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# FLOWERING AND PLANT HEIGHT OF THIRTY PIGEON PEA (Cajanus cajan (L.) Millsp.) IN RESPONSE TO THREE SOWING DATES IN BARBADOS

B. A. Clarke [1/]

## SUMMARY

A factorial design was used to ascertain the vegetative and reproductive responses of thirty Cajanus cajan (L.) Millsp. accessions to three sowing dates. Data for the number of days to 50% flowering and the plant heights at that stage are presented herein.

Preflowering durations and plant heights varied between planting dates and accessions. The interaction between plant height and sowing date was significant, but negligible variation occurred in the temperature and the daylength at 50% flowering.

Data did not facilitate delineation of the relative photoperiodic sensitivity of the accessions but facilitated classification based on the average preflowering phase over the three planting dates.

## INTRODUCTION

Pigeon pea (Cajanus cajan (L.) Millsp.) has considerable potential as a food legume in Barbados. Currently it is intercropped with sugar cane on a small scale yielding an estimated one tonne of seed from three hectares annually. Of this, equal quantities are consumed in the fresh green and dry seed states. The observed seasonality of supply of pigeon peas locally is attributed to the cultivation of unselected, tall, late maturing photoperiod sensitive, determinate cultivars. Hammerton (1976) observed that flower induction occurs during the shortening days of October to December. The above has precipitated large annual imports of dried, fresh, chilled and frozen pigeon pea averaging 321,535 kg valued at $396,957 from 1976 to 1981 (Clarke 1983).

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1/ Central Agronomic Research Station
Ministry of Agriculture, Food and Consumer Affairs
Barbados

Owing to their photoperiodic sensitivity the vegetative and reproductive development of pigeon pea is strongly influenced by planting date, (Abrams et. al., 1969; Derieux; Hammerton 1971; Singh et. al, 1971; Spence and Williams, 1972; Abrams and Julia, 1973; Dahiya 1974; Akinola and Whiteman 1975 a; Hammerton 1976; Wallis et. al., 1979). Climatic factors, primarily rainfall distribution patterns, have limited planting dates to mid-June to mid-August in Barbados. Later plantings have been explored utilizing the system defined by Spence and Williams, (1972). This, concomitant with the use of irrigation resources, since it appears that interactions between photoperiod, thermoperiod and soil moisture status at planting can influence the onset of flowering, has not improved supply significantly.

Thus this study was initiated to evaluate the performance of thirty C. cajan genotypes, collected from the University of the West Indies, the University of Queensland and the International Crop Research Institute for the Semi Arid Tropics, sown at different times. The lines from the University of Queensland are purportedly photoperiod insensitive in that environment. The paper describes the number of days to flowering and plant heights on that date for three planting dates.

## MATERIALS AND METHODS

The investigation was carried out between March 1982 to February 1983 at the Central Agronomic Research Station at Graeme Hall on the south coast of Barbados. The soil is described as the Black Association by Vernon and Carrol, (1965). Rainfall, temperature and daylength data are given in Table 1. A randomised complete block design was used for each of three planting dates, March, May and October 1982. Three replicates of thirty genotypes were incorporated, Table 2.

Seeds selected from an initial planting in September, 1981 were hand-sown to a depth of 4.0 cm at a rate of one per station. Forty plants were planted in each replicate and spaced at 25.0 cm between rows and 10 cm within rows. Plot size was 100 x 100 cm. Irrigation removed the constraint of uneven rainfall distribution. Each experiment was hand-weeded at three and six weeks after planting.

Responses to planting date were investigated with respect to a reproductive and vegetative parameter. Time to flowering was regarded as the number of days from planting to 50% first

flower opening. Plant height was measured from the plumular node to the last visible node for five plants in each plot when flowering occurred.

## RESULTS AND DISCUSSION

For the purpose of statistical analysis a factorial technique described by Steel and Torrie, (1960) was used. Main effects were sowing dates and accessions.

Within each sowing date significant variation occurred between accessions in the number of days to 50% flowering. For the March 15, 1982 sowing date the period from sowing to 50% flowering varied from 70 days for QPL 29 to 131 days for Royes (Table 3). For sowing on May 10, 1982 and October 7, 1982 the preflowering phase ranged from 62 days in QPL 22 to 124 days in T-21 and 57 days in QPL 20 to 90 days in 908-4, respectively. Except for a few instances most accessional differences were insignificant. Differences of significance pertained to a few accessions with some consistency. Some accessions were always earlier than others.

