War on Western Weeds initiative and War on Northern Invasive Weeds project updates
December 2017

Project overviews

WoWW initiative
The War on Western Weeds (WoWW) initiative aims to reduce the impact and spread of prickly acacia and bellyache bush (two of Australia’s worst weeds) in western Queensland through improved weed management, research and training.

WoWW is a five-year $1.88 million Queensland Government initiative managed by the Department of Agriculture and Fisheries (DAF), concluding in June 2018.

Project aims are being achieved through adaptive management trials; community based research; best practice field days and promotion; development of decision support tools; and, biological control investigations. The results, to date, have been increased capacities, skills, tools and motivation to achieve practical and cost-effective outcomes for prickly acacia management and scoping of possible biological control agents to reduce the impacts of both prickly acacia and bellyache bush.

WoNIW project
Funded by the Australian Government, the War on Northern Invasive Weeds (WoNIW) is a two year $306,500 project that aims to refine innovative on-ground control techniques and approaches for prickly acacia management.

The project will trial chemical applicators (heli-drop and skattergun) for prickly acacia; implement a Good Neighbour Program case study; and, facilitate weed control technical information exchange across Northern Australia. The project is being delivered in conjunction with the WoWW initiative and concludes in June 2018.

Recent outcomes and achievements

This report collates the key activities and outcomes of the WoWW project from July to December 2016. The recent key achievements are summarised as:

- Four new factsheets and two revised factsheets have been published to provide accessibility to project trial and study results. This brings the total number of decision support tool factsheets to 11 (http://www.southerngulf.com.au/resources/fact-sheets/).
- Project staff have led and/or contributed to eleven regional events as well as the Queensland Weeds Symposium to provide best practice control and management information arising from the project. This has directly provided an estimated 380
stakeholders (not including those at public events such as the Beef Expo) with increased access to project outcomes.

- Notable events associated with both the WoWW and WoNIW projects was the ‘What’s new in prickly acacia control’ field day at Richmond. This event showcased the SR3 heli-drop, skattergun and Marshall Tree Saw to 40 graziers and others.
- The WoWW project team was awarded the George N. Batianoff Award for excellence in weed management at the Queensland Weeds Symposium in December 2017.
- The Muttaburra Good Neighbour Program Case Study was completed and an associated publication launched in June 2017. The case study has reinforced the finding that control operations for ‘weed-free’ boundary buffer zones are generally quick, easy and of low to moderate cost. Their introduction was considered reasonably practical for the participating properties.
- The Richmond Good Neighbour Program case study involves ten properties with initial treatment completed of priority weeds on 380 km of property boundary.
- A new heli-drop trial, to test the SR3 developed by Fox Helicopter Services, was established at Vernon Downs near Richmond. Results of the trials found that the SR3 could treat from 100 to 400 ha per hour at a density range of 0.5 to 5.5 plants per hectare.
- The Eppl Skattergun and other techniques comparative trial was expanded to include buggy-based skattergun trials. Results to date indicate the skattergun provides superior treatment speeds when densities of prickly acacia are above 20 plants per hectare.
- The Marshall Tree Saw was trialled at St Elmo in the Julia Creek area of north west Queensland. The trials demonstrated the application of this bob-cat mounted device to clear prickly acacia areas and provide fodder benefits. Further analysis of these trials will occur in 2018.
- Ecology studies have continued for prickly acacia seed longevity with 5% of seed found to still be viable after 8 years (for seed lot 1) and 29% viability after two years (for seed lot 2).
- During the past year, prickly acacia biological control investigations have primarily focussed on new opportunities for agents from Ethiopia and Senegal in Africa. Prospective agents include gall thrips, two gall mites and a galling fly. Studies have also continued on the scale insect from India.
- Biological control investigations are also ongoing for bellyache bush with testing underway for the Jatropha rust, Jatropha leaf-miner, Jatropha webber and Jatropha gall midge.

**Project coordination, decision support tools, best practice promotion and case studies**

**Purpose**

This component of the WoWW initiative is about ensuring new information and improved approaches for prickly acacia management are delivered through stakeholder networks. The decision support tools and the means of delivering key messages and products are jointly determined between WoWW project staff, the advisory group and key community partners. Case studies have been undertaken in conjunction with local government, land managers and community groups to facilitate innovative approaches such as the Good Neighbour Program.
Project coordination

War on Northern Invasive Weeds – Prickly Acacia (WoNIW)

The ‘Northern Invasive Weeds – prickly acacia’ project is an Australian Government funded project ($306,550) being led by the Department of Agriculture and Fisheries in conjunction with the WoWW initiative.

