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# ArMet example customisation

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# 1. Introduction

This document describes an example system that implements a customisation of ArMet to support plant metabolomics experiment personnel involved in growing plants. The system is designed for an example greenhouse containing up to 9 shelves, each of which may hold up to 180 individual plants. The system is designed to:

- Enable description of genotypes, experiments, growth conditions and harvest procedures.
- Randomly locate plants of a set number of genotypes over the shelves in the greenhouse.
- Enable automatic logging of plant harvest in real-time via a laptop computer.

This document aims to provide an example of:

- How ArMet may be customised for use in particular experimental situations.
- How systems that are intuitive to use may be built to support the work of experiment personnel and cut down the amount of retrospective data-entry that often leads to transcription errors.

## 2. The Customisation

In this system, a customisation of ArMet (v3.1) has been used that includes the core data for the following components:

1. Admin
2. Biological Source
3. Growth
4. Collection
5. Sample Handling

The following associations within these components have been constrained:

**Table 1. Customisation of Component Associations**

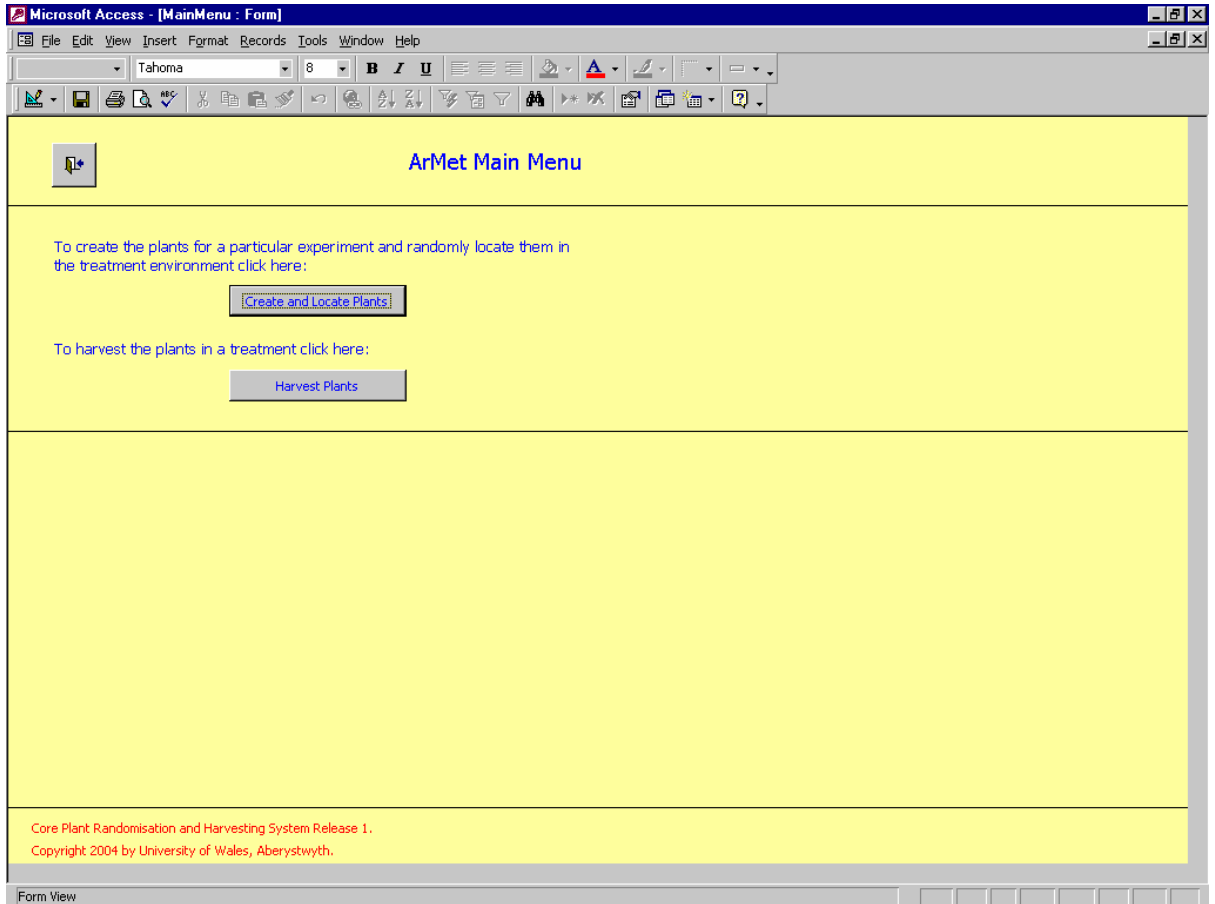
| Association           | Core      | Customisation |
|-----------------------|-----------|---------------|
| Treatment:Environment | 1..*:1..* | 1..1:1..*     |
| Collection:Event      | 1..*:1..* | 1..1:1..*     |

