Water Use Efficiency and Evapotranspiration of Hybrid Napier (*Pennisetum purpureum* x *P. americanum*) under Semi-Arid Indian Region

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Introduction

Napier bajra hybrid (*Pennisetum glaucum* x *P. purpureum*) is a highly valued for its abundant quality forage, round the year fodder availability, regenerative ability and suitability to silage and hay making. It yields upto 110-120 t/ha fresh fodder as sole crop. Though, it requires moist regimes for optimum growth, but it can withstand drought for a short spell and regenerate with rains. It contains 8.7-10.2 % crude protein, 28-30.5% crude fibre and 10-11.5 % ash on dry matter basis (Agrawal *et al*., 2001). The hybrid napier has wider adaptability and is grown all over the country, particularly in milk shed area of Gujrat, Maharashtra and north and central India.

Estimation of evapotranspiration (ET) as a function of crop stages is important in determining crop water use for efficient irrigation management. Evapotranspiration loss and the rate of evapotranspiration at different cutting stages indicate the amount of water required at different growth periods for its satisfactory growth and optimum production. Few results in measurement of evapotranspiration and water use efficiency of fodder crops are available (Alvarez and Quiroga, 1992; Pradeep Behari *et al.*, 2003). The water stress in the plant can be quantified by actual evapotranspiration rate, as the level of evapotranspiration is related to the evaporative demand of the air (Doorenbos and Kassam, 1979). However, the information on these aspects for hybrid napier is lacking. In present study we estimate, the water use efficiency and evapotranspiration of the hybrid napier in central India.

Materials and Methods

A field experiment was conducted for two years during *kharif* season of 2011 and 2012 at Indian Grassland and Fodder Research Institute, Jhansi, using 4 weighing lysimeters. The NB hybrid was established during July, 2009 at spacing of 100 x 50 cm, supplemented with recommended levels of fertilization and other ago-management techniques. The maximum capacity of weighing machine was 2000 kg and the sensitivity of the system was $\pm$ 0.2 kg, which is equivalent to 0.12 mm of evapotranspiration or, rainfall. The daily evapotranspiration was measured by recording successive weight loss and taking rainfall into account. Soil of the experimental site was fine, loamy, mixed, hyperthermic typic Ustochrept. It was neutral in reaction (pH_2 7.1) and non saline in salt content (EC_2 0.10 dS/m). The initial status of organic carbon (0.46%), available nitrogen (185 kg/ha) and available phosphorus (17.22 kg P/ha) in the soil was low, whereas available potassium content of the soil was in high range (423.9 kg K/ha). The soil depth was 100 cm.
All the four lysimeters were surrounded with strips (5x50 sq m) of hybrid napier grown under standard management practices to provide similar environment to the grass grown in the lysimeters. Five cuttings of the hybrid napier at were taken in both years. First cut was taken at 30 and 31 days in first and second year and subsequent cuttings at an interval of 30, 32 ,29 and 34 days and 31, 30,31 and 30 days, in respective years.

Results and Discussion

The average green and dry matter yield of the hybrid napier under inorganic nutrient sources is presented in Table 1. The mean green fodder and dry matter yield of hybrid napier ranged between 8.6 to 31.6 t/ha and 1.7 to 5.3 t/ha, respectively in different cuttings. The highest dry matter yield (5.3 t/ha) was obtained in first cutting followed by second cutting. The minimum yield (1.7 t/ha) was observed during fifth cutting, which may be attributed to the fact that the hybrid napier remains dormant during winter season, which coincides with the fifth cut duration.

The cut wise mean evapotranspiration (ET) of hybrid napier is depicted in Table 1. The results showed that the total evapotranspiration losses ranged between 244.0 to 131.3 mm in different cuttings under inorganic situation. The ET loss was highest (244 mm) during first cut followed by second cut (197.6 mm). The water use efficiency (WUE) of the hybrid napier was 21.8, 23.9, 23.4, 17.6 and 13.1 kg DM ha^{-1} mm^{-1} in first to fifth cut, respectively. The estimated water use

efficiency of hybrid napier showed that the maximum water use efficiency (23.9 kg DM ha^{-1} mm^{-1}) coincides with the second cutting.

Table 1: Mean evapotranspiration (ET) and water use efficiency (WUE) of Hybrid napier

Cutting	Green fodder yield (t/ha)	Dry fodder yield (t/ha)	ET(mm)	WUE (kg DM/ha mm)
I	31.6	5.3	244	21.8
II	27.2	4.75	197.6	23.9
III	23.8	4.15	174.4	23.4
IV	13.3	2.5	141.3	17.6
V	8.6	1.7	131.3	13.1

Conclusion

The maximum water use efficiency (23.9 kg DM ha^{-1} mm^{-1}) of hybrid napier was observed during second cut, whereas, peak evapotranspiration losses was noticed during first cutting in the region.

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