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OPTIMISING THE IRRIGATION WATER REQUIREMENT OF CASSAVA

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Cultivation of cassava *(Man/hot esculenta)* under irrigation is widespread especially in the command areas of the state, the planting of which is done in November-December after the withdrawal of north east monsoon. Earlier studies conducted at Chalakudy revealed that supplemental irrigation for this crop had to be scheduled at 0.50 IW/CPE ratio (50 mm depth) during summer season for higher tuber yield (Sushama *et al.*, 1982). In the present study, it is attempted to formulate an irrigation schedule which will further reduce the irrigation water requirement of the crop since water is a scarce input during snmmer season and the need for its optimisation is ever increasing.

Materials and Methods

Tha experiment was taken up for two consecutive years (1982-'83) and (1983-"84) during November-December to May-June in the sandy loam soil (coarse sand 60.9%, fine sand 22.1, silt 5.5% and clay 9.5%) of Agronomic Research Station, Chalakudy. A fertility evaluation of the soil of the experimental field indicated that it contained 0.51 per cent organic carbon, 12.5 kg P_2O_5/ha and 56.2 kg K_2O/ha. The pH of the soil was 5.8. The field capacity and permanent wilting point of the soil were 14.8 and 6.7 per cent, respectively. The depth of water table ranged from 30-120 cm. The weather data during the crop season are furnished in Table 1.

Table 1

Weather data during the experimental period

Month	1982-'83				1S83-'84			
	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Pan evaporation (mm/day)	Maximum temperature (°C)	Minimum temperature (°C)	Rainfail (mm)	Pan evaporation (mm/day)
November	32.6	23.5	164.4	2.81	31.5	25.4	98.5	2.78
December	32.9	20.4	8.6	3.11	30.0	22.5	20.8	3.64
January	35.0	19.5	—	3.93	32.2	21.8	115.1	3.23
February	35.5	22.4	—	4.30	33.8	22.8	—	3.55
March	36.7	24.2	—	5.01	34.2	23.9	62.6	4,00
April	37.2	25.6	10.5	5.49	33.6	25.1	119.6	3.99
May	35.7	26.5	32.2	4.67	34.3	25.3	53.8	4.13

The experiment was laid out in randomised block design with three replications and the following 12 treatments

T_1 All furrow irrigation with 50 mm water at 100 mm CPE
T_2 All furrow irrigation with 3/4 of 50 mm water at 100 mm CPE
T_3 All furrow irrigation with 3/4 of 50 mm water at 75 mm CPE
T_4 All furrow irrigation with 1/2 of 50 mm water at 100 mm CPE
T_5 All furrow irrigation with 1/2 of 50 mm water at 75 mm CPE
T_6 Alternate furrow irrigation alternatively with 25 mm water at 100 mm CPE
T_7 Alternate furrow irrigation alternatively with 25 mm water at 75 mm CPE
T_8 Alternate furrow irrigation alternatively with 3/4 of 25 mm water at 100 mm CPE
T_9 Alternate furrow irrigation alternatively with 3/4 of 25 mm water at 75 mm CPE
T_{10} Alternate furrow irrigation alternatively with 1/2 of 25 mm water at 100 mm CPE
T_{11} Alternate furrow irrigation alternatively with 1/2 of 25 mm water at 75 mm CPE
T_{12} No irrigation control

T, is the present recommended irrigation schedule for cassava and the depth of irrigation to other treatments was fixed in relation to this.

The stakes of cassava cv. M4 were planted on ridges at a spacing of 120 x 80 cm in plots of 7.2 m x 6.0 m size. There were six rows per plot. A uniform fertilizer dose of 50:50:50 kg/ha of NPK was given to all the treatments. All the plots received uniform cultural and plant protection operations as per the package of practices recommendations of Kerala Agricultural University (Anon., 1982). For scheduling irrigation, evaporation readings were recorded daily using a USWB class A pan evaporimeter and whenever the desired cumulative pan evaporation (CPE) values were attained, differential irrigations were administered with varying depths of water, as per the treatments, through furrows. Measurement of irrigation water was done with a circular orifice. The details of irrigation are furnished in Table 2.

Results and Discussion

Tuber yield (Table 3)

A statistical analysis of the data for the individual years and pooled analysis revealed the significant influence of irrigation on tuber yield of cassava.

Among the treatments, the highest tuber yield was recorded by T_1 during both the years of study. It was followed by T_3, T_2, T_5, T_4, and T_7 in the descending order and all these treatments were comparable with T_1 during both the years and in pooled analysis. However, during the second year, T_6 also recorded comparable yield with T_1. As compared to the unirrigated control, yield increases to the tune of 13072, 12811, 12629, 11611, 10661 and 10541 kg/ha were recorded by T_1 T_3, T_2, T_5, T_4 and T_7 respectively. The corresponding increases in percentage were 100, 98, 97, 89, 82 and 81. It can further be seen that all tha irrigated treatments recorded significantly higher yield than the unirrigated control during both the years of the study and in pooled analysis. However the unirrigated control registered comparable yields with T_{10} and T_{11} during the second year of study. Moisture stress due to inadequate amount of irrigation water was responsible for very low yields in T_8 to

Table 2

Details of irrigation

Treatment	* No. of irriga-tions given	Interval between irrigations (days)	Depth of irrigation (mm)	Total irrigation water applied (mm)	Effective rain fall (mm)	Total water require-ment (mm)
T_1	7	27	50.00	350	211	561
T_2	7	27	37.50	253	211	474
T_3	9	20	37.50	338	211	549
T_4	7	27	25.00	175	211	386
T_5	9	20	25.00	225	211	436
T_6	7	27	25.00	175	211	386
T_7	9	20	25.00	225	211	436
T_8	7	27	18.75	131	211	342
T_9	9	20	18.75	169	211	380
T_{10}	7	27	12.50	88	211	299
T_{11}	9	20	12.50	113	211	324

