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Agronomic Performance of Soybean Genotypes in Low Latitude in Teresina-PI, Brazil

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Abstract

The soybean is one of the most important grain exports. In order to evaluate the agronomic traits and yield components of different soybean genotypes grown under low latitude conditions of Teresina-PI, developed in this research. It were evaluated the phenological and productive traits related to the development of soybean plants of 18 genotypes in the agricultural year 2009/10. Under the conditions studied, the genotypes showed significant differences for all traits analyzed, except plant height at maturity. Plant height at flowering, maturation and first pod showed variations from 42 to 57 cm, 42-63 cm and 6-11 cm, respectively. The genotypes 174 BCR1069X7RG and 169 BCR1069X7RG were considered the most precocious in flowering. In contrast, the genotypes 177 BCR1069X7RG and 176 BCR1069X7RG, with more than 57 days from germination to flowering, were considered the most late. In 1000 grain weight variation was from 15.02 to 20.72 g in values found. The genotypes showed satisfactory yield, especially 171 BCR1069X7RG (4.19 t ha^{-1}) and 174 BCR1069X7RG (3.84 t ha^{-1}) equivalent to 69.80 and 63.97 sacks of 60 kg, respectively. Overall, the genotypes showed good agronomic performance.

Keywords: *Glycine max* (L.) Merrill, phenological observations, morphological observations, soybean, seed yield

1. Introduction

The soybean [*Glycine max* (L.) Merrill] is a species of great economic importance, due to the formation of the complex structure of production, storage, processing and marketing in all countries where it is cultivated. The great demand in international markets provided rapid expansion of this crop in Brazil (Rezende & Carvalho, 2007). The Brazilian soybean production in 2009/10 crop, according to Companhia Nacional de Abastecimento (2010) was 65.16 million tons, representing an increase of 14% (8.0 million tons) compared to 2008/09 crop.

The high soybean production in Brazil is due to the changes the country underwent in the last 32 years, with increases of 333% in planted area and 1,536 times in the production, which resulted in greater use of agricultural inputs, encouraging the use of application technologies for this crop (Farinha, Martins, Costa, & Domingos, 2009). Also the appearance, selection and recommendation of soybean cultivars adapted to low latitudes, basic objectives of genetic improvement programs, as promoted the use of unexplored areas of the Cerrado (Lima et al., 2008). Although the present Cerrado soils with low fertility chemistry, topography and weather are highly suitable for cultivation (Oliveira Júnior, Prochnow, & Klepker, 2008).

To have successful in soybean crop is necessary to meet their nutritional requirements and water, and using cultivars with high yield, resistant to lodging, pests and diseases and adapted to different environmental conditions. However, soybean is manifested differently when subjected to different climatic conditions, and its production cycle changed as a function of air temperature and photoperiod (Rezende & Carvalho, 2007).

The regions of expansion and production potential of the Brazilian soybean comprise part of the North and Northeast, located at latitudes lower than 10°, especially in the states of Tocantins, Pará, Maranhão and Piauí (Embrapa, 2003). It is known that the Piauí state to its production capacity to the recommendations of soybean varieties adapted to low latitude. Between the producers cities in Piauí can to detach Uruçuí, Baixa Grande do Ribeiro, Ribeiro Gonçalves and Bom Jesus, located in the Cerrado (Andrade Júnior, Basto, & Silva, 2007). The Cerrado piauiense occupies approximately 11.5 million ha, being five million arable, of which three million are suitable for large scale cultivation (Fontenele, Salviano, & Mousinho, 2009).

Obtaining high grain yield has been limited by the adverse weather, which is still a risk factor and failure of soybean (Companhia Nacional de Abastecimento, 2009). Given the size of the productive chain of the soybean agribusiness, research on this crop has the potential to promote significant socioeconomic gains (Streck, Paula, Camera, Menezes, & Lago, 2008), since the increase in crop yield is a target sought by producers and researchers.

In this context, the objective of this study was to evaluate agronomic traits and yield components of different soybean genotypes in low latitude, in the region of Teresina - PI.

2. Materials and Methods

The experiment was accomplished in the year 2009/2010 at the site of the Department of Plant Science Center of Agrarian Sciences, Universidade Federal do Piauí - UFPI in Teresina-PI, with the following coordinates: latitude 05°02'40, 10 "S, longitude 42º 47'03, 79 "W and the altitude of 72 meters.

