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EFFECT OF TIME AND QUANTITY OF NITROGEN ON DRY MATTER ACCUMULATION IN SORGHUM

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Field experiments were conducted in summer and *kharif* 1974 under irrigation to study the effect of time and quantity of N application on dry matter accumulation in Sorghum (CSH. 5). Sampling was done from 20th day of sowing until maturity (100 days) at an interval of 10 days from specially reserved sample rows. Plants were dried and dry matter estimated. Application of entire quantity of N basally, especially at higher doses (over 150 kg/ha) caused an initial set back on the growth of the plant. Foliar application of N in the early stages increased the dry matter production. The dry matter accumulation was slower in *kharif* than in summer mainly due to moderate temperature prevailing in that season. In summer, the rate of dry matter production was rapid and reached peak in the grand growth period (40-50 days) but in *kharif* the dry matter accumulation was steady and spread out for the entire cropping period.

Sorghum agronomy has undergone a revolutionary change with the introduction of high yielding hybrids. These hybrids accumulate dry matter very rapidly and have the capacity to distribute a greater portion of the accumlated dry matter to reproductive parts, thereby increasing the harvest index. But the potentiality of these hybrids cannot be fully exploited without sound N management. This envisages supply of N at the time when the crop needs it most. Banda Rao and Reddy (1973) observed that increased levels of nitrogen (0 to 150 kg N/ha) increased the dry matter production at all the stages of plant growth. Anand Rao and Reddy (1973) also reported the similar results. Warsi (1973) concluded that treatments differed in rate of accumulation of dry matter. Accumulation was faster in fertilized plots than in unfertilized plots. Maximum accumulation of dry matter occurred during dough stage. Most of stem and leaf growth was completed by the time of anthesis. More than 50 per cent of total dry matter accumulated in reproductive phase. About 70% of it was contributed by the panicle. Roy and Wright (1974) reported that the rate of dry matter accumulation in fertilized

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Table 1. Treatment schedule

Summer, 1974		Kharif, 1974	
Treatments	Symbol	Treatments	Symbol
Main plot : Four levels of N		*Main plot* : Four levels of N	
0 kg/ha	N_0	50 kg/ha	N_{50}
50 kg/ha	N_{50}	100 kg/ha	N_{100}
100 kg/ha	N_{100}	150 kg/ha	N_{150}
150 kg/ha	N_{150}	200 kg/ha	N_{200}
Sub plot : Six times of application		*Sub plot* : Five times of application	
All N at planting	T_1	$\frac{1}{5}$ at planting and $\frac{1}{5}$ on 30th day	T_1
$\frac{1}{2}$ at planting, $\frac{1}{2}$ on 40th day	T_2	$\frac{1}{3}$ each at planting, 30th and 45th day	T_2
$\frac{1}{4}$ at planting, $\frac{1}{4}$ each on 26th, 52nd and 80th day	T_3	$\frac{1}{4}$ each at planting, 30th, 45th and 60th day	T_3
$\frac{1}{5}$ each at planting, on 15th, 30th, 45th, 60th, and 80th day	T_4	$\frac{1}{5}$ each at planting, 30th, 45th, 60th and 75th day	T_4
$\frac{1}{6}$ each at planting, on 20th, 30th, 40th, 50th, 60th, 70th and 80th day	T_5	Foliar application $\frac{1}{5}$ at planting through soil and $\frac{4}{5}$ in equal quantities on 30th, 46th and 60th day	T_5
Foliar application : $\frac{1}{5}$ at planting through soil and $\frac{4}{5}$ through foliage in equal quantities on 40th, 60th and 80th day.	T_6		
Date of sowing :	Feb. 24, 1974		July 20, 1974
Date of harvest :	May 31, 1974		Nov. 1, 1974

Split plot design with 3 replications. Plot size : 4.5x3.0 m (Gross)
A common application of 45 kg/ha each of P_2O_5 and K_2O was applied to all plots at the time of planting

plants was rapid early in the season and continued almost linearly until maturity but in unfertilized plants it began to drop atter 70 days. With a view to find out the effect of time and quantity of N application on the dry matter accumulation of the popular sorghum hybrid (CSH 5), this investigation was undertaken.

