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Effect of spacing, Row Distance and Nitrogen leavel on leaf area, Leaf area index and Weight of leaves in Sesamum indicum L.**

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In a field study at the Tamil Nadu Agricultural University the influence of Spacing (15 and 30 cm), row distance (20, 30 and 40 cm) and nitrogen levels (0, 20, 40 and 60 Kg/ha) on the leaf. leaf area, weight and the yield of *Sesamum indicum* L was investigated. Marked reduction in the number of leaves, leaf area, weight of leaves was noticed in the rainfed rather than in summer crop. In Sesamum variations in leaf area are outstanding phenomena caused primarily by spacing and also row to a certain extent. An interaction of spacing and nitrogen effects involved whose efficiency in improving the source is considerably restricted by shading. Shading caused leaf area and concomitant reduction in yield due to light interception.

In the study of spacing in Sesamum agronomy shading manifests itself as the outstanding central theme. As shading leads to reduction of leaf area, presumably due to temperature and nitrogen. It is needless to emphasis the pivotal role of leaves in crop productivity. Milthorpe (1956) in an excellent publication presents a wide amplitude of environmental factors that modify leaf growth. Light intensity has its subtle influence on leaf area production. In India earlier studies have brought out the marked influence of photoperiod a leaf heteromorphism index to the crop.

METERIAL AND METHODS

In order to find out the effects of spacing (15 and 30cm) row distance (20, 30 and 40cm) and nitrogen levels (0, 20, 40, 60 Kg/ha) on the leaf, leafarea and leaf weight of *Sesamum indicum* L. and finally the yield a study was undertaken at the Tamil Nadu Agricultural University, Coimbatore–3 during 1975 both in summer and rainfed seasons. Split plot design was adopted involving three factors, spacing and row distance in main plots and nitrogen in sub-plots replicating three times.

RESULTS AND DISCUSSION

Effect on number of leaves: The effect of spacing, row distance and nitrogen levels was considered for the production of leaves per plant in 30 days old crop. (Table 1)

The leaf production was considerably reduced in the rainfed season. wider spacing appeared to reduce the production of leaves. Both spacing and spacing-nitrogen interaction had significant effect. Effect of row distance was also seen where high row distance tended to decrease leaf production which

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however was not borne out by stastistical significance.

Effect on Leaf area Index: Leaf area index is helpful for evaluating the response of Sesamum. This again is considered with reference to crop growth progressively 30 and 60 days after sowing and also at harvest. Data are presented as pooled values of nitrogen for bringing out the influence of spacing as well as row distance besides the progressive changes with age of the plant (Table 2) The trend is compared for the two seasons, summer and rainfed. Marked reduction in LAI is met with in rainfed season. A decline in LAI is effected by increasing row distance and this is much more marked with wide spacing. The difference is appreciable when the crop is at 30 days stage. LAI values were halved when row distance is raised from 20cm to 40cm. For the same row distance, the corresponding values for wide spacing are also halved. This aspect so closely linked to productivity is an important phenomenon as environmental effect in Sesamum. The LAI increased to fourfolds at the time of harvest. The increase in LAI was at a faster rate under wider spacing and narrow spacing in summer(2.4 vs 2.93). In rainfed the impact is of a much higher order (1. 68 vs 2.19).

An association of LAI with yield becomes difficult in the absence of precise studies on Sesamum regarding optimal LAI. A consideration of leaf weight as well as leaf area at close intervals has been made for assessing the relative soundness in reckoning the parameter as the basis for associating with production. The suitability of this parameter may be established in spacing studies. Pooled nitrogen values are presented for leaf weight and leaf area for narrow and wide spacing and for low, medium and high row distance as a function of age for both summer and rainfed seasons (Table 3)

Leaf weight is more in summer than in rainfed. This difference in weight is influenced by spacing. This is once again modified by row distances. With narrow spacing the rapid increase in leaf weight in summer in contrast to rainfed is maintained at all row distances. With wide spacing the same observation may be made except that under high row distance even rainfed promotes leaf weight equally fast. An overall similarity in trend between leaf weight and leaf area obtained from pooling the values of nitrogen values and row distances is noticed. The effect of season is conspicuous both in terms of area and weight; a reduction is met with under rainfed season. Apart from this, in summer, with narrow spacing the leaf area and also leaf weight do not continue to increase about the 50th day but subsequently they increase. Wider spacing tended to incease the leaf weight Leaf area index increase over the period 30 to 80 days is larger in summer than rainfed at corresponding row distances when spacing is narrow (Table 4). Wide spacing with medium row distance shows larger differences. These observations estimated along-side leaf weight and leaf area time trends only bring out the effect of spacing where in leaf weight fluctuates to a lower extent while leaf area changes are wide.

