# INDUSTRY BIOSECURITY PLAN
# FOR THE GRAINS INDUSTRY

## Threat Specific Contingency Plan

## Maize dwarf mosaic virus

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Plant Health AUSTRALIA

GRDC Grains Research & Development Corporation

CRC PLANT biosecurity

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## Further information

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# 1 Purpose of this Contingency Plan

This Contingency Plan provides background information on the pest biology and available control measures to assist with preparedness for an incursion into Australia of *Maize dwarf mosaic virus* (MDMV). It provides guidelines for steps to be undertaken and considered when developing a Response Plan to this pest. Any Response Plan developed using information in whole or in part from this Contingency Plan must follow procedures as set out in PLANTPLAN and be endorsed by the National Management Group prior to implementation.

The information for this plan has been primarily obtained from documents as cited in the reference section as well as material sourced from the *Maize dwarf mosaic virus* pest risk review (Geering, 2005).

# 2 Pest information/status

## 2.1 Pest details

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|---|---|
| **Scientific name** | *Maize dwarf mosaic virus* (*Potyvirus*) |
| **Other names** | *Sorghum red stripe virus*, *Maize mosaic virus*, *European maize mosaic virus*, *Indian maize mosaic virus*, *Maize stripe mosaic virus*, *Maize dwarf mosaic potyvirus* |
| **Common names** | Dwarf mosaic of maize, MDMV |

### 2.1.1 General information

Taxonomic position – Group: Viruses; Family: *Potyviridae*; Genus: *Potyvirus*

MDMV has filamentous virions, 750 nm long × 13 nm wide, and a ssRNA genome consisting of 9515 nucleotides (Shukla *et al*., 1994). MDMV is closely related to *Sugarcane mosaic virus* (SCMV), *Johnsongrass mosaic virus* (JGMV), *Sorghum mosaic virus* (SrMV) and *Zea mosaic virus* (ZeMV) and together these constitute the sugarcane mosaic virus subgroup of potyviruses. Five strains of MDMV (strains A, C, D, E and F) are recognised based on symptomatology on inbred maize lines including inbred line N20 and frequency of transmission by different aphid species (Shukla *et al*., 1994).

Inoculum sources of MDMV are mainly infected plants, and to a lesser extent the soil that is contaminated with MDMV infected johnsongrass (*Sorghum halepense*) rhizomes. Important natural sources of the virus are johnsongrass (Onazi & Wilde, 1974) and *Sorghum verticilliflorum* (Garrido & Trujillo, 1989). Transmission occurs by numerous aphid species from infected wild or cultivated host plants, with corn the most-likely cultivated plant to become infected (Onazi & Wilde, 1974). Aphid vectors transmit the virus in a non-persistent manner, and persistence of the virus in the aphids is usually between 30 minutes and 4 hours. Increased virus transmission occurs where high aphid concentrations are found at virus sources.

### 2.1.2 Life cycle

MDMV is an obligate parasite, and cannot survive outside of either its host or vector. Johnsongrass, a perennial weed, is a critical overwintering host between annual corn and sorghum crops (Toler, 1985). Even when frosts kill the foliage of *S. halepense*, the rhizomes of this plant persist and provide a refuge for the virus.

MDMV is transmitted in a non-persistent manner by a broad range of aphids including *Schizaphis graminum, Aphis maidiradicis, Aphis craccivora, Aphis fabae, Acyrthosiphon pisum, Myzus persicae, Aphis gossypii, Therioaphis maculata, Sitobion (Macrosiphum) avenae, Rhopalosiphum padi, Rhopalosiphum poae, Macrosiphum euphorbiae, Rhopalosiphum maidis, Brevicoryne brassicae* and *Rhopalosiphum fitchii* (Ford *et al.*, 2004). Aphids can acquire and transmit the virus in a matter of minutes (Ford *et al.*, 2004). Active spread of the virus often occurs with little evidence of aphid colonisation.

Non-persistently transmitted viruses are traditionally perceived as only being retained by the aphid for a maximum of 1-2 hours. However, under experimental conditions, viruliferous *Schizaphis graminum* have been observed to retain infectivity for over 20 hours (Berger *et al.*, 1987). Epidemics of MDMV periodically occur in the northern states of the USA and even in Ontario in Canada, where the harsh winters prevent survival of the overwintering host of the virus, *S. halepense* (Zeyen *et al.*, 1987). It is believed that these epidemics are caused by large-scale migrations of air-borne aphids from more southerly latitudes in the USA. Immediately preceding an epidemic of MDMV in Minnesota in 1997, low-level jet winds swept through the Great Plains and it was estimated that with a wind assistance of 80 km/h, aphids could have flown from Texas, more than 1500 km away, in as little as 20 hours (Zeyen *et al.*, 1987).

