Horticulture Innovation Australia

Final Report

Enhancing best practice in vegetable production and business management in the Northern Territory

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Project Number: VG12113

VG12113

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Summary

VG12113 Enhancing best practice in vegetable production and business management in the Northern Territory 1/8/13 – 31/7/16

This project was an engagement project to identify vegetable growers in the NT and build relationships with the all commercial vegetable growers of the Top End who are predominantly Vietnamese or Cambodian in heritage. The project endeavored to engage these growers by providing a dedicated engagement officer to be a stable and trusted point of contact on best practice farming and farm business practices. The project was in place for 3 years during which time the engagement officer updated and consolidated the existing vegetable grower's data bases to reveal 153 active NT vegetable growers over that period.

The project officer was able to use previous engagement with the growers as a departmental extension officer and to leverage on existing economic, social and cultural relationships to enhance engagement with these growers as described in the stakeholder engagement plan in this report. Initial surveys identified gaps in vegetable production best practice knowledge and implementation in the NT in the areas of pest and disease management, IPM strategies for the tropics, irrigation monitoring and scheduling and supply chain management. The initial surveys also found that business practices, including QA systems, were very basic and in need of modernization and direction. The initial project action plans were developed to target these gaps.

Midway through the project the NT vegetable and melon industries were impacted severely in late 2014 with the identification of Cucumber Green Mottle Mosaic Virus (CGMMV) in melon crops in Katherine and early 2015 in cucurbit vegetable crops in Darwin. The project became a best practice biosecurity and market access business practices project. These biosecurity requirements severely limited the amount of on-farm group activities and farm visits by the project officer.

Large melon and pumpkin producers in the Katherine region were completely shut down following detection of the virus on these properties in 2014. Every commercial cucurbit producer and every cucurbit crop known to NT quarantine authorities was tested for the virus so that interstate market access plant health certification could be obtained. The project played a vital role in connecting those growers who needed testing and certification with the NT Quarantine service throughout 2015. Four small Vietnamese vegetable farms in the Darwin Rural area were found to be infected with CGMMV in early 2015.

The value of building relationships with these growers was clearly demonstrated as the project was able to work with quarantine to isolate and remove the infected crops and to transition the farms to non-host species. The project facilitated meetings with this farming community constantly through this period to update the growers on the current situation and regulations but much more importantly what they could do on-farm to protect their businesses. These practices, taken from various farm biosecurity information sources, evolved into the on-farm CGMMV biosecurity plans that have now been accepted as the management tool for the disease for interstate market access in Australia and been

checked by New Zealand quarantine authorities to allow trade in NT melons to continue through southern ports. The result has been industry wide practice change resulting from necessity but facilitated by the engagement project that was in place at this crucial time.

The other gaps in best practice management remain to be tackled by subsequent extension and capacity building projects that will follow and build on this successful project.

Keywords

Grower engagement

Best practice vegetable production

Capacity building

Biosecurity incursion

Grower response

Grower biosecurity working groups

On-farm biosecurity plans

Market access

Introduction

The Northern Territory is one of the younger regions for horticulture and vegetable production in Australia. There was a need in this developing region to engage with the growers to build relationships for the adoption of improved best practices. The engagement officer did cover Darwin and Katherine as the major vegetable growing areas of the Northern Territory. Vegetable production has increased significantly in the last 15 years, predominantly due to the Vietnamese and Cambodian growers. The Northern Territory relies on its market window with most vegetable production occurring in the Dry season which is the southern winter period and supplies the Traditional wholesale and Asian markets in Sydney, Melbourne and Adelaide.

There are now about 140 of these vegetable growers in the Darwin area (CGMMV survey 2014-16) as well as about 10 more traditional pumpkin growers in the Katherine Douglas Daly and Mataranka areas. Key vegetables grown are Asian melons, traditional cucurbits like cucumber, squash, zucchini and pumpkin, snake beans and okra with a smaller amount of Asian greens, capsicums, chilies, eggplant, spring onions, tomatoes and herbs. The industry was estimated to be worth between $30-40million in 2015 even with the incursion of Cucumber Green Mottle Mosaic virus (CGMMV).

The Northern Territory is a developing region for vegetable production in Australia. There was, and still is, a need to demonstrate to growers the current best practice crop and business management and to provide ongoing support in adopting research and development. Growing practices such as spray programs, biosecurity, food safety, pest and disease management and product integrity could all have implications for the broader vegetable industry in terms of market access and quality assurance. There is also a move to more intensive production in hydroponics and protected cropping as soil diseases and pest and other disease pressures mount which need significant support and improved access to the latest research and development in the area.

This project was designed to identify the vegetable growers in the NT and compile an accurate data base of growers. It also was an engagement and information collection project to build relationships with the vegetable growers of the NT. In assisting the growers towards best practice it was necessary to survey them for the level of knowledge and skills and their attitudes and aspirations to achieving best practice in their farming and business practices. The surveys and interactions with growers consistently showed a need for targeted extension in the areas of pest and disease management, sustainable soil health, cool chain management, farm labour, supply chain relationships, quality assurance programs, training and most critical of all was on-farm biosecurity and interstate market access issues.

The project had a wide suite of best practice priorities at the beginning but that was changed dramatically when the CGMMV outbreak occurred. The overwhelming priority for

best practice was on farm biosecurity to protect their farms from the spread of this virus. The project focus was to give the farmers enough information and skills to meet this threat and then to maintain the interstate market access that was critical for their very survival as individuals and an industry.

Methodology

The project methodology was defined by the 2 major areas of activity as defined in the original project proposal. These were to:-

a) engage with and build relationships with the vegetable growers of the NT, in particular those of the growers of Vietnamese and Cambodian ethnic groups, and to develop a comprehensive vegetable grower data base for the NT,
b) and survey the current industry growing and business practices, identify the gaps and design and deliver activities that built capacity for the growers to work towards industry best practices.

VG12113 Grower and Stakeholder Engagement Plan

The project initially set up a steering committee of growers and industry representatives to oversee the delivery of VG12113 to the NT vegetable growers. The steering committee was specifically designed with representatives of the key ethnic groups involved in vegetable production in the Top End. The NT vegetable growers are a very diverse group and include many South East Asian nationalities. In 2013 the Vietnamese growers had just formed an NT Vietnamese Horticulture Association which was a major point of access to these growers. The President of this Association was on the steering committee for this project and this association became a big part of the project. There was a very high proportion of the NT Asian growers at the inaugural meeting of the NT Vietnamese Horticultural Association (also attended by the project officer) which meant it was an excellent avenue to approach growers. Growers outside this group were approached individually as either members of the NT Farmers Association or as individual growers.

