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EVAPOTRANSPIRATION LOSS OF WATER FROM RICE AND WHEAT PLANTS GROWN IN SAND AND SANDY SOIL IN BOTTOM CLOSED EARTHEN POTS UNDER GRAVITY IRRIGATION SYSTEM

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Evapotranspiration includes both transpiration from plants and evaporation from the soil surface. It is controlled by (a) climatic conditions, (b) plant cover in relation to soil surface, (c) efficiency of water use by different plants and management practices, and (d) length and season of the plant growing period (Brady and Weil 2012). Soil water availability is a factor of increasing concern for most crop production under both rainfed and irrigated systems. Water is an important factor with respect to plant survival in wetland and dry landscapes (Nazrul-Islam and Alam 1986). Efficient field tools and sophisticated instrumentation techniques are needed to monitor soil moisture and crop demand for water under different irrigation systems. Adaptive management practices are needed to promote optimal soil physical, chemical and biological properties, stimulate deep rooting within the soil profile, and lessen the impact of reduced water availability (Prochnow and Cantarella 2015). Water use efficiency (WUE) has several important implications related to agricultural sustainability, soil and water conservation (Rahman and Nakamura 2012). The relative water content (RWC) of leaves indicate water status of plants which in turn regulates transpiration, eco-physiological activities, stomatal aperture and reflect the ability of the plant to absorb water. Irrigation accuracy depends mainly on correct estimates of crop evapotranspiration, available soil water and soil types. Bangladesh is facing two opposite natural calamities, one is flood in monsoon and another one is drought in winter. A large number of *Charland* farmers of the different river basin areas of Bangladesh grow vegetable crops abundantly in winter on sand - dominated land to reduce poverty and to meet the growing demand of the country. But irrigation is a major problem due to high rate of leaching loss of this land. The aim of the present experiment was to assess the evapotranspiration loss of water from rice and wheat plants grown in sand and sandy soil in bottom closed square earthen pots under gravity irrigation system.

The experiment was carried out in the Department of Soil, Water and Environment, University of Dhaka during 6 months (November to April). Pots were arranged in a complete randomized block design. Each pot had a capacity for 12.8 kg of sand or soil. Sand and soil had a moisture at field capacity of 15.35 and 22.15%, respectively. The soil being sandy loam in texture and had a pH of 7.2, organic carbon 0.62%, CEC 7.16 meq/100 g soil, available NPK were 85,

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4 and 120 mg/kg, and total NPK were 0.08, 0.03 and 0.72%, respectively. Nitrogen as urea at the rate of 111 kg/ha, phosphorus as TSP at the rate of 84 kg/ha, and potassium as MP at the rate of 84 kg/ha were added to sand and sandy soil.

Six seedlings of rice (BR3) of three weeks old were transplanted and six seeds of wheat (LV Sonalika) were sown in sand and sandy soil media per pot. Seeds of rice and wheat were collected from Bangladesh Rice Research Institute (BRRI) and Bangladesh Agricultural Research Institute (BARI) Gazipur, respectively. Each morning, water was added at the rate of half field moisture capacity per pot to sand and soil, respectively. Evapotranspiration loss was measured at 06:30, 08:30, 10:30, 12:30,14:30, 16:30 and 18:30 hours of the day at flowering stage under sun habitat by weighing the pots at regular intervals (two hours) on a large scale top balance. Results shown are the mean of three replicates (Table 1). Loss of water through evapotranspiration for rice at 08:30 hour was 12 and 15 g and progressively increased up to 14:30 hour and the values were 25.5 and 28 g/h, respectively. The total loss of water at day light hours was117.5 and 133.5 g in sand and sandy soil, respectively. For wheat plants, the evapotranspiration loss of water at 08:30 hour was 12.5 and 10.30 g/h and progressively increased up to 14:30 hour and the values were 26.5 and 24g/h in sand and sandy soil, respectively. The total loss of water was 121 and 108.3g in sand and sandy soil, respectively (Table 1). Evapotranspiration loss of water increased from morning till noon and then decreased towards evening in both the media for both crops. The highest plateau of evapotranspiration loss was observed at 14:30 hour. Evapotranspiration increased gradually due to increasing temperature which probably brought out the changes in the physiological characteristics for both crops and accelerated the rate of evaporation from land surface. Loss of water for rice was higher in sandy soil than in sand and it was reverse in case of wheat. The results did not vary significantly ($p = 0.05$). Growth and leaf area were also found higher for rice in sandy soil. Warm air temperatures increase the potential for evaporation and therefore increase rates of transpiration.

Table 1. Diurnal changes in evapotranspiration loss of water from rice and wheat plants grown in sand and sandy soil in bottom closed earthen pots under gravity irrigation system.

Treatments	Rate of evapotranspiration (g/hour) at day time						Total loss (g)
Hours	08:30	10:30	12:30	14:30	16:30	18:30	
Rice							
Sand (loss of water g/h)	12.0 ±1.78	16.5 ±2.02	21.5 ±2.28	25.5 ±2.55	22.5 ±2.24	19.5 ±1.93	117.5
Sandy soil "	15.0 ±1.67	19.0 ±1.80	24.5 ±2.07	28.0 ±2.50	25.0 ±2.34	22.0 ± 2.10	133.5
Wheat							
Sand "	12.5 ±1.61	17.0 ±1.73	22.5 ±1.90	26.50 ±2.05	23.0 ±1.73	19.5 ±1.67	121
Sandy soil "	10.30 ±1.50	14.50 ±1.58	20.0 ±1.76	24.0 ±2.14	21.5 ±1.67	18.0 ±1.52	108.3

± = Standard deviation.

Evapotranspiration was higher in wheat plants grown in sand (Table 1). It might be due to efficient utilization of water and nutrient under relatively dry soil conditions. The results showed no significant ($p = 0.05$) variation. Similar trends of the results were observed in case of transpiration loss (Rahman 2015). The plateau of RWC of rice and wheat plants grown in sand and sandy soil was observed at 1400 hours and RWC gradually declined because of increasing transpiration loss (Rahman 1999). Results of the present experiment are in agreement with this finding. Growth and leaf area were higher in sand for wheat plants. Leaf area is an important variable for most eco-physiological studies in terrestrial ecosystems for elucidating competition among different plant species concerning irrigation response, evapotranspiration, plant growth and yield potential. The rate of growth of plant cells and the efficiency of their physiological processes are highest when the cells are at maximum turgor. The ability of soils to perform crucial air and water services, and to support plant growth relies on many unseen vital processes. Plant roots grow in an incredibly complex soil environment. Healthy soils sustain plants, animals and humans and function as a living ecosystem maintaining a diverse community of soil organisms that not only improve crop production, but also promote the quality of air and water environments (Roberts and Ryan 2015). Nakamura *et al.* (2005) conducted an experiment for three years in a sandy loam soil to investigate the effect of irrigation depths on the utilization of stored subsoil water by cabbage (*Brassica oleracea* L.) and maize (*Zea mays* L.). The results indicated that relatively dryconditions were necessary and drip irrigation (DI) was more efficient than subsurface drip irrigation (SDI) for subsoil water utilization under subtropical conditions at Ishigaki island, JIRCAS Okinawa Subtropical Station, Japan.

Therefore, the evapotranspiration loss values of the present experiment indicated that the degree of turgidity of plants and evaporation from land surface was dependent on the efficient application of water and utilization of nutrients under relatively dry land conditions (50% FC) under gravity irrigation system. This system of irrigation might be useful in sand-dominated land.

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