

Effects of Planting Date, Variety, and Plant Population on the Flowering and Yield of Pigeonpeas (*Cajan cajan* L.)¹

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INTRODUCTION

The increasing importance of pigeonpeas in Puerto Rico can be ascertained by the farm value of this crop as reported by Rodríguez and Candelas (4)³ to be \$1,665,000 during the year 1957-58, when a total production of 111,000 hundredweights was obtained. According to Llórens (3), about 25 percent of the whole production of green pigeonpeas is consumed locally in the fresh state, and the balance, or 75 percent, is canned by five processing plants. During the 1953-54 season 250,000 cases of canned pigeonpeas were processed, this being the highest record of annual production. It is estimated that two-thirds of the total cannings are generally shipped to the United States mainly for consumption of the Puerto Ricans who live in New York City.

Though pigeonpeas are grown in all parts of the Island, the major areas of production are found in the municipalities of Coamo, Guayanilla, Peñuelas, Villalba, and Yauco. Usually pigeonpeas are planted on marginal lands with insufficient rainfall which are not suitable for raising other crops profitably. Because of dry weather the planting season is generally limited to the period of April to August. The harvesting of the crop in the green stage generally extends from December to February.

In spite of the economic importance of this crop it has been observed that the cultural methods followed are very primitive and, consequently, yields are very low, on the average less than 16 hundredweights of green pigeonpeas per acre. Intercropping with corn, squash, or beans is a common and undesirable practice followed by most farmers. Varieties are generally mixed, no attempts have been made to control disease or insect pests, and no fertilizers are applied to this crop.

It is felt that the obtaining of basic information on the behavior of selected varieties and on the effect of better cultural practices will undoubt-

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³ Italic numbers in parentheses refer to Literature Cited, p. 134.

edly lead to an increase in yield and an improvement in the quality of this important crop.

Among the cultural practices involved it is necessary to determine the best season for planting and the most suitable distances or population required for obtaining the highest yields. It is also desirable to determine how different varieties behave when planted at different seasons and at different population levels. With these objectives in mind two experiments were established on Coto Clay soil at the Isabela Agricultural Experiment Substation.

PROCEDURE

The first experiment consisted of 12 plantings performed around the 15th of each of the different months of the year. On July 15, 1954, the first sowing was made and the last one on June 15, 1955. The pigeonpea varieties included were Saragateado, Florido, and Kaki. Seed were sown 5 by 6 feet apart in order to obtain 12 plants in each plot the size of which was 18 by 20 feet, or about 1/121 acre. Each month up to 12, represented 1 seasonal treatment, with 4 replicates. Varieties included were also replicated 4 times. Information was recorded as to age and height of plants at time of flowering as affected by date of planting and variety.

In the second experiment varieties Saragateado and Kaki were planted 2, 3, and 4 feet apart within the row, and 8 feet apart between rows, and during three different planting months, namely: April 30, June 30, and August 30. The size of plot was 16 by 24 feet, or about 1/113 acre. The experimental design was a split plot in which varieties were studied in the whole plots and the different plant populations in the subplots. Yield was actually recorded in terms of pounds of green pods for every plot and variety at the different levels on population and for the three planting dates. For the purpose of commercial comparisons yield was converted into terms of hundredweights per acre of green pods.

According to the rainfall records shown in table 1, both experiments were conducted with sufficient and generally well-distributed rainfall and for that reason, it was not necessary to irrigate.

RESULTS AND DISCUSSION

FIRST EXPERIMENT

In the first experiment it was found that Florido and Kaki were similar in behavior as to height and age at time of flowering as affected by variations in planting dates. As shown in table 2 and figure 1, there was a striking linear decrease in height of plants and number of days to flower, beginning with plantings made in January all the way through up to the month of October. A similar behavior was shown by Saragateado, but this variety

TABLE 1.—*Rainfall in inches during the years when the 2 experiments with pigeonpeas were grown, 1954 and 1959*