Up to the conclusion of the experiment accession Royes had not flowered for either the May or October sowings.

The period from sowing to 50% flowering in most accessions declined appreciably between March and May 1982 sowing dates whereas increases were observed between the latter sowing date and the October 1982 date though the magnitude of differences were smaller than the above. The number of days to 50% flowering were generally greater for the first sowing date than the third. Less variation was however observed between March and October sowing dates than for other comparisons.

Marked variation in times to flowering were observed in accessions UW-17, 900-5,BC-3 and QPL-29 of +33 days, - 29 days - 22 days and - 27 days respectively between March and May sowing dates. Meanwhile for the same sowing dates accession QPL 25, 922-4, QPL 20, Pusa Ageti and QPL 3 were earlier by 1, 4, 4, 5 and 6 days respectively. UPAS 120 flowered 1 or 2 days later and T-21 was later by 20 days.

For T-21 the average preflowering durations were 103, 124 and 74 days for March, May and October sowings respectively. The October sowing flowered 50 and 30 days sooner than May and March sowings respectively. Other accessions differed less. The least difference was observed in UPAS-120 where the

three sowing dates averaged 2, 1 and 3 days respectively. For fifteen accessions observed variations in the preflowering phase of March and October sowings averaged less than 10 days.

A maximum of 131 days was recorded for Royes (March sowing) and the minimum was 57 days for QPL 20 (October sowing).

The distinction between flowering responses of the accessions was examined in relation to the daylength and mean temperature on the day of 50% flowering (Table 5). Neglible differences were observed in mean daylengths and temperatures for intra-accessions, intra-sowing dates and inter-sowing date comparisons for March and May sowings. Similar daylengths were recorded for all accessions of the October sowing and neglible variations mean in daily temperature were observed. However observed daylengths at which the preflowering phase ended were 1.5 to 1.3 hours less for the latter sowing date than the other sowing dates.

Observations on plant height at 50% flowering were greatest when accessions were sown on May 10, 1982 (Table 4). The general pattern of reduced plant heights was evident for most accessions with respect to sowings in March and October. The exceptions were Pant A-2 whose average plant height for the May sowing was 31 cm less than that of the March sowing. For QPL 27, DSLR-38 and ICPL-81 there were no observed differences in plant height for these dates. Over the three sowing dates highest and lowest plants heights were recorded in UW-17 (May sowing) and QPL 20 (October sowing), 159.3 cm and 52.7 cm, respectively.

Amongst accessions within sowing dates variable differences were observed at each planting. For the March sowing, plant heights ranged from 140 cm for T-21, Pant A-2 and Royes to 55 cm for QPL 3. Four accessions were in the plant height range 120 cm to 140 cm, five in the 100 cm to 120 cm class, ten in the 80 cm to 100 cm class, nine from 60 cm to 80 cm and two less than 60 cm. This distribution is at variance with those of the May and October sowings. For the May sowing there was less interaccession variation. Eighteen accessions, primarily of the QPL grouping exhibited non-significant differences in plant height at 50% flowering.

The ratio computed for the interaction between plant height and sowing date was statistically significant at 0.05% level. This can be attributed to the climatic factors and their influence on growth. Marked variation was observed in

precipitation during the experimental period.

When sown at different times Cajanus cajan accessions can be distinguished because of the diversity in reproductive and vegetative responses. The experimental objective purported delineation of the relative photoperiod-sensitivity of the accessions included. Though the data indicated that under the conditions at Graeme Hall most of the accessions will flower, several factors militate against concrete conclusions with respect to response to photoperiod. In order to satisfy the criteria of delineation more frequent sowings should be investigated thus to expand the exposure to variations in day-length. Within the range of sowings investigated the pre-flowering period was generally less under shorter days thus necessitating an increased frequency during the longer days.

Akinola and Whiteman (1975 a) were able as a result of their study to compute growing degree-days (GDD) to 50% flowering as the summation of daily mean temperatures from sowing- to 50% first flower opening. Since there is little variation in temperature between years, if appropriate statistics of the pertinent agrometeorological parameters are known those workers indicated that suitable sowing dates can be formulated given the GDD of a particular accession.

The data presented herein is utilized to establish a system of accessional classification based on the mean number of days to 50% flowering presented in Table 4. Accessions will be grouped as follows: less than 70 days, 70 - 80 days, 80 - 90 days, 90 - 100 days, more than 100 days. Future studies will investigate the influence of sowing dates on flowering within each group.

