Co-funded by the Erasmus+ Programme of the European Union

DEVELOPMENT OF A TRAINING PROGRAM FOR ENHANCING THE USE OF ICT TOOLS IN THE IMPLEMENTATION OF PRECISION AGRICULTURE

2018-1-ES01-KA202-050709

Training Package 4

Case 3 South Europe: Variable rate application of pesticides in vineyards

Student guidelines

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Date: June 2021

Contents

1 Objective

The aim of Case 3 of Training Package 4 on Information and Communication Technologies (ICT) Devices is to present one of the most important Precision Agriculture (PA) technologies example: Variable Rate Application (VRA) of pesticide in vineyards. Variable Rate Application (VRA) rate for pesticide application in vineyard has been one of the most important improvements in the last years. The process is based in considering canopy characteristics and its intra parcel variability to adjust the optimal amount of PPP (and volume rate).

This activity will present the theory behind variable rate application of pesticide distribution and the expected benefits. It will demonstrate the procedure for creation of variable rate application maps. In the exercises students will work together to create and modify pesticide application maps.

2 Guidelines

2.1 Practical information

- **Main target group**: Agricultural advisers, extension workers, farmers and other agricultural professionals who are interested in VRA and how to benefit from it
- **Expected duration**: 4 hours
- **Student preparations before the course**:
  - Bring a personal computer with internet access.
  - If you want to work on specific fields: bring the maps and main canopy characteristics of the vineyard (height, width and density vine canopy values).
  - If you have equipment for VRA: Find out which data format the equipment requires. Find out how prescription maps files are loaded into the tractor terminal.
- **Homework after the course**:
  - Practice creating other VRA for pesticide distribution maps.
  - Exchange practical experience with other participants: Did the software and the pesticides equipment work as expected? Was variable rate application an advantage? What can be improved next year?
- **Software**: There are various software products available for making VRA pesticide distribution maps and for decision making on pesticide variables. The lecture and the exercise of this course mainly use the products QGIS for

maps management but it can be exchanged for alternative software products that are better adapted to local conditions and language. To determine spray rates in each zone of the field Dosaviña® tool will be used.

2.2 Suggested agenda

1. Welcome and presentation of participants (*10 mins*)
2. Brief presentation of the AgrICT e-training Platform, of the five training packages (TPs) of the platform, and of this case study as part of TP4 (ICT) (*10 mins*)
3. The program of today and alignment of expectations (*10 mins*)
4. Lecture: The theory behind of variable rate application of pesticide and the expected benefits (*60 mins*)
5. Presentation of the procedure for creation of variable rate application maps used in the exercises (*15 mins*)
6. Review of the instructions to the exercise and composition of groups (1-3 persons) for the exercise (*15 mins*)
7. Exercise (*90 mins*)
8. Questions, clarifications and conclusion (*30 mins*)

2.3 Learning goals

- Participants will be able to realize that vineyards presents variability on field that affect the size of the canopy.
- Participants will learn how to use a decision support system to determine the volume application rate of pesticides according crop characteristics
- Participants will understand why adjustment of pesticides to the canopy will reduce spray losses and increase efficiency of the product uses.
- Participants are able to produce variable rate of pesticide maps by following the procedure described.

3 Exercise

3.1 Goal

Determine the product dose rate per each variable zone and sprayer calibration to accomplish the goal. Determine the inputs to prepare to spray one certain parcel.

3.2 Instructions to the exercise

1. Main characteristics of the sprayer and the pest disease to be controlled

Before starting developing variability maps and field characteristics, is relevant to define the sprayer of the farm which will be used and its capacity to read prescription maps and the characteristics of the disease that has to be controlled.

The sprayer used on this farm was the latest model Fede Tecnovid 9.0 Q (Pulverizadores Fede, Cheste, Spain) with 2000 L tank capacity and 20 nozzles. This sprayer is provided with the H3O system which allows to upload the prescription map in order to proceed with a VRA process. The system changes automatically the working pressure depending on the georeferenced position of the sprayer. Figure 1 shows the sprayer used.

