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Original Research Paper

Pod shattering of different soybean varieties, *Glycine max* (L) Merrill, as affected by some growth and yield parameters

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Adeyeye[1*], A.S., Togun[2], A.O., Akanbi[3], W.B, Adepoju[1], I.O. and Ibirinde[1], D.O

[1]Department of Crop Production and Protection, Federal University Wukari Taraba State, Nigeria.
[2]Department of Crop Protection and Environmental Biology, University of Ibadan. Nigeria.
[3]Department of Agronomy, Ladoke Akintola University of Technology, Ogbomoso. Nigeria.

*Corresponding Author:
E.mail:solorach2002@yahoo.com
Tel.: +2348035531840

Pot and field trials were conducted to assess pod shattering in 15 varieties of soybean as affected by growth and yield attributes of the crop .Varieties used in this study included ; TGx1740-2F,TGx1871-12E,TGx1895-33F,TGx1019-2EB,TGx1485-1D,TGx1882-2F,TGx1880-3E,TGx1873-16E,TGx1842-1E, TGx1888-15F,TGx1866-7F, TGx1869-13E,TGx1848-10E, TGx1896-3F and TGx1448-2E At plant maturity, plant height and number of leaves, branches, nodes, pod, and shattered pod per plant, as well as pod length, pod diameter, pod weight and seed yield were assessed. Results indicated that variety TGx1888-15F had significantly the highest number of leaves while variety TGx1740 produced significantly the tallest plant. In field trial, there were no significant differences in the number of leaves per plant among varieties. Soybean varieties varied widely in their yield in both experiments. Variety TGx1448-2E produced the highest and significant seed yield while TGx1019-2EB had the lowest Pod shattering showed a significant negative correlation with pod diameter while plant height had negative but not significant effect on number of shattered pod per plant. The analysis also revealed that number of pod per plant, pod length, number of seed per plant, pod weight, seed weight and husk weight per plant had a direct but not significant effect on number of shattered pod per plant.

Key word: soybean, pod shattering, growth and yield attributes

INTRODUCTION

Soybean (Glycine max L. Merill) is one of the world most valued oil seed crop and most important grain legumes in Nigeria. It is a legume of very high nutritional value that has a tremendous potential for alleviating protein-based malnutrition in Nigeria. The demand for soybean protein is relatively high because of the high cost of other sources of protein such as meat, egg, etc (Addo and Oguntona, 1993).Legumes including soybean are very important components of tropical Agriculture. They are important in human and animal nutrition and also have industrial uses. It has become an increasingly important agricultural commodity with a steady increase in worldwide annual production which was 155.1 million metric tons in 1989 with the major producer being the United State, Brazil, Argentina, China and India(USDA,2000).The present emphasis on consumption and utilization of soybean in Nigeria will no doubt step up both domestic and industrial demand for only about 70,000-75,000 metric tons of soybean seeds were produced in the country annually mainly from the middle belt or Guinea savanna region with average yield of 300-500kg/ha (FAO,1989). One among the major problems associated with soybean production in tropical and sub-tropical ecology is pod shattering. Pod shattering, when crops reach maturity in hot and dry condition could lead to serious seed yield losses. Cultivation of shattering resistance or tolerant varieties is one of the remedial recourses for minimizing pod shattering in soybean (Tiwari and Bhatnagar, 1989).Also proper application of plant growth regulators has been found to regulates some of the morphological and physiological

processes of the plant especially under hot and dry conditions to slow quick drying consequently alleviate pod shattering (Leyla et al,2006).Genetic variability is an important tools for the selection of diverse parental characters which could be used for crop improvement program and the information from the genetic studies indicates that pod shattering in soybean is controlled by two genes which are dominant and non dominant genes (Sujata et al 2012,Rubaihayo et al,2000). Further investigations are therefore needed in this aspect. This study was therefore designed to examine the pod shattering behavior of soybean varieties as affected by other agronomic parameters.

