STUDIES ON RESPONSES OF THE RICE PLANT TO PHOTOPERIOD

III. RESPONSE OF KOREAN VARIETIES

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Daylength and temperature affect the growth duration of rice varieties. Under Korean conditions, these two environmental factors show a wide range of change during the cropping season. On the other hand, changes in the tropics are comparatively small although the small changes in daylengtht are easily discernable by the varieties in the tropics. The old tropical varieties are very sensitive to small changes in daylength that a dealy of several months is not unusual if sown at an improper month.

Since the growing season in Korea is short, the varvieties must either be relatively insensitive to temperature and daylength to prevent any delay in growth durations; or highly sensitive to day length with a long critical photoperiod. Although temperature and daylength have a wide range in Korea, the rice varieties are adapted to such conditions. The effect of these factors on growth duration and the characters of the rice varieties responsible for such adaptation would help in understanding the growth duration of Korean varietieus and in introducing new varieties to Korea. Thus, the present experiment was undertaken.

MATERIALS AND METHODS

Fifty Korean varieties were used for the first expe riment and 15 varieties representing early, medium and late types were selected from these 50 for use in second experiment.

Experiment 1. Field Experiment. The seeds were germinated on May 28, 1963 and transplanted three days later to a meter square concrete pots. Fertilizer was applied before transplanting at the rate of 48, 15, 13g of ammonium sulphate, superphophate, and muriate of potash, respectively per pot.

The plants were divided into 4 treatments;

1. natural daylength and high temperature
2. natural dayelngth and low temperature
3. short day and and high temperature
4. short day and low temperatu

The short day was obtained by covering the plants with a dark cloth from 5 p.m. to 9 a.m. Plants grown outside the greenhouse were considered as having grown under low temperature while those inside the greenhouse as under high temperature.

The experiment was carried out at Iiri, Korea (3 5°58'N) during the late cropping season.

Experiment 2. Greenhouse Experiment. The 15 varieties were directly sown on plastic pots containing 3 Kg of soil and 5, 2, 2 g of ammonium sulphate, superphosphate, and muriate of potash, respectively. The soil was flooded at all times.

The plants were exposed to 8 hours of natural light in the greenhouse and then transferred to darkrooms with different phofoperiods, photoperiodic treatments were 8, 10, 12, 13, 14 and 16 hours of light, using artifical lights of ow intensity for extending the photoperiod. The temperature in the darkrooms was maintained at 21°C. Each treatment had two pots per variety, containing 4 plants per pot. The date of the first panicle emergence per hill was considered the flowering date.

The experiment was carried out at the International Rice Research Institute, Los Banos, Laguna, Phillppines in January 1967.

RESULTS AND DISCUSSION

Experiment 1. Figure la shows the decrease in growth duration by short daylength. The early varieties least affected while the late vareties showed the greatest response. Varieties considered as "early" have growth durations relatively shorter than the late varieties when planted under normal conditions in Korea. The trend of response to daylength is the same whether the plants were grown under high or low

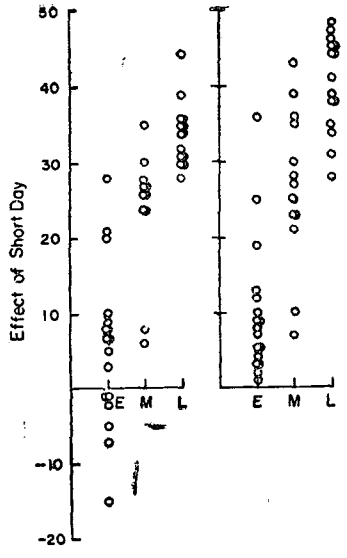


Fig. la. Effect of short days on the growth duration of Korean varieties grown under high and low temperatures. Effect of short day was determined by subtract ing the growth duration under short day from natural day length.

temperatures. The generally higher photoperiod sensitivity of late varieties have been reported by Lee (1964) & Choi (1966) in Korean varieties and by several workers (Yoshii 1926, Hara 1930, Velasco De la Fuente 1958), using different varieties.

