampling of untreated plots in plant and first ratoon cane at all trials.

Trial no.	Trial reference	Canegrubs in samples taken from untreated plots	
	Co-operator	Plant crop	First ratoon crop
1	EN12-01 W Thomas	1/16 samples	0/16 samples
2	EN12-02 J. Castini	1/16 samples	11/16 samples (March) 17/16 samples (April)
3	EC12-01 P&R Ribaldone	3/16 samples (1 replication only)	14/16 samples (March) 6/16 samples (May)
4	EC12-02 T Reed	2/16 samples	14/16 samples (March) 20/48 samples (May)
5	ES12-01 Bundaberg Sugar	0/8 samples	1/16 samples
6	ES12-02 C Francis	0/6 samples	0/16 samples
7	ES12-03 A Chapman	0/6 samples	2/16 samples
8	EN13-01 J. Downing	0/16 samples	NA
9	EN13-02 D.Thomas	0/16 samples	NA
10	EC13-01 G. Borg	4/16 samples	NA
11	EC13-02 G. Davies	0/16 samples	NA
12	EA13-01 P. Marano	0/8 samples	NA
13	EA13-02 G Lyon	0/8 samples	NA
14	ES13-01 G & M Fritz	1/16 samples	NA
15	ES13-02 A & A LaRocca	1/16 samples	NA
16	ES13-03 E. Zunker	0/16 samples	NA

NA= Data not available at the time of going to press.

During the plant crop stage, significant (>0.5 grubs/sample) canegrub infestations were not detected in any of the 16 trials.

In the first ratoon crop of the 2012 established trials, consistent significant infestation was only detected at one trial (trial 2). At this trial, there was a mean of 1.06 greyback canegrubs/sample in untreated plots in late autumn 2014.

Both suSCon maxi and Senator WG treatments significantly reduced canegrub numbers; there was no consistent difference between these insecticide treatments. Results are shown in Table 3.

Table 3—Average greyback canegrub numbers/treatment in first ratoon cane at trial 2 in comparison to untreated cane.

Trial no. and year of assessment	Treatment formulation and rate of application kg a.i./ha					F test
	suSCon maxi 0.50	suSCon maxi 0.75	Senator WG 0.368	Senator WG 0.504	Untreated	P value
2. EN12-02 2013–14	0.00b[1]	0.13b	0.13b	0.13 b	1.06a	<0.0001**

[1]Numbers followed by the same letter in the row are not significantly different. (LSD P=0.05).

At trials 3 and 4, initial assessments of untreated plots showed average populations of close to one greyback canegrub/sample, although this was inconsistent across the trials. Full sampling of these sites was delayed by wet weather. Later assessments found far fewer canegrubs and full sampling was not carried out.

Cane yield

Plant cane

Details of the effect of insecticides on sugarcane yield for the plant (2012 and 2013 trials) crop are shown in Table 4. At all eleven trials where sugarcane yield was measured there was no significant difference between insecticide treatments and untreated plots.

The combined analysis of the data from these eleven trials showed a very low probability (P=0.9863) of differences between any of the treatments.

Yield increases for insecticide treatments as a proportion of untreated plot yields were less than 2%.

Considering the lack of canegrub infestation in the plant cane at all these trials, these results do not support the case for any positive effects from these treatments in the absence of canegrubs.

First ratoon cane

Details of the effect of insecticides on sugarcane yield for the first ratoon (2012 trials only) crop are shown in Table 5.

Yield estimates were obtained for six of the seven trials that were at the first ratoon stage in 2013–14. Logistic problems prevented the harvest of trial 1.

At trial 3, both the high rate of suSCon maxi (750 g a.i./ha) and Senator WG (504 g a.i./ha) resulted in significant (P=0.0407) yield increases in the first ratoon compared to untreated plots.

Lower rates of both products did not. There were no significant sugarcane yield differences between treatments at the other five trials harvested.

A combined analysis of the six trials showed that the high rate of Senator WG significantly (P=0.0148) increased sugarcane yield compared to one set of the untreated plots but not the other. The yield increase was around 7% in this case.

Three trials (2, 3 and 4) where numerical yield increases in insecticide treated plots compared to untreated plots were seen had some evidence of greyback canegrub infestation in the first ratoon crop.

Even though this was only consistent across the trial at trial 2, greyback canegrub control by insecticides may have contributed to these differences.

Table 4—Yields (t sugarcane/ha) for plant crops at each of 11 trial sites comparing effects from treatment with suSCon maxi and Senator WG to untreated cane.