Items	Data for months indicated											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<i>First Experiment, 1954-55</i>												
Monthly precipitation	3.33	2.64	2.26	4.16	7.56	11.13	4.55	6.06	7.39	8.95	1.89	1.80
Days that it rained within the month	8	11	15	8	17	19	21	19	15	21	9	15
Days with more than 1" of rainfall	0	0	0	1	2	3	1	2	3	1	0	0
<i>Second experiment, 1958-59</i>												
Monthly precipitation	2.73	6.10	8.21	5.14	4.43	4.38	4.77	11.01	8.07	4.95	5.97	4.95
Days that it rained within the month	7	12	9	16	13	11	11	17	16	11	14	14
Days with more than 1" of rainfall	0	2	1	0	1	1	2	5	3	1	0	0

TABLE 2.—*The effect of different planting dates on age and height of plants at time of flowering on 3 varieties of pigeonpeas, 1954-55*

Planting month, 1954-55	Data for varieties indicated—					
	Saragateado		Florida		Kaki	
	Time to flowering	Height	Time to flowering	Height	Time to flowering	Height
	<i>Days</i>	<i>Feet</i>	<i>Days</i>	<i>Feet</i>	<i>Days</i>	<i>Feet</i>
January	367	14.4	322	15.0	318	14.0
February	336	12.4	291	12.5	291	13.0
March	310	13.4	265	14.6	265	13.5
April	282	11.5	236	13.1	233	11.4
May	249	11.4	212	12.5	205	11.4
June	216	10.5	185	10.6	171	9.4
July	174	7.5	164	8.0	164	7.1
August	177	5.6	145	6.0	156	5.9
September	186	4.8	143	4.4	139	4.0
October	222	5.1	130	3.0	122	2.9
November	430	12.8	142	3.5	134	3.5
December	400	13.0	141	3.6	139	4.6

was from 10 to 50 days later in flowering when plantings were made from the month of January up to September. On the other hand, when Saragateado was planted during the months of October, November, and Decem-

