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GENETIC PERFORMANCE OF SOME VEGETABLE SOYBEAN GENOTYPES UNDER EGYPTION CONDITIONS.

Ghobary, H. M. M. and M.M.B.Shokr
Veg. Res. Dep., Hort. Res. Inst.,Agric. Res. Center, Giza, Egypt.

ABSTRACT

Edamame are large-seeded soybean (*Glycine max* (L.) Merr) harvested as green pods at the R_6 stage when the seed are approximately 80 % matured. The demand for Edamame as fresh or frozen vegetable is increasing world wide. Until the beginning our research in 2009 Edamame varieties had not has been tested extensively or developed specifically for production in Egypt.

We have been testing six advanced breeding lines form the Asian Vegetable Research and Development Center (AVRDC) in Taiwan for production in Egypt. The study was carried out during 2009 and 2010 seasons in order to determine the genetic performance vegetable soybean genotypes grown in North East region of Delta Egypt.

Results revealed that the studied genotypes significantly differed for all traits studied in each season. Combined analysis variance elucidates that seasons were significant impact for all studied traits except for number of days to flowering, number of seeds per pod and 100 – seed weight. Genotypes X season interaction was significant for all studied traits except for number of days to pods fill, plant height and number of pods per plant. Data of mean performance of six genotypes revealed that genotypes X – 601 possessed that earliest flowering and maturity plants. Whereas, genotype Soja non ogm– 03-19 possessed the latest ones.

Soja non ogm–03-19 showed the highest values for plant height, number of branches per plant and fresh weight of plant. Whereas, Soja non ogm–03-11exhibited the shortest plants and lowest fresh weight of plant and Soja non ogm–03-10 had the lowest branched plants. Results showed that the Soja non ogm–03-16 possessed the highest values for number of pods, seeds per pod and fresh green seed yield / plant. Whereas, the Soja non ogm–03-19 possessed the harvest seed weight. Soja non ogm–03-11 exhibited the lowest values for number of pods and fresh green seed yield per plant. The highest estimates of broad sense heritability (h^2) were obtained for days to pods fill, fresh weight of plant, number of pods per plant and number of days to flowering. These results indicated that selection based on mean would be successful in improving the performance through breeding program.

INTRODUCTION

Vegetable soybean , called Edamame (pronounced eh-dah-MAH-meh) in japan or Mao dou in china (Shurtleff an lumpkin 2001),are large seeded soybean with a sweet ,nutty flavor that can be eaten as snack either boiled in salt water or roasted similarly to pea nut (*Arachis hypogaea* L.) seed. Edamame is Japanese name, meaning "beans on a branch ". It is a green vegetable soybean and rich in protein (up to 40 %) and also high in vitamin A, B, Calcium, Iron and dietary fiber. Missina 2001 summarized the results of several clinical studies that showed the association of soy foods, particularly soy iso flavones with reduction in blood serum cholesterol levels, reduction in the risk of cardiovascular diseases in human, reduction in mammary and prostrate cancers in woman and men, respectively, and

increased bone density and reduced osteoporosis among menopausal women. Because of these nutraceutical benefits of soybean and the recent approval of soybean protein extract as dietary supplement by the food and drug administration, the demand for soy foods may continue to increase over the long term.

In Asia , where Edamame is an important vegetable , farmers harvest fresh green pods along with the stem when the pods are fully filled and just before turning yellow (Shanmugasundaram *et al*.,1991). This stage corresponds to the R6 stage of soybean development (Fehr *et al*., 1971). Fresh or frozen vegetable soybean can be cooked just like sweet pea (*Pisum sativum* L.) or Lima bean (*Phaseolus limensis* L.) either stirfried or added to stews and soups. They are nutritious and rich in phyto-chemical beneficial to humans.

