SEASONAL VARIATIONS IN THE GROWTH DURATION OF SOME RICE VARIETIES GROWN IN CROSS RIVER STATE

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ABSTRACT

Two experiments were carried out in 2008 and 2009, in four locations in Cross River State, to determine seasonal variations in the commonly grown rice varieties. Their response to different photoperiod treatments were investigated with rice plants in polyethylene bags subjected to varying lengths under artificial light. High photoperiod - sensitive varieties, showed significant difference in their maturation periods when planted at different times of the year. The longer growth duration occurred when plantings were made in January - February. The shortest growth duration occurred when plantings were made in the October - November period. In some of the photoperiod - sensitive varieties, there were big differences in the growth duration when planted in the same month, of different years. These varieties would be unsuitable for planting during the off season (August to September). The results are discussed in light of photoperiod sensitivity of some rice varieties planted at different times of the year.

KEYWORDS: Seasonal variation, growth duration of rice.

INTRODUCTION

In the Southern part of Nigeria where there are few or no irrigation facilities, rice is grown once a year. The growth duration and photoperiod sensitivity of the rice varieties cultivated may therefore appear relatively unimportant. Dore (2000) found that some of the Nigerian rice varieties are photoperiod sensitive (season fixed). The differences on maturation periods when planted at different dates are governed by the prevailing day length. Van (2001) suggested that work on the selection of photoperiod - sensitive varieties of rice was very important in determining the growth duration of rice varieties in relation to the prevailing day length.

Work on this aspect of crop improvement is scanty, especially study in the area that is related to the commonly grown rice varieties in Cross river State, Nigeria. Thus, a knowledge of the growth duration of both photoperiod - sensitive and insensitive varieties of rice under field and controlled condition is necessary. An explanation for the growth duration pattern when planted in different months is desirable. This study was carried out with the objective of estimating the growth duration of some Nigerian rice varieties as to determine the best season for greater crop yield.

MATERIALS AND METHODS

Location of Experiment:

The experiments were carried out simultaneously at four localities in cross river state, namely: Adim, Idomi, Assiga and Ofodua. The four locations are within longitude 8° 03’ to 8° 17E° and Latitude 38° to 5°, 59° N. The main rainfall in most of the experimental area is 2500mm with a range of (2250 to 1700mm). Mean daily minimum and maximum temperatures vary from 21°c to 24°c and 27° to 32° respectively. Relative humidity varies from 82 to 97% (Eshiet, 1994).

The source for the planting materials was International Institute for Tropical Agriculture (IITA), Ibadan. The rice varieties were: Faro 12, Farao 15, Faro 44 and Faro 52.

The experiments were laid out in a randomized complete Black Design (RCBD), replicated three times with intra and inter – row spacing of 15x15cm. Plot size of 25 x20m, was maintained with sampling area of 2’m.

For the natural day length, three seedlings were transplanted into the polyethylene bags containing about 5kg of soil later thinned to two plants and fertilized with 1g of N, P and K because the initial soil analysis results showed low values of the soil nutrients. The soils were flooded throughout the growth of plants.

The experiment for photoperiod was carried out at the World Bank Rice project Adim in June, 2008. Three 7 - day old seedlings were transplanted to each polyethylene bag containing 5kg of soil later thinned to two plants and fertilized with 1g of N, P and K because the initial soil analysis results showed low values of the soil nutrients. The soils were flooded throughout the growth of plants.

The experiment for photoperiod was carried out at the World Bank Rice project Adim in June, 2008. Three 7 - day old seedlings were transplanted to each polyethylene bag containing 5kg of soil and fertilized with 2 each of N1, P1,05 and K2O. The plants were subjected to 8, 10, 12, 13, 14, 16 and 24 hours photoperiods, in a 24 hours cycle. The experiment was terminated after 200 days. Field data was subjected to analysis of variance (ANOVA) and means were compared using fishers least significant different at 5% probability level, using the methods of Obi (2000).

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RESULTS

Experiment 1:

The average number of days from sowing to flowering of different varieties planted at various locations and months of the year are summarized in Table 1. The mean values of photoperiod sensitivity of Faro 44 at the three locations (Adim, Idomi and Assiga) were significantly (p<0.05) higher in January 2009 than January 2008. Conversely, the mean values of Faro 52 and Faro 15 were significantly higher in 2008 than in 2009 planting season, under similar experimental conditions. The differences in maturity period (156 days) between January 2008 and January 2009 was highest in Adim location in plots where Faro 44 was planted and lowest (29 days) in plots where Faro 52 variety was planted (Table 1), the variations may be attributed to change in whether pattern.