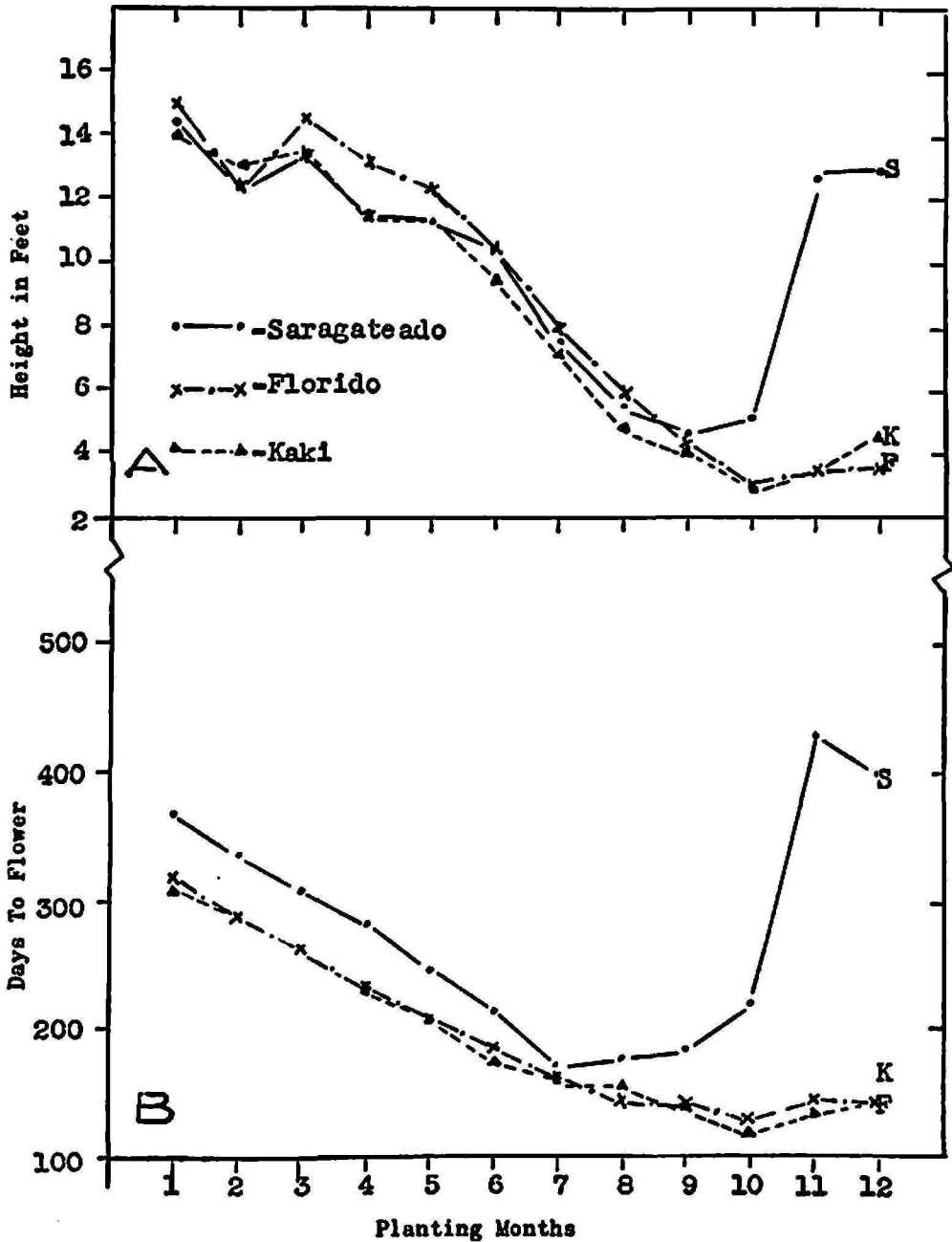


FIG. 1.—The effect of the planting months on the Saragateado, Kaki, and Florido pigeonpeas as to: A, Plant height at the time of flowering, and B, number of days required to flower.

ber, it required from 100 to 290 more days than Florido and Kaki to obtain proper development for flower induction.

In Florido the extremes of plant development at time of flowering

fluctuated from a height of 15 feet when planted in January, with a growing period of 322 days, to 3 feet when planted in October and having a growing period of 130 days. With slight variations, similar extremes were also recorded for Kaki.

Since it is a late variety, growth and flowering behavior of Saragateado were different, though the trend in height as affected by season also followed a similar pattern. In this late variety fluctuations in height at time of flowering were from 14.4 feet in January plantings down to 4.8 feet in the September plantings.

The small flowering plants obtained in the three varieties during the September and October plantings has led farmers to believe there are many dwarf pigeonpea varieties. On this subject Barret (1) and Kraus (2) have mentioned the existence of gradations from very dwarf (18 inches, early-maturing, and annual) to arborescent types that persist for several years.

The extreme variations in height at time of flowering as recorded from different planting dates, suggest that these plants are possibly affected by photoperiodism. That is some early and some late varieties, no matter when planted, usually flower during the short-day months of December, January, and February. For the Island of Puerto Rico that is located in latitude $18^{\circ} 15'$, the length of day as determined for the middle of the month, varies from 13 hours and 12 minutes in June, to 11 hours and 12 minutes in December. It seems that the shorter days of November, December, January, and February are required for flower induction.

The remarkable variations in height at time of flowering as affected by different planting dates, suggest the possibility of controlling the growth of plants for introducing better cultural practices and for devising more efficient methods of picking the crop either by hand or by machine.

SECOND EXPERIMENT

In the second experiment the yields in hundredweights per acre for the monthly plantings of April, June, and August were 45.01, 24.66, and 1.75, respectively, as shown in table 3, and figure 2. The difference between any of the planting seasons is highly significant. These results indicate clearly that yield decreases sharply from early to late season, indicating that it is not advisable to plant these two varieties later than June 30.

