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DRY MATTER ACCUMULATION AND DISTRIBUTION AT DIFFERENT GROWTH STAGES IN RELATION TO GRAIN YIELD IN SORGHUM

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The dry matter production and distribution in sorghum revealed that there are genotypic differences in different components of the source. An increase in TDM from boot leaf stage to grain maturity stage was observed but the stem and leaf dry matter showed a decreasing trend as there was a proportionate increase in the panicle dry matter. The economic yield was in accordance with the biological yield and the harvest index was indicative of the biological efficiency of the genotype.

Breeding for higher yields necessitates consideration of genetical, physiological and environmental factors capable of influencing agricultural yields. Studies on the physiological analysis of yield have clearly brought out the differential yield response of sorghum varieties and it has necessitated to determine the efficiency of dry matter production by different genotypes at various growth stages of the crop. With this background, this study was undertaken and the results are reported.

MATERIALS AND METHODS

The material for the present investigation consisted of 12 varieties of sorghum. Of them, five are released varieties from Tamil Nadu Agricultural University, two are All India varieties and the rest are under pre-release tests. These ganotypes were raised in a randomised block design replicated thrice. Each genotype was grown in a ten row plot of 3m long. The usaul spacing of 45 x 15 cm and other agronomic practices were adopted. Five rows in each plot were utilised for pre-harvest observations and the remaining five rows for observations at the time of maturity. Observations on the total dry matter produced and the dry matter accumulated in the root, stem, leaves and panicle were recorded at three distinct growth stages of the crop viz; boot leaf stage, dough stage and physiological maturity stage. Five randomly selected plants maturity stage. Five randomly selected plants from each variety in each replication were utilised for recording observation on even dry basis and the data on mean single plant basis was taken for statistical analysis.

RESULTS AND DISCUSSION

The total dry matter produced by the different genotypes at the three stages and their proportionate accumulation in the root, stem, leaves and panicle are presented in Tables-1 & 2 There were significant differences among the varieties for DMP at all the three stages. They also performed differently for grain yield.

There was an increase in total dry matter of the plants from the boot

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leaf stage till maturity. However, the total dry matter accumulated in the roots did not show any significant difference from one stage to another.

The proportion of total dry matter accumulated in leaves was higher in the boot leaf stage (21.03 per cent) and as the crop growth advanced to ripening stage, it gradually declined to the lowest at the final stage (12.24 per cent). A similar observation was recored by Krishnamurthy *et. al.*, (1976) in sorghum. As regards the stem dry matter, a similar trend was observed. But the stem weight started to decrease at a faster rate in maturity phase is from 47.10 per cent during boot leaf stage it declined to 39 90 per cent at maturity. Similar decrease in the dry matter of vegetative parts has been observed by Oizumi *et al.*, (1965). This leads one to think that a certain amount of the photosynthates may perhaps get translocated from the stem to the ears in addition to current photosynthates.

In contrast to the accumulation of dry matter at the vegetative parts, a marked increase in the DM acculation was observed in the panicle The number of grains which a genotypes is capable of producing is fixed well before the bloot leaf stage. Hence any increase in the dry matter of the panicle should go to fill up the grains. In the present study, there was an increase of 7.12 per cent from the boot leaf stage to dough stage and 11.50 per cent increase from maturity stage to dough stage. This increase in panicle dry matter almost corresponds with the proportionate decrease in leaf and stem dry matter. The increased rate of dry matter in the ear and decreased leaf and stem dry matter indicate that materials assimilated by the vegetative parts during active photosynthetic process were transferred to the ear for filling the grain. Ronald *et al* (1966) were of the opinion that major portion of the total dry matter of corn was from earhead only. Basu and Reddy (1971) also reported an increased rate of translocation from vegetative parts to panicle in sorghum.

There were significant differences among the genotypes in panicle dry matter at maturity. SPV 351 was better in the proportion of dry matter accumclated at maturity stage. This may be due to contribution from the photosynthetically active parts of the plant during grain filling stage and accumulation of greater amount of dry matter in the larger number of grains (sink). Besides, the extent of translocations of metabolites from source to sink may be another factor operating here. Similar observation have been made by watson *et al.* (1958) in barley, Krishnamurthy (1968) in barley and Krishnamurthy *et al.* (1976) in sorghum.