Table 1: Growth duration (days from sowing to flowering) and differences between years of photoperiod sensitive varieties planted in January 2008 and 2009 at several locations.

| variety | locations | years | Year Jan.2008 | Year Jan. 2009 | LSD (0.05) | Difference in maturation period |
|---------|-----------|-------|---------------|----------------|------------|-------------------------------|
| Faro 44 | Adim      | 136   | 292           | 148.9          | 97         |                                |
|         | Idomi     | 146   | 243           | 91.6           | 37         |                                |
|         | Assiga    | 134   | 97            | 35.7           | -          |                                |
|         | Total     | 4.6   | 544           | -              | -          |                                |
|         | Mean      | 138.6 | 181.3         | -              | -          |                                |
|         | LSD (0.05)| 8.4   | 44.6          | -              | -          |                                |
| Faro 12 | Adim      | 270   | 224           | 44.3           | 46         |                                |
|         | Idomi     | 171   | 138           | 31.9           | 33         |                                |
|         | Ofodua    | 276   | 176           | 84.6           | 100        |                                |
|         | Total     | 717   | 3.4           | -              | -          |                                |
|         | Mean      | 239   | 157           | -              | -          |                                |
|         | LSD (0.05)| 5.6   | 37.1          | -              | -          |                                |
| Faro 52 | Adim      | 213   | 184           | 27.8           | 29         |                                |
| Faro 15 | Ofodua    | 305   | 268           | 35.1           | 37         |                                |

Table 2 shows photoperiod of four rice varieties from sowing to flowering with day length indicated in hours. At day length of 8 hours Faro 12 and 15 had flowering days of 67 and 66 respectively. The Faro 44 and Faro 52 had 72 and 106 days respectively. Increasing the number of hours from 8 to 10 did not show any significant different in terms of number of hours. When the numbers of hours were increased from 12 to 16 hours, there was a consistent increase in number of days from sowing to flowering. When it was further increased from 16 to 24 hours there were 7.0% drop in days in Faro 44, 5.9% in Faro 12 and 2.0% in Faro 52 during the study period.

Table 2: Photoperiod of four Nigerian rice varieties

| variety | days from 8 to 12 | from 12 to 13 | from 13 to 14 | from 14 to 16 | from 16 to 24 | BVP | PSP |
|---------|-------------------|---------------|---------------|---------------|---------------|-----|-----|
| Faro 44| 72                | 64            | 80            | 112           | 119           | 121 | 113 | 7.1 | 29  | 57  |
| Faro 12| 67                | 67            | 89            | 86            | 123           | 144 | 136 | 15.6| 32  | 77  |
| Faro 52| 106               | 88            | 116           | 146           | 153           | 171 | 168 | 9.0 | 53  | 83  |
| Faro 15| 66                | 65            | 80            | *             | *             | *   | *   | 12.3| 30  | 100P|
| Mean    | 77.8              | 71.0          | 91.3          | 114.6         | 131.7         | 145.3| 139.0| -   | -   | -   |
| LSD (0.05) | 5.0              | 18.3          | 8.6           | 32.1          | 28.5          | 25.6 | 30.7 | -   | -   | -   |

BVP = Basic vegetative phase (earlier flowering minus 35 days)
PSP = Photoperiod - sensitive phase (difference in days between earliest to latest flowering)
Table 3 shows growth duration (days from sowing to flowering of one rice variety planted at four locations (Faro 44). The values of growth duration for Faro 44 for 2008 and 2009 vary from one location to another, from January to December. The following days ranged as follows: 71-91 for Adim and Ofodua; 71-94 for Idomi; 80-91 for Assiga.

Table 3: Growth duration (days from sowing to flowering of one rice variety planted at different dates and localities.

| Variety: Faro 44 |
|------------------|
| LOCATIONS        |
| Adim | Idomi | Assiga | Ofodua | LSD (0.05) |
|------------------|
| January 2008     | 91    | 94    | 81     | 89         | 3.0     |
| 2009             | 86    | 94    | 83     | 88         | 3.3     |
| February 2008    | 87    | 93    | 85     | 85         | 4.0     |
| 2009             | 89    | 93    | 86     | 91         | 3.0     |
| March 2008       | 83    | 91    | 87     | 88         | 5.0     |
| 2009             | 91    | 88    | 84     | 88         | 4.1     |
| April 2008       | 86    | 94    | 91     | 90         | 3.0     |
| 2009             | 89    | 84    | 89     | 90         | 5.0     |
| May 2008         | 86    | 91    | 89     | 94         | 3.3     |
| 2009             | 89    | 71    | 88     | 90         | 3.0     |
| June 2008        | 87    | 87    | 89     | 93         | 3.0     |
| 2009             | 86    | 85    | 82     | 84         | 3.2     |
| July 2008        | 92    | 94    | 88     | 89         | 7.5     |
| 2009             | 86    | 87    | 84     | 90         | 4.5     |
| August 2008      | 81    | 96    | 86     | 93         | 3.1     |
| 2009             | 81    | 86    | 84     | 71         | 6.0     |
| September 2008   | 81    | 82    | 86     | 86         | 3.0     |
| 2009             | 80    | 78    | 84     | 84         | 4.2     |
| October 2008     | 80    | 75    | 84     | 84         | 6.1     |
| 2009             | 75    | 78    | 85     | 82         | 5.0     |
| November 2008    | 79    | 89    | 84     | 94         | 5.4     |
| 2009             | 71    | 78    | 86     | 80         | 4.8     |
| December 2008    | 88    | 83    | 84     | 83         | 3.6     |
| 2009             | 80    | 83    | 80     | 80         | 3.0     |
| Longest          | 91    | 94    | 91     | 94         |
| Shortest         | 71    | 71    | 80     | 71         |
| Differences      | 20    | 23    | 11     | 23         |