Apart from aphid transmission, MDMV is also transmitted in dent corn seed at frequencies from 0.007% to 0.4% (Ford *et al.*, 2004). Seed transmission of MDMV in sorghum is not recorded (Toler, 1985), although this possibility cannot be discounted.

## 2.2 Affected hosts

### 2.2.1 Host range

In the field, MDMV has only ever been found infecting *Sorghum bicolor*, *Sorghum halepense*, *Sorghum sudanense* and *Zea mays* (Brunt *et al.,* 1990; Rao *et al.*, 1996; Toler, 1985). With respect to incursion management, it is critical that these hosts of MDMV are surveyed and carefully considered when implementing containment and eradication programs.

The potential host range of MDMV is, however, much broader. Experimentally susceptible hosts of MDMV include *Arundo donax*, *Bromus mollis*, *Bromo secalinus*, *Bromus tectorum*, *Chloris gayana*, *Cynodon dactylon*, *Echinochloa crus-galli*, *Eleusine coracana*, *Lagurus ovatus*, *Oryza sativa*, *Panicum acapillare*, *Panicum maximum*, *Panicum miliaceum*, *Paspalum dilatatum*, *Phalaris paradoxa*, *Rotboellia exaltata*, *Saccharum officinarum*, *Sacciolepsis indica*, *Setaria italica*, *Setaria viridis*, *Sorghum bicolor* and *Zea mays* (Brunt *et al.*, 1990). These hosts also need to be carefully considered when planning surveys and control strategies. Experimentally insusceptible hosts include *Anthoxanum odoratum*, *Avena sativa*, *Dactylis glomerata*, *Hordeum vulgare*, *Lolium perenne*, *Lolium temulentum*, *Poa pratensis*, *Secale cereale* and *Triticum aestivum* (Brunt *et al.*, 1990).

### 2.2.2 Geographic distribution

MDMV probably occurs in every country in the world where corn is grown with the main exception of Australia. Disease reports in some countries are ambiguous, as appropriate tests have not been done to eliminate the possibility that plants are infected with other members of the sugarcane subgroup of potyviruses.

MDMV has been confirmed in the following countries (information obtained from the Crop Protection Compendium – **www.cabicompendium.org**):

| | |
|---|---|
| **Europe** | Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Czechoslovakia (former), Yugoslavia (former), France, Germany, Greece, Hungary, Italy, Romania, Russia, Serbia and Montenegro, Spain and Ukraine. |
| **Africa** | Burkina Faso, Cameroon, Côte d'Ivoire, Egypt, Ethiopia, Kenya, Mauritius, Morocco, Niger, Nigeria, South Africa, Zambia and Zimbabwe. |
| **Asia** | China, Georgia (Republic), India, Iran, Iraq, Israel, Kazakhstan, Republic of Korea, Pakistan, Philippines, Turkey, Turkey-in-Asia, Uzbekistan and Yemen. |
| **North America** | Canada, Mexico and the USA. |
| **Central America** | Cuba, Haiti and Honduras |
| **South America** | Argentina, Brazil, Chile, Colombia, Peru and Venezuela |

### 2.2.3 Symptoms

Maize plants infected with MDMV show mosaic or mottle symptoms, particularly near the base of the youngest leaves. In hot weather, the mosaic symptoms may disappear and instead be replaced by general chlorosis in new growth. Severely infected plants are stunted, exhibit increased tillering and poor seed set. Infected plants are predisposed to other root rotting pathogens. Symptoms of MDMV in sorghum are similar to those in maize. Sorghum lines carrying the *rlf* gene develop a severe necrotic red leaf reaction when infected and grown under cool temperatures (Lapierre and Signoret, 2004).

Symptoms expressed by affected plant parts are as follows:

- Leaves: abnormal patterns
- Whole plant: dwarfing

## 2.3 Entry, establishment and spread

The majority of information from this section has been taken from the *Maize dwarf mosaic virus* pest risk review (Geering, 2005) with the risk analysis for MDMV based on the methodology in Biosecurity Australia's guidelines on Import Risk Analysis for Plants and Plant Products (2001).

