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CONSUMPTIVE USE, PATTERN OF SOIL MOISTURE EXTRACTION AND WATER USE EFFICIENCY OF BITTERGOURD (*MOMORDICA CHARANTIA* L.) UNDER VARYING IRRIGATION AND NITROGEN LEVELS

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Abstract: The influence of graded doses of nitrogen and varying levels of irrigation on consumptive use of water, pattern of soil moisture extraction, water use efficiency and fruit yield of bittergourd were evaluated during 1988-89 and 1989-90. The consumptive use of water and Et/Eo values of bittergourd increased progressively with levels of nitrogen and irrigation. At higher moisture regimes the variation in consumptive use and Et/Eo values did not reflect in crop yield. Water use efficiency of the crop maintained a positive relation with levels of nitrogen and a negative relation with levels of irrigation. The soil moisture extraction paltern was not influenced by nitrogen levels. Major part of water was extracted from upper layers of soil irrespective of treatments.

INTRODUCTION

Bittergourd is a popular summer vegetable. In rice fields it is generally sown during December-January after the harvest of second crop of rice. In areas where the third crop of rice is not possible due to inadequate supply of water, vegetable cultivation is highly profitable and permits a crop rotation also. The high intensity of sunshine enhances the atmospheric need of water from January onwards and hence an efficient and economic water management schedule for the crop is essential during this period. In this paper, consumptive use of water, pattern of soil moisture extraction and water use efficiency of bittergourd under graded doses of nitrogen and varying levels of irrigation and their influence on yield are discussed.

MATERIALS AND METHODS

The investigation was carried out at the Agronomic Research Station, Chalakudy during summer seasons of 1988-89 and 1989-90 with four levels of nitrogen (0, 30, 60 and 90 kg N/ha) and irrigation (at 15, 30, 45 mm CPE and farmers' practice of irrigation). The experiment was laid out in factorial RBD and replicated thrice. The variety used was 'Priya'. The crop was sown during January in both the years and harvest of fruits started one month after sowing. Daily pan evaporation was recorded using USWB class A pan evaporimeter and added to get the cumulative value. The rain water contribution if any will be subtracted from this. Irrigation treatments were scheduled when the CPE values corresponding to treatments were obtained. The depth of irrigation was 40 mm. Before and 24 hours after every irrigation soil samples from 0-15, 25-30, 30-60 and 60-90 cm depths were drawn for soil moisture studies. The moisture determination was done gravimetrically. The field capacity, permanent wilting point and bulk density of the soil were 15.2%, 7.8% and 1.39 g/cc, respectively. Total number of irrigations given under 25, 30 and 45 mm CPE and farmers' practice of irrigation were 16, 8, 6 and 30 during 1988-89 and 17, 8, 6 and 26 during 1989-90, respectively. The weather parameters during the crop period are presented in Table 1.

Table 1. Weather parameters during the crop period

Month	1[redacted]89					1989-90				
	Rainfall		Temperature (°C)		*CPE mm/day	Rainfall		Temperature (°C)		*CPE mm/day
	Total	No. of rainy days	Maximum	Minimum		Total	[redacted]	Maximum	Minimum	
January	-	-	[illegible].04	1[illegible].56	[illegible].15	-	-	[illegible]3.12	[illegible].50	[illegible].24
February	-	-	[illegible]5.10	1[illegible].8[illegible]	[illegible].5[illegible]	-	-	[illegible]4.51	[illegible]	4.0[illegible]
March	[illegible]1.20	[illegible]	[illegible]5.08	2[illegible].80	4.[illegible]6	-	-	[illegible]5.05	[illegible].20	4.7[illegible]
April	76.[illegible]	5	34.50	2[illegible].50	3.[illegible]	[illegible]9.00	[illegible]	[illegible]5.85	[illegible]	4.[illegible]

* Open pan evaporation

RESULTS AND DISCUSSION

Consumptive use of water

The consumptive use of water increased progressively with increasing levels of nitrogen (Table 2). The percentage increments in water use for 90 kg N/ha ovef no nitrogen were 10.67 during 1988-89 and 4.23 during 1989-90. Bond *et al.* (1971) also reported increase in consumptive use with increasing levels of nitrogen.

Consumptive use of water increased with frequency of irrigation. The highest value for consumptive use was recorded by farmers' practice of irrigation followed by irrigation at 15 mm CPE. It was observed that as the number of irrigation decreased, the consumptive use also decreased and higher values were obtained at higher moisture regimes. But the extent of variation in consumptive use did not reflect in yield under higher moisture regimes indicating that irrigation at 15 mm CPE was more economical since the yield of two treatments were statistically on par with each other.

Evapo-transpiration (Et) and pan-evaporation (Eo) ratio:

Et/Eo ratio increased progressively with levels of nitrogen and the increases in Et/Eo ratio in 90 kg N/ha over no nitrogen were 10.61% (1988-89) and 4.19% (1989-90). In all the cases the values were less than one. Increase in the value of Et/Eo ratio with levels of nitrogen was attributed to increase in consumptive use of water at higher levels of nitrogen.

