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Data Article

An annotated image dataset of downy mildew symptoms on Merlot grape variety

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ABSTRACT

This article introduces a dataset of high-resolution colour images of grapevines. It contains 99 images acquired in the vineyard from a cruising tractor. Each image includes the full foliage of a grapevine plant. These images display a diverse range of symptoms caused by the grapevine downy mildew (*Plasmopara viticola*), a major fungal disease. The dataset also includes various confounding factors, *i.e.* anomalies that are not related to the disease. These anomalies are the natural and common phenomena affecting vineyards such as results of mechanical wounds, necroses, chemical burns or yellowing and discolorations due to nutritional or hydric deficiencies. Images were acquired in-situ on "Le Domaine de la Grande Ferrade" a public experimental facility of INRAE, in the area of Bordeaux. Acquisitions took place at early fruiting stages (BBCH 75-79) corresponding to the main sanitary pressure during growth. The acquisition device, embedded on a vine tractor, is composed of an industrial colour camera synchronised with powerful flashes. The purpose of this device is to produce a "day for night" effect that mitigates the variation of sunlight. It enables to homogenise images acquired during different weathers and time of the day and to ensure that the foreground (containing foliage) displays appropriate brightness, with minimum shadows while the background is darker. The images of the dataset were an-

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notated manually by photo-interpretation with a careful review of expertise regarding phytopathology and physiological disorders. The annotation process consists in associating pixels with a class that defines its membership to a type of organ and its physiological state. Pixels from healthy, symptomatic or abnormal grapevine tissues were labelled into seven classes: “Limbus”, “Leaf edges”, “Berries”, “Stems”, “Foliar mildew”, “Berries mildew” and “Anomalies”. The annotation is achieved with the GIMP2 software as mask images where the value attributed to each pixel corresponds to one of the seven considered classes.

Specifications Table

Subject	Agricultural engineering
Specific subject area	Grapevine disease detection by proximal imagery and machine learning
Type of data	Raw RGB images and associated annotation images.
How data were acquired	Industrial Basler Ace (acA2500-14gc GigE) 5 Megapixels RGB camera Neewer speedlite 750ii flash
Data format	Raw Analysed Filtered Annotated (*i.e.* groundtruthing)
Parameters for data collection	The dataset is composed of 99 high-resolution RGB images (2592 $\times$ 2048 pixels, around 4px/mm) in JPEG format. Ninety-five (95) of them are accompanied by annotated (*i.e.* labelled) image versions that provide membership classes for a significant number of pixels (PNG format). Among the 95 annotations, 23 are complete annotations while the other 72 cover only mildew symptoms.
Description of data collection	The image dataset was collected in-field, at day-light during varying sunlight. Images represent the trellising plane of plants and were acquired orthogonally from the middle of the row, at 70 cm above ground and at 50 cm from the target. Annotated images were obtained by photo-interpretation with the GIMP2 software. 95 images were randomly selected in order to represent the variability among the plots, in terms of morphology and physiology. In total, more than 5 $\times$ 10^6 pixels are annotated.
Data source location	Le Domaine de la Grande Ferrade, a public experimental facility of INRAE (French National Institute for Agriculture, Food and Environmental Research) in the area of Bordeaux. (44°47′30.9"N 0°34′36.6"W)
Data accessibility	With the article
Related research article	Abdelghafour, F.; Keresztes, B.; Germain, C.; Da Costa, J.-P. In Field Detection of Downy Mildew Symptoms with Proximal Colour Imaging. *Sensors* 2020, *20*, 4380. https://doi.org/10.3390/s20164380

Value of the Data

- This dataset is a collection of annotated and standardised images of grapevines acquired in-situ in vineyards affected by downy mildew and various abiotic stresses. These data are essential for the study of health status, whether it is used to calibrate, validate or compare models. These data were used for to develop an application of real-time and in-situ detection of downy mildew foliar symptoms in [2].

- The proposed dataset can be exploited by research or technical institutes whose activities are related with the monitoring of phytopathology but also with other precision viticulture applications.
- These data can be used to calibrate models / image processing pipelines, compare results on standardised samples or enrich other image databases. In addition, it provides basic guidelines for the acquisition and annotation of images acquired in-situ.

1. Data Description

This dataset contains 99 images of grapevine plants, which are stocked in the main folder. Some of these images have been annotated and these annotations are stored in two folders.