Masuda,(1991) compared vegetable soybean quality with that of green peas (*P.sativum* L.) and reported nearly 56 % more protein content for vegetable soybean than that of green peas. Vegetable soybean, also commonly Known as fresh vegetable soybeans is a healthy and delicious vegetable. It is not only fun to eat but also rich in vitamins and balanced nutrient ingredients. The medical communities have been paying more and more attention to its effectiveness in health maintenance and disease prevention. Therefore, the future of Edamame products including frozen vegetable soybean is promising especially in advanced countries.

Production of vegetable soybean is similar to a grain soybean expect that vegetable soybeans are harvested when the pods are still green and full. The seeds of vegetable soybeans are larger, sweet and tenderer than grain soybean. In addition to domestic consumption, vegetable soybean also has export potential.

The present investigation we have been testing some advanced breeding lines from the Asian Vegetable Research and Development Center (AVRDC) in Taiwan for production in Egypt.

MATERIALS AND METHODS

This study was carried out during 2009 and 2010 growing summer seasons at El-Bramoon Horticulture Research Farm (Latitude 30^0.50, 31.5 N,Longitude30^0 , 32.0 E, Altitude 12 meters). The physical and chemical properties of the experiment soil at the depth of 50 cm are shown in Table (1) with determine according to Black, (1965) and Page *et al*., (1982).

Table (1): Some physical and chemical analysis of experiments soil:

Soil / erties	Texture class	Clay %	Silt%	Sand %	pH	EC ds/m	O.M	N (ppm)	Available p(ppm)	Available k (ppm
Value	clayey	65.63	12.37	22	7.6	0.85	1.78	75.1	16.4	350

Six vegetable soybean genotypes (Soja non ogm–03-11, Soja non ogm–03-10, Soja non ogm–03-16, Soja non ogm–03-19, X- 601 and No.11) from the Asian Vegetable Research and Development Center (AVRDC) in Taiwan were planted 20 April 2009 and 15 April 2010 in a randomized

complete block design with four replications. Each plot consisted of two 5 m – long rows planted 45 cm apart, spaced 10 cm within the row. All agriculture practices used in the experiment were applied in accordance to recommendation of AVRDC.

Flowering:

Numbers of days to 50 flowering were recorded each year on mean plot basis. Thirty days after planting, the crop was checked at 2- days' interval to record flowering.

Vegetable traits:

At R_1 stage (Fehr *et al*., 1971) when the crop was at peak vegetative to early flowering, ten guarded plants were randomly taken from each plot to measure the total fresh weight of plant, plant height and number of primary branches per plant.

Fresh green seed yield and yield components:

Each year plants were sampled from each plot when the crop was at R6 stage[(when the pods are fully developed but still green and immature with seeds still green and 80% matured (Fehr *et al*., 1971)] to determine the green seed yield and yield components. Number of days to pods fill was recorded on the mean plot basis. The pods per plant were recorded and then shelled the pods to determine the number of seeds per pods, fresh weight of 100 green seeds and fresh seed weight per plant. All seed yield data were expressed on fresh weight basis.

Statistical analysis:

The combined analysis of variance was carried out according to Steel and Torrie, (1980). Broad sense heritability (h^2) was estimated by using variance components method (Fehr, 1987).

RESULTS AND DISCUSSION

Significance of mean squares due to different source of variability for studied traits in separate analysis and combined ones are summarized in Table (2). Results revealed that the studied genotypes differed significantly for all the traits in each season and combined analysis. Combined analysis of variance over seasons elucidates that years were significant or highly significant for days to fill pods, plant height, number of branches per plant, fresh weight of plant, number of pods per plant and fresh green seed yield per plant. Therefore, it could be concluded that environmental effects significantly affected the performance of the present vegetable soybean genotypes. However the evaluation for two seasons under the same location has led to narrower environmental fluctuation, which might have resulted in insignificant effects of season on the performance of yield and some of the important components such as number of seeds per pods and 100- seed weight. Results showed that genotypes X season interaction were significant for all studied traits except for number of days to fill pods, Plant height and number of pods per plant. This declared that the studied genotypes differed significantly for ranks from one season to another. These results are in agreement with obtained by (Chen *et al*., 1991).

