Agri. Res. J. Kerala, 1973, 11 (1) 47-52

STUDIES ON AN EARLY RTCE CULTURE 24-20. DRY MATTER PRODUCTION AND ITS DISTRIBUTION AMONG PLANT PARTS

T. F. Kuriakose and C. M. George
Agricultural College, Vellayani, Kerala

A breeding programme was initiated during June 1968 for evolving early maturing, high yielding rice varieties through hybridisation and selection. One of the progenies, namely, 24-20 maturing in 75-80 days, possessed desirable plant characters and high yielding ability. Trials Were conducted with this culture (F_9 generation) to study the pattern of dry matter production and its distribution among the plant parts at different stages of growth under four levels of nitrogen.

Materials and methods

IR8 was crossed with T140 an early Iniica variety maturing in 70 days. The progenies were carried forward adopting the mass pedigree method. Plant selection was done following the criteria suggested by Jennigs and Beachell (1964) for breeding varieties for nitrogen responsiveness.

Agronomic trials were conducted in the wet-lands attached to the college Farm, Vellayani during the dry season (January-March) and wet season (July-September) of 1972. The fertilizer treatments consisted of four levels of nitrogen namely 30 kg., 60 kg., 90 kg., and 120 kg., per hectare. Nitrogen in the form of ammonium sulphate was applied in two equal doses - as a basal dressing and at the active tillering phase. Forty kg. of P_2O_5, 20 kg of K_2O and 2500 kept well rotten cattle manure were applied as basal dressing. Twenty kg of K_2O was also given as top dressing at tillering stage. The experiments were laid out in a randomised block design with six replications. Fifteen day old seedlings were planted at 15 cm. x 10 cm. with three seedlings per hill.

The dry matter yield of lamina, sheath, culm and ear of the five plant hill samples selected at random at different stages of growth was estimated during the dry season. The dry matter yield of the whole sample alone was estimated during the wet season. The techniques described by Yoshida, *etal.* (1971) was followed for sampling and sample preparation.

Results and discussion

The morphological characters of the culture 24-20 are presented in Table 1 and the data on the dry matter yield at different stages of growth are given in Table 2.

Table I. Morphological characters of the culture 24-20.

		Seedling characteristics			
1.	Juvenile growth habit	Frect	2	Colour of colioptile and primary leaf sheath	Light purple washed
		Adults plant characteristics			
1.	Leaf blade	Medium, erect, dark green.	2.	Number of leaves on the main culm at flowering	Four or five
3.	Flag leaf	Small, broad erect.	4.	Panicle	Intermediate type, exerted, intermediate density.
5.	Glume size	Medium	6	Lemma and palea	Green ripening to straw.
7.	Stigma	Purple washed	8.	Apiculus	Green ripening to straw.
9.	Awn	Absent	10.	Shattering	Intermediate.
II.	Grain	Medium, bold.	12.	Rice colour	Fed.
13.	Abdominal white	Absent	14.	Glutinous or not	Non-glutinous.
i.s.	Translucency	Intermediate.	16.	Dormancy	Grains require 20 days after harvest for full germination.

It may be observed from Table 2 that at the tillering stage, the dry matter weight of lamina was maximum at 90 kg nitrogen and this was on par with that at 120 kg nitrogen. In the case of sheath, application of 120 kg. nitrogen gave the maximum dry matter weight and showed no difference with that at 90 kg. and 60 kg. nitrogen levels. The ratio of the mean dry matter yield of lamina to that of sheath was 1.32. Contributions of lamina and sheath to the total dry matter were 56.87 percent and 43.13 percent, respectively. The total dry matter weight was not influenced by the application of nitrogen beyond 90 kg, during the dry and wet seasons. This is a recognized feature of high nitrogen responsive varieties, especially at the early stages of growth. In the low nitrogen responsive varieties under study would not require nitrogen manuring beyond 90 kg. for best performance. During both the seasons, the total dry matter weight was maximum at 90 kg. nitrogen and this was on par with that at 120 kg. nitrogen. This evidently suggests that the total dry matter production of this early rice culture would not increase by the application of nitrogen beyond 90 kg. per hectare. Among the four plant parts, the contribution by the ear to the total dry matter was the maximum (66.15 percent). This high contribution by the ear is generally a characteristic of early maturing varieties.

