Estimation of the porosity of wind breaks by using GIS-based ortho-image analysis

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The optimal design of windbreaks is very important to reduce wind erosion on farmlands and to combat soil degradation. Main parameters that must be considered when designing windbreaks are: height, width, orientation, porosity (density), distance between barrier rows, and length. There are two types of windbreaks, living (natural) and non-living (artificial). For tree shelterbelts (living windbreak) some of these parameters are related to inherent characteristics of the plants. For example, the height of a windbreak depends on the type of the plant, its growing conditions and the age of the plant. Porosity of windbreaks is considered to be one of the most important factors that controls wind erosion. It is expressed as the ratio between pore space and the space occupied by tree stems, branches, twigs and leaves. For the assessment of porosity it is necessary to convert the three-dimensional plant structure to a two-dimensional model of its shape or plant silhouette, because a direct measurement in the field is very inefficient, time consuming, and therefore impractical. To solve this issue, different approaches have been introduced to estimate the porosity of wind breaks, e.g. optical or aerodynamic porosity.

In this study, the porosity of wind break networks was assessed for agricultural land in north Jutland, Denmark. The objective of this study was to develop a GIS-based Ortho-Image Analysis (OIA) method to estimate the porosity of windbreaks. The images of the windbreaks have three visible (RGB) bands and were taken in autumn 2012. The pixel size of 0.5 m is sufficient to visually distinguish the tree rows from their surrounding background. The identification of trees was done using grayscale images, where the dark trees strongly contrast to the bright sky in the background. The preliminary results indicate that the GIS based Ortho-Image analysis can be used as a quick, accurate, and reliable method to estimate the porosity of wind break networks. It can therefore be used as an alternative to visual estimations of windbreak porosity in the field. Problems with detecting the porosity occur, when tree rows are too narrow or there is an overlap with other objects in the background.