Non-destructive assessment of basic parts of the plant grown in hydroponic medium using image processing algorithms

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Abstract

In the proposed work, laser biospeckle technique has been used for visual inspection as well as quantitative evaluation of basics parts of the plant grown in hydroponic medium for the first time. Co-Occurrence matrix, Inertia Moment, Absolute Value Difference and Parameterized Global Average Fujii algorithms have been used for biospeckle activity analysis. It is concluded that biospeckle activity obtained using the algorithms can be used for visual inspection as well as quantitative evaluation successfully. In addition, it is also concluded that biospeckle activity has been found highest in the roots and more in leaf in comparison to stem and seed.

Keywords: *hydroponic medium, laser biospeckle technique, image processing algorithms, biospeckle activity*

1. Introduction

Laser biospeckle technique is a non-destructive, non-invasive and easy technique which is used to obtain the biospeckle activity (BA) [1]. In the present paper, biospeckle technique and its ability have been used to detect changes of BA across basic parts such as root, leaf, stem and seed of the turmeric plants grown in hydroponic medium.

2. Experimental

2.1 Theory

Four image processing algorithms namely existing Co-Occurrence matrix(COM), Inertia Moment (IM), Absolute Value Difference (AVD) [2] and our earlier proposed algorithm Parameterized Global Average Fujii(PGAF) [3] have been used for the BA analysis.

2.2 Materials and methods

Turmeric plants were grown in hydroponic medium from seedling process. For seedling process, mixture of perlite, coconut coir and compost mixed with water has been taken. Some wood ash has also been added. Seed of turmeric has been sowed into the container containing the mixture. The plant was grown after 18 days.

2.3 Experimental setup

The schematic diagram of experimental set up is shown in figure 1. A He-Ne laser of 10mW and 632.8nm wavelength has been used to illuminate the sample. Spatially filtered and expanded laser beam was used to cover the sample. Sequences of 128 images with 512 X 512 pixels were captured by a CCD camera at every 80 ms and 8 bit digitized images were stored in the computer.

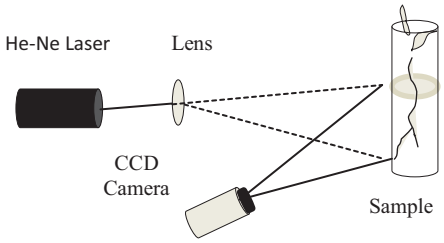

FIG 1. Experimental setup

3. Results and Discussion

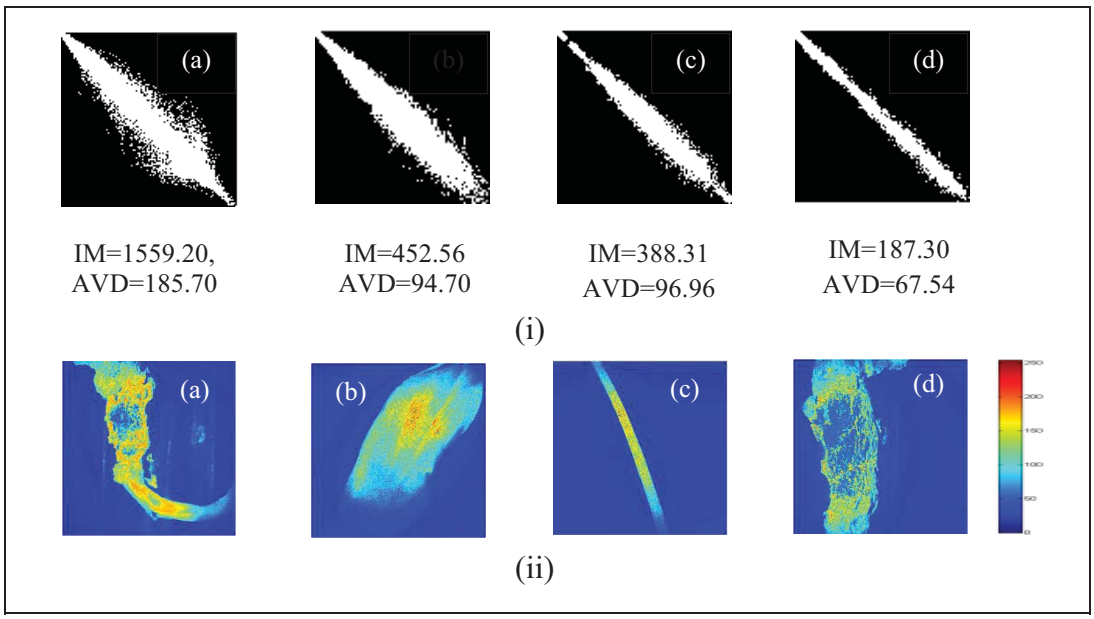

FIG 2. COM images and corresponding IM and AVD value (i); spectral maps obtained from PGAF at 0.5 for (a) root, (b) leaf, (c) stem and (d) seed of turmeric plant (ii).

Fig. 2 shows the COM images, IM and AVD value (i), and spectral maps with colour bar obtained using PGAF (ii) for (a) root, (b) leaf, (c) stem and (d) seed of turmeric plant. In COM images, the more spread shows high activity and less vice versa. IM and AVD show the mean BA. In colour bar, red colour shows highest activity level and blue colour shows lowest level of activity. From both the results (i) and (ii) it is clear that BA has been found highest for root and least for seed

4. Conclusion

- Good agreement can be seen between qualitative result obtained from COM, PGAF and quantitative results obtained from IM and AVD.
- BA has been found highest in the roots. In addition, BA has been found least in seed and more in leaf in comparison to stem.

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