The WoNIW project is complementing the WoWW initiative through expanded heli-drop trials, skattergun trials, support for additional community-based innovation, field days and technology exchange.

A number of notable adaptive management trials and other activities have occurred during 2017 with details of project outcomes provided in this report.

Decision support tools – factsheet series

A co-branded factsheet series was developed by DAF in partnership with SG NRM to increase awareness of WoWW research results, promote case study outcomes and facilitate best practice adoption for prickly acacia management.

Four new factsheets and two revised factsheets (‘The prickly acacia control toolbox for western Queensland’ and ‘Spray misting – a new method for prickly acacia control’) were published in 2017. An overview of the new factsheets, written by Nathan March, Wayne Vogler and/or Kelsey Hosking, is provided:

- **Simple actions to prevent the spread of prickly acacia** – synthesises the results of ecology studies and a Longreach Spread Prevention Workshop outcomes into practical actions and guidelines to reduce spread of prickly acacia seed and limit the expansion of infestations.

- **Using visual seed and pod cues for assessing prickly acacia seed viability** – provides a tool for land managers to assess seed and pod maturity risks associated with livestock browsing of pods.

- **Marshall Tree Saw – a mechanical control option for prickly acacia** – provides an overview of a new mechanical device for prickly acacia control, including the results of a field trial and a discussion of optimal conditions for use.

- **From prickly acacia to pasture – a mechanical control field study** – examines the results of a field study comparing a dozer pushed site with an untreated site over three years. The study provides key lessons for timing and targeting of mechanical control to reduce prickly acacia re-establishment risks while gaining fodder benefits.
Four new factsheets were published in 2017. The factsheets are being made available at forums, field days, regional shows and at the DAF and SG NRM offices. Additional copies can be downloaded from the SG NRM website (http://www.southerngulf.com.au/resources/fact-sheets/).

Best practice promotion – regional forums, workshops and field days
Project staff have contributed to a range of events to promote best practice and convey key research and case study results. These include:

- **Northern Beef Producers Expo, Charters Towers (March 2017)**
  - WoWW banner display and decision support factsheets made available.

- **‘Woody weed control day’, Giru (March 2017)**
  - Kelsey Hosking provided technical input to demonstrations regarding prickly acacia management.

- **Flinders Shire Pest Management Advisory Group meetings, Torrens Creek & Prairie (March & October 2017)**
  - Provide technical input to meetings regarding prickly acacia management.

- **Agriculture and Environment Committee enquiry into the impact of weeds, Hughenden session (June 2017)**
  - Provide technical input and support for the prickly acacia field tour of prickly acacia.

- **North Queensland Dry Tropics meeting, TWRC Charters Towers (June 2017)**
  - Present WoWW research, outcomes and implications.

- **University of Queensland student workshop, TWRC Charters Towers (July 2017)**
  - Wayne Vogler presented WoWW research, outcomes and implications to students.
• Prickly Acacia Alliance meeting, Cloncurry (August 2017)
  – provide technical input to meeting regarding WoWW and WONIW project progress and
  prickly acacia management.

• ‘What’s new in prickly acacia management field day’, Richmond (September 2017)
  – Kelsey Hosking and Nathan March provided updates on ecology studies and adaptive
  management control trial results. Refer to Figures 2 and 3.

Figure 2. Nathan March (DAF) presents WoWW and WoNIW project updates to field day
participants (left) while Dave Fox (Fox Helicopter Services) provides an overview of the SR3 heli-
drop device and its application (right).

Figure 3. Robert Hacon, Julia Creek grazier, demonstrates the buggy-based application of the
Epple Skattergun (left) while Keith Morrow discusses the Marshall Tree Saw.

• Mount Isa Landcare Group Weeds Workshop, Mount Isa (September 2017)
  – Nathan March provided an overview of control options for weeds in north west
  Queensland.

• Prickly Acacia Management Plan Workshop, Ayr (September 2017)
  – The aim of the workshop was to develop an integrated long-term management plan
  based on achieving clear and measurable goals to reduce the impact of prickly acacia
on high value agricultural and ecological assets within the Burdekin Dry Tropics NRM region. As part of the workshops discussions, stakeholders participated in the identification of strategic locations to focus management efforts. These discussions included identifying the best practice management techniques that will be required to deliver integrated, on-ground prickly acacia control works.

– Wayne Vogler and Kelsey Hosking provided technical input regarding prickly acacia ecology and management. Other attendees included staff from Burdekin Regional Council, Whitsunday Regional Council, and the region’s Biosecurity Officer.