The standard error and least significant differences required for significance between means for the yield of the three seasons are shown in the following tabulation:

<i>Comparisons</i>	<i>1-percent level</i>
Least significant difference between highest and lowest means	12.43
Least significant difference between 2 adjacents	10.94
Standard error, 2.86 with 45 degrees of freedom	

TABLE 3.—Mean yield in hundredweights per acre of green pods from 2 varieties of pigeonpeas as affected by different planting dates and planting distances, 1959

Planting dates, 1959	Yields as affected by planting distances indicated								Monthly mean
	Kaki				Saragateado				
	2 ft.	3 ft.	4 ft.	Variety mean	2 ft.	3 ft.	4 ft.	Variety mean	
Apr. 30	65.25	63.05	62.66	63.65	26.70	25.83	26.56	26.36	45.01
June 30	37.39	36.04	33.85	35.76	16.03	14.59	10.08	13.57	24.66
Aug. 30	4.46	3.77	2.29	3.51	(¹)	(¹)	(¹)	(¹)	1.75
Mean	35.70	34.29	32.93	34.31	14.24	13.47	12.21	12.31	23.81

(¹) No crop.

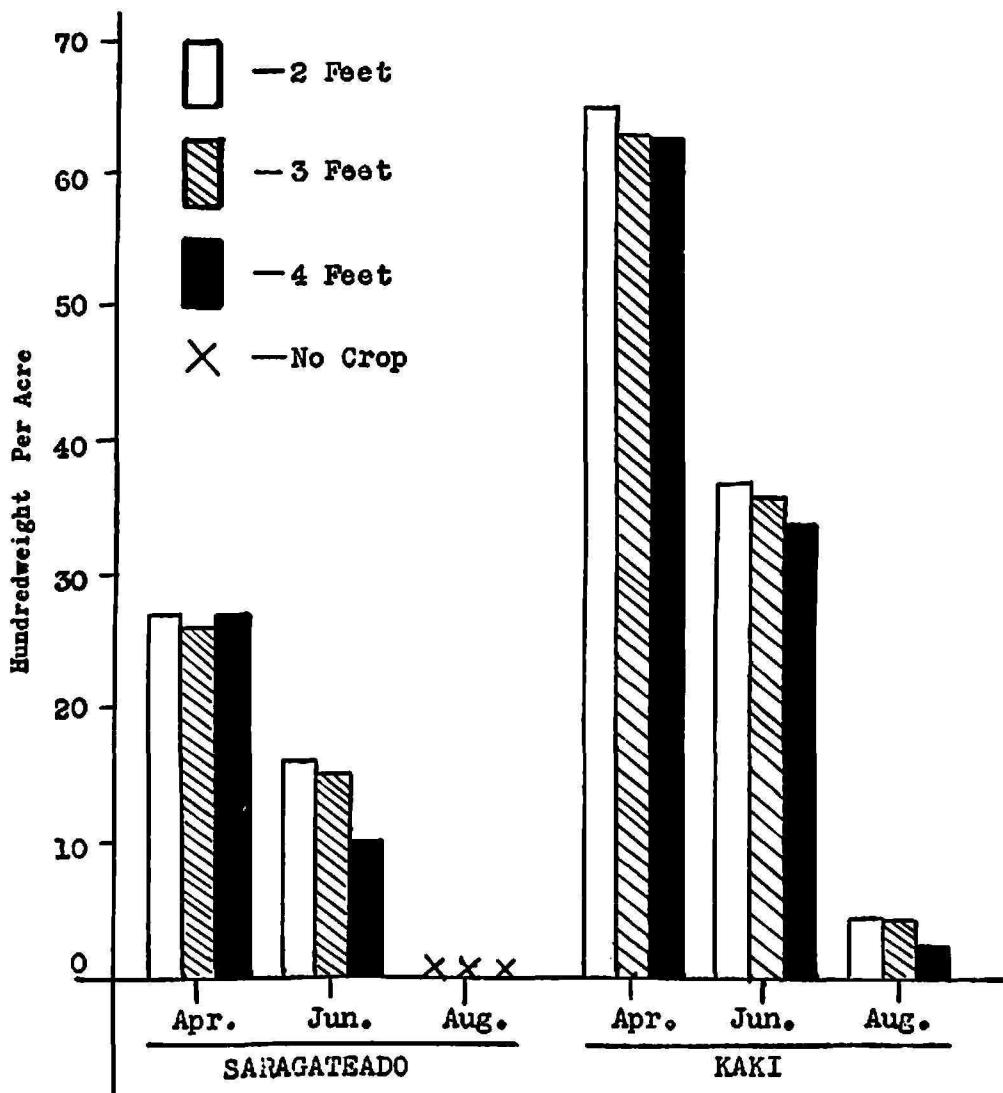


FIG. 2.—The effect of different planting dates and planting distances on the yield of pigeonpea varieties Kaki and Saragateado.

