Original Article

GENETIC VARIABILITY AMONG 79 SOYBEAN PROGENIES FROM UFU-BREEDING PROGRAM

VARIABILIDADE GENÉTICA ENTRE 79 PROGÊNIES DE SOJA PROVENIENTES DO PROGRAMA MELHORAMENTO GENÉTICO UFU

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ABSTRACT: Achieving high yield strains and early maturity are primary objectives in Soybean Breeding Program. As a result, the objective of this study was to evaluate 79 soybean progenies derived from ten biparental crosses from the Soybean UFU- Breeding Program. The experiment was conducted at Capim Branco Farm in Uberlândia, Minas Gerais. Initially the hibridation occurred among the parental genotypes with the desirable agronomic trai ts in a greenhouse. Subsequently, the selection by Bulk was made until the F4 generation. From this, individuals in the F5 generation progeny test were selected considering the traits grain yield and early. On February 10, 2010 it was carried out the conventional seeding of 79 progenies derived from ten biparental crosses in order to assess the following traits: Cycle (days), type of growth (TC), color of flower (CF), color of pubescence (CP), plant lodging (PL), number of pods with three grains (P3), number of pods with two grains (P2), number of pods with one grain (P1), total number of pods (PT), weight of 100 grains (W100), number of days to flowering (NDF), plant height at flowering (HPF), number of days to maturity (NDM), plant height at maturity (HPM), insertion height of first pod (H1V) and grain yield (PROD). With the exception of trait plant lodging, the agronomic traits that were evaluated allowed to identify genetic variability among the genotypes. The progenies UFUS 32, UFUS 02, UFUS 01, UFUS 37, UFUS 12, UFUS 36, UFUS 16, UFUS 29, UFUS 14 and UFUS 51 were the most promising genotypes for the conditions of Uberlândia – Minas Gerais, plant height at flowering and more adequate maturity and type of indeterminate growth, these being more productive, can be inserted in final testing of the Soybean UFU-Breeding Program and released as new cultivars.

KEYWORDS: Soybean production. Breeding. Early strains.

INTRODUCTION

Soybean is one of the most important crops worldwide and especially in Brazil, by virtue of the entire production chain and technology developed around this oleaginous species. Occupying only 2.7% of the country's productive potential (EMBRAPA, 2010), the soybean, besides being the main source of oil for the growing national biodiesel production, as a result of a market that seeks alternatives to reduce the use of non-renewable sources of energy it is also used as food, and the soybean meal is the main source of protein in animal feed.

In the context of global agribusiness, Brazil stands out as the second largest producer of soybeans, reaching in the 2011/2012 season according to estimates from CONAB (2012) a planted area of 25 million hectares and a production of 66.4 million tons. Adverse weather conditions characterized by prolonged hydric stress, caused by the phenomenon "La Niña" were responsible for the reduction of the harvest. The average yield of soybeans was 2650.00 kg ha^{-1}(CONAB, 2012).

With the growing global demand for food, Breeding programs seek to develop cultivars suitable to different producing areas, aiming at improving the genetic gains, eliminate the restrictive factors for yield and incorporate disease resistance. However, a successful breeding program resides mainly in the existence of variability in a population. Thus, divergent genotypes with high agronomic performance are prioritized in the parental choice for the formation of the base population (NOGUEIRA, 2011).

Therefore, plant breeding has been an important tool for understanding the inheritance of the traits that are involved and the parental genetic basis. Since this information crucial to the success of genetic improvement of plants whose genetic basis is narrow, such as the case of soybeans that originated from few ancestral strains (ARANTES et al., 1999; MULATO et al., 2010).

Thus, using agronomic traits can be performed to study the genetic variability among genotypes, obtaining information to identify which junction will result in greater genetic gain, so that in segregating generations there is a greater chance of obtaining superior genotypes (MUNIZ,

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2007; ALMEIDA et al., 2011; CRUZ et al., 2004).

In studies of genetic diversity, agronomic traits are used to identify additional and different genotypes resulting in higher variability of the segregating population, and therefore more likely to rearrange the alleles into new favorable combinations (MACHADO et al., 2002; CARPENTIERI-PÍPOLO et al., 2003; BARBIERI et al., 2005; AMORIM et al., 2007; ARRIEL et al., 2007). Therefore, the assessment of genetic variability may provide enlarged genetics basis in breeding programs.