Differences between locations in terms of days from sowing to flowering of Faro 44 variety were statistically significant (p<0.05). However, values for Assiga and Ofodua for February, March, April, July, September, October and December tended to be similar in 2008 (Table 3). There were no variations in values of certain months in 2009 from April to June then September and December.

Table 4 shows values of Faro 12 on growth duration for four locations in which values ranged as follows: 79-114 for Admin, 76-94 for Idomi, 79 – 117 for Assiga and 74 – 118 days for Ofodua during the 2008 and 2009 planting seasons. Differences between locations in terms of growth duration were significant (p<0.05), from January to December in 2008 and 2009 planting seasons. The mean values were higher from February to July for Adim and Ofodua. The average mean values tended to decrease in the four locations from August to December and the decrease followed a similar pattern.
Table 4: Growth duration days from sowing to flowering of Faro 12 rice variety planted at different dates and localities.

| Variety: Faro 12 |
|------------------|
| LOCATIONS        |
| 2008             |
| 2009             |
| Adim             |
| Idomi            |
| Assiga           |
| Ofodua           |
| LSD (0.05)       |
| January 2008     |
| 90               |
| 83               |
| 104              |
| 90               |
| 9.2              |
| February 2008    |
| 99               |
| 106              |
| 104              |
| 90               |
| 9.0              |
| March 2008       |
| 104              |
| 117              |
| 104              |
| 94               |
| 11.1             |
| April 2008       |
| 111              |
| 113              |
| 117              |
| 102              |
| 5.7              |
| May 2008         |
| 112              |
| 114              |
| 111              |
| 99               |
| 7.2              |
| June 2008        |
| 109              |
| 103              |
| 111              |
| 82               |
| 6.8              |
| July 2008        |
| 111              |
| 103              |
| 111              |
| 94               |
| 9.6              |
| August 2008      |
| 93               |
| 103              |
| 103              |
| 87               |
| 9.0              |
| September 2008   |
| 82               |
| 80               |
| 103              |
| 83               |
| 3.0              |
| October 2008     |
| 81               |
| 85               |
| 90               |
| 76               |
| 4.7              |
| November 2008    |
| 80               |
| 79               |
| 83               |
| 86               |
| 5.4              |
| December 2008    |
| 88               |
| 79               |
| 83               |
| 83               |
| 4.0              |

The results of growth duration of variety Faro 52 planted at four locations is presented in Table 5, in which the highest growth duration 199 days was recorded in May 2008 at Assiga while the lowest, 105 in September was recorded in Idomi location. The implication here is that Faro 52 variety had delayed flowering in the four locations than either Faro 12, or Faro 44.

Table 5: Growth duration (days from sowing to flowering of one rice variety planted at different dates and localities (Faro 52)

| Variety: Faro 52 |
|------------------|
| LOCATIONS        |
| 2008             |
| 2009             |
| 2008             |
| 2009             |
| Adim             |
| Idomi            |
| Assiga           |
| Ofodua           |
| LSD (0.05)       |
| January 2008     |
| 121              |
| 131              |
| 112              |
| 125              |
| 5.0              |
| February 2008    |
| 119              |
| 130              |
| 117              |
| 125              |
| 5.0              |
| March 2008       |
| 123              |
| 131              |
| 118              |
| 118              |
| 6.4              |
| April 2008       |
| 124              |
| 127              |
| 118              |
| 121              |
| 7.9              |
| May 2008         |
| 124              |
| 127              |
| 118              |
| 121              |
| 7.6              |
| June 2008        |
| 120              |
| 116              |
| 116              |
| 127              |
| 6.2              |
| July 2008        |
| 126              |
| 125              |
| 118              |
| 123              |
| 4.0              |
| August 2008      |
| 114              |
| 112              |
| 112              |
| 122              |
| 7.7              |
| September 2008   |
| 117              |
| 111              |
| 113              |
| 119              |
| 4.0              |
| October 2008     |
| 117              |
| 115              |
| 113              |
| 123              |
| 4.5              |
However, differences in mean values between the four locations were significant (p<0.05) throughout the experimental seasons.

