SYSTEMIC INSECTICIDAL CONTROL OF THE FLATID *JAMELLA AUSTRALIAE* KIRKALDY, A PEST ON *PANDANUS* IN SOUTHEAST QUEENSLAND

N.J. Smith[1] and D. Smith[2]

[1]Queensland Department of Environment PO Box 168 Cottontree Maroochydore Qld 4558

[2]Department of Primary Industries, Queensland Horticultural Institute, Centre for Subtropical Fruit, Maroochy Research Station, Box 5083 SCMC, Nambour Qld 4560

Summary

From about 1990 to 1998, the flatid *Jamella australiae* Kirkaldy has caused severe dieback and death of pandanus from Noosa to Coolangatta in southeast Queensland.

The systemic insecticides imidacloprid, monocrotophos and dimethoate were tested against the pest by applying them as spot-sprays into the growing points of the pandanus heads or as injections into the trunk and/or main limbs.

All three insecticides gave effective control when applied as a spot-spray of 100 mL per head at rates of 1.75, 5.25 and 17.5 g.a.i.L^{-1} (imidacloprid), 12 g.a.i.L^{-1} (monocrotophos) and 20 g.a.i.L^{-1} (dimethoate). Based on safety, cost and residual efficacy, imidacloprid spot-sprayed onto the pandanus growing points at 1.75 g.a.i.L^{-1} was the most efficient treatment, giving control for at least 12 months.

Trunk injection of imidacloprid, using a mechanical injection system (Sidewinder®), was also effective for over twelve months and was less labour intensive, safer to the applicator and less disruptive to the natural enemies of the flatid than were spot-sprays. Imidacloprid injected as a 1:1 mix with water was effective at 2.5, 5 and 10 mL of product per single trunk or main limb. The most efficient dose was 2.5 mL, minimising the cost and volume of fluid injected into the tree. Tissue damage was minimal using a 6 mm drill and a maximum injection pressure of about 700 kPa.

INTRODUCTION

Pandanus tectorius var. *pedunculatus* (R. Br.) Domin is the most common pandanus species occurring in southeast Queensland and northern New South Wales. It grows naturally on coastal rocky headlands and dune areas and is a significant component of coastal plant communities, particularly in coastal National Parks and on major islands. It is regarded as a botanical tourist symbol on the Sunshine and Gold Coasts.

Since about 1990, a small flatid, *Jamella australiae* Kirkaldy, has caused severe dieback in pandanus from Noosa to Coolangatta (Medler 1990; Smith 1995; Smith 1996; Smith 1998). Heavy infestations feeding between the tightly packed leaves destroy leaf tissue and produce large amounts of honeydew, which encourages the growth of moulds. Affected leaves drop and growing points die. Tree death follows within 3–18 months of infestation.

A survey of 3220 pandanus in Noosa National Park from 1995 to 1997 showed a high correlation between tree health and flatid numbers ($P<0.001$). The percentage of trees in poor health increased from 45.8% in October 1995 to 66.4% in September 1996 and 75% in July 1997. The percentage of dead plants increased from 7% in October 1995 to 25% in September 1996, 37% in July 1997 and 45% in March 1998 (Smith 1995; Smith 1996; Smith and Smith 2000).

The flatid feeds between the tightly packed leaves of the pandanus growing points, and is difficult to control even with high volume applications of contact insecticides. Additionally, such practice applied to coastal plant communities is unacceptable environmentally and is not practical on steep terrain.

This paper describes trials with systemic pesticides, particularly imidacloprid applied as a spot-spray to pandanus growing points or by injection into the trunk or limbs.

MATERIALS AND METHODS

Insecticide trials

Maroochy Research Station (MRS), Nambour: Using a cordless drill, a hole 2.5 cm deep and 0.5 cm in diameter angled downwards at 30° was made in the base of the stems of 0.75 m tall potted pandanus plants. Stems were about 5 cm in diameter.

