



## Original papers

# A non-destructive method based on digital image processing for calculate the vigor and the vegetative expression of vines



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## ABSTRACT

The vigor and the vegetative expression of vines are parameters of great interest in viticulture since they are indicative of the entire guidance system state. Traditionally these parameters are estimated and obtained using a destructive method by cutting the sticks, weighing them and finally obtain the medium weight of pruning sticks. This paper presents a non-destructive method that successfully determines the vine vigor based on a digital image processing. The method consists of acquiring a digital image of vines and applying a software to those images to determine vigor and vegetative expression. This application can be divided in two independent phases: the first one consists in a digital image processing, that isolate the vine sticks and determines the mean area per stick of the vine; the second one determines the vine vigor and vegetative expression based on a polynomial relationship between mean area and mean weight of stick. The software application was tested on thirty vines (*Vitis vinifera* cv. Touriga Nacional) characterized by low, medium and high vigor and selected during a three-year study. Since the mean weight of stick obtained using the mathematical expression and the values calculated using the real sticks present a 0.998 correlation, we can conclude that this new methodology successfully determines the vigor and the vegetative expression of vines. With this new methodology it is unnecessary determinate the pruning mass and the number of sticks per plant in the vineyard. It's a simple use application that determines vigor and vegetative expression, based on a digital image of the vine and independent of the pruning date. This new method has a patent register in Portugal, with the reference number 105163.

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## 1. Introduction

The quality of a vine is manifested by the annual production of new sticks, bunches of grapes and reserve substances (such as saccharine and starch). This production is directly related to the charge left at pruning, i.e., the number of buds that was left in the vine when performed the operation of winter pruning (Branas, 1974; Fregoni, 1999; Magalhães, 2008).

Regardless of their guidance system, the charge left at pruning in a vine is directly related with its vegetative expression and vigor.

The vegetative expression is the total biomass produced by a vine and in practice is determined by the weight of the pruning

wood of the vine, expressed in kilograms (Champagnol, 1984; Galet, 1983; Magalhães, 2008).

The vigor is related to the growth dynamics of the vine and is characterized by sticks with large diameters and lengths, with long internodes and with emission of secondary releases. In practice the vigor is defined as the average weight of a pruning stick, that is, the value of vegetative expression divided by the number of sticks expressed in grams (Champagnol, 1984; Galet, 1983; Magalhães, 2008).

The vigor determination is of extreme importance in technical and scientific works because it is one of the most important indicators for the assessment of vegetative balance/production of a vine.

Only with a balanced vigor and a good level of carbohydrates in the vine, it is possible to have a good differentiation of inflorescences and a good lignifications process of young sticks (Hidalgo, 1999).

When the vigor is too high particularly due to the great fertility of the soil or to a very severe pruning, the resulting increased

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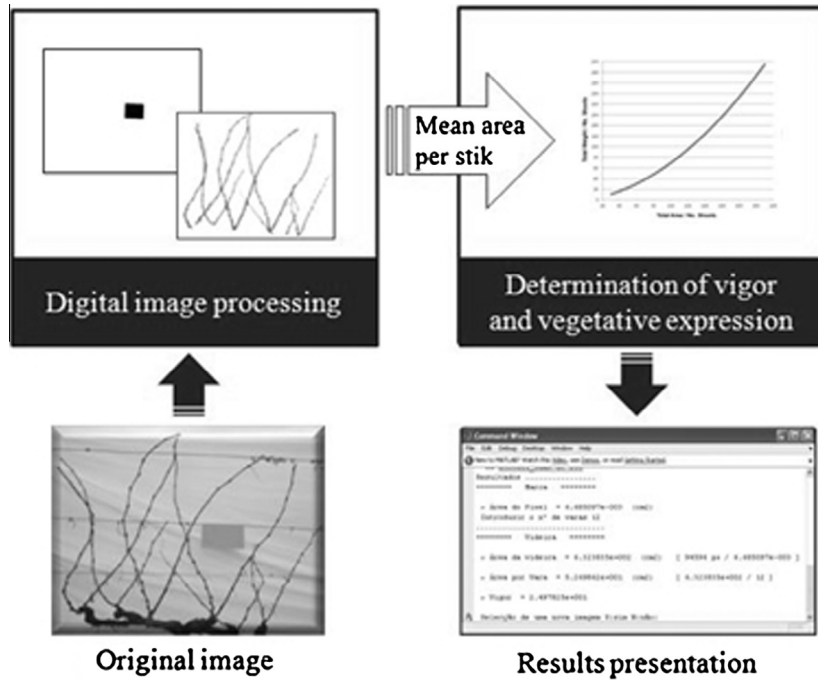