The support industries also provided an excellent avenue to contact growers and assess issues and impacts on the NT vegetable industry. These stakeholders had an economic interest in improving grower profitability and sustainability which translates into best practices and improved communication and logistics for the NT vegetable producers. The project officer has extensive contacts in this area and in the past has partnered with many representatives in these support industries to deliver extension services, conduct demonstrations, on-farm trials and supply chain monitoring and improvement.

A key strategy was to include a number of industry champions on the steering committee for this project. Industry champions are excellent allies in the engagement process. The proposed steering committee includes leading Asian vegetable growers, experienced Territory supply chain operators, Primary Industries staff currently working in the vegetable area and key Association staff. The steering committee importantly had a Vietnamese and Cambodian vegetable grower as well as the President of the NT Vietnamese Horticultural Association. Each came with their own circle of growers and provided access to different sections of the vegetable growing community. The commitment and energy these stakeholders brought to the project was a major driver in the engagement process.

As an ex-extension officer of the NT DPI&F the project officer had on-going high level and operational links with existing research, extension and managerial officers of this department. There were projects running for example with the row crop growers to look at Nitrous oxide (N_xO) emissions from horticultural soils in the Top End from different cultivation and growing practices. This was an excellent vehicle to begin dialogue with progressive farmers in improving sustainable soil management practices into the future.

The initial engagement of the growers was key to the ongoing success of this project. The project officer needed to offer something of value, either information or service, during the visits so that there was a development of the perception of benefit to the growers which will lead to good-will and welcome. This banking of social capital is a critical concept in working with Asian growers that have often experienced more withdrawals than deposits from government agencies. As the project developed and best practice issues of production, supply chain and farm management emerged then the engagement became more individualised, meaningful and mutually beneficial as the project officer responded to the identified needs of the growers.

Vegetable Growers Data base

The original methodology proposed to generate an accurate NT vegetable grower's data base was to use the plethora of existing but out of date data bases in the NT Department of Primary Industries (NTDPIF) and NT Farmers from the parent organisations of NT Horticulture Association and NT Agricultural Association. These were used to form the basis of the updated data base which would be updated with grower visits and using the communication networks of the commercial resellers, industry champions and other links to growers. The formation of the NT Vietnamese Horticultural Association in late 2013 offered another avenue to connect to growers and update these data bases.

The CGMMV outbreak was a game changer in production of an accurate vegetable grower data base for the NT. A partnership of the project officer from NT Farmers and the operations staff from NT Quarantine was formed to quickly update the existing grower data base. An accurate list of growers was critical to all cucurbit vegetable and melon growers maintaining access to interstate markets. This list was updated when growers apply for testing for interstate access and by the CGMMV field surveillance team. Phone numbers, postal addresses, fax or emails, land and business ownership were all collected by surveillance officers during sampling farm visits and entered into the response data base. This data base was shared with NT farmers in the Industry liaison role and was used to manage the NT farmer data base up to the present. (Attached in Appendix)

The project officer also worked with a GIS specialist from Territory Natural Resources Management (TNRM) to regularly update grower data on a freely available spatial platform which will interface with the NT cadastral data held by TNRM and the Resources and Primary Industry NT departments. This was then superseded by the ACLUMP Land Use Mapping project that has begun in July 2016 and will map all horticultural land uses in the NT and link to the cadastral data in NR maps held by NT Department of Land Resource Management (NTDLRM). This data will be ground proofed against the data base generated by the project and NT quarantine and will form the basis of an ongoing up-to-date grower data base.

Capacity Building and Best Practice

In the project document the capacity building methodology was given as

a) The engagement officer will plan and facilitate regular grower workshops, seminars or training program, (four per year – specific to seasonality) covering a range of customized and up to date topics of relevant R&D within the region.

b) The delivery to growers and groups will begin to build a clear understanding of the industry, markets and business needs of the growers within the vegetable industry. The extension of materials produced by the national research and development program would be promoted as appropriate.

c) Linkages to vegetable R&D program – the engagement officer will be responsible for the consistent delivery (via face to face, phone and/or email) of R&D outputs from HAL (now HIA) funded projects to growers regionally as appropriate. This will also include regular liaising and support from the NT DPI, building relationships with researchers and supplying available information from the AUSVEG website and projects available on the Vegetable Insights Database (KM).

The growers were surveyed in the initial phase of the project and the list of best practice priorities were developed and used to develop the initial project yearly activity plans. The initial priorities were checked against those that had been scoped by the NTDPIF in previous assessment of extension and capacity needs for the vegetable industry. This drove the initial component of the capacity building component of the project.

A yearly action plan was developed by the project officer and submitted to the project steering committee. The plans were checked at the end of each year to judge the progress of the project and the update plan for the next year submitted to the steering committee for endorsement. With the CGMMV incursion that action plan needed to be quickly revised and was used to plan out the approach of the project in a rapidly changing environment.

Outputs

The key outputs of this project were defined in the project document as below

- Dedicated resource to help evolve the vegetable industry for best practice production, business management and food safety in NT
- Generation of a database for contact details of growers in the region, ongoing updates
- Profile of current production and business management practices
- 5 face to face grower contacts per week
- 4 grower group activities per year

The project achieved these outputs during the three years of the project, and many times exceeding the expectation of the project's intention despite the heavy restrictions placed on farm visits by the CGMMV incursion and response.

Grower Interactions

Farm visits and grower face to face contacts

The project officer visited 92 separate vegetable farms in the NT which is 60% of the identified 153 vegetable and mixed farms that have been recorded in the NT Vegetable Growers data base that was also an output of this project. A spatial representation of the farms visited along with an abbreviated copy of the data base is supplied in the appendix to this report. The number of individual farm visits and grower face to face contacts is estimated in the table from the project records but is probably well short of the true total. Some farms, like the project champions, were visited multiple times over the course of the project and often other famers were there, as these visits were targeted at midday. Growers were finished in the field by this time and were often socializing within their community until work restarted in the cooler afternoons.