Monocrotophos (400 g L^{-1} emulsifiable concentrate—Azodrin®), imidacloprid (350 g L^{-1} suspension concentrate—Confidor®) or dimethoate (400 g L^{-1} emulsifiable concentrate—Rogor®) were injected into each of 3 plants for each treatment, using a 20 mL syringe. Plants were arranged in 3 blocks as replications. Monocrotophos was used undiluted (1 mL) or mixed 1:1 or 1:4 with water. Imidacloprid and dimethoate were used undiluted (1 mL). A foliar spray of buprofezin (400 g L^{-1} flowable concentrate —Applaud®) was included along with an untreated control (Table 1).

Table 1. Effect of treatments on *Jamella australiae* on potted pandanus plants at MRS, Nambour, 1995–96.

Treatment	Mean no. of live nymphs plus adults per plant			
	Pre-treatment	Post-treatments		
	13 Oct.	16 Nov.	23 Oct. / 6 Nov. / 23 Nov.	2 Jan.
monocrotophos 1 mL—trunk injected	32.7 a	0 a	0.3 a	27.0 a
monocrotophos 1 mL + 1 mL water—trunk injected	28.3 a	0.3 a	0 a	8.7 a
monocrotophos 1 mL + 4 mL water—trunk injected	36.3 a	3.7 a b	2.7 a	8.3 a
dimethoate 1 mL—trunk injected	35.3 a	20.3 b c	1.3 a	53.3 b
imidacloprid 1 mL—trunk injected	27.7 a	30.7 c	3.3 a	1.0 a
buprofezin 0.0125% spray	28.0 a	53.7 d	181.3 b	plants dead
Untreated	30.7 a	90.0 e	293.3 c	plants dead
LSD P = 0.05	16.1	19.9	56.8	12.8

Means within columns followed by the same letter are not significantly different.
Data transformed with Log(x+1); presented data back-transformed.

Leafhoppers were counted before treatment and on 5 occasions after treatment over a period of 3 months. The flatid counts were performed by recording the number of live adults and nymphs *in situ* in the first 5 leaf layers of the growing terminals of selected trees. Five terminals (or heads) were tagged (for counting) per selected tree at each assessment site.

Caloundra: A heavily infested patch of pandanus on the coastal dunes at Caloundra was utilised to test the chemical treatments and rates listed in Table 2. Formulations of the insecticides were the same as used in the MRS trial. Methidathion (400 g L^{-1} emulsifiable concentrate—Supracide®) and chloropyrifos (500 g L^{-1} emulsifiable concentrate — Lorsban®) were also tested.

Most of the treatments were applied as 'spot-sprays' of 100 mL of spray mixture per pandanus head. This dose was delivered into the growing point of the head, using a knapsack to pump the spray up a 1 cm diameter plastic tube attached to a long telescopic aluminium pole.

Two trunk injection treatments were included. In the first treatment, 3 holes (1 cm in diameter and 10 cm deep) were drilled downward at a 30° angle with a cordless drill into each major limb (or into the trunk of single-trunked trees), approximately 1.5 m above the ground. Five mL of imidacloprid diluted with 5 mL of water was injected into each hole using a 20 mL plastic syringe. 50 mL was injected into large multi-limbed trees. The alternative trunk treatment employed 20 mL spring-loaded injectors (Chemjet®) which were screwed into pre-drilled holes of 0.5 cm diameter and 10 cm depth. This spring-loaded injector gently forces liquid under pressure into the plant's vascular system over a period of 5–20 minutes.

A high volume application (a mixture of methidathion, dimethoate and chloropyriphos—all at 0.5 g.a.i.L^{-1}) was also applied to large and small trees. A twin-piston pump, delivering 100 litres of spray per large tree using a 4 m spray wand was used to apply the treatments.

Trees were graded as large (4–6 m high) and multi-branched or small (2–4 m high) and single trunked. Each treatment was replicated three times and all treatments were completely randomised.

For most of the treatments, three large and three small trees were assessed prior to treatment and on four occasions after treatment over a period of 12 months. For each assessment, the top 2–3 leaves of the pandanus head were parted and the number of nymphs and adults was counted. Between one and five heads were assessed per plant.

Noosa: The systemic imidacloprid was tested as a trunk injection at a 1:1 dilution mixture with water. The various imidacloprid treatments are listed in Table 3. Injections were made using a mechanical injection system (Sidewinder®). This system consists of a power driven 6 mm drill which bores a 0.5 cm diameter hole 10 cm deep into the trunk. The liquid dose is then injected under pressure from the same

Table 2. Effect of insecticide treatments on *Jamella australiae* on pandanus trees at Caloundra, 1996–97.

