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**Girase VS**  
 Botany Section, College of  
 Agriculture, Dhule,  
 Maharashtra, India

**Khedkar DJ**  
 Botany Section, College of  
 Agriculture, Dhule,  
 Maharashtra, India

**Rajmane VB**  
 Botany Section, College of  
 Agriculture, Dhule,  
 Maharashtra, India

**Deokar SD**  
 Botany Section, College of  
 Agriculture, Dhule,  
 Maharashtra, India

**Correspondence**  
**Girase VS**  
 Botany Section, College of  
 Agriculture, Dhule,  
 Maharashtra, India

## Evaluation of soybean germplasm for shattering resistance

**Girase VS, Khedkar DJ, Rajmane VB and Deokar SD**

### Abstract

The seed shattering behaviour analysed in 40 genotypes of soybean by the natural field and hot air oven method. In the natural field method seed shattering behaviour analysed after the harvesting, five plants from each genotypes kept as it is in field condition. In hot air oven method twenty pod collected from each genotypes after harvesting and were kept in brown paper bag. These bags are placed in hot air oven at 44 °C for 6 hrs daily and further procedure carried out for 7 days regularly and pod breakage behavior was recorded. The genotypes EC-251350 was the most resistant and LC-12, LC-11 and LC-13 were the tolerant among the forty genotypes, shown by both seed shattering by field and seed shattering by HAO method.

**Keywords:** Genetic diversity, seed shattering, pod breakage, soybean

### Introduction

Soybean (*Glycine max* (L.)Merrill) is an important oilseed crop belonging to family *leguminosae /fabaceae*, sub-family *papilionaceae* and tribe *phaseoleae*. It contains about 40 per cent protein and 20 per cent oil and plays a major role in world food system. It has served as staple diet from thousand of years and known as “meat of the fields”. Soybean is one of important crop of the world cultivated in USA, China, Brazil, Mexico, Russian federation and India.

Soybean has emerged as one of the major oilseed crop in India with the coverage of above 110.656 lakh hectare with estimated production of over 86.426 lakh metric tons having average yield 788 kg per hectare <sup>[1]</sup>. Soybean has revolutionized the rural economy of the country and also lifted socio-economic status of the farmers. There is immediate need to utilize the cheapest source of protein domestically, so that the problem of malnutrition can be managed to some extent and also harness other health benefits of soybean.

Seed shattering refers to the opening of mature pods along the dorsal or ventral sutures and dispersal of seed as the crop reaches maturity as well as during the harvesting. The extent of seed loss due to pod shattering in soybean may range from 34 to 99 per cent depending upon delayed harvesting after maturity, the environmental condition during harvesting and genotype <sup>[2]</sup>. Fully mature pods are extremely sensitive to opening, resulting in seed loss. This can take place in susceptible varieties prior to harvest due to disturbance of the canopy by the wind or during the harvesting as the harvesting equipment move through the crop during dry weather conditions leading seed losses of 50-100%. Through this trait is important for the adaptation of the wild species to the natural environment as a mechanism for seed dispersal, it leads to a significant yield loss in soybean production, if found in cultivated forms. This loss of seed not only has a drastic effect on yield but also result in the emergence of the crop as a weed in a subsequent growing season.

### Materials and Methods

A piece of land selected for experiment was brought to a fine tilth by ploughing followed by harrowing. The 40 genotypes of soybean was evaluated in a Randomised Block Design (RBD) with two replications during *kharif* 2015. Sowing of experiment was done on 16<sup>th</sup> June, 2015 at a distance of 45 X 10 cm. Seed shattering refers to the opening of mature pods along the dorsal or ventral sutures and dispersal of seed as the crop reaches maturity as well as during harvesting.

In present investigation seed shattering behaviour studied by two method, viz; 1. Seed shattering by natural field method and 2. Seed shattering by Hot Air Oven [HAO] method

### Seed shattering by natural field method

Seed shattering initiation and progress thereof was studied by delay in harvesting after maturity. The environmental conditions prevails during harvesting, the fully matured pods are extremely sensitive to opening, resulting in seed loss [2].