### 2.3.1 Entry potential

**Rating: Medium**

The entry potential of MDMV is Medium for the following reasons:

- MDMV has a very broad distribution around the world, suggesting many previous examples of intercontinental movement and also multiple potential routes of entry of the virus into Australia.
- Seed transmission is the most likely mode of entry of MDMV into Australia and there is a high risk that the virus could enter in illegal importations of grain. Although there is evidence of long distance dispersal of MDMV by migrating aphids, it is unlikely that the virus could travel the great distances over oceans in this way.
- Maize and sorghum grain is imported into Australia for breeding purposes and for use as fodder during drought times. When new maize and sorghum lines are imported into Australia for breeding purposes, plants must be grown for one generation in post-entry quarantine and seed collected from these plants then released. Symptoms of MDMV infection in post-entry quarantine should be obvious and virus particles should be readily detectable in these plants by electron microscopy. Maize grain imported into Australia for fodder must be devitalised. The importation of popping corn for human consumption is prohibited.

### 2.3.2 Establishment potential

**Rating: High**

The establishment potential of MDMV in Australia is High for the following reasons:

- The aphid vectors of MDMV are already widespread in the country.
- The major cereal hosts of MDMV, corn and sorghum, are important crops and *S. halepense* is a weed throughout arable areas of northern Australia.
- It is unlikely that MDMV would quickly be recognised, as symptoms of infection are essentially identical to those caused by JGMV, a virus that is already widespread in Australian corn and sorghum crops. MDMV would only be likely to be discovered through targeted surveillance or when resistance-breaking strains of potyvirus in maize and sorghum crops were further investigated.

### 2.3.3 Spread potential

**Rating: High**

The spread potential of MDMV in Australia is High for the following reasons:

- The main hosts and vectors of MDMV are already widespread in Australia.
- JGMV, which has a very similar disease cycle to MDMV, is one of the most important pathogens of maize and sorghum in Australia and it is anticipated that MDMV would become equally widely distributed.
- Once MDMV became established in the common weed johnsongrass (*S. halepense*), there would be no effective method of either eradicating or limiting spread of the virus.

- The most effective control method for MDMV in maize and sorghum is deployment of virus-resistant plant lines. Maize and sweet corn lines have not been specifically bred for resistance to MDMV, although the different plant lines currently grown could be expected to carry varying levels of tolerance to the virus. Sorghum lines carrying the Krish resistance gene are widely grown in Australia as this gene confers immunity to most strains of JGMV, although resistance-breaking strains have emerged. The Krish resistance gene also confers immunity to MDMV strain A (Toler, 1985).

### 2.3.4 Economic impact

**Rating: High**

The economic impact of MDMV is likely to be significant. MDMV is regarded as being one of the most important pathogens of sorghum and corn in the USA. In 1967, two years after MDMV was first discovered in Arkansas, disease epidemics were observed in highly susceptible sorghum genotypes grown in Texas, with estimated yield losses of over 15% (Toler, 1985). However, in 1985, when less susceptible sorghum genotypes were deployed, yield losses were estimated to be 2% (Toler, 1985).

### 2.3.5 Environmental impact

**Rating: Negligible**

The potential environmental impact of MDMV is unlikely to be discernible. Overseas, the only field hosts of MDMV that have been recorded are *Zea mays*, *Sorghum bicolor* and *Sorghum halepense*, although the experimental host range is much greater and the virus could potentially infect native grass species in Australia, so reducing their longevity and competitiveness. Of particular note, 13 Sorghum spp. are endemic to Australia, more than half of the total number of species in this genus worldwide (Morley & Toelken, 1983).

### 2.3.6 Overall risk

**Rating: Medium**

## 2.4 Diagnostic information

MDMV is unlikely to be contained unless detected within a few months of an introduction. Follow up diagnostic tests should be done for any potyvirus isolate in maize or sorghum that tests negative for JGMV, as there is a strong possibility that the virus will be exotic (either MDMV or SrMV). The identity of any virus isolate in breeding plots that causes atypical disease symptoms or breaks previously durable resistance genes should be investigated.

### 2.4.1 Diagnostic protocol

MDMV can only be definitively identified using either RT-PCR or ELISA (methods are provided in the Maize dwarf mosaic virus National Diagnostic Protocol (Geering *et al.,* 2004)). Host reactions may assist in the identification of exotic potyviruses in sorghum and maize in Australia. JGMV infection on the inbred sorghum line OKY8 produces a necrotic red stripe reaction, whereas this line is either

symptomless or develops mosaic symptoms in response to infection with MDMV, SrMV and nearly all strains of SCMV (Persley *et al*., 1985; Tosic *et al*., 1990). Of the sugarcane mosaic virus subgroup of potyviruses, JGMV alone infects oats (Seifers *et al*., 2000; Tosic *et a*l., 1990). It must be emphasised that reactions on indicator plants are only a guide for identification and any diagnosis should be supported by a serological or molecular test.

