EFFECT OF UREA APPLICATION THROUGH DRIP IRRIGATION ON YIELD, WATER AND NITROGEN USE EFFICIENCY OF SUMMER BITTER GOURD

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ABSTRACT

The productivity of summer bitter gourd (*Momordica charantia* L.) was significantly influenced by methods of N-fertilization and water scheduling through gravity drip system in sandy loam soils of lower Gangetic plains. Drip irrigation along with N-fertigation increased the yield up to 193% as compared to surface irrigation. Irrigation at 1.0 ET_c + urea fertigation was the best considering the higher yield and water use efficiency of summer bitter gourd. Drip irrigation saved 35 to 61% of water over surface irrigation. Fertigation increased the water and N use efficiency by 2 to 3 folds as compared to surface irrigation along with N-soil application.

Keywords*:* Bitter gourd, drip irrigation, N-fertigation, precision application, vegetables

INTRODUCTION

Bitter gourd (*Momordica charantia* L.) is one of the important vegetable crops grown during summer months in high lands of Lower Gangetic Plains. Crop is very much responsive to water and nutrient but water is limiting in dry summer months. Farmers generally adopt furrow irrigation and hand watering with pitcher for growing this crop. Drip irrigation is a new dimension for increasing crop water productivity. An attempt has been made to assess the production potential and water use efficiency of summer bitter gourd.

MATERIAL AND METHODS

The field experiment was carried out on low cost gravity drip irrigation system at Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India during summer months of 2001-2004. The study area is located in the humid subtropical region. The soil of the experimental site was sandy loam in texture under Aeric Haplaquept great group status with soil pH 6.8 and organic carbon 0.55%, nitrogen 0.59%, available P_2O_5 30 kg ha^{-1} and available K_2O 145 kg ha^{-1}. Bulk density value was of 1.47 Mgm^{-3} and soil retained at field capacity and permanent wilting capacity were 0.36 m^3 m^{-3} and 0.21 m^3 m^{-3} respectively, in the root zone depth (0-90 cm). Three drip water supply levels based on the replenishment rate of ET_c: I_1 - 75% (0.75 ETc), I_2 – 100% (1.0 ETc), I_3 – 125% (1.25 ETc) were tested with N @ 100 kg ha^{-1} as Fertigation (F) of urea (100 ppm) in 10 schedules at weekly interval and soil application (S) of N at 2 splits (½ at land preparation + ½ at peak flowering) taking control as surface irrigation (IW:CPE = 1.0, IW-50 mm). The full dose of P_2O_5 and K_2O were applied @ 50 and 50 kg respectively, during land preparation. The drip running time was calculated based on dripper's discharge and plot area following the equation $ET_{crop} = E_p*K_p*K_c*K_r$, where, E_p - open pan evaporation (mm day^{-1}), K_p = pan co-efficient (0.8); K_c - crop co-efficient (0.5, 1.1 & 0.75); K_r - ground reduction factor or wetted area fraction (0.3, 0.4 & 0.5). On-line pressure compensating button type dripper was used with discharge rate 1.8 lit hour^{-1}. The alternate day irrigation frequency was maintained for early period but it was daily at later stages. Seeds of bitter gourd were sown in the 1st week of March and harvesting started in the middle of May. Crop was raised with recommended agro-techniques. Production potential, water and nitrogen efficiency was calculated.

RESULTS AND DISCUSSION

Productivity of summer bitter gourd was significantly influenced by methods of N-fertilization and water scheduling through drip system (Table 1). Effect of N-fertigation was more pronounced on yield (9.1 to 10.79 tha^{-1}) of bitter gourd crop at 75 – 125% replenishment rate of evapotranspiration (ET_c) than drip irrigation without fertigation (3.63 to 5.59 t ha^{-1}) in summer months because of reduced leaching of N due to small flux of water applied under drip system (Deolanker and Firake, 1999 and Malick *et al.*, 1994). But yield difference due to drip irrigation scheduling based on ETc was more distinctive in crops without fertigation (35.0 to 51.9%) than the crops without fertgation (16.8 to 18.6%). Yield difference from control (surface irrigation) revealed that fertigation irrespective of ETc replenishment rate increased the yield at 5% level of significance but drip irrigation with soil N-application failed to increase the yield significantly. N-fertigation increased the fruit sizes and its number per plant. Drip irrigation at 0.75 ET_c + F recorded the highest water use efficiency (66.6 kg ha-mm^{-1}) followed by 1.0 ET_c + F. Drip irrigation with fertigation increased the WUE by 2-3 folds as compared to drip irrigation with N-soil application. Surface irrigation recorded the lowest WUE (10.5 kg ha- mm^{-1}). N-use efficiency value was more than double in urea fertigation compared to N-soil application. In fertigation, Agronomic N-use efficiency (kg fruit kgN^{-1}) significantly increased (91.0 to 107.9) with increased volume of water application but the value decreased (49.3 to 36.3) with more water application when N applied in soil.

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Table 1. Yield, water and nitrogen use efficiency of summer bittergourd as influenced by drip irrigation with fertigation (Pooled data of 3-years)

Treatment	Fruits plant^{-1}	Fruit size (g)	Yield (t ha^{-1})	Water use (mm)	WUE (kg ha- mm^{-1})	N - use efficiency (kg fruit kg N^{-1}

0.75 ET_C + F	12.7	60.0	9.10	136.5	66.6	91.0
1.0 ET_C + F	17.4	51.0	10.63	182.0	58.4	106.3
1.25 ET_C + F	15.6	56.6	10.79	227.4	47.4	107.9
0.75 ET_C + S	8.4	50.0	4.97	136.5	36.4	49.7
1.0 ET_C + S	8.8	53.2	5.59	182.0	30.7	55.9
1.25 ET_C + S	5.1	52.0	3.63	227.4	15.9	36.3
Surface Irrigation	5.7	54.1	3.68	350.0	10.5	36.8
LSD (*P*=0.05)	1.47	1.07	9.79	22.70	6.45	9.79

F –fertigation, S- soil application; Surface irrigation at IW:CPE =1.0,
WUE –water use efficiency