Leaf Characters of Tall and Short Lines of Rice and Their Response to Gibberellin

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Leaf Characters of Tall and Short Lines of Rice and Their Response to Gibberellin[1]

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Summary

The leaf characters of the tall and short lines of rice and their changes under GA treatment were studied. The leaves of the tall lines are long, heavy and narrow. When the leaf weight for single leaves is considered, their leaf-area/leaf-weight ratio is higher compared to those of the short lines since the ratio decreases with the increasing leaf weight.

The leaf characters of the short lines became similar to their corresponding tall lines under GA treatment. These results suggest that the amount of GA-like substances in the rice plant is a major factor affecting the leaf characters.

It is well known that most tropical rice varieties are tall and leafy while Japonica varieties are the opposite. These characters are closely related to the nitrogen response; tall Indicas adapt to light fertilization while Japonicas give a high yield under heavy fertilizer conditions (1).

It has also been suggested that these varietal differences of leaf characters may be due to the gibberellin (GA)-like substances contained in the rice plant.[2]

Therefore, this experiment was initiated to clarify the leaf characters of the tall and short lines of rice and their changes under GA treatment.

Materials and Methods

Two pairs of lines were used in this experiment; Fujisaka 5 versus Dwarf C and early tall Peta (ETP) versus early short Peta (ESP).[3] Fujisaka 5 is a normal Japonica rice and Dwarf C is a dwarf mutant. ETP and ESP were the isogenic lines obtained by crossing Peta, a tall Indica variety and Taichung (Native) 1, a short Indica variety, and then back-crossing the progenies to Peta three times.

[1] A portion of the data was collected at The International Rice Research Institute, Los Baños, Laguna, Philippines.

[2] Harada, J. and Vergara, B.S. Unpublished data.

[3] These are known as IR 262 A43-8-4-10-5 and IR 262 A43-8-11-31-5, respectively.

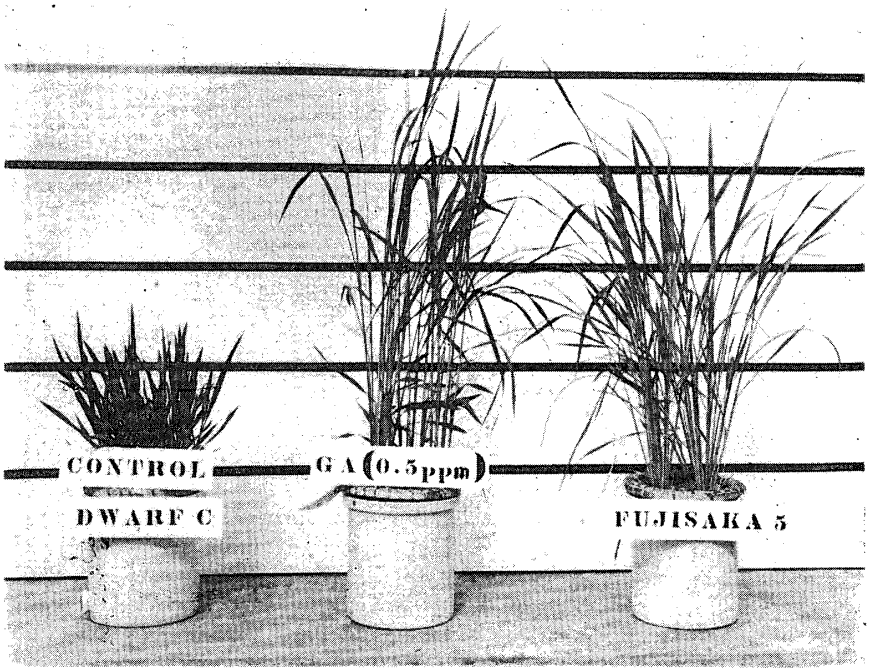

FIG. 1. Plant types of Fujisaka 5, Dwarf C and GA-treated Dwarf C.