The mean performances for different traits for six vegetable soybean genotypes are given in Table (3). Data revealed that flowering among the six genotypes ranged from 34 (X-601) to 51 (Soja non ogm–03-16) days after planting. There were significant genotypes differences for days to achieve fully filled pods (R6 stage) when the green pods could be harvested (Fehr *et al*., 1971). The average number of days from planting to R_6 stage ranged from 79.5 (X-601) to 96.5 (Soja non ogm–03-19). The three early flowering genotypes, X-601, No.11 and Soja non ogm–03-19, also achieved R6 stage significantly earlier than other genotypes. The genotypes that achieved the R6 stage within 80 days after planting may be categorized as early. No.11, Soja non ogm–03-11 and Soja non ogm–03-10 achieved R_6 stage significantly earlier than Soja non ogm–03-19 but significantly later than X-601. These genotypes which took about 82 to 85 days to reach R6 stage could be categorized as medium range, whereas remaining genotypes Soja non ogm– 03-10, Soja non ogm–03-16 and Soja non ogm–03-19 which attained the R6 stage more 85 days after planting may be classified as late under Egypt conditions. Planting early and late maturing genotypes in a sequence will enable the farmer to market fresh vegetable soybean over a longer duration. The time of harvesting is a critical factor in determining consumer acceptability and marketability of fresh vegetable soybean (Mbuvi and Litchfield, 1995). The optimum time for harvesting fresh vegetable soybean to combine the best product quality with maximum yield is a function of a dynamic relationship between maturity, yield and quality parameter. Quality properties such as color, texture and seed size of vegetable soybean are a function of development time (Mbuvi and Litchfield, 1995). Since these quality parameters do not peak at the same time, it is necessary to compromise time of harvest of green beans. Shanmugasundarem *et al*., (1991) reported that the optimum time for harvesting green beans was when the pods are still green, immature, and tight with fully developed immature green seeds. This stage coincides with the R6 stage of soybean development as staged by Fehr *et al*., (1971). Thus harvest at R6 stage is very critical for ensuring bean yield and quality Figure (1).

Regarding to plant height, Soja non ogm–03-16 and Soja non ogm–03-19 are possessed to tallest plants (37.6 cm) whereas; Soja non ogm–03-11 exhibited the shortest plants (30 cm). For number of branches per plants, Soja non ogm–03-19 showed the profuse plants (4.0) whereas X-601 and Soja non ogm–03-10 were possessed the lowest branched plants. For the average fresh weight of plant the Soja non ogm–03-19 possessed the harvest plant fresh weight (217 g) among the six genotypes. On the other hand, Soja non ogm–03-11 possessed the lowest value (77.3 g).

The mean number of green pods per plant across years ranged from 26.5 for Soja non ogm – 03-11 to 88.5 for Soja non ogm–03-16. Soja non ogm–03-16, Soja non ogm–03-19 and No.11 produced significantly greater number of pods / plant than all other genotypes. Soja non ogm–03-11 produced fewer pods than most other genotypes. For number of green seeds per pod, Soja non ogm–03-16 had more seeds per pod (2.8) whereas X – 601 had the lowest number of green seeds per pod (2.4).

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Figure (1): Pods and green seeds at R_6 stage when the green pods could be harvested.

The number of seeds per pod is one of the important quality characteristics that determine the marketability and profitability of Edamame. Pods with more than two seeds are generally preferred and fetch premium prices in the Asian markets (Shanmugasundarem *et al*., (1991).