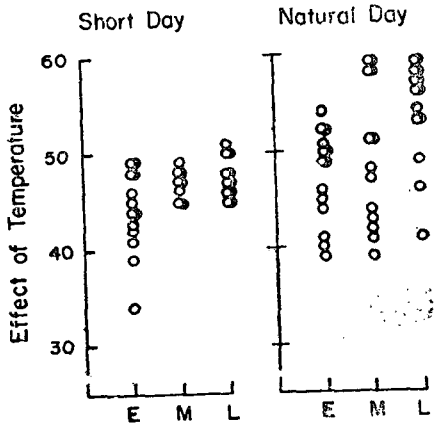
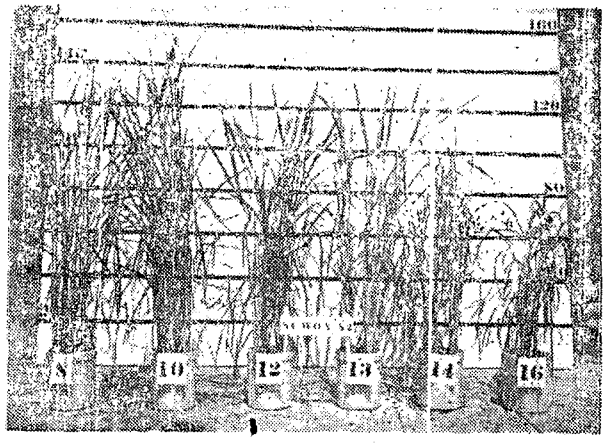


Fig. lb. Effect of temperature on the growth dura tion of Korean varieties using short and natural daylengths. Effect of temperature on growth duration at low temperature-duration at high temperature.



Low temperature definitely delays flowering (Fig. lb), either under short daylength or natural daylength. No differences in response, however. could be obtained between the early, madium or late varieties. Since the difference in response between the short day treatment is less than the temperature treatment, it would seem that temperature has a greater controlling factor than daylength in the growth duration of the Korean varieties

Vergara et al (1965) has divided the growth duration of a rice variety into 3 phases. The vegetative phase consisted of the basic vegetative phase (bvp) and the photoperiod sensitive phase (psp), the bvp being the initial growth stage whose length or duration is not affected by photoperiod while the psp is the stage after

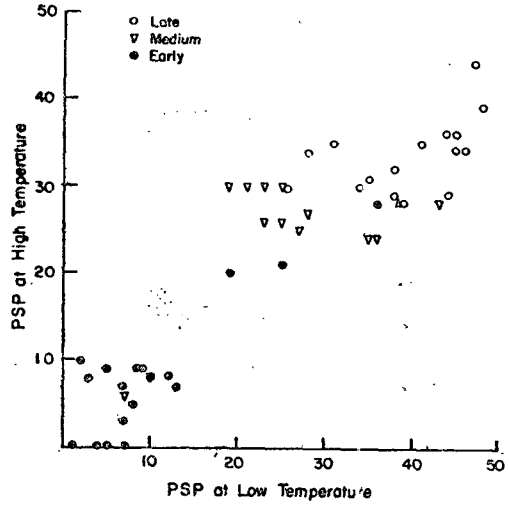


Fig. 2. Photoperiod sensitive phase of Korean varieties determined at high and low temperature.

bvp which is most receptive to photoperiod stimulus.

The psp of the Korean varieties were arbitrarily determined by subtracting the growth duration of the variety grown under short day from the one grown under natural daylength. Fig. 2 shows that the same psp at high and low temperstures are more or less the indicating that temperature has very little effect on psp. The late varieties had longer psp than the early varieties.