Trial no. and year of assessment	Treatment formulation and rate of application kg a.i./ha						F test P value
	suSCon maxi 0.50	suSCon maxi 0.75	Senator WG 0.368 or 0.252 #	Senator WG 0.504 or 0.368#	UT1	UT 2	
1. EN12-01 2012–13	117.7 a[1]	111.2 a	109.3 a	114.5 a	108.2 a	109.9 a	0.9679
2. .EN12-02 2012–13	81.8 a	NA	89.9 a	76.7 a	NA	88.9 a	0.2271
4. EC12-02 2012–13	88.5 a	88.7 a	85.7 a	84.5 a	85.4 a	93.6 a	0.1199
5. ES12-01 2012–13	99.6 a	99.3 a	100.2a	102.3 a	96.9 a	100.1 a	0.9918
6.ES12-02 2012–13	92.5 a	87.9 a	94.2 a	92.7 a	95.3 a	90.5 a	0.6105
7.ES12-03 2012–13	77.1 a	78.4 a	78.5 a	78.7 a	77.0 a	78.2 a	0.9999
8. EN13-01 2013–14	61.0 a	62.7 a	59.2 a	59.6 a	NA	52.4 a	0.0779
10. EA13-01 2013–14	164.2 a	174.4 a	167.0 a	164.9 a	170.1 a	177.8 a	0.5674
11. EA13-02 2013–14	163.6 a	165.6 a	161.4 a	167.4 a	155.2 a	151.3 a	0.8203
12.EC13-01 2013–14	47.2 a	44.0 a	55.6 a	53.7 a	50.5 a	52.1 a	0.0626
13 EC13-02 2013–14	108.5 a	115.2 a	104.4 a	110.1 a	106.4 a	115.1 a	0.6148
Mean[2]	100.2 a (100.4)	101.2 a (101.4)	100.3 a (100.5)	`100.4 a (100.6)	100.1 a	99.4 a	0.9863

Higher rates used in northern, Burdekin and central trials and lower rates used in southern trials.
[1]Numbers followed by the same letter in the row are not significantly different. (LSD P=0.05) in individual trials or the combined analysis. [2]Data from all individual trials were analysed by a Mixed Model analysis to compare combined estimates for the means of sugarcane yield. ( ) Values in brackets are proportions relative to estimated mean of untreated plots. NA= Treatment not included in trial or data not obtained from treatment.

Table 5—Yields (t sugarcane/ha) for first ratoon crops at each of six trial sites comparing effects from treatment with suSCon maxi and Senator WG to untreated cane.

Trial no. and year of assessment	Treatment formulation and rate of application kg a.i./ha						F test P value
	suSCon maxi 0.50	suSCon maxi 0.75	Senator WG 0.368 or 0.252 #	Senator WG 0.504 or 0.368#	UT 1	UT 2	
2. EN12-02 2013–14	98.6 a[1]	97.1 a	100.5 a	90.6 a	91.1 a	86.2 a	0.6415
3 EC12-01 2013–14	102.4 bcd	106.4 ab	92.1 cd	107.6 ab	NA	90.0 d	0.0407*
4. EC12-02 2013–14	75.2 a	77.4 a	80.4 a	85.1 a	75.5 a	67.7 a	0.1433
5. ES12-01 2013–14	114.3 a	112.1 a	110.7 a	115.2 a	110.8 a	110.6 a	0.8823
6.ES12-02 2013–14	121.0 a	111.6 a	114.4 a	119.9 a	125.7 a	119.1 a	0.2392
7.ES12-03 2013–14	113.1 a	109.8 a	103.2 a	110.0 a	109.8 a	108.7 a	0.5329
Mean[2]	104.1 ab (104.4)	102.5 ab (102.8)	101.2 ab (101.5)	107.0 a (107.3)	102.4 ab	97.0 b	0.0148*

Higher rates used in northern, Burdekin and central trials and lower rates used in southern trials.
[1]Numbers followed by the same letter in the row are not significantly different. (LSD P=0.05) in individual trials or the combined analysis. [2]Data from all individual trials were analysed by a Mixed Model analysis to compare combined estimates for the means of sugarcane yield. ( ) Values in brackets are percentages relative to estimated combined mean of untreated plots. NA= Treatment not included in trial or data not obtained from treatment.

Sugarcane shoot numbers and gaps between shoots

Ratooning following plant crop harvest

Shoot counts

At three trials (8, 10 and 12) there were significant differences in ratoon shoot numbers between treatments after the plant crop harvest (Table 6).

