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Evaluation of Urd bean local germplasm for seed shattering resistance

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Abstract
Present investigation consisted of 50 local genotypes of Urd bean evaluated for seed shattering in RBD with two replications during kharif-2020 at Botany Section Farm, College of Agriculture, Dhule (MS). Seed shattering in pulse crops is one of the most important constrain to be overcome, it can also expect revolution in pluses to fight this problem. The present study discuss about "assessment of seed shattering characters" in 50 genotypes of Urd bean. In this investigation we observed seed shattering % age of fifty genotypes of Urd bean under hot air oven and categorized them into different criteria according to shattering % age. The average % age of pod breakage in hot air oven on 7 days was 44.35%. The shattering % age was ranged from 7.50(LCU-47) to 90.00% (LCU-41). Out of fifty genotypes, LCU-47 (7.5%), TPU-4 (25%), LCU-1 (27.50%), LCU-2 (27.50%) and TAU-1 (27.50%) were found lower to moderate for seed shattering. The genotypes LCU-41 (90.00%), LCU-35 (82.00%), LCU-11 (57.50%), LCU-15 (57.50%) and LCU-31 (57.50%) had higher pod breakage. (Table No.1) The resistant and tolerant genotypes found in present investigation may be utilized in breeding program for development of resistant or tolerant recombinants for seed shattering, which may permit time to the farmers for 1 or 2 weeks delayed harvesting during labour crises.

Keywords: Seed shattering, pod dehiscence, Urd bean

Introduction
Seed shattering or pod shed after maturity is a major problem in pulse production worldwide, and shattering can cause up to 50% yield loss if harvesting is delayed due to adverse conditions. Urd bean (*Vigna mungo* L. (Hepper)) is one of the important pulse crops grown throughout India. It is consumed in the form of 'dal' (whole or split, husked and un-husked) or perched. It is used as nutritive fodder especially for Milch animals. It is also green manuring crop. High values of lysine make Urd bean an excellent complement next to rice in terms of balanced human nutrition. It is one of the important pulse crops grown throughout the country during rainy season. It is a self-pollinated leguminous crop which contains 24% protein, 60% carbohydrate, 1.3% fat, 3.2% minerals, 0.9% fiber, 154 mg calcium, 385 mg phosphorus, 9.1 mg iron, arginine 520 mg, lysine 170 mg and small amount of Vitamin-B complex. It also contains 0.37 g riboflavin and 0.42 mg thiamin in per 100 g of Urd bean. Pulses are the main source of dietary protein, particularly for vegetarians, and contribute about 14% of the total protein of an average Indian diet. Among the pulses Urd bean is an important crop in India. It is a protein rich (24%) staple food containing almost three times that of cereals. It accounts for 10% of total pulse production in India. Among pulses, it contributes 16.28% of the total area and 11.48% of the total production with an average productivity of 451.6 kg ha^{-1}. India has become self-sufficient with respect to production of cereals but still lags behind with respect to the production of pulses, even though it is the largest producer of pulses in the world. Seed shattering refers to the splitting 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 may range from 34 to 99% depending upon delayed harvesting after maturity, environmental condition during harvesting and genotype. Fully mature pods are extremely sensitive to opening, resulting in seed loss. This mechanism of seed dispersal causes significant yield losses in Urd bean including all pulses.

Materials and Methods
A piece of land selected for experiment was brought to fine tilth by ploughing followed by Harrowing. The 50 genotypes of Urd bean were evaluated in a Randomized Block Design (RBD) with two replications during *kharif*-2020.

Sowing of experiment was done on 22nd-June-2020 at a distance of 30 X 10 cm. Analysis of variance for the individual characters was worked out as per Randomized Block Design to test the significances among the genotypes. The mean values of five randomly selected observational plants for 13 different characters were used for statistical analysis. Seed shattering was studied naturally in field condition. In the field method 5 plant kept after harvesting to evaluate shattering to natural environmental conditions also seed shattering incidence was studied by hot air oven method by taking 20 pods from each variety and were kept at 44 ºC for 6 hrs and further procedure carried out for 7 days regularly and shattering % age was estimated.

Result and Discussion

The present investigation undertaken with view to assess of shattering incidence in the fifty diverse genotypes of Urd bean. Seed shattering refers to the splitting of mature pods along the dorsal or ventral sutures and dispersal of seed as the crop reaches maturity as well as during harvesting.