MATERIALS AND METHODS

Pot and field trial were carried out with 15 varieties of soybean:TGx1740-2F,TGx1871-12E,TGx1895-33F,TGx1019-2EB,TGx1485-1D,TGx1882-2F,TGx1880-3E,TGx1873-16E,TGx1842-1E,TGx1888-15F,TGx1866-7F,TGx1869-13E,TGx1848-10E,TGx1896-3F and TGx1448-2E at Ibadan, Oyo State Nigeria during the growing season 2009 and 2010 to determine the pod shattering behavior of soybean as affected by other agronomic character of the plant i.e. growth and yield parameters . Experimental site is located on the Zone between the forest to the south and savanna to the North. on Latitude 7°33N and longitude 3°56E at an elevation of 240m above sea level with the annual rainfall ranges between 1250mm to 1500mm The soil of the experimental site is mainly Alfisols and belongs to Egbeda series which is derived from fine grained biotites gnesis (Agboola, 1987).

Pot experiment

Seeds of each variety were planted in a plastic pot filled with 4kg sandy loam soil at the rate of three seeds per pot. Post-emergence, seedlings were thinned to one seedling per pot. Pots were then kept at the roof top of the Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria for 12-14 weeks until the experimental plants mature. Five pots were used for each variety, with three replicates. Insecticide, karate EC, was applied to plants starting from four weeks after planting till onset of pod formation to prevent insect attack. Plants were watered twice per day plant height, number of leaves, days from seeding to maturity, number of shattered pods, length of pod, diameter of pod total number of seeds per plant, number of harvestable pods per plant, weight of pod per plant, weight of seeds per plant, percentage pod shattered, seed to husk ratio and grain yield were calculated.

Field experiment

The experiment was carried out at the University of Ibadan Teaching and Research Farm, Ibadan in Oyo State ,Nigeria.. Each variety of soybean was planted in a plot measured 3 m x 2 m with planting spacing of 60 cm by 5 cm and one meter space between plots and 2 m between replicates. –After germination, seedlings were thinned to one plant per a hole with a total number of 20 seedlings per plot. Each treatment was replicated three times. During the experimental period, weeds were controlled manually and insects were managed by karate insecticide as needed. The same vegetative and reproductive parameters mentioned above were recorded.

RESULTS

Pot experiment

Varieties of soybean varied widly in the plant height, number of leaves, number of branches and number of nodes per plant as illustrated in Table 1. Varieties TGx 1888-15F and TGx 1448-2E showed significantly the highest number of leaves while TGx 1880-3E was the least one. The highest Plant height was recorded in variety TGx 1740-2F, but TGx 1485-1D, TGx 1882-2F and TGx 1880-3E produced the shortest plants.

TGx 1888-15F created the highest number of branches, followed by TGx 1882-3E and TGX 1448-2E, whereas and least value was recorded for variety TGx 1019-2EB was the least significant one. Also, varieties differed significantly in the number of nodes per plant, where TGx 1895-53F had significantly the highest number TGx 1888-15F with the least value. of node

Table (2) shows the performances of different soybean varieties under field conditions as indicated by number of leaves per plant, plant height, number of branches and number of nodes per plant. at 8weeks after planting TGx 1880-3E displayed the highest number of leaves followed by TGx 1882-2F, while and least with TGx 1869-13E produced the least number of leaves. The highest plant height was recorded for variety TGx 1848-10E, followed by TGx 1896-3F. . The least values were recorded for TGx 1740-2F and TGx 1871-12E. The variety TGx 1448-2E has the highest value of (13.0) with respect to the number of branches and least with TGx 1019-2EB (0.7). The highest number of nodes was recorded for TGx 1896-3F and followed by TGx 1848-10E, and least with TGx 1740-2F, TGx 1895-33F and TGx 1866-7F.

Table (3) showed the pod characteristics of soybean grown in pot as affected by variety at maturity. All parameters measured were significantly influenced by varietal effects.