For the study of genetic variability various methods can be employed such as the method of clusters which is intended to separate an original group of observations in several subgroups in order to achieve homogeneity within the subgroups and heterogeneity among them (CRUZ et al., 2004). Thus, the objective of this study was to evaluate 79 soybean progenies resulting from ten biparental crosses derived from the Soybean Breeding Program of the Federal University of Uberlândia (UFU).

MATERIAL AND METHODS

The experiment was conducted at Capim Branco Farm which belongs to the Federal University of Uberlândia (UFU), It is located in the city of Uberlândia, Minas Gerais, latitude 18º 55' 23" S and longitude 48º 17' 19" W, at an average altitude of 872 meters. The annual pluviometric average is approximately 1.250 to 1.500 mm. The soil is characterized by Red Dark Dystrophic Latosol (EMBRAPA, 1999), in which soybeans are grown for more than 10 years.

On February 10, 2010 it was carried out the conventional seeding of 79 progenies of the F5 generation resulting from ten biparental crosses. The soil preparation was done by plowing and two harrowing; the last harrowing was made one day prior to sowing. Seeding was performed manually with approximately 2 cm of depth and plant density of twelve seeds per linear meter regardless of the percentage of germination of the progeny.

The experimental design that was used was a randomized complete block with two replications and the witnesses are the cultivars M-SOY 6101, M-SOY 8100 and UFUS MILIONÁRIA. The experimental area had topography with mild declivity. Each plot was represented by two rows of soybean plants with 5 meters, spaced 0.5 m between the rows. The total area of each plot was 5 m^2 and for the evaluations 0.5 m from each end of the line and 0.25 m of edging were eliminated, totaling 2 m^2 of usable area. Between the blocks with an aisle with width of 1 m was installed to separate lines of each treatment.

The cultural practices relevant for soybean cultivation were practiced by recommendations for the crop (EMBRAPA, 2010). The experiment was fertilized in the planting furrow according to the soil analysis.

Evaluations were made regarding the most important agronomic traits for soybeans, according to the scale of Fehr and Caviness (1977). The evaluated traits were: Cycle (days), type of growth (TC), color of flower (CF), color of pubescence (CP), plant lodging (PL), number of pods with three grains (P3), number of pods with two grains (P2), number of pods with one grain (P1), total number of pods (PT), weight of 100 grains (W100), number of days to flowering (NDF), plant height at flowering (HPF), number of days to maturity (NDM), plant height at maturity (HPM), insertion height of first pod (H1V) and grain yield (PROD).

The obtained data were submitted to statistical analysis. To assess the genetic variability among genotypes a variance analysis was performed adopting the 5% of probability level of significance. Subsequently, the averages were grouped using the Scott Knott test, at 0.05 level of significance.

Analyzes were performed with the aid of the computer application in genetics and experimental statistics GENES (CRUZ, 2009).

RESULTS AND DISCUSSION

The population that was studied showed genetic variability for the evaluated traits (Table 1). There was the formation of several groups, which facilitates the selection of the best progeny to be inserted in the final tests of the Breeding Program Soybeans of the Federal University of Uberlândia (Table 1).

The most early progenies for the studied condition were: UFUS 20 and UFUS 29, with an average cycle of 92 days, in average 15.5% earlier than the control M-Soy 8001, which presented average cycle of 109 days. It was noted that due to the time of sowing, plants were induced to early flowering, which is explained by the fact that soy is a short-day plant and sensitive to the oscillations of photoperiod (CÂMARA et al., 1998; BARROS; SEDIYAMA, 2009).

The traits related to flowering and maturity are important for improving yield, especially agronomic value and there are difficulties in obtaining new productive and early genotypes (LOPES et al., 2002).

Table 1. Average[1] of the evaluated traits the 79 soybean progenies and three witnesses and description of the characterization for qualitative traits, Capim Branco Farm, in Uberlândia – Minas Gerais, 2010.

