Evaluation of Crop Biomass and Water Use Efficiency for Feed barnyard grass, Feed corn, and Coix Affected by Ground Water Table

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Abstract
Pot experiment using lysimeter controlled with 5 depths of ground water table (GWT); 0, 25, 50, 75, and 100cm, respectively were conducted to investigate crop biomass, water use efficiency, and changes of soil moisture for feed barnyard grass, feed corn, and Coix. All the lysimeter randomized with four replication arrangements were filled up soils and were adjusted to the constant bulk density treated with twice water infiltration from bottom side to upper side of lysimeter. Dry weights of above ground part of feed barnyard grass and feed corn grown on the plot of 75cm GWT were the highest showing the following order of 50cm > 100cm < 0 & 25cm GWT while that of coix was gradually increased with increase of GWT showing the highest in the plot of 100cm GWT. Total amount of evapotranspiration affected by different ground water tables during the growing season of crop showed the same tendency as that of dry weight. Evapotranspiration ratio calculated by evapotranspiration volume(ml) per dry weight(g) were 110.6~163.6ml for feed barnyard grass, 101.4~143.6ml for feed corn, and 133.0~210.0ml for coix showing the order of coix>feed barnyard grass>feed corn. Evapotranspiration ratio was increased with decrease of GWT that is the saturation condition of soil moisture. Estimation of GWT for maximum amount of dry weight of upper part of feed barnyard grass was 97cm. However those of feed corn and coix were increased with increase of GWT showing the almost linear equation.

Key Words
Lysimeter, Evapotranspiration, Feed barnyard grass, Feed corn, Coix, Ground water table, Water use efficiency

Introduction
Evapotranspiration information is required for many applications in agricultural and natural resource management from hydrological applications to plant growth and yield models to irrigation scheduling recommendation. Early observations of diurnal shallow water table fluctuation were made by White (1932), Troxell (1936), and Meyboom (1967). White (1932) proposed a method that utilizes observation of shallow water table fluctuation to estimate the direct consumption of groundwater by plants. Even lysimeters that are used for measuring water use by irrigated crops were found to give inaccurate estimates of evapotranspiration when the state The objective of this paper is to evaluate crop biomass and water use efficiency such as evaporation and evapotranspiration affected by shallow ground water table conditions ranging from 0cm to 100cm.

Methods
Lysimeter controlled with 5 depths of ground water table; 0, 25, 50, 75, and 100cm, respectively was made by PVC pipe with 30cm diameter to investigate crop biomass, water use efficiency, and changes of soil moisture for Whole-crop barley, Rye, Pearl millet, All the lysimeter randomized with four replication arrangements were filled up soils and were adjusted to the constant bulk density by twice water infiltration from bottom side to upper side of lysimeter. The seedlings of Feed barnyard grass were on April 7 , 2008 , and Feed corn were on April 21, 2008 and Coix were on April 28, 2008 and harvested on June 2, 2008 for Feed barnyard grass, June 28, 2008 for feed corn, and July 9, 2008 for Coix . Evaporation from lysimeter grown without crop and evapotranspiration form lysimeter grown with crop were measured everyday by amount of water consumption in water supplying bottle. So transpiration was calculated by difference between evapotranspiration and evaporation measurement. Also bulk moisture content of soils during the growing season was measured by TDR sensor installed at different soil depth from surface with 25cm interval. Air temperature and humidity during the growing season were measured by data logger with 30 minute interval.

Results

Table 1. Above-ground dry matter of crops affected by different ground water table

Crop	Growth period	GWT-0cm		GWT-25cm		GWT-50cm		GWT-75cm		GWT-100cm	
		DW	Index	DW	Index	DW	Index	DW	Index	DW	Index
Feed barnyard grass	56days	94.7	79.5	59.9	50.4	133.6	112.3	152.9	128.4	119.0	100.0
Feed corn	68days	199.7	69.7	193.4	67.5	244.1	85.2	310.4	108.3	286.6	100.0
Coix	72days	91.3	62.5	109.9	75.2	127.9	87.5	127.8	87.4	146.2	100.0

Dry weights of above ground part of feed barnyard grass and feed corn grown on the plot of 75cm GWT were the highest showing the following order of 50cm > 100cm < 0 & 25cm GWT while that of coix was gradually increased with increase of GWT showing the highest in the plot of 100cm GWT. As the results, all the crop have a little tolerance against excess moisture condition of 0cm and 25cm GWT showing a remarkable decrease of dry weight of crop (Table 1).

Table 2. Total amount of evapotranspiration affected by different GWT during the growing season

Crop	GWT-0cm	GWT-25cm	GWT-50cm	GWT-75cm	GWT-100cm
Feed barnyard grass	15.48	14.11	15.75	16.05	13.16
Feed corn	28.68	28.21	29.10	33.24	29.06
Coix	19.18	19.42	19.75	18.72	19.45

GWT ; ground water table

Total amount of evapotranspiration affected by different ground water tables during the growing season of crop showed the same tendency as that of dry weight showing the highest in plot of 75cm GWT for feed barnyard grass and feed corn while in the 100cm GWT for coix (Table 2).

Table 3. Evapotranspiration ratio affected by different GWT during the growing season

Crop	GWT-0cm	GWT-25cm	GWT-50cm	GWT-75cm	GWT-100cm
Feed barnyard grass	163.55	235.43	117.87	104.98	110.59
Feed corn	143.61	145.89	119.21	107.08	101.41
Coix	209.99	176.65	154.36	146.44	133.00

*GWT ; ground water table

**Evapotranspiration ratio was calculated by total amount of evapotranspiration(g) / above-ground dry matter(g)

Evapotranspiration ratio calculated by evapotranspiration volume(ml) per dry weight(g) were 110.6~163.6ml for feed barnyard grass, 101.4~143.6ml for feed corn, and 133.0~210.0ml for coix showing the order of coix>feed barnyard grass>feed corn. Evapotranspiration ratio was increased with decrease of GWT that is the saturation condition of soil moisture (Table 3).

Table 4. Ground water table at the highest dry weight estimated by regression equation

Crop	Regression equation($0<x<100$)	Ground water table (cm)
Feed barnyard grass	$Y=-0.006x^2+1.1687x+76.168$	97
Feed corn	$Y=-0.0022x^2+1.384x+185.91$	Linear increase
Coix	$Y=-0.0021x^2+0.7223x+92.475$	Linear increase

Estimation of GWT for maximum amount of dry weight of upper part of feed barnyard grass was 97cm. However those of feed corn and coix were increased with increase of GWT showing the almost linear equation.

Conclusion

Dry weights of above ground part of feed barnyard grass and feed corn grown on the plot of 75cm GWT were the highest showing the following order of 50cm > 100cm < 0 & 25cm GWT while that of coix was gradually increased with increase of GWT showing the highest in the plot of 100cm GWT. Evapotranspiration ratio calculated by evapotranspiration volume(ml) per dry weight(g) were 110.6~163.6ml for feed barnyard grass, 101.4~143.6ml for feed corn, and 133.0~210.0ml for coix showing the order of coix>feed barnyard grass>feed corn. Estimation of GWT for maximum amount of dry weight of

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