In this study, the six genotypes retained more than two seeds per pod Soja non ogm–03-16 had the highest mean seeds per pod (2.8) among the genotypes whereas X – 601 produced the lowest (2.4). A similar number of seeds per pod were reported for several vegetable soybean genotypes grown in Virgnia (Mebrahtu *et al*., 1997) and Washington (Konovsky *et al*., 1996). The number of seeds per pod is one of the yields determinate of soybean. (Shanmugasundarem *et al*., (1991) reported a significant liner relationship between seed fresh weight and pod length ($r^2 = 0.674$) and pod width ($r^2 = 0.689$) suggesting that these two physical characteristics could be useful selection criteria for breeding vegetable soybean with more seeds per pod.

For 100 seed fresh weight ranged from 35.6 g for X – 601 to 51.8 g for Soja non ogm–03-19. Seed fresh weight is an important yield determinate and quality parameter that determines consumer acceptability (Shanmugasundarem *et al*., (1991); Mbuvi and Lilchfield, 1995). Generally, seeds quality characteristics achieve their peak levels when the seed size is also at its maximum. The numbers of seed per pod and seed weight are generally negatively related as they compete for the same resources. A compensatory mechanism between number of seeds per pod and seed

weight have been operative in the present study since Soja non ogm–03-16 with smaller , lighter seeds could retain more seeds per pod than Soja non ogm–03-19 which produced heavier seeds.

The mean fresh green seed weight per plant ranged from 32.8 g for Soja non ogm–03-11 to 93.0 g for Soja non ogm–03-16. Genotypes that produced more pods and seeds also produced high fresh seed weight. Soja non ogm–03-16 possessed the highest values for number of pods, seeds per pod and seed weight per plant and recorded 88.5, 2.8 and 93 g respectively. On the other hand, Soja non ogm–03-11 possessed the lowest value for the number of pods (26.5) and fresh weight per plant (32.8 g). These results are in agreement with obtained by Rao *et al*., 2002.

Genetic parameter:

Estimates of phenotypic (δ^2 ph) and genotypic (δ^2 g) variances as well as broad sense heritability from the partition of mean squares in separate analysis and combined ones are presented in Table (4). Data revealed that the magnitude of phenotypic and genotypic variances varied from trait to another whether estimated from each season or from combined analysis. Heritability (h^2) estimates were generally high for all studied traits of separate and combined analysis.

The highest estimates of broad sense heritability (h^2) was recorded as 99.8, 99.6, 97.4, 97.3 and 96.1 % for number of days to pod full , average fruit weight of plant , number of pods per plant , number of days to 50% flowering and fresh seed green per plant respectively. These results indicated that the environmental factor had a small effect on the inheritance of such traits. High estimates of heritability indicated that selection based on mean would be successful in improving these traits.

Table (4): Estimates of phenotypic (δ^2 ph), genotypic (δ^2 g) and heritability in broad sense for studied traits in 2009, 2010 and combined data.

Parameters / Traits	2009			2010			Combined data		
	δ^2 ph	δ^2 g	$h^2_{(b.s)}$	δ^2 ph	δ^2 g	$h^2_{(b.s)}$	δ^2 ph	δ^2 g	$h^2_{(b.s)}$
Days to 50 % flowering	51.367	49.411	96.2	56.967	54.077	94.9	106.217	103.328	97.3
Days to pods fill	61.5587	61.29	99.5	43.362	43.093	99.3	102.3	102.1	99.8
Plant heights (cm)	17.333	16.969	95.2	19.092	15.128	79.2	18.45	14.238	77.2
No. of Branches / plant	0.474	0.289	61.0	1.208	0.789	65.3	1.567	0.988	63.1
Average fruit weight / plant	2770	2761.1	91.6	2770	2751.989	99.3	5534.750	5516.956	99.6
No. of pods / plant	483.229	473.44	97.9	499.13	483.34	96.8	254.745	242.325	97.4
No. of seeds / pod	0.036	0.02	55.6	0.027	0.017	63.0	0.054	0.041	75.9
100 – seed weight	48.47	42.25	87.2	64.48	41.7	64.7	101.75	85.56	84.1
Fresh green yield / plant (g)	729.22	712.49	97.7	614.93	522.69	84.9	1281.05	1230.52	96.1