* Inclusive of one common irrigation

Table 3

Tuber yield and WUE of cassava as influenced by irrigation

Treatment	Tuber yield (kg/ha)			WUE (kg/ha mm)
	1982—'83	1983—'84	Pooled mean	
T_1	22076	30208	26142	46.6
T_2	21883	29514	25699	54.2
T_3	22073	29688	25881	47.1
T_4	19188	28274	23731	61.5
T_5	20048	29313	24681	56.6
T_6	17320	26313	21817	56.5
T_7	19097	28125	23611	54.2
T_8	15311	24264	19788	57.9
T_9	18229	25136	21683	57.1
T_{10}	12980	23438	18209	60.9
T_{11}	18089	24479	21284	65.7
T_{12}	5828	20312	13070	61.9
CD (0.05)	3572	4528	3249	

T_{12}. The study conclusively proved the profound influence of supplemental irrigation in boosting tuber yield of cassava.

In terms of water use efficiency (WUE), the low yielding treatments (T_8 to T_{12}) with their low water requirement recorded higher values than the high yielding treatments (T_1 to T_7). However, among the high yielding treatments T_4 recorded the highest WUE, lowest being by T_1.

Among the six treatments which recorded consistently higher tuber yield during both the years of study and in pooled analysis, T_1 required the highest amount of irrigation water (350 mm) followed by T_3 (338 mm). T, (263 mm), T_7/T_5 (225 mm), and T_4 (175 mm) (Table 2). The yield being comparable with T_1, the present recommended schedule, it can be inferred that T_4 followed by T, and T_5 are the superior treatments in view of their reduced irrigation water requirement. T_4 and T_5 are similar treatments which received 1/2 water (25 mm depth) through all furrow irrigation except that T_5 received irrigation at 75 mm CPE whereas T_4 received irrigation at 100 mm CPE. Hence between the treatments, T_4 is better than T_5 since it requires only less number of irrigations and amount of water, the depth and method being the same. Though both T_7 and T_5 required the same quantity of irrigation water, T_7 can be considered as a better treatment since it needs only half the number of furrows to be irrigated at a time which definitely lowers the labour requirement. The IW/CPE ratios for T_4 and T_7 were worked out to 0 25 and 0.33 respectively, indicating considerable improvement over 0.50 ratio reported by Sushama *et al.*, (1982). Accordingly, the following two treatments ensuring efficient water consumption and higher tuber production were identified from the study: i) All furrow irrigation with 25 mm water at 100 mm CPE and ii) Alternate furrow irrigation alternatively with 25 mm water at 75 mm CPE. The first schedule requires seven irrigations at an interval of about 27 days. whereas the second schedule requires nine irrigations at an interval of 20 days.

Biometric and yield characters (Table 4)

The irrigation treatments significantly influenced all the three biometric characters studied viz., height of plant and number of total and functional leaves per plant. The unirrigated treatment invariably recorded significantly lower values as compared to the irrigated ones. However, the irrigated treatments were comparable among themselves except in the case of number of total leaves per plant wherein T_6, T_{10} and T_{11} recorded signficantly lower values. The higher number of leaves per plant provided more photosynthetic surface for assimilation of food thereby increasing the tuber yield in irrigated treatments.

While the number of tubers per plant and weight per tuber were significantly influenced by irrigation its effect was non-significant on the length and girth of tuber. However, the lowest values were invariably recorded by the unirrigated control. The number of tubers per plant and weight per tuber were found to b3 comparatively higher in those treatments which ranked high in their tuber yields.

Table 4

Biometric and yield characters of cassava as influenced by irrigation

Treatments	Height of plant (cm)	No. of total leaves per plant	No. of functional leaves per plant	No. of tubers per plant	Weight per Tuber (g)	Length of tuber (cm)	Girth of tuber (cm)
T_1	174.7	180.9	75.2	8.9	240	24.5	12.8
T_2	173.9	176.6	81.8	7.9	229	22.7	12.4
T_3	174.1	175.4	82.0	8.8	231	22.2	12.5
T_4	150.5	170.3	79.1	7.7	227	25.1	12.0
T_5	152.9	172.1	79.3	7.8	252	23.4	12.6
T_6	151.0	149.8	77.3	6.0	202	22.7	11.1
T_7	156.1	168.9	83.1	7.6	214	22.2	12.0
T_8	172.8	164.0	84.7	6.5	196	21.0	12.0
T_9	175.2	166.4	86.5	6.0	205	21.9	12.1
T_{10}	174.7	139.3	76.8	5.3	203	20.9	12.0
T_{11}	174.3	140.3	79.4	6.0	206	20.4	12.3
T_{12}	114.7	99.2	50.7	4.9	104	15.9	8.6
CD (0.05)	27.5	26.8	15.1	1.4	62	NS	NS

Summary

A two year study was undertaken at the Agronomic Research Station, Chalakudy during 1982-'83 and 1983-'84 to formulate a suitable water management schedule which optimises the irrigation water requirement of cassava planted during November-December months. The trial consisted of 12 irrigation treatments (unirrigated and irrigated at 75 mm and 100mm CPE, through all furrows and alternate furrows and with varying quantities of irrigation water (Recommended (50 mm) and its 3/4 and 1/2 depths) in different combinations. Two treatments having the added advantages of economy in water and labour viz., (i) All furrow irrigation with 1/2 water (25 mm) at 100 mm CPE and (ii) Alternate furrow irrigation alternatively with 25 mm water at 75 mm CPE were identified. the first schedule approximately requires seven irrigations at an interval of 27 days whereas the second schedule requires nine irrigations at an interval of 20 days,

References

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