The bvp was also calculated arbitrarily by subtracting 35 dasy from the plants grown under short day conditions. Generally, the bvp is longer with the early varieties than the late ones (Fig. 3). For a particular variety, the bvp under high temperature is much shorter than lowunder temperature, showing the great effect oftemperature on the duration of the bvp.

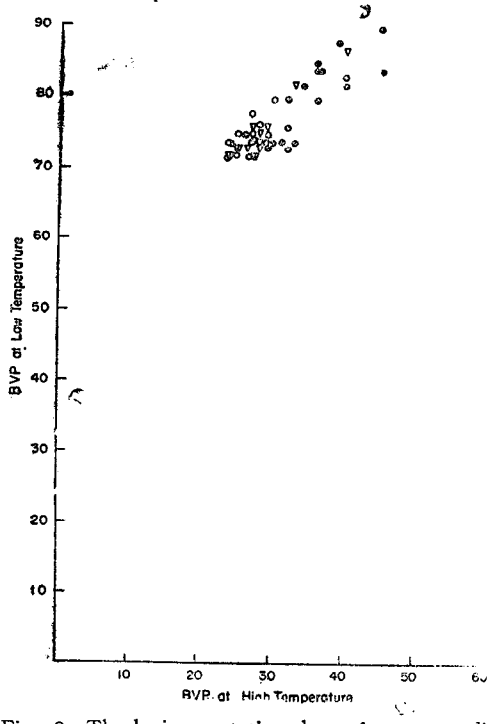


Fig. 3. The basic vegetative phase of e..ly, medium and late Korean variety detormined as high and low temperatures.

The results of the experiment show that temperature has greater effect on the growth duration of Korean varieties than daylength. Low temperature prolongs the bvp while high temperature shortens it. However, temperature seems to have very little effect on the psp. The longer growth duration of the late variety is the result of longer psp and not the bvp.

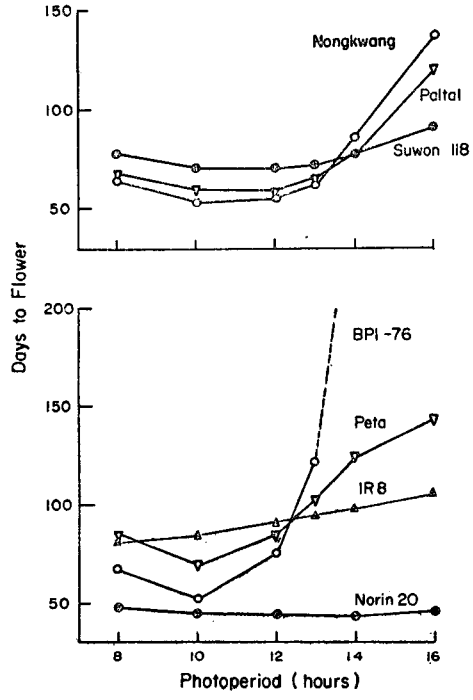


Fig. 4. Folweoring respense of representative varietie st diferent photoperiods. The brokon lie indicatos that no flowering has occurred asof that date.

Experiment 2. The performance of the Korean varieties under controlled daylengths or photoperiod gves a better picture of the sensitivity of the varieties. Table I shows the respons of the early, medium and late varieties. All varieties flowered at all photoperiods used indicating that the Korean varieties are relatively insensitive to photoperiod. A delay, however, is expected in these varieties if the daylangth is beyond 14hours. Under tropical conditions, the effect of daylength on the growth duration of Korean varieties. The Korean varieties have a similar photoperiod reaction as Peta and IR8, essen-tially photoperiod insensitive but show ing a delay atphotoperiods between 12 and 18 hours.

At 14 and 16 hour photoperiods, the early varieties. generally flowered earlier than the medium and late varieties However, there seems to be no distinct difference between the medium and late varieties. The bvp,

dtermined by subtracting 35 days from the minium growth duration, is longer in the early than late varieties, supporting the field results.