Seed shattering by natural field method

According to present investigation average days required for initiation of seed shattering of fifty genotypes in natural field method were 14.09 days. The genotypes, LCU-47 (21 days), TPU-4 (20 days), LCU-1 (18 days), LCU-2 (17 days) and TAU-1 (17 days) were found lower to moderate for seed shattering. The genotypes LCU-41 (17days), LCU-35 (15 days), LCU-11 (14 days), LCU-15 (5 days) and LCU-31 (5 days) had higher pod breakage. Out of fifty genotypes, sixteen taken more while, thirty-four taken less days for initiation of seed shattering in natural field than general mean. (Table no. 1)

Seed shattering by HAO method

In present investigation seed shattering behaviour studied by using Hot Air Oven method by following the method of Tiwari and Bhatnagar (1997) [10]. In this method, 20 pods were selected from each genotype after harvest and they were kept in bowl. These bowl were kept in Hot Air Oven at 44 ºC (6 hrs in a day) for 7 days continuously and % pod breakage was estimated. (Photo plate 3). The average % age of pod breakage in hot air oven on 7 days was 44.35%. The shattering % age was ranged from 7.50(LCU-47) to 90.00% (LCU-41). Out of fifty genotypes, LCU-47 (7.5%), TPU-4 (25%), LCU-1 (27.50%), LCU-2 (27.50%) and TAU-1 (27.50%) were found lower to moderate for seed shattering. The genotypes LCU-41 (90.00%), LCU-35 (82.00%), LCU-11 (57.50%), LCU-15 (57.50%) and LCU-31 (57.50%) had higher pod breakage. (Table no. 2). The 16 genotypes were significantly less shatterer than general mean. Out of fifty genotypes, only two genotype *viz.*, LCU-35 and LCU-41 were early shatterer, showing 71 to 100% pod breakage; hence they were susceptible or early shatterer. The resistant and tolerant genotypes found in present investigation may be utilized in breeding program for development of resistant or tolerant recombinants for seed shattering, which may permit time to the farmers for 1 or 2 weeks delayed harvesting during labour crises.

Similar observations were also made by Bhor, *et al.* (2014) [4], Khedkar and Girase (2018) [7] in soybean and Girase *et al.* (2020) [8] in mungbean. From present investigation, it was observed that, the resistant or tolerant varieties, which showed tendency to have longer stem with more nodes on the main stem, lower pod-setting height, medium pod length, smaller seed size, thick pod, pod pubescence, thick pod coat, and leaf pubescence (Photo plate 1, 2).

The review of past finding recorded effect of different morphological characters, have much more contribution in seed shattering like length of pod has indirect correlation to shattering % age, also hairiness of pod contribute towards shattering in indirect proportion i.e. as pod length and hairiness on pods increases its shattering % age decreases. Similar observation was also made by (Tsuchiya; 1987; Bara *et al*. 2013; Abeyeye *et al*. 2014; Borude; 2016, Krisnawati; 2017, and Fatima *et al*. 2020) [11, 3, 1, 5, 9].

Table 1: observations for seed shattering in field under natural conditions

Sr. No	Days required for shattering	Genotypes
1	0-5 days	LCU-15, LCU 31, LCU-47
2	6-10 days	LCU-3, LCU-4, LCU-5, LCU-6, LCU-7, LCU-8,LCU-9, LCU-10, LCU-12, LCU-13, LCU-14, LCU-16, LCU-17, LCU-18, LCU-19, LCU-20, LCU-21, LCU-22, LCU-23, LCU-24, LCU-25, LCU-26, LCU-27, LCU-28, LCU-29, LCU-30, LCU-32, LCU-33, LCU-34, LCU-36, LCU-37, LCU-38, LCU-39, LCU-40, LCU-42, LCU-43, LCU-44, LCU-45, LCU-46, LCU-48.
3	11-15 days	LCU-35, LCU-11,
4	16-25 days	LCU-47, TPU-4, LCU-1, LCU-2, TAU-1, LCU-41

Table 2: Scale to measure seed shattering by hot air oven method was given by Bailey *et al*. (1997) [2] and Mohammed (2014) [12] as below

Sr. No.	Criteria for seed Shattering	Number of Genotypes	Genotypes and % age of pod breakage in parenthesis
1.	Resistant (0-10%)	1	LCU-47(07.50%)
2.	Tolerant (11-70%)	47	LCU-1(27.50%), LCU-2(27.50%), LCU-3(57.50%), LCU-4(47.50%), LCU-5(42.50%), LCU-6(52.50%), LCU-7(47.50%), LCU-8(62.50%), LCU-9(42.50%), LCU-10(55.50%), LCU-11(57.50%), LCU-12(37.50%), LCU-13(47.50%), LCU-14(47.50%), LCU-15(57.50%), LCU-16(42.50%), LCU-17(27.50%), LCU-18(42.50%), LCU-19(32.50%), LCU-20(35.00%), LCU-21(32.50%), LCU-22(42.50%), LCU-23(42.50%), LCU-24(27.50%), LCU-25(32.50%), LCU-26 (37.50%), LCU-27(42.50%), LCU-28(37.50%), LCU-29(27.50%), LCU-30(32.50%), LCU-31(57.50%), LCU-32(57.50%), LCU-33(42.50%), LCU-34(52.50%), LCU-36(47.50%), LCU-37(42.50%), LCU-38(52.50%), LCU-39(47.50%), LCU-40(42.50%), LCU-42(57.50%), LCU-43(42.50%), LCU-44(52.50%), LCU-45(55.50%), LCU-46(42.50%), LCU-48(47.50%), TAU-1(27.50%), TPU-4(25.00%).
3.	Susceptible (71-100%)	2	LCU-35(82.50%) and LCU-41(90%)