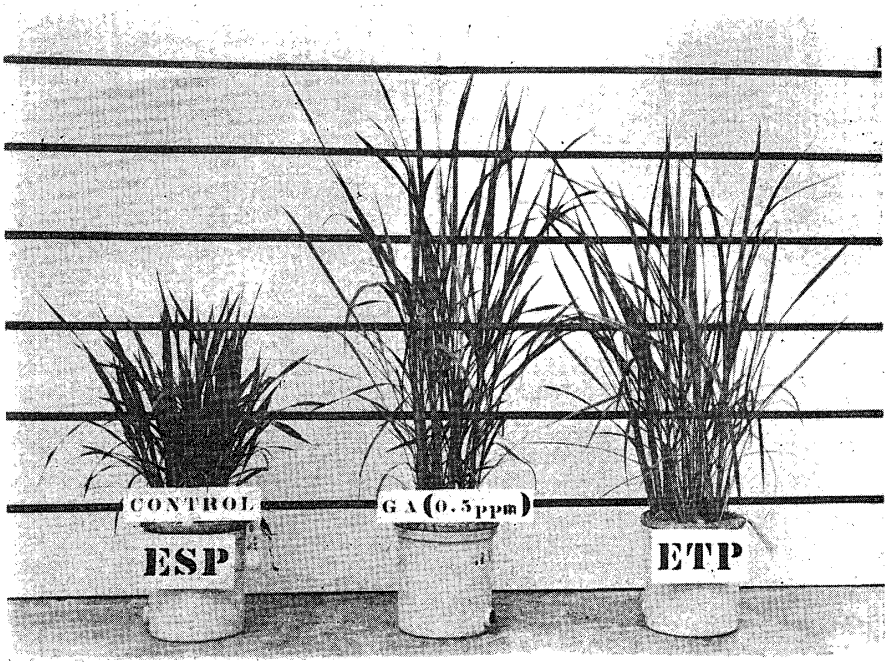

FIG. 2. Plant types of ETP, ESP and GA-treated ESP.

The seeds were sown on February 3, 1968 and four plants per pot were transplanted on February 9 in porcelain pots containing 4 liters of culture solution. The nutrient levels were the same as in the previous paper (2). The culture solution was renewed twice a week during this experiment. GA[4] was mixed into the culture solution giving a final concentration of 0.5 ppm twice a week starting from the 8th leaf (February 26) to sampling time. Five pots or 20 plants were used in each treatment.

Plants were sampled on March 11. The leaf characters of the 10th leaf of the main culm which elongated during the treatment was examined. The leaf area was measured by the blue print method.

Results and Discussion

The number of tillers in the short lines were more than those of the corresponding tall lines. Also, they were reduced by the GA treatment instead of increasing in height (Table 1).

TABLE 1. *Leaf Characters of Tall and Short Lines of Rice and Their Changes by GA Treatment.*

	Plant height (*cm*)	No. of tillers	10th leaf				
			Area (cm^2)	Dry wt. (*mg*)	Length (*cm*)	Width (*cm*)	Thickness* (mm^2/mg)
Dwarf C (Control)	30.9	14.9	17.3	77.1	19.5	1.14	22.5
(GA-treated)	87.7	7.4	33.7	141.3	46.4	0.95	23.9
Fujisaka 5	80.7	7.7	37.0	174.7	47.5	1.05	21.2
ESP (Control)	50.8	15.9	24.6	122.6	31.4	1.07	20.1
(GA-treated)	93.0	9.1	36.6	166.5	47.9	0.97	22.0
ETP	83.0	11.0	40.5	193.0	53.4	0.96	21.1

* Leaf thickness is expressed as the leaf-area/leaf-weight ratio. Therefore, "thick" stands for a low leaf-area/leaf-weight ratio and "thin" stands for a high leaf-area/leaf-weight ratio.

The leaves of the short lines are erecting while those of the tall lines and GA-treated short lines are leafy. Therefore, the GA-treated short lines look like their corresponding tall lines (Figs. 1 and 2).

The leaf characters of these plants are shown in Table 1. Tall lines have long and heavy leaves and their leaf areas are larger compared to the short lines, although the leaf widths of the tall lines are smaller. These characters of GA-treated short lines were also similar to those of their corresponding tall lines.

The leaf thickness, leaf-area/leaf-weight ratio, however, is more complicated because it decreases markedly with the increasing leaf weight for single leaves (3).

[4] Gibberellin was kindly supplied by Kyowa Hakko Kogyo Co., Ltd., Tokyo, which contained at least 93% pure GA_3.