Estimated face to face discussions with NT Vegetable growers from project records

Year	Darwin Rural On-farm	Darwin market visits and NTFA Office	Katherine	Total
2013/2014	86	65	14	165
2014/2015	134	86	17	237
2015/2016	160	62	12	234

Often these contact were held off farm as the practicalities of the incursion made it less threatening for the growers. Regular attendance by the project officer at the Rapid Creek, Coolalinga and Palmerston wet markets in the Darwin area made it was possible to check in

with about fifteen Vietnamese vegetable growers and their families, three Cambodian vegetable market garden families and four growers of Caucasian decent. Many farmers dropped into the NT Farmers office as they were traveling in and out of town or were met in conversation in the many rural supply businesses in the Darwin Rural and Katherine area. Another good place for face to face conversations were the departmental field days and local agricultural shows and numbers for these face to face discussions are difficult to estimate.

The numbers given in the table are those of noted visits and individual contacts with growers in the superseded NT Farmers CiviCRM data base, a grower contact spreadsheet and the Microsoft Outlook diary maintained by the project officer. These numbers do not record many of the casual contacts resulting from living in the same community as most of the growers and their families. The project officer had previous taught senior Chemistry, Physics and Agriculture at the local high school and knew the children and parents of this community as students. This history was instrumental in maintaining close relationships with many of the farming families.

Grower activities

The project achieved a large number of grower group activities that started with the identified best practice chemical and pest and disease management focus and then became focused on biosecurity. It was imperative for the growers being up to with best practice activities for biosecurity to stay in business. The growers achieved this by attending seminars and training activities that would support this continued interstate market access.

A total of 38 events of 12 different types of activities with attendance is recorded in the table below.

Type	Title	Number of events	Place	Number of attendees
Training activities	Auschem Chemical Safety Training	6	Golf Club and NT Farmers Coolalinga Office	21, 3, 2 , 5, 4, 3
	Effective Spray technology	1	On-Farm 6 Barr Rd Marrakai	24
	Pest, disease & beneficials handbook launch and workshop	1	Berrimah farm	25
	Weeds Scoping Survey	1	Farms in Katherine and Darwin	6
	Training workshop Sampling using GPS for Biosecurity	1	On-farm 86 Gregory Rd	15

	On- farm Biosecurity plan training workshop and mock audit	1	On-farm 94 Gregory Rd	23
Industry Meetings	AUSVEG Roadshow National Horticulture Convention VG12113 Steering committee	3 3 5	Darwin and Katherine Cairns, Gold Coast x 2 NT Farmers Coolalinga	3, 45, 14 5 3
CGMMV	Grower Meetings Seminars Dr. Aviv Grower working group meetings	6 4 4	Darwin and Katherine Darwin and Katherine Darwin and Katherine	18, 20, 35, 65, 19, 35 28, 24, 20, 18 15,10,14
Total	12 types	38 events	Darwin and Katherine 4 x on farm	431

Capacity Building and Best Practice

The project was tasked to identify and document the issues affecting growers and the gaps in best practices within the NT vegetable industry. The growers were surveyed in the initial phase of the project and the list of best practice priorities were developed and used to develop the initial project yearly activity plans. The list below was also checked against the priorities that NT DPIF had for the vegetable industry at the start of the project. The department highlighted supply chain and cool chain management as their number one priority but had very little resources in vegetable R&D to devote to the issue.

Grower Priorities developed from the initial grower survey

Growing Practices

- Pest, disease and physiological disorder, ID and effective management options
- Plant nutrition for minor crops in the tropics
- Enhancing plant health practices
- Spray technology

WH&S and Compliance

- Chemical registrations and permits

- Chemical licenses for S7, records of use and audits by Chemical branch
- Safety procedures and regulated training
- Old or inappropriate equipment
- Effective operation of new equipment
- Safety Plans for audit by Work Health and or QA programs

Supply chain

- Cost and complexity of QA Systems compliance and audits.
- Cooling capacity
- Limited competition of cool chain service providers
- Road access in the Wet season

The initial response to these survey findings was to instigate a field activity in conjunction with local chemical and farm equipment suppliers looking at effective coverage spray techniques in the common trellised vegetable production systems. A Silvan technical expert was present to assist with the demonstrations and to bring the growers up to date on new nozzle technology for air assisted spraying. The second response was to instigate a Farm Chemical Safety Training session for a Vietnamese farmers group with a local RTO and an interpreter to get a significant number of these growers back to compliance for their QA and chemical permit requirements. Both workshops were very successful with 21 and 24 growers respectively attending these events. Not long after this in July 2014 rumours of an unusual disease in Katherine started to circulate and by October 2014 the NT was in full CGMMV response mode.

Best Practice Priorities developed from ongoing discussions and the final grower survey.

Despite the constraints of the virus response the project officer was continually ground proofing issues for growers during the course of the project. The issues in bold are the dominant issues during the last 12 months of the project and were highlighted by all growers in the final survey. It is no surprise that bio-security is forefront in everyone's thinking at the moment as the NT Industry transitions out of the CGMMV quarantine response into an on-farm disease management phase. The other perennial issues of pest control and implementing IPM are always present and will be a central theme of the next project that will aim to break the dependence on chemical control and introduce more sustainable practices.

Cost of production and compliance issues are also high on the agenda. Maintaining up to date Farm Chemical Safety certification, QA systems and compliance with changes in water licence arrangements in the Greater Darwin area are all issues impacting directly on the profit margins of growers and they are looking at various ways of building their capacity to respond to these challenges. The ongoing project will be able to help growers build this capacity and resilience by facilitating training and learning opportunities for growers to address most of these issues.

Grower Priorities developed from the project and final grower survey

Grower practices

- **On-farm Biosecurity Plans**
- **Chemical resistance in insect populations** i.e. Heliothis, aphids & mites
- **Effective IPM strategies for NT vegetable crops**

- Pollination
- Water use efficiency due to poor Wet seasons
- Efficient fertigation equipment
- Land clearing guidelines
- Pest, disease and physiological disorder, ID and management
- Plant nutrition for minor crops in the tropics
- Enhancing plant health practices
- Spray technology

Business Practices

- Land development application and development regulation compliance
- Farm labour, visa and tax issues affecting supply, reliability and skills
- Water Licenses in the Greater Darwin Water Control District

W H & S and Compliance

- **Chemical licenses for S7, records of use and audits by Chemical branch**
- **Chemical registrations and permits**
- Safety procedures and regulated training
- Old or inappropriate equipment
- Effective operation of new equipment
- Safety Plans for audit by Work Health and/or QA programs

Supply chain

- **Market access with CGMMV**
- **Limited competition of cool chain service providers**
- Plant health certification, ICA's and accreditation
- Cost and complexity of QA Systems compliance and audits
- Road access in the Wet season: Flat punt boat purchased by Marrakai growers for wet season flooding of Adelaide River floodplains and Arnhem Highway, non-issue due to poor Wets
- Cooling capacity on farm and at consolidators

NT Vegetable Growers Data Base

The project started with a number of incomplete data bases for the vegetable growers in the NT in the first phase of the project in 2013/2014.These came from a number of sources and needed updating and checking for completeness. NT Farmers had a data base of members and contacts inherited from the previous NT Horticulture Association. The project started updating this data by ensuring that attendance at all industry events was recorded and contact details checked against the existing data base which was then hosted on the NT Farmers Association website in a CRM client management data base.

