## Evapo-transpiration from Different Crops exposed to the Same Weather

PENMAN[1] has concluded from a physical analysis of the process of evaporation that the rate of evapo-transpiration is the same for different crops exposed to the same weather provided that each crop covers the ground completely and is approximately of the same colour. Rider[2], however, has concluded from microclimatic measurements made above extensive areas of different crops that these can so modify the effective weather that large differences in the water loss from different crops can occur.

Table 1. ENERGY BALANCE, WELLESBOURNE (JUNE 6–OCTOBER 1, 1957)
Energy expressed as in. of water (1 in. = 1,500 gm.cal.)

| Measurement | Method | Grass | | Carrots | | Open water surface |
|---|---|---|---|---|---|---|
| | | Daily irrigation | Rain only | Daily irrigation | Rain only | |
| Short-wave sun and sky radiation | Measured by Kipp solarimeter | 18·54 | 18·54 | 18·54 | 18·54 | 18·54 |
| Heat storage change | Calculated from temperature and moisture measurements | 0·16 | 0·18 | 0·14 | 0·16 | 0·24 |
| Long-wave radiation | Calculated from temperature, humidity and hours of sun | 5·34 | 5·34 | 5·34 | 5·34 | 5·34 |
| Albedo | Calculated from measurements of visible albedo with infra-red albedo taken as 45 per cent | 5·56 | 5·56 | 4·64 | 4·64 | 1·11 |
| Growth | Calculated from measurements of dry weight and energy equivalent | 0·10 | 0·07 | 0·38 | 0·17 | 0·00 |
| Evapo-transpiration | Measured (see text) | 9·04 | 5·89 | 12·88 | 7·65 | 8·82 |
| Heat transfer: from air to crop | Calculated by subtraction | 1·34 | — | 4·56 | — | — |
| ,, from crop to air | | — | 1·86 | — | 0·90 | 3·51 |

The evapo-transpiration from grass and carrots was measured at the crop weather station, Wellesbourne[3], continuously from mid-June until early October 1957 in the centre of plots 600 square yards in area. There were two soil-moisture treatments; in one the plants were irrigated each day to restore the soil to field capacity and in the other the plots received only rainfall. Each measurement was based on the mean of the readings from three similar lysimeters. The lysimeters used to measure evapo-transpiration in the plots supplied by rainfall only consisted of weighable monolith soil cores, whereas for the plots irrigated daily, drainage lysimeters[4] were used. The twelve lysimeters were buried to their rims and completely surrounded by plants which received the same soil-moisture treatment and were similar in size to those growing in the lysimeters. The instruments were tested before and after use and found to be water-tight.

Fig. 1 shows the measured cumulative evapo-transpiration from the grass and carrot crops plotted against the measured cumulative evaporation from a standard evaporation tank. The relation was linear in each case. The use of the evaporation tank readings as an index of the evaporative conditions is supported by the close agreement between the measured evaporation and that estimated by Penman's method[1].

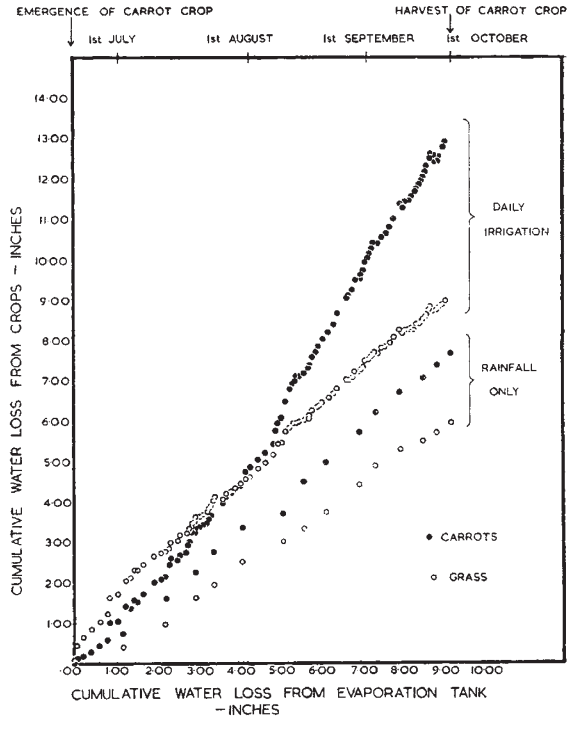


Fig. 1. Effect of crop type and soil moisture treatment on relative rate of evapo-transpiration

After the irrigated carrots had covered 40 per cent of the ground surface there was an alteration in the slope of the linear relation between evapo-transpiration from the crop and evaporation from the water tank (top line, Fig. 1), and further increases in crop cover and height had no effect on the rate of evapo-transpiration. With both grass and carrots receiving only rainfall the rate of evapo-transpiration was reduced by 40 per cent as compared with those that were irrigated.

Meteorological observations enabled the energy balance to be calculated for the grass and carrot crops grown under the two soil-moisture treatments and for the open water surface of the evaporation tank.

The differences in the amount of evapo-transpiration from the two crops could not be explained by the differences in the amount of energy used for growth, heat storage or for reflexion, so that large differences must have occurred in the amount of heat transferred to and from the air.

Similar comparisons are now being made with other vegetable crops in order that the relation between evapo-transpiration and evaporation from an open water surface may be established for crops usually irrigated.

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