Table 6 shows the growth duration values of Faro 15, in four study locations in which the highest (250 days) occurred in February 2009 at Adim while the lowest (106 days) occurred in October 2009 at Idomi. Days from sowing to flowering of this variety showed greater values in 2008 planting, on the average than 2009 planting. Equally, these values showed that Faro 15 variety delayed flowering at different planting dates and locations more than Faro 12 and Faro 44 varieties throughout the study season.

| month    | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| November | 115  | 108  | 111  | 121  | 6.1  | 4.0  | 4.0  | 6.3  | 6.2  |      |      |      |      |      |
| December | 112  | 116  | 109  | 118  |      |      |      |      |      |      |      |      |      |      |
| Longest  | 147  | 132  | 119  | 141  |      |      |      |      |      |      |      |      |      |      |
| Shortest | 112  | 105  | 109  | 113  |      |      |      |      |      |      |      |      |      |      |
| Differences | 35  | 27  | 10  | 38  |      |      |      |      |      |      |      |      |      |      |

Table 6: Growth duration (days from sowing to flowering of four rice varieties planted at different dates and localities. (Faro 15)

Variety: Faro 15

Experiments 2

In the photoperiod experiment, the two varieties which showed high variation in growth duration in the field also showed high photoperiod sensitivity. The turning points for these varieties were less than 12 hours. The turning point is defined as the minimum photoperiod longer than 10 hours was found to definitely prolong the growth duration of faro 52 and Faro 15, in which for 198 days there was no flowering (Fig 1)

DISCUSSION

The existing Nigerian rice varieties can be divided essentially into two groups; those that are highly photoperiod sensitive and those that are weakly photoperiod - sensitive. The flowering of highly photoperiod sensitive varieties (classified as season - fixed) represented by Faro 52, was greatly delayed by a small increase in length of the photoperiod. At certain photoperiods no flowering was obtained even after 200
The weakly photoperiod-sensitive varieties (Period-Fixed) such as Faro 15 and Faro 52 showed very little variation in growth duration under field conditions, but were delayed in flowering when subjected to long photoperiods (12-16 hours). The delay however was not as great as the highly photoperiod-sensitive varieties, (Table 3-6).

Although the results of the experiments tend to show that sensitivity to photoperiod is the factor determining the growth duration, it is not the only factor. Growth duration of any variety is determined by the length of the vegetative reproductive and ripening phases. Since the duration of reproductive and ripening phases are essentially constant, it is therefore the vegetative phase that differs and determines the growth duration of the variety (Vergara et al, 1995). Two varieties that were photoperiod-insensitive were Faro 44 and Faro 12, although the growth duration of Faro 12 is longer than Faro 44, both varieties showed very little variation in growth duration with different photoperiods, (Van, 2001) Jugoe, 2003; Later, 2005).

The test varieties Faro 52 and Faro 15, which were considered as “period fixed” and their curves, (Fig I); contrast strongly with those of Faro 44 and Faro 12. The relative short duration of Faro 44 was mainly the result of high temperature (Vergara et al, 1995: Dore, 2000). Varieties that do not flower or take longer than 200 days to flower at 13 hours, will be sensitive to day length changes in Cross River State, Nigeria.

An interesting observation made in the field experiments was the great difference in growth duration of the highly photoperiod sensitive varieties, planted in the same month not in different year. It is suggested in this study that cloudiness may have something to do with this big difference in photoperiod sensitivity of Faro 12 and Faro 44.

A small difference in day length may cause a great delay in the growth duration of a photoperiod-sensitive variety. It was found that cloudy weather in the early and late part of the day shortens the twilight hour, and hence, the effective day length.

A difference of 30-40 days in growth duration as a result of cloudiness has been reported (VETCH, 2000; Jagoe and Later, 2002).

CONCLUSION

The result of this study has shown that growth duration of any rice variety is determined by the length of the vegetative reproductive and ripening phases. Since the duration of reproductive and ripening phases is essentially constant, it is the vegetative phase that differs and determines the growth duration of the rice variety. In this test, the growth duration of Faro 44 and Faro 12 did not vary much with different photoperiods—These test varieties Faro 44 and Faro 12 did not vary much with different photoperiod. These test varieties (Faro 44 and Faro 12) contrast strongly with those of Faro 52 and Faro 15.

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