In the light of non-uniform trends it is difficult to be specific as regards the effect of spacing. Even though a remarkable parallel trend between leaf area and leaf weight may be noted. It is the extent of change that is pertinent in considering the impact in terms of photosynthetic efficiency leading to yield. For this purpose row distance has been pooled and difference over narrow spacing is expressed as percent (Table 5). In rainfed on the 30th, 40th and 80th days a reduction in leaf area, accompanied by a reduction in leaf weight has occured. In addition on the 70th day leaf area has increased due to spacing but the corresponding event on leaf weight tended to decrease

The significance of leaf area-leaf weight relationship may be appreciated as a funtion of plant development The stage at the 50th day is post-flowering phase when both in summer and rainfed increase in leaf weight dominates over the leaf area change. This is well-poised for subsequent development, but the effectiveness is conditioned by the subsequent favourable environment. This is considered between 60th and 80th days which is boxed in Table 5. It may be noted that virtually no deviation has occurred between leaf area and leaf weight indicating unfavourable environment in summer which may be studied in justaposition with rainfed. In summer a reduction of maximum temperature due to untimely receipt of rain has possibly operated against of translocating efficieney while a steady higher temperature has prevailed during the corresponding phase in rainfed. On 70th day there was an increase in leaf area by 27.53 percent a decrease in leaf weight to the extent of 7.43 percent have resulted indicating perhaps the efficient translocation of photosynthates. The significance of this phenomenon is reflected distinctly in yield increase due to spacing. The crop requires heavy nitrogen supplements to annull the downward yield trend. Strangely enough wide spacing is benefitted by nitrogen supplements. Also it had reduced leaf area. However, beyond 20 kg/ha nitrogen disturb the optimal balance essential for photosynthetic efficiency' resulting in low yield (Table 6).

In the present investigation in sesamum, variation in leaf area is an outstanding phenomenon caused primarily by spacing and also row to a certain extent. The effect of nitrogen undoubtedly has marked impact on leaf area. An interaction of spacing and nitrogen effects is involved whose efficiency in improving the source is considerably restricted by shading. Shading has the same effect of reduced leaf area from the point of view of light interception reduces the yield. The seed yield difference, can be traced only to spacing but not sustained stastistically. The conspicuous feature has been the high yield obtained in rainfed in the 516.0-661.3 kg/ha range, contrasting with the summer yield in the 132.9-655.4 kg/ha range. Yield reduction noticed due to addition of nitrogen both in the light of spacing and row distance has turned out to be a source-limited phenomenon and not sink-limited.

The present results has shown that the effect of nitrogen in the direction of improving the source has operated so as to annull the benefit of spacing suggesting a harmful effect of nitrogen. Incidentally spacing as an economic agronomic practice emerges as a dominating influence whereas nitrogen supplement would seem to be not desirable.

Sesamum undergoes notable changes in leaf shape due to temperature effect and in this context "leaf weight", "leaf area" relationship assume importance. The relative chages in leaf weight and leaf area evaluated bring out the subtle environmental differences prevalent in both the seasons summer and rainfed. The maximum seed yield of 655.4 Kg/ha is effected by "wide" spacing (30 cm) and "high" row distance (40 cm) with 20 kg/ha as nitrogen supplement, as against a minimal seed yield of 132.9 kg/ha with "narrow" spacing (15 cm) and "low" row distance (20 cm) with 60 kg/ha as nitrogen supplement. An interesting feature is the 'unfavourable' effect of nitrogen. The beneficial effects of 'high' row distance and 'wide' spacing are annulled by nitrogen supplements. The higher the dosage, the greater the depression in seed yield. This mechanism operating through an increase of leaf area to an undesirable degree entailing 'Shading effect.

REFERENCES

MILTHORPE, F. L. 1956 'The growth of leaves. Butterworths Scientific Publications, London.

Table 1. Effect of spacing (15 and 30 cm), row distance (20, 30 and 40 cm) and nitrogen (0, 20, 40 and 60 Kg/ha) on number of leaves per plant

Spacing (cm)	Row Distance (cm)	Summer				Rainfed			
		ON	20N	40N	60N	ON	20N	40N	60N
15	20	12.2	12.1	12.0	12 4	7,8	8.4	8.3	8.4
	30	12.6	12.8	12.0	12.4	8.2	8.4	8.9	8 6
	40	11.2	11.4	11.6	10.9	7.8	8.5	7.9	8,5
30	20	11.1	11.2	10 9	11.4	8.1	8.1	8.4	7.8
	30	12.4	12,6	11.7	11.6	7.6	7.3	8.3	7.2
	40	11.3	12.1	12 5	11.6	7,9	7.2	7.7	7,2

Abstract of stastical significance Number of leaves

Stage days	Summer							Rainfed						
	S	R	N	SR	RN	SN	SRN	S	R	N	SR	RN	SN	SRN
30	-	-	-	-	-	-	-	*	-	-	-	-	*	-

* 5 per cent S: Spacing R; Row distance N: Nitrogen

Table 2. Effect of spacing (15cm and 30cm), Row distance (20, 30 and 40cm) and the stage of the plant (30 and 60 days and harvest) on LAI