## 3. The System

The system has been written for Microsoft® Access 2000. This document describes release 1 of the example system which is available for download from <http://www.arinet.org/>.

The following sections describe how the system is designed to be used, illustrated with screen dumps.

### 3.1. The Main Menu



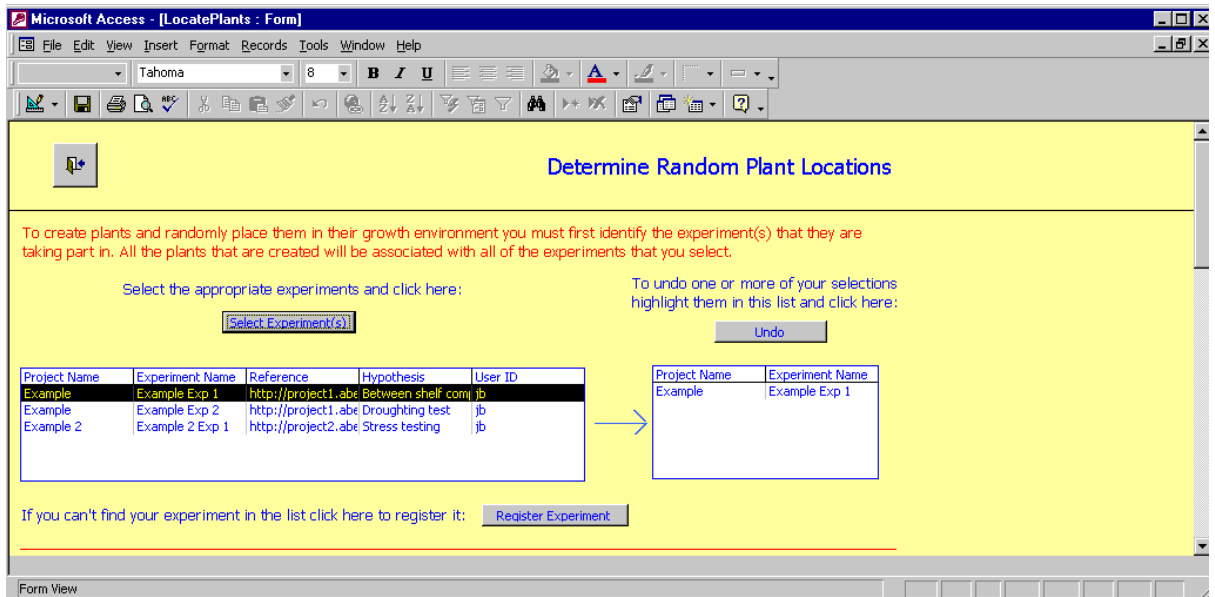
The main menu has two buttons leading to further forms:

1. To create plant identifiers and randomly locate the plants in the growth location.
2. To register the harvest of the plants in real-time.

#### 3.1.1. Determine Random Plant Locations

This form has a number of parts for data-entry.

**Part 1: Identifying the experiment(s) for which the plants are being grown.**



Experiment(s) may be highlighted in the list on the left and then selected with the *Select Experiment(s)* button to move them to the list on the right. They may be removed from the list on the right by highlighting them and selecting the *Undo* button.

If the required experiment does not appear in the list on the left it may be registered (along with User information) using a simple form that is reached by selecting the *Register Experiment* button.

### Part 2: Identifying the genotype(s) to be cultivated.

**Determine Random Plant Locations**

You must next specify how many different genotype(s) will be cultivated and specify which genotype(s) they will be.