Present capabilities in Australia include skills in virus identification using ELISA and/or RT-PCR are available in every state either in Departments of Agriculture, university plant pathology groups or CSIRO. Dried leaf cultures of MDMV for use as positive controls are held in the Department of Employment, Economic Development and Innovation Plant Virus Collection.

## 2.5 Response checklist

### 2.5.1 Checklist

Guidelines for response checklists are still to be endorsed. The following checklist provides a summary of generic requirements to be identified and implemented within a Response Plan:

- Destruction methods for plant material, soil and disposable items
- Disposal procedures
- Quarantine restrictions and movement controls
- Decontamination and farm cleanup procedures
- Diagnostic protocols and laboratories
- Trace back and trace forward procedures
- Protocols for delimiting, intensive and ongoing surveillance
- Zoning
- Reporting and communication strategy

Additional information is provided by Merriman and McKirdy (2005) in the Technical Guidelines for Development of Pest Specific Response Plans.

## 2.6 Delimiting survey and epidemiology study

Delimiting surveys should comprise local surveys around the area of initial detection concentrating on areas of poor growth.

### 2.6.1 Sampling method

Plants infected with MDMV show mosaic or mottle symptoms, particularly near the base of the youngest leaves. In hot weather this is replaced by general chlorosis in new growth. Material should be collected at the margin between the diseased and healthy portions of the plant. At a minimum, three surveys of the infected crop should be undertaken in order to detect the disease and estimate its intensity. The first survey to be completed when plants have 5-7 leaves, the second when plants are silking and heading, and the final survey to be completed later in the season, but before plants

start to senesce. Mosaic symptoms on corn and sorghum crops can also be detected by long distance photography (aerial detection – Ausmus & Hilty, 1972).

Symptoms of MDMV may not always be obvious in infected plants. Resistant and/or tolerant lines of maize and sorghum may have varying degrees of MDMV infection and varying degrees of symptoms may be expressed. In some instances johnsongrass has been reported to be symptomless, particularly when stressed. As such, delimiting surveys should consider sampling that will screen both symptomatic and symptomless MDMV infected plants.

Any personnel collecting samples for assessment should notify the diagnostic laboratory prior to submitting samples to ensure expertise is available to undertake the diagnosis. General protocols for collecting and dispatching samples are available within Appendix 3 PLANTPLAN (Plant Health Australia, 2009).

#### *2.6.1.1 NUMBER OF SPECIMENS TO BE COLLECTED*

Five to ten samples of symptomatic plants should be collected for initial identification. If a survey to determine the incidence of MDMV within a crop or geographic area is required, then a more formalised, statistical-based sampling strategy should be employed (see Section 2.6.4 for more details).

#### *2.6.1.2 HOW TO COLLECT*

Samples should be treated in a manner that allows them to arrive at the laboratory in a fresh, well-preserved state. An esky with ice packs or portable fridge should be carried when sampling crops. Samples should be wrapped in damp newspaper, bundled into a plastic bag and clearly labelled. For appropriate labelling and packaging procedures for suspect emergency plant pests consult PLANTPLAN (Plant Health Australia, 2009).

It is important to record the precise location of all samples collected, preferably using GPS, or if this is not available, map references including longitude and latitude and road names should be recorded. Property and owners names should also be included where possible.

Infected plant material is collected using sterilised scissors and placed into a self-sealing plastic bag to prevent desiccation of the plant tissue. Alternatively, in the absence of a self-sealing plastic bag, the plant tissue can be wrapped in moist towelling.

#### *2.6.1.3 HOW TO COLLECT PLANT SAMPLES IF REQUIRED*

As above.

#### *2.6.1.4 HOW TO PRESERVE PLANT SAMPLES*

Collected material can be stored at 2-5°C inside sealed plastic bag.

#### *2.6.1.5 HOW TO TRANSPORT PLANT SAMPLE*

Plant material contained within a sealed plastic bag with dry tissues or paper towel should be mailed as a flat package.

### 2.6.2 Epidemiological study

MDMV has the potential to spread to all regions in Australia where maize and sorghum is cultivated, as well as any area where *Sorghum halepense* occurs as a weed. Several of the aphid species that are reported to transmit MDMV are also widespread in Australia. Significant outbreaks of MDMV can occur when virus-infected johnsongrass overwinters in close proximity to young susceptible maize and sorghum cultivars.