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TABLE 1

Climatic Data for the Central Agronomic Research Station, Graeme Hall during 1982-1983

| Year | Month | Rainfall (mm) | Mean Daily Temperature (°C) | Mean Five-day Period Day Length |
|---|---|---|---|---|
| 1982 | March | 17.0 | 25.6 | 12.1 |
| | April | 62.2 | 26.3 | 12.4 |
| | May | 30.5 | 27.6 | 12.7 |
| | June | 23.1 | 27.2 | 12.9 |
| | July | 91.7 | 27.2 | 12.8 |
| | August | 202.2 | 27.3 | 12.7 |
| | September | 66.8 | 27.1 | 12.2 |
| | October | 119.6 | 27.0 | 11.9 |
| | November | 60.5 | 25.7 | 11.6 |
| | December | 63.0 | 25.3 | 11.4 |
| 1983 | January | 60.2 | 25.1 | 11.5 |
| | February | 8.6 | 26.3 | 11.7 |

TABLE 2

Characteristics of C. cajan Accessions

| Pedigree | Origin | Flowering Habit | Pedigree | Origin | Flowering Habit |
|---|---|---|---|---|---|
| T-21 | Uttar Pradesh, India | NDT | QPL 2 | Australia PI | DT |
| Pusa Ageti | New Delhi, India | DT | QPL 3 | Australia PI | DT |
| UPAS - 120 | U.P., India | NDT | QPL 4 | Australia PI | DT |
| ICPL - 81 | Andhra Pradesh, India | NDT | QPL 19 | Australia PI | DT |
| Pant A - 2 | U. P. India | NDT | QPL 20 | Australia PI | DT |
| Pant A - 3 | U. P. India | DT | QPL 22 | Australia PI | DT |
| DSLR - 38 | Madhya Pradesh, India | NDT | QPL 23 | Australia PI | DT |
| Prabhat | New Delhi, India | DT | QPL 25 | Australia PI | DT |
| UQ Line | Australia | DT | QPL 27 | Australia PI | DT |
| UW 17 | Trinidad | DT | QPL 29 | Australia PI | DT |
| Royes | Trinidad | DT | 839 - 11 | - | - |
| 908 - 4 | | - | 1 000 - 1 | - | - |
| 922 - 4 | | - | 915 - 10 | - | - |
| 900 - 5 | | - | 834 - 5 | - | - |
| BC - 2 | | - | BC - 3 | - | - |

DT - determinate; NDT - indeterminate; PI - photosensitive in Australia.

TABLE 3

Number of Days to 50% Flowering in Thirty C. cajan Accessions at Three Sowing Dates

| Accession | Sowing Dates | | | Mean No. of Days Three Sowing Dates |
|---|---|---|---|---|
| | 1982-03-15 | 1982-05-10 | 1982-10-07 | |
| T-21 | 103.3 | 123.7 | 73.7 | 100.1 |
| Pusa Ageti | 88.0 | 82.7 | 87.0 | 85.9 |
| UPAS - 120 | 81.3 | 85.0 | 84.0 | 83.4 |
| ICPL - 81 | 75.3 | 67.0 | 879.3 | 73.9 |
| Pant A-2 | 101.7 | 87.0 | 84.0 | 90.9 |
| Pant A-3 | 90.0 | 73.7 | 82.0 | 81.9 |
| DSLR - 38 | 102.0 | 86.0 | 84.0 | 90.7 |
| Prabhat | 81.7 | 73.7 | 81.0 | 78.8 |
| UQ Line | 77.3 | 68.3 | 77.0 | 74.3 |
| UW-17 | 90.0 | 123.7 | 84.0 | 99.2 |
| Royes | 131.0 | Did Not Flower | Did not Flower | - |
| 908-4 | 87.3 | 68.3 | 90.3 | 82.0 |
| 922-4 | 74.3 | 70.3 | 84.0 | 76.2 |
| 900-5 | 92.3 | 63.3 | 81.0 | 78.9 |
| BC-2 | 89.0 | 66.3 | 73.7 | 76.3 |
| BC-3 | 90.0 | 67.7 | 62.7 | 73.5 |
| 834-5 | 80.3 | 71.7 | 78.0 | 76.7 |
| 915-10 | 89.0 | 77.3 | 80.7 | 82.3 |
| 1000-1 | 81.7 | 74.3 | 77.0 | 77.7 |
| 839-11 | 93.3 | 73.3 | 79.3 | 82.0 |
| QPL 29 | 97.3 | 70.7 | 86.0 | 84.7 |
| QPL 27 | 83.3 | 67.0 | 81.0 | 77.1 |
| QPL 25 | 70.0 | 69.0 | 76.7 | 71.9 |
| QPL 23 | 80.3 | 73.3 | 84.0 | 79.2 |

