Water Requirement of Banana and Papaya in Lower Indus Basin

Water requirement of banana and papaya, the two most important fruit cash crops of Pakistan is not known due to which farmers keep on applying water even if the crop does not need it. This information is particularly required for the shallow water table areas where contribution from groundwater to meet crop water requirement is dominant. The research studies conducted on banana (1995-1999) and papaya (2013-2016) at 1.50 m, 2.00 m and 2.50 m water table depths in silty loam soil using drainage-type lysimeters. Water requirement of banana at 1.50 m to 2.50 m water-table depths were found between 2211 mm to 2584 mm. Papaya requires 1573 mm to 1766 mm of water.

Background

Banana and papaya are the two most important fruit cash crops of Pakistan. About 85% of banana and 43% of papaya is cultivated in the Sindh province. Due to the high economic return, the cultivated area of these two crops is increasing with time in the Sindh province. However, water requirement of these two crops are not known.

Water requirement defines as the depth of water required to the plants for its growth and bringing better yield. The knowledge of crop water requirement is very important for efficient management of the available water resources particularly in areas where water table is shallow (≤ 1.5 m below ground surface) under a larger area like Sindh province of Pakistan.

Lysimeter provides an opportunity to measure the crop water requirement.

A lysimeter is a controlled structure in which different reference soil types are filled layer by layer and water tables are maintained artificially through different instruments.

Knowledge of crop water requirement is important for irrigation water allocation and devising irrigation scheduling according to scientific methods. Irrigation scheduling is the knowledge about when to irrigate and how much to irrigate the crop.

This important scientific information was complemented by long term research studies conducted on banana (1995-1999) and papaya (2013-2016) at 1.50 m, 2.00 m and 2.50 m water table depths in silt loam soil using drainage-type lysimeters of PCRWR located at Drainage and Reclamation Institute of Pakistan (DRIP), Tandojam. In Sindh province, DRIP PCRWR is the only Institute that houses a well maintained and functioning Lysimeter stations to study crop water requirements at different water table and soil type conditions.
Major Findings

1. Banana (Musa Paradidica)
Water requirement for banana was found between 2211 mm to 2584 mm at 1.50 m to 2.50 m watertable depths. Groundwater table contributes 12%-17% (270 mm – 442 mm) to the water requirements of banana. Banana water requirements largely vary with plant density and sowing time. These figures are in the case when corm is transplanted in mid of March with rows spacing of 2.13 m and a single mat (single mother plant with two subsequent suckers) suckers package was followed.

Banana yield was between 58638 kg/ha to 72496 kg/ha. Banana produces highest yield with shallow watertable depths (1.50 m – 2.00 m). Banana yield was 8% and 19% highest at 1.50 m than 2.00 m and 2.50 m water table depths. Farmers apply 30%-40% more water to banana leading to 11%-18% yield loss than its potential obtained in lysimeters. Banana water use efficiency (yield produced per m$^3$ of water) was highest with shallow watertable conditions. It was 2.81 kg/m$^3$ at 1.50 m, 2.73 kg/m$^3$ at 2.00 m and 2.65 kg/m$^3$ at 2.50 m water-table depth. However, water use efficiency under farmer's practices in the Sindh province is 1.67 kg/m$^3$.

The irrigation schedule based on lysimeter data developed for banana is to apply 100 mm of irrigation water in summer months (March-October) with an interval of 10-15 days and 75 mm water in winter (November-February) with an interval of 15-21 days.

2. Papaya (Carica Papaya)
Papaya requires 1573 mm to 1766 mm of water at 1.50 m to 2.50 m watertable depths. Groundwater contribution towards meeting water requirement varies between 103 mm to 324 mm. However, papaya farmers in Sindh province apply 45%-51% more water to the crop. Papaya water requirements largely vary with plant density and sowing time. These figures are in the case when plants are transplanted by the mid of May with rows spacing of 2.13 m.

Papaya yield was between 64998 kg/ha to 83004 kg/ha. Papaya produces highest yield with shallow watertable depths (1.50 m – 2.00 m). Papaya yield was 16% and 22% highest at 1.50 m than 2.00 m and 2.50 m watertable depths. Irrigation water application by farmers more than its requirement leading to 24%-40% yield loss than its potential obtained in lysimeters. Papaya water use efficiency (yield produced per m$^3$ of water) was highest with shallow watertable conditions. It was 4.70 kg/m$^3$ at 1.50 m, 4.21 kg/m$^3$ at 2.00 m and 4.13 kg/m$^3$ at 2.50 m water-table depth. However, water use efficiency under farmer's practices in the Sindh province is 1.53 kg/m$^3$. The irrigation schedule developed for papaya is to apply 50 mm of irrigation water in summer months (March-September) with an interval of 8-10 days and with an interval of 15-21 days in winter (October-February).

Conclusion
Water requirement of banana at 1.50 m to 2.50 m watertable depths were found between 2211 mm to 2584 mm. Papaya requires 1573 mm to 1766 mm of water. There is huge potential of water saving, increase in yield and enhancing water use efficiency, if the irrigation schedule developed for banana and papaya is adopted.