The formation of the NT Vietnamese Horticultural Association which had mango and vegetable growers gave another contact pathway or data base to NT Vietnamese vegetable growers. The CGMMV incursion was a game changer in this area as well. The most complete vegetable grower data base was held by NT Quarantine. This was shared with NT Farmers and the project officer to assist as the industry liaison person for the vegetable industry and was meticulously updated by NT Quarantine field and office staff to facilitate

the sampling and plant health certification requirements for market access of NT cucurbit produce into other Australian state markets. The full data base with regional breakdown is available to HIA and NT Farmers as an output of this project.

Outcomes

The most significant outcome of the project was the increase in engagement on what was a dis-engaged and disillusioned industry sector. The vegetable growers of the Darwin rural area are for the most part Vietnamese and Cambodian and those of the Katherine area are mostly large melon growers that grow some pumpkins for the southern winter markets. Both groups felt alienated and owed their survival to the internal community strength and the support of the resellers and their market agents who had a commercial interest in their success. The project offered an alternative engagement that was dedicated to their benefit in growing their capacity as vegetable growers to be as successful as possible and taking advantage of the available best practices and the new R&D results that would add to their capacity as growers.

The CGMMV incursion was a shock to the industry and almost instantly put all the commercial cucurbit producers under threat of losing their business. Large water melon farms in Katherine and Darwin were completely shut down and the interstate market access severely restricted to a total testing and plant health certificate regime. Asian melons, zucchini, pumpkin and cucumbers make up more than 50% of the vegetable produce of the Top End. The project officer played a critical role in getting the message out to growers.

The project officer used the developing communication channels to help organize the required testing and then the distribution of test results and certification. This engagement became a matter of economic survival for individual growers and the industry as a whole. During visits to Melbourne, the project officer would follow up the use of the certification by checking with the stall holders at Footscray and then the new Epping wholesale fruit and vegetable markets to ensure correct documentation and procedures were being adhered to in the supply chain and to advise growers of any issues that may have arisen in the market.

When four Darwin vegetable farms were found to be positive to CGMMV, the project officer worked extensively with those four growers and their neighbors to contain the spread of the virus, implement best practice on-farm biosecurity practices and keep the wider industry aware of the threats and how to mitigate them. This developed further into assisting all the affected cucurbit growers to develop their own on-farm biosecurity plans and assisted growers in training and implementation for their farms. This has resulted in broad industry practice change towards industry best practice for on-farm biosecurity. This process has now been accepted by interstate quarantine authorities as enough to open market access for NT cucurbits into southern markets.

The documents and practices successfully used to manage the outbreak of CGMMV in the NT are now being used as a basis for assisting growers in the Geraldton WA, where there was a positive test to CGMMV in a cucumber farm. These resources were shared with Vegetables WA and DAFWA and have been adapted for the WA growers. This included a

Vietnamese translation produced by Vegetables WA as the vegetable growers in the Geraldton area are also predominantly Vietnamese like their NT counterparts.

The overwhelming response to the final evaluation surveys was that the project officer provided a unique and trusted engagement point for growers and other stakeholders for any issue or opportunity that affected vegetable growers in the Top End. The key role of the project in being the independent contact during the virus incursion and making every effort to keep individual farms and the industry in business was much appreciated. The effort was recognized with the NT taking two Community Stewardship Awards at consecutive National Horticulture conventions. One for a Vietnamese vegetable grower who gave his time to be part of the NT industry grower working group and the other for the project officer. The project officer was also engaged on a national level by being invited to participate in the Nation CGMMV Working group to develop a National CGMMV management strategy.

The respect the project officer built within the grower community was built on a simple philosophy of adding value to any engagement with growers and dealing with their immediate concerns, like CGMMV, as well as tackling long term industry practice change issues. In doing so the project officer was also able to build a core of growers with increased skills in their business practices. All growers have to deal with their immediate issues before implementing long term change. Often these issues are imposed by outside forces like a biosecurity incursion but also other regulatory changes imposed by government or retailers.

Government red and green tape around issues like land clearing and farm development are often an insurmountable barrier to a lot of growers with limited English literacy and in fact to most Australian born growers. By helping key growers to work their way through such application and compliance processes gave them the confidence to help other members of their farming community with their applications. This built capacity and resilience within the community and has helped to reduce the amount of non-compliant clearing.

The same is currently taking place in the Greater Darwin Water control district where a change in regulation has resulted in all growers, particularly our small vegetable growers, having to apply for commercial water use licenses out of their own bores. It is a testimony to the success of the engagement achieved by the project in that the first person the growers are asking for information is the project officer. The NT Vietnamese Horticultural Association approached the project officer immediately to organize an information workshop for their growers and the relevant department came first to NT Farmers because of their recognized connection to the growers to assist in their information program.

The use of the meeting room at NT farmers for the vegetable growers has resulted in not just a comfortable relationship with the project officer but in having a recognized “grower owned” space to interact with government where they feel comfortable. The workshop will go a long way to having the growers complete their own successful water license application and these interactions build true capacity in their business practices for the next

industry wide regulation change imposed.

Specific farming practices workshops showed direct adoption of improved industry practices and to feed issues back to service and product suppliers. Following the effective spray field activity growers were asking for water sensitive paper so they could check their own application of their own sprays onto their crops. It was noted by one of the resellers that growers often talked about what was happening at CGMMV meetings when they were in the shops and were actively spreading the information provided by the meetings facilitated by the project.

The project facilitated engagement with a number of other completed and ongoing R&D projects that encouraged participation and engagement with these research and development activities. Growers were given the opportunity to be involved in the following projects that came to the Territory during the course of the project or were running in parallel with VG12113.

- VG13114 NTDPIF Vegetable Pest, Disorders and Beneficials Field Guide
- VG14048 Review of current vegetable irrigation technologies
- Soil Wealth Project
- VG15013 Improved Management Options for Cucumber Green Mottle Mosaic Virus
- VG12033 – Vegetables Australia Magazine column contribution
- AOTGR2-0046 Action on the ground (Nitrogen Emission project row crops)
- National Horticulture Convention including Innovation and Export workshops.

