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YIELD AND POD SHATTERING BEHAVIOUR OF SOME SOYBEAN GENOTYPES ACROSS LOCATIONS IN NIGERIA

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ABSTRACT

Soybean producers in Nigeria are always interested in soybean varieties that can yield high with minimal seed loss through pod shattering. In view of the above, this study was conducted to evaluate the seed yield and pod shattering resistance of twenty-six (26) soybean genotypes. This was conducted in three locations across Nigeria during 2020 cropping seasons. In each location, the experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. After harvest, pod shattering evaluation was done using the sun-dry method. Data on seed yield and pod shattering were collected and analyzed using Analysis of Variance (ANOVA). Five genotypes (NCRI SOYAC78, NCRI SOYAC17, NCRI SOYAC69, NCRI SOYAC76, and NCRI SOYAC61) were outstanding in yield across the three locations, while Chinka having an average yield of 1.41 ton/ha, was the best among the locations. Out of outstanding genotypes, only NCRI SOYAC61 was not resistant to pod shattering. Therefore, farmers or researchers interested in a soybean genotype that can yield high and resist pod shattering could consider the other four genotypes.

KEY WORDS: Genotype, Location; Shattering; Soybean; Yield

INTRODUCTION

Soybean (*Glycine max* (L) Merril) is a grain 1egume that grows in tropica1 and sub tropica1, as well as temperate climatic conditions. It has the genetic potential to yield up to 4 ton ha^{-1}, if improved varieties are used (Hailu and Kelemu, 2014). However, according to United States Department of Agriculture (USDA, 2021), soybean production in Nigeria in 2019/2020 farming season was on an average of 0.88 ton/ha, in farmers' field. This achievement is not satisfactory considering soybean genetic potential. In Nigeria, Soybean is largely produced in the middle belt. However, its production in recent years has extended beyond these traditional areas to cover other Northern and Southern regions of the country (Ikeogu and Nwofia, 2013). The cultivation of this crop in Nigeria has been faced with some challenges including pod shattering and poor yield.

Pod shattering, which is the opening of mature pods along the dorsal or ventral sutures of the soybean pod and subsequent seed dispersal as the crop reaches maturity may result to a yield loss, which may be up to 100 %. It could be caused by the time of harvesting after maturity, environmental conditions, chemical composition of the pod wall; anatomical structure of the pod, and genetic factor of the variety (Krisnawati and Adie, 2017). In the major soybean

production areas of Nigeria, the crop due to the time of planting, reaches maturity at the end of October or early November. Coincidentally, this is the period of rainfall cessation and the beginning of dry harmattan wind, with low relative humidity and rising temperatures, creating a suitable condition for pod shattering. Krisnawati and Adie (2017) ranked soybean genotypes with no pod shattering as very resistant; less than 25 % pod shattering as resistant, 25-50 % as moderately resistant; 21-75 % as highly susceptible; and greater than 75 % as very highly susceptible. The objective of this study is to identify and select some soybean genotypes with high yield and pod shattering resistance across locations in Nigeria.

MATERIALS AND METHODS

The study was conducted using 26 soybean genotypes (Table 1), in three locations in Nigeria during 2020 cropping season. The first location was in Minna, Niger State (Latitude 9.6737^{o}N, Longitude 6.5109^{o}E); the second was in Chinka, Kaduna State (Latitude 9.0535^{o}N, Longitude 7.3026^{o}E); while the third location was in Awka, Anambra State (Latitude 6.3437^{o}N, Longitude 7.0938^{o}E). The GPS coordinates were taken at the middle of each experimental site.

The field experiment was laid out in Randomized Complete Block Design (RCBD) with three (3) replications in each of the environments. The gross plot size was 6 m^2. The net plot size was 3 m^2. Gross plots within a replication were separated by a distance of 0.5 m, while an alley of 1 m separated one replication from the other. The total experimental area was 715 m^2. Two (2) soybean seeds were sown per hill. The planting distance used was 75cm × 20cm between and within rows, respectively. Single super phosphate (SSP) was applied at the rate of 40kg/ha at 2 weeks after planting. Manual weeding was done at 2 and 6 weeks after planting. Data were collected on seed yield and pod shattering percentage.

