

## Project SAMBUG

### Stink Bug Identification and Geotag Application for Smartphones for the South African Macadamia Industry

#### Introduction

South Africa is currently the largest producer of macadamia nuts in the world. One of the main production and quality limiting factors is the incidence of stink bug damage. Macadamias are native to Australia, but in the past two decades the industry has grown drastically in South Africa. Consequently, it was expected that new pests and diseases would emerge on this crop in South Africa. This expectation was soon met and the industry suffers at least R50 million annually due to poor quality kernel as a result of stink bug damage.

Based on several research projects funded by SAAGA (The South African Avocado Growers' Association) and SAMAC (The Southern African Macadamia Growers' Association), and the involvement from the chemical industry, several control methods have been implemented. Unfortunately, chemical control still forms the basis of the mostly undeveloped IPM strategy. Accurate timing of chemical sprays, in turn, rely on accurate scout data and economic threshold levels of the insect pests in an orchard. However, scouting for these pests has a major shortfall, namely the accurate identification of pests, despite efforts to train growers and scouts by various means.



Area wide control of pests and diseases is a concept that has been considered, but with the lack of scout data from across and within growing regions it is impossible to make such recommendations. Furthermore, growers that scout faithfully are unlikely to share their results, presumably due to the effort involved.

An innovative approach to this would be to develop a smartphone application, mainly aimed at avocado and macadamia growers and their scouts in Southern Africa, that is able to identify specific hemipteran species (possibly other insects as well) by making use of the built-in camera of the smartphone. This application should ideally be able to make use of the smartphone's built-in GPS to perform geotagging and uploading information to a central database.

## Objectives

The first objective of this study is to enable growers and their scouts to accurately identify pest stink bug species. The second objective will enable a grower to retrieve the scout data for his or her own farm. The third objective would be to enable the Subtrop technical staff to access all the data collected by growers, in order to warn growers of potential high pest population pressures in certain areas for better control.

## Project owner

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## Project Scope

The scope of the project is to design and develop a software application for smartphones or tablets, to enable growers and their scouts to:

- a) Accurately and instantly identify the various species and growth stages of hemipteran pests of macadamia nuts\*. This might need to make use of something similar to facial recognition, to identify species-specific and life stage-specific patterns on the insects.
- b) Allow the input of the amount of insects of a particular species and life stage.
- c) Geotag the information with coordinates, scout data, date- and timestamp.
- d) Record and upload the captured information onto a central database via internet.
- e) Allow growers to access the information for their own farm per block, but not allow access to other growers' data
- f) Enable Subtrop to access all the information from all growers
- g) Subtrop should be kept updated with regards to progress and the use of GIT is recommended.

\* This list will only comprise of the most common and economically important stink bug pests. Currently this is limited to four pest species. A complete list of the insect species and their respective growth / life stages will be provided, along with pictures of each.

## Architectural requirements and Design

In terms of which programming language to use, which smartphone or tablet brand, we do not have any specific requirements, however it might be more convenient for the students as well as the growers to make use of Samsung / Android since this is the most widely used smartphone and tablet in South Africa and is more open to new software development. However, the students will be welcome to make use of any hardware and software platform they are comfortable working with.

- **Hardware** - Subtrop will supply a smartphone or tablet of choice to the successful team for the duration of the project.
- **Operating system compatibility** – The developed app must be compatible with Android version 4 as well as the latest version of Android.

In terms of the functionality, the following will be required:

- **Registering / logging in / signing in** – The operator (grower or grower representative) will need to register and thereafter sign in to his own account. It would be ideal if that person could then stay signed in to that account (or at least sign in automatically when opening the application), even after the application is closed and subsequently reopened. A person would ideally need to actively log out / sign out of the application before it would require to enter a username and password. The username and password does not need to contain a minimum length, capital letters, numbers or special characters. It must be as user friendly as possible, since it would be farmers and their workers operating this application.
- **Input data** – The operator will need to input the following data:
  - Orchard name/ block number
  - Identify the species and life stages of each species that was found. This can be done by:
    - Making use of the smartphone or tablet's built-in camera to take a picture of a specific specimen.
    - An additional option by selecting the correct species and life stage from a list of pictures
  - After identification of a particular species and life stage, the operator must be given the opportunity to select the number of specimens of that particular species and growth stage.
  - [This must then be repeated for all the different species / life stages]
  - Finally the amount of trees that were scouted must be selected or typed in. Typically this would be 10 but often it is less than or more than 10. This is necessary to calculate the threshold value of the number of stink bugs per tree, which is at this stage 0.4. When the threshold is exceeded, a grower could be informed that he/she should spray a particular orchard.
- **Geotagging and uploading of data** – The approximate location (GPS coordinates) of where the data is being captured should be recorded and uploaded to a database, along with the data.

- **Output data** – After using the smartphone or the tablet's built-in camera to identify a particular specimen, the name and life stage of the particular species must be displayed. After completion of the scouting for a particular orchard or block number, the amount of stink bugs per tree must be displayed. Furthermore, the grower must be able to access the farm's historical data online. This data could be stored on Google Sheets, Microsoft Excel or any other format which will be easily accessible. It would be an added benefit if the data could be shown on a map for a particular day/week/month/year to the grower so that the grower would be able to visibly see where the data was being collected. This will make the data easy to interpret visually. Furthermore, this function will enable growers to manage their workers by seeing whether the scout process was done properly by using random trees as is required.

**Intellectual Property:** Subtrop is a non-profit organisation consisting of four growers' associations. Each of the four growers' associations consist of mainly grower members that join the associations voluntarily. Subtrop would therefore in principle support the development of an open source application which could be of benefit to the entire macadamia industry.

**Project Deliverables:** A functional application as described above. All coding should be made available.

**Client Commitments:** A fun field trip (preferably 1 night stay over) to Nelspruit, South Africa's largest production region, could be arranged for the group working on the project. This will depend on whether the students will have time to do so and whether the students would like to do this. This will be an interesting experience where students will be able to see the applicability and value of this App for the world's largest macadamia industry. A demonstration can be arranged of how insect scouting is currently being performed on farms.

Students will be welcome to contact Subtrop (Barry Christie) at any time through the duration of the project for advice, skype meetings etc. Subtrop staff will be willing to meet in Pretoria with the student group for meetings if the students require assistance with functionality etc.