The mean increase of the total dry matter at different stages of growth during the two seasons have shown that the increase from tillering to flower initiation was 96.2 percent while that from flower initiation to flowering was 154.7 percent. The percentage of increase from flowering to harvest was 102.1. These results indicate that the maximum increase of the dry weight of plants has taken place during the reproductive crop. It is during this period the assimilation products for translocation to the ear is actively manufactured. This corroborates the findings of Tanaka (1964J and Togari, etal. (1954). The studies of Murata (1964) have brought out that the ratio of photosynthetic capacity to respiration is higher in early nitrogen responsive groups at heading stage. It is possible that the larger increase of dry matter observed during the reproductive phase may be the result of higher photosynthetic efficiency exhibited by this early rice culture.

Summary

An early duration rice culture 24-20 maturing in 75-80 days was evolved through hybridisation between IR and T_{140} followed by selection. The pattern of dry matter production and its distribution among the plant parts were studied under four levels of nitrogen.

The dry weight of lamina increased with increasing levels of nitrogen, but the effects of levels of 90 kg. and 120 kg. were the same except at flowering stage when 120kg. gave higher dry weight of lamina. Increase of dry weight of sheath upto 120 kg. nitrogen was noticed at flower initiation and harvest. Higher levels of nitrogen increased the dry weight of culm but the effects of 90 kg. and 120 kg. were the same. Higher dry weight of ear was recorded at 90 kg. nitrogen and thereafter it declined. During both the seasons, the total dry matter at harvest was not increased beyond 90 kg. nitrogen.

The contributions of lamina and the sheath to the total dry matter at tillering and flower initiation were almost equal; the contribution

Tanaka (1964) observed that the active absorption and metabolism of nitrogen resulted in a larger increase of dry weight and leaf area. The restricted growth of the rice culture under study as reflected from the quantitative development of lamina, sheath and the total dry matter under an abundant supply of nitrogen is indicative of its nitrogen responsiveness. At the flower initiation stage also, the dry weight of lamina showed no difference at 90 kg. and 120 kg. nitrogen. But the dry weight of sheath was higher at 120 kg. nitrogen. Such quantitative development of stem like organs restricting the development of leaves is in accordance with the views of Tsunoda (1964). The percentage contribution of lamina and sheath to the total dry matter did not change considerably. This indicated that only a proportionate development of the assimilation and storage organs has taken place at a time when the plants entered into the reproductive stage. The total dry matter was maximum at 120 kg. nitrogen and this was on par with that at 90 kg. nitrogen during the dry season. The total dry matter production was higher at 120 kg, nitrogen during the wet season.

The dry weight of lamina at flowering stage was higher at 120 kg. nitrogen level. But the dry weight of sheath or culm showed no difference at 90 and 120 kg nitrogen levels The ratio of the mean dry matter yield of lamina to that of sheath was 1.06. This ratio at 120 kg. nitrogen level was 1.12 while that at 90 kg. it was 0 97. This indicates that plants possessed a well balanced and more strengthened lamina-sheath system at 90 kg. nitrogen level. At flowering stage, the four plant parts contributed more or less equally to the total dry matter produced. This observation is in accordance with the views of Tsunoda (1962) that the relative quantitative development of the stem system to the leaves should be encouraged! in the course of evolution of cultivated plants especially in grain crops. During both the seasons, higher dry matter weight was obtained at 120 kg. nitrogen.

At harvest, the dry matter weight of lamina showed no difference at 120 kg. and 90 kg nitrogen levels. The mean dry matter yield of lamina was found to increase gradually upto harvest. This suggests that the absorption of nutrients as well as photosynthetic activity of leaves continued upto the advanced stage of maturity. Higher dry matter weight of sheath was reorded at 120 kg. nitrogen. But a small reduction in the dry matter weight of sheath and culm was noticed from that at flowering stage. Murayama (1964) concluded that sheath and culm gradually become high in carbohydrates after flower iniation and store surplus products of photosynthesis in the form cf starch. The reduction in the dry weight of sheath and culm may possibly be due to the translocation of starch and other subtances to the ear. Higher dry weight of the ear was recorded at 90 kg. nitrogen and thereafter it declined. This indicates that the rice culture