### 2.6.3 Models of spread potential

There are no models available that will forecast disease associated with MDMV.

### 2.6.4 Pest Free Area guidelines

Points to consider in determining Pest Free Area (PFA) guidelines relevant to this pest are:

- Design of a statistical delimiting field survey for MDMV based on virus-testing of host (see Section 2.6.1 for points to consider in the design).
- Plant sampling should be based on 100 random samples per crop.
- Assessment of plants requires appropriate diagnostic tests such as ELISA or RT-PCR as plants may be symptomless or have symptoms which may be confused with other mosaic viruses.

Additional information is provided by the IPPC (1995) in Requirements for the Establishment of Pest Free Areas. This standard describes the requirements for the establishment and use of PFAs as a risk management option for phytosanitary certification of plants and plant products. Establishment and maintenance of a PFA can vary according to the biology of the pest, pest survival potential, means of dispersal, availability of host plants, restrictions on movement of produce, as well as PFA characteristics (size, degree of isolation and ecological conditions).

## 2.7 Availability of control methods

There are a number of methods available for the control of MDMV including sanitation, the use of insecticides to kill vectors, management of habitat, and crop rotation.

### 2.7.1 General procedures for control

- Keep traffic out of affected areas and minimize movement in adjacent areas.
- Adopt best-practice farm hygiene procedures to retard the spread of the pest between fields and adjacent farms.
- After surveys are completed, destruction of the infected crop is an effective control.
- On-going surveillance of infected paddocks to ensure MDMV is eradicated.

### 2.7.2 Control if small areas are affected

As above.

### 2.7.3 Control if large areas are affected

As above.

### 2.7.4 Cultural control

Reduction in the incidence of MDMV can be achieved through a number of agricultural processes, such as a good tillage system (All *et al.,* 1977), greater plant densities (Popov, 1978), early sowing (Scott & Rosenkranz, 1974; Popov, 1979; Forster *et al.,* 1980) and wide crop rotations (Piper *et al.,* 1996), however these methods may be unsuitable for eradication.

### 2.7.5 Host plant resistance

Breeding of corn and sorghum genotypes resistant to MDMV is the most important and effective way to control MDMV. Resistant lines are characterised by the absence or reduction in symptom expression, lower percentage of plants developing symptoms, longer incubation times, suppressed virus movement within the plant, restriction of symptoms within a leaf and low virus titres. Examples of immune or tolerant lines are prevalent in both corn (Pa405, B68, Ph1EP, 0H7B, Ga209, Oh514, Oh514, Oh07, I11A, W70, Oh28, 38-11, C103, A632, A634, B64, PI536518 and PI536519) and sorghum (621, Tx 414, RS 625, BTx 399 (wheatland), Tx 398 (Martin), NM 960, Mer 75-6, Mer 76-1, Mer 77-2, Mer 77-7, Tx2536, RTx 430, Tx 2726, RTx 435, RTx 2858, QL 11, QL 3-Tx and QL 3-India).

There are no reported resistance-breaking strains of MDMV in the literature but it is important to recognise that such strains of MDMV may emerge from time to time.

### 2.7.6 Chemical control

Control of MDMV through the use of pesticides to kill the aphid vectors presents a large challenge. As MDMV is transmitted non-persistently, aphids can inoculate healthy plants before being affected by insecticides. Insecticide treatments have shown reduction in aphid densities without affecting virus infection (Rains & Christensen, 1983). Better results may be obtained through the application of insecticides to the source plants of the virus. Herbicide eradication of johnsongrass within and adjacent to maize and sorghum fields, particularly early in the growing season and before aphid numbers have built up on the weeds, can reduce the incidence of MDMV on sorghum and maize crops.

### 2.7.7 Mechanical control

There are no effective mechanical control measures for MDMV.

### 2.7.8 Biological control

No biological control measures are currently known for MDMV.

# 3 Course of Action – Eradication Methods

Additional information is provided by the IPPC (1998) in Guidelines for Pest Eradication Programmes. This standard describes the components of a pest eradication programme which can lead to the establishment or re-establishment of pest absence in an area. A pest eradication programme may be developed as an emergency measure to prevent establishment and/or spread of a pest following its recent entry (re-establish a pest free area) or a measure to eliminate an established pest (establish a pest free area). The eradication process involves three main activities: surveillance, containment, and treatment and/or control measures.

