Agric. Res. J. Kerala 27 (1989) : 27 - 31

RESPONSE OF SESAMUM TO WATER MANAGEMENT PRACTICES UNDER VARYING LEVELS OF NITROGEN

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Abstract: A field experiment on **sesamum** ***(Sesamum indicum)*** with five water management practices (No irrigation and irrigation at 0.25, 0.50 and 0.75 **IW/CPE** ratios and at critical stages of **3-4** leaf stage, **branching,** flowering and pod formation) and four nitrogen levels (0, 15, 30 and 45 kg **N/ha)** was conducted in the sandy loam soil of the Agronomic Research **Station,** Chalakudy during the three summer seasons of 1983, 1985 and 1986. Irrigating sesamum with 40 mm water at the critical stages of 3 - 4 leaf stage, branching, flowering and pod formation or at 0.75 IW/CPE ratio (at an approximate interval of 13 days) resulted in significant higher grain yield as compared to **unirrigated** or less frequently irrigated crops. The response to nitrogen application up to 45 **kg/ha** was linear in nature having no interaction effect with water management practices. However, the yields of grain at 30 and 45 **kg/ha** of nitrogen were comparable.

INTRODUCTION

Sesamum is an important oilseed crop widely cultivated during summer season in the rice fallows of Kerala utilising residual moisture. Due to the occurrence of soil moisture stress, the productivity of the crop is very low during the season. Earlier studies, based on critical phytophase approach, conducted at the Agronomic Research Station, Chalakudy revealed the possibility of boosting sesamum yield by scheduling irrigation at selected critical stages of the crop **(Ramankutty** *et al.*, 1980). In the present study an attempt is made to formulate an optimum irrigation schedule for sesamum during summer season based on **climatological** approach which is considered as more reliable. It is also intended to find out the nitrogen requirement of irrigated sesamum.

MATERIALS AND METHODS

The experiment was conducted at the Agronomic Research Station, Chalakudy during the summer seasons of 1983, 1985 and 1986. The soil of the experimental field was sandy loam in texture having a bulk density of 1.45 **g/cc** and pH 5.5. It contained 0.53 per cent organic carbon and 7.7 and 25.7 **kg/ha** of available P and K, respectively. The field capacity and wilting point were 19.2 and 9.3 per cent respectively. The water table depth was below 2.0 m during the crop period. The important weather conditions during the cropping season are furnished in Table 1. The crop received 10.5 mm, 36.1 mm and 25.8 mm of rainfall in two, two and five rainy days in the first, second and third years, respectively. The other weather parameters **viz.,** the maximum and minimum temperature and the open pan evaporation did not show much variation.

The treatments consisted of five water management practices (No irrigation and irrigation at IW/CPE ratios of 0.25, 0.50 and 0.75 and at critical stages of **3-4** leaf stage, branching, flowering and pod formation) and four nitrogen levels (0, 15, 30 and 45 kg **N/ha).** The experiment was laid out in split plot design with water management practices in the main plot and nitrogen levels in the subplot, with four replications. The test variety was **Kayamkulam** 1 which was sown at a spacing of 25 cm x 15 cm adopting a seed rate of 5 **kg/ha.**

All the plots received 15 kg P_2O_5**/ha** and 30 kg K_2O**/ha** and nitrogen as per treatments. Full dose of phos-

Table 1. Weather conditions during the cropping season

	Rainfall		Temperature (°C)		Open pan evaporation (mm/day)	Relative humidity (%)
	Total (mm)	No. of rainy days	Maximum	Minimum		
1983						
January	-	-	35.0	19.5	3.93	78.4
February	-	-	35.5	22.4	4.30	77.3
March	-	-	36.7	24.2	5.01	79.9
April	10.5	2	37.2	25.6	5.50	72.5
1985						
January	112.9	5	32.8	21.3	3.36	85.6
February	0.4	-	34.1	22.6	4.25	84.4
March	-	-	35.3	24.4	4.65	83.6
April	33.7	2	34.0	25.0	4.36	77.8
1986						
January	1.4	-	32.9	20.2	3.36	82.7
February	0.6	-	33.7	22.4	4.11	79.7
March	25.2	5	35.2	23.8	4.16	77.9
April	80.3	6	35.5	25.3	4.95	79.9

phorus and potassium were applied as basal along with half the dose of nitrogen. The remaining half of nitrogen was applied as two per cent foliar spray one month after sowing. Other cultural and management practices were done as per the package of practice recommendations of the Kerala Agricultural University (Anon., 1981).

One pre-sowing irrigation was given to all the treatments including the no irrigation control to ensure good germination. For scheduling irrigation, evaporation readings were recorded daily using a USWB class A pan evaporimeter and whenever cumulative pan evaporation minus effective rainfall reached 160 mm, 80 nun and 533 mm differential irrigations were given at a depth of 40 mm to 0.25, 0.50 and 0.75 1W/CPE ratios respectively. Irrigation at critical stages were administered by judging the growth stage of the crop. The details of irrigation are furnished in Table 2.

RESULTS AND DISCUSSION

Grain yield

Statistical analysis of the yield data revealed the significant effect of water management practices and nitrogen levels during all the three years of study. The interaction effect was significant in none of the years.

