Table 1. Chlorophyll content of flag leaf blade and sheath at heading in 11 rice genotypes. IRRI, 1989 dry season.

Genotype	Chlorophyll content (mg/100 cm^{2a})	
	Lamina	Sheath
Group I		
IR47686-6-2-2-1	3.9	1.6
IR29723-143-3-2-1	3.6	1.7
IR35686-56-2-2-2	3.4	1.7
Suweon 290	3.3	1.9
IR33043-46-1-3	3.1	1.5
Mean	3.5	1.7
SEM	0.1	0.1
Group II		
IR47705-Ac5	5.6	2.3
IR47705-Ac3-2	5.2	2.1
IR47705-Ac6	4.9	2.0
IR34615-75-1-1	4.6	2.4
IR47705-Ac5-1	4.2	2.7
IR28211-43-1-1-2	4.2	2.3
Mean	4.8	2.3
SEM	0.2	0.1

[a]SPAD 502 reading converted to chlorophyll content $y = 0.0996r - 0.152$, where y = chlorophyll content and r = SPAD 502 reading.

Six additional lines, growing without replication in a different field, were selected for their dark green foliage (group 2). Their flag leaf blade and sheath chlorophyll values were higher than those for the first varieties studied. IR47705-Ac5 had the highest chlorophyll content in the lamina while IR47705-Ac5-1 had the highest content in the sheath.

In 1989 wet season, we screened 22 additional genotypes without replication. Genotype means were based on five culms each from separate, randomly selected hills. Acc. 2293 had 91% higher chlorophyll content in the lamina than Acc. 1525 (Table 2). Acc. 1214 had 81% higher chlorophyll content in the sheath than Acc. 1097. Evaluation of more lines would likely reveal even larger differences for these traits.

Nonsignificant correlations between lamina and sheath chlorophyll content for the two groups of genotypes during 1989 dry season and 22 genotypes during 1989 wet season indicate that it should be possible to develop recombinants having high chlorophyll content in both lamina and sheath. Such recombinants are likely to have higher photosynthetic potential and, thus, higher yield potential.

Alternatively, high lamina and sheath chlorophyll contents could be combined with reduced laminar area without loss of a plant's photosynthetic potential. Such a plant type could produce higher yields through more panicles/unit area under high density planting. □

Table 2. Chlorophyll content of flag leaf lamina and sheath at heading in 22 rice genotypes. IRRI, 1989 wet season.

Acc no.	Name	Origin	Chlorophyll content (mg/100 cm^2)	
			Lamina	Sheath
2293	Zi Talc	Korea	6.1	2.0
2286	Wase Shinsu	Korea	5.6	1.9
26168	Riuc V13	Brazil	5.5	2.0
3236	Coll 7393	Turkey	5.2	2.1
3197	Paraitalica Fiacco	Portugal	5.2	2.1
1179	Hung Chao Lu Hyu	China	4.7	2.1
1414	Tu Pien	China	4.7	1.9
2531	Coll 232	Japan	4.7	1.8
2575	Ishikari Shiraj	Japan	4.7	1.9
2622	Norin 11	Japan	4.6	1.7
2663	Shinao Mochi 3	Japan	4.6	1.8
9277	Fujisaka 3	Japan	4.6	2.1
61802	He Jiang 19	China	4.6	1.8
2511	Suito Norin	Japan	4.4	2.1
2627	Norin 28	Japan	4.4	2.1
3105	82	Italy	4.4	2.2
3123	Sancio P6 Tipo	Italy	4.4	2.0
1214	Dacca 345	China	3.7	2.9
8433	DNJ 133	Bangladesh	3.5	2.0
1097	Tawng 282	China	3.4	1.6
1588	K 184	China	3.4	1.6
1525	Tsu Ta Li	China	3.2	1.9
	Mean		4.5	2.0
	SEM		0.2	0.1

Biomass, grain yield, and harvest index of F_1 rice hybrids and inbreds

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Grain yield is the product of total dry matter (biomass) and harvest index (HI). Total dry weight measures the overall crop photosynthetic performance; HI is the ratio of biomass partitioned into grains. Significant heterosis for total dry matter and HI has been observed, and genetic manipulation to develop hybrids with higher biomass and HI merits consideration.

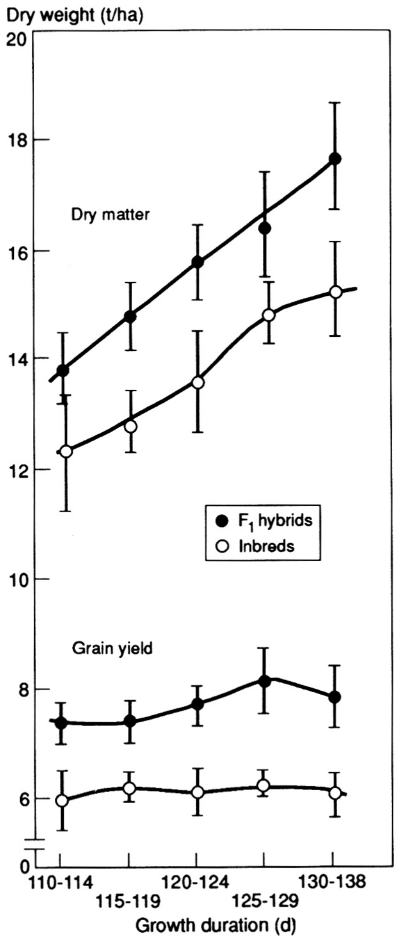
We evaluated the performance of 57 F_1 hybrids and 43 inbreds with growth durations ranging from 110 to 138 d in an unreplicated irrigated field trial in 1988 dry season. Hybrids and inbreds were grouped according to maturity, with 5-d intervals for each group. Plots were fertilized basally with 80-13-25 kg NPK/ha and 40 kg N/ha was topdressed 6 wk after transplanting. Plant spacing was 20 × 20 cm with 1 seedling/hill. Total dry weight at maturity and grain yield were measured from 20 hills/variety.