Conclusion

From the above mentioned results, it could be concluded that genotypes used in this study may be suitable for production in Egypt. There were significant genotypic differences for most studied traits. The genotypes X – 601 , No.11 and Soja non ogm–03-11 that achieved the R6 stage within 82 to 85 days after planting may be categorized as early whereas the other

genotypes which attained the R_6 stage more 85 days after planting may be classified as late under Egypt conditions. This study has most only helped identify several potential high yielding vegetable soybean genotypes for production in Egypt, It also provides valuable information that could be used for further improvement of soybean for food uses through breeding programs. There is a need for similar researches in Egypt.

REFERENCES

Black,C.A(1965). Methods of soil analysis .Part 1- phsical and mineralogical proprieties A. S. A. Madisun Wisc, USA.

Chen,K.F.; S. H. Lai and Chen, S. T. (1991). Vegetable soybean seeds production technology in Taiwan. P. 45-52. Ins. S. Shanmugasundaram (Ed) Vegetable soybean: research needs for production and quality improvement .Asian Vegetable Research and Development Center.

Fehr,W.R.; C.E.Cariness ; D.T.Burmood and J.S.Pennington(1971). Stage of develop[ment descriptions for soybeans (*Glycine max* L.) MERRILL.Crop Sci.11:929 – 931(Abstract / free full text).

Fehr, W. R. (1987). Principles of cultivar Development Vol.1 Mac Millan Publishing Co. New York.

Konovsky,J.,D.W.Evans,and T.A.Lumpkin (1996). Heritability of yield, plant architecture, and quality traits of edamame : the vegetable soybean. Soybean Genet.Newsl.23:243-249.

Masuda,R.(1991). Quality requirement and improvement of vegetable soybean .P.92-102. In S.Shanmugasundaram (ed) Vegetable soybean: research needs for production and quality improvement .Asian Vegetable Research and Development Center.

Mbuvi.S.W.,and J.B.Litchfield.(1995). Green soybean as vegetable: comparing green soybean with green peas and Lima beans; and maximized harvest time determination using mathematical modeling J.Veg.Crop.Prod.1:99-121.

Mebrahtu,T.;A.Mohammed and A.Elmi (1997). Accumulation of phytate in vegetable – type soybean genotypes harvested at four development stages.Plant foods Human Nutr.50:179-187 (Medline).

Messina ,M.(2001). An overview of the health effects of soy foods and soybean isoflavones P.117-122.In T.A.Lumpkin and S. S. Shanmugasundaram (Compilers) Int. Vegetable soybean Conference , 2nd ,Tacoma ,WA.10-12.Aug.2001 Washington Stat Univ , Pullman,WA.

Page,A.L. ; R.H.Miller and D.R.Keeney (1982). Methods of soil analysis .Part 11-phsical and mineralogical proprieties A.S.A.Madisun Wisc,USA.

Rao,M.S.S. ; A.S.Bhagsari and A.I.Mohamed (2002). Fresh green, seed yield and seed nutritional traits of vegetable soybean genotypes .Crop Science 42:1950 – 1958.

Shanmugasundaram S., S. T. Cheng, M. T. Huang and M. R. Yan. (1991). Varietal improvement of vegetable soybean in Taiwan P. 30 - 42. In S. Shanmugasundaram (Ed) Vegetable soybean: research needs for production and quality improvement . Asian Vegetable Research and Development Center.

Shurtleff, W. and T.A. Llumpkin (2001). Chronology of green vegetable soybean and vegetable – type soybeans. P 99-103 . In T.A. Lumpkin and S. Shanmugasundaram (Compilers) Int. Vegetable soybean Conference, 2nd , Tacoma, WA. 10-12 .Aug.2001 Washington Stat Univ , Pullman, WA.