Number of genotype(s) to be cultivated:

Select the genotype(s) to be cultivated and click here:

To undo one or more of your selections highlight them in this list and click here:

| Species              | Name   | Reference  | Background |
|----------------------|--------|------------|------------|
| Arabidopsis thaliana | adg1   | NASC N3094 | Col-0      |
| Arabidopsis thaliana | pqm1   | NASC N210  | Col-0      |
| Arabidopsis thaliana | fad2-1 | NASC N8041 | Col-0      |
| Arabidopsis thaliana | act1   | NASC N200  | Col-0      |

If you can't find your genotype in the list click here to define it:

The required number of genotypes should be entered first. This provides a sanity check to ensure that the correct number of genotypes are selected and is used in the calculation of plants per shelf described below. Genotype selection and de-selection follows the same procedure as experiment selection and de-selection as described above. A simple form reached by selecting the *Define Genotype(s)* button facilitates the registration of genotypes that do not appear in the list.

### Part 3: Greenhouse description.

**Determine Random Plant Locations**

Finally, specify the number of shelves in your growth environment and the number of plants to be placed on each shelf. An equal number of plants of each genotype will be placed randomly on each shelf. You must also specify your treatment ID.

Number of shelves:

Number of plants per shelf:

Treatment (growth conditions):  To view more information about the treatments or to create a new one click here:

To create a report of your randomised plants click here:

To output a spreadsheet for the labeller select the treatment in the box above and click here:

To view an existing report select the treatment in the box above and click here:

The configuration of the greenhouse should be entered (up to 9 shelves and up to 180 plants per shelf). The “treatment” (growth conditions and date of sowing) should then be selected from the pull-down list. If the required treatment does not appear in the pull-down list it may be described using a simple form reached by selecting the *Create Treatment* button.

Once all of the above information has been entered the *Locate Plants* button may be selected, thereby causing the following processing to take place:

1. The number of plants per shelf will be divided by the number of required genotypes to calculate the number of plants of each genotype that will be placed on each shelf. If there is a remainder after division an error message is displayed.
2. For each shelf the appropriate number of plant identifiers of each genotype are created and assigned a random position within the shelf.
3. A report is generated of the plant identifiers, their genotypes and their shelf positions (shown below).

The screenshot shows a Microsoft Access window titled 'Microsoft Access - [LocReport]'. The main content is a report titled 'Plant Locations' with a yellow background. The report contains a table with the following data:

| Experiment Name | Shelf | Genotype | Position | Plant ID |
|-----------------|-------|----------|----------|----------|
| Example Exp 1   | 1     | adg1     | 1        | 7        |
|                 |       |          | 5        | 4        |
|                 |       |          | 7        | 5        |
|                 |       |          | 13       | 2        |
|                 |       |          | 14       | 3        |
|                 |       |          | 17       | 1        |
|                 |       |          | 19       | 8        |
|                 |       |          | 21       | 6        |
|                 |       |          | 23       | 9        |
|                 |       |          | Fac2-1   |          |
| 4               | 18    |          |          |          |
| 9               | 15    |          |          |          |
| 10              | 12    |          |          |          |
| 18              | 10    |          |          |          |
| 22              | 14    |          |          |          |
| 24              | 13    |          |          |          |
| 25              | 17    |          |          |          |
| 27              | 16    |          |          |          |
| act1            |       |          |          |          |
|                 |       |          | 6        | 26       |
|                 |       |          | 8        | 20       |
|                 |       |          | 11       | 25       |
|                 |       |          | 12       | 21       |
|                 |       |          | 15       | 24       |
|                 |       |          | 16       | 27       |
|                 |       |          | 20       | 22       |
|                 |       |          | 26       | 19       |
|                 |       |          | 28       | 29       |
| 2               |       | adg1     | 6        | 36       |
|                 |       |          | 8        | 29       |

The randomisation report for a pre-existing treatment may be viewed by selecting the treatment from the pull-down list in part 3 of the form and selecting the *View Existing Report* button.