Pod shattering identification was done using sun-dry method (Krisnawati and Adie, 2016). Twenty pods were placed inside brown envelops and sun-dried for seven days. On the 7th day the number of shattered pods were counted and expressed in percentage. Data collected were subjected to Analysis of Variance (ANOVA) using General Linear Model (GLM) procedure of SAS. Levels of significance were determined at 5%. Means were separated using Duncan Multiple Range Test at $P<0.05$.

RESULTS

Weather

The peak of rainfall in each location was within the period of field experiment. The rainfall pattern was more fairly distributed in Minna and Chinka than in Awka. The highest annual rainfall was recorded in Awka (2777 mm), followed by Minna (1763.57 mm); while the lowest annual rainfall was recorded in Chinka (1031.4 mm). The maximum monthly temperature during the field experiment ranged from 28.9-35.7 ^{o}C in Minna; 28.7-35.3 ^{o}C in Chinka; and 29.8-34.6 ^{o}C in Awka. Interestingly, temperature was rising as the crop approached maturity and the hottest temperature in each environment during the field experiment was recorded in November, which was the month of harvest and pod shattering identification. The relative humidity ranged from 43-86 % in Minna; 43-85 % in Chinka; and 69-84 % in Awka. The relative humidity across the environments was fairly uniform, but there was an apparent decline as the crop was approaching harvest (October-November).

Yield

In Minna, NCRI SOYAC78 had the highest yield (1.53 tons/ha), which differed significantly from only NCRI SOYAC73, NCRI SOYAC26, NCRI SOYAC25, NCRI SOYAC28, NCRI SOYAC64, NCRI SOYAC9, NCRI SOYAC68, and NCRI SOYAC67. NCRI SOYAC25 on the other hand, was the lowest in yield (0.67 ton/ha). However, it differed significantly from only four genotypes namely; NCRI SOYAC78, NCRI SOYAC18, NCRI SOYAC17, and NCRI SOYAC29. In Chinka, NCRI SOYAC9 had the highest average seed yield (1.97 tons/ha), which differed significantly from only NCRI SOYAC18, NCRI SOYAC77, NCRI SOYAC73, NCRI SOYAC29, NCRI SOYAC64, NCRI SOYAC3, NCRI SOYAC7, NCRI SOYAC68, NCRI SOYAC20, NCRI SOYAC10, and NCRI SOYAC22. Conversely, NCRI SOYAC18 was the least in average seed yield (0.9 ton/ha) and it differed significantly from NCRI SOYAC17, NCRI SOYAC69, NCRI SOYAC26, NCRI SOYAC25, NCRI SOYAC65, NCRI SOYAC24, NCRI SOYAC9, NCRI SOYAC62, NCRI SOYAC75, and NCRI SOYAC76. The mean seed yields of NCRI SOYAC61 (1.4 tons/ha) and NCRI SOYAC25 (1.37 ton/ha) in Awka were the highest in this location, and they differed significantly from only NCRI SOYAC26, NCRI SOYAC29, NCRI SOYAC65, NCRI SOYAC24, NCRI SOYAC62, NCRI SOYAC63, NCRI SOYAC75, NCRI SOYAC10 and NCRI SOYAC67. The poorest in yield among the genotypes was NCRI SOYAC63 (0.7 ton/ha). However, it differed significantly from only five genotypes namely; NCRI SOYAC78, NCRI SOYAC18, NCRI SOYAC25, NCRI SOYAC9, and NCRI SOYAC61. Five genotypes (NCRI SOYAC78, NCRI SOYAC17, NCRI SOYAC69, NCRI SOYAC76, and NCRI SOYAC61) were outstanding in

yield across the three locations, while the genotypes performed better in Chinka than in other locations (Table 1).

