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Image Analysis to Estimate Mulch Residual on Soil

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Organic farmers are currently allowed to use conventional polyethylene mulch, provided it is removed from the field at the end of the growing or harvest season. To some, such use represents a contradiction between the resource conservation goals of sustainable, organic agriculture and the waste generated from the use of polyethylene mulch. One possible solution is to use biodegradable plastic or paper as mulch, which could present an alternative to polyethylene in reducing non-recyclable waste and decreasing the environmental pollution associated with it. Determination of mulch residues on the ground is one of the basic requisites to estimate the potential of each material to degrade.

Determination the extent of mulch residue on the field is an exhausting job while there is not a distinct and accurate criterion for its measurement. There are several indices for estimation the residue covers while most of them are not only laborious and time consuming but also impressed by human errors. Human vision system is fast and accurate enough in this case but the problem is that the magnitude must be stated numerically to be reported and to be used for comparison between several mulches or mulches in different times. Interpretation of the extent perceived by vision system to numerals is possible by simulation of human vision system. Machine vision comprising image processing system can afford these jobs. This study aimed to evaluate the residue of mulch materials over a crop campaign in a processing tomato (Solanum lycopersicon L.) crop in Central Spain through image analysis.

The mulch materials used were standard black polyethylene (PE), two biodegradable plastic mulches (BD1 and BD2), and one paper (PP1) were compared. Meanwhile the initial appearance of most of the mulches was sort of black PE, at the end of the experiment the materials appeared somewhat discoloured, soil and/or crop residue was impregnated being very difficult to completely remove them. A digital camera (Canon PowerShot A80 - 35 mm) was used to acquire colour digital images (JPG format) under similar lighting conditions at experimental field “El Chaparrilo” (Ciudad Real). A total of 24 photographs, 6 per mulch, were taken according to a randomized block design. Images were captured accurately covering a 1×0.5 meter frame which yielded cropped images to be 1200*1200 pixels. Image Processing Toolbox version 6.0 for MATLAB version 7.1 was used.

HSV (Hue, Saturation and Value) has a good capability of representing the colours of human perception, for this reason it was chosen to analyze the image. Segmentation process was based on the histogram values of the Saturation plane as it showed a good contrast between soil and mulch. Different thresholding methods were applied to this histogram function: Otsu, Ridler-Calavard local entropy and visual threshold. Then the percentage of pixels that were black and white (i.e. mulch or soil) was used to calculate the mulch coverage factor (C-Factor).

The C-Factor comparison of thresholding methods as well as the different mulch materials is shown.