Treatment	Mean no. of live nymphs plus adults per head inspection				
	Pre-treatment	Post-treatments			
	1 Aug	17 Apr	6 Sep	20 Oct	4 Aug
imidacloprid 0.5 mL/100 mL (lg)	39 ab	2 a	0 a	0 b	0.3 c
imidacloprid 0.5 mL/100 mL (sm)	46 ab	0 a	0 a	0 b	0 c
imidacloprid 1.5 mL/100 mL (lg)	43.7 ab	9.3 a	3.6 a	0 b	0 c
imidacloprid 1.5 mL/100 mL (sm)	28 a	9.7 a	1 a	0 b	0 c
imidacloprid 5 mL/100 mL (lg)	39 ab	0.1 a	0 a	0 b	0 c
imidacloprid 5 mL/100 mL (sm)	26 a	4.8 a	51. a	0 b	0 c
monocrotophos 3 mL/100 mL (sm)	38 ab	1 a	0 a	0 b	0 c
dimethoate 5 mL/100 mL (sm)	48 ab	18.5 a	4 a	0 b	0.6 c
imidacloprid in trunk holes 5 mLs + 5 mLs water per hole (lg)	62 b	11.8 a	18.6 a	—	—
imidacloprid in trunk holes 5 mLs + 5 mLs water per hole (sm)	34 a	16.8a	0 a	0 b	0 c
imidacloprid injected 5 mLs + 5 mLs water per hole	38.8 ab	8.3 a	6.1 a	0 b	0 c
untreated (lg)	45 ab	82 b	34.3 a	29.3 a	28.3 a
untreated (sm)	33 a	33.3 a	108 b	30.8 a	23.3 a
imidacloprid 1.5 mL/100 mL (vsm)	51 ab	0 a	0 a	0 b	0 c
complete foliar spray (lg) 0.5 g.a.i.L^{-1} mixture of methidathion, dimethoate, chloropyrifos	45 ab	8.3 a	10.6 a	1.3 b	8 b
complete foliar spray (sm) 0.5 g.a.i.L^{-1} mixture of methidathion, dimethoate, chloropyrifos	43 a	11.3 a	0.6 a	0 b	0 c
LSD P=0.05	25.1	36.2	52.9	17.3	6.1

Means within columns followed by the same letter are not significantly different. (lg)—large trees; (sm)—small trees; (vsm)— very small trees

Table 3. Effect of pressurised trunk injection treatments of imidacloprid on *Jamella australiae* on pandanus trees at Noosa, 1996–97.

Treatment (imidacloprid diluted 1:1 with water)	Mean no. of live nymphs plus adults per head inspection				
	Pre-treatment	Post-treatment			
	10 Oct	2 Nov	7 Jan	20 Feb	23 May
10 mLs per hole/2 holes per limb/lg	50.0a	21.4 b	11.5 b	2.2 b	0 b
10 mLs per hole/2 holes per limb/sm	45.9ab	30.7ab	3.1 b	1.6 b	0 b
5 mLs per hole/2 holes per limb/lg	45.9ab	21.9 b	9.9 b	2.1 b	0.5 b
5 mLs per hole/2 holes per limb/sm	40.0abc	26.7ab	2.9 b	1.7 b	0 b
5 mLs per hole/1 holes per limb/lg	40.0abc	28.5ab	4.0 b	0.7 b	0 b
5 mLs per hole/1 holes per limb/sm	40.0abc	30.3ab	5.4 b	2.3 b	0 b
20 mLs per hole/2 holes per ls trunk	39.0 bc	26.7ab	6.7 b	4.5 b	0 b
10 mLs per hole/2 holes per ls trunk	35.1 c	44.7a	6.7 b	4.9 b	0 b
5 mLs per hole/2 holes per ls trunk	38.0 bc	26.0ab	6.3 b	4.1 b	0 b
untreated	45.0abc	38.5ab	45.7a	46.7a	43.3 a
LSD P = 0.05	10.1	19.4	18.2	18.8	3.5

Means within columns followed by the same letter are not significantly different. lg—large trees; sm—small tree; ls—large single trunked tree

drill and finally a plastic colour-coded plug 2 cm long is inserted to plug the hole. The pressure and dose can be adjusted. About 700 kPa was used in this trial, injecting into one or two holes per trunk on major limbs about 1–1.5 m above the ground.