Pod Shattering

In all the locations, the highest pod shattering percentage was recorded in NCRI SOYAC63 (98.33 % in Minna, 80 % in Chinka and 90 % in Awka), and was significantly different from other genotypes. For low shattering genotypes in different locations, genotypes NCRI SOYAC78 and NCRI SOYAC7 that had the lowest pod shattering percentage in Minna (5 %), NCRI SOYAC28 that had the lowest pod shattering percentage (3.33 %) in Chinka, while NCRI SOYAC22 that had the lowest in Awka (1.67 %). Based on mean pod shattering percentage across the three locations and using the ranking of Krisnawati and Adie (2017), none of the genotypes was very resistant to pod shattering, twenty-one were resistant; four were moderately resistant, while only one was very highly susceptible.

Table 1 Mean yield (ton/ha) and pod shattering (%) of the genotypes across the three locations

	Yield (ton/ha)				Pod shattering (%)			
Genotype	Minna	Chinka	Awka	Mean	Minna	Chinka	Awka	Mean
NCRI SOYAC78	1.53a	1.47abcdef	1.33ab	1.44	5.00g	6.67fg	21.67bcde	11.11
NCRI SOYAC18	1.37abcd	0.90f	1.17abc	1.15	31.67b	48.33b	36.67bc	38.89
NCRI SOYAC17	1.47ab	1.67abc	1.07abcd	1.40	6.67fg	6.67fg	18.33bcde	10.56
NCRI SOYAC69	1.20abcde	1.70abc	1.13abcd	1.34	13.33defg	31.67bcd	25.00bcd	23.33
NCRI SOYAC77	1.23abcde	1.33bcdef	0.97abcd	1.18	10.00defg	8.33efg	3.33e	7.22
NCRI SOYAC73	0.73de	1.20cdef	1.03abcd	0.99	6.67fg	6.67fg	16.67cde	10.00
NCRI SOYAC26	0.83bcde	1.83ab	0.87cd	1.18	25.00bcd	6.67fg	18.33bcde	16.67
NCRI SOYAC29	1.40abc	0.97ef	0.87cd	1.08	8.33efg	13.33defg	10.00de	10.55
NCRI SOYAC25	0.67e	1.53abcde	1.37a	1.19	21.67bcdef	11.67defg	18.33bcde	17.22
NCRI SOYAC28	0.80cde	1.40abcdef	0.90bcd	1.03	11.67defg	3.33g	25.00bcd	13.33
NCRI SOYAC64	0.87cde	1.03def	1.03abcd	0.98	30.00bc	20.00cdefg	25.00bcd	25.00
NCRI SOYAC65	1.00abcde	1.57abcd	0.80cd	1.12	20.00bcdefg	30.00bcd	38.33b	29.44
NCRI SOYAC24	1.00abcde	1.87ab	0.83cd	1.23	11.67defg	16.67cdefg	26.67bcd	18.34
NCRI SOYAC3	1.10abcde	0.97ef	1.00abcd	1.02	18.33bcdefg	35.00bc	11.67de	21.67
NCRI SOYAC9	0.77cde	1.97a	1.20abc	1.31	11.67defg	18.33cdefg	21.67bcde	17.22
NCRI SOYAC7	0.97abcde	1.17cdef	1.00abcd	1.05	5.00g	18.33cdefg	8.33de	10.55
NCRI SOYAC68	0.87bcde	1.20cdef	1.13abcd	1.07	10.00defg	11.67defg	28.33bcd	16.67
NCRI SOYAC20	1.20abcde	1.30bcdef	1.13abcd	1.21	10.00defg	13.33defg	20.00bcde	14.44
NCRI SOYAC62	0.93abcde	1.57abcd	0.87cd	1.12	23.33bcde	15.00cdefg	25.00bcd	21.11
NCRI SOYAC63	1.27abcde	1.47abcdef	0.70d	1.15	98.33a	80.00a	90.00a	89.44
NCRI SOYAC75	1.10abcde	1.63abc	0.77cd	1.17	13.33defg	26.67cdef	25.00bcd	21.67
NCRI SOYAC10	0.93abcde	1.20cdef	0.90bcd	1.01	18.33bcdefg	8.33efg	25.00bcd	17.22
NCRI SOYAC67	0.83bcde	1.40abcdef	0.90bcd	1.04	16.67bcdefg	28.33bcde	26.67bcd	23.89
NCRI SOYAC76	1.00abcde	1.60abcd	1.13abcd	1.24	11.67defg	6.67fg	10.00de	9.45
NCRI SOYAC61	1.03abcde	1.47abcdef	1.40a	1.30	31.67b	21.67cdefg	26.67bcd	26.67
NCRI SOYAC22	0.97abcde	1.33bcdef	1.13abcd	1.14	15.00cdefg	50.00g	1.67e	7.22
Mean	1.04	1.41	1.02	1.16	18.65	19.17	23.21	20.34
±SE	0.23	0.21	0.15		5.57	7.06	7.16	
CV	38.47	25.25	26.02		51.68	63.84	53.45	

