Measurement of Total Light Energy in a Carnation Bench

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The distribution of light in a carnation bench determines how much food will be manufactured by the leaves. Available light not only depends on the amount of light on the outside of the bench, but also on plant density, bench width, plant height and bench arrangement. By using a simple technique, we found in a raised carnation bed with plants about 50" tall, total energy at 36" above the soil, and 5" in from the outside was only 31% of that outside. At 20" above the soil, the same distance in, the amount was reduced to 8% of that outside. The results were the same regardless of the side of an east-west oriented bench, In the center, at soil level and at 20" height, the total energy received in one day was less than 4% of that outside. Density was 3 plants per sq. ft. It suggests that once the soil surface is covered, total energy rapidly drops to negligible levels. Perhaps, while additional plants in the middle of a bench may provide higher yields for the first and possibly second crops, the advantage rapidly disappears.

Method

An expensive light totalizer can be made from petri plates and blueprint paper. If several layers of blueprint paper are exposed, the degree of development can be equated to the total amount of sunlight. The technique has been described by Friend (1). For our purposes, small booklets, containing 10 layers of blueprint paper were stapled together. The top and bottom were covered by black construction paper, with the upper piece pierced by a 1 sq. in. hole to expose the blueprint. The booklets were placed in petri plates, located at various positions in a carnation bench, and left for a 24 hour period.

Plates were located 48" (120 cm) above the soil surface, 36" (90 cm), 20" (50 cm), and at the soil surface in the center of the bench. Another 2 sets were placed at the same heights, 5" (12 cm) in from the outside edges, on either side of the bench. The carnations were in their second year, planted in a raised greenhouse bench, oriented east-west, with no significant shading from adjacent benches. The greenhouse had a glass roof.

The system was calibrated in the same greenhouse with an Eppley pyranometer. A graph was made, correlating the number of papers exposed with the solar energy as measured with the Eppley. The system was not completely satisfactory as the calibration curve was not linear, with some difficulty in accurately reading exposure of papers two to three layers below the top sheet.

Results

At 48", there was no difference across the top of the crop, with a total incoming radiation level of 291.5 calories per square centimeter (cal cm^{-2}) (Fig. 1). However, the total dropped rapidly the further into the canopy. At 36" above the soil surface, or less than a third of the total distance below the top, the total light had dropped to 91.8 cal cm^{-2}, or 31% of the total outside radiation, 5" in from either north or south outside edge. At 20", and 5" in from the outsides, the total radiation was 24 cal cm^{-2} and only 2.7 cal cm^{-2} in the center of the bench. At zero height, the center of the bench received about 1 calorie, or less than 1% of the total (Fig. 1).

The results emphasize that in a glass greenhouse, very little energy reaches the interior of a dense carnation planting. Is it possible that an advantage of fiberglass is better light penetration? What does this mean in respect to double poly? Would it be to our advantage to deliberately remove breaks when cutting on the inside of a bench? Would the better light actually increase productivity? These, and other questions, might lead us to some new ideas on how to handle carnations for better yield.

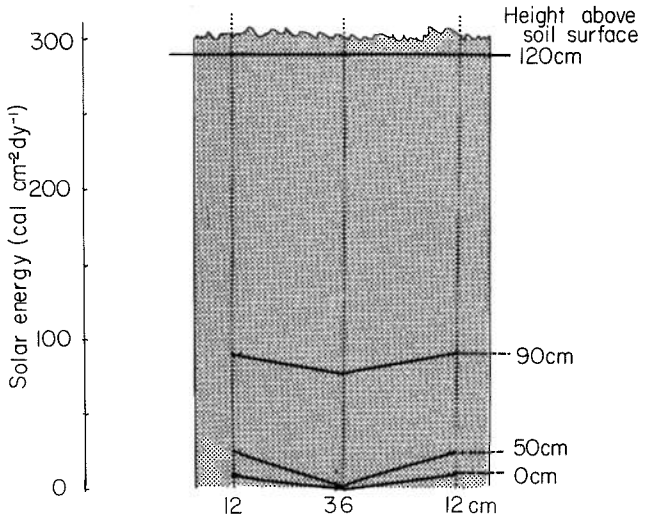

Fig. 1: Distribution of total solar radiation in a carnation bench oriented east-west in a glass covered greenhouse. Total energy values obtained by exposing blueprint paper in the locations shown for a 24 hr period.

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