A Soil Wealth demonstration site has now been established at Lambells Lagoon with the first field walk being planned for 18 August 2016 to see the results of using different green manure crops in the NT on vegetable production and overlaid with the use of biochar as a soil carbon additive. This site was provided information into the AOTGR2-0046 Action on the Ground project that looked at effectiveness of various Nitrogen applications and new formations of N fertilisers in tropical row crops.

VG15013 is the research and development project looking into various aspects of the CGMMV issues that will affect how growers and authorities manage this disease. The project is investigating key issues on the retention of the virus in soil, organic matter, weeds and bee hives in the NT. The project will also investigate more timely and accurate diagnostic techniques and build the protocols for the detection of the disease in seeds and in the fields over the near future. This relationship means the growers in the NT are participating in the research and will assist in increasing knowledge of this disease to the benefit of the entire Australian vegetable industry.

The CGMMV incursion lead to the production of an accurate NT Vegetable and Melon growers data base that was required to fulfil the industry engagement for the management of the disease in the NT. It is a truism that there is nothing like a biosecurity event to tidy up the existing data bases. In a state where there is no registration of growers and only limited documentation required for most interstate vegetable commerce it is hard to keep data bases current. The data base is now as good as it will get and provides enough contact information to allow access to all vegetable growers in the NT.

The impact of labour supply and skills shortages was clearly identified as a major issue for the NT Vegetable growers in common with other horticultural producers in the NT. Access to existing programs like the Seasonal Workers program could see a reliable labour force accessed from Timor Lesté but is extremely difficult for growers to complete the required documentation and standards. The NT Farmers Association has been funded to run a pilot project that will case manage five NT horticultural farms through the Seasonal Worker application process and through to implementation of one season's labour. This will build the capacity of those farmers who can then act as industry leaders to build the connections needed to develop this mutually beneficial relationship with Timor Lesté.

Evaluation and Discussion

VG12113 was a large part of achieving a state wide industry practice change within its project life which is very unusual in an engagement and capacity building project. The project was pivotal to the growers being able and resourced to adopt best practice on-farm biosecurity practices for cucurbit vegetable production in the NT. There is direct hard evidence in the form of audited on-farm biosecurity plans and compliance with NT Quarantine currently for the 76 identified cucurbit vegetable farmers in the NT. This adoption was recognized by all other states in the changes in regulation for interstate access. The interstate market access was no doubt a strong driver but it can be strongly argued that it was the engagement and capacity building project that helped the growers have the capacity to achieve this industry change required.

The evaluation of the project was completed using Bennett's Hierarchy. Industry adoption can be measured in terms of the direct impacts on the growers in terms of their knowledge, skills, attitudes and aspirations, practice changes on farm and the impact of these changes on the wider industry and the evidence is outlined as follows. The final project evaluation was a mixture of survey information from rich interview technique for growers of ethnic background, survey emails to stakeholders and project data.

Evaluation Evidence

Broader Impact
Social- economic-environmental outcomes

The project can claim that it was integral to achieving an NT vegetable industry wide impact in the final outcome of the response to the CGMMV incursion. Changes to interstate market access conditions were based on the behaviour changes demonstrated by NT cucurbit growers. Interstate quarantine authorities accepted the use of on-farm biosecurity plans and accompanying audit by NT Quarantine as evidence of the industry successfully managing the risk of CGMMV transmission through the sale of cucurbit produce in interstate markets. The changes were gazetted by all Australian jurisdictions by February 2016 and allowed NT growers to trade as per prior to the CGMMVC outbreak in 2015.

Evidence of this system wide change was the acceptance by New Zealand Quarantine Investigation team that visited Darwin and Katherine in April 2016 of the NT CGMMV management model and not imposing any further restrictions on the trade of cucurbit products into NZ. The export trade in water melons to NZ during the NT season is substantial and as it occurs mostly out of Sydney markets it was critical that the authorities had confidence in the NT CGMMV management systems.

Direct effects

Practice change

Growers were asked to change their practices immediately once the detection of the CGMMV incursion in the NT was announced. There were the regulatory changes, including testing, that were imposed but more importantly were the changes to the farming and social practices on the farm. The greatest evidence of this system wide practice change was the adoption of the "shut the gate" practice. CGMMV is a mosaic virus and is spread by seed and by touch of contaminated clothing, plant material, vehicles flesh etc. By shutting the gate, even to fellow farmers that often helped on each other's farm, the growers were demonstrating that they had understood the method of transmission and the risks involved. Other practices that changed were things like the sharing of seed, the introduction of parking areas in the front of farms and restriction on pick-up and delivery vehicles.

Farm gate biosecurity signs were printed and 71 of the 76 cucurbit farms to be audited, have secured these signs to vegetable farm gates in the rural area. This prompted enquiries from the public if there was a new biosecurity problem in the Darwin Rural area. These individual practice changes have now been consolidated into the on-farm biosecurity plans that are being developed by each farm and then audited by NT Quarantine. This audit process forms further evidence of the practice change and will go on after the end of the project. This clearly demonstrates that the practice change is for the benefit of the industry in the short, medium and hopefully long term. By 27 July 2016, 11 farmers have successfully met the audit standards, with many other farms close to being compliant. (Operations Manager NT Quarantine) NT Quarantine is tasked with auditing all commercial cucurbit growers by the end of the 2016 season.

The practice change was also clearly visible in the associated melon industry and the on-farm biosecurity plan template developed for vegetable growers in the NT for CGMMV has been adopted by an number of the larger melon growers in the Katherine region and used as a basis of documenting and demonstrating their practice change to meet the challenge of managing this virus and other potential incursions on their farms. A mung bean field day event at Douglas Daly on a farm that had previously grown melons demonstrated excellent on farm bio-security, with outside parking for the visitors, signage and footbath at the gate and farm vehicles only for transport of the visitors around the farm to the field day site.

Knowledge, attitudes, skills, and aspirations. (KASA)

There is direct evidence of the increase in knowledge of the growers following a number of project activities. The clearest examples are from the training workshops were growers had to complete assessment materials to complete the course. The Farm Chemical Safety courses have a set of assessment tasks. The Biosecurity sampling training workshop required growers to sample and bag a trial crop using sterile procedures and complete the required record sheet. Growers demonstrated their improved knowledge and skills in completing this task.

The survey by a Charles Darwin PhD student looked specifically at the attitudes of the

Vietnamese vegetable growers to biosecurity and their resilience in coping with biosecurity incursions. This survey is being completed with similar Vietnamese farmers in South Australia and Western Australia and results will be available for the follow-on project. The growers were surveyed orally after most of the CGMMV meetings and seminars.