Photographs Showing Characters Responsible to Seed Shattering Resistanse/Tolerance

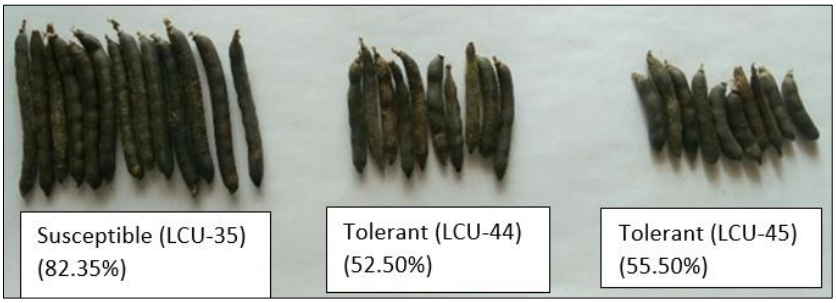

Plate 1: Length of Pods

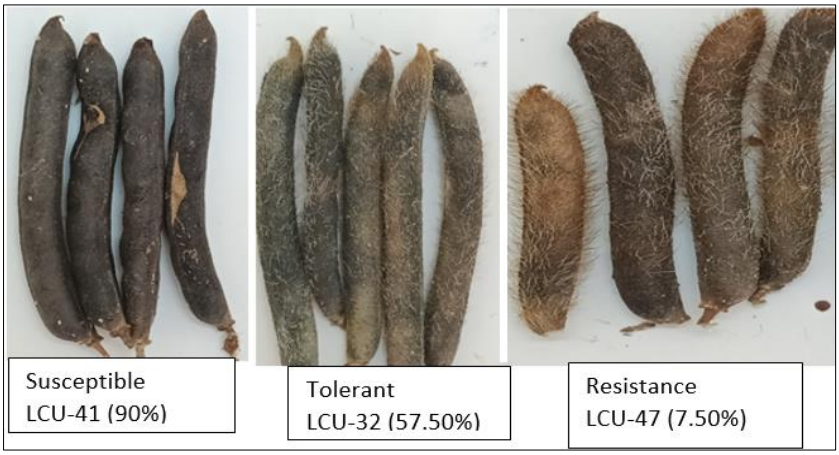

Plate 2: Hairiness on Pods (Pod Pubescence)

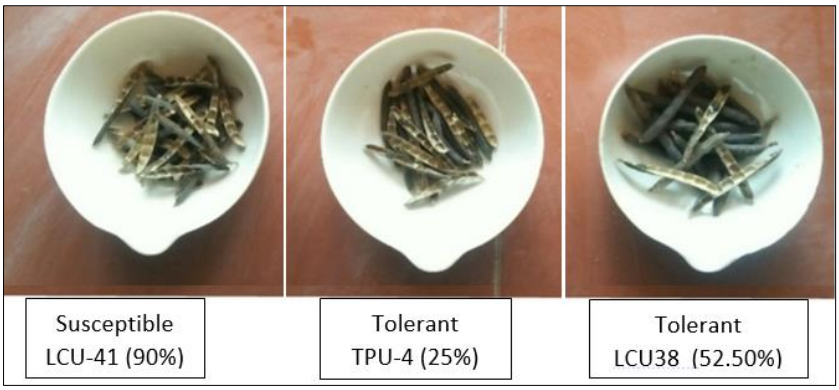

Plate 3: Pod Shattering in Hot Air Oven

Conclusion

The six genotypes LCU-47, TPU-4, LCU-1, LCU-2, TAU-1, LCU-41 were observed resistant to shattering in filed condition. According to Table no.1 the genotypes LCU-47 was found to be resistant for seed shattering as it showed 7.50% shattering. The forty-seven genotypes were showed 25.00 to 62.50% shattering, indicated tolerant to the seed shattering. These genotypes may incorporate in breeding program for development of seed shattering resistance or tolerant recombinants in Urd bean. According to Table No. 2, LCU-47 genotypes is under resistant criteria of seed shattering. Genotypes having 11 to 70% seed shattering are under the criteria of tolerant genotype for shattering. Further LCU-35 and LCU-41 are totally susceptible for shattering.

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