At trial 8, which had not been infested,(no grubs from sixteen samples in untreated plots) high rates of suSCon maxi and Senator WG had significantly (P=0.0231) more ratoon shoots than both sets of untreated plots. Low rates of both products did not result in significant increases in shoot numbers.

Table 6—The effect of suSCon maxi and Senator WG on ratoon shoots after the plant crop harvest at each of 16 trials in comparison to untreated cane.

Trial no. and year of assessment	Treatment formulation and rate of application kg a.i./ha						F test
	suSCon maxi 0.50	suSCon maxi 0.75	Senator WG 0.368 or 0.252 #	Senator WG 0.504 or 0.368#	UT1	UT 2	P value
1. EN12-01 2012–13	359 a[1]	340 a	327 a	322 a	NA	365 a	0.7011
2. .EN12-02 2012–13	453 a	419 a	446 a	421 a	NA	442 a	0.7229
3.EC12-01 2012–13	377 a	374 a	386 a	372 a	NA	357 a	0.9943
4. EC12-02 2012–13	305 a	322 a	303 a	310 a	NA	329 a	0.8941
5. ES12-01 2012–13	175 a	184 a	181 a	217 a	NA	192 a	0.9265
6.ES12-02 2012–13	210 a	199 a	191 a	212 a	NA	190 a	0.9880
7.ES12-03 2012–13	201 a	197 a	195 a	191 a	NA	223 a	0.9999
8. EN13-01 2013–14	240 abc	288 a	253 ab	286 a	209 bc	220 bc	0.0231*
9. EN13-02 2013–14	292 a	310 a	308 a	322 a	338 a	337 a	0.9239
10. EA13-01 2013–14	107 ab	120 a	100 ab	92 b	NA	105 ab	0.0237*
11. EA13-02 2013–14	180 a	176 a	176 a	180 a	187 a	179 a	0.8874
12.EC13-01 2013–14	357 bcd	392 abc	395 ab	404 a	346 d	412 a	0.0164*
13 EC13-02 2013–14	332 a	331 a	310 a	311 a	327 a	355 a	0.7741
14. ES13-01 2013–14	144 a	143 a	145 a	168 a	147 a	152 a	0.9937
15. ES13-02 2013–14	261 a	261 a	248 a	241 a	256 a	259 a	0.9999
16. ES13-03 2013–14	205 a	216 a	199 a	194 a	210 a	212 a	0.9717
Mean[2]	287 a (97.2)	293 a (99.3)	306 a (104)	312 a (106)	NA	295 a	0.6669

Higher rates used in northern, Burdekin and central trials and lower rates used in southern trials.
[1]Numbers followed by the same letter in the row are not significantly different. (LSD P=0.05) in individual trials the combined analysis.
[2]Data from all individual trials were analysed by a Mixed Model analysis to compare combined estimates for the means of ratoon shoot populations. ( ) Values in brackets are the % shoots in comparison to the mean of untreated plots. NA= Treatment not included in trial or data not obtained from treatment.

At trial 10, which had been lightly infested (4 grubs from 16 samples), the high rate of suSCon maxi significantly (P=0.0237) increased shoot numbers compared to the high rate of Senator WG , but not untreated plots or other insecticide treatments.

At trial 12, which had not been infested (no grubs from eight samples in untreated plots), the high rate of Senator WG significantly (P=0.0164) increased shoot numbers compared to the low rate of suSCon maxi and one set of untreated plots but not the other.

At the remaining 13 trials, probability (P values from 0.7011 to 0.9999) of differences between treatments was very low.

The combined analysis of all 16 trials did not show any significant effect of insecticide treatments on ratoon shoot counts following plant crop harvest.

Overall these data do not demonstrate any consistent benefit to ratooning after the plant crop harvest from imidacloprid insecticides.

Gap counts

There was no evidence at the 95% level of confidence that insecticide treatments affected the number of gaps between shoots following the plant crop harvest at any of the individual sites or in the combined analysis of the sixteen trials. This is consistent with the absence of any measureable canegrub pressure at these sites in plant crops.

Table 7—The effect of suSCon maxi and Senator WG on gaps (>0.6 m) between ratoon shoots after the plant crop harvest at each of 16 trials in comparison to untreated cane.