Table 3 (Cont'd)

Number of Days to 50% Flowering in Thirty C. cajan Accessions at Three Sowing Dates

| Accession | Sowing Dates | | | Mean No. of Days Three Sowing Dates |
|---|---|---|---|---|
| | 1982-03-15 | 1982-05-10 | 1982-10-07 | |
| QPL 22 | 76.3 | 61.7 | 88.0 | 75.3 |
| QPL 20 | 74.0 | 69.7 | 56.7 | 66.8 |
| QPL 19 | 81.7 | 64.3 | 73.3 | 73.1 |
| QPL 4 | 80.7 | 67.3 | 70.3 | 72.8 |
| QPL 3 | 73.0 | 67.3 | 67.3 | 69.2 |
| QPL 2 | 82.0 | 65.0 | 79.3 | 75.4 |

LSD 0.05 Level 17.2 SD 10.63

LSD 0.01 Level 22.7

TABLE 4

Plant Heights (cm) at 50% Flowering in Thirty *C. cajan* Accessions at Three Sowing Dates

| Accession | Sowing Dates | | | Mean No. of Days Three Sowing Dates |
|---|---|---|---|---|
| | 1982-03-15 | 1982-05-10 | 1982-10-07 | |
| T-21 | 140.0 | 151.0 | 108.7 | 133.2 |
| Pusa Agetil | 90.3 | 112.7 | 98.0 | 100.3 |
| UPAS - 120 | 96.7 | 126.7 | 97.0 | 106.8 |
| ICPL - 81 | 101.3 | 100.3 | 112.7 | 104.8 |
| Pant A-2 | 140.0 | 108.5 | 107.7 | 118.7 |
| Pant A-3 | 78.3 | 110.0 | 100.0 | 96.1 |
| DSLR - 38 | 127.0 | 126.7 | 84.7 | 112.8 |
| Prabhat | 95.3 | 103.3 | 97.0 | 98.5 |
| UQ Line | 65.3 | 98.7 | 72.3 | 78.8 |
| UW-17 | 111.7 | 159.3 | 89.7 | 122.2 |
| Royes | 140.0 | - | - | - |
| 908-4 | 107.3 | 121.7 | 105.7 | 111.6 |
| 922-4 | 97.7 | 112.7 | 103.0 | 104.5 |
| 900-5 | 101.7 | 94.0 | 88.3 | 94.7 |
| BC-2 | 65.0 | 97.0 | 81.7 | 81.2 |
| BC-3 | 85.3 | 92.3 | 60.7 | 79.4 |
| 834-5 | 101.7 | 102.3 | 95.7 | 101.9 |
| 915-10 | 69.0 | 93.7 | 85.0 | 82.6 |
| 1000-1 | 81.3 | 97.3 | 81.7 | 86.8 |
| 839-11 | 84.7 | 112.3 | 97.3 | 98.1 |
| QPL 29 | 87.7 | 104.3 | 87.7 | 93.2 |
| QPL 27 | 90.0 | 90.0 | 101.0 | 93.7 |
| QPL 25 | 74.3 | 94.3 | 93.0 | 87.2 |
| QPL 23 | 77.7 | 98.7 | 89.7 | 88.7 |

Table 4 (Cont'd)

Plant Heights (cm) at 50% Flowering in Thirty *C. cajan* Accessions at Three Sowing Dates

| Accession | Sowing Dates | | | Mean No. of Days Three Sowing Dates |
|---|---|---|---|---|
| | 1982-03-15 | 1982-05-10 | 1982-10-07 | |
| QPL-22 | 86.7 | 93.3 | 73.0 | 84.3 |
| QPL-20 | 62.3 | 93.7 | 52.7 | 69.6 |
| QPL 19 | 75.3 | 81.3 | 70.7 | 75.8 |
| QPL 4 | 58.3 | 97.0 | 72.7 | 76.0 |
| QPL 3 | 55.0 | 96.7 | 64.7 | 72.1 |
| QPL 2 | 75.7 | 90.0 | 61.0 | 75.6 |