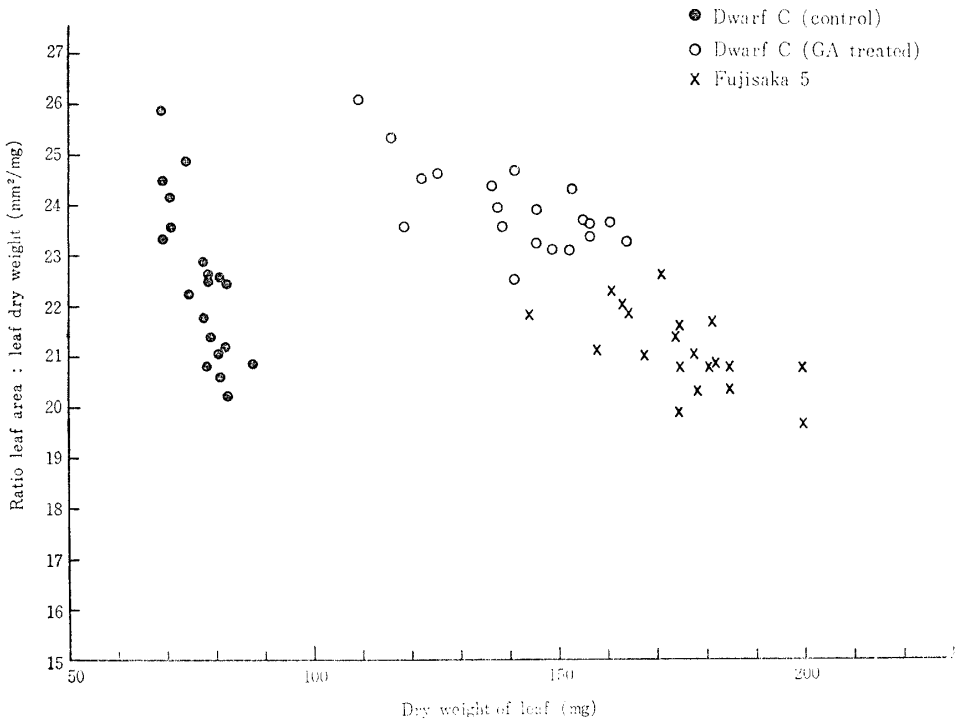

FIG. 3. Relationship between leaf-area/leaf-weight ratio and leaf weight for single leaves of Fujisaka 5, Dwarf C and GA-treated Dwarf C.

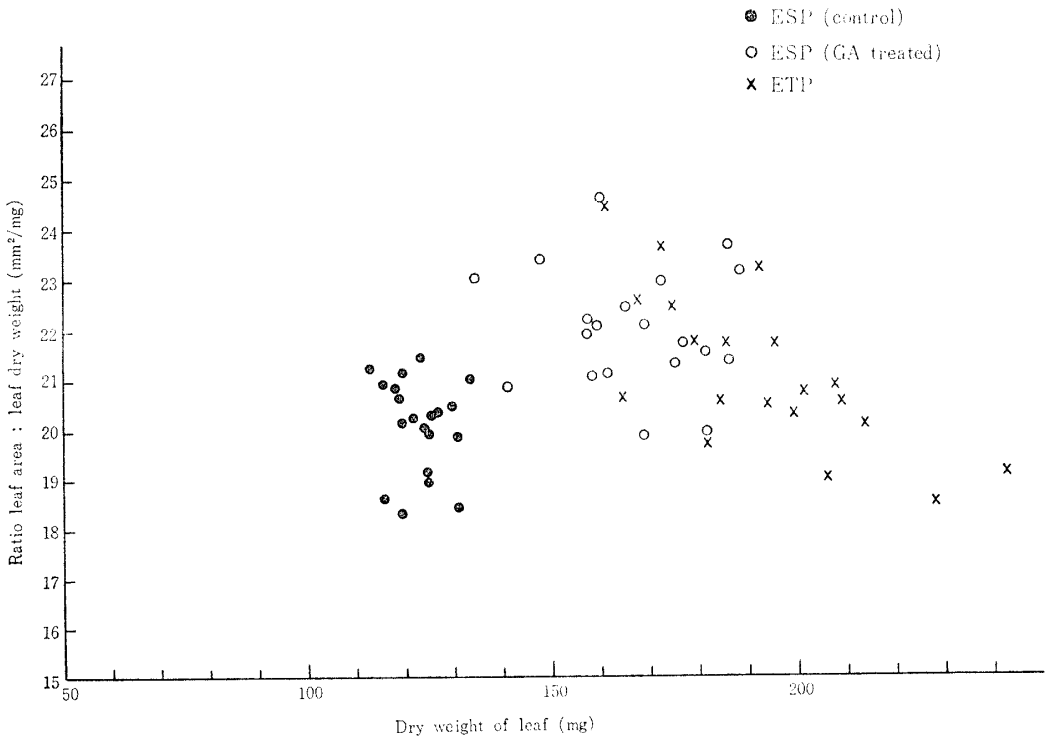

FIG. 4. Relationship between leaf-area/leaf-weight ratio and leaf weight for single leaves of ETP, ESP and GA-treated ESP.

Figs. 3 and 4 show the relationship between the leaf-area/leaf-weight ratio and leaf weight for single leaves. There was a negative correlation between them, except in the case of ESP. Data showed the tendency of the tall lines having a larger leaf area per unit of leaf weight compared to the short lines and also the leaf-area/leaf-weight ratio of the short lines became higher with GA treatment.

Tsunoda (4) pointed out that sweet potato, soybean and rice varieties that adapted to light fertilization tend to show a higher leaf-area/leaf-weight ratio for the weight of their single leaves than those adapted to heavy fertilization. Moreover, it has been reported in some plants that there was a positive correlation between leaf-area/leaf-weight ratio and plant height (4), which was greatly affected by GA.

These findings may suggest that the amount of GA-like substances in the rice plants is the major factor affecting the leaf characters.

Acknowledgement

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