**Stamford Property Management Planning Workshop (November 2017)**

– The workshop, co-led by Desert Channels Queensland (DCQ), Southern Gulf NRM (SGNRM) and DAF focussed on integrating Mitchell grass, prickly acacia and livestock management to assist business resilience, protect investments in prickly acacia control by reducing risk of reinfestation and to sustainably manage Mitchell grass pastures.

– Six grazing enterprises, including both beef and sheep producers, attended and tackled these issues around the business production goals. Producers were provided with property maps generated by DCQ which showed the location, size and density of prickly acacia infestations. The maps provided a basis for discussion of management options for prickly acacia on their properties with respect to pasture and animal production goals, and meeting biosecurity obligations.

– More workshops are planned in the future and form an important part of meeting project milestones for each agency. The integration of weed, pasture and animal management goals is an important part of improving grazing business and landscape resilience in the Mitchell grasslands of western Queensland. Wayne Vogler and Kelsey Hosking contributed technical information (Figure 4) regarding prickly acacia impacts, management and control.

![](image)

**Figure 4.** DAF staff consider property maps and discuss best approaches to tackling prickly acacia for specific grazing businesses.
Queensland Weeds Symposium
An oral paper and a poster paper regarding prickly acacia were presented at the Queensland Weeds Symposium in December 2017. The papers were:

- Advancing prickly acacia management through the War on Western Weeds
- From prickly acacia to pasture – key lessons from a mechanical control field study (poster).

In addition, the WoWW project team were awarded the George Batianoff Award for team excellence in weed management (figure 5). This is a prestigious award made biennially by the Weeds Society of Queensland.

Figure 5. Nathan March presents an overview of WoWW project achievements (left) which were recognised (right) by the Weeds Society of Queensland through the George Batianoff Award for team excellence in weed management.

Good Neighbour Program Case studies

Muttaburra Good Neighbour Program case study
The Muttaburra GNP case study, a collaboration between DAF, SG NRM, Barcaldine Regional Council (BRC) and participating landholders was completed in the first half of 2017. The case study aimed to assess the cost and effort associated with establishing ‘weed free’ property boundary buffer zones for a cluster of 12 properties. Buffer zones are a minimum of 20m except where intersected by a watercourse, upon which the buffer is 250m on the upstream side.

A case study publication was launched (Figures 6 & 7) at Verastan station via Muttaburra in mid-June. The event was co-hosted by DAF, Barcaldine Regional Council (BRC) and the Remote Area Planning and Development Board and had about 40 attendees. Nathan March provided a presentation titled Outcomes of the Muttaburra GNP Case Study - boundary weed management challenges and practical prevention action.

A summary if GNP case study findings is provided:

- Case study data analysis:
  - initial control for boundary buffer zones took from 1 to 3 days per property with a team of 2 to 4 personnel. The treatment rate averaged 1.32 km/hr/pp with costs of materials averaging $1300 per property and full commercial costs averaging $3000 per property.
- follow-up control for boundary buffer zones took from ½ to 3 days per property with a team of 2 to 4 personnel. The treatment rate averaged 2.35 km/hr/pp with costs of materials averaging $370 per property and full commercial costs averaging $1200 per property.

- **Benefits of GNP:**
  - immediate reduction in weed seed spread between properties
  - incentive for properties who are weed-free or aiming to progress their property or paddocks to weed-free.
  - transfers the weed burden back to the property producing the weed seed.
  - increases motivation and exposure to new techniques
  - fence maintenance
  - mustering ease

- **Overall results:**
  - the establishment of weed-free boundary buffer zones was reasonably practical.
  - results similar to Flinders Shire pilot study.
  - control operations were usually quick and of low to moderate cost.
  - nearly 600km of property boundary ‘weed-free’ buffer was established
  - plus 33km of watercourse treated, creating about 250 buffer zone areas on watercourses
  - a worthwhile result for the efforts involved.

The case study results have given BRC the impetus to consider the broader implementation of a Good Neighbour Program.

**Figure 6.** The Muttaburra GNP case study involved the treatment of weeds on approximately 594 km of property boundary (left) with the results recently published (right).
Richmond Good Neighbour Program case study (WoNIW funded activity)
The Richmond GNP case study commenced late 2016 and is focused on an area about 60 km south west of Richmond in north west Queensland. Ten properties (comprising six farming businesses) have now been incorporated into the case study with initial control of priority weeds completed on approximately 380 km of property boundary (Figure 8 & 9). The case study is being led by DAF in partnership with SGNRM and the participating landholders.