LSD 0.05 Level 22.1 SD 13.67

LSD 0.01 Level 29.2

TABLE 5

Temperature (°C) and Daylength (hrs.) at 50% Flowering in Thirty C. cajan Accessions in Response to Sowing Date

| Accession | Sowing Dates | | | | | |
|---|---|---|---|---|---|---|
| | 1982-03-15 | | 1982-05-10 | | 1982-10-07 | |
| | Temperature | Day-Length | Temperature | Day-Length | Temperature | Day-Length |
| T-21 | 28.2°C | 12.9 | 26.9°C | 12.3 | 27.5°C | 11.4 |
| Pusa Ageti | 27.9 | 12.9 | 27.6 | 12.7 | 24.9 | 11.4 |
| UPAS-120 | 27.8 | 12.9 | 24.0 | 12.7 | 24.2 | 11.4 |
| ICPL-81 | 27.3 | 12.8 | 27.5 | 12.8 | 26.8 | 11.4 |
| Pant A-2 | 28.1 | 12.9 | 27.3 | 12.7 | 25.2 | 11.4 |
| Pant A-3 | 27.6 | 12.9 | 27.5 | 12.8 | 23.0 | 11.4 |
| DSLR-38 | 28.1 | 12.9 | 26.4 | 12.7 | 25.2 | 11.4 |
| Prabhat | 28.2 | 12.9 | 27.5 | 12.8 | 25.4 | 11.4 |
| UQ Line | 26.8 | 12.8 | 26.5 | 12.8 | 26.0 | 11.4 |
| UW-17 | 26.7 | 12.9 | 26.9 | 12.3 | 25.2 | 11.4 |
| Royes | 27.7 | 12.8 | - | - | - | - |
| 908-4 | 27.9 | 12.9 | 26.5 | 12.8 | 26.5 | 11.4 |
| 922-4 | 27.3 | 12.8 | 27.0 | 12.8 | 25.2 | 11.4 |
| 900-5 | 27.2 | 12.9 | 27.8 | 12.9 | 25.4 | 11.4 |

Table 5 (Cont'd)
Temperature (°C) and Daylength (hrs) at 50% Flowering in Thirty *C. cajan* Accessionsin Response to Sowing Date

| Accession | Sowing Dates | | | | | |
|---|---|---|---|---|---|---|
| | 1982-03-15 | | 1982-05-10 | | 1982-10-07 | |
| | Temperature | Day-Length | Temperature | Day-Length | Temperature | Day-Length |
| BC-2 | 27.3°C | 12.9°C | 27.8°C | 12.8 | 27.5°C | 11.4 |
| BC-3 | 27.6 | 12.9 | 27.5 | 12.8 | 26.0 | 11.4 |
| 834-5 | 28.0 | 12.9 | 26.5 | 12.8 | 26.0 | 11.4 |
| 915-10 | 27.3 | 12.9 | 27.2 | 12.8 | 25.4 | 11.4 |
| 1000-1 | 28.2 | 12.9 | 27.5 | 12.8 | 25.2 | 11.4 |
| 839-11 | 28.1 | 12.9 | 27.4 | 12.8 | 26.8 | 11.4 |
| QPL 29 | 27.5 | 12.9 | 27.7 | 12.8 | 24.4 | 11.4 |
| QPL 27 | 28.5 | 12.9 | 27.5 | 12.8 | 25.4 | 11.4 |
| QPL 25 | 27.0 | 12.8 | 27.4 | 12.8 | 26.7 | 11.4 |
| QPL 23 | 28.0 | 12.9 | 27.4 | 12.8 | 25.2 | 11.4 |
| QPL 22 | 26.8 | 12.8 | 27.3 | 12.9 | 25.7 | 11.4 |
| QPL 20 | 26.9 | 12.8 | 27.0 | 12.8 | 26.0 | 11.4 |
| QPL 19 | 28.2 | 12.9 | 28.2 | 12.8 | 26.4 | 11.4 |
| QPL 4 | 27.8 | 12.9 | 27.5 | 12.8 | 25.0 | 11.4 |
| QPL 3 | 28.0 | 12.8 | 27.5 | 12.8 | 26.4 | 11.4 |
| QPL 2 | 28.2 | 12.9 | 28.1 | 12.8 | 26.8 | 11.4 |