

Effect of Daylength on the Panicle Exsertion of Panicle Enclosing "Gamadi" Rice Cultivar

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日長條件이 水稻 GAMADI 品種의 이삭 抽出에 미치는 影響

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ABSTRACT

The panicle enclosing Gamadi rice cultivar from western Tarai of Nepal was treated with different daylengths; 8 hours, natural daylength i.e. 14 hours 30 minutes to 12 hours 30 minutes, and 24 hours throughout its life cycle. The extremely long daylength of 24 hours induced the panicle exsertion, and elongated the first internode from the top, but did not affect the second internode significantly, suggesting that the panicle exsertion was strongly correlated with the first internode elongation in the Gamadi rice cultivar.

INTRODUCTION

Gamadi is the peculiar rice cultivar in which the panicle does not come out at heading stage and onward upto the maturing stage, and instead, the panicle remains enclosed within the flag leaf sheath. This variety is one of the common rice cultivars in the western Tarai of Nepal where tropical to sub-tropical climate exists. This cultivar is also known as "Sathi" variety which means maturing within 60 days after transplanting, "Dulahania", and "Garve". One of the advantages of this panicle enclosing character of this variety is the protection of the grains from the damage by the rice bug *Leptocorisa varicornis*. The protein content of this variety showed more than 14 percent in the brown rice.

In 1936, Sethi et al. reported the inheritance of panicle enclosing character supposing three genes

governing this character. Shrestha (1980) reported that GA3 treatment to this variety at panicle initiation stage stimulated the elongation of lower internodes significantly, whereas the second internode from the top was almost reduced, and the exogenous GA3 did not affect the panicle exsertion of this variety. Vergara and Chang (1976) reviewed that the common rice cultivars i.e. panicle exsertion types when subjected to insufficient photoinductive cycles, sometimes form the panicle, but do not exsert. But no report is available on the effect of the photoinductive cycle on the panicle exsertion of the panicle enclosed rice cultivar.

This paper reports the effect of the daylength on the panicle enclosing character of Gamadi rice cultivar.

MATERIALS AND METHODS

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Gamadi, a panicle enclosing photoperiod insensitive rice cultivar was seeded and transplanted in 1/5000 are plastic pots on 7 and 17 July respectively in 1979 and 1980. Single seedling per hill was transplanted with one plant per pot and 6 replications per treatment. Fertilizer and other cultural practices were followed as usual. Upto first week of September plants were grown under natural condition i.e. outside and then moved inside the greenhouse. Three different daylength treatments viz. 8 hours, natural daylength, and 24 hours daylengths were subjected to from transplanting to maturity. The natural daylength of Suweon ($37^{\circ} 16' N$), Korea, varies from 14 hours 30 minutes to 12 hours 30 minutes from July to November last week.

10 tillers from each replication were sampled for observations on different characters at harvesting time. Observations were taken on panicle exertion, grain fertility, culm length, and internodes elongation. Panicle exertion character was measured as the length of the panicle coming out of the base of the flag leaf blade to the total panicle length upto necknode.

RESULTS AND DISCUSSION

1. Panicle Exsertion

Two years data of this experiment showed that the panicle exsertion of Gamadi rice cultivar from its flag leaf sheath was induced greatly i.e. more than 71 percent by continuous 24 hours daylength treatment from transplanting to maturity whereas the natural and 8 hours daylengths did not affect the panicle enclosing character as shown in Table 1

The panicle enclosing condition within its flag leaf sheath during heading stage and onward upto maturity stage is the special character, and thus, generally the heading condition can not be observed in Gamadi rice cultivar. Under Tarai condition of Nepal (26° to $28^{\circ} N$), this cultivar does not exert the panicle when grown during the rice cultivation i.e. from May, June to September, October. The maturity condition is generally noticed by observing

the leaf senescence. When this cultivar was grown under greenhouse condition during summer season of April to September in Suweon in 1979 and 1980, the panicle remained enclosed within the flag leaf sheath indicating that the panicle enclosing character has not been affected under natural conditions of daylength at both, Tarai of Nepal, and Suweon, Korea where natural daylengths vary from 13 hours to 11 hours, and 14 hours 45 minutes to 11 hours respectively during the rice cultivation.