Pod length varies from 2.4 in TGx 1888-15F to 3.7 in TGx 1871-12E. Pod diameter of 5.6mm which was the highest was obtained from TGx 1448-2E and the least value of (3.9mm) was recorded for TGx 1869-13E. Also number of pod per plant was significantly affected by variety with TGx

Table 1. Vegetative characteristics of soybean as affected by different variety in the pot experiment 8 WAP

Variety	Number of leaves	Plant height (cm)	Number of branches	Number of nodes / plant
TGx 1740-2F	72.7c	46.3a	5.2bc	12.0b
TGx 1871 – 12E	70.0e	27.0l	4.5d	11.5bc
TGx1895 -33F	61.0h	44.7b	5.1c	13.1a
TGx 1019 – 2EB	46.0l	32.0i	3.0f	10.3e
TGx 1485 – 1D	52.7j	26.0m	4.5d	7.9h
TGx 1882 – 2F	71.7d	36.3m	5.7ab	12.0b
TGx 1880 – 3E	65.7f	26.3m	3.7e	8.7g
TGx 1873 – 16E	72.7c	35.7f	5.3bc	9.4f
TGx 1842 – 1E	72.7c	35.3f	4.2de	10.5de
TGx 1888 – 15F	82.0a	29.7j	6.0a	7.2i
TGx 1866 -7F	66.0f	28.7k	5.2bc	8.7g
TGx 1869 – 13E	50.3k	33.3h	5.2bc	11.0cd
TGx 1848 – 10E	62.3g	42.7c	3.7e	11.2cd
TGx 1896 – 3F	59.3i	39.7d	4.4d	10.3e
TGx 1448 – 2E	80.3b	34.3g	5.7ab	11.1cd

Values with different letters along column are significantly different using DMRT at 5% probability level

Table 2. Vegetative characteristics of soybean as affected by different variety in the field experiment 8

Variety	Number of leaves	Plant Height(cm)	Number of branches	Number of nodes /plant
TGx 1740-2F	15.0def	35.5e	3.2cd	10.7cd
TGx 1871 – 12E	22.7bcde	36.0e	4.0abc	17.0a
TGx1895 -33F	21.3bcde	50.1abc	4.0abc	10.7cd
TGx 1019 – 2EB	14.0def	49.6abcd	0.7e	11.3bcd
TGx 1485 – 1D	16.7cdef	47.0abcde	3.3bcd	11.3bcd
TGx 1882 – 2F	28.0ab	46.8abcde	5.0ab	11.7bcd
TGx 1880 – 3E	33.0a	39.7cde	4.0abc	11.7bcd
TGx 1873 – 16E	18.0cdef	46.3abcde	3.3bcd	13.0bc
TGx 1842 – 1E	16.7cdef	44.3bcde	3.0cd	11.3bcd
TGx 1888 – 15F	23.0bcd	35.2e	3.3bcd	18.7a
TGx 1866 -7F	13.3ef	48.2abcd	2.7cd	10.3cd
TGx 1869 – 13E	11.3f	38.0de	2.3cde	9.7d
TGx 1848 – 10E	14.3def	57.2a	2.0de	14.0b
TGx 1896 – 3F	21.7bcde	53.6ab	3.7abcd	17.3a
TGx 1448 – 2E	25.3abc	43.8bcde	5.3a	13.0bc

Values with different letters along column are significantly different using DMRT at 5 % probability level.

1448-2E produces the highest number of 57.7 while 30.0 which was the least obtained from TGx 1845-1D, the value for the number of shattered pods per plant at maturity varied from (1.4) in TGx 1740-2F to (0.3) IN TGx 1896-13E. The highest weight of pod per plant was recorded for TGx 1448-2E (18.0g) and the least (9.0 g) for TGx 1019-2EB. The shattering percentage was below 5 %, variety TGx 1485-1D had the highest of 4.9 % while the least of 0.7% was for TGx 1869-13E. TGx 1448-2E produced the highest seed yield of 11.7g/pot while TGx 1019-2EB with the least seed yields of 5.4 g/pot while in the field the highest seed yield of 4.3g/plant and 4.2g/plant are obtained from varieties TGx1895-33F and TGx1866-7F respectively.

Field experiment

Table (4) showed the effects of variety on pod and seed parameters in the field experiment. The number of shattered pod and seed weight per plant were significantly affected by varieties of soybean . The number of pod per plant was highest in varieties TGx 1871-12E and TGx 1873-16E and least with TGx 1896-3F and TGx 1740-2F. the least value was recorded for TGx 1485-1D.