Reactions

The overwhelming reaction to the project by the vegetable growers and key industry stakeholders from the final survey was the appreciation of having someone, the project officer, available to contact with any issue regarding vegetable production in the NT who was

- Constant
- Knew the Territory and its horticulture industry and its history and participants
- Understood the industry markets and logistics
- Approachable and returned calls
- Impartial and independent
- "Not trying to sell anything"
- Knew where to connect growers to technical experts and service providers
- Aware of current R,D&E projects and best practices and what was applicable to their businesses
- Knew how to work with government and connect growers to services or through regulatory pathways.

The vegetable growers had a strong desire to learn how to deal with the disease and to comply with any regulations that would allow them to send their vegetables to interstate markets. This was clearly demonstrated by the growers asking for another Vietnamese only meeting following an open meeting so that they could discuss their issues with the presenters and to have the time for translations and with time to discuss amongst themselves. This resulted in the largest CGMMV meeting with 65 Vietnamese growers attending at the NT Farmers meeting room.

It was observed by one of the resellers that it was very noticeable in their business that growers were talking about the meetings and training workshops run by the project and that the information was being widely distributed within the growing community. This was also evident during the visits to the Darwin weekend markets where stall holder growers would use that engagement opportunity to catch up with the latest information.

Participation

Farm visits

The project officer visited 92 separate vegetable and mixed farms in the NT over the course of the project. This ranged from grower cooperators that hosted meetings, demonstrations and workshops to brief meetings involving CGMMV testing schedules or plant health certification. There are a number of cluster areas for vegetable production and

often the project officer would meet most of the growers in an area even without visiting their farms. Another excellent site for grower interaction was at the local weekend markets and this also added to the face to face interactions with growers other than on farm. The project officer visited the Coolalinga and Rapid Creek at least monthly through the life of the project. It was a good way of meeting with some less easy to contact growers. A visual representation of the actual farm visits over the life of the project is included in the appendix.

Grower activities

Total		12 types	38 events	Darwin and Katherine 4 x on farm	431

The first field event which looked at effective spray coverage was an excellent example of participation in the project activities by the Vietnamese growers. The owners of the property used their equipment with the technical representative from Silvan to demonstrate the impact of different nozzles, speeds and fan settings. The workshop participants were quick to assist in the placement of water sensitive paper using the PVC pole technique to look at higher spray distribution patterns. They followed this by being very attentive in meetings and seminars about CGMMV and then volunteering their properties for the bio-security sampling and on-farm biosecurity plan training and mock audit workshops.

Internal Project Factors

Activities

Farm visits by the project officer were curtailed by the incursion but he still managed to visit 92 different vegetable farms in the NT, with a total of 636 logged face to face grower interactions. The project ran a number of training and meeting events and with 38 events and a total of 431 attendees recorded. This alone provides a strong basis for the claim of the development of the higher level changes noted by the project.

Inputs

The project inputs included the provision of a project officer salary, vehicle, communication and other operating expenses from HIA as a combination of Vegetable levy and Australian Government contributions for the 3 year project. NT Farmers Association hosted the project and provided in-kind contributions of office space and support, professional insurance, meeting room, facilities, and a cash contribution.

Outputs

The significant outputs of the project were the grower activities and farm visits listed, the NT vegetable growers data base and the on-farm biosecurity plan templates that are being used by growers to plan and implement their on practice changes. The documents and

practices successfully used to manage the outbreak of CGMMV in the NT are now being used as a basis for assisting growers in the Geraldton WA, where there was a positive test to CGMMV in a cucumber farm in July 28. These resources were shared with Vegetables WA and DAFWA and have been adapted for the WA growers.

Factors outside the project control

The project was completely refocused by the CGMMV incursion in 2014, only one year into a three year project. This changed the focus from a broad best practice capacity building project to one focused on best practice on-farm biosecurity management and the increase in capacity to comply to rapidly changing government regulations and market access conditions.

Other NT Government agencies that contributed their time and support were NT Department of Primary industries and Fisheries and NT Department of Land Resource Management and the non-government agencies like AUSVEG, Territory Natural Resource Management and NT Vietnamese Horticultural Association.

Recommendations

The major recommendation of VG12113 is to build on the success of its engagement with growers by implementing a wider capacity building project for the vegetable growers of the NT. In order to build on the established relationships it is important that the same project officer be involved. This will occur in the form of the National Vegetable Extension Network NT VG15044 that has already been awarded to the NT Farmers Association. The NT project should take advantage of the other similar projects commencing across Australia to build strong relationships and enable growers to exchange learnings and experiences with growers from other regions in Australia.

The final survey has identified on farm issues of pest control, chemical use and IPM as major priorities of on-going capacity building. Developing and getting growers to implement an IPM strategy utilizing beneficial insects and compatible chemistry for vegetable production in the NT will be a major aim of VG15044.

The business skills development priorities are to enable the growers to access markets through QA systems, and labour from the multiple programs in place in the Australian labour market. The growers will need to build confidence in compliance with government regulation especially in the area of development applications, land clearing and the newly required water licenses for the Darwin Rural Area.

The project needs to better connect the growers to regular industry communications and R&D projects from across Australia. The next NT vegetable project should also ensure that the business development projects like the Season Worker Coordinator pilot project being commenced at NT Farmers.

Scientific Refereed Publications

None to report

Intellectual Property/Commercialisation

No commercial IP generated.

References

<Insert text – if applicable, otherwise delete this section>

Methods, Monitoring, Evaluation and Reporting of Extension

Kate Roberts, *Roberts Evaluation Pty Ltd, Melbourne Victoria*
Jeff Coutts, *Coutts J&R Pty Ltd, Toowoomba Queensland*

Acknowledgements

The project would like to thank the members of the VG12113 Steering Committee for their contribution to the project. The members of the committee have given their time and energy in making sure the project was what was needed by the growers and was delivered in the best way possible.