Table-1. Distribution of Total Dry Matter (TDM)

Genotype	Boot leaf stage					Dough stage				
		Proportion in percent					Proportion in percent			
	TDM	Root	Stem	Leaf	Panicle	TDM	Root	Stem	Leaf	Panicle
SPV 346	144.89	14.23	52.38	18.97	14.42	136.56	14.66	41.52	20.89	22.93
Co 18	94.19	18.18	40.19	23.14	18.49	128.88	15.02	34.24	19.98	30.76
TNS 23	84.86	14.76	53.14	17.44	14 66	90 90	17.05	45.10	15.40	22 45
Co 23	142.28	14.19	55.63	18.31	11.87	162.38	14.32	49.48	15 00	21.20
CS 3541	93.99	17.79	39.57	25.70	16.94	128 38	14.30	43.82	18.19	23 69
SPV 386	77.32	17.66	37.50	26.07	18.77	99.96	15 23	38.11	17.03	29.63
SPV 126	91.76	16.23	32.65	26.91	24.21	147.35	13.61	49.92	18.25	18.22
SPV 475	63.62	18.43	42.17	20.84	18.56	90.39	15.96	41.74	16.63	26.67
Co 22	88.95	16.47	43.50	21.94	18.02	95.25	14.29	38.59	16.93	30.19
Co 21	79.72	16.59	44.02	21.90	17.49	108 69	14.26	44.99	16.12	24.63
Co 24	135.39	16.12	50.05	18.16	15.68	145.60	17.03	40.96	19.45	22.56
SPV 351	160.06	15.13	52.16	17.55	15.16	170.10	15 20	49.47	16.55	18.78
Mean	102.14	15.24	47.10	21.03	16.62	125.35	15.02	43.68	17.56	23.74

Table-2. Distribution of TDM and grain yield

Genotype	Harvest stage					Grain yield	Grain as percent of TDM at maturity
		Proportion in percent					
	TDM g.	Root	Stem	Leaf	Panicle		
SPV 346	185.32	14.54	35.39	12.24	37.83	46.83	25.26
Co 18	175.11	13.20	37.38	14.71	34.71	34.06	19.45
TNS 23	100.53	13.00	45.95	11.76	29.29	17.76	17.66
Co 23	177 72	13.56	41.89	12 39	32.16	37.10	20.87
CS 3541	170.85	10.72	42.72	11.80	34.76	40.96	23.97
SPV 386	104 32	12.39	41.21	12.61	33.79	27 70	26 55
SPV 126	169.55	12.30	36.09	11.38	40.23	48 53	28.62
SPV 475	99 55	11.88	45.26	11.15	31.71	15.66	15.73
Co 22	102.76	12.06	36.64	13.42	37.88	26.23	25.52
Co 21	137.08	12.08	45.27	10.21	32.44	29.16	21.27
Co 24	195.12	13.40	40.43	13.83	31.34	41.03	21.02
SPV 351	209.65	11.59	36.56	10.90	40.95	63.36	30.22
Mean	152.28	12.61	39.90	12.24	35.24		23.44

Table-3

Genotype	HI incl. root DMP	Relative Rank	HI excl. root DMP	Relative rank	Grain yield *Per se*	Relative rank
SPV 346	0.252	5	0.296	4	46.83	3
Co 18	0.195	10	0.224	10	34.06	7
TNS 23	0.177	11	0.203	11	17.76	11
Co 23	0.209	9	0.242	9	37.10	6
CS 3541	0.240	6	0.269	6	40.96	5
SPV 386	0 265	3	0.303	3	27.70	9
SPV 126	0.286	2	0.326	2	48.53	2
SPV 475	0.157	12	0.179	12	15.66	12
Co 22	0.255	4	0.290	5	26 23	10
Co 21	0.231	7	0.242	8	29.16	8
Co 24	0.210	8	0.243	7	41.03	4
SPV 351	0 302	1	0.342	1	63.36	1

The harvest index which is the relationship of the total biological yield to economic yield or grain yield helps to visualise more clearly the performance or efficiency of varieties. The ultimate economic yield is only a fraction of the total dry matter accumulated by the plant. The proportion of the total dry matter converted into grain ranged from 15.73 per cent in the variety SPV 475 to 30.22 per cent in SPV 351. The variation in the proportion (Harvest index) reflected on the differences in the total dry matter produced. The harvest index tended to rise progressively with increase in biological yield. This situation appears to be a common feature of all cereals as reported by Donald and Hamblin (1976).

The harvest index was measured by two approaches. Economic yield or grain yield remains the same. While estimating the biological yield the dry matter of roots is usually left out. In the present study, the harvest index was calculated with and without including the roots and the results obtained are tabulated below along with grain yiele *per se*

The relative ranking of the harvest index did not change in whichever way the biological yield is estimated and that the root dry matter remains almost unaltered even though the total dry matter showed a progressive increase from boot leaf stage to maturity. This factor explains the constant ranking of the Harvest Index whether it includes the root dry matter or not. As opined by Adams (1967) the biological yield and harvest index are the simplest instruments for better analysis of the growth of the cereals and serve as valuable criteria for the assessment of performance of the genotypes.

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