Madras Agric. J., 85(7-9): 411 - 413 July - September 1998
https://doi.org/10.29321/MAJ.10.A00772

RATE OF MOISTURE USE AND PATTERN OF EXTRACTION IN BITTERGOURD DURING DIFFERENT GROWTH STAGES

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ABSTRACT

Estimation of rate of soil moisture use and pattern of extraction by bittergourd was attempted with four levels of N and irrigation. The irrigation at 15 mm CPE was found to be the optimum level of irrigation for bittergourd since its fruit yield was statistically on par with the fruit yield of farmer's practice of irrigation which recorded the highest yield. The crop extracted the highest quantity of moisture from top 0-30 cm soil layer, during both vegetative and reproductive stages. Peak period of soil moisture use for bittergourd was during 25 to 40 days after sowing (DAS) which coincides with the actively growing vegetative period and the start of profuse flowering. The seasonal average for daily water intake of bittergourd, for irrigation at 15 mm CPE and farmer's practice were 4.07 and 4.43 mm, respectively.

KEY WORDS : Soil moisture, pattern of extraction, cumulative pan evaporation (CPE)

MATERIALS AND METHODS

The study was conducted at Agronomic Research Station, Chalakudy during the summer seasons of the years 1988-89, 1989-90 and 1990-91 on bittergourd, variety Priya. The soil was well drained loamy sand, low in available nitrogen (185 kg ha^{-1}), medium in available P (13.7 kg ha^{-1}) and low in available K (42 kg ha^{-1}) with a pH of 5.8. The field capacity, permanent wilting point and bulk density of 0 to 30 cm soil were 15.7, 7.1 per cent in 1.4 g cm^3 respectively. The water table depth was below 2 m from the ground surface during both the seasons. The weather parameters during the crop period are presented in Table 1.

Experiment was laid out in factorial RBD with four levels of irrigation viz., irrigation at 15 mm CPE, 30 mm CPE, 45 mm CPE and farmers practice of alternate day irrigation and four levels of nitrogen (0, 30, 60 and 90 kg ha^{-1}) and replicated thrice. The crop was sown during January in both the years and harvest of fruits started 45 days after sowing. Daily pan evaporation was recorded using a USWB class. A pan evaporimeter and added to get the cumulative value. The rain water contribution if any was subtracted from this. Irrigation treatments were scheduled when the CPE values corresponding to the treatments were obtained. The depth of irrigation was 40 mm. The details of irrigation are presented in Table 2.

Before and 24 hours after every irrigation soil samples were collected from 0-15, 15-30, 30-60 and 60-90 cm depths to study the moisture depletion pattern. The moisture extracted from each soil layer by the crop was computed from the following equation and summing up these values at different irrigation intervals, total quantity of moisture depleted was worked out.

Quantity of moisture extract (mm) = Difference in soil moisture content between successive irrigations (%) X depth of soil layer (mm) X bulk density

Table 1. Weather parameters during the crop period (mean values)

Month	Rainfall				Temperature. OC		Open pan evaporation, (mm/day)
	Total mm	No.of rainy days	Total rain fall during crop period mm	Effective rainfall during crop period mm	Maximum	Minimum	
January	-	-			33.13	20.02	3.80
February	-	-	73.8	50.6	34.85	20.81	3.94
March	15.6	2			35.07	23.04	4.39
April	58.2	4			35.30	24.40	4.08

Table 2. Details of irrigations scheduled to bittergourd and fruit yield

Particulars	Irrigation at 15 mm CPE	Irrigation at 30 mm CPE	Irrigation at 45 mm CPE	Farmer's practice
Depth of irrigation, mm	40	40	40	40
No. of irrigation	19	10	7	31
Irrigation water applied, mm	760	400	280	1240
Water requirement, mm	849.5	491.5	372.7	1329.1
WUE	19.5	30.4	37.2	12.8
CU, mm	352	267	234	384
Fruit yield, kg/ha	13895	12667	12008	14100
SEm+		358		
CD (0.05) for fruit yield Irrigation schedules & Nitrogen levels		706		

RESULTS AND DISCUSSION

Moisture use and pattern of extraction

Bittergourd extracted highest quantity of moisture from the top 0- 30 cm layer at all levels of irrigation (Table 3) during vegetative and reproductive stages due to larger root density and more evaporation from the upper layer. The upper 15 cm has contributed 35 to 37 percent of moisture extracter by the crop for irrigation at 15 mm CPE and farmer's practice, during both vegetative and reproductive stages. From the lower most layer only 10-11% was extracted by irrigation at 15 mm CPE. In farmer's practice of irrigation the moisture contribution from the lower most layer was slightly higher. It was observed that roots of bittergourd were more profusely distributed within the 50 cm depth. For plants receiving irrigation at lesser frequent intervals (irrigation at 30 and 45 mm CPE) the contribution from lower layers were comparatively higher. In that treatments, 60% of moisture was extracted from 0-30 cm and remaining 40% from 30-90 cm depth. The water stress has caused deeper penetration of roots in search of moisture and resulted in better moisture absorption from lower layers. About 18-20% of the total moisture extracted was from the lower most layer (60-90 cm) for these two treatments. Proportional contribution from lower layers was more under reduced water supply. Similar observations were reported by Rana and Sharma (1992) and Menon and Marykutty (1993).