The information within the reports can also be output as a Microsoft® Excel spreadsheet (shown below) by selecting the *Output Spreadsheet* button. Such a spreadsheet could be used as input to a plant pot labelling system.

|    | A    | B     | C        | D        | E | F | G | H | I | J | K | L | M | N | O |
|----|------|-------|----------|----------|---|---|---|---|---|---|---|---|---|---|---|
| 1  | name | shelf | position | sourceID |   |   |   |   |   |   |   |   |   |   |   |
| 2  | act1 | 1     | 3        | 23       |   |   |   |   |   |   |   |   |   |   |   |
| 3  | act1 | 1     | 6        | 26       |   |   |   |   |   |   |   |   |   |   |   |
| 4  | act1 | 1     | 8        | 20       |   |   |   |   |   |   |   |   |   |   |   |
| 5  | act1 | 1     | 11       | 25       |   |   |   |   |   |   |   |   |   |   |   |
| 6  | act1 | 1     | 12       | 21       |   |   |   |   |   |   |   |   |   |   |   |
| 7  | act1 | 1     | 15       | 24       |   |   |   |   |   |   |   |   |   |   |   |
| 8  | act1 | 1     | 16       | 27       |   |   |   |   |   |   |   |   |   |   |   |
| 9  | act1 | 1     | 20       | 22       |   |   |   |   |   |   |   |   |   |   |   |
| 10 | act1 | 1     | 26       | 19       |   |   |   |   |   |   |   |   |   |   |   |
| 11 | act1 | 2     | 2        | 50       |   |   |   |   |   |   |   |   |   |   |   |
| 12 | act1 | 2     | 3        | 46       |   |   |   |   |   |   |   |   |   |   |   |
| 13 | act1 | 2     | 4        | 47       |   |   |   |   |   |   |   |   |   |   |   |
| 14 | act1 | 2     | 10       | 49       |   |   |   |   |   |   |   |   |   |   |   |
| 15 | act1 | 2     | 11       | 51       |   |   |   |   |   |   |   |   |   |   |   |
| 16 | act1 | 2     | 12       | 53       |   |   |   |   |   |   |   |   |   |   |   |
| 17 | act1 | 2     | 13       | 52       |   |   |   |   |   |   |   |   |   |   |   |
| 18 | act1 | 2     | 20       | 48       |   |   |   |   |   |   |   |   |   |   |   |
| 19 | act1 | 2     | 24       | 54       |   |   |   |   |   |   |   |   |   |   |   |
| 20 | act1 | 3     | 2        | 80       |   |   |   |   |   |   |   |   |   |   |   |
| 21 | act1 | 3     | 9        | 75       |   |   |   |   |   |   |   |   |   |   |   |
| 22 | act1 | 3     | 11       | 74       |   |   |   |   |   |   |   |   |   |   |   |
| 23 | act1 | 3     | 15       | 79       |   |   |   |   |   |   |   |   |   |   |   |
| 24 | act1 | 3     | 17       | 81       |   |   |   |   |   |   |   |   |   |   |   |
| 25 | act1 | 3     | 19       | 78       |   |   |   |   |   |   |   |   |   |   |   |
| 26 | act1 | 3     | 20       | 77       |   |   |   |   |   |   |   |   |   |   |   |
| 27 | act1 | 3     | 24       | 73       |   |   |   |   |   |   |   |   |   |   |   |
| 28 | act1 | 3     | 26       | 76       |   |   |   |   |   |   |   |   |   |   |   |
| 29 | act1 | 4     | 4        | 103      |   |   |   |   |   |   |   |   |   |   |   |
| 30 | act1 | 4     | 5        | 108      |   |   |   |   |   |   |   |   |   |   |   |
| 31 | act1 | 4     | 7        | 105      |   |   |   |   |   |   |   |   |   |   |   |
| 32 | act1 | 4     | 10       | 101      |   |   |   |   |   |   |   |   |   |   |   |
| 33 | act1 | 4     | 11       | 100      |   |   |   |   |   |   |   |   |   |   |   |
| 34 | act1 | 4     | 15       | 104      |   |   |   |   |   |   |   |   |   |   |   |
| 35 | act1 | 4     | 16       | 102      |   |   |   |   |   |   |   |   |   |   |   |
| 36 | act1 | 4     | 19       | 107      |   |   |   |   |   |   |   |   |   |   |   |
| 37 | act1 | 4     | 21       | 106      |   |   |   |   |   |   |   |   |   |   |   |

### 3.1.2. Harvest Shelves

**Harvest Shelves**

To harvest your shelves first select the treatment that is taking place on them and select (or create) the collection that describes the harvest and then select the shelves below to identify the plants involved in that collection.