Spacing	Row	Summer 30	Summer 60	Summer Harvest	Rainfed 30	Rainfed 60	Rainfed Harvest
15	20	1.007	1.941	3.812	0.732	1.278	2.825
	30	0.703	1.945	3.626	0.487	0.931	2.073
	40	0.565	1.712	2.446	0.371	0.465	1.425
	Mean	0.758	1.866	3.295	0.530	0.891	2.108
30	20	0.513	1.640	1.895	0.358	0.599	1.332
	30	0.384	0.932	1.883	0.224	0.532	0.767
	40	0.266	0.836	0.988	0.178	0.519	0.834
	Mean	0.388	1.136	1.590	0.253	0.550	0.978

Table 3. Effect of Spacing (15 and 30cm) row distance (20, 30and40cm) on leaf weight and leaf area time trend (Pooled Nitrogen values)

Age	Summer						Rainfed					
	Narrow Spacing			Wide Spacing			Narrow Spacing			Wide Spacing		
(Days)	L 20R	M 30R	H 40R	L 20R	M 30R	H 40R	L 20R	M 30R	H 40R	L 20R	M 30R	H 40R
	Leaf Weight (g)/plant											
30	1.89	1.88	2.12	1.93	2.16	2.01	1.41	1.43	1.46	1.39	1.33	1.39
40	2.85	3.54	2.94	3.60	2.90	2.84	2.11	2.25	2.40	2.19	1.77	1.98
50	4.76	5.70	5.48	5.01	6.19	5.51	2.21	3.00	2.05	3.12	3.32	4.75
60	3.60	5.52	6.21	5.94	5.30	6.32	1.92	2.68	1.82	2.32	3.05	3.98
70	5.65	6.24	5.71	6.17	6.87	5.90	3.75	5.49	5.63	6.38	4.92	7.67
80	7.18	10.23	9.20	7.16	10.63	7.46	5.33	5.77	5.39	5.04	4.37	6.31
	Leaf Area (cm^2)											
30	75.5	79.3	84.8	77.0	86.3	80.0	55.0	67.5	56.0	54.0	51.0	53.0
40	121.8	141.5	117.5	144.0	115.8	113.5	84.0	88.0	95.0	86.0	69.0	77.7
50	175.5	228.0	219.0	200.5	247.5	220.5	87.0	118.0	80.0	73.0	137.0	133.0
60	146.0	219.0	257.0	246.0	210.0	251.0	96.0	105.0	70.0	90.0	120.0	121.7
70	226.0	259.0	228.5	246.8	274.5	236.0	149.0	218.0	225.0	254.0	195.0	251.7
80	286.0	408.0	367.0	285.0	424.0	295.0	212.0	225.0	214.0	200.0	173.0	208.0

Table 4. Effect of Spacing (15, and 30 cm), Row distance (20, 30 and 40cm) on Leaf Area Index (LAI) Time Trend

Age Days	Summer						Rainfed					
	15S			30S			15S			30S		
	20R	30R	40R	20R	30R	40R	20R	30R	40R	20R	30R	40R
30	1.007	0.703	0.565	0.513	0.384	0.266	0.732	0.487	0.370	0.358	0.224	0.178
40	1.624	1.255	0.783	0.959	0.513	0.378	1.119	0.781	0.632	0.573	0.305	0.258
50	2.534	2.025	1.459	1.335	1.098	0.734	1.159	1.046	0.532	0.824	0.607	0.604
60	1.946	1.945	1.712	1.646	0.932	0.835	1.278	0.931	0.465	0.599	0.532	0.519
70	3.011	2.301	1.522	1.645	1.218	0.785	1.986	1.936	1.498	1.692	0.864	1.020
80	3.812	3.626	2.446	1.898	1.883	0.988	2.826	1.998	1.425	1.332	0.767	0.844

Table 5. Leaf weight, Leaf Area change Percent over 15cm Spacing (±)

Seasons	Weight or Area	Days 30	40	50	60	70	80
Summer	Weight	2.52	-2.34	5.01	13.67	6.02	-5.08
	Area	1.57	-1.97	-16.71	13.67	6.13	-5.33
Rainfed	Weight	-4.22	-12.73	67.54	35.06	-7.43	-2.65
	Area	-10.92	-12.73	40 00	34.67	27.53	-4·15

Table 6. Effect of spacing (15 and 30 cm) Row distance (20, 30 and 40 cm) and Nitrogen (0, 20, 40 and 60 kg/ha) on seed yield kg/ha

Spacing	Row	Summer ON	20N	40N	60N	Rainfed ON	20N	40N	60N
15	20	185.2	211.1	394.0	132.9	549.3	620.0	562.3	516.0
	30	277.2	325.8	281.8	465.2	632.0	650.3	654.0	582.6
	40	358.1	258.5	160.7	422.5	585.0	529 0	563.6	626.0
	Mean	273.5	265.1	278.8	340.2	588.8	599.8	593.3	575.9
	20	484.5	375.8	376.2	287.9	537.6	574.0	608.0	594.0
30	30	423.6	325.4	360.2	526.0	610.6	632.3	661.3	597.0
	40	498.8	655.4	504.3	481.0	577.0	636.0	675.0	631.3
	Mean	469.0	452.2	413.6	431.6	575.1	614.1	648.0	607.4