Graziers have been strong contributors of both labour and materials to the case study. Follow-up control and case study completion will occur following the 2017 – 2018 summer wet season.

This case study has been funded by the Australian Government through the War on Northern Invasive Weeds – Prickly acacia project.

Figure 7. The launch of the case study (left) was well attended by 40 participants and included a demonstration of the Epple Skattergun (right).

Figure 8. Treatment of higher density boundary infestations required a team of contractors, DAF personnel and landholders (left) or aerial options (right).
Figure 9. Basal treatment of prickly acacia near native vegetation (left) and tebuthiuron treatment of scattered prickly acacia (right).

Adaptive management trials, community based research and ecological research

Purpose
Adaptive management trials and community based research are being undertaken as part of the War on Western Weeds initiative to facilitate the development of new tools for improved prickly acacia management. These tools are frequently the result of innovation from the community and industry that benefit from collaborative support to field test, refine and/or promote their adoption. The design and implementation of new tools is often enhanced by new ecological findings and knowledge.

SR3 heli-drop trial (part WoNIW funded)
This trial has been implemented on Vernon Downs near Richmond to assess the efficiency and effectiveness of heli-drop application. The SR3 is a new heli-drop applicator designed and operated by Fox Helicopter Services, Richmond Qld. It varies from the Weed Sniper in that the hopper and applicator is skid mounted on the pilot’s side.

The trial (Figure 10) was led by Nathan March with assistance from Kelsey Hosking with eight 25 ha areas selected for treatment and two 25 ha retained as control (no treatment) plots. Low density plots of 0.5 to 5.5 plants/ha were sought as these are likely to be optimal for the advantages provided with heli-drop application.

Interim results found that the SR3 could treat from 100 to 400 ha per hour at a density range of 0.5 to 5.5 plants/ha (Figure 11). Further monitoring will occur in 2018 to assess efficacy.

Funding for this trial was provided by the Australian Government through the War on Northern Invasive Weeds – Prickly acacia project.
Figure 10. The Fox Helicopter Services’ SR3 heli-drop being trialled at Vernon Downs via Richmond.

Figure 11. Trial results demonstrated that large areas could be treated quickly using the SR3 heli-drop.
**Epple Skattergun and comparative techniques trials (part WoNIW funded)**

These trials aim to compare cost, effectiveness and efficacy of the skattergun technique to ground applied tebuthiuron on varied densities of prickly acacia. The trials, on Wyaldra station north of Julia Creek, were established in 2016 and expanded during 2017.

The plots now include:
- 7 x 10 ha plots (tractor-based skattergun)
- 7 x 10 ha plots (buggy-based skattergun)
- 60 x 1 ha plots (12 each of tractor-based skattergun, buggy-based skattergun, hand dispensing from single quad bike, hand dispensing from two quad bikes and no treatment plots).
- 400 m of bore drain margin treatment.

Implementation of the trials, led by Nathan March, occurred in November 2016 and April 2017 with the skattergun performing reliably in all paddock trials (Figure 12). Treatments were timed and all herbicide usage measured. Brett Epple operated the skattergun during trials.

Preliminary results indicate that a buggy-based skattergun is superior in treatment speed to hand application from a quad bike at densities above 20 plants per hectare (Figure 13). Analysis of costs, herbicide usage and labour is underway with post-treatment assessments to occur in 2018.

Funding for these trials was provided by the Australian Government through the War on Northern Invasive Weeds – Prickly acacia project.

![Image of Brett Epple undertaking buggy-based skattergun application](image)

**Figure 12.** Brett Epple undertaking buggy-based skattergun application of tebuthiuron for a 10 ha plot as part of the trials.
The buggy-based skattergun provided significantly higher treatment rates than hand application from a quad bike in densities above 20 plants per hectare.

**Mechanical control trials – tree saw and puller (part WoNIW funded)**

A prickly acacia control trial was undertaken of the Marshall Tree Saw (Figure 14 & 15) and a tree puller at St Elmo Station via Julia Creek. Both devices were mounted on a Kubota bobcat. Both devices are operated by Keith Morrow Tree Removal Specialists. Keith has been proactively demonstrating the devices at properties throughout north, north west and central west Queensland.

Ten x 1 ha plots were established with seven treated by tree saw, one by tree puller and two left as control sites (untreated). The broken stem is sprayed with an Access™ and diesel mix immediately following treatment by the Marshall Tree Saw.