The climate of the city of Teresina is Aw' (tropical warm subhumid), according to the climatic classification of Köppen (Andrade Júnior et al., 2004), and has two defined seasons: dry season (June-November) and rainy (December-May). According to Medeiros (2006), the region has annual average rainfall of 1377 mm, the largest concentration of rainfall in March and April. Presents average annual potential evapotranspiration 2973 mm, relative humidity annual average of 69.9%, total annual sunshine 2625h, average annual temperature of 28°C, temperature range of 11.5ºC, average annual photoperiod of 12 h 19 min day^{-1}, with a minimum of 11 h 46 min day^{-1} and a maximum of 12 h 29 min day^{-1}.

18 genotypes were evaluated as treatments, of which 14 are in pre-release, obtained from the soybean breeding program BMS-CEBACURI, based in Minas Gerais and Goiás, and four genotypes obtained from Embrapa Meio Norte - PI: varieties BRS Sambaíba, BRS Candeia, BRS 219 Boa Vista and BRS 271 RR, adopted as regional control treatment. The genotypes tested are shown in Table 1.

Table 1. List of genotypes and their morphological traits, flower color (FC), pubescence color (PC), hilum color (HC) and color of the seed tegument (CST), analyzed in the agricultural year 2009/2010 in the region low latitude, Teresina – PI

GENOTYPES	FC	PC	HC	CST
BRS SAMBAÍBA (C)	White	Brown	Pale brown	Bright yellow
BRS CANDEIA (C)	Purple	Brown	Black	Yellow
BRS 219 BOA VISTA (C)	White	Brown	Black	Opaque yellow
BRS 271RR (C)	White	Brown	Black	Bright yellow
114 BCR336F8	White	Brown	Black	Opaque yellow
142 SOY94F5G	White	Brown	Black	Opaque yellow
164 SOY94F5G	Purple	Brown	Black	Bright yellow
179 SOY24F5G	Purple	Brown	Black	Opaque yellow
168 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
169 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
170 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
171 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
172 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
173 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
174 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
175 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
176 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow
177 BCR1069X7RG	Purple	White	Pale brown	Opaque yellow

C: Control Variety

The area was prepared for planting with normal operations in order to control weeds with herbicide application, plowing and harrowing; correction with Calcareous Filler (2000 kg ha^{-1}) and fertilization with 300 kg NPK ha^{-1} 5-35-15+ FTE, attending the nutritional needs of the culture. Table 2 shows the results of the physical-chemical analysis of soil.

Table 2. Chemical and physical traits of soil (0-20 cm) of the experimental area of Department of Plant Science, Center of Agricultural Sciences, UFPI, Teresina-PI, 2009

Granulometric composition of the fine land (dispersion with NaOH N) g kg^{-1}					Texture	Density apparent g cm^{-3}	Moisture % Kg kg^{-1}		
Thick sand 2-0.20 mm	Fine sand 0.20-0.05 mm	Silt 0.05-0.002 mm		Clay < 0.002	Frank sand	1,53	M Pa 0.033	1.5	Available (0.033-1.5)
320	510	130		40			6	3	3
pH (1:2.5)		Exchangeable cations (cmol Kg^{-1})							
Water	KCl N	Ca^{2+}	Mg^{2+}	K^+	Na^+	Valor S	Al^{3+}	H^+	Value T
5.7	5.4	2.6	-	0.17	0.02	2.8	-	2.2	5.0
Value V $\frac{100S}{T}$	Sat. com Al^{3+} $\frac{100Al^{3+}}{S+Al^{3+}}$	P Assimilable mg Kg^{-1}		C (g Kg^{-1})		N (g Kg^{-1})	$\frac{C}{N}$	Sat. com Na^+ $\frac{100Na^+}{T}$	C.E. of the Extract MS cm^{-1}
56	-	8.9		6.71		0.58	12	-	0.1

Source: Laboratory analysis of soil from CCA - SOIL.