Genotypes	C	TC	CF	CP	PL	P3		P2		P1		PT		W100		NDF		HPF		NDM		HPM		PROD	
UFUS [illegible]	[illegible]	D	[illegible]	M	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	b	[illegible]	[illegible]	[illegible]	c	[illegible]	c	[illegible]	c	[illegible]	b	[illegible]	b	[illegible]	[illegible]
UFUS [illegible]	[illegible]	I	B	M	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	b	[illegible]	[illegible]	[illegible]	c	[illegible]	[illegible]	[illegible]	b	[illegible]	[illegible]	[illegible]	a	[illegible]	[illegible]
UFUS 03	109	I	B	M	1	42,41	b	50,86	a	14,70	b	25,95	b	6,55	c	46,50	c	38,85	c	108,50	a	52,90	a	1780,45	e
UFUS 04	98	I	B	M	1	52,14	b	33,47	b	22,18	a	52,40	b	10,50	c	42,00	c	32,70	c	98,00	b	42,10	b	1803,29	e
UFUS 05	93	I	B	M	1	47,76	b	44,84	a	15,73	b	60,70	a	16,30	c	51,00	c	43,40	b	127,00	a	55,60	a	2245,99	d
UFUS 06	93	I	B	M	1	56,85	a	32,47	b	18,88	a	48,50	b	13,00	c	42,00	c	34,20	c	108,50	a	48,20	b	2973,69	c
UFUS 07	93	I	B	M	1	50,84	b	40,03	b	17,21	a	49,60	b	7,50	c	42,00	c	37,50	c	98,00	b	50,80	b	1521,32	e
UFUS 08	115	I	B	B	1	58,67	a	34,07	b	14,97	b	37,90	b	9,40	c	42,00	c	39,15	c	114,50	a	53,90	a	2691,79	d
UFUS 09	115	I	B	B	1	54,56	b	42,40	a	8,65	b	47,40	b	11,30	c	51,00	c	46,05	b	114,50	a	55,70	a	3165,78	c
UFUS 10	109	I	B	M	1	60,87	a	31,51	b	15,99	b	40,20	b	14,30	c	61,50	c	44,15	b	108,50	a	60,00	a	2606,79	d
UFUS 11	108	I	R	M	1	43,60	b	53,10	a	9,44	b	57,50	b	11,10	c	42,00	c	30,70	c	98,00	b	36,80	b	2277,96	d
UFUS 12	103	D	B	M	1	48,56	b	49,21	a	6,48	b	79,30	a	15,10	c	64,50	b	39,30	c	104,50	b	52,80	a	3477,33	b
UFUS 13	127	I	B	M	1	63,76	a	31,56	b	11,39	b	68,70	a	14,60	c	42,00	c	35,35	c	93,00	b	47,60	b	3147,62	c
UFUS 14	109	D	B	M	1	50,50	b	37,40	b	20,20	a	50,50	b	9,10	c	42,00	c	32,75	c	109,50	a	53,90	a	3291,29	c
UFUS 15	121	I	B	M	1	44,46	b	45,01	a	18,73	a	58,90	b	13,40	c	69,00	b	37,75	c	115,00	a	52,50	a	1696,54	e
UFUS 16	112	I	B	M	1	47,86	b	35,80	b	23,50	a	37,50	b	8,50	c	87,00	a	54,90	a	108,50	a	61,60	a	3321,35	c
UFUS 17	104	I	B	M	1	46,29	b	49,40	a	10,47	b	29,60	b	7,30	c	42,00	c	38,65	c	109,50	a	56,40	a	2440,00	d
UFUS 18	103	I	R	M	1	47,93	b	49,92	a	18,35	a	38,30	b	14,50	c	46,50	c	33,00	c	93,00	b	44,10	b	1612,10	e
UFUS 19	104	I	B	M	1	62,24	a	32,13	b	12,02	b	34,20	b	8,60	c	42,00	c	38,30	c	97,00	b	48,00	b	1433,70	e
UFUS 20	92	I	B	M	1	54,40	b	30,07	b	22,86	a	49,20	b	11,60	c	42,00	c	28,30	c	92,00	b	38,60	b	1717,69	e
UFUS 21	115	I	R	M	1	64,46	a	31,16	b	10,88	b	66,65	a	14,25	c	87,00	a	55,40	a	115,00	a	65,50	a	3143,90	c
UFUS 22	103	I	B	M	1	39,63	b	54,11	a	13,79	b	99,20	a	17,90	b	81,00	a	47,95	b	121,00	a	65,90	a	2528,57	d
UFUS 23	97	I	B	M	1	59,75	a	38,49	b	5,46	b	67,30	a	16,60	c	42,00	c	29,65	c	109,00	a	50,00	b	2879,44	c
UFUS 24	104	I	B	M	1	51,26	b	45,55	a	9,31	b	61,20	a	14,30	c	46,50	c	33,85	c	103,50	b	39,40	b	2085,19	e
UFUS 25	115	I	B	M	1	41,67	b	57,74	a	3,12	b	55,00	b	16,00	c	51,00	c	41,80	b	115,00	a	57,10	a	2400,00	d
UFUS 26	121	I	B	M	1	31,13	b	54,30	a	22,31	a	60,30	a	14,10	c	84,00	a	48,10	b	115,00	a	58,70	a	2858,76	c
UFUS 27	108	I	B	M	1	56,77	a	30,64	b	20,76	a	59,30	b	13,00	c	51,00	c	48,40	b	108,50	a	58,20	a	2830,26	c
UFUS 28	98	D	B	M	1	63,33	a	33,65	b	8,49	b	67,70	a	15,60	c	42,00	c	34,95	c	93,00	b	40,10	b	2074,29	e
UFUS 29	92	I	B	M	1	61,84	a	36,37	b	6,11	b	75,00	a	25,40	a	51,00	c	44,15	b	115,00	a	58,50	a	3312,31	c

Continues...