Final assessment will occur until after the 2017 – 2018 wet season but preliminary results and observations include:

- treatment of 1 ha plots by Marshall Tree Saw took from 8.5 minutes (density of 43 plants/ha) to nearly 120 minutes (density of 707 plants/ha).
- treatment of a 1 ha plot by the tree puller took 76 minutes for a density of 435 plants/ha.
- both treatments could not efficiently target plants under 1 m.
- the tree puller had difficulty removing plants of 4 m height and above.
Mechanical treatments were slow in comparison to some tebuthiuron application methods but offered advantages of immediate control, improved access for mustering and fodder benefits for stock. A disadvantage may be higher follow-up control requirements from soil disturbance.

![Image](image1.png)

**Figure 14.** The Marshall Tree Saw undertaking trials (left) with the cut stem (right) with dye highlighting Access™ and diesel application.

![Image](image2.png)

**Figure 15.** Nathan March (DAF) with Keith Morrow (left) with the Marshall Tree Saw while the tree puller (right) removes a prickly acacia tree.

**Ecology studies – seed longevity**

Several long term trials are currently underway to quantify the seed longevity of prickly acacia soil seed banks. One experiment, led by Dr Shane Campbell, has been going since September 2008 (8 years) and incorporates treatments to determine the influence of burial depth (0, 2.5 and 10 cm), soil type (river loam or cracking clay) and level of pasture cover (bare or full grass cover). To test whether seasonal conditions have an influence on seed longevity of prickly acacia the trial was repeated in March 2014, but it only incorporates soil depth and pasture cover treatments using a black cracking clay soil similar to the Mitchell Grasslands.

The initial seed lot had low viability to start with (only 24%) but retrievals after 8 years burial found that 5% of seeds still remained viable, when averaged across all imposed treatments (Figure 16). The second seed lot was highly viable initially (97%) and has declined to 29% viability after two years burial across all imposed treatments (Figure 16). Analysis will be undertaken at the end
of the trials to determine if soil type, burial depth or level of pasture cover has an influence. These trials will be continued until there are no viable seeds left.

![Figure 16](image1.png)

**Figure 16.** Change in viability of prickly acacia seed lots over time, averaged across different soil types, burial depths and levels of pasture cover.

A seedling emergence trial has also been initiated, within the seed longevity trial area, using spare plots. Approximately 500 fresh seeds still in pods were placed in cages in December 2015 either on bare soil (Figure 17a.) or under pasture cover (Figure 17b.), with each treatment replicated four times. Every two weeks monitoring is undertaken to record if any seedlings have emerged. Recording changes in seedling emergence over time will not only provide another indication of the longevity of prickly acacia seed banks but it will also identify the environmental conditions (i.e. temperature and rainfall) that germination will occur under.

![Figure 17](image2.png)

**Figure 17.** Prickly acacia pods placed on bare soil (a) as part of the seedling emergence trial, with the mesh cage (right) preventing anything from taking them (left) while seedlings emerging in July 2016 from a pod in the pasture cover treatments. The trial started in December 2015.
Other ecological studies have been completed with results being formulated into decision support tool factsheets. The only remaining major ongoing study is focused on seed longevity of prickly acacia.

**Biological control research**

**Purpose**

Biological control investigations have been identified by Department of Agriculture and Fisheries and other stakeholders as a priority research action for prickly acacia and bellyache bush. DAF is leading this component of the WoWW initiative to identify, test and potentially introduce agents which may reduce the invasive threat and impacts of these weeds.

**Prickly acacia biological control**

**Native range surveys**

Surveys for potential biological control agents were conducted in Ethiopia from 18 November to 1 December 2017. In partnership with researchers from the Ethiopian Forest Research Centre, surveys were conducted at 14 sites with two prickly acacia subspecies in northern Ethiopia (Figure 18). A gall thrips (*Acaciothrips ebneri*) and a gall mite (*Aceria* sp.) have been identified as prospective biological control agents for prickly acacia. In Ethiopia, the gall thrips and the gall mite were found only on prickly acacia (*Vachellia nilotica*) and not on other closely related *Vachellia* species co-occurring with prickly acacia. Mite galls in alcohol and prickly acacia leaf samples in silica gel were also imported into Australia for identification and molecular studies.

![Native range survey in Ethiopia in November 2017.](image)

Surveys were conducted in Senegal from 12 to 17 March 2017 and from 19 to 29 October 2017. Surveys were conducted at 8 sites in March 2017 and at 18 sites in October 2017, in partnership...
with researchers from Senegalese Institute of Agricultural Research (Figure 19). This include seven sites in the northern parts of Senegal along the Senegal River, and 11 sites in southern parts of Senegal. A gall thrips (*Acaciothrips ebneri*), two gall mites (*Aceria* spp.) and a stem galling fly (*Notomma mutilum*) have been identified as prospective biological control agents.