The seeds were inoculated with *Bradyrhizobium japonicum* and then treated with molybdenum, insecticide, fungicide and bactericide. There was thinning 15 days after emergence, leaving 15 plants per linear meter (corresponding to 320 000 plants ha^{-1}). In 4th vegetative stage (V4 - four nodes formed) foliar application with a molybdenum (30 g ha^{-1}), and in 10th vegetative stage (V10 – 10 nodes formed**)** another with manganese sulfate at 30% (200 g ha^{-1}). At 35 days after sowing was made a dressing with 60 kg ha^{-1} of ammonium sulfate and 60 kg ha^{-1} potassium chloride. Sprinkler irrigations were performed whenever necessary to ensure the establishment of plants in the field. Weeds were controlled by hand hoeing.

It was adopted the randomized block design with four replications. Each plot was a row of plants with 5.0 m of length and distance between them of 0.50 m. Eliminated by 0.5 m at the ends of each row being an area of 2 m^2 in each plot. At the beginning and end of each block a line was cultivated to reduce boundary effects. The portions of the other treatments were placed side by side, to simulate field conditions, in other words, were the borders of each other. Some rows were planted to serve as side borders and end of each block. Thus all plants in the plots suffered from competition as if it were in a conventional planting.

During the development of culture were evaluated morphological characteristics, flower color (FC), pubescence color (PC), hilum color (HC) and color of the seed coat (CST) as shown in Table 1 and the phenological traits according to Fehr and Caviness (1981):

a) Number of days to flowering (NDF), given in days after emergence to early flowering. Growth stage defined by the presence of 50% of the plants with an open flower first reproductive stage (R1 - start flowering: an open flower at any node on the main stem). We noted the date of the emergency and date of opening of flowers.

b) Number of days to maturity (NDM), given in days after emergence and timing of maturity (R8 - full maturation), which is defined by the presence of 50% of plant the useful area with 95% of mature pods.

Their dates of occurrence were tabulated and converted to number of days (corresponds to the cycle of the crop).

c) Reproductive period (RP) corresponded to the number of days between the start of flowering (NDF) and the R7 stage (RS), then (RP = RS - NDF).

d) Percentage of the reproductive period (RP%): evaluation based on the number of days between flowering and maturity and the number of days to maturity (RP%: (RP / maturity) x 100).

e) Average plant height in flowering (PHF) in centimeters (cm), measured from the soil surface to the insertion of the apex of the raceme of the main stem of the plant second reproductive stage (R2 - full flowering). This average was determined from the height of 10 randomly sampled plants in each plot.

f) Average plant height at maturity (PHM) in cm, measured from the soil surface to the insertion of the apex of the raceme of the main stem of the plant 8th reproductive stage (R8 - full maturation). This average was determined from the height of 10 randomly sampled plants in each plot.

g) Average height of the first pod (HFP) in cm measured from the ground surface to the lower end of the first pod. Characteristic determined by the average of 10 randomly sampled plants in each plot.

h) Lodging index (LI): the plots were classified by visual grades: 1 - all plants erect, 2 - some plants slightly lodged, 3 - all plants moderately inclined (25 to 50% of lodged plants) 4 - all the plants substantially inclined (50 to 80% of the plants) and 5 - all the plants lodged.

i) Final Stand (FS): total number of useful plants in the plot, after the establishment of the whole plant 8th reproductive stage (R8).

During the final stage of the soybean were randomly collected 10 plants in the useful area of each plot, to evaluate the following components of the morphology and yield:

a) Length of green pods (LGP) using samples of 10 pods, randomly selected, measured the length (in cm) with the aid of a caliper.

b) b) Number of pods per plant (NPP) was assessed at the time of maturity (R8), counting the number of pods present in 10 plants, randomly selected from the useful area.

c) Number of seeds per pod (NSP) provided by the ratio between the total number of grains and the total number of pods on the plants selected useful areas of each plot.

d) Length of dry pods (LDP) using samples of 10 pods, randomly selected, measured the length (in cm) with a caliper.

e) Average weight of 100 grains (W100G) in grams (g), was determined by collecting and counting of 100 grains per plot. Then there were the weights with the aid of AL500 analytical balance, accurate to one milligram, standardizing the moisture content to 13%, measured by the apparatus Geole 400.

f) Average grain yield (GY) evaluated at final maturity (harvest time), determined after the harvest and processing, with hand threshed pods, and weighing of grain harvested in the useful area of each plot, with moisture standardized to 13% (Geole 400). The values observed in the useful plot were extrapolated to l kg ha^{-1}.

g) Grain index (GI): value obtained from the percentage of grain weight in relation to the total weight of the pod, obtained by the following formula: GI (%) = (WG5P/W5P) .100 where WG5P = weight grains of 5 pods and W5P = weight 5 pods.