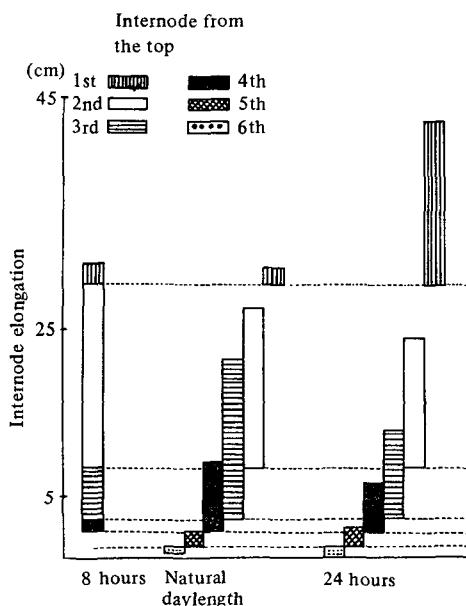


Figure 1. Effect of daylength on the internode elongation of rice cultivar "Gamadi".

Vergara et al. ³⁾ reported that the panicle of the common rice cultivars was not usually exerted when they were subjected to insufficient photoinductive cycles. And in this experiment the natural and 8 hours daylength treatments throughout the experiment duration did not affect the panicle enclosing condition. From this point of view this result indicates that the panicle enclosing character of Gamadi rice cultivar is affected only under extremely long daylength of 24 hours condition.

2. Length of Culm and Internode

Table 2 shows that 8 hours daylength treatment

Table 1. Panicle exertion and grain fertility of Gamadi rice cultivar under different daylengths for two years at Suweon, Korea.

Characters	Daylength								
	8 hours			Natural (12.30-14.30 hrs)			24 hours		
	1979	1980	Ave.	1979	1980	Ave.	1979	1980	Ave.
Panicle length(cm)	14.9±0.57	14.05±1.23	14.48	15.6±0.47	13.84±1.91	14.74	15.1±0.40	15.30±1.14	15.2
Panicle exertion(cm)	0.1±0.02	0.11±0.24	0.11	0.3±0.13	0.45±0.28	0.38	13.0±0.35	8.84±1.82	10.9
Panicle exertion rate(%)	0.7±0.2	0.67±0.09	0.69	1.9±0.71	3.25±0.25	3.58	86.1±3.03	57.78±1.25	71.9
Spikelets no./panicle	36.1±0.28	33.00±4.85	34.55	34.7±0.60	49.60±4.77	42.15	39.4±3.25	57.45±5.00	48.4
Fertile grains no./panicle	0.3±0.14	0.00±0.00	0.15	0.4±0.20	0.20±0.02	0.30	19.0±1.85	0.48±0.21	9.7
Grain fertility(%)	0.8±0.38	0.00±0.00	0.40	1.2±0.54	0.40±0.00	0.80	44.2±4.03	0.84±0.12	24.5

Table 2. Culm length and internode elongation of Gamadi rice cultivar under different daylengths for two years at Suweon, Korea.

Length of culm and internode	Daylength								
	8 hours			Natural (12.30-14.30 hrs)			24 hours		
	1979	1980	Ave.	1979	1980	Ave.	1979	1980	Ave.
Culm length(cm)	27.3±0.57	31.57±2.90	29.44	46.40±1.02	37.98±2.80	42.19	44.40±1.04	44.37±2.56	44.39
1st internode(cm)	1.0±0.00	3.43±0.77	2.22	1.00±0.00	2.11±0.68	1.56	17.60±0.69	14.10±2.76	15.85
2nd internode(cm)	17.6±0.32	23.11±2.64	20.36	16.50±0.52	15.47±1.26	15.99	14.20±0.70	11.88±1.81	13.00
3rd internode(cm)	7.5±0.66	4.22±1.08	5.86	16.40±0.53	15.57±2.99	15.95	5.80±0.26	11.25±1.39	8.53
4th internode(cm)	1.1±0.25	0.99±0.33	1.05	9.90±0.77	3.84±1.69	6.87	4.00±0.14	4.63±1.01	4.30
5th internode(cm)	0.1±0.00	0.00±0.00	0.05	1.90±0.20	1.03±0.38	1.47	1.80±0.20	1.60±0.48	1.70
6th internode(cm)	0.0±0.00	0.00±0.00	0.00	0.70±0.17	0.00±0.00	0.35	1.00±0.00	0.88±0.22	0.94