Select Your Treatment:  To view more information about the treatments in the list click here:

Select Your Collection:  To view more information about the collections in the list or to create a new

| Collection ID | Development Scale     | Development Stage | Date/Time | Protocol Name      |
|---------------|-----------------------|-------------------|-----------|--------------------|
| 1             | Boyes et al., The P 6 |                   | 04/06/04  | Harvest Protocol 1 |
| 2             | Boyes et al., The P 6 |                   | 05/06/04  | Harvest Protocol 1 |

1 2 3 4 5 6 7 8 9

To view a report of the plants harvested in a particular collection enter the collection ID in the box above and click here:

To view a report of the plants involved in a treatment, annotated with their collection IDs enter the treatment ID in the box above and click here:

Form View

To harvest the plants in the greenhouse the treatment that is to be harvested and the collection (harvest details including date) must be selected from the pull-down lists. Once this has been done the button corresponding to the shelf number to be harvested may be selected (see Section 3.1.2.1 below). Once the chosen shelf has been harvested, further shelves to be harvested with the same collection details, i.e. on the same date following the same protocol, may also be selected.

The *Treatment Report* and *Collection Report* buttons generate harvesting reports (shown below) for a complete treatment (describing which plants have been harvested in which collection) or for a particular collection (date) respectively.

The screenshot shows a Microsoft Access window titled 'Microsoft Access - [TreRep : Report]'. The main content area is titled 'Treatment Report' and contains the following information:

**Treatment Details:**

| Treatment ID | Date/Time | Growth Location | Protocol Name     |
|--------------|-----------|-----------------|-------------------|
| 1            | 04/05/04  | IBS UWA GH1     | Growth protocol 1 |

The plants involved in this treatment are as follows:

| Shelf | Name   | Position | Plant ID | Collection ID |
|-------|--------|----------|----------|---------------|
| 1     | act1   | 3        | 23       |               |
| 1     | act1   | 6        | 26       | 1             |
| 1     | act1   | 8        | 20       | 1             |
| 1     | act1   | 11       | 25       | 2             |
| 1     | act1   | 12       | 21       | 1             |
| 1     | act1   | 15       | 24       |               |
| 1     | act1   | 16       | 27       | 1             |
| 1     | act1   | 20       | 22       |               |
| 1     | act1   | 26       | 19       | 1             |
| 1     | adg1   | 1        | 7        |               |
| 1     | adg1   | 5        | 4        | 2             |
| 1     | adg1   | 7        | 5        | 2             |
| 1     | adg1   | 13       | 2        |               |
| 1     | adg1   | 14       | 3        | 1             |
| 1     | adg1   | 17       | 1        |               |
| 1     | adg1   | 19       | 8        |               |
| 1     | adg1   | 21       | 6        | 2             |
| 1     | adg1   | 23       | 9        |               |
| 1     | fad2-1 | 2        | 11       | 1             |
| 1     | fad2-1 | 4        | 18       |               |
| 1     | fad2-1 | 9        | 15       | 1             |
| 1     | fad2-1 | 10       | 12       |               |

The status bar at the bottom indicates 'Page: 1 of 1' and 'Ready'.

Microsoft Access - [CollRep : Report]

File Edit View Tools Window Help

100% Close

### Collection Report

Collection Details:

| Collection ID | Dev Scale                       | Dev Stage | Date/Time | Protocol Name      |
|---------------|---------------------------------|-----------|-----------|--------------------|
| 1             | Boyes et al., The Plant Cell, V | 6         | 04/06/04  | Harvest Protocol 1 |