Husk weight per plant was highest for TGx 1848-10E which

Table 3. Pod characteristics of soybean as affected by different varieties in the pot experiment

Variety	Pod length (cm)	Pod diameter (cm)	No. of pods/plant	No. of shattered pod /plant	% pod shattering	Pod weight/ plant	Seed yield (t/ha)
TGx 1740-2F	3.2de	4.1fg	38.7f	1.4a	3.6b	12.7e	8.1cd
TGx 1871 – 12E	3.7a	4.1fg	34.0g	0.9de	2.6d	14.0cd	8.1cd
TGx1895 -33F	3.1ef	5.0cd	37.7f	0.3g	0.8hi	12.7e	6.9e
TGx 1019 – 2EB	2.9gh	4.7c	28.3gh	0.3g	0.9hi	9.0f	5.4f
TGx 1485 – 1D	3.5bc	4.6cd	30.0i	1.4ab	4.9a	12.7e	7.8de
TGx 1882 – 2F	3.2def	5.0b	37.3hi	1.1bcd	3.7b	12.7e	8.7cd
TGx 1880 – 3E	2.8h	5.6a	42.0f	0.6efg	1.6fg	12.7e	8.7cd
TGx 1873 – 16E	2.9gh	4.6cd	42.0e	0.7ef	1.7ef	14.3c	9.0bc
TGx 1842 – 1E	3.3cd	4.2ef	42.7de	1.3abc	3.0c	13.7cd	9.0bc
TGx 1888 – 15F	2.4j	5.6a	47.0c	1.5a	3.2c	14.3c	9.9b
TGx 1866 -7F	3.6ab	4.4de	47.7e	0.7ef	1.7f	15.7b	9.9b
TGx 1869 – 13E	3.1def	3.9g	45.0cd	0.3g	0.7i	13.3de	9.9b
TGx 1848 – 10E	3.0fg	5.1b	50.0b	0.5fg	1.0h	15.7b	9.0bc
TGx 1896 – 3F	2.7i	4.7c	36.7f	0.5fg	1.4g	14.0cd	9.0bc
TGx 1448 – 2E	3.2def	5.6a	57.7a	1.1cd	1.9e	18.0a	11.7a

Values with different letters along column are significantly different using DMRT at 5 % probability level.

Table 4. Pod characteristics of soybean as affected by different varieties in the field experiment

Variety	No. of pods / plant	No. of seeds / plant	Seed weight /plant	No. of shattered pod /plant	% pod shattering	Husk weight /plant	Seed yield (t/ha)
TGx 1740-2F	23.7d	43.7bc	7.0a	2.0a	8.4a	3.1c	2.3f
TGx 1871 – 12E	67.0a	105.7a	12.0a	1.3a	1.9hi	6.1ab	4.0ab
TGx1895 -33F	44.3abcd	100.0a	12.5a	1.3a	2.9e	5.0b	4.2a
TGx 1019 – 2EB	55.0abc	96.7a	10.1a	1.7a	3.1e	5.2b	3.4cd
TGx 1485 – 1D	25.0d	34.3c	6.2a	2.0a	8.6a	2.2d	2.1f
TGx 1882 – 2F	28.0d	62.0abc	10.2a	1.7a	6.1b	5.4b	3.4cd
TGx 1880 – 3E	47.7abcd	94.0a	10.2a	1.0a	2.1gh	4.0bc	3.4cd
TGx 1873 – 16E	68.0a	105.8a	11.8a	1.3a	1.9hi	6.0b	3.9abc
TGx 1842 – 1E	38.3bcd	65.7abc	7.7a	0.3a	0.8j	3.2c	2.6ef
TGx 1888 – 15F	36.3cd	82.7ab	8.8a	2.0a	5.5c	3.7c	2.9de
TGx 1866 -7F	48.3abcd	97.3a	12.9a	1.3a	2.7ef	5.5b	4.3a
TGx 1869 – 13E	41.0bcd	88.3ab	9.8a	2.0a	4.9d	4.7bc	3.3cd
TGx 1848 – 10E	63.3ab	96.3a	9.3a	1.0a	1.6i	7.1a	2.4ef
TGx 1896 – 3F	28.7d	60.0abc	7.2a	0.7a	2.4fg	3.6c	2.4ef
TGx 1448 – 2E	47.0abcd	78.0abc	10.6a	0.7a	1.5i	4.3bc	3.5bcd