reduced the total culm length remarkably over the natural and 24 hours daylengths. The taller culm lengths were mainly contributed by the elongation of 3rd and 4th internodes in the natural daylength, and of the first internode in 24 hours daylength. The first internode from the top has almost reduced to 2.0cm under 8 hours and natural daylength treatments as shown in Figure 1, whereas it elongated significantly, about 17.0cm under 24 hours daylength condition. The 2nd internode showed remarkable elongation in 8 hours treatment (20.36cm) in comparison to 15.99cm of natural daylength and 13.00cm of 24 hours treatment. It shows that the 3rd and 4th internodes elongation has been adversely affected by the short or long daylength over the natural daylength. The lower 5th and 6th internodes have been completely reduced under 8 hours treatment as shown in Figure 1.

The length of the internode under natural

daylength in this experiment is corresponding to the previous report²⁾. Exogenous GA3 caused increase in the total culm length by the first and lower internodes, and reduced specially the 2nd internode, whereas the first internode was very short and second one was normal in the control plant. In this experiment the second internode was affected by only 24 hours condition. This result indicated that the first internode elongation of Gamadi cultivar was strongly correlated with the panicle exertion, and it also suggested that the effect of exogenous GA3 and long daylength treatments on the elongation of first internode was same, but the effect on panicle exertion was different.

3. Other Characters

The panicle length of this cultivar was not affected by different daylength treatments as shown in Table 1. During both years of experimentation,

the panicle length was nearly constant (12.8cm to 15.6cm) indicating that there was no effect of daylength on the panicle length.

Number of spiklets per panicle was nearly constant i.e. 36 to 39 spiklets per panicle in all the treatments in 1979, whereas in 1980 it varied from 33 to 57 spiklets per panicle depending on the treatment, as shown in Table 1. In 1980, 8 hours daylength treatment produced the minimum spiklets per panicle in comparison to 49 spiklets per panicle in natural daylength and 57 spiklets per panicle in 24 hours daylength. The result indicates that the spiklet formation period of 1980 in natural and 24 hours treatments received more favourable conditions over 8 hours in 1979.

In both years the grain fertility was extremely poor in all the treatments except in 24 hours in 1979. When this cultivar was planted in the field as well as in the greenhouse condition during the rice cultivation, under Suweon condition, satisfactory grain setting of more than 60 percent was observed, and in the western Tarai of Nepal this variety is generally cultivated. During the grain formation stage in 8 hours treatment i.e. late August and onward night temperature becomes low under Suweon condition, and it becomes still lower as the time advances even under the greenhouse condition. Therefore, the lower temperature during September and onward as well as insufficient light intensity under the greenhouse condition might be the main reason for such high sterility.

From this experiment it was found that the panicle enclosing of Gamadi rice cultivar, being genetically controlled, was almost exerted under 24 hours daylength condition. It can be expected that the genetic study of this character can be easily studied elsewhere in the rice growing countries under the field condition where the lower temperature is not

a problem during cultivation, and the natural daylength will not cause any disturbance on "panicle enclosing" character.

摘 要

出穂後收穫할 때까지 이삭이 전혀 抽出하지 않고 葉초에 싸여 登熟되는 特性을 가진 Nepal의 水稻品種 GAMADI를 圃場 및 溫室 兩條件의 8時間, 自然日長 및 24時間 日長下에서 生育시켜 日長條件이 GAMADI品種의 이삭 抽出에 미치는 影響을 檢討하였다.

그 結果를 要約하면 다음과 같다.

1. 8時間과 自然日長 條件에서는 이삭이 전혀 抽出되지 않았으며 24時間 日長條件에서 生育된 경우에 만 전체 이삭 길이의 71% 程度가 抽出되었다.
2. 24時間 日長條件에서는 上位 第一節間伸長 程度가 8時間과 自然日長에 比하여 顯著하여 이삭 抽出과 有意한 關係에 있는 것으로 나타났다.
3. 第3 및 第4節間伸長 程度는 自然日長에 比하여 8時間 및 24時間 日長條件에서 有意하게 낮게 나타났다.
4. GAMADI品種의 穗長, 穗當粒數는 日長에 영향하지 않았다.
5. 水原의 自然狀態에서의 GAMADI品種의 稔實率은 Nepal에서 보다 顯著하게 낮았다.

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