Steel, R . G. and J. H.Torrie,(1980). Principles and procedures of statistics: Edn.Mc Graw - Hill. Book Co. Inc., New York .

السلوك الوراثى لبعض التراكيب الوراثية لفول الصويا الخضار تحت الظروف المصرية.

حامد محمد محمد غباري و محمود محمد بدوى شكر.

قسم بحوث الخضر – معهد بحوث البساتين – مركز البحوث الزراعية – مصر.

فول صويا الخضار المعروف فى اليابان باسم Edamame يتميز بكبر حجم بذورة عن فول صويا الحبوب ويتم حصاد القرون وهى خضراء عند ٨٠ % نضج ويتم استهلاك البذور خضراء وحيث ثبت ارتفاع قيمتة الغذائية ازداد الاهتمام به على مستوى العالم ولما لم يتم زراعتة على النطاق التجارى بمصر حتى الان اجريت هذة الدراسة لاختبار سلوك ستة تراكيب وراثية تم الحصول عليها من المركز الاسيوى لبحوث الخضار بتيوان (AVRDC) تحت الظروف المصرية بهدف ادخال زراعتة على النطاق التجارى بمصر – تمت هذة الدراسة بموسمى ٢٠٠٩ ، ٢٠١٠ بالمزرعة البحثية بالبرامون – دقهلية.

وكانت اهم النتائج المتحصل عليها :

- التراكيب الوراثية المدروسة كان بينها اختلاف معنوى فى الصفات المدروسة فى كلا الموسمين.
- كان هناك تاثير معنوى لموسم الزراعة لكل الصفات المدروسة ما عدا صفات عدد الايام حتى الازهار ، عدد البذور فى القرن ووزن١٠٠ بذرة.
- تاثير التفاعل بين الموسم والتركيب الوراثى كان غير معنوى لكل الصفات المدروسة ماعدا عدد الايام حتى امتلاء القرن ، ارتفاع النبات و عدد القرون / النبات.
- التركيب الوراثى X-601 كان ابكر التراكيب فى الازهار والنضج بينما التركيب الوراثى Soja non ogm–03-19 كان اكثرهم تاخير فى الازهار والنضج.
- التركيب الوراثى Soja non ogm–03-19 كان اكثر التراكيب بالنسبة للنمو الخضرى (طول النبات – عدد الافرع / نبات – الوزن الكلى للنبات) بينما التركيب الوراثى Soja non ogm–03-11 كان اقل تركيب وراثى فى النمو الخضرى.
- التركيب الوراثى Soja non ogm – 03-16 كان متفوقا فى عدد القرون / نبات – عدد البذور / القرن ومحصول البذور الخضراء / نبات بينما التركيب الوراثى Soja non ogm– 03-19 كان متفوقا فى وزن البذرة ولكن التركيب الوراثى Soja non ogm–03-11 كان اقل التراكيب فى عدد القرون على النبات ومحصول النبات.
- اظهرت التقديرات ان درجة التوريث على النطاق الواسع كانت عالية بالنسبة لصفات عدد الايام حتى امتلاء القرن – الوزن الطازج للنبات – عدد القرون / النبات – عدد الايام حتى الازهار مما يشير على ان الانتخاب لهذة الصفات على اساس متوسط السلوك تؤدى الى التحسين فى سلوك هذة الصفات خلال برامج التربية.