MATERIALS AND METHODS

Field experiments were conducted during summer (February-May) and *kharif* (July - November) seasons in 1974 with Sorghum (CSH.5). The treatment schedule is given in Table 1. The summer experiment was conducted on a black clay loam soil (pH 8.2)

Table 2. Dry matter accumulation (g/plant) at various stages of crop growth summer 1974.

Treatments	Days after sowing							
	20	30	40	50	60	70	80	90
Nitrogen levels :								
N_0	0.54	3.21	9.46	21 77	38.36	63.67	81.80	90.56
N_{50}	0.64	3.40	8.61	30.15	44.12	84.60	105.01	128.23
N_{100}	0.52	3.06	9.34	26.94	50.57	81.61	99.76	117.53
N_{150}	0.61	2.68	8.15	28.62	51.56	90.95	107.12	125.14
Time and method of N application :								
T_1	0.62	2.58	8.16	24.54	44.73	89.22	98.30	124.66
T_2	0.55	2.91	8.77	25.04	47.00	86.58	100.51	116.01
T_3	0.47	3.23	9.05	30.86	52.82	83.83	112.37	132.05
T_4	0.58	3.03	8.78	28.07	51.23	87.06	104.93	126.46
T_5	0.65	3.25	8.16	30.32	48.95	85.23	104.16	121.41
T_6	0.66	3.27	9.26	32.57	47.78	82.38	103.51	121.21
Grand mean	0.59	3.05	8.70	28.57	48.75	85.72	103.96	123 63

Table 3. Dry matter accumulation (g/plant) at various stages of crop growth *kharif* 1974.

Treatments		Days after sowing								
		20	30	40	50	60	70	80	90	100
Nitrogen levels :										
N	N_{50}	0.62	3.06	6.14	19 88	37.08	63.13	87.21	111.52	122.00
	N_{100}	0.66	4.16	6.63	21.26	39 60	64.44	95.37	120.78	140.41
	N_{150}	0.68	4.00	8.45	28.76	48.35	71:30	97.30	119.94	141.52
	N_{200}	0.68	4.66	9 60	33.25	49 54	72 92	92.38	120.36	138.88
Time and method of N application :										
	T_1	0.65	4.43	7.75	24.99	42.13	66.91	93.30	118.15	133.65
	T_2	0.67	3.76	8 58	25.80	42 96	67.11	92.75	117.80	135.14
	T_3	0.66	3.60	7.64	26.30	44.90	68.56	94.43	121.30	141.20
	T_4	0.70	3.78	7.40	26.05	43.55	73.11	92.97	116.27	137.70
	T_5	0.61	4.26	7.15	25.80	43.67	54.04	91.86	117.23	130.82
Grand mean		0.66	3.97	7 70	25:79	43.64	67.95	93 06	118.15	135.70

high in available N, P_2O_5 and K_2O. The *kharif* experiment was conducted on a red sandy clay loam (pH 7.4) medium in available N, P_2O_5 and high in available K_2O. Fertilizers were placed approximately 5cm away from the seed line at a depth of 5cm. In the case of foliar application of N, concentration of urea varying from 1.32 to 5.28 per cent was applied depending on the quantity of N to be supplied. Two plants were removed from rows of plants especially left for sampling in each plot, starting from 10th day of sowing to harvest at 10 days interval. After oven drying at 60°C, the dry matter production was determined. The data obtained were statistically scrutinised IBM 1420 computer.