The data were subjected to analysis of variance and genotypes compared by Scott-Knott(1974) at 5% probability using the software SAEG (SAEG9.1, 2007).

3. Results and Discussion

Based on analyzes of variance, significant differences were observed ($p < 0.05$) by F test between genotypes for all traits analyzed, except for plant height at maturity (PHM). The Table 3 shows the mean number of days to flowering, days to maturity, reproductive period in days and percentage of this.

Table 3. Mean values for the number of days to flowering (NDF), number of days to maturity (NDM), reproductive period in days (RP) and percentage (RP%) of different soybean genotypes evaluated in low latitude, in Teresina – PI

GENOTYPES*	Cycle (days)		Classification cycle°	Reproductive period	
	NDF	NDM		(RP) days	(RP%)
BRS SAMBAÍBA	49.00 C	114.00 F	Medium	55.25 C	47.12 B
BRS CANDEIA	48.25 C	117.00 E	Medium	66.50 A	55.64 A
BRS 219 BOA VISTA	46.25 D	101.25 I	Precocious	56.00 C	47.14 B
BRS 271RR	45.75 D	104.50 H	Precocious	60.00 B	48.62 B
114 BCR336F8	50.50 C	134.00 A	Late	59.25 B	43.40 D
142 SOY94F5G	53.75 B	130.50 B	Late	65.00 A	49.34 B
164 SOY94F5G	51.00 C	114.50 F	Medium	55.50 C	45.63 C
179 SOY24F5G	50.25 C	107.50 G	Precocious	61.25 B	48.62 B
168 BCR1069X7RG	53.25 B	120.75 D	Medium	55.50 C	45.30 C
169 BCR1069X7RG	45.00 D	121.25 D	Medium	55.50 C	45.31 C
170 BCR1069X7RG	48.50 C	123.00 D	Medium	50.00 D	39.52 E
171 BCR1069X7RG	50.25 C	120.25 D	Medium	65.25 A	53.59 A
172 BCR1069X7RG	50.50 C	126.00 C	Late	62.50 B	48.54 B
173 BCR1069X7RG	51.00 C	121.25 D	Medium	56.75 C	46.32 C
174 BCR1069X7RG	47.75 D	122.75 D	Medium	55.00 C	45.17 C
175 BCR1069X7RG	49.00 C	128.00 C	Late	62.00 B	48.06 B
176 BCR1069X7RG	57.25 A	117.50 E	Medium	63.00 B	48.64 B
177 BCR1069X7RG	58.00 A	114.00 F	Medium	56.25 C	45.93 C
C.V. (%)	4. 62	1.55	-	5.16	4.85
General Average	50.29	118.77	-	58.91	47.33

*Means followed by same letter do not differ by Scott-Knott test ($P \leq 0.05$).

Classification soybean cycle: early (until 110 days), medium (111 - 125) and late (> 125 days) according to Embrapa (2008).

There was variation between genotypes in relation to flowering, where there was a separation of the genotypes into four groups: one group with the lowest values, with amplitude from 45 to 47.75 days, especially the controls genotypes BRS 219 Boa Vista and BRS 271RR and the genotypes 174 BCR1069X7RG e 169 BCR1069X7RG, considered precocious. The second group of 10 genotypes with values between 48.25 and 51 days. The genotypes 142 SOY94F5G and 168 BCR1069X7RG formed the third group with average 53.75 and 53.25 days, respectively. The last group consisting of 177 BCR1069X7RG and 176 BCR1069X7RG, with more than 57 days from germination to flowering, were considered late. In experiments with varieties of different cycles the researchears Cruz, Peixoto and Martins (2010) obtained values close to those obtained in this experiment. In this, the number of days to flowering varies from 40 to 56 days (12°45'30"S, Bahia). It should be noted that the planting of cultivars with different maturity cycles can extend the harvest period and sometimes assist in obtaining the best quality seeds (Rezende & Carvalho, 2007).