Trees were classed as (1) large (4–6 m high) and multi-branched, (as at Caloundra) (2) small (1.5–4 m high) and with a single trunk or (3) large and single-trunked (5–6 m high). Each treatment was replicated 2–7 times and all treatments were completely randomised.

Flatid numbers were assessed pre-treatment and on four occasions post-treatment over a period of eight months.

A log x+1 transformation was performed on the data from MRS, Nambour. All results were subjected to one-way analysis of variance (ANOVA) and LSD's (P=0.05) calculated.

RESULTS

MRS Nambour: Monocrotophos, dimethoate and imidacloprid effectively controlled *J. australiae* on potted plants. Dimethoate and imidacloprid appeared to take longer for initial absorption (see result on 16 October) but reduced the population to a low level by 23 October (10 days post-treatment). Buprofezin was ineffective (Table 1).

On 2 January (81 days post-treatment), effective control was maintained in the imidacloprid treatment, but reinfestation had occurred in the monocrotophos and dimethoate treatments. The buprofezin and untreated plants had died from the effects of the infestation. Both monocrotophos and dimethoate caused noticeable necrosis around the injection hole. The amount of necrosis around the injection hole was much less for imidacloprid, but was still noticable. The drill holes used in this trial were clearly too large for potted plants of this size.

Caloundra: Imidacloprid, spot-sprayed into the heads gave very effective control at all dosage rates with almost no flatid survival after 3 months (Table 2). Twelve months after the treatment, the trees remained free of the pest. Monocrotophos and dimethoate were also effective.

Imidacloprid was also effective applied as trunk treatments (Table 2). Assessment of the syringe treatments in large trees concluded on 6 September because there was a risk of losing the trees due to poor health. These trees were then spot-sprayed with monocrotophos.

Noosa: Flatid numbers were reduced only slightly by imidacloprid injections during the first month (Table 3). However, after 4 months the infestation was largely controlled. There were no significant differences in efficacy between the different rates of imidacloprid used or tree sizes. After 8 months, the infestations had been eliminated or were at very low levels in all of the injected trees.

DISCUSSION

Spot-spraying: Spot-spraying with imidacloprid was shown to be an effective treatment for *J. australiae* on pandanus trees. Depending on age, pandanus trees carry from one to 100 heads, with most trees having fewer than 20 heads. Considering the effective dosage in relation to the cost of imidacloprid, optimum dosage for practical use was determined to be 0.5 mL per 100 mL of water applied per head. This treatment costs about $0.20 per head for the insecticide.

Spot-spraying with a knapsack and spraying rod avoided the need for heavy motorised spray equipment with its accompanying problems of excessive spray drift and accessing difficult locations. Imidacloprid has a significantly lower mammalian toxicity than monocrotophos and dimethoate, making it safer to the operator for spot-spraying. Because of the high dosage rates required, it would be unsafe to use the latter materials.

Trunk injection: Trunk injection of imidacloprid was very effective. In Trial 3, efficacy improved over time with each post-treatment count from November 1996 to May 1997. It was observed that where pandanus heads were healthy, uptake of the systemic insecticide was rapid and populations of the pest on those heads were reduced within 1–2 months. Where heavily infested heads were in a poor condition, reduction of pest numbers took much longer, presumably because translocation of the chemical was inhibited because of damage to the plant tissue.

The Noosa trial tested the injection procedure on taller and multi-branched trees up to 6 m high. Up to 8 months was required to completely control the infestation on some of the taller trees. By December 1996, there were no significant differences between dosage rates or the number of holes (1 or 2). Infestations tended to persist more on large trees than small trees but this effect dissipated by 20 February.