Table 2. Dry matter yield of five plant hills (gm) at different growth stages

(a) **Tillering stage.**

Nitrogen levels.	Lamina-	Sheath.	Culm.	Ear.	Total Dry matter	
					Dry Season	Wet Season.
N_1	4.64	3.05	-	-	7.69	8.22
N_2	5.43	4.19	-	-	9.62	9.04
N_3	6.08	4.6!	-	-	10.69	10.33
N_4	5.83	4.84	-	-	10.67	10.63
Mean	5.50 .	4.17		-	9.67	9.56
C.D. at 0.05	0.55	0.69	-	-	0.81	0.68
	56 87*	43.13*	-	-	100.00	-
			(b) Flower initiation stage			
N_1	8.55	6.89	-	-	15.44	15.76
N_2	10.64	7.50	-	-	18.14	17.38
N_3	11.67	8,57	-	-	20.24	19.57
N_4	12.21	10.18	-	-	22.39	22.02
Mean	10.77	8.29	-	-	19.05	18.68
C.D. at 0.05	1.53	0.95		-	2.25	2.23
	56.54*	43.46*	-	-	100.00	-
			fc) Flowering stage			
N_1	9.27	9.60	9.50	11.39	39.76	39.07
N_2	13.15	11.42	10.95	12.79	48.31	43.42
N_3	12.73	13.07	11.58	13.53	50.91	50.69
N_4	15.92	14.22	12.72	13.65	56.51	55.73
Mean	12.77	12.08	11.19	12.84	48.87	47.23
C.D. at 0 05	1 .64	1.22	1.30	1.46	3.69	3.54
	26.13*	24.71*	22.89*	26.27*	100.00	
			(d) Harvest stage			
N_1	12.10	9.45	6.87	58.50	86.92	85 78
N,	13.28	10.27	7.22	62.61	93.38	91.94
	15.73	11.08	8.40	71.25	106.46	110.14
N_4	16.38	12.28	8.31	64.34	101.31	100.78
Mean	14.37	10.77	7.70	64.18	97.02	97.16
C.D. at 0.05	1.75	1.02	0.80	6.61	8.38	11.53
	14.81*	11.10*	7.94*	66.15*	100.00	-

Variations in the dry matter yield of plant parts and the total dry matter are significantat 1 percent level.

*Percentage contributions by the plant parts to the total.

of lamina being higher than that of the sheath. At flowering, the four plant parts contributed more or less equally to the total dry matter. At this stage a well balanced lamina-sheath system prevailed at 90 kg. nitrogen level. At harvest, the ear contributed maximum to the total dry matter.

A reduction in the dry weight of sheath and culm was observed at harvest, The increase of the total dry matter weight was maximum between flower initiation and harvest as compared to the vegetative phase.

Acknowledgements

The authors are thankful to the Dean, College of Agriculture Vellayani, for facilities provided.

REFERENCES

Jennings, P R. and Beachell, H M. 1964. Breeding rice for nitrogen responsiveness. *I R.C News Letter,* 13, 1-9.

Murata, Y. 1964. Photosynthesis, respiration and nitrogen response. In "The mineral nutrition of the rice plant". (Proc. *Symp.*) The Johns Hopkins Press, Baltimore. pp. 385-400.

Murayama, N. 1964. The influence of mineral nutrition on the characteristics of plant organs. *Idid.* pp. 157-172.

Tanaka, A: 1964. Plant characters related to nitrogen response in rice. *Idid.* pp. 419-435,

Togari, Y., Okamoto, Y. and Kumura, A. 1954. Studies on the production and behaviour of carbohydrates in rice plants. I. Changes of principal constituents in each organ accompanied with its development. *Proc. Crop. Sci. Soc. Japan,* 22, 95-97.

Tsunoda, S. 1962. A developmental analysis of yielding ability in varieties of field crops. IV. Quantitative and spatial development of the stem systems. *Jap.], Breeding,* 12, 49-56.

Tsunoda, S. 1964. Leaf characters and nitrogen response. In "The mineral nutrition of the rice plant". (Proc. *Symp*) The Johns Hopkins Press, Baltimore. pp. 401-418.

Yoshida, S., Forno, D. A. and Cock, J. H. 1971. Laboratory manual for Physiological Studies of rice. The International Rice Resarch Institute, Philippines PP 5-8,

(M. S. *received 25-9-1973.*)