Prospective agents collected in Senegal were exported into a quarantine facilities in South Africa and Australia for identification and colony establishment. Leaf samples in silica gel of both subspecies of *V. nilotica*, as well as other closely related *Vachellia* species native to Senegal were field collected and exported to Australia for molecular studies.

*Figure 19.* Native range survey in Senegal (October 2017).

**Scale insect**

The colony of the scale insect (*Anomalococcus indicus*) is being maintained in quarantine. A paper on the host testing of the scale has been submitted to a scientific journal for publication.

Choice host specificity test for the scale insect under open field conditions in India is in progress (Figure 20). Data on the incidence of scale insect on prickly acacia control plants and Australian native test plant species were collected. So far there is no evidence of scale insect attack on the non-target plants in the ongoing trial at the Institute of Forest Genetics and Tree Breeding, Coimbatore, India. The field experiment will continue till June 2018.
Due to high mortality among the native Australian test plant species in India, Dr Dhileepan hand delivered fresh seeds of six Australian test plant species (Neptunia major, N. gracillis, Vachellia valida, V. sutherlandii, Acacia bidwillii and A. falcata) for inclusion in choice field host range tests for the scale insect in India.

**Prickly acacia gall thrips**
Studies on the lifecycle and longevity of the gall thrips are in progress in quarantine (Figure 21).

*Figure 20.* Choice host specificity tests for the scale insect in India (September 2017).

*Figure 21.* Host specificity tests for the gall thrips in quarantine in Brisbane, Australia.
It was difficult to conduct lifecycle studies in quarantine, as the adult thrips fed and laid eggs within the closed galls, and also the developing larvae fed and developed within closed galls. So, it was difficult to quantify how many eggs the thrips laid within the galls, how many eggs hatched, how long it takes for the eggs to hatch and the emerging larvae to complete development without destructively sampling the galls. To overcome this, we have trialled a new method – using a pair of newly emerged and mated adult thrips (male + female) on each potted prickly acacia plant in an insect-proof cage, and destructively sampling the newly induced galls at weekly intervals. In each week, any newly induced galls were sacrificed and the number of eggs and nymphs in the gall counted and the adult pair from the sacrificed gall transferred onto a new prickly acacia plant/shoot tip, to continue the longevity studies. As were still in the process of standardizing the method, only limited number of replications have been completed. The preliminary studies (due to limited replications) suggests that the thrips can live for more than six weeks.

The no-choice host specificity tests are still in progress, with a minimum of five replications for each test plant species. The potential host range of the gall thrips was evaluated on the basis of no-choice adult feeding, survival and gall initiation (oviposition) tests in a high security quarantine. Batches of test plants were tested as they became available. In each batch a control prickly acacia plant was included. In no-choice tests, 20 newly emerged adult thrips were released on to a single potted test plant in an insect-proof cage, and test plant monitored three times a week for six weeks for thrips survival and signs of gall development (in control prickly acacia plants gall development and thrips progeny emergence occurred in 4 to 5 weeks in quarantine conditions). To date, over 55 test plant species have been tested and so far there has been no gall initiation or reproduction by the gall thrips on any non-target test plant species. Testing will continue for the remaining test plant species.

**Prickly acacia gall mites**

A colony of type-3 gall mite (Aceria sp.) field collected from Ethiopia in December 2016 has been established on potted Australian prickly acacia plants (grown from seeds sourced from Australia) in a quarantine facility at Pretoria, South Africa.

Field collected mite galls from Ethiopia was thoroughly checked under stereo-microscope in quarantine in Pretoria, South Africa, to remove any potential predators. Mite galls without any predators or other mites/thrips, were inoculated on to Australian prickly acacia plants (Figure 22). New mite gall development was observed on inoculated plants within three weeks.
The population growth of the mite was however found to unexpectedly slow towards the end of winter (August-September 2017). Examination of older galls found little to no mite activity, and new gall formation declined substantially despite seemingly favourable abiotic conditions and the presence of new shoot growth on the culture plants. It is unclear as to what has caused this population decline but new gall formation has since been seen both on plants in the glasshouse compartment, and on additional plants set up in the adjacent quarantine laboratory where temperature and humidity can be better maintained. This decline in the population has nonetheless delayed the initiation of host-range testing.

Seed from 61 species of Acacia, Vachellia and other closely related plants have already been sourced for inclusion in host specificity tests. These include seeds both purchased or field collected in Australia, Ethiopia, Senegal and South Africa.