In the present investigation, after harvesting, five plants of each genotype of all forty were kept as such in field to assess the seed shattering behaviour of soybean. The observation showed that after harvesting, some genotypes initiated the seed shattering within 4 to 5 days and few remained unshattered in the field up to 20 days.

### Seed shattering by HAO method

Seed shattering screening was done as per oven dry method reported by [2] with little modification. In this method, 20 pods were selected from each genotypes after harvest and these 20 pods from each genotype was kept in brown paper bag. These bags were kept in Hot Air Oven at 44 °C (6 hrs in a day) for continuous 7 days and per cent pod breakage was estimated.

## Results and Discussion

### 1. Seed shattering by natural field method

The knowledge of shattering behaviours of germplasm available in soybean crop is essential for selection of parent for development of resistant or tolerant genotype for seed shattering. The published literature on seed shattering revealed that the resistant or tolerant genotype for seed shattering showed a tendency to have a longer stem with more nodes on main stem, lower pod setting height and smaller seed size. The pod diameter and thickness of pod showed significant and negative correlation with seed shattering [3].

The genotypes EC-251352 (25 days), LC-12 (24 days), LC-13 (20 days) and EC-251456 (15 days) required more than 15 days for initiation of seed shattering and hence they are treated as resistance and tolerance genotypes [Table 1]. These genotypes also bears the either of the characters like pod hairiness, longer stem, lower pod setting height, big and thick pod, which are responsible for imparting seed shattering resistance in soybean. The genotypes JS-79-837 (4 days) followed by KDS-954 (5days), LC-14 (5 days), KDS-837 (5 days) and JS-335 (6 days) required less than six days for initiation of seed shattering hence they are early shatterer or susceptible to seed shattering [4] also observed resistant intermediate and susceptible genotype for seed shattering in their investigation.

### 2. Seed shattering by HAO method

The observation showed that the average percentage of breakage of pod in hot air oven at 7 days was 80.87%. The genotypes showed seed shattering percentage ranging from 10 to 100%. The genotype EC-251352 had 10% pod breakage hence it was treated as resistant [Table 2]. The genotypes, LC-12, LC-11 and LC-13 showed 30, 35.5, and 37.5%, respectively pod breakage. They are late shatterer and hence they were treated as tolerance or intermediate. Out of forty genotypes, 27 were early shatterer, showing 71 to 100% pod breakage, hence they were susceptible or early shatterer. The resistant and tolerant genotypes funneled by, both the methods may be utilized in breeding programme for development of resistant or tolerant recombinants for seed shattering. Similar observations also made by [4] in their investigation. Percentage of shattering was recorded when more than 70% pods of susceptible genotypes were shattered and scored. Based on the scale by [5, 6] 1-3 was developed and phenotype classes were assigned.

**Table 1:** Days required for initiation of seed shattering in field under natural condition.

S. No	Number of days for initiation of seed shattering	Genotypes
1.	0-5 days	JS-79-214 (4), KDS-954 (5), LC-14 (5), KDS-837 (5),
2.	6-10 days	KDS-103 (6), JS-335 (6), EC-274755 (6), EC-34157 (6), EC-481518 (6), EC-329156 (7), EC-396067 (7), KDS-797 (7), EC-13054 (7), KDS-726 (8), KDS-798 (8), KDS-804 (8) KDS-344 (8), EC-456447 (8), EC-251470 (8), KDS-753 (9), KDS-755 (10), EC-481615 (10), EC-250583 (10).
3.	11-15 days	JS-9305 (11), KDS-730 (13), KDS-786 (13), KDS-975 (13), LC-11 (13), KDS-975 (13), EC-251456 (15), LC-15 (15).
4.	16-25 days	EC-60889-6 (16), KDS-754 (16), KDS-869 (16), KDS-889 (16), DS-228 (16), KDS-792 (19), LC-13 (20), LC-12 (24.00), EC-251352 (25)

**Table 2:** Scale to measure seed shattering in hot air oven method was given by Bailey *et al.* (1997) and Mohammed (2010) as below.