Biomass production increased with growth duration (Fig. 1). Heterosis was observed for biomass and grain yield. F_1 hybrids showed almost 10% advantage in biomass and 20% advantage in grain yield over the high-yielding inbreds.

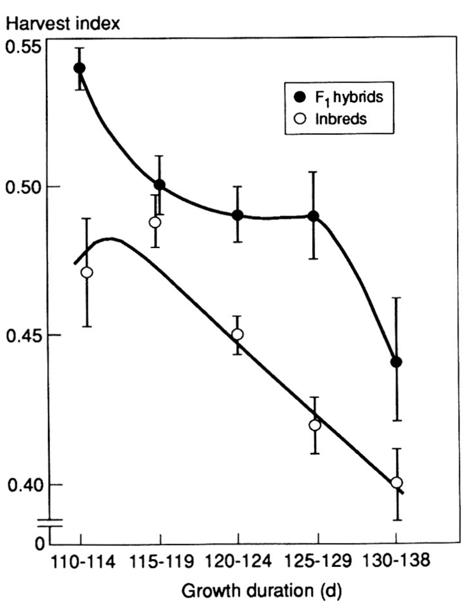
Regardless of growth duration, grain yield was almost the same except for a slightly lower yield by very short-duration entries. F_1 hybrids and inbreds with growth durations of 125-129 d had the highest grain yield.

The increase in biomass with growth duration and the almost constant grain yield regardless of growth duration resulted in higher HI in short-duration cultivars (Fig. 2). F_1 hybrids showed an average 10% advantage in HI over inbreds. (HI higher than 0.50 is often observed in short-duration F_1 hybrids.)

F_1 hybrids, regardless of duration, showed heterosis for total dry weight production and HI, with greatly increased grain yields. □



1. Dry matter yield and grain yield of 57 F_1 hybrids and 43 inbreds with different growth durations, IRRI, 1988 dry season. Vertical lines represent the standard error of the mean.



2. Harvest index of F_1 hybrids and inbreds with different growth durations, IRRI, 1988 DS. Vertical lines represent the standard error of the mean.

Effect of stem thickness and carbohydrate content on ratoon rice yield

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We studied the effect of stem thickness and carbohydrate content on yield of ratoon rice in 1984-85 and 1985-86. Varieties were Bhavani, Ponni, and IR20, in a randomized block design with three replications. The main crops were cultivated according to recommended practices.

Stem thickness of the ratoons was measured with a screw-gauge at harvest of the main crop. Carbohydrate content of the stubble was estimated immediately after harvest by the method suggested by Somogyi, using the Spectronic-20 colorimeter.

In both years, Bhavani had significantly higher ratoon crop grain yield (see table). Its stem thickness was also significantly higher than that of the two other varieties. Bhavani also had the highest carbohydrate content in the stubble. This could have induced more vigorous regeneration of ratoon tillers, resulting in the production of a larger number of tillers and higher grain yield. □

Stem thickness, carbohydrate content, and ratoon rice yield.

Variety	1984-85			1985-86		
	Stem thickness (mm)	Carbohydrate content (%)	Ratoon grain yield (t/ha)	Stem thickness (mm)	Carbohydrate content (%)	Ratoon grain yield (t/ha)
Bhavani	3.5	8.9	1.6	3.1	8.8	2.9
Ponni	2.8	7.8	1.0	2.7	7.9	1.3
IR20	2.8	7.6	0.3	2.8	7.6	0.3
LSD (0.05)	0.5	0.4	0.1	0.1	0.7	0.2

Variation in rice hull weights

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One way to further improve rice yields in the tropics is to increase the harvest index (HI) — the ratio of grain weight to biomass. (Wheat shows higher HI than rice, whose hull weight is substantially heavier than wheat chaff.) Reducing the partitioning of dry weight to the hull could be an approach to improving HI.

We examined seasonal variations in hull weight. Early-maturing IR58 and medium-maturing IR29723-143-3-2-1 were transplanted each month for 1 yr. Spacing was 20 × 20 cm, fertilizer was 120 kg N/ha. Filled grains (1.06 specific gravity) of each harvest were separated by salt solution and dried at 80°C for 5 d. Three 200-seed samples per transplanting month were dehulled manually, redried for 24 h, and hull and kernel weight determined. Grains of 10 different cultivars were dehulled for comparison.