The first one is "Annotation_complete" (23 images), where the annotations concerned healthy and contaminated vine organs (leaf, grape and vine shoot). The second folder is "mildew_annotation" (72 images) where only leaf symptoms have been annotated.

Here are the different classes and their RGB values (0–255):

- 0,0,0: downy mildew foliar symptoms
- 25,25,25: downy mildew symptoms on grapes
- 50,50,50: healthy leaf
- 75,75,75: healthy grape
- 100,100,100: vine shoot
- 125,125,125: leaf border
- 150,150,150: other anomalies (deficiency, necrosis…)

Fig. 1 shows a typical image of the dataset representing a "Merlot Noir" plant at an early fruiting phenological stage (~BBCH 75). The image exhibits various symptoms of downy mildew such as "textbook case" oilspots. Some examples of symptoms are detailed in Fig. 1.b.

Fig. 2 shows the annotations corresponding to the image of Fig. 1. Annotations are sampled to be representative of the spatial variability within the plant and according to the density of information present in each part of the image. In this manner, models calibrated or results validated on these samples are quite representative for the whole image.

2. Experimental Design, Materials and Methods

Images were acquired at Le Domaine de la Grande Ferrade, a public experimental facility of INRAE (French National Institute of Agriculture, Food and Environmental Research) in the area of Bordeaux. Images were taken on two 0.3 ha plots planted with the red wine grape variety "Merlot Noir". One of the plots is cultivated with integrated crop protection and the other according to organic standards. For both plots, phytosanitary inputs are reduced to 50% of the conventional prescribed dose. The plants were affected only by downy mildew and abiotic stresses. At the end of July 2018, the plots were extensively photographed weekly with examples of healthy vinestocks and examples of vinestocks with early and late symptoms corresponding to phenological stages between BBCH (Biologische Bundesanstalt, Bundessortenamt und CHemische Industrie [1]) 75 (berries pea-sized, bunches hang) and 79 (majority of berries touching).

The imaging system is composed of a 5 Mpx industrial Basler Ace (acA2500-14gc GigE,Basler AG, Ahrensburg, Germany) global shutter RGB camera with a 55° horizontal field of view lens. To overcome the weather- and time-dependent variations of illuminations in outdoor environments, the imaging system includes a high-power 58GN xenon flash (Neewer speedlite 750ii, Shenzhen Neewer Technology Co., Guangdong, China) used with a short exposure time (250–300 μs). All the components are powered by a 12 V battery. The device is equipped with an on-board industrial computer that simultaneously controls the shooting of the camera and the trigger of the flash, and stores the acquired image data. The computer is built around a low