Peak period of moisture use for bittergourd was during 25 to 40 days after sowing (DAS) which coincides with the actively growing vegetative period and the start of profuse flowering at all levels of irrigation. Daily water intake by bittergourd for irrigation at 15 mm CPE was 4.33 mm (Table 4) during the initial stages and increased to 5.44 mm towards 25-40 DAS. After that a decreasing trend was observed and the lowest value of 3.77 mm was observed during 70-95 DAS where the crop was nearing the senescence stage. The other treatments also followed a similar trend, but the rate of soil moisture use was lower at lower levels of irrigation and the highest value was noted for once in alternate day irrigation. The daily average of soil moisture use was 4.07 mm for irrigation at 15 mm CPE while that of once in alternate day irrigation was 4.43 mm which results in difference of 31 mm in seasonal consumptive use. From the study it was confirmed that irrigation at 15 mm CPE is sufficient for bittergourd and the peak period of CU is during 25- 40 DAS.

Fruit yield and yield attributes

Fruit yield was significantly influenced by the levels of irrigation and nitrogen. The farmers

Table 3. Moisture extraction pattern of bittergourd (%)

Depth, cm	15 mm CPE		30 mm CPE		45 mm CPE		Farmer's practice	
	vegetative	reproductive	vegetative	reproductive	vegetative	reproductive	vegetative	reproductive
0-15	37.1	35.8	31.0	32.1	30.4	29.6	36.6	36.0
15-30	30.2	32.5	28.4	28.2	27.2	27.0	27.1	28.2
30-60	22.2	21.2	22.6	21.6	21.5	22.8	22.3	23.3
60-90	10.5	11.9	18.0	18.2	20.9	20.6	14.0	12.5

Table 4. Rate of soil moisture use by bittergourd at different growth stages

Levels of irrigation	10-25 DAS	25-40 DAS	40-55 DAS	55-70 DAS	70-95 DAS	Seasonal average
	mm/day					
15 mm CPE	4.33	5.44	4.94	4.54	3.77	4.07
30 mm CPE	3.36	3.88	3.72	3.62	2.71	3.05
45 mm CPE	3.26	3.50	3.37	2.94	2.13	2.67
Farmer's practice	5.07	5.85	5.09	4.89	4.20	4.43

practice of irrigation ie., irrigation once in alternate days recorded the highest yield of 14.1 t ha^{-1} which was statistically on par with irrigation at 15 mm CPE, yielding 13.9 t ha^{-1}. The above two treatments were significantly superior to irrigation at 30 and 45 mm CPE. Since irrigation at 15 mm CPE was on par with farmers practice, it is more economical to irrigate bittergourd at 15 mm CPE (approximately 3 days interval) with 40 mm of water which ensures better water utilization (a saving of 480 mm of water) without affecting the fruit yield.

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(Received : November 97 Revised : August 98)

Madras Agric. J., 85(7-9): 413 - 417 July - September 1998

LABOUR REQUIREMENT FOR ARABICA COFFEE AND CARDAMOM AND ITS RELATIONSHIP WITH PRODUCTIVITY LEVELS IN THE MIXED CROPPING SYSTEMS

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ABSTRACT

The field experiment carried out at Chettalli northern part of Kodagu district, Karnataka revealed that, the mixed cropping of arabica coffee with cardamom able to generate gainful employment 1.90 times higher than the mono crop of arabica coffee. In both the crops the utilisation of women labourers was maximum. A significant correlation between yield levels and labour requirement was observed in arabica coffee. In cardamom, the variation in labour requirement in tune with the yield levels was observed as indicated by their coefficient of variation. Thus, mixed cropping of arabica coffee with cardamom found superior both with respect to generation of gainful employment and income in the high ranges of western ghats.

KEY WORDS : Labour requirement, correlation, yield levels, cardamom, arabica coffee.

In India, coffee has a place of pride among plantation crops and is a leading agro-based industry. It is cultivated in 3 lakh hectares in about 1.4 lakh holdings. Majority of these holdings (98%) are under small grower sector (ha) accounting for 65% of the area contributing around 60% of the country's production. Productivity of these units should be increased by intensive cultivation of coffee, resorting to diversification with suitable perennial crops to improve and sustain high income from available land (Hanumanth Rao, 1986). The selected component crops should have a short gestation and of a high value which can provide flow of income at different periods of the year (Korikanthimath and Peter, 1992).

Coffee industry is a labour intensive one and it provides direct employment to 3.62 lakh persons and to many others in the processing and marketing field. Almost all the operations in coffee and cardamom have to be carried out by manual labourers in the high ranges of western ghats where