Can be seen in Table 3 significant difference between genotypes in relation to maturation. This trait nine groups were formed, where the BRS 219 Boa Vista was considered precocious, with 101.25 days and genotype 114 BCR336F8, with 134 days, considered a late cycle. These results are in disagreement with those obtained by Pelúzio, Fidelis, Almeida Júnior, Santos and Didonet (2008), in which no variations observed between cultivars at two sowing dates on the traits of the number of days to flowering and number of days to maturity of the seeds. Xavier, Campos, Araújo and Santos (2008) found significant differences in the number of days to flowering and maturity, where he excelled BRS Sambaíba, which reduced its cycle. Using the classification proposed by

Embrapa (2008), the genotypes analyzed would form only three groups, precocious cycle (BOA VISTA BRS 219, BRS 271RR SOY24F5G and 179) medium cycle (Sambaíba BRS, BRS lamp, 164 SOY94F5G, 168 BCR1069X7RG, 169 BCR1069X7RG , 173 BCR1069X7RG, BCR1069X7RG 174, 176 and 177 BCR1069X7RG BCR1069X7RG) and late cycle (114 BCR336F8, SOY94F5G 142, 172 and 175 BCR1069X7RG BCR1069X7RG).

After determining the reproductive period (flowering, fruiting and seed production) in days and percentage, can gather the genotypes in four and five groups, respectively. The genotype 170 BCR1069X7RG had the lowest average (50 days and 39.52%). The genotype Candeia deserved detach, with an average of 66.5 days and 55.64%. Between the other genotypes studied showed that the 142 SOY 94F5G and 171 BCR1069X7RG had the highest average days above 65.25, and 171 BCR1069X7RG was the only one to stand out in terms of percentage of 53.59% (Table 3.) The record of the reproductive period is crucial to the success of the population, to ensure the survival and establishment of young individuals (Lenzi & Orth, 2004).

The average values of agronomic traits from genotypes related to high plant are shown in Table 4. Significant effects were observed between genotypes for plant height at flowering (PHF), but did not differ statistically from one another, the genotypes BRS Sambaíba, 114 BCR336F8 and 164 SOY94F5G, were detach because they had good heights (above 52.8 cm) when compared with other genotypes. As for plant height at maturity (PHM), the genotypes did not differ statistically.

The values of plant height were within recommended by Sediyama et al. (1996), about 50 to 60 cm. However, Rezende and Carvalho (2007) consider values between 60 and 120 cm for plant height as suitable for mechanized harvesting, values higher than these were obtained in the present study. In relation to lodging index, there was no significant difference between genotypes, which had note 1 with all plants erect. This result is desirable because tall plants can provide higher lodging index for presenting thinner stems, being more susceptible to overturning by the wind (Guimarães et al., 2008).

Table 4. Mean values of plant height at flowering (PHF), plant height at maturity (PHM), height of first pod (HFP) in different soybean genotypes evaluated in low latitude, in Teresina – PI

GENOTYPES	PLANT HEIGHT (cm)		
	PHF	HFP	PHM
BRS SAMBAÍBA	57.12 A	7.15 C	56.40 A
BRS CANDEIA	42.40 B	6.17 D	53.17 A
BRS 219BOA VISTA	46.37 B	6.15 D	42.52 A
BRS 271RR	48.65 B	6.30 D	52.07 A
114 BCR336F8	55.33 A	7.13 C	54.36 A
142 SOY94F5G	48.27 B	7.72 C	49.47 A
164 SOY94F5G	52.80 A	11.25 A	63.45 A
179 SOY24F5G	47.82 B	6.65 D	49.42 A
168 BCR1069X7RG	46.87 B	7.50 C	51.80 A
169 BCR1069X7RG	49.10 B	7.52 C	48.70 A
170 BCR1069X7RG	46.47 B	8.95 B	53.55 A
171 BCR1069X7RG	50.25 B	9.97 A	54.75 A
172 BCR1069X7RG	50.50 B	9.55 B	51.17 A
173 BCR1069X7RG	48.07 B	7.60 C	50.80 A
174 BCR1069X7RG	50.42 B	10.15 A	52.07 A
175 BCR1069X7RG	46.82 B	7.95 C	50.65 A
176 BCR1069X7RG	45.85 B	8.62 B	52.52 A
177 BCR1069X7RG	44.65 B	8.55 B	46.82 A
C.V %	8.82	12.15	9.25
General Average	48.76	8.05	51.87

