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Screening of germplasm of urdbean against pod borer complex

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Abstract

Screening of germplasm of urdbean against pod borer complex was carried out during *Kharif* 2023-2024 at the Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya in Raipur (C.G.). Among the 40 germplasm, LBG 1002 observed the least pod damage (1.0%) caused by *Helicoverpa armigera*, whereas JLP 813-12 observed least pod damage (6.50%) by *Maruca vitrata*. LBG 1002 had maximum grain production of urdbeans at 652.08 kg/ha, followed by JLP 813-12 at 633.48 kg/ha. Similarly, 4 germplasm are categorized under resistant category followed by 7 germplasm under moderately resistant category, 7 germplasm are categorized under tolerant category, 17 germplasm under equal to check, and 5 germplasm are categorized under moderately susceptible. no germplasm was found to be under immune, highly resistant, susceptible and highly susceptible category.

Keywords: Urdbean, Germplasm, Screening, *Helicoverpa armigera*, *Maruca vitrata*

Introduction

Black gram, *Vigna mungo* L. (Hepper) