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Drip irrigation and fertigation studies in tapioca

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Abstract : Experiments were conducted in sandyloam soils of Agricultural Research Station, Bhavanisagar for three years during 1996-2000 to evaluate the efficiency of drip system of irrigation and to assess the impact of fertigation of nitrogen in tapioca. The results revealed that scheduling irrigation through drip once in two days at 100 per cent of surface method of irrigation registered the highest mean tuber yield of 58.7 t ha^{-1} which was significantly superior over surface irrigation scheduled at 0.60 IW/CPE ratio. The tuber yields in surface irrigation and irrigation through drip at 50 per cent of surface method were comparable. Fertigation of N at different levels failed to reveal marked variation on yield. The per cent saving in irrigation water under drip scheduled at 50 per cent of surface irrigation was 48.4 per cent compared with that of surface method of irrigation. The water use efficiency was 20 to 60 per cent higher in drip irrigation treatments compared to that of surface irrigation method.

Keywords: Tapioca, Drip irrigation, Fertigation of N, Water use efficiency.

Introduction

Water for irrigation is becoming both scarce and expensive and necessiates to be utilised in a scientific manner. Drip irrigation with its ability of small and frequent irrigation applications have created interest because of decreased water requirements, possible increased production and better quality produce. Among tuber crops, tapioca is most popular in water deficit areas and it's cultivation is gaining importance in tail end regions of irrigation commands. The crop is mostly grown under conventional surface method of irrigation in which major portion of irrigation water is lost by evaporation and deep percolation resulting in lower efficiencies.

Drip irrigation has proved to be a success in terms of water and increased yield in a wide range of crops (Bhardwaj, 2001). However the system is generally most successful for high income crops because of the relatively high initial cost of most installations. The use efficiency of both water and fertilisers could be increased substantially through drip irrigation and fertigation. Fertigation enjoys various advantages like higher use efficiency of water and fertiliser, minimum losses of N due to prevention of leaching, optimisation of nutrient balance by supplying nutrient directly to root zone in available form and so on. The present study has been aimed to optimise the irrigation requirement of tapioca through drip system of irrigation in conjunction with fertigation of nitrogen.

Materials and Methods

Field experiments were conducted for three years during 1996 to 2000 at Agricultural Research Station, Bhavanisagar, Tamil Nadu with tapioca variety MVD 1. The experiment was laid out in split plot design with three replications. In the main plot, surface irrigation at 0.60 IW/CPE ratio to 5 cm depth was compared with drip irrigation once in two days at three levels *viz.* 100, 75 and 50 per cent of surface irrigation. In the sub plot, three levels of nitrogen at 40, 60 and 80 kg N ha^{-1} was tried and applied through irrigation water in drip treatments and as band placement in surface irrigation plots.

The soils of the experimental site was moderately deep, well drained, red sandy loam with medium in available N and P and high in available K. The pH of the soil was neutral with the EC values of 0.2 dSm^{-1}. Paired row method of planting was adopted for drip system (60 cm spacing between plant rows between which drip lateral was laidout and 90 cm spacing between pairs of rows). For surface irrigation, 75 x 75 cm spacing was adopted. Drippers were placed at 75 cm apart along the lateral line with a discharge capacity of 4 lph each. The quantity of water in drip irrigation treatments was worked out based on daily pan evaporation value (for eg. Drip irrigation at 100per cent of surface = 1.0 x 0.6 x pan evaporation in mm). Nitrogen was applied as urea as per treatment in two equal splits at planting and at 90th day after

Table 1. Yield attributes, tuber yield and cost benefit ratio as influenced by the treatments

Treatments	Yield attributes (Pooled mean)			Tuber yield (t ha^{-1})			B:C ratio		
	No.of tubers per plant	Tuber length (cm)	Tuber weight per plant (kg)	1996-1997	1998	1999-2000	1996-1997	1998	1999-2000
a. Irrigation regimes									
Surface, 5cm, 0.60 IW/CPE	7.74	29.6	4.91	48.53	59.78	45.79	5.64	3.42	5.09
Drip at 100 per cent of surface	8.53	35.2	6.29	57.62	67.28	51.18	4.48	2.65	3.97
Drip at 75 per cent of surface	7.64	33.5	5.64	53.95	64.62	50.40	4.20	2.54	3.91
Drip at 50 per cent of surface	7.25	33.5	5.66	51.59	62.19	46.17	4.02	2.45	3.58
CD (P=0.05)	0.25	2.4	0.87	3.83	3.67	3.35	-	-	-
b. Levels of N									
40 kg N ha^{-1}	7.82	32.9	5.58	51.67	63.19	46.73	4.53	2.81	4.06
60 kg N ha^{-1}	7.79	32.0	5.68	53.04	63.01	49.00	4.62	2.75	4.19
80 kg N ha^{-1}	7.74	33.9	5.71	54.04	64.13	49.43	4.60	2.74	4.16
CD (P=0.05)	NS	NS	NS	NS	NS	NS	-	-	-

planting (DAP). All other cultural operations were commonly followed as recommended for tapioca. Tuber yield and yield parameters were recorded at harvest and cost benefit ratio was worked out. Total water used and water use efficiency were computed for irrigation treatments.