For the height of the first pod were observed the formation of four groups, with average variation from 6.15 to 11.25 cm (Table 4). Considering the recommendations of Valadão et al. (2008), in which the soybean cultivars, on plane land, must have the first pod height equal to or not much higher than 10.0 cm. It was observed in this experiment, values less than 9.55 cm, could hamper the proper handling, such as the occurrence of waste in mechanized harvesting. Xavier et al. (2008), evaluating the genotypes BRS Tracajá, Sambaíba, Babaçú, Seridó and Candeia no significant differences between cultivars for the traits plant height at flowering and height of first pod. These results disagree with those obtained in this experiment, which showed significant differences for these traits (Table 4).

For the final stand there were no significant differences between genotypes, since it was done thinning standardizing (15 plants per meter), corresponding to 320,000 plants ha^{-1}. Raising the density of plants has been a way to enhance the yield of soybean (Kuss et al., 2008), however with the appearance of rust, population around 350,000 plants ha^{-1} have been preferred. At the end of the cycle of each genotype were analyzed components of the yield, which means are shown in Table 5.

Table 5. Mean values for length of green pods (LGP), length of dry pods (LDP), number of pods per plant (NPP) and number of seeds per pod (NSP) in different soybean genotypes evaluated in low latitude, in Teresina – PI

GENOTYPES *	Length (cm)		Pods	Seeds
	LGP	LDP	NPP	NSP
BRS SAMBAÍBA	4.01 B	3.69 D	72.62 A	2.36 A
BRS CANDEIA	4.26 A	3.95 B	61.95 B	2.45 A
BRS 219BOA VISTA	4.21 A	3.66 D	77.32 A	2.29 A
BRS 271RR	3.65 C	3.55 D	83.50 A	2.40 A
114 BCR336F8	4.21 A	3.92 B	63.96 B	2.18 B
142 SOY94F5G	3.93 B	3.76 C	72.27 A	2.06 B
164 SOY94F5G	4.31 A	3.99 B	75.95 A	2.46 A
179 SOY24F5G	3.77 C	3.72D	70.65 B	2.15 B
168 BCR1069X7RG	4.25 A	4.01 B	82.62 A	2.35 A
169 BCR1069X7RG	3.96 B	4.29 A	90.20 A	2.39 A
170 BCR1069X7RG	4.25 A	4.15 A	77.10 A	2.35 A
171 BCR1069X7RG	4.09 B	3.89 C	69.37 B	2.20 B
172 BCR1069X7RG	4.23 A	3.77 C	77.27 A	2.21 B
173 BCR1069X7RG	4.63 A	3.80 C	77.15 A	2.18 B
174 BCR1069X7RG	4.42 A	4.00 B	80.45 A	2.43 A
175 BCR1069X7RG	4.23 A	3.85 C	82.62 A	2.45 A
176 BCR1069X7RG	4.29 A	3.73 D	50.85 C	2.10 B
177 BCR1069X7RG	4.48 A	4.08 B	82.42 A	2.32 A
C.V %	9.87	5.14	2.96	6.93
General Average	4.18	3.84	74.90	2.30

* Means followed by same letter do not differ by Scott-Knott test (P ≤ 0.05)

In the trait length of green pod (LGP) the genotypes were also separated into groups. One group had a mean length of green pod above 4.2 cm, comprising 12 genotypes and two other groups of length less than 4 cm. Variations within the groups may be attributed to the effect of environment on the genotype. Viana (2007) evaluating three soybean cultivars, realized that in assessing the length of green pods, the Pirarara cultivar (average length 5.2 cm) produced more pods than the Pati and JLM 004 cultivars both with average length 4.7 cm. Embrapa (2008) recommends cultivars producing length of pod equal to or greater than 5.0 cm. However, in this study the genotypes had a variation from 4.01 to 4.63 cm in length green pods (LGP). It was noticed that the length of dry pods (LDP) formed four groups, with detach for two of them. The first group containing only the genotypes 170 BCR1069X7RG (4.15 cm) and 169 BCR1069X7RG (4.29 cm), and the second group containing other six genotypes with length of dry pods ranging 3.92 to 4.08 (Table 5).