## 3.1 Destruction strategy

### 3.1.1 Destruction protocols

- Disposable equipment, infected plant material or soil should be disposed of by autoclaving, high temperature incineration or deep burial.
- Any equipment removed from the site for disposal should be double-bagged.

### 3.1.2 Decontamination protocols

Machinery, equipment, vehicles in contact with infected plant material or soil or which are present within the Quarantine Area, should be washed to remove soil and plant material using high pressure water or scrubbing with products such as a farm degreaser or a 1% bleach solution in a designated wash down.

General guidelines for wash down areas are as follows:

- Located away from crops or sensitive vegetation.
- Readily accessible with clear signage.
- Access to fresh water and power.
- Mud free, including entry and exit points (e.g. gravel, concrete or rubber matting).
- Gently sloped to drain effluent away.
- Effluent must not enter water courses or water bodies.
- Allow adequate space to move larger vehicles away from hazards such as power lines.
- Waste water, soil or plant residues should be contained (see PLANTPLAN 2009 Appendix 18).
- Disposable overalls and rubber boots should be worn when handling infected soil or plant material in the field. Boots, clothes and shoes in contact with infected soil or plant material should be disinfected at the site or double-bagged to remove for cleaning.

- Skin and hair in contact with infested plant material or soil should be washed.
- Decon 90 is a suitable detergent for using to decontaminate equipment or personnel.

### 3.1.3 Priorities

- Confirm the presence of the pest.
- Prevent movement of vehicles and equipment through affected areas.
- Priority of eradication/decontamination of infected host material.

### 3.1.4 Plants, by-products and waste processing

- Infected plant material should be destroyed by (enclosed) high temperature incineration, autoclaving or deep burial (in a non-cropping area).
- As the virus can be mechanically transmitted, killed crops should be ploughed in.

### 3.1.5 Disposal issues

- Particular care must be taken to minimize the transfer of infected soil or plant material from the area as the MDMV-infected johnsongrass rhizomes can survive in soil for long periods of time.
- No particular issues with resistance of disease to chemicals or physical treatments are known to exist.

## 3.2 Quarantine and movement controls

### 3.2.1 Quarantine priorities

- Plant material and soil at the site of infection to be subject to movement restrictions.
- Machinery, equipment, vehicles and disposable equipment in contact with infected plant material or soil to be subject to movement restrictions.

### 3.2.2 Movement control for people, plant material and machinery

Movement of people, vehicle and machinery, from and to affected farms, must be controlled to ensure that infected soil or plant debris is not moved off-farm on clothing, footwear, vehicles or machinery. This can be achieved through:

- Signage to indicate quarantine area and/or restricted movement in these zones.
- Fenced, barricaded or locked entry to quarantine areas.
- Movement of equipment, machinery, plant material or soil by permit only.

- Clothing and footwear worn at the infected site should either be double-bagged prior to removal for decontamination or should not leave the farm until thoroughly disinfected, washed and cleaned.
- Hay, stubble or trash must not be removed from the site.
- All machinery and equipment should be thoroughly cleaned down with a pressure cleaner prior to leaving the affected farm. The clean down procedure should be carried out on a hard surface, preferably a designated wash-down area, to avoid mud being re-collected from the affected site onto the machine.
- Seed from the affected site should not be used for planting new crops, feeding stock or for human consumption.

## 3.3 Zoning

The size of each quarantine area will be determined by a number of factors, including the location of the incursion, biology of the pest, climatic conditions and the proximity of the infected property to other infected properties.

### 3.3.1 Destruction zone

The size of the destruction zone (i.e. zone in which the pest and all host material is destroyed) will depend on the ability of the pest and its vector to spread, distribution of the pest (as determined by delimiting surveys), time of season (and part of the pest life cycle being targeted) and factors which may contribute to the pest spreading.

The entire crop or pasture should be destroyed after the level of infection has been established. The delimiting survey will determine whether or not neighbouring host crops are infected and need to be destroyed. The Destruction Zone may be defined as contiguous areas associated with the same management practices as the infected area (i.e. the entire trial, paddock or farm if spread could have occurred prior to the infection being identified).

### 3.3.2 Quarantine zone

The Quarantine Zone is defined as the area where voluntary or compulsory restraints are in place for the affected property(ies). These restraints may include restrictions or movement control for removal of plants, people, soil or contaminated equipment from an infected property.