A total of 28 test plant species, encompassing seeds from each of these regions, has been sown and are currently in varying stages of growth in quarantine nursery/greenhouse and are ready for host specificity tests.

In preliminary no-choice host specificity tests, the gall mites induced galls only on the Australian prickly acacia (Vachellia nilotica subsp. indica) and no gall induction seen on South Africa prickly acacia (V. nilotica subsp. kraussiana), highlighting that the gall mite is highly host specific, at subspecies level of the plant.

In November 2017 collected and imported over 1500 mite galls from Ethiopia into quarantine in the Agricultural Research Council - Plant Protection Research Institute (ARC-PPRI), Pretoria, South Africa for colony establishment and host specificity testing. Processed the mite galls in quarantine in Pretoria, South Africa, and selected about 500 predatory and parasite free mite galls for host specificity tests. Commenced no-choice host specificity tests for the gall mite on 10 test plant species, with five replications for each test plant species.
In November 2017 hand delivered seeds of 24 Australian native test plant species to Ethiopian Forest Research Centre researchers for inclusion in no-choice host specificity tests for gall mites in Ethiopia. Seeds of four Australian native test plant species delivered to ARC-PPRI researchers for inclusion in host specificity tests for prickly acacia gall mites in South Africa.

**Prickly acacia gall fly**  
Permit to export prickly acacia stem-galling fly (*Notomma mutilum*) from Senegal into quarantine in South Africa and Australia obtained.  
Cuttings of galled stems with developing larvae of gall fly (Tephritidae) collected on prickly acacia were exported to a quarantine facility at the Agricultural Research Council - Plant Protection Research Institute (ARC-PPRI), Pretoria, South Africa, for identification and colony establishment. The cut prickly acacia stems with tephritid galls were maintained in an aerated plastic container over damp/moist vermiculite within the quarantine in Pretoria, South Africa for pupation and adult emergence. A total of 10 adults emerged and the adults were sent to the ARC-PPRI identification services, where the gall fly has been identified as *Notomma mutilum* (Figure 23).

![Prickly acacia gall fly (*Notomma mutilum*)](image)

**Figure 23.** Prickly acacia gall fly (*Notomma mutilum*).

Permits to import the prickly acacia stem-galling fly from Senegal into quarantine in Australia obtained from the Australian regulatory authorities (Department of Agriculture and Water Resources & Department of the Environment and Energy)
From Senegal, over 800 stem-cuttings with stem galls of *N. mutilum* (Figure 24) were collected and imported into quarantine at the Ecosciences Precinct, Boggo Road in October 2017 for colony establishment and host specificity testing.

**Figure 24.** Prickly acacia gall fly damage in Senegal.

**Bellyache bush biological control**

Biological control efforts for bellyache bush are ongoing with exploration in Peru, Bolivia and Paraguay. International trials are continuing in Trinidad and the UK with a focus on the Jatropha rust, Jatropha leaf-miner and Jatropha webber. Preliminary studies have also begun on gall-midge collected from Bolivia. Key activities include:

**Jatropha rust**

Host-range testing of the Jatropha rust completed for 41 non-target species and urediniospore dose-response experiments were completed under quarantine conditions at CABI, UK. Experimentation to elucidate the life cycle of the rust is continuing, attempting to confirm if the rust can complete its development on just *J. gossypiifolia*, or whether an alternate host might be required is in progress.

**Jatropha leaf-miner**

No-choice host specificity testing of Jatropha leaf-miner has been completed for 40 test plant species. The adults laid eggs on numerous non-target species, however larval development only occurred on bellyache bush and its congener physic nut (*Jatropha curcas*). In choice oviposition trials, the females laid eggs equally on both bellyache bush and physic nut. Approximately 80% of eggs develop into adults on each of these species. Physic nut, native to tropical America, is a declared weed in Western Australia and the Northern Territory. It is also an approved target for biological control. Test results provide strong evidence that the leaf-miner is highly host specific and is suitable for release in Australia. An application seeking approval to release the leaf-miner will be submitted to relevant regulatory authorities in Australia.

**Jatropha webber**

Host range testing has been fully completed on 12 species (with five replications each), completed partially for 26 species, and 14 species are yet to be tested. In no-choice larval development tests to date, full larval development occurred on six non-target species – four of them exotics (*J. curcas, J. podagrica, Euphorbia neriifolia* and *E. grantii*), and two are Australian natives (*Macaranga tanarius* and *E. plumerioides*). However, the larval development was much slower (longer development time) with higher larval mortality on all the non-target test plant species. Jatropha curcas, a declared weed, is an approved target for biological control and *S. divisella* has been known to occur on this host as well in India. Jatropha podagrica and *E.*
neriifolia are exotic ornamentals, while E. grantii and is a highly toxic exotic ornamental, but all are uncommon in Australia. *Macaranga tanarius* and *E. plumerioides*, both are Australian natives and the larval development was quicker on *E. plumerioides* than on *M. tanarius*. In view of the non-target feeding and development on Australian native species, no further research on the agent will be pursued.