S. No	Criteria for seed shattering	Genotypes and percentage of pod breakage in parenthesis
1.	Resistant (0-10%)	EC-251352 (10.00)
2.	Intermediate/ Tolerance (11-70%)	LC-12 (30.00) LC-11 (35.00), LC-13 (37.50) DS-228 (40.00), KDS-869 (42.50), EC-608896 (42.50), EC-251456 (50.00), KDS-792 (50.00), KDS-786 (52.50), KDS-889 (57.50), EC-396067 (62.50) and EC-481615 (67.50).
3.	Susceptible (71-100%)	EC-251295 (72.50), JS-79-214 (92.50), EC-250583 (95.00), KDS-975 (95.00), KDS-753 (97.50), JS-9305 (97.50), KDS-754 (100), KDS-755 (100), KDS-804 (100), KDS-344 (100), JS-335 (100), EC-329156 (100), EC-251470 (100), EC-481518 (100), EC-456447 (100), LC-14 (100) KDS-798 (100), KDS-837 (100), KDS-954 (100), KDS-103 (100), EC-274755 (100), EC-34117 (100), EC-13054 (100), KDS-726 (100), KDS-730 (100), KDS-797 (100) and LC-15 (100).

**Table 3:** Number of days required for seed shattering [Pod Breakage]by natural field method in soybean

S. No	genotypes	date of Harvest	Initiation	25% pod breakage	50% pod breakage	75% pod breakage	100% pod breakage
1.	KDS-726	28-9-15	08	10	11	12	15
2.	KDS-730	25-9-15	13	18	21	24	27
3.	KDS-753	29-9-15	09	15	19	24	25
4.	KDS-754	23-9-15	16	25	29	33	35
5.	KDS-755	27-9-15	10	17	25	27	31
6.	KDS-786	1-10-15	13	20	24	26	29
7.	KDS-792	27-9-15	19	26	32	34	36
8.	KDS-797	29-9-15	07	08	13	25	28
9.	KDS-798	3-10-15	08	11	15	19	23
10.	KDS-804	1-10-15	08	15	20	25	28
11.	KDS-837	29-9-15	05	07	08	11	13
12.	KDS-869	28-9-15	16	23	30	34	40
13.	KDS-889	28-9-15	16	25	31	36	41
14.	KDS-954	1-10-15	05	07	09	12	16
15.	KDS-975	27-9-15	13	19	24	29	32
16.	KDS-344	30-9-15	08	15	18	21	25
17.	KDS-103	12-10-15	06	09	12	14	16
18.	DS-228	15-10-15	16	19	27	31	33
19.	JS-9305	25-9-15	11	14	18	23	28
20.	JS-335	8-10-15	06	10	15	18	21
21.	EC-274755	3-10-15	06	06	11	16	19
22.	EC-329156	3-10-15	07	11	16	20	24
23.	EC-251456	13-10-15	15	21	25	33	38
24.	EC-396067	3-10-15	07	10	15	21	23
25.	EC-251295	3-10-15	04	08	21	26	30
26.	EC-34157	2-10-15	06	09	11	15	17
27.	EC-251470	30-9-15	08	13	18	21	24
28.	EC-481518	1-10-15	06	11	13	17	21
29.	EC-481615	27-9-15	10	12	18	20	22
30.	EC-13054	28-9-15	07	14	16	20	23
31.	EC-60889-6	28-9-15	16	19	23	27	31
32.	EC-250583	30-9-15	10	15	24	27	29
33.	EC-456447	30-9-15	08	10	14	18	21
34.	EC-251352	10-10-15	25	33	38	40	45
35.	JS-79-214	10-10-15	04	10	14	17	19
36.	LC-11	15-10-15	13	20	23	27	30
37.	LC-12	15-10-15	24	29	31	33	35
38.	LC-13	8-10-15	20	24	29	33	37
39.	LC-14	1-10-15	05	11	14	18	22
40.	LC-15	17-10-15	15	17	22	25	27