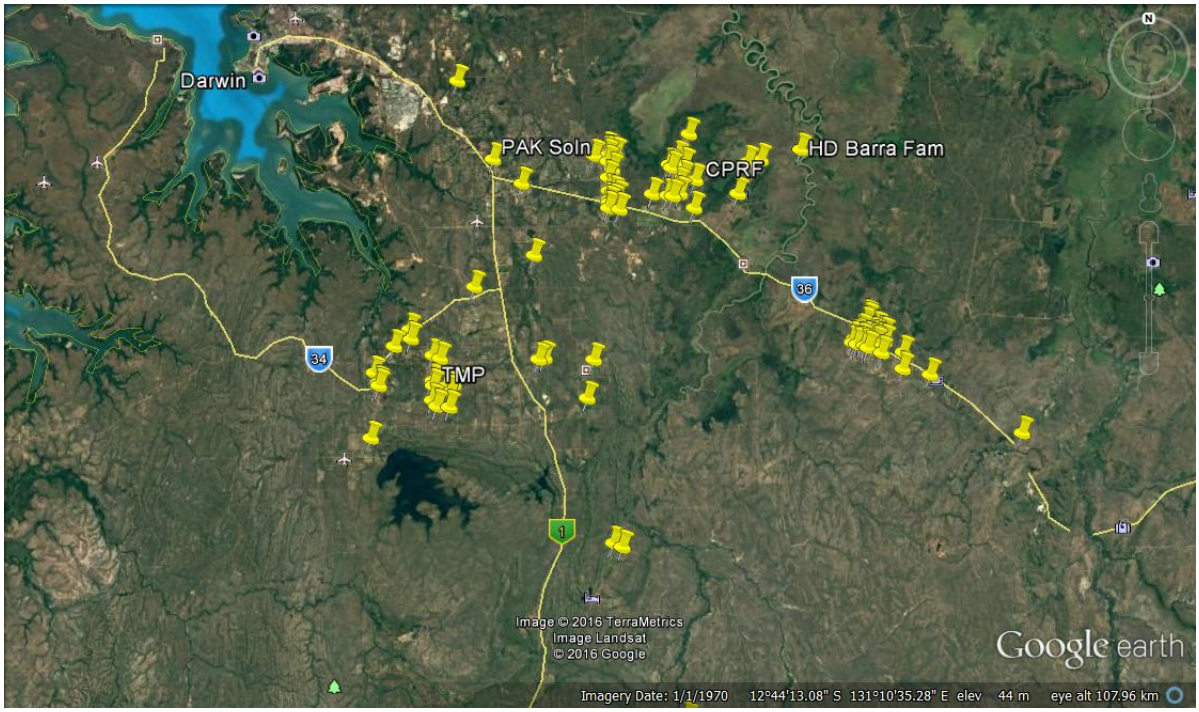
The Industry Champions were invaluable to the project. Despite two of the champions testing positive to CGMMV they continued to play a strong role in assisting with the engagement and dissemination of key information and coordination within their communities. A large vote of thanks to these dedicated community members.

The project would like to acknowledge the support of the Staff and Board at NT Farmers Association in providing an environment that totally focused on getting the best outcomes possible for the NT vegetable growers and making the meeting room facilities available in such a way that even the most skeptical grower felt that they had a place that they could be comfortable in and the events could help them

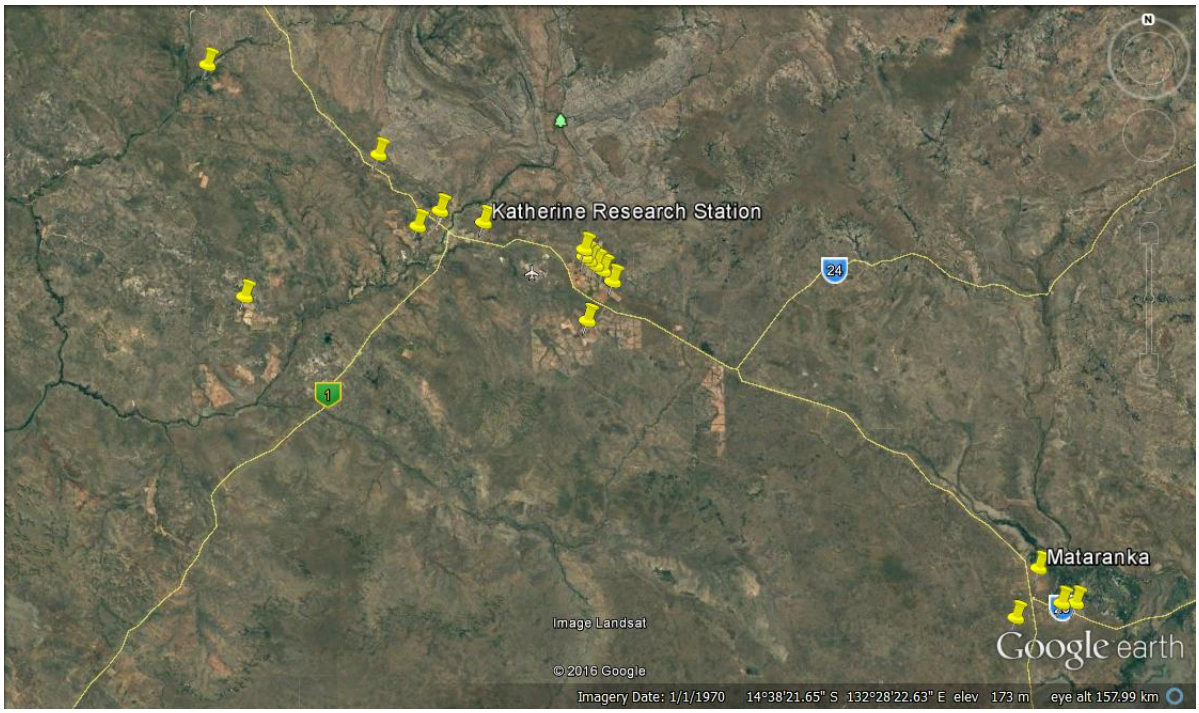
The project would like to acknowledge the other supporting agencies and grower groups who assisted in the development and/or delivery of the project including, AUSVEG, NTDPIF, NTDLRM, TNRM, and AMA.

