

Effect of Irrigation and Hydrogel on the Water Use Efficiency of Zeto-Tiled Green-Gram Relay System in the Eastern Indo Gangetic-Plain

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Abstract : Jute can be sown as relay crop in between the lines of 15-20 days old green gram for additional pulse yield without reducing the yield of jute. The main problem of this system is water use efficiency (WUE). The increase in water productivity and reduction in production cost were reported in the zero-tilled crop. The hydrogel can hold water up to 400 times of its weight and can release 95 % of the retained water. The present field study was carried out during 2015-16 at BCKV (tropical sub-humid, 1560 mm annual rainfall, 22058/ N, 88051/ E, 9.75 m AMSL, sandy loam soil, aeric Haplaquept, pH 6.75, organic carbon 5.4 g kg⁻¹, available N 85 kg ha⁻¹, P₂O₅ 15.3 kg ha⁻¹ and K₂O 40 kg ha⁻¹) with four levels of irrigation regimes: no irrigation - RF, cumulative pan evaporation 250mm (CPE250), CPE125 and CPE83 and three levels of hydrogel: no hydrogel (H0), 2.5 kg ha⁻¹ (H2.5) and 5 kg ha⁻¹ (H5). Throughout the crop growing period a linear positive relationship remained between Leaf Area Index (LAI) and evapotranspiration rate. The strength of the relationship between ET_a and LAI started increasing and reached its peak at 7 WAS (R²=0.78) when green gram was at its maturity, and both the crops covered the nearly entire base area. This relation starts weakening from 13 WAS due to jute leaf shading. A linear relationship between system yield and ET was also obtained in the present study. The variation in system yield might be predicted 75% with ET alone. Effective rainfall was reduced with increasing irrigation frequency due to enhanced water supply in contrast to hydrogel application due to the difference in water storage capacity. Irrigation contributed a major source of variability of ET. Higher irrigation frequency resulted in higher ET loss ranging from 574 mm in RF to 764 mm in CPE83. Hydrogel application also increased water storage on a sustained basis and supplied to crops resulting higher ET from 639 mm in H0 to 671mm in H5. WUE ranged between 0.4 kg m⁻³ (RF) to 0.63 kg m⁻³ (CPE83 H5). WUE increased with increased application of irrigation water from 0.42 kg m⁻³ in RF to 0.57 kg m⁻³ in CPE 83. Hydrogel application significantly improves the WUE from 0.45 kg m⁻³ in H0 to 0.50 in H2.5 and 0.54 in H5. Under relatively dry root zone (RF), both evaporation and transpiration remain at suboptimal level resulting in lower ET as well as lower system yield. Green gram - jute relay system can be water use efficient with 38% higher yield with application of hydrogel @ 2.5 kg ha⁻¹ under deficit irrigation regime of CPE 125 over rainfed system without application of the gel. Application of gel conditioner improved water storage, checked excess water loss from the system, and mitigated ET demand of the relay system for a longer time. Hence, irrigation frequency was reduced from five times at CPE 83 to only three times in CPE 125.

Keywords : zero tillage, deficit irrigation, hydrogel, relay system

Conference Title : ICRCRE 2017 : International Conference on Resource Conservation and Restoration Ecology

Conference Location : Madrid, Spain

Conference Dates : March 26-27, 2017