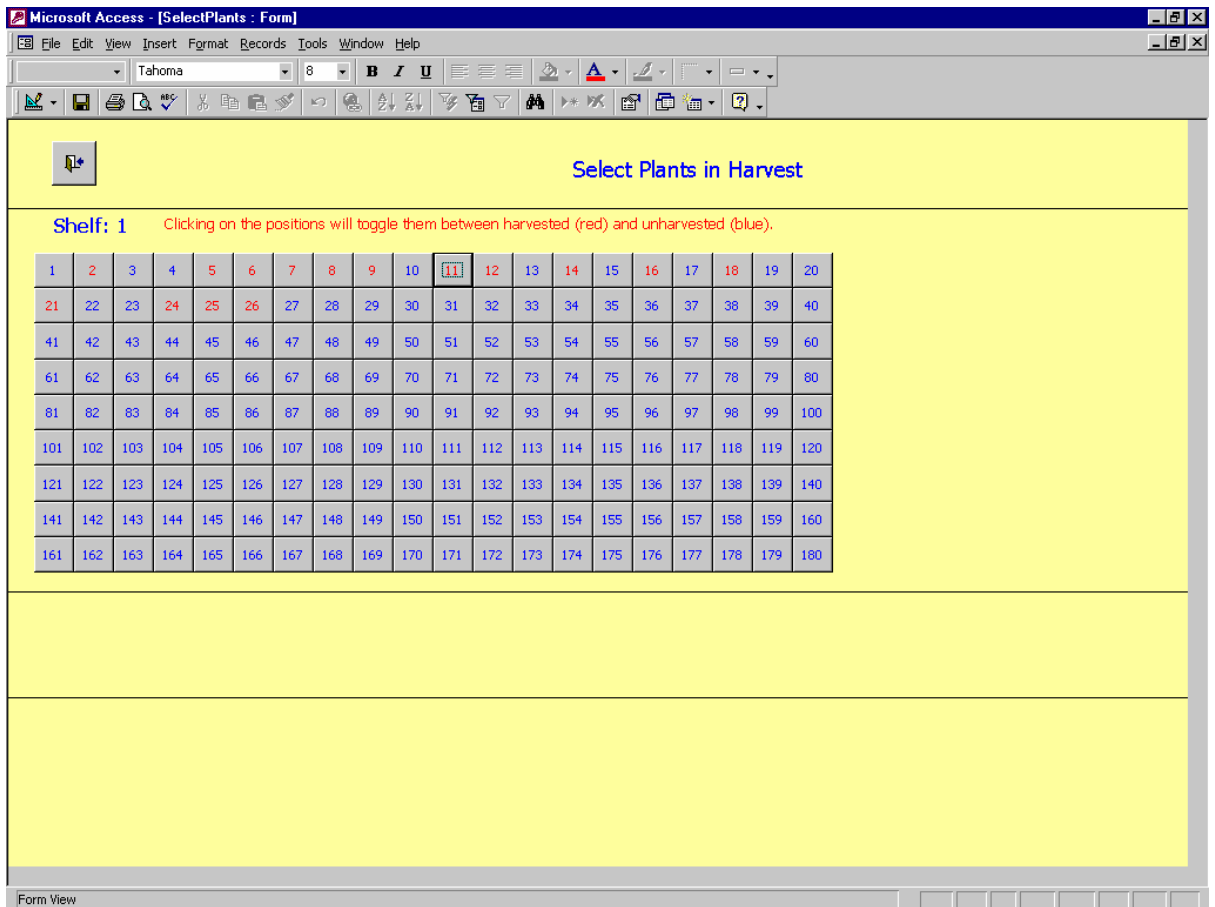
The following plants were harvested in this collection:

| Shelf | Position | Plant ID | Name   |
|-------|----------|----------|--------|
| 1     | 2        | 11       | fad2-1 |
| 1     | 6        | 26       | act1   |
| 1     | 8        | 20       | act1   |
| 1     | 9        | 15       | fad2-1 |
| 1     | 12       | 21       | act1   |
| 1     | 14       | 3        | sdg1   |
| 1     | 16       | 27       | act1   |
| 1     | 18       | 10       | fad2-1 |
| 1     | 24       | 13       | fad2-1 |
| 1     | 26       | 19       | act1   |

Page: 1 of 1

Ready

### 3.1.2.1. Select Plants in Harvest



Selecting a plant position in the grid toggles it between unharvested (blue) and harvested (red). When a blue position is selected the identifier for the plant that is growing in that position is associated with the collection details specified on the Harvest Shelves form. This association is broken if the position is selected again. If a position is selected at which there is no plant growing an error message is displayed.