Trial no. and year of assessment	Treatment formulation and rate of application kg a.i./ha						F test
	suSCon maxi 0.50	suSCon maxi 0.75	Senator WG 0.368 or 0.252 #	Senator WG 0.504 or 0.368#	UT1	UT 2	P value
1. EN12-01 2012–13	0.0 a[1]	0.0 a	0.1 a	0.1 a	NA	0.0 a	0.7035
2. .EN12-02 2012–13	0.5 a	1.2 a	0.4 a	1.0 a	NA	1.2 a	0.4958
3.EC12-01 2012–13	0.5 a	0.2 a	0.9 a	0.5 a	NA	0.5 a	0.9888
4. EC12-02 2012–13	6.5 a	4.7 a	5.9 a	4.6 a	NA	6.5 a	0.5409
5. ES12-01 2012–13	11.0 a	11.0 a	11.0 a	10.0 a	NA	10.0 a	0.4947
6.ES12-02 2012–13	3.5 a	4.5 a	3.5 a	2.8 a	NA	1.0 a	0.8559
7.ES12-03 2012–13	0.3 a	0.5 a	0.1 a	0.1 a	NA	0.3 a	0.7719
8. EN13-01 2013–14	3.7 a	3.0 a	1.9 a	2.2 a	4.4 a	4.2 a	0.7692
9. EN13-02 2013–14	0.5 a	0.7a	1.6 a	1.2 a	0.7 a	0.2 a	0.4838
10. EA13-01 2013–14	0.0	0.0	0.3	0.3	NA	0.1	NA
11. EA13-02 2013–14	1.5 a	1.6 a	2.0a	2.4 a	1.8 a	2.5 a	0.8206
12.EC13-01 2013–14	0.5 a	0.0 a	0.4 a	0.4 a	0.7 a	1.7 a	0.3728
13 EC13-02 2013–14	3.0 a	2.5 a	3.2 a	2.4 a	2.9 a	1.7 a	0.7581
14. ES13-01 2013–14	9.5 a	9.5 a	7.7 a	7.7 a	8.7a	9.2 a	0.9780
15. ES13-02 2013–14	2.2 a	4.5 a	3.0 a	3.5 a	4.7 a	3.2 a	0.3043
16. ES13-03 2013–14	2.5 a	2.5 a	4.3 a	3.3 a	2.5 a	1.8 a	0.8703
Mean[2]	0.10 a	0.04 a	0.69 a	0.68 a	NA	0.12 a	1.0000

Higher rates used in northern, Burdekin and central trials and lower rates used in southern trials.
[1]Numbers followed by the same letter in the row are not significantly different. (LSD P=0.05) in individual trials or the combined analysis. [2]Data from all individual trials were analysed by a Mixed Model analysis to compare combined estimates for the means of gap numbers. Data presented are the back transformed means of the analysis.
NA= Treatment not included in trial or data not obtained from treatment.

Ratooning following first ratoon crop harvest

Shoot counts

At trial 4 there was a significant difference (P=0.0064) in ratoon shoot counts among treatments (Table 8). However there were no significant differences among the treatment set that is the subject of this paper. This site did have some evidence of grub damage and consequent damage from pigs, but it was not consistent across the site and this may have biased results.

There were no significant differences in ratoon shoot populations at any of the other sites or in the combined analysis of all sites for young second ratoons.

Table 8—The effect of suSCon maxi and Senator WG on ratoon shoots after the first ratoon crop harvest at each of seven trials and in a combined analysis in comparison to untreated cane.

Trial no. and year of assessment	Treatment formulation and rate of application kg a.i./ha						F test P value
	suSCon maxi 0.50	suSCon maxi 0.75	Senator WG 0.368 or 0.252 #	Senator WG 0.504 or 0.368#	UT1	UT 2	
1. EN12-01 2013–14	503 a[1]	474 a	464 a	474 a	502 a	442 a	0.8994
2. .EN12-02 2013–14	527 a	518 a	557 a	537 a	NA	444 a	0.3833
3.EC12-01 2013–14	351 a	367 a	346 a	361 a	NA	316 a	0.5905
4. EC12-02 2013–14	516 ab	609 ab	595 b	513 b	490 b	576 ab	0.0064**
5. ES12-01 2013–14	230 a	214 a	243 a	233 a	233 a	248 a	0.9838
6.ES12-02 2012–13	257 a	229 a	290 a	222 a	277 a	227 a	0.9989
7.ES12-03 2012–13	226 a	213 a	237 a	202 a	274 a	253 a	0.5747
Mean[2]	373 a (103.0)	375 a (103.6)	376 a (103.9)	365 a (100.8)	366 a	358 a	0.8744

Higher rates used in northern, Burdekin and central trials and lower rates used in southern trials.
[1]Numbers followed by the same letter in the row are not significantly different. (LSD P=0.05) in individual trials or the combined analysis.
[2]Data from all individual trials were analysed by a Mixed Model analysis to compare combined estimates for the means of ratoon shoot populations
( ) Values in brackets are percentages relative to estimated mean of untreated plots.
NA= Treatment not included in trial or data not obtained from treatment.