RESULTS AND DISCUSSION

Dry matter accumulation : There was no significant difference in dry matter production between the treatments in both the seasons on 20th day (Table 2 and 3). Since the young seedlings derive their nourishment mainly from the seeds, absorption of nutrients is rather limited. In summer, the dry matter production was lower in plots receiving the entire 150 kg N/ha as basal dose. This is probably due to the salt injury caused to the young seedlings by the high concentration of applied N. At boot leaf stage (50th day) maximum dry matter production was recorded at high level of N application (150 kg/ha) and the minimum in control plots. (Table 2 and 3). Application of N, half through soil and the other half through foliage, seemed to be better than other methods of application. At this stage of crop growth, the leaf area available was high and so the foliar applied N would have been effectively utilised. At flowering (60th day) and grain filling (70th day stage) increasing N levels produced greater dry matter (Fig. 1). At these stages the dry matter accumulation was rapid and so the demand for nutrients, particularly N, would also have been greater. Hence, application of N produced an appreciable increase in dry matter accumulation (Tables 1 and 3).

At dough stage also, this difference due to N application was clearly seen. Dry matter production at harvest was highly correlated with grain yield ($r = 0.4213^{**}$). Dry matter production was compratively higher in summer than in *kharif*, probably due to higher temperature prevailing in summer which favoured vigorous crop growth (Table 4 and 5). Application of N in four to six splits produced more dry matter at harvest.

Rate of dry matter accumulation : In summer, the rate of dry matter accumulation was rather slow until about 30 days (Fig. 1). Hereafter it increased rapidly, reaching a peak around 70th day. This period coincided with the grand growth and flowering stages. After 70th day, the rate decreased until maturity. During grain formation stage (70 to 80 days) the increase was only marginal (Fig. 1). In *kharif*, no sharp peaks in the rate of dry matter accumulation was seen as in

Table 4 Dry matter accumulation (g/plant) summer 1974.

Time and method of N application	90th day				
	N_0	N_{50}	N_{100}	N_{150}	Mean
T_1	—	133.30	110.43	130.26	124.66
T_2	—	129.50	105.86	112.66	116.01
T_3	—	132.66	121.30	142.20	132.05
T_4	—	116 56	124.83	138.00	126.46
T_5	—	129.30	122.03	112.90	121.41
T_6	—	128.06	120.73	104.83	121.21
Mean	90.56	128.23	117.53	125.14	123.63

	S. E. ±	C. D. (P=0.05)
Nitrogen levels	1.28	4.45
Time and method of N application	3.79	4 45
N levels at the same level of time and method of N application	6.57	18.75
Time and method of N application at the same level of N	6.13	17.67

Table 5. Dry matter accumulation (g/plant) *kharif* (1974)

Time and method of N application	100th day				
	N_{50}	N_{100}	N_{150}	N_{200}	Mean
T_1	113.40	136.80	139 40	145 03	133.65
T_2	117.26	137.50	148.53	137.26	135.14
T_3	126.76	144.43	145.26	148.36	141.20
T_4	123.40	144.96	138.20	144.23	137.70
T_5	129 20	138.36	136.23	119.50	130.82
Mean	122.00	140.41	141.52	138.88	135.70

	S. E. ±	C. D. (P=0.05)
Nitrogen levels	2.79	9.68
Time and method of N application	2.58	N S.
N levels at the same level of time and method of N application	5.16	N.S.
Time and method of N application at the same level of N	5 40	N.S.

N.S.=Non-significant

the case of summer, since the dry matter production was spread over a longer period due to extended duration of the crop in *kharif*.

In summer, until about 80th day there was no significant difference in the rate of dry matter accumulation due to N levels. But, at maturity, the rate was much higher in plots receiving higher quantities of N. At peak vegetative phase (40 to 50 days), application of N, half through soil and the other half through foliage, was found to be effective but this effect disappeared as the crop advanced in age Another interesting observation was that flowering was advanced by about a week in plots receiving higher quantities of N. Hence the time available for grain formation is greater in these treatments. This was possibly one of the main reasons for higher yields.

From the results of this study, it could be stated that application of N upto 150 kg/ha increased the dry matter production during the stages of crop growth resulting in higher yield. Splitting the dose and applying in four to six splits increase the N use efficiency and the dry matter production.

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