Fig. 1. Vigor and vegetative expression determination process.

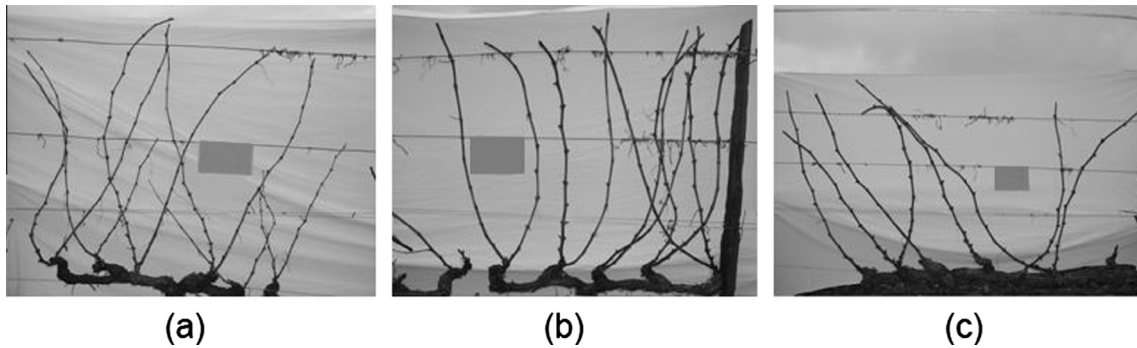


Fig. 2. Vine digital images: (a) low vigor, (b) medium vigor, (c) high vigor.

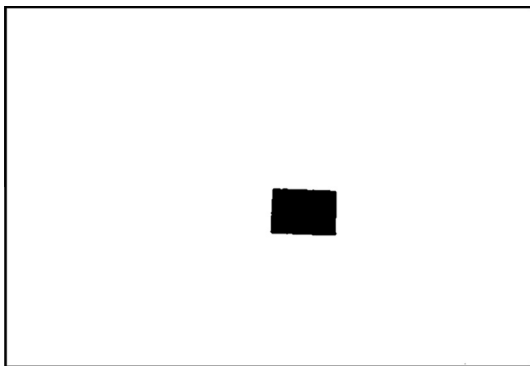


Fig. 3. Segmented reference mark.

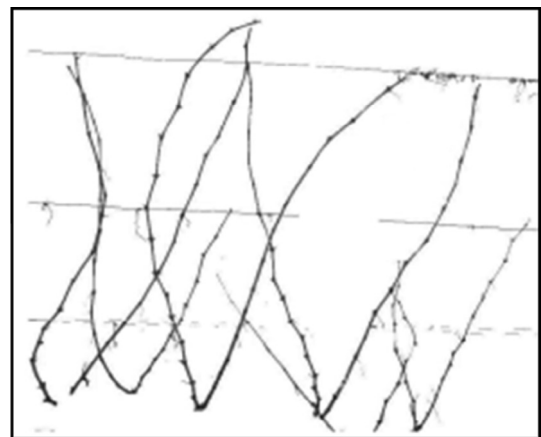


Fig. 4. Vine binary image.

density of vegetation creates microclimate conditions (low temperature and low light intensity) unfavorable to the reproductive cycle. Moreover, in the redistribution of carbohydrates by the various vine functions, the bunches maturation is affected since the young leaves consume large quantities of carbohydrates on their metabolism and growth. Consequently, fertility of the buds and

its consequent potential productivity in the next vegetative cycle can be affected (Winkler et al., 1974; Fregoni, 1999; Magalhães, 2008).

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