New Project Summary Report for PO 016 - The role of environmental factors in the incidence of Pansy mottle syndrome

Project Number	30900160
Title	The role of environmental factors in the incidence of Pansy Mottle Syndroms (PaMS)
Short Title	PO 016
Lead Contractor	ADAS UK Ltd
Other Contractors	N/A
Start & End Dates	30 April 2013 - 29 April 2015
Industry Representative	Mr Chris Need – Roundstone Nurseries; Ms Fay Richardson – Coletta & Tyson; Mr Mike Smith – W D Smith & Son
Project Budget	£64,637
AHDB Contribution	£64,637

The Problem

Symptoms of pansy mottle syndrome (PaMS) have been reported since the 1960s, and have generally been considered to be a physiological response to stress. Symptoms include leaf distortion, mottling, leaf bleaching, stunting and apical blindness, with symptom expression varying from year to year on nurseries; bedding plant species including Antirrhinum, marigold, Petunia, stocks, sweet pea, Verbena, Gerbera and Primula can display similar symptoms. Determination of the cause is complicated by the transient and intermittent nature of the symptoms, and difficulty in replicating the symptoms and linking the cause with effect (McPherson, 2010). The condition has become more common in recent years,

particularly under the relatively cool, wet conditions of 2013, which has renewed interest in identifying the cause.

Grower observation suggests that PaMS may be varietal, with incidence occurring in specific seed batches and colours. Outbreaks have however, been linked to environmental factors, because symptoms have often been observed under humid conditions. These include warm, wet and windy weather when glasshouse vents are shut, causing humidity to increase within the glasshouse. Symptoms also tend to appear after transplant, although they may have been triggered earlier and have also been linked to high root-zone moisture levels.

Aims and Objectives

i) Project aim(s): To investigate the role of selected environmental factors on the incidence of PaMS.

(ii) Project objective(s): To monitor nursery environment (humidity, temperature, light) within commercial bedding plant production systems and, using regression analysis approaches, elucidate any statistically robust causal relationships between the incidence of PaMS and environment.

Approach

Data Exploration

To better understand the events surrounding the incidence of PaMS then there is a need to either establish a robust relationship or rule out selected environmental factors with the incidence of PaMS. To provide an evidence base, a range of pansy crops will be monitored for growth, development, appearance, management and environmental monitoring on UK grower holdings around time periods and locations when PaMS has been know to occur and one grower holding where PaMS does not generally occur. There is an element of risk with this approach whereby no symptoms may occur during the monitoring timeframe. PaMS, however, is sufficiently problematic that the likelihood of no occurrence within the site monitoring network is low. The methodology, described below, is predicated on the assumption that the overall dataset will be a composite of both qualitative and quantitative datasets to provide the depth and breadth of coverage of the factors that could be linked to expression of PaMS symptoms.

Data types

Within-sowing monitoring will provide environmental data (temperature, humidity and light) as time series data. Within each sowing in year one there will be two sets of environmental data time-series; from two locations within the sowing at canopy height. If the analysis of the data shows that temperature and humidity are important, then in year two, the number of locations within the sowing would be increased, and monitoring above the canopy would be included as necessary to provide more detailed information

on the impact of environmental conditions.

If appropriate, in year two we will collect data from the glasshouse control system (ventilation rate, temp and humidity) and outdoor weather stations used on the nurseries. This will be used to attempt to correlate the measured environmental variables within a sowing with the measured glasshouse and outdoor climate. These data are likely to be time-series data, but with differing frequencies of sampling. Operational data will be supplied in terms of operations records, showing times of sowing, number of crops per season, transplantation, fungicide applications, substrate type, watering regime and relocation of pansies and growth stage as they move through production. In addition to this, the spatial location of the monitored trays within the glasshouse will be recorded to allow for the identification of any possible influence of specific locations within the glasshouse on expression of PaMS symptoms. Growing media and irrigation water samples will be collected and will be analysed if potentially linked to causal factors of PaMS.

Data for observations of any observed development of pansy mottle syndrome will form another time series data source. This data will be in the form of percentage incidence within a tray/sowing, and where possible, spatial data indicating the spatial location of plants expressing PaMS symptoms in each tray/sowing.

Data integration and preparation

As set out above, the need to understand the causal conditions of PaMS, requires the collection of a comprehensive set of monitoring and associated data (environmental and operational). This data will be monitored on different timescales, consisting of time series (environmental data), event series (operations) and incidence (binomial) data (PaMS monitoring data).

As there is a potential for there to be a delay between the plant experiencing the causal factors and the expression of PaMS symptoms, a set of environmental time windows (Coakley et al, 1998) will be used, covering a range of delay times and period lengths. Within a time window, environmental data will be accumulated, summarised and averaged to provide additional factors for use in the statistical analyses. Data will be averaged, summarised and accumulated over key periods of interest to created summary variables e.g. by growth stage or location in the greenhouse so that correlations between observations of disease and summary variables over different time periods may be determined.

Data exploration

Critical to investigation of the environmental conditions in the development of pansy mottle syndrome is a process of investigative and iterative exploration of the data. It is proposed to utilise standard statistical techniques for preliminary analysis of the data (Window pane analysis (Coakley et al., 1998), Principle

Component Analysis and ANOVA), and where appropriate (i.e. signifcant correlations are identified) further analysis using more advanced techniques (e.g. Boosted Regression Trees (Elith et al., 2008) will be used. A range of statistical analysis and data handling programs (Genstat, Matlab, Excel) will be utilised in the analyses. The modelling team will work closely with the ADAS statistician to ensure that the relationships identified between the observed data and pansy mottle syndrome are statistically robust.

These techniques will be applied to the data from each of the nurseries, both individually and as an aggregated set of data across all nurseries. Statistically significant correlations between the incidence of PaMS and the environmental and operational data will be identified using the analyses. We will specifically look for consistent responses across all nurseries, where PaMS symptoms occur. It is possible that different causes may occur on different nurseries, and this would be indicated by inconsistency in causal factors across nurseries.

The ideal outcome of the analysis is the identification of a set of causal factors (environmental and/or operational) for PaMS and the time window (within the production process) in which these factors occur.