قام بتحكيم البحث

أ.د / طه محمد السيد عمر الجزار — كلية الزراعة – جامعة المنصورة

أ.د / سيف الدين محمد فريد — مركز البحوث الزراعية

Table (2): Mean squares due to different sources of variation for studied traits in 2009, 2010 and combined over them

Traits \ S.O.V	d.f	2009		2010		Combined			
		Genotypes 5	Error 15	Genotypes 5	Error 15	Genotypes 5	Season 1	Genotypes X Season 5	Error 33
Days to flowering		199.6**	1.9556	219.2**	2.8895	416.2**	0.21ns	2.6 ns	2.889
Days to pods fill		245.442**	0.264	172.642**	0.269	408.483**	3.333**	8.933**	0.240
Plant heights (cm)		68.742**	0.864	64.475**	3.969	109.233**	24.084*	23.983 **	4.212
No. of Branches / plant		1.342**	0.186	3.575**	0.419	4.533**	5.334**	0.399 ns	0.179
Average fruit weight / plant		11053.3**	8.922	11026.067**	18.11	22085.62**	82.688*	12.288 ns	17.773
No. of pods / plant		1903.566**	9.788	1949.146**	13.786	3781.721**	117.188**	70.988**	12.49
No. of seeds / pod		0.106**	0.013	0.080**	0.010	0.178**	0.017 ns	0.074 ns	0.012
100 – seed weight		175.229**	6.211	189.622**	22.765	358.436**	45.63 ns	6.415 ns	16.182
Fresh green yield / plant (g)		2866.703**	16.729	2183.021**	92.246	4972.62**	463.763**	77.104 ns	50.526

N.s,* and ** indicate insignificant and significant at 0.05 and 0.01 level of probability, respectively.

Table (3): Mean performances of six soybean genotypes for studied traits during 2009, 2010 and combined data.

Genotypes	Days to 50 % flowering			Days to pods fill			Plant height (cm)			No.of Branches/ plant			Average fresh weight / plant (g)			No.of pods / plant			No.of seeds / pod			100 – seed weight(g)			Fresh green yield / plant (g)		
	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
Soja non ogm–03-11	36.0	36.0	36.0	83.5	85.5	84.5	30.8	29.3	30.0	2.0	2.5	2.3	78.3	76.3	77.3	26.0	27.0	26.5	2.6	2.7	2.7	45.2	49.6	47.4	29.6	36.0	32.8
Soja non ogm–03-10	42.0	41.5	41.8	87.5	89.5	88.5	34.8	36.5	35.6	1.8	2.3	2.0	102.0	98.0	100.0	36.8	45.3	41.0	2.6	2.6	2.6	38.7	39.9	39.3	35.5	45.8	40.7
Soja non ogm–03-16	50.0	51.0	50.5	97.3	95.3	96.3	39.5	35.8	37.6	2.5	2.8	2.6	153.0	156.5	154.8	84.3	92.8	88.5	2.8	2.8	2.8	38.2	38.0	38.1	89.3	96.8	93.0
Soja non ogm–03-19	49.0	51.0	50.0	97.5	95.5	96.5	34.8	40.5	37.6	3.3	4.8	4.0	219.8	214.3	217.0	71.5	64.0	67.8	2.4	2.4	2.4	51.2	52.4	51.8	87.8	81.8	84.8
X- 601	35.0	34.0	34.5	78.5	80.5	79.5	29.5	32.5	31.0	1.8	2.3	2.0	90.5	86.0	88.3	48.3	52.8	50.5	2.3	2.4	2.4	33.7	37.5	35.6	37.3	48.3	42.8
No.11	36.0	36.5	36.3	83.5	81.5	82.5	28.5	31.8	30.1	2.0	2.3	2.1	112.5	110.5	111.5	60.8	64.5	62.6	2.6	2.6	2.6	35.2	36.5	35.9	54.5	62.6	58.5
LSD0.05 genotypes (G)	2.1	2.6	2.0	0.8	0.5	0.5	1.4	2.9	2.1	0.6	0.9	0.4	4.5	6.4	4.3	4.7	5.9	3.6	0.2	0.2	0.1	3.8	7.2	4.1	6.2	14.5	7.2
LSD0.05 Season (s)			Ns			0.3			1.2			0.2			2.5			2.1			Ns			2.4			4.2
L.S.D 0.05 G X S			Ns			0.7			2.9			Ns			Ns			5.1			Ns			Ns			Ns

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