Means followed by the same letter(s) within a column are not significantly different at P≤0.05 using DMRT; ±SE = Standard error of the mean; CV = Coefficient of Variation.

DISCUSSION

The mean yield of all the genotypes across the three locations, which was best in Chinka, could be a reflection of adequate rainfall pattern in this location. Similarly, the high annual rainfall observed in Awka, which was higher than the recommended range of 700-1200 mm (Mondine *et al.*, 2001) could be responsible for the comparatively poor yield obtained in the location. The similar behaviours of the genotypes in pod shattering across locations, which was evident in NCRI SOYAC63 (highest across the locations) shows location had little or no influence on the pod shattering pattern of genotypes. This could be as a result of similar temperature and relative humidity levels observed across the locations since pod shattering behaviour of a soybean genotype is greatly influenced by these two climatic parameters (Zhang *et al*., 2018). This means that irrespective of location; some soybean genotypes can still exhibit the same level of resistance or susceptibility to pod shattering. This is in agreement with the findings of Bhor *et al*. (2014), which stated that the genotypic characteristics of any genotype play a key role in the overall expression of pod shattering of that genotype irrespective of climatic factors.

CONCLUSION AND RECOMMENDATION

The genotypes differed in their yield and pod shattering across the three locations. Five genotypes (NCRI SOYAC78, NCRI SOYAC17, NCRI SOYAC69, NCRI SOYAC76, and NCRI SOYAC61) were outstanding in yield across the three locations, while Chinka was the best location in terms of yield. Out of these five outstanding genotypes, only NCRI SOYAC61 was not resistant to pod shattering. Therefore, farmers or researchers could select the other four for optimum productivity.

REFERENCES

Bhor, T. J., Chimote, V. P., & Deshmukh, M. P. (2014). Inheritance of pod shattering in soybean [*Glycine max* (L.) Merril]. *Electronic Journal of Plant Breeding,* 5(4) 671-676.

Hailu, M. & Kelemu, K. (2014). Trends in soybean trade in Ethiopia. *Research Journal of Agriculture and Environmental Management*, 3(9), 477-484.

Ikeogu, U. N. & Nwofia, G. E. (2013). Yield parameters and stability of soybean [*Glycine max.* (L.) merril] as influenced by phosphorus fertilizer rates in two ultisols. *Journal of Plant Breeding and Crop Science*, 5(4), 54-63.

Krisnawati, A. & Adie, M. M. (2016). Pod shattering resistance in different soybean genotypes. *Proceedings of ILETRI National Seminar*. ILETRI, IAARD, Malang, 193-200.

Krisnawati, A. & Adie, M. M. (2017). Identification of soybean genotypes for pod shattering resistance associated with agronomical and morphological characters.*Journal of Biology and Biology Education,* 9(2), 193-200.

Mondine, M. L., Vieira, C. P. & Cambraia, L. A. (2001). Seeding time: an important

factor affecting the productivity of soybean. *Dourados: Embrapa Agropecuária Oeste*,16, (Embrapa Agropecuária Oeste. Documentos, 34).
USDA (2021). World Agricultural Production. *Circular Series WAP* 7-21. July, 2021.
Zhang, Q., Tu, B., Liu, C. & Liu, X. (2018). Pod anatomy, morphology and dehiscing forces in pod dehiscence of soybean (*Glycine max* (L.) Merrill). *Flora* 248 (2018): 48-53.