Results and Discussion

Among the yield attributes, mean number of tubers per plant was favourably influenced by the irrigation treatments and irrigation through drip at 100 per cent of surface irrigation recorded the highest values. Similarly tuber length and tuber weight per plant showed positive response to drip irrigation treatments recording higher values as compared with that of surface irrigation. Nitrogen levels failed to reveal significant variation on yield parameters (Table 1).

Tuber yield was significantly influenced by the irrigation treatments and irrigation through drip at 100 per cent of surface method of irrigation registered the highest yield in all the three years of study recording the mean tuber yield of 58.7 t ha^{-1} which was significantly superior over surface irrigation scheduled at 0.60 IW/CPE ratio (Table 1). However, tuber yield at 100 per cent and 75 per cent of irrigation through drip were comparable. Tuber yield was lowest at surface irrigation scheduled at 0.60 IW/CPE ratio to 5 cm depth. Irrigation scheduled through drip at 50 per cent of surface irrigation produced tuber yields on par with surface irrigation in all the years of study. Nitrogen levels failed to reveal marked variation on tuber yield as so in yield parameters.

It is quite obvious that continuous application of water and fertigation of nitrogen at optimum levels would result in higher yield under drip system. Selvaraj *et al.* (1997 b) reported that the fresh rhizome yield of turmeric under drip irrigation scheduled at 80 per cent of surface irrigation was superior over surface irrigation scheduled at 0.90 IW/CPE ratio. Bhardwaj (2001) reported 100 per cent yield increase in banana, 40 to 50 per cent in sugarcane, pomegranate and around 25 per cent in grapes and cotton under drip method of irrigation. Selvaraj *et al.* (1997 a) also reported 32 per cent yield increase in sugarcane under drip irrigation system over surface method.

Irrigation through drip at 75 per cent of surface has consumed 993 mm of water for the

Table 2. Total water used and water use efficiency in different irrigation treatments (mean over three years)

Particulars	Irrigation regimes			
	Surface irrigation	Drip at 100 per cent of surface	Drip at 75 per cent of surface	Drip at 50 per cent of surface
Irrigation water applied (mm)	915	852	653	472
Irrigation water saving (per cent)	-	6.9	28.7	48.4
Effective rainfall (mm)	340	340	340	340
Total water used (mm)	1255	1192	993	812
Tuber yield (kg ha^{-1})	51370	58690	56320	53320
Water use efficiency (kg ha^{-1}mm)	41.0	49.2	56.7	65.5
Percent increase in WUE	-	20.0	38.3	59.8

whole period with a water saving of 28.7 per cent and recorded the water use efficiency of 56.7 kg ha^{-1} mm (Table 2). The per cent saving in irrigation water under drip irrigation scheduled at 50 per cent of surface irrigation was 48.4 per cent compared to that of surface method of irrigation. The water use efficiency was 20 to 60 per cent higher in drip irrigation compared to that of surface method. These results are in confirmity with the findings of Selvaraj *et al.* (1997 a, b) in sugarcane and turmeric. In banana, saving in irrigation water to the tune of 70 per cent was achieved besides improvement in yield and quality (Upadhyay, 1995). Bhardwaj (2001) reported 40 to 70 per cent saving in irrigation water compared to conventional method of irrigation in a wide range of crops.

The economic evaluation of the results revealed that the net return and gross returns were higher under drip irrigation treatments compared with that of surface irrigation. However the cost benefit ratio was higher under surface irrigation owing to high initial installation cost of drip system.

It can be concluded that in moderate water scarcity areas, drip irrigation once in two days at 100 per cent of surface irrigation could be recommended for getting higher yield in tapioca. In areas where water is very scarce, drip irrigation at 50 per cent of surface irrigation can be very well recommended to obtain yields on par with conventional surface irrigation with water saving of about 50 per cent. By resorting to application of fertiliser through drip system as fertigation, 33 per cent nitrogen could be saved over the recommended level.

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