UFUS 32	101	I	B	M	1	51,06	b	35,12	b	21,61	a	87,10	a	29,70	a	51,00	c	47,25	b	112,00	a	56,60	a	4393,59	a
UFUS 33	97	I	B	M	1	53,74	b	35,98	b	17,70	a	66,70	a	14,60	c	51,00	c	42,70	b	105,50	a	56,55	a	2761,91	c
UFUS 34	102	I	B	M	1	48,94	b	39,41	b	19,80	a	36,75	b	11,45	c	42,00	c	38,10	c	101,50	b	43,20	b	2167,17	d
UFUS 35	121	I	B	M	1	68,31	a	25,84	b	12,50	b	73,90	a	18,20	b	51,00	c	47,45	b	112,00	a	63,40	a	2591,06	d
UFUS 36	93	D	B	M	1	62,23	a	31,52	b	13,73	b	85,70	a	17,60	b	51,00	c	37,40	c	115,00	a	42,10	b	3350,73	c
UFUS 37	97	I	B	M	1	52,76	b	41,52	a	12,41	b	53,50	b	22,15	b	51,00	c	34,50	c	115,00	a	38,75	b	3590,28	b
UFUS 38	109	I	B	M	1	48,27	b	37,21	b	22,27	a	70,20	a	20,50	b	51,00	c	41,35	c	115,00	a	43,70	b	3007,49	c
UFUS 39	98	I	B	M	1	53,17	b	28,92	b	24,52	a	36,80	b	20,90	b	46,50	c	36,05	c	92,00	b	49,90	b	2674,51	d
UFUS 40	108	D	B	M	1	56,99	a	38,60	b	10,90	b	53,90	b	24,80	a	69,00	b	45,15	b	118,00	a	62,50	a	2328,39	d
UFUS 41	93	I	R	M	1	48,27	b	40,11	b	19,79	a	63,90	a	15,00	c	69,00	b	53,30	a	112,00	a	53,90	a	2669,46	d
UFUS 42	112	I	B	B	1	70,55	a	25,65	b	9,81	b	85,70	a	24,10	a	69,00	b	62,05	a	102,00	b	59,70	a	2529,17	d
UFUS 43	112	I	R	M	1	67,83	a	28,39	b	9,79	b	63,70	a	13,60	c	42,00	c	33,95	c	115,00	a	68,40	a	2511,08	d
UFUS 44	118	I	B	M	1	70,55	a	25,20	b	10,28	b	61,20	a	11,30	c	51,00	c	47,55	b	112,00	a	53,80	a	2282,81	d
UFUS 45	112	I	B	M	1	54,62	b	36,37	b	16,68	a	65,60	a	19,30	b	51,00	c	44,40	b	127,00	a	52,50	a	3003,68	c
UFUS 46	121	I	B	M	1	58,93	a	28,72	b	20,41	a	43,00	b	17,70	b	46,50	c	38,75	c	121,00	a	49,10	b	2900,00	c
UFUS 47	115	I	B	M	1	52,88	b	36,45	b	18,91	a	34,40	b	10,00	c	51,00	c	37,00	c	108,50	a	42,50	b	1728,78	e
UFUS 48	108	I	B	M	1	69,85	a	27,78	b	6,67	b	51,20	b	13,60	c	46,50	c	34,70	c	92,00	b	41,10	b	2500,56	d
UFUS 49	109	I	B	M	1	64,49	a	30,62	b	11,81	b	52,00	b	17,25	b	46,50	c	44,10	b	97,00	b	47,50	b	2848,41	c
UFUS 50	97	D	R	M	1	66,31	a	20,10	b	21,36	a	48,80	b	13,60	c	42,00	c	34,40	c	93,00	b	49,30	b	2222,61	d
UFUS 51	109	I	B	B	1	46,78	b	46,27	a	14,93	b	52,00	b	20,50	b	42,00	c	41,00	c	92,00	b	51,80	b	3285,66	c
UFUS 52	109	I	B	B	1	59,59	a	30,00	b	18,59	a	39,10	b	12,20	c	51,00	c	45,40	b	102,00	b	51,30	b	2367,08	d
UFUS 53	97	I	B	M	1	72,06	a	24,39	b	9,61	b	48,10	b	14,00	c	42,00	c	30,65	c	100,50	b	39,90	b	2238,14	d
UFUS 54	121	I	B	M	1	45,60	b	45,16	a	17,28	a	57,50	b	21,50	b	46,50	c	38,80	c	97,00	b	49,80	b	3053,05	c
UFUS 55	105	I	R	B	1	71,79	a	19,15	b	17,20	a	39,20	b	17,00	b	51,00	c	40,05	c	97,00	b	45,90	b	2773,34	c
UFUS 56	97	D	B	M	1	49,62	b	45,59	a	11,68	b	44,60	b	11,40	c	51,00	c	45,15	b	92,00	b	52,90	a	2516,17	d
UFUS 57	121	D	B	M	1	47,21	b	46,27	a	9,90	b	29,10	b	5,70	c	51,00	c	37,60	c	115,00	a	46,75	b	1869,77	e
UFUS 58	102	I	B	B	1	67,86	a	25,50	b	14,18	b	66,30	a	13,20	c	51,00	c	43,70	b	127,00	a	62,40	a	2135,23	d