**Jatropha gall midge**

The Jatropha gall midge (*Prodiplosis longifila*) induces rosette galls in shoot-tips, emerging leaves, petioles, and stems resulting in shoot-tip dieback on *Jatropha clavuligera* in Bolivia (Figure 25).

![Jatropha gall midge damage in Bolivia.](image)

Based on morphological criteria the gall midge from Bolivia was identified as *Prodiplosis longifila* Gagné, a polyphagous species that attacks several crop plants (citrus, asparagus, alfalfa, potato, tomato, bean, capsicum, cotton, castor oil plant, etc.) in the neotropics. However, the gall symptoms on *J. clavuligera* appears unlike the reported damage symptoms on crop plants. Under no-choice conditions in quarantine in South Africa and in a field transplant experiment in Bolivia, *P. longifila* induced galls on *J. gossypiifolia* that were morphologically similar to those occurring on *J. clavuligera*. There was no evidence of *P. longifila* induced-galls or larval feeding damage on potato, tomato, citrus, cotton and castor oil plants (the reported hosts in Florida in the USA, Ecuador, Peru and Columbia), other species of Jatropha and a few species of Euphorbiaceae grown near *J. clavuligera* in Bolivia and in choice tests conducted in quarantine in South Africa. So far, there is no record of *P. longifila* as a pest of any crops in Bolivia. It is likely that the gall-inducing *P. longifila* in Bolivia is a sibling species of *P. longifila* and not the same species known on other plants.

In view of the susceptibility of *J. gossypiifolia* to the Bolivian gall-inducing *P. longifila* tested in field transplant experiments in Bolivia and no-choice quarantine facility tests in South Africa, the gall-inducing *P. longifila* in Bolivia has the potential to be used as a new association biological control agent for *J. gossypiifolia* in Australia.
The easier and quicker approach to determine whether the gall-inducing P. longifila on J. clavuligera is a host related cryptic species within the P. longifila species complex or a polyphagous pest species with a wide host range, is to conduct robust no-choice host specificity tests in quarantine. Host specificity tests involving various plants reported as hosts should help resolve whether the gall-inducing P. longifila is a polyphagous taxon or a cryptic species with its host range restricted to Jatropha. To ascertain whether the gall-midge is a host specific cryptic species or a polyphagous pest species, further research will be conducted by the Fundación Para Estudio De Especies Invasivas (FuEDEI) in Argentina. A contract with FuEDEI is being finalised to conduct preliminary no-choice host specificity tests involving 20 economically important test plant species (crop plants reported as hosts for the midge in the Neotropics), with five replications for each test plant species. Since no species of Jatropha is native to Australia, the gall-inducing P. longifila, if proven specific to a few species of Jatropha, is a potential ‘new-association’ biological control agent for J. gossypiifolia.

**Publications/conference presentation**

A lead paper titled ‘Biological control of prickly acacia: prospective agents from Ethiopia and Senegal’ has been presented at the 26th Asian-Pacific Weed Society Conference, Kyoto, Japan in September 2017.

An oral presentation titled ‘At last, Biological control of Bellyache bush’ presented at the 14th Queensland Weed Symposium, 4-7 December 2017, Port Douglas, Queensland.

A scientific paper titled ‘Gall thrips Acaciotrips ebneri (Karny), a promising new biological control agent for prickly acacia in Australia’ has been submitted to the African Entomology journal.

A scientific paper titled ‘Host associations of gall-inducing Prodiplasis longifila (Diptera: Cecidomyiidae) from Bolivia: implications of its use as a biological control agent for Jatropha gossypiifolia (Euphorbiaceae)’ has been accepted for publication in Florida Entomology journal.

Biological control of bellyache bush: research updates. Mareeba Shire Council Pest Management Advisory Committee Meeting, Mareeba, 20 April 2017.

**Report compilation**

This project update was compiled by Nathan March with major contributions from Dr Wayne Vogler, Dr Kunjithapatham Dhileepan, Kelsey Hosking and Dr Shane Campbell.

**More information**

Call the DAF Customer Service Centre on 13 25 23 and ask for the WoWW Project.