LIGHT TRANSMISSION AND PHOTOSYNTHESIS IN GREENHOUSES

T. Kozai, J. Goudriaan and M. Kimura. 1978. *Simulation Monograph,* Wageningen, The Netherlands.

The authors present computer programs for simulating radiation transfer in greenhouses, and a similar program for photosynthesis by green plants. The publication is typical of the advanced work carried out by Dutch investigators. In this monograph, the authors discuss the relevant literature and compare radiation transfer for typical houses in Holland and in Japan, citing several Japanese references on the subject. It should be kept in mind that Holland's latitude is 52° North, whereas Tokyo is at 34° North, and Denver is located near 42° North.

The authors summarized the results of their study:

"For efficient use of greenhouses during the winter, it is necessary to obtain maximum transmissivity and uniformity of solar light.

"The daily average of direct solar light transmissivity in an E-W house is, in general, higher than that in a N-S house. The phenomenon is more pronounced:

"-when the ratio of the height of side walls to the width of the span is greater than about 0.5. The transmissivity of an E-W house decreases with the number of spans, whereas that of a N-S house is almost independent of the number of spans.

"-when the ratio of length of the house to the width of the span is greater than about 5. The transmissivity of a N-S house decreases with the increase of the ratio, whereas the transmissivity of an E-W house is less dependent upon the ratio.

"-at higher latitudes."

The cross sectional distribution of daily integrated direct light on the floor in a E-W house is less uniform than in a N-S multispan house. However, for a E-W single-span house, or for the southerly spans of an E-W multispan house, the cross sectional distribution on the floor is as uniform as in a N-S house.

The longitudinal gradient of the daily integrated direct light on the floor is considerable in a N-S house with a relatively high pitch, especially at higher latitudes. Diffusive covering materials increase the uniformity of the light on the floor.

"As stated above, there is much variation in the average transmissivity of direct light with latitude, although it is not shown. The transmissivity of a single span greenhouse is more sensitive to orientation than that of a multispan house, especially at higher latitudes. These effects, of course, are confined to sunny periods. The more direct light, the greater the effects."

This study did not cover the effects of diffusive covering materials or effect of condensation on the cover, corrugated materials, or materials with unusual optical characteristics. Nor was the loss of light due to weathering considered.

Advantages and disadvantages of N-S and E-W houses.

Number of spans	Length width	Orientation	Uniformity	Transmissivity	Notation for greenhouses below
1	20	E-W	Good	Very high	A
3	20	E-W	Bad	Very high	B
5	20	E-W	Worse	High	C
20	5	E-W	Worse	High	D
1	20	N-S	Good	Low	A′
3	20	N-S	Good	Low	B′
20	5	N-S	Good	Medium	C′
5	20	N-S	Good	Low	D′