Appendices

1. **Farm visits** Spatial view of Farm Visits in VG12113



Farm visit sites Darwin



Farm Visit sites Katherine and Mataranka

2. Activities list from milestone reports with attendance

May 2014

- Chemical Safety Training Vietnamese group at golf club 27& 28 Feb 2014 21 attendees
- Effective spray application field activity 15 may 2014 24 attendees
- Steering committee

Dec 2014

- Cairns Conference 3 attendees
- CGMMV outbreak meeting 13 Oct 2014 18 attendees
- Weeds R&D Scoping Survey Meeting Katherine , 6x Farm visits Katherine & Darwin
- CGMMV growers working group meeting Katherine 15 Dec 2014 5 veg & 6 melon attended
- Steering committee meeting 4 Mar 2014 6 attendees

May 2015

- Steering committee meeting 7 May 2015
- CGMMV Meetings and seminars (number of attendees in Brackets)
    - DR Aviv 9 Jan 2015
        - Darwin (28) and
        - Katherine (24)
    - CGMMV Meetings
        - 26/3/15 Katherine, (20)
        - 27/3/15 Darwin (35)
    - CGMMV Grower working group meetings Management working group
        - Katherine 15/12/14 (15)
        - Katherine 9/4/15 (10)
        - Katherine 16/4/15 (14)
    - Protected cropping meeting 31/3/15(2) + NT Biosecurity to develop best practice protected cropping shade-house biosecurity guidelines
    - NT Vietnamese CGMMV meeting 9/4/15 (65) Coolalinga

  AUSVEG R&D information sessions
    - Darwin & 17/3/15 (45)
    - Katherine 20/3/15 (14)
    - Release of the field Guide at Berrimah farm (25)

Dec 2015

- Steering committee August 2015 5 attendees
- National Horticulture Convention July 2015 1 Attendee

  CGMMV self- sampling workshop 19 Nov 2015
    - 15 growers attended and included collection of CDU/NTFA survey

  CGMMV Meetings and seminars (number of attendees in Brackets)
    - DR Aviv25 & 26 June 2015
        - Darwin (20) and
        - Katherine (18)

May 2016

- Steering committee April 2016 6 Attendees (phone)
- National Horticulture Convention June 2016 1 Attendee
- CGMMV Meetings and seminars (number of attendees in Brackets)
    - CGMMV new regulations meeting
        - Katherine (19) 17 Dec 2015
        - Darwin (35) March 2016
    - On farm biosecurity training and mock audit 23 attendees

3. On farm biosecurity template and Vietnamese translation (Front page only)

NT FARMERS

Farm Biosecurity Plan Template for CGMMV and NT Cucurbit farms

Business name .....

Farm Address .....

Contact .....

Office .....

Mobile .....

Email .....

Completed by .....

Signed ..... Date ...../...../.....

Horticulture Innovation Australia

This template is funded by Horticulture Innovation Australia using the National Vegetable Levy and funds from the Australian Government.

NT FARMERS

Farm Biosecurity Plan Template for CGMMV and NT Cucurbit farms
Bảng mẫu quy hoạch An toàn sinh hoc trang trại đối phó bệnh CGMMV cho trang trại bầu bí dưa

Business name/tên doanh nghiệp .....

Farm Address/địa chỉ trang trại.....

Contact/người liên hệ .....

Office/văn phòng .....

Mobile/số di động .....

Email .....

Completed by/người lập bảng .....

Signed/ký tên ..... Date/Ngày ...../...../.....

4. Evaluation Strategy

The evaluation strategy is outlined in the table below.

Evaluation Strategy for VG12113 using Bennett's Hierarchy

Evaluation levels	Description	Indicated by	Measured by
Broader Impact	Social- economic-environmental outcomes	Changes in Industry practices that impact on the economic sustainability of the targeted farming community	System wide changes that can be linked to the practice changes demonstrated by industry
Direct Effects	Practice changes	Changes in actual farm practices	Survey questions and observed changes in farm practices
	Knowledge **A**ttitudes **S**kills **A**spirations	**Increased K**nowledge **Positive A**ttitudes **Improved S**kills **Higher A**spirations	Measured by survey questions and observed farm activities. Assessment sheets for knowledge and skills activities.
	Reactions	Feedback verbal and written, trends in attendance, changes in re-active and pro-active behaviours,	Previous feed-back forms, Survey questions Observations of participation and responses to requests
	Participation	No of attendees, Steering committee, inputs from industry stakeholders	Data from project records
Internal Project factors	Activities	Meetings, Field Activities, Surveys, Grower visits, Industry events, Representation on industry bodies and committees, Documents produced	Data from Project records Documents produced and media articles, interviews and posts
	Inputs	VG12113 Budget Project Officer Knowledge, skills and experience Partner organisations	Data from project documents
Outside project control	Context –policies; climate; external impacts; related projects	Recruitment period, CGMMV & Banana Freckle biosecurity incursions, failed wet season	Information from project records and other agencies

5. Final Project Grower and Stakeholder Survey

Survey Executive Summary

The final survey personally interviewed 11 growers, of the 16 growers approached, either face to face or by phone and surveyed 10 key stakeholders with 7 responding to the email survey questions. The survey was used to complete the final evaluation in the main report and to confirm the list of priority areas for capacity building in future projects.

The grower interviews were carried out by the rich interview technique, with the list of prompting questions to direct the conversation to the components of the Bennett's evaluation that would affect them and their business and their impressions on the impact of the project on the local industry. These were predominantly focused on Reactions, Participation, KASA and Practice changes.

The stakeholders were asked similar questions in a survey email that asked questions on their involvement in the project and their views of the outcomes and how industry has been affected by the project. They were also asked what any subsequent projects should focus on in the future.

All of the vegetable growers surveyed had attended an event or had a visit from the project officer. The impact of the CGMMV incursion was very obvious in their responses from the growers and dominated the increases in knowledge and skills in managing their own on farm biosecurity and in the changes in practices on their farms that were noted in the interviews. These changes in on-farm biosecurity practice are now almost finished as a topic of conversation which indicates they are being normalized in the farming systems.

A common theme was that the project and project officer was critical in the role of liaising between farmers and the government in the CGMMV incursion response. The reactions recorded also indicated a level of trust in the project officer that was built over the life of the project and will be important in the industry for the next project.

Response extracts from the interviews included these comments

- Constant, too many people come and go in the NT
- Knew the Territory and its horticulture industry and its history and participants
- Understood the industry markets and logistics
- Approachable and returned calls
- Impartial and independent
- Not trying to sell anything
- Knew where to connect growers to technical experts and service providers
- Aware of current R,D&E projects and best practices and what was applicable

to their businesses

- Knew how to work with government and connect growers to services or through regulatory pathways.

The need for better insect control rather than the chemical treatments that are being used by the majority of the small vegetable farms was reinforced by the majority of the respondents, both growers and stakeholders. Even if the respondent was not having issues they could point to growers that were having difficulties and would also comment on the growers reluctance or inability to change to more sustainable practices even when they were spending large dollars on chemicals and achieving very little control. As indicated in the recommendations this is the one major practice change that needs to happen across the NT vegetable industry

The other business issues that growers wanted the project to help them with was in dealing with other government regulations, like land clearing and water license applications.