Continuation, Table 1.

Genotypes	C	TC	CF	CP	PL	P3		P2		P1		PT		W100		NDF		HPF		NDM		HPM		PROD	
UFUS 59	118	I	R	M	1	47,53	b	44,27	a	16,22	a	21,70	b	8,90	c	51,00	c	44,95	b	109,00	a	54,00	a	1957,38	e
UFUS 60	121	I	R	M	1	67,89	a	32,11	b	0,00	b	58,90	b	13,40	c	42,00	c	25,00	c	93,00	b	34,10	b	2041,38	e
UFUS 61	104	I	B	M	1	61,59	a	25,81	b	20,76	a	34,90	b	11,55	c	51,00	c	44,15	b	112,00	a	56,50	a	1726,73	e
UFUS 62	109	I	R	M	1	64,15	a	27,49	b	16,58	a	57,50	b	24,00	a	51,00	c	43,15	b	115,00	a	48,50	b	2654,08	d
UFUS 63	101	I	R	M	1	40,01	b	54,29	a	12,40	b	74,70	a	15,90	c	51,00	c	52,15	a	92,00	b	57,30	a	2440,28	d
UFUS 64	108	D	R	M	1	59,57	a	34,21	b	13,67	b	53,40	b	11,10	c	46,50	c	39,50	c	97,00	b	48,60	b	2234,09	d
UFUS 65	109	D	R	M	1	40,20	b	44,48	a	22,67	a	43,90	b	11,10	c	51,00	c	49,40	b	115,00	a	60,70	a	1987,00	e
UFUS 66	105	I	R	M	1	73,82	a	23,67	b	7,14	b	52,20	b	13,40	c	51,00	c	46,15	b	109,00	a	60,30	a	2213,69	d
UFUS 67	100	I	B	M	1	52,24	b	41,67	a	13,39	b	105,00	a	21,40	b	51,00	c	47,05	b	115,00	a	55,00	a	2395,96	d
UFUS 68	100	D	B	M	1	46,76	b	48,29	a	11,86	b	51,20	b	14,30	c	42,00	c	35,65	c	92,00	b	47,80	b	2420,29	d
UFUS 69	100	D	B	M	1	39,59	b	60,42	a	3,43	b	71,90	a	19,00	b	42,00	c	37,90	c	94,00	b	45,80	b	2914,13	c
UFUS 70	121	D	R	M	1	58,22	a	37,54	b	10,22	b	39,85	b	12,15	c	42,00	c	39,35	c	94,00	b	53,70	a	2318,64	d
UFUS 71	121	D	B	M	1	55,54	b	42,72	a	5,41	b	33,00	b	8,00	c	51,00	c	47,95	b	102,00	b	54,30	a	1881,01	e
UFUS 72	127	D	B	M	1	65,81	a	26,02	b	7,99	b	103,60	a	26,20	a	51,00	c	45,80	b	109,00	a	58,90	a	2686,42	d
UFUS 73	112	I	B	M	1	61,87	a	33,83	b	10,37	b	47,70	b	12,50	c	51,00	c	42,10	b	92,00	b	48,70	b	2656,12	d
UFUS 74	108	I	B	M	1	53,78	b	36,74	b	17,64	a	53,60	b	12,70	c	46,50	c	42,15	b	92,00	b	57,60	a	2484,56	d
UFUS 75	121	I	B	M	1	57,30	a	33,65	b	17,17	a	65,20	a	14,70	c	51,00	c	42,60	b	115,00	a	68,80	a	2859,65	c
UFUS 76	121	I	B	M	1	47,89	b	43,96	a	16,19	a	53,70	b	13,90	c	51,00	c	44,65	b	115,00	a	59,10	a	2474,92	d
UFUS 77	115	D	B	M	1	60,55	a	36,68	b	7,93	b	54,50	b	12,05	c	46,50	c	36,10	c	115,00	a	65,40	a	2284,56	d
UFUS 78	108	I	B	M	1	49,18	b	36,64	b	21,79	a	50,20	b	14,00	c	51,00	c	54,70	a	115,00	a	74,80	a	2638,89	d
UFUS 79	112	I	B	M	1	56,67	a	29,69	b	21,38	a	36,50	b	9,60	c	42,00	c	36,60	c	92,00	b	61,40	a	1896,09	e
M-Soy 6101	127	I	B	M	1	60,86	a	34,53	b	11,04	b	66,90	a	22,70	a	42,00	c	37,60	c	109,00	a	48,10	b	3422,58	c
M-Soy 8001	109	I	B	M	1	33,88	b	64,77	a	5,39	b	81,30	a	15,95	c	87,00	a	51,65	a	127,00	a	64,40	a	3598,99	b
Milionária	115	I	B	M	1	56,22	a	41,86	a	6,29	b	51,80	b	11,90	c	51,00	c	53,65	a	115,00	a	65,90	a	2548,49	d