Figure 1. Multi row sprayer used for spray application on the farm.

The spray process was arranged with the objective to apply a certain fungicide against Downy mildew (*Plasmopara viticola*), a common disease of vineyard crops. The pesticide dose applied was fixed at 0.2% (200 cc/100 L water). Previous to the adoption of VRA system, the same parcel was sprayed using an average volume rate of 300 L/ha at a constant forward speed of 6.5 km/h.

2. Obtain a variability map with different zones

The enclosed map (see attached document: Contorno_VV_chardonnay.geojson) corresponds to a 6 Ha parcel (Lat: 41.995709, Long: 0.129937 WGS84) from a winery located in the heart of DO Somontano region (Barbastro, Huesca, Spain). This map (Fig. 2) has been processed after the information obtained with an UAV and data have been transformed into NDVI values, defining three categories.

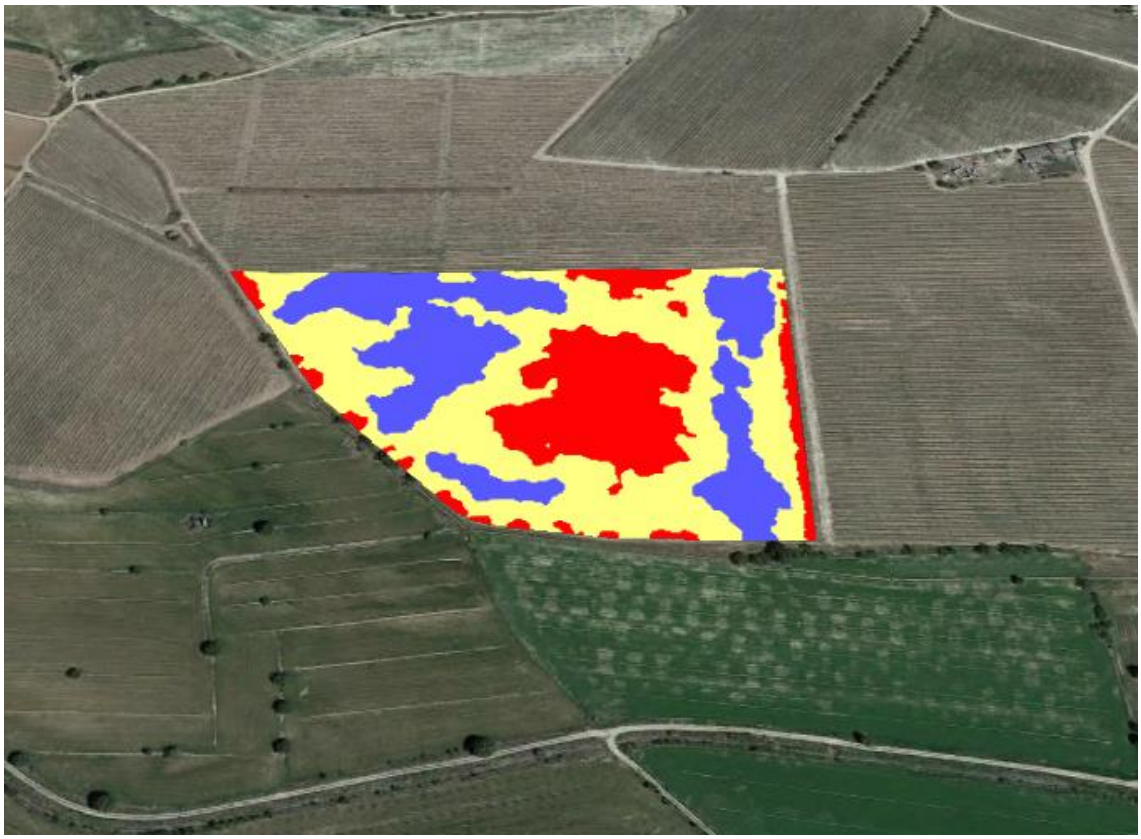

Figure 2. NDVI map of the Chardonnay parcel.

