Robot visiting tulips: detection of the tulip breaking virus (TBV) using machine vision

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The tulip breaking virus (TBV) causes severe economic losses in the Netherlands. The estimated losses amount up to 9 million yearly. Infected plants have to be removed from the field as soon as possible to prevent further spread of this potyvirus by aphids. There is an urgent need for a rapid and objective method of screening as the human expert eyes is becoming very scarce. For several years now a vision system, using multispectral and color camera's, artificial light and advanced software have been tested, adapted and optimized. Pattern recognition techniques were developed to quantify the typical color pattern caused by the virus.

In this study, optical sensing techniques for detection of TBV in tulip plants were tested and compared with the visual assessment by crop experts as well as with an ELISA (enzyme immunoassay) analysis of the same plants [1]. In November of 2010 flower bulbs of cultivar Yokohama with 0 and 10 % TBV were planted at low density (4 bulbs/m^2). The plants were examined after the first two leafs with putative virus symptoms in March 2011 occurred. Special camera's mounted on a wheeled platform with computer and artificial light were used.
The camera system scored 83% of the diseased tulips in contrast to the experienced eyes of growers looking for virus symptoms ("ziekzoekers") which scored 100%; when evaluating the healthy tulips the "ziekzoekers" did not score healthy plants as diseased in contrast to the camera system, which scored 9% of the healthy plants as diseased.
The experimental results are promising and have led to further research to develop an autonomous robot for the detection and removal of diseased tulip plants in the open field. The application of this robot system will reduce the amount of insecticides in tulips and the considerable pressure on labor for selecting diseased plants by the crop expert.

1. Polder, G. et al., 2010. Detection of the tulip breaking virus (TBV) in tulips using optical sensors. *Precision Agriculture*, 11(4), pp.397–412.

2. http://youtu.be/BEiH3J1CbWA