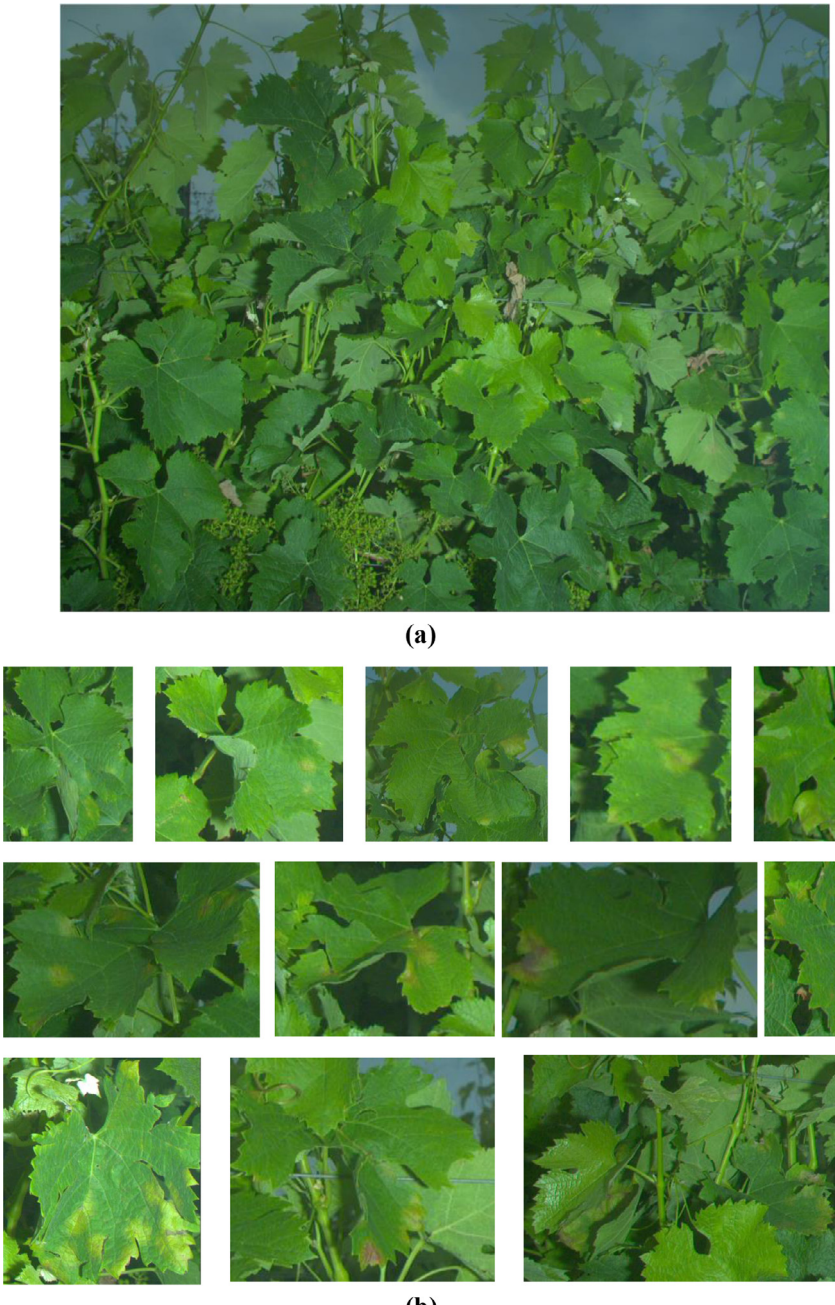

Fig. 1. Example of a typical image from the dataset. (a) Presents the whole foliage and the fruiting zone of a "Merlot Noir" vine affected by early symptoms downy mildew just after fruit-set (around BBCH 75). It corresponds to image "im_206.jpg" in the database. (b) Exhibits details of various "oilspots" like early and advanced foliar symptoms.

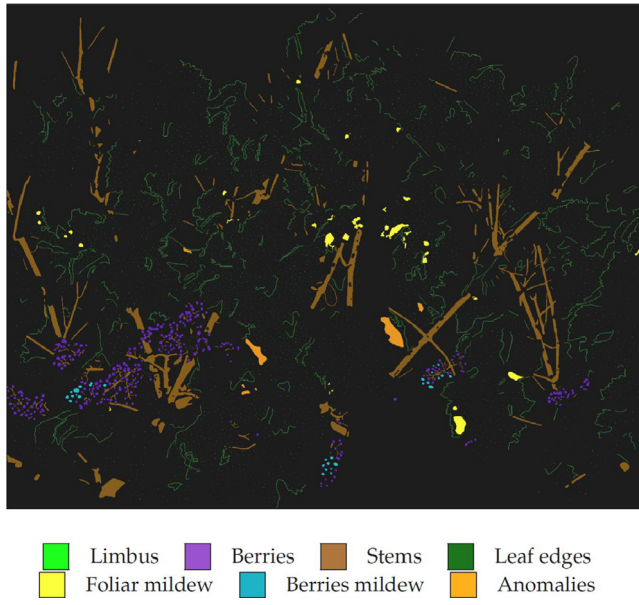

Fig. 2. Example of annotation image. Samples are annotated with a colour code corresponding to their class according to photo-interpretation.

consumption 4-core ARM chip robust to vibrations and watertight. The device is embedded on a vineyard tractor at 70 cm above ground and at 50 cm from the target. At this distance, each image (2592 $\times$ 2048 px) covers a 1.3 m^2 area which enables to approximately capture a vinestock and its full canopy at a resolution of 4 $px{\cdot}mm^{-1}$.

CRediT Author Statement

Florent Abdelghafour: Conceptualization, Software, Writing - original draft preparation; **Barna Keresztes:** Data curation, Software; **Aymeric Deshayes:** Data curation, Software, Writing-Original draft preparation; **Christian Germain:** Supervision, Validation; **Jean-Pierre Da Costa:** Conceptualization, Supervision, Validation, Writing - original draft preparation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships, which have or could be perceived to have influenced the work reported in this article.

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Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2021.107250.

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