[1]Averages with the same lowercase letter on the line belong to the same group by the Scott Knott test at 5% of probability. Cycle (days), type of growth (TC), color of flower (CF), color of pubescence (CP), plant lodging (PL), number of pods with three grains (P3), number of pods with two grains (P2), number of pods with one grain (P1), total number of pods (PT), weight of 100 grains (W100), number of days to flowering (NDF), plant height at flowering (HPF), number of days to maturity (NDM), plant height at maturity (HPM), insertion height of first pod (H1V), weight per plot (PP) and grain yield (PROD). I: type of indeterminate growth and D: type of determinate growth, R: purple flower color and B: white flower color.

Continuation, Table 1.

Regarding the type of growth, most of the evaluated progenies showed indeterminate growth which has been an interesting option for the producer since cultivars of indeterminate growth have greater plant height and higher number of nodes on the main stem. The end portion of the stem is thinner and the leaves and the petioles are larger in the central region of the stem. The pod maturation is initiated at the bottom part (SEDIYAMA et al., 2005; MUNDSTOCK; THOMAS, 2005), this feature has caught the attention of producers, since these cultivars due to the continued growth suffer less from adverse conditions, such as moisture stress or prolonged drought

Cober and Tanner (1995) evaluated 35 strains of type of determinate and indeterminate growth originating from biparental cross between parents of maturity groups 0 and I. They verified that on average the lines of particular type of growth exhibited lower yield, a decrease in the average weight of 100 grains, lowest height, late flowering, early maturation and consequently shorter reproductive period when compared to indeterminate growth strains. However, according to Robinson e Wilcox (1998) and Quattara and Weaver (1995), the potential of high yield is expressed equally in both types of growth existing in culture.

Plant architecture, high yield potential, low laying index, resistance and/or tolerance to pests and diseases are some essential features, when choosing the parents for hybridization. However, currently, attention was drawn to the category and type of growth cycle of the cultivars. Pitombeira and Fonseca (2011) report that the Coodetec Company released the cultivars CD250RR and CD241RR directed to southern region of Mato Grosso do Sul, Paraná, Santa Catarina and Rio Grande do Sul, however, recommended for all agricultural zonings in Brazil, aiming to improve the harvest from the type of indeterminate growth and its early. The authors state also that, currently, companies in possession of seeds require this junction of traits so producers can anticipate the planting of season maize crop in the best time of year.