The pod formation may be impaired because of competition for assimilates with the pods formed earlier, and may limit the potential size of the grain (Navarro Júnior & Costa, 2002). The size of the seeds, according to Barbosa, Smiderle, Alves, Vilarinho and Sediyama (2010), influenced the physical and physiological quality of BRS Tracajá during storage, and larger seeds had a higher thousand seed weight.

At maturation, we obtained the average number of pods per plant (NPP) and of seeds per pod (NSP) (Table 5). The yield component most affected was the number of pods per plant. The number of pods per plant (NPP) showed overall average of 74.90 pods, with genotypes grouped into three groups. In the first group, stood the genotype BCR1069X7RG 169, which itself equaled 12 other genotypes. The second group, represented by BRS CANDEIA, 114 BCR336F8, 171 BCR1069X7RG and 179 SOY24F5G, with mean change from 61.95 to 70.65. The third group, consisting only 176 BCR1069X7RG with number of seeds per pod had an average 50.85. Xavier et al. (2008) observed that genotypes BRS Tracajá, Sambaíba and Babaçú did not differ on the number of pods per plant. For this experiment differences were observed between the control varieties, they can be grouped in BRS SAMBAÍBA and BRS 219 BOA VISTA, or BRS CANDEIA and BRS 271RR.

It was obtained in this experiment a amplitude from 2.06 to 2.46 seeds per pod, resulting in the formation of two groups (Table 5). The first group of 11 genotypes, with mean change from 2.29 to 2.46 seeds per pod and the second group with seven genotypes. In an experiment conducted by Pelúzio, Barros, Rocha, Silva and Nascimento (2002), working with levels of defoliation and its influence on yield components, the authors report that a reduction in the availability of assimilates for pod filling can cause a reduction in this trait, besides the reduction in grain yield, which can be result of abortion of flowers and pods and fewer seeds per pod. In this experiment, there was no reduction in this trait, even not being applied foliar fertilizer to raise the level of productivity. Instead, the average of 2.30 seeds per pod indicates that genotypes with other modern cultivars share the characteristic form of three eggs per pod (Navarro Junior & Costa, 2002).

There was a variation from 15.02 to 20.72 g in values found in the weight of 100 grains (Table 6). In this parameter, were formed three groups of genotypes: one group involved more than half of the genotypes, averaging more than 18.25 g per 100 grains. The genotypes BRS Sambaíba, BRS 219 Boa Vista and 168 BCR1069X7RG formed the second group, with averages ranging from 16.76 to 17.57 g. The last group consisting of BRS 271RR, reached the lowest weight, 15.02 g. According to results obtained by Xavier et al. (2008), for the trait weight of 100 grains, Candeia presented a greater phenotypic behavior, which resulted in increased grain yield. Menezes, Garcia, Rubin and Bernardi (1997) characterizing soybeans observed lower weight in cultivars with late cycle, the opposite occurring in this research because the genotypes 114 BCR336F8, 142 SOY94F5G, 172 BCR1069X7RG and 175 BCR1069X7RG, which showed late cycle were among the best weight of 100 grains.

It was observed for the trait grain yield (GY), a variation from 1.73 to 4.19 t ha^{-1} (28.91 - 69.80 sacks of 60 kg), verifying the presence of four groups (Table 6). Detach for first group with the genotypes 171 BCR1069X7RG and 174 BCR1069X7RG, which presented the highest yield levels, 4.19 t ha^{-1} (69.80 sacks) and 3.84 t ha^{-1} (63.97 sacks), respectively. The second group consisted of three genotypes, only with 177 BCR1069X7RG presenting yield below 3.0 t ha^{-1}. The third group was composed of 10 genotypes and the last group of three genotypes with the lowest yield. It should be noted that the genotypes adopted as controls did not had the best yields, and yields were lower than those of the best genotypes in competition.