The psp, determined by subtracting 35 days from the minium growth duration is longer in the early ohan varieeies, suppoiting the field results. The psp, determined by subtracting the minimum growth duration from the maxium growth duration, is shorter for the early than the late varieties, also supporting the field results. Based on bvp and psp, the rice varieties have been classified into four types (Vergara et al, 1965): eA) short bvp and short psp as in Norin 20; B) short bvp and long psp as in BPI—76; C) long bvp and short psp as in IR8 and, D) long bvp and long psp. The last type is rarely found in standard varieties. The Korean varieties are of type A.

The optimum photoperiod for the Korean varieties is around 10 hours, which is the general tendency for rice varieties (Hara 1930, Miyabayashi 1944, Velasco & Manuel 1955, Ormrod et al. 1960, Chandraratna 1961, Roberts & Carpenter 1962).

If planted in the warm tropical regions, the growth duration of Korean varieties will be short. There will be no problem of plants not flowering because of daylength. On the other hand, varieties to be developed or introduced to Korea would seem to fit best in Korea if they are relatively insensitive to photoperiod, based on the general photoperiod characteristic of the Korean varieties. Since most of the known photoperiod sensitive varieties have short critical photoperiods (around 12 hours), it would be difficult to introduce these varieties to Korea as their flowering will be greatly delayed. A variety with a critical photoperiod of around 13 might be able to adapt to Korean conditions, however, no such variety has been reported.

Summary

The photoperiod and temperature response of Korean varieties were studied under field and greenhouse conditions. Results of the experiment indicated that all varieties tested were relatively insensitive to photoperiod. The early varitiees were least affected by photoperiod while the late varieties showed the greatest response. Low temperature delays flowering either under short daylength or natural daylength. In general, temperature has a greater effect than photoperiod on the growth duration of the varieties used.

The late varties had longer photoperiod-sensitive phase than the early varieties. Temperature has very little effect on the phootperiod-sensitive phase. The baasic vegetative phase is longer in the early varieties than the late verieties. High temperature results shorter duration of the basic vegetative phase

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摘 要

水稻栽培時期移動時의 品種의 適應性 또는 外國品種導入時 그 適否判斷의 基準이 되는 日長및 溫度効果의 本質과 韓國品種들의 感應度를 分析比較하였다.

試驗結果 供試品種들은 全部 日長에 對하여 比較的 鈍感하고 어느 處理日長下에서나 出穗하여 限界日長이 없었으나 晩生品種은 早生種에 比하여 感光性이 銳敏하고 基本榮養生長期間이 짧었고 早生品種은 基本榮養生長性이 컸으며 最適日長은 全 品種 10時間前後였다.

또한 溫度도 日長과 같이 生育期間에 對하여 影響이 큰 것 같고 低溫은 日長의 長短,品種의 早晩에 關係없이 出穗를 遲延시키고 高溫은 基本榮養生長期間을 短縮시키고 日長感應性에는 別로 影響이 없었다.

Table1. Flowering response of Korean vaieties to different Photoperiods.

Variety	Photoperiod (hours) 8	10	12	13	14	16	B. V. P.	P. S. P.
	(Days to flowering)							
Suwon 118	78	71	71	72	80	91	36	20
Norin 17	78	69	70	73	79	89	34	20
Fujisaka 5	67	60	60	60	69	79	25	19
Yuku 132	73	66	68	71	80	91	31	25
Suwon 82	68	62	63	63	81	131	27	69
Sunseo	64	55	64	59	81	127	19	73
Paltal	69	60	59	67	80	121	24	62
Shirogane	66	59	60	63	80	124	24	65
Pungok	69	64	64	73	87	128	29	64
Jinhung	67	56	56	60	81	136	21	80
Norin 29	63	56	56	60	88	118	21	62
Chonbonuk	67	59	59	65	65	117	24	58
Palkwoeng	67	60	60	65	89	125	25	65
Unbangju	63	57	57	63	89	122	22	65
Nongkwang	65	54	55	62	86	137	19	83