Among the water management practices, the highest grain yield was recorded when irrigations were scheduled at 0.75 IW/CPE ratio followed by the treatment receiving irrigations at the four critical growth stages, both of which were comparable during all the years of study. These were followed by the schedules receiving irrigations at 0.50 and 0.25 IW/CPE ratios and invariably the lowest yield was recorded by the no irrigation control. The two top yielding treatments viz., the schedule receiving irrigation at 0.75 IW/CPE ratio and at critical growth

Table 2. Details of irrigation

Particulars	Water management				
	No irrigation	0.25 IW/CPE ratio	0.50 IW/CPE ratio	0.75 IW/CPE ratio	Irrigation at critical stages
00 *Total number of irrigations given during the crop season	1	3	4	6	5
(b) Depth (mm) of water applied each time	40	40	40	40	40
(c) Total water applied (mm) during the crop season	40	120	160	240	200
(d) Interval between irrigation (days)	-	28	17	13	-
(e) Method of irrigation followed	Check basin	Check basin	Check basin	Check basin	Check basin

* includes one pre-sowing irrigation

Table 3. Grain yield sesamum (kg/ha) as influenced by water management and nitrogen levels

Treatments	1983	1985	1986	Pooled mean	WUE (kg/ha mm)
Water management	155	458	381	331	8.3
No irrigation	214	554	487	419	3.5
Irrigation at 0.25 IW/CPE ratio	295	655	544	498	3.1
Irrigation at 0.75 IW/CPE ratio	405	797	713	638	2.7
Irrigation at critical stages	325	741	698	588	2.9
CD (0.05)	86	116	147	-	
Nitrogen levels (kg/ha)					
0	244	516	478	413	-
15	265	598	530	464	-
30	294	697	610	534	-
45	312	753	642	569	-
CD (0.05)	46	63	74	-	-
Interaction	NS	NS	NS	-	-

stages recorded a mean yield increase of 307 and 257 kg/ha, respectively, over the unirrigated control. The corresponding increases in percentages were 93 and 78. While 0.75 IW/CPE received six irrigations and 240 mm of water, critical stage irrigation received five irrigations and 200 mm of water. The water use ef-

Table 4. Economics of treatments (three year mean)

Treatments		Gross income (Rs/ha)	Cost of production (Rs/ha)	Net return (Rs/ha)	Benefit: cost ratio
Water management					
No irrigation		2648	1415	1233	1.87
Irrigation at 0.25 IW/CPE ratio		3352	1495	1857	2.24
Irrigation at 0.50 IW/CPE ratio		3984	1535	2449	2.60
Irrigation at 0.75 IW/CPE ratio		5104	1615	3489	3.16
Irrigation at critical stages		4704	1575	3129	2.99
Nitrogen levels (kg/ha)	0	3304	1410	1894	2.34
	15	3712	1488	2224	2.49
	30	4272	1566	2706	2.73
	45	4552	1644	2908	2.77

Price of sesamum : Rs 8.00 per kg grain
Cost of nitrogen : Rs 5.20 per kg N
Cost of irrigation : Rs 10.00 per ha cm

ficiencies (WUE) of these two treatments were almost similar (Table 1). The study conclusively proved the benefit of irrigating sesamum during summer reason in boosting grain yield. Considering the three year data which showed almost identical results it could be concluded that sesamum is to be irrigated at 0.75 IW/CPE ratio (at an approximate interval of 13 days) or at the four critical stages of 3-4 leaf stage, branching, flowering and pod formation for higher grain production during summer season.

The grain yield showed an increasing trend with every incremental doses of nitrogen. The response function to nitrogen application was found to be linear in nature. Consequently the lowest yield of 413 kg/ha was recorded by the no nitrogen control and the highest yield of 569 kg/ha by 45 kg N/ha. The application of 15, 30 and 45 kg N/ha resulted in an yield increase of 12, 29 and 38 per cent over the no nitrogen control. However, the yields recorded at 30 and 45 kg N/ha were found to be on par during all the three years. The optimum dose of nitrogen was not influenced by the water management practices as indicated by the absence of any significant interaction between the two factors.

Haulm yield

Both the water management practices and nitrogen levels significantly influenced the haulm yield of sesamum while the effect due to interaction was non-significant. Among the water management practices, the highest haulm yield was obtained when irrigated at 0.75 IW/CPE ratio which was on par with 0.5 IW/CPE ratio and critical stage irrigation except during the first year wherein critical stage irrigation recorded significantly lower yield. The trend was more or less similar to that of grain yield. The increased haulm yield was directly related to the increased vegetative growth facilitated by the favourable influence of irrigation.

Except during the first year, application of 45 kg N/ha out yielded all the lower levels significantly in haulm

yield. However, the haulm production at this level of nitrogen did not seem to favourably influence grain yield since grain production at 30 and 45 kg N/ha was observed to be on par.

Growth and yield attributes

The water management practices significantly influenced the height of plant and number of leaves and pods per plant. Though not significant other growth and yield attributes were also favourably influenced by the irrigation levels. The increased grain and haulm yield at higher levels of irrigation can be attributed to the positive influence of optimum soil moisture on the different growth and yield attributes of sesamum.

Except the number of grains per pod and 1000 grain weight, all the growth and yield attributes were significantly influenced by the graded levels of nitrogen. However, the number of grains per pod and 1000 grain weight also showed an increasing trend with an increase in the level of nitrogen. In most cases, 30 and 45 kg N/ha recorded comparable values. The favourable influence of higher levels of nitrogen on the growth and yield attributes had reflected on the haulm and grain production.

Economics

Among the water manamgement practices, the highest gross income, net return and benefit:cost (B:C) ratio were recorded by the treatment receiving irrigation at 0.75 IW/CPE ratio. Though the highest gross income, net return and B:C ratio were recorded when nitrogen was applied at 45 kg/ha, the increase was only marginal as compared to 30 kg/ha of nitrogen. However, all these values were drastically reduced in control and the 15 kg/ha nitrogen treatment.

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