Values with different letters along column are significantly different using DMRT at 5 % probability level

had a value of (7.1 g) while (2.2 g) was for TGx 1485-1D as the least value. Percentage pod shattering was significantly affected by soybean variety. TGx 1740-2F had the highest pod shattering of 8.4 % while TGx 1448-2E had the least of 1.5 %. Seed yield also was highest in TGx 1895-33F (4.2 t/ha) followed by TGx 1871-12E (4.0 t/ha) and least with TGx1485-1D (2.1 t/ha).

Table 5 showed the effect of different agronomic parameters on pod shattering. Pod shattering was found to be negatively correlated with pod diameter while the plant height also had negative correlation to pod shattering. Number of seeds per plant was found to be significantly correlated to pod shattering. The number of pod per plant, pod length, pod weight, seed weight, and husk weight per plant had no significant effect on number of shattered pods per plant.

DISCUSSION AND CONCLUSION

There were varietal differences in term of pod shattering generally and breeders therefore can explore these varieties to improve soybean for shattering. seed characters have negative effect on pod shattering which means that these characters could be used as an indicator for pod shattering selection.

Table 5. Correlation between different agronomic characters on pod shattering in soybean

Characters	No of pods/plant	Plant height	Length of pods	Pod diameter	No. of shattered pod / plant	No. of seeds / plant	Pod weight /plant	Seed weight /plant	Husk weight /plant
Plant height	-0.006ns								
No. of pods / plant		-0.01ns							
Length of pods	-0.21ns	-0.05ns							
Pod diameter	-0.46**	-0.15ns	-0.05ns						
No. of shattered pod /plant	-0.05ns	-0.01ns	0.09ns	-0.60**					
No. of seeds / plant	-0.23ns	0.17ns	-0.09ns	0.41**	0.11ns				
Pod weight /plant	0.09ns	0.44**	0.12ns	0.11ns	0.17ns	0.67**			
Seed weight /plant	0.10ns	0.43**	0.03ns	0.04ns	0.12ns	0.66**	0.85**		
Husk weight /plant	0.19ns	0.29*	0.05ns	-0.07ns	0.26ns	0.54**	0.72**	0.63**	

Diameter of pod has high significant negative correlation with pod shattering which implied that the bigger the pod the lower the pod shattering in soybean. This is a good indicator for pod shattering in breeding programmes.

The methods used for assessing shattering in this study could be improved upon. Further studies on shattering in soybean should attempt an improvement in the method of assessing shattering, taking into consideration factor such as the moisture retention capacity of dry pods and absolute humidity. (Not relative humidity). The varieties indicated here are TGx1740-2F, TGx1448-2E and TGx1842-1E.

Pod shattering in soybean is a field problem which could lead to serious yield losses if care is not taken. Pod shattering behavior of soybean variety is found to be associated with other agronomic characteristics. Among the varieties tested, it was observed that a lot of variability existed in terms of vegetative growth, seed yield and shattering ability. This revealed the existence of genotypic differences among the varieties tested. This is in line with the observation of Tiwari and Bhatnagar (1991), and Salih and Khidir (1975). They reported that pod shattering in soybean could be linked to both genetic and environmental influences. Pod and seed traits were also found to vary among the soybean varieties tested. e.g. pod length and diameter as well as number of pod per plant were significantly influence by varieties. This observation supported earlier findings of high heritability for pod shattering in soybean (Etebom, 1987).

Knowledge of correlation existing between characters is of great use in breeding programmes, where the breeder can easily identify those characters that he may use as selection indices. The observation that shattering had no significance correlation with number of pods per plant, number of seeds per plant, length of pod and seed weight is in agreement with the finding of Ghobnal and Denis (1979) and Etebom (1987), which suggested that these parameters will not be useful as an index for pod shattering selection.

The finding that association between shattering and pod diameter is negative and highly significant suggested that the thicker the pod of the soybean plant, the lesser the shattering. Therefore variety with bigger pod diameter is a reliable index for use in selecting for shattering resistance and a good indicator for pod shattering in breeding programmes.

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