### 3.3.3 Buffer zone

A Buffer Zone may or may not be required depending on the incident. It is defined as the area in which the pest does not occur but where movement controls or restrictions for removal of plants, people, soil or equipment from this area are still deemed necessary. The Buffer Zone may enclose an infested area (and is therefore part of the Control Area) or may be adjacent to an infested area.

### 3.3.4 Restricted Area

The Restricted Area is defined as the zone immediately around the infected premises and suspected infected premises. The Restricted Area is established following initial surveys that confirm the presence of the pest. The Restricted Area will be subject to intense surveillance and movement control with movement out of the Restricted Area to be prohibited and movement into the Restricted Area to occur by permit only. Multiple Restricted Areas may be required within a Control Area.

### 3.3.5 Control Area

The Control Area is defined as all areas affected within the incursion. The Control Area comprises the Restricted Area, all infected premises and all suspected infected premises and will be defined as the minimum area necessary to prevent spread of the pest from the Quarantine Zone. The Control Area will also be used to regulate movement of all susceptible plant species to allow trace back, trace forward and epidemiological studies to be completed.

## 3.4 Decontamination and farm clean up

Decontaminant practices are aimed at eliminating the pest thus preventing its spread to other areas.

### 3.4.1 Decontamination procedures

General guidelines for decontamination and clean up:

- Refer to PLANTPLAN (Plant Health Australia, 2009) for further information.
- Keep traffic out of affected area and minimize it in adjacent areas.
- Adopt best-practice farm hygiene procedures to retard the spread of the pest between fields and adjacent farms.
- Machinery, equipment, vehicles in contact with infected plant material or soil or present within the Quarantine Area, should be washed to remove soil and plant material using high pressure water or scrubbing with products such as Decon 90 detergent, a farm degreaser or a 1% bleach solution in a designated wash down area as described in Section 3.1.2.
- Plant material should be destroyed using herbicide and then ploughed in to promote plant tissue degradation to minimise the potential of mechanical transmission of the virus. Only recommended materials are to be used when conducting decontamination procedures, and should be applied according to the product label.

### 3.4.2 Decontamination if pest is identified in small or large areas

Destruction of plant material by herbicide is described. The infected area would need to be monitored for a few years for self sown plants which should be tested for MDMV and then destroyed.

### 3.4.3 General safety precautions

For any chemicals used in the decontamination, follow all safety procedures listed within each MSDS.

## 3.5 Surveillance and tracing

### 3.5.1 Surveillance

Detection and delimiting surveys are required to delimit the extent of the outbreak, ensuring areas free of the pest retain market access and appropriate quarantine zones are established.

Initial surveillance priorities include the following:

- Surveying all host growing properties in the pest quarantine area.
- Surveying all properties identified in trace-forward or trace-back analysis as being at risk.
- Surveying all host growing properties that are reliant on trade with interstate or international markets which may be sensitive to MDMV presence.
- Surveying commercial nurseries selling at risk host plants.
- Surveying other host growing properties and backyards.

### 3.5.2 Survey regions

Establish survey regions around the surveillance priorities identified above. These regions will be generated based on the zoning requirements (see Section 3.3), and prioritised based on their potential likelihood to currently have or receive an incursion of this pest. Surveillance activities within these regions will either allow for the area to be declared pest free and maintain market access requirements or establish the impact and spread of the incursion to allow for effective control and containment measures to be carried out.

Steps outlined in Table 1 form a basis for a survey plan. Although categorised in stages, some stages may be undertaken concurrently based on available skill sets, resources and priorities.

***Table 1.*** *Phases to be covered in a survey plan*

| | |
|---|---|
| **Phase 1** | • Identify properties that fall within the buffer zone around the infested premise<br>• Complete preliminary surveillance to determine ownership, property details, production dynamics and tracings information (this may be an ongoing action) |
| **Phase 2** | • Preliminary survey of host crops in properties in buffer zone establishing points of pest detection |
| **Phase 3** | • Surveillance of an intensive nature, to support control and containment activities around points of pest detection |
| **Phase 4** | • Surveillance of contact premises. A contact premise is a property containing susceptible host plants, which are known to have been in direct or indirect contact with an infested premises or infected plants. Contact premises may be determined through tracking movement of materials from the property that may provide a viable pathway for spread of the disease. Pathways to be considered are:<br>o Items of equipment and machinery which have been shared between properties including bins, containers, irrigation lines, vehicles and equipment<br>o The producer and retailer of infected material if this is suspected to be the source of the outbreak<br>o Labour and other personnel that have moved from infected, contact and suspect premises to unaffected properties (other growers, tradesmen, visitors, salesmen, crop scouts, harvesters and possibly beekeepers)<br>o Movement of plant material and soil from controlled and restricted areas<br>o Storm and rain events and the direction of prevailing winds that result in air-born dispersal of the pathogen during these weather events |
| **Phase 5** | • Surveillance of nurseries, gardens and public land where plants known to be hosts of pathogen are being grown |
| **Phase 6** | • Agreed area freedom maintenance, pest control and containment |