The performance data obtained in this experiment were higher than those obtained in 2008/2009 season in the Brazilian South region (2.35 t ha^{-1}) and Rio Grande do Sul (2.20 t ha^{-1}) (Companhia Nacional de Abastecimento, 2009). The Piauí State, in 2007/2008 season, with a cultivated area of 253,700 ha, achieved an average yield of 3.24 t ha^{-1} (Companhia Nacional de Abastecimento, 2008).

In this experiment, it was found that the control genotype BRS Sambaíba achieved a yield of 2.35 t ha^{-1}, above the obtained by Dias, Pitombeira, Teófilo and Barbosa (2009) in the Ceará State: BRS Sambaíba (1.89 t ha^{-1}), BRS Tracajá (1.88 t ha^{-1}) and MA 97 BR 1665 (1.73 t ha^{-1}). Rezende and Carvalho (2007), studying the behavior of 45 cultivars, found that these yields were satisfactory, with an emphasis on Vencedora, Paiaguás, Aventis 2056-7, Monarch and FT 2000 with production in excess of 3.40 t ha^{-1}. In this experiment, it is evident satisfactory levels of yield, since several genotypes showed the highest income or equaled those of Rezende and Carvalho (2007). These high levels of yield have ensured the competitiveness of Brazilian soybean on the international market.

In the grain index (GI) it was found to separate the genotypes into two groups, both with half of genotypes, with amplitude from 2.89 to 4.04%. One group had index higher than 3.6%, with detach for the genotype 177

BCR1069X7RG, with 4.04% and another, less than 3.50%. The relationship weight of the grains and weight of the pod tells the seed size, larger seeds have greater weight.

Table 6. Mean values of weight of 100 grains (W100G), grain yield (GY) and grain index (GI) in different soybean genotypes evaluated in low latitude, Teresina - PI

GENOTYPES *	Mass		GI %
	W100G (g)	GY (t ha^{-1})	
BRS SAMBAÍBA	17.31 B	2.35 C	3.71 A
BRS CANDEIA	19.28 A	1.81 D	3.38 B
BRS 219BOA VISTA	16.76 B	2.74 C	3.47 B
BRS 271RR	15.02 C	1.73 D	3.51 B
114 BCR336F8	18.81 A	1.86 D	3.44 B
142 SOY94F5G	19.67 A	2.40C	3.57 B
164 SOY94F5G	19.70 A	2.63 C	2.89 B
179 SOY24F5G	19.89 A	2.53 C	3.23 B
168 BCR1069X7RG	17.57 B	2.35C	3.74 A
169 BCR1069X7RG	19.20 A	3.08 B	3.23 B
170 BCR1069X7RG	18.29 A	3.46 B	3.94 A
171 BCR1069X7RG	19.73 A	4.19 A	4.00 A
172 BCR1069X7RG	19.14 A	2.67C	3.30 B
173 BCR1069X7RG	18.90 A	2.45 C	3.79 A
174 BCR1069X7RG	20.72 A	3.84 A	3.94 A
175 BCR1069X7RG	19.50 A	2.80 C	3.67 A
176 BCR1069X7RG	19.13 A	2.77C	3.78 A
177 BCR1069X7RG	19.22 A	3.25 B	4.04 A
C.V %	6.88	13.21	8.87
General Average	18.77	2.72	3.59

* Means followed by same letter do not differ by Scott-Knott test ($P \leq 0.05$).

4. Conclusions

The most genotypes were classified as medium and late cycles, with detach for 114 BCR336F8 (134 days), being that these started the flowering near the 50 days after the germination.

All genotypes tested showed the same result in lodging, although this may be determined by short stature presented, which resulted in a low insertion of the first pod to unwanted mechanical harvesting.

The genotypes 171 BCR1069X7RG (4.19 t ha^{-1}), 174 BCR10697RG (3.84 t ha^{-1}), 170 BCR1069X7RG (3.46 t ha^{-1}), 177 BCR1069X7RG (3.25 t ha^{-1}) and 169 BCR1069X7RG (3.08 t ha^{-1}) were very competitive for the conditions of the experiment, all above of the regional controls BRS 219 Boa Vista (2.74 t ha^{-1}), BRS Sambaíba (2.35 t ha^{-1}), BRS Candeia (1.81 t ha^{-1}) and BRS 271RR (1.73 t ha^{-1}).

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