In this experiment it was found that at any of the planting dates of April, June, and August, Kaki outyielded Saragateado in a highly significant degree as shown in table 3 and figure 2. In fact, no yields were obtained from Saragateado when planted on August 30. The mean total yield for Kaki was 34.31 hundredweights, whereas for Saragateado it was 23.81 per acre. These results indicate that the Kaki variety should be recommended for high production and an early crop.

Variation in plant population obtained from different planting distances failed to affect flower induction or yield. No significant difference in yield was found between planting distances within the row of 2, 3, and 4 feet apart, although there was a slight increase in production as the number of plants per acre was increased, as shown in table 3. It seems that greater increases in population such as would be obtained from closer plantings between rows might cause further increments in yield, provided this did not interfere with mechanical methods of cultivation.

The interaction between seasons and varieties was highly significant. Lateness in planting reduced yield in both varieties, but in a more drastic way for Saragateado. Though this variety is late and a shy bearer, it is planted commercially to a minor extent because it helps in extending the period of marketing the fresh product and in expanding the time for canning operations. The need of developing a late variety of higher yield is evident.

SUMMARY

Two experiments were conducted in 1954 and 1959 at the Isabela Agricultural Experiment Substation for the purpose of obtaining information for improving certain cultural practices in three pigeonpea varieties.

The results of the experiment with monthly plantings of varieties Saragateado, Florido, and Kaki demonstrated that height at time of flowering could be controlled through changes in planting dates. There was a linear reduction in the size of plants at time of flowering as the season of planting was retarded in the course of the year. This suggested the possibility of being able to adjust the size of the plant so as to develop better methods of harvesting by hand or by machine.

Disregarding the season of planting, varieties Saragateado, Florido, and Kaki generally bloomed and produced a crop during the months of December, January, and February. However, Saragateado was always a late variety.

Variations in planting distances within the row of 2, 3, and 4 feet apart did not affect time of flowering nor yield in a significant way.

Kaki is an earlier and higher yielding variety than Saragateado. There is need for developing a substitute variety for Saragateado having a higher yield and producing a later crop.

RESUMEN

Se establecieron dos experimentos en la Subestación Experimental Agrícola de Isabela con el propósito de obtener información para mejorar ciertas prácticas agrícolas en el cultivo de tres variedades de gandur.

Los resultados del experimento de siembras mensuales efectuado con las variedades Saragateado, Florido y Kaki demostraron que era posible controlar la altura de las plantas al tiempo de la florecida mediante cambios en las fechas de siembra. Se encontró que había una reducción lineal en el tamaño de las plantas al tiempo de la florecida, a medida que se retardaba la época de siembra durante el transcurso del año. Esto sugiere la posibilidad de ajustar el tamaño de la planta para desarrollar mejores métodos de cosechar, bien sean estos manuales o mecanizados.

Sin tomar en cuenta la época de siembra, las variedades Saragateado, Florido y Kaki generalmente florecieron y produjeron cosecha durante los meses de diciembre, enero y febrero. Sin embargo, en todas las ocasiones el Saragateado se comportó como una variedad tardía.

El desarrollo y comportamiento de estas tres variedades de gandur sugieren el efecto del fotoperiodismo, requiriéndose días cortos para inducir la florecida. Con las siembras tardías hubo una reducción drástica en la producción, siendo esta reducción más pronunciada en el gandur Saragateado.

Las siembras efectuadas a 2, 3 y 4 pies de distancia dentro de la hilera no afectaron en forma significativa la época de la florecida ni la producción.

La Kaki es más temprana y más productiva que la variedad Saragateado. Es evidente la necesidad de desarrollar una variedad que sustituya al Saragateado para obtener una cosecha tardía de alta producción.

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