The three different colors in the map represent the three different identified canopy vigor zones, with the following distribution:

- Red zone (25% of the total area) corresponds to low vigor zone
- Yellow zone (50% of the total area) corresponds to medium vigor zone
- Blue zone (25% of the total area) corresponds to high vigor zone.

3. Obtain the canopy characteristics of each zone.

Once the user has the variability information, obtain a representative canopy characterization of all field. For that, in field measurements at every zone have to be carried out following:

- Canopy height (measure from the bottom of the canopy to the top, not the trunk area)
- Canopy width (measure the distance transversal to row direction)
- Density of the canopy (establish a quality measure between four levels: slightly dense, low dense, dense, very dense)

For this example, on table 1, you can find different measurement obtained in field with a row distance for all the zones of 3.0 m.

Table 1. Main characteristics of the canopy

Zone	Canopy height (cm)	Canopy width (cm)	Density
Low vigor (red)	88.5	42.9	Very dense
Medium vigor (yellow)	98.2	45.5	Very dense
High vigor (blue)	112.2	50.7	Very dense

4. Use Dosaviña® tool to determine volume rate for each zone

On your web browser, search the application Dosaviña® (https://dosavina.upc.edu/#). Dosaviña® is a tool for determining the optimal volume rate for pesticide spray application in trellis vines based on the adapted method of Leaf Wall Area (LWA). This APP allows to determine the suitable parameters for a correct spray application (forward speed, working pressure, type and number of nozzles).

Students will follow the next steps to determine the volume rate for each area:

1. Select the button 'Calculation of the optimal volume'.

2. Select 'Trellis system formation'.

3. Introduce values of canopy height and row distance. Canopy width will be determined selecting between 3 options.

Zone	Canopy height (m)	Canopy width (cm)
Low vigor (red)		
Medium vigor (yellow)		
High vigor (blue)		

4. Select the crop density from 4 different options.

Zone	Density
Low vigor (red)	
Medium vigor (yellow)	
High vigor (blue)	

5. Introduce pesticide information. It is possible to introduce a theoretical value of 0.2% or search a commercial product dose rate if you prefer.

6. Select the sprayer type between 4 options.

7. Add tank capacity of the sprayer.

   Steps from 1 to 7 has to be repeated for each area of the field (fill the following table) to obtain the volume rate adjusted to canopy characteristics in each zone.

Zone	Volume rate (L/ha)	Dose rate (L/ha)
Low vigor (red)		
Medium vigor (yellow)		
High vigor (blue)		

8. Determine the sprayer configuration.
   Once the volume rate is determined per each zone, go to "Sprayer adjustment" from the main menu, and determine de calibration parameters.
   You have to consider that the forward speed is 6.5 km/h as defined at the top of this section. The sprayer used in this farms (multi-row sprayer), has the capacity to spray 2 rows at the same time.

Fill the blanks of the following table:

Zone	Forward speed (km/h)	Sprayed rows at same time	Working pressure (bar)	Nozzle flow rate* (L/min)	Nozzle size (ISO)
Low vigor (red)					
Medium vigor (yellow)					
High vigor (blue)					

9. Determine the amount of inputs to prepare for one single field, considering an increase 5% of the total amount of liquid to add on the tank to avoid emptying the tank before finish the field.

Zone	Surface (ha)	Volume rate (L/ha)	Liters used in each zone	Tank concentration (%)	Pesticide to prepare (kg or L)
Low vigor (red)					
Medium vigor (yellow)					
High vigor (blue)					
Total					
Total +5%					

10. The last step is to load the maps with zones on a QGIS software, provide each volume rate to each zone and generate a new maps with this attributes

11. Fill the tanks of the sprayer with 1220 L to spray the field of 6 ha and charge 2.44 kg or L of pesticide product and mix it.

After having completed this procedure, answer these questions:

1. Savings on water compared with the conventional application

	VRA (L)	Conventional (L)	Savings (L)	Savings (%)
Total amount of liquid				

2. Savings on pesticide compared with the conventional application

	VRA (kg or L)	Conventional (kg or L)	Savings (kg or L)	Savings (%)
Total amount of pesticide				