Egli and Legget (1973), comparing cultivars of determinate and indeterminate type of the same maturity group, reported that the specific type reached more than 90% for final height and number of nodes on the occasion of R1, while the indeterminate type reached in R1 between 50 and 60% of its final height and number of nodes on the main stem, respectively. In a study made by Foley et al. (1986) wherein 21 strains of type of determined growth were evaluated and 21 strains of indeterminate growth at three locations in Minnesota, verified that the types of determined growth reached an average of three days prior to maturity, and showed lower plant height when compared to the indeterminate type, however they did not differ in seed production.

The highest average of number of pods of three grains was 73.82 for the progeny UFUS 66, which was in the same group of the witnesses M-Soy 6101 and M-Soy 8001, and as for the average number of pods of two and three grains, two distinct groups were formed with the highest values of pods of two grains for the witness M-Soy 8001 and the progeny UFUS 30, with an average of 66.24 and 66.77, respectively. It is known that the higher the number of pods with three grains greater will be the yield, since the number of pods is the important component for the yield of the genotype. In a study done by Carpentieri-Pípolo et al. (2005), aiming to identify parents to be included in a breeding program, thirty-four soybean lines for twelve traits were evaluated, and the highest average was 45 pods of three grains per plant, 34.97% lower than the average found in this study.

For the weight of 100 grains, there was the formation of three groups, with the highest average of 29.70 g for the progeny32, being in the same group of the witness M-Soy 6101 which reported an average of 22.70 g and above the value found by Navarro-Júnior; Costa (2002) which studying the relative contribution of yield components for final grains production in soybeans, which was 16.55 g. This trait is determined genetically, but it is greatly influenced by the environment.

The number of days to flowering showed variability among genotypes, in which the progenies UFUS 22, UFUS 40, UFUS 15, UFUS 42, UFUS 41, UFUS 22, UFUS 26, UFUS 2, UFUS 16, UFUS 21 and the cultivar M-Soy 8001, stayed in the same group, being the group later, with an average 78 days, was considered high, since most varieties on the market have an average of 50-60 days to flowering, number of days that have secured good results in the final yield of the culture. For this study the most early progenies presented averages between 41 and 52 days. Differences of flowering date between cultivars when grown in the same sowing date and latitude occur mainly due to their differential response to day length (photoperiod) (EMBRAPA, 2011).

A cultivar with long juvenile period remains in the vegetative phase longer than cultivars of short juvenile period when exposed to short days, but it may bloom earlier than some conventional cultivars under long days. Thus, cultivars with long juvenile period appear to be less sensitive to photoperiod than the majority of the traditional cultivars according Farias et al. (2007).

The progenies UFUS 63, UFUS 41, UFUS 78, UFUS 16, UFUS 21, UFUS 42 and the cultivars M-Soy 8001 and UFUS Milionária, showed greater height at flowering, with an average of 55 cm, considered acceptable, since the plant was able to accumulate enough carbohydrate to produce well in the next stage of development.

The progenies UFUS 63, UFUS 73, UFUS 74, UFUS 20, UFUS 68, UFUS 31, UFUS 56, UFUS 51, UFUS 48, and UFUS 39, were favorable for the region of Uberlândia, compared to the witnesses UFUS Milionária, M-Soy 6101 and M-Soy 8100, for presenting an earlier cycle, with an average of 92 days. According to Marques (2010), the number of days to maturity is the main indicator of the crop cycle, also associated to photoperiodic, climate and soil traits, and the latitude in which soybeans are planted.

The trait plant height at maturity interferes significantly in grain yield, either to increase it or to decrease it. It is dependent on the plant population per hectare, because the higher is the density of plants per meter, the smaller is the diameter and thus the greater is the possibility of shading the stem and may cause lodging and difficulty to harvest, interfere with the final yield crop. In this study, the progenies which stood out were: UFUS 10, UFUS 66, UFUS 31 and UFUS 65 with an average height of 60 cm, being in the same group of the cultivar M-Soy 8001 and 50% of the progenies.

However, it is known that the greater is the row spacing, the greater is the side branch and the greater is the diameter of the main stem, which defines plants with smaller lengths, but laterally developed in such a way that the weight of the rods and pods formed per plant involves the their lodging and also complicates the harvest, which ends up interfering with the final average yield. According to Queiroz et al. (1978), the morphological traits that affect the adaptation of soybeans to mechanized harvesting are: plant height at maturity, insertion height of first pod, number of branches, lodging and diameter of the main stem. These traits vary with the population, sowing date and cultivar, for a given level of soil fertility. Plant height is important because it can relate to the control of weeds, lodging and the efficiency of mechanical harvesting.