' Irrigation at 25 mm CPE and farmers' practice recorded higher values for Et/Eo ratio. The percentage increase in Et/Eo ratio for irrigation at 15 mm CPE

Table 2. Consumptive use of water (CU), Et/Eo ratio and water-use efficiency (WUE) as affected by levels of nitrogen and irrigation

Treatments	1988-1989						1989-1990					
	Qty. of water applied (mm)	CU (mm)	Total pan evaporation during crop period (mm)	Et/Eo ratio	Fruit yield (t/ha)	WUE (kg/ha mm)	Qty. of water applied (mm)	CU (mm)	Total pan evaporation during crop period (mm)	Et/Eo ratio	Fruit yield (t/ha)	WUE (kg/ha mm)
Nitrogen kg/ha												
0	600	255	381	0.66	10.08	16.8	570	304	364	0.836	10.96	17.6
30	600	272	381	0.71	14.99	24.9	570	313	364	0.859	12.94	22.7
60	600	279	381	0.73	17.31	28.8	570	313	364	0.860	13.91	24.3
90	600	282	381	0.74	18.27	30.4	570	317	364	0.871	14.89	26.1
Irrigation												
15 mm CPE	640	309	381	0.81	16.24	25.3	680	344	364	0.943	13.67	20.1
30 mm CPE	320	231	381	0.60	15.00	44.9	320	288	364	0.791	12.44	38.8
45 mm CPE	240	162	381	0.42	13.17	68.92	240	237	364	0.650	11.80	49.1
Farmers' practice (once in 2 days)	1200	386	381	1.01	16.84	14.0	1040	379	364	1.039	13.87	13.3
CD (0.05)	Nitrogen				0.71						0.76	
	Irrigation				0.71						0.76	
	N x I interaction				N.S						N.S	

Table 3. Pattern of soil moisture extraction (%) from different depths as affected by levels of nitrogen and irrigation

Treatments	Depth (cm)	Per cent of soil moisture extraction		
Nitrogen (kg/ha)		1988-1989	1989-1990	Mean
0	0-15	29.71	32.12	30.92
	15-30	28.81	29.59	29.20
	30-60	22.87	22.36	22.62
	60-90	18.61	15.90	17.26
30	0-15	29.70	31.46	30.58
	15-30	27.13	29.34	28.24
	30-60	23.73	22.48	23.11
	60-90	19.43	16.71	18.07
60	0-15	29.68	30.80	30.24
	15-30	27.46	29.08	28.27
	30-60	24.23	23.04	23.64
	60-90	18.62	17.06	17.84
90	0-15	30.70	30.67	30.69
	15-30	27.39	29.41	28.40
	30-60	23.45	22.82	23.14
	60-90	18.44	17.08	17.76
Irrigation				
15 mm CPE	0-15	33.55	34.58	34.07
	15-30	28.25	32.10	30.18
	30-60	24.55	21.92	23.24
	60-90	13.65	11.37	12.51
30 mm CPE	0-15	29.40	30.57	29.99
	15-30	28.33	28.45	28.39
	30-60	22.96	24.23	23.60
	60-90	19.29	16.75	18.02
45 mm CPE	0-15	27.80	31.07	29.44
	15-30	26.55	27.84	27.20
	30-60	23.81	21.18	22.50
	60-90	21.83	19.90	20.87
Farmers' practice (once in 2 days)	0-15	28.66	28.43	28.55
	15-30	26.13	27.97	27.05
	30-60	23.43	23.31	23.37
	60-90	21.78	20.27	21.03

was 90.58 and 3322 (1988-89) and 45.08 and 19.21 (1988-90) over irrigation at 45 mm CPE and 30 mm CPE respectively. For farmers' practice of irrigation, the percentage increase was 138.58 and 66.77 (1988-89) and 59.84 and 31.35 (1989-90) over treatments receiving irrigation at 45 mm CPE and 30 mm CPE respectively. The variation in Et/Eo ratio did not influence the fruit yield at higher moisture regimes.

Water use efficiency

Water-use efficiency also increased progressively with levels of nitrogen (Table 2). The percentage increments for 60 kg and 90 kg N/ha over no nitrogen were 71.72 and 8125 during 1988-89 and 382 and 48.07 during 1989-90. The variation in water-use efficiency between the years was attributed to the difference in yield and water use.

Water-use efficiency decreased with increasing number of irrigation. The highest value was recorded by irrigation at 45 mm CPE and this is mainly due to the application of lower quantity of water. Lower water-use efficiency with higher water regimes may be attributed to higher values of consumptive use and comparatively less magnitude of difference in fruit yield.

Pattern of soil moisture extraction

Application of nitrogen did not influence the pattern of soil moisture extraction from various depths (Table 3). A major part of the water requi rement was met from upper layers up to 60 cm depth.

Though the treatments irrigation at 25 mm CPE and farmers' practice were statistically on par in fruit yield, the moisture extraction pattern was highly different. With irrigation at 15 mm CPE, the crop extracted a major part of water required from the upper soil layers and the extraction from lower layer (60-90 cm) was only about 11 to 13%, while in the farmers' practice of irrigation, the percentage of moisture extraction from different layers did not vary much, though the per cent of moisture extraction decreased with depth. The irrigation at 45 mm CPE also showed a similar pattern of moisture extraction. At higher moisture regimes, more water was extracted from upper layers due to more availability of water and better ramification of roots in upper soil layers. Similarly, more water extraction from lower layers under low moisture regime might be due to the penetration of roots to lower layers in search of water.

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REFERENCE

Bond, J.J., Power, J.I. and Willis, W.O.C. 1971. Soil water extraction by N fertilized spring wheat. *Agron. J*. 63 (2) : 280

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