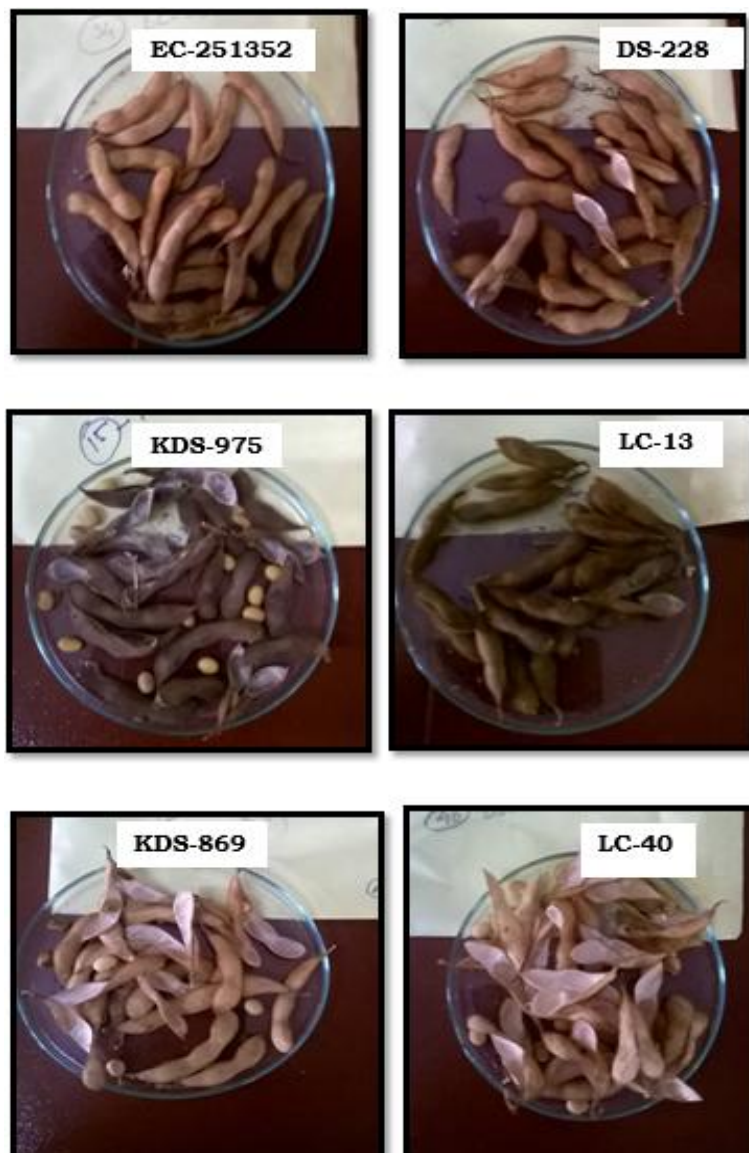


Above genotypes were susceptible to seed shattering under natural field conditions



Above genotypes were shows tolerance to seed shattering under natural field condition after harvesting.

**Plate 1:** Seed shattering by natural field method



Seed shattering behaviour analyse by Hot Air Oven method.

The EC-251352 shows most resistance genotypes to seed shattering in HAO method and LC-13, DS-228 were moderately resistance. Genotypes KDS-869, KDS-975 and LC-40 were susceptible genotypes.

**Plate 2:** Seed shattering by Hot Air Method





The genotypes shows the morpho-physiological characteristics like pod thickness, less number off seeds in pod, hairs on pods and pods setting near to ground level were avoid the seed shattering in soybean.



From investigation shows that less number of seed in pod and thicker pod were less shatterer.

**Plate 3:** Traits associated with shattering resistance

### Conclusion

The genotype EC-251352 was found to be resistant for seed shattering as it started for shattering after 24 days and showed 10% shattering on 7<sup>th</sup> day by HAO method. It had 100% seed shattering at 45 days after harvesting. The genotype LC-12 was remain unshattered for 23 days, after harvest maturity and showed 30% shattering on 7<sup>th</sup> day by HAO method, indicated tolerance to the seed shattering. It took 43 days for complete seed shattering by natural field method These genotypes may incorporated in breeding programme for development of shattering resistance or tolerance recombinants in soybean. The twelve genotype were grouped as a tolerant by HAO methods, which required more than 30 days for 100% shattering in natural field methods [Table 3]. The genotypes EC 251352, KDS-889, KDS-869, LC-12, LC-13 could be used as a donar parents in breeding programme for development of shattering resistance genotypes in soybean.

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