Tall plants and/or etiolated tend to lodging with relative ease. To avoid such problems, it is known that the minimum height desirable for mechanical harvesting on soil with flat topography is around 50 to 60 centimeters. Generally, plants with 70 to 80 centimeters of height induce an efficient operation of the harvester and plants with over 100 cm of height tend to lodging (SEDIYAMA, TEIXEIRA; REIS, 2005).

The height of the first pod insertion is an important trait in soybeans, given its relationship to possible losses during the mechanized harvesting. It was observed values between 8 and 12 cm, below the results observed by Pereira-Júnior et al. (2010) and the value recommended by Sediyama (2009) as it states that the standards for normal cutting height on the mechanized harvesting of soybeans would be 15 cm. The progeny that stood out with higher insertion height of the first pod was UFUS 43, which was in the same group of 50% of the progenies that were evaluated. The low height found between the genotypes can cause losses by the cutting deck of the harvester, which contributes to reducing the final grains yield. There is a relationship between plant height and formation of the first pods. If the plant is low, therefore, the first pods will be very close to the ground, hindering the mechanized harvesting (QUEIROZ et al., 1978).

For the trait yield, the progenies which stood out were the UFUS 2 and UFUS 32, with average yield of 4333.25 and 4393.59 kg ha^{-1}, around 32% higher than the average yield of the witnesses and 12% higher than that found by Chioderoli et al. (2012), that evaluated the yield of soybean cultivars aiming to determine the quantitative losses, distribution of straw and operational traits of the harvester through statistical process control, as well as to check the quality of the harvesting operation. Unêda-Trevisoli et al. (2010) when evaluating the agronomic performance of 19 early soybean cultivars that exist and are traded on the market for use on crops in areas of renovation of sugar cane in the region of Ribeirão Preto and adjacencies found average yield of 3134.40 kg ha^{-1} which is lower than that found in this study.

CONCLUSIONS

With the exception of trait plant lodging, the agronomic traits have identified genetic variability among genotypes.

The progenies UFUS 32, UFUS 02, UFUS 01, UFUS 37, UFUS 12, UFUS 36, UFUS 16, UFUS 29, UFUS 14 and UFUS 51 were the most promising genotypes for the conditions of Uberlândia – Minas Gerais, and the traits of more adequate plant height at flowering and maturity and type of indeterminate growth were more productive which can be inserted in final tests of the Soybeans

Breeding Program of the Federal University of Uberlândia (UFU) and be released as new cultivars.

RESUMO: A obtenção de linhagens de alta produtividade e de ciclo precoce são objetivos primordiais em programas de melhoramento genético da soja. Em função disso, o objetivo deste trabalho foi avaliar 79 progênies de soja resultantes de dez cruzamentos biparentais provenientes do Programa de Melhoramento Genético de Soja da UFU. O experimento foi conduzido na Fazenda Capim Branco, no município de Uberlândia, MG. Inicialmente, a hibridação ocorreu entre os parentais com as características agronômicas desejáveis, em casa de vegetação. Posteriormente, a seleção por Bulk foi efetuada até a geração F4. A partir disso, selecionaram-se os indivíduos na geração F5 pelo teste de progênie, levando em consideração os caracteres produtividade de grãos e precocidade. No dia 10 de fevereiro de 2010, realizou-se a semeadura convencional de 79 progênies resultantes de dez cruzamentos biparentais a fim de avaliar as seguintes características: Ciclo (dias), tipo de crescimento (TC), cor de flor (CF), cor de pubescência (CP), acamamento (AC), número de vagens com um grão (V1), número de vagens com dois grãos (V2), número de vagens com três grãos (V3), número de vagens total (VT), peso de 100 grãos (P100), número de dias para floração (DIASF), altura da planta na floração (APF), número de dias para maturidade (DIASM), altura da planta na maturidade (APM), altura de inserção de primeira vagem (A1V), peso por parcela (PP) e produtividade de grãos (PROD). Com exceção do caráter acamamento, os caracteres agronômicos avaliados permitiram identificar variabilidade genética entre os genótipos. As progênies UFUS 32, UFUS 02, UFUS 01, UFUS 37, UFUS 12, UFUS 36, UFUS 16, UFUS 29, UFUS 14 e UFUS 51 foram os genótipos mais promissores para as condições de Uberlândia-MG, sendo estes mais produtivos, altura de planta mais adequada na floração e maturidade e tipo de crescimento indeterminado, podendo ser inseridos em ensaios finais do Programa melhoramento genético de soja UFU e lançados como novas cultivares.

PALAVRAS-CHAVE: Sojicultura. Melhoramento genético. Linhagens precoces.

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