The cost of the insecticide was an important consideration in determining the final dosage for injection. Additionally, minimisation of the volume of the liquid injected is preferable as small volumes are less likely to cause internal damage to the tree trunk. Examination of the injection hole sites after 6 months showed an area of internal necrosis to a radius of 0.5 cm around the original bore hole. There was very little evidence of external damage at the injection sites. This level of injury appeared to be acceptable, with no effect on structural strength. The most economical rate for trunk injection was 2.5 mL

of product mixed with 2.5 mL of water (total 5 mL) injected into one hole in each trunk or major limb. This represented a cost of about $1.00 per injection site for the insecticide.

The period of protection given by the injected imidacloprid has not yet been fully determined. A 3 m tree injected in October 1995 (south of Sunrise Beach, Noosa) has remained free of *J. australiae* for 2 years while all of the untreated neighbouring trees have died. The trees treated in the Caloundra and Noosa trials in 1996 are also free of the pest after 2 years.

The mechanised method (Sidewinder®) of injecting the trees was effective and efficient and the use of plastic threaded plugs prevented leakage of chemical and may have provided a barrier to infection. However, care had to be taken to minimise drill speed and size and injection pressure to minimise the risk of tissue damage.

Observations on six large trees at Coolum (commenced in January 1997) showed that injection of imidacloprid as high up on the limb as possible gives more rapid uptake of the chemical and translocation to the head. Also, injection sites should be placed on sections of the trunk or limbs of sufficient diameter to maximise natural uptake of the mixture and minimise tissue displacement. Injections were made at a points where the limbs were at least 150 mm in diameter and 1.5–2 m above the ground. The number and placement of injection sites for each tree was subject to the position and number of main limbs.

To prevent an imminent loss of disastrous proportions, more than 3000 pandanus trees on the Sunshine and Gold Coasts were treated with imidacloprid throughout 1997. Trunk injection (using the Sidewinder® system) was the favoured method of treatment because of efficiency, cost, practicality and minimal environmental impact. In some cases, spot-spraying of the heads was also employed, particularly where plants have been in very poor health and less capable of translocating the systemic treatment quickly enough to prevent death. The program has been very successful. In Noosa National Park over 1500 pandanus, less than half the original population before dieback, were treated (most by injection) in September 1997. By March 1998 (6 months after treatment) 46% were healthy, 9% in poor health and 45% dead in comparison with 25% healthy, 38% poor and 37% dead before treatment. The percentage of dead trees, had increased (these trees being too sick to save) but the percentage of healthy trees had almost doubled and the percentage of plants which were in poor health had greatly decreased.

The treatment should hold the flatid at bay until introduced egg parasitoids become widely established and control the flatid (Smith and Smith 2000).

ACKNOWLEDGMENTS

The trials and development of the trunk injection technique were conducted in collaboration with Geoff Eldridge (Sidewinder® designer), Ashley Barkle (Maroochy Shire Council arborist) and Barry Parkinson (spray contractor, Caloundra).

REFERENCES

Medler, J.T. (1990). Review of *Jamella* Kirkaldy and *Malleja* gen.nov. in Australia and New Guinea with descriptions of new species (Homoptera: Flatidae). *Invertebrate Taxonomy.* **3:** 995–1004.

Smith, N.J. (1995). Noosa National Park study on the relationship between the flatid *Jamella australiae* and dieback in *Pandanus tectorius* var. *pedunculatus*. Industrial Placement Report. University of Queensland, Gatton 1995.

Smith, N.J. (1996). Studies on the flatid *Jamella australiae* Kirkaldy causing dieback in *Pandanus tectorius* var. *pedunculatus* (A. Br.) Domin on the Sunshine Coast in South East Queensland. Study Project. University of Queensland, Gatton. 1996.

Smith, N.J. (1998). Pandanus dieback: Report for the management of *Jamella australiae* in pandanus in Southeast Queensland. Queensland Department of Environment and Heritage and the Queensland Department of Primary Industries. 72 pp.

Smith, N.J. and Smith, D. (2000). Studies on the Flatid *Jamella australiae* Kirkaldy causing dieback in *Pandanus tectorius* var. *pedunculatus* (A. Br.) Domin on the Sunshine and Gold Coasts in south east Queensland. *General and Applied Entomology* **29:** 11–20.

This page left blank intentionally