Gaps

Trials 2 and 4 had significant differences in the gaps between ratoon shoots following the first ratoon harvest (Table 9).

At trial 2, there were no significant differences between gaps for the treatment set which is the subject of this paper. Infestation of greyback canegrub in the first ratoon crop (Table 3) is likely to have increased gaps in untreated plots at this trial.

At trial 4 there was a significant effect of treatments (P=0.0414) on gaps between ratoon shoots. Untreated plots appeared to have more gaps than insecticide treatments, although this was not significant. As with shoot numbers, any differences may be explained by some grub infestation across the trial in the first ratoon.

None of the other five trials or the combined analyses of all seven trials showed any significant differences in gaps between shoots after the first ratoon harvest.

Table 9—The effect of suSCon maxi and Senator WG on gaps (>0.6 m) between ratoon shoots after the first ratoon crop harvest at each of seven trials and in a combined analysis in comparison to untreated cane.

Trial no. and year of assessment	Treatment formulation and rate of application kg a.i./ha						F test P value
	suSCon maxi 0.50	suSCon maxi 0.75	Senator WG 0.368 or 0.252#	Senator WG 0.504 or 0.368#	UT1	UT 2	
1. EN12-01 2013–14	0.3a[1]	0.0 a	0.0 a	0.1 a	0.0 a	0.0 a	0.4386
2. .EN12-02$ 2013–14	0.9 ab	1.1 ab	0.7 ab	1.6 ab	NA	4.2 a	0.0040**
3.EC12-01 2013–14	0.7 a	2.2 a	2.9 a	3.9 a	NA	3.0 a	0.4735
4. EC12-02 2013–14	4.5 a	3.5 a	6.6 a	4.6 a	6.7 a	8.7 a	0.0414*
5. ES12-01 2013–14	11.5 a	16.0 a	11.1 a	10.4 a	11.5 a	12.0 a	0.9297
6.ES12-02 2012–13	6.7 a	13.0 a	8.7 a	9.5 a	6.2 a	6.0 a	0.9947
7.ES12-03 2012–13	3.3 a	3.8 a	2.0 a	5.5 a	2.5 a	3.8 a	0.8921
Mean[2]	2.27 a	1.01 a	1.01 a	3.96 a	NA	1.04 a	0.9875

Higher rates used in northern, Burdekin and central trials and lower rates used in southern trials.
$ Data in EN12-02 was transformed by a log (x+1) transformation. Data shown are back transformed means.
[1]Numbers followed by the same letter in the row are not significantly different. (LSD P=0.05) in individual trials or the combined analysis.
[2]Data from all individual trials were analysed by a Mixed Model analysis to compare combined estimates for the means of gap numbers. Data presented are the back transformed means of the analysis.

NA= Treatment not included in trial or data not obtained from treatment.

Conclusions

1. In plant crops, applications of suSCon maxi (50 g/kg imidacloprid) at 10 or 15 kg/ha (0.5 or 0.75 kg a.i./ha) and Senator WG (700 g/kg imidacloprid) at 520 or 720 g/ha (368 or 504 g a.i/ha) provided no consistent positive abiotic affects to sugarcane growth, as measured by sugarcane yield and ratooning strength, in the absence of canegrub infestation.
2. In first ratoon crops, where Senator WG was reapplied to the same plots at the same rate after the plant crop harvest, suSCon maxi and Senator WG provided significant control of greyback canegrub (*Dermolepida albohirtum)* at one site where it occurred consistently across the trial.
3. At two of the other six first ratoon trials, there was some evidence of positive effects from insecticide treatments as measured by increased sugarcane yield and/or shoot growth in the young second ratoon crops. Although greyback canegrub infestation was not consistent across these trial sites, canegrubs were present in some cases and may have had a negative impact on sugarcane in untreated plots.
4. The results from 16 plant cane trials and 7 first ratoon trials across a range of environmental conditions have provided little consistent evidence that imidacloprid products will provide positive effects to sugarcane yield and ratooning ability in the absence of canegrub infestation.

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