### 3.5.3 Post-eradication surveillance

The period of pest freedom sufficient to indicate that eradication of the pest has been achieved will be determined by a number of factors, including cropping conditions, the previous level of infection and the control measures applied. As a guide, the following activities should be carried out following the eradication of the pathogen:

- Establishment of sentinel plants at the site of infection (see Section 2.6.4).
- Maintain good sanitation and hygiene practices throughout the year.
- Sentinel plants should remain in place and inspected on a fortnightly basis for a further 6 weeks and then on a monthly basis.
- Surveys comprising plant sampling for and testing for MDMV to be undertaken for a minimum of 3 years to demonstrate eradication has been achieved.

# 4 References

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## 4.1 Websites

CAB Compendium (**www.cabicompendium.org/cpc/home.asp**).

# 5 Appendices

## Appendix 1. Standard diagnostic protocols

For a range of specifically designed procedures for the emergency response to a pest incursion refer to PLANTPLAN (Plant Health Australia, 2009).

## Appendix 2. Experts, resources and facilities

The following tables provide lists of experts (Table 2) and diagnostic facilities (Table 3) for use in professional diagnosis and advisory services in the case of an incursion.

***Table 2.*** *Experts who can be contacted for professional diagnostic and advisory services*

| Expert | State |
|---|---|
| Denis Persley | Qld |
| John Thomas | Qld |
| Andrew Geering | Qld |

***Table 3.*** *Diagnostic service facilities in Australia*

| Facility | State | Details |
|---|---|---|
| DPI Victoria Knoxfield Centre | Vic | 621 Burwood Highway<br>Knoxfield VIC 3684<br>Ph: (03) 9210 9222<br>Fax: (03) 9800 3521 |
| DPI Victoria Horsham Centre | Vic | Natimuk Rd<br>Horsham VIC 3400<br>Ph: (03) 5362 2111<br>Fax: (03) 5362 2187 |
| Industry and Investment New South Wales, Elizabeth Macarthur Agricultural Institute | NSW | Woodbridge Road<br>Menangle NSW 2568<br>PMB 8 Camden NSW 2570<br>Ph: (02) 4640 6327<br>Fax: (02) 4640 6428 |
| Industry and Investment New South Wales, Tamworth Agricultural Institute | NSW | 4 Marsden Park Road<br>Calala NSW 2340<br>Ph: (02) 6763 1100<br>Fax: (02) 6763 1222 |

| Facility | State | Details |
|---|---|---|
| Industry and Investment New South Wales, Wagga Wagga Agricultural Institute | NSW | PMB Wagga Wagga<br>NSW 2650<br>Ph: (02) 6938 1999<br>Fax: (02) 6938 1809 |
| SARDI Plant Research Centre - Waite Main Building, Waite Research Precinct | SA | Hartley Grove<br>Urrbrae SA 5064<br>Ph: (08) 8303 9400<br>Fax: (08) 8303 9403 |
| Grow Help Australia | QLD | Entomology Building<br>80 Meiers Road<br>Indooroopilly QLD 4068<br>Ph: (07) 3896 9668<br>Fax: (07) 3896 9446 |
| Department of Agriculture and Food, Western Australia (AGWEST) Plant Laboratories | WA | 3 Baron-Hay Court<br>South Perth WA 6151<br>Ph: (08) 9368 3721<br>Fax: (08) 9474 2658 |

# Appendix 3. Communications strategy

A general Communications Strategy is provided in PLANTPLAN

# Appendix 4. Market access impacts

Within the AQIS PHYTO database (January 2011), the following countries require a declaration stating that “Maize dwarf mosaic virus is not known to occur in Australia” when exporting corn (*Zea mays*), wheat (*Triticum* spp.), sorghum (*Sorghum* spp.) or panic grass (*Panicum maximum*):

- Sri Lanka (corn)
- Mauritius (wheat, corn)
- Malaysia (panic, corn, sorghum)
- New Zealand (corn)
- French Polynesia (corn)
- Vanuatu (corn)

Latest information can be found within PHYTO, using an Advanced search “Search all text” for *maize dwarf mosaic virus.*