THE EFFECT OF DIFFUSE LIGHT ON CROPS

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Abstract

In Dutch glass greenhouses light is not distributed equally in the greenhouse. Fruit vege¬tables like cucumbers with a high leaf area index intercept a high quantity of light with the upper leaves, the lower leaves receive much less light and hardly contribute to photosynthesis and therefore to growth and production. If we it is possible to shift light from the upper crop layer to the lower crop layer the photosynthetic efficiency of the whole plant will be increased. This can be realised by making all incoming light into the greenhouse diffuse. From earlier investigations in ecosystems it is known that diffuse light is able to penetrate deeper into a plant canopy in comparison to direct light. In young plants and plants with a low plant canopy like pot plants also the horizontal light distribution is not optimal. Cast shadows from the greenhouse construction have a negative influence on the plant production. To get a uniform production the light distribution has to be uniform over the whole canopy. This can also be achieved by diffuse light. Wageningen UR Greenhouse Horticulture studies the effect of diffuse light on crops since several years. Model and experimental studies showed that crops as well fruit vegetables with a high plant canopy as ornamentals with a small plant canopy can use diffuse light better than direct light. The light distribution within the crop changes as well as the photosynthetic response does. The yield of cucumbers is increased, the growth of several pot plants is accelerated. The effects of diffuse light on photosynthesis, morphology, crop temperatures and greenhouse climate will be explained. Several parameters were investigated such as leaf orientation, leaf area, LAI, dry matters of different plant organs, RuBisCo content, light-response curves, SPAD values with modern techniques and sensors such as 2D and 3D vision technique, modern light sensors and a mobile photosynthetic meter. The result of these investigations is a quantitative foundation for the potentials of diffuse light in Dutch horticultural greenhouses and the selection of technological methods to make sunlight diffuse including a practical verification. Moreover, the suitability of several greenhouse covering materials and their optical properties (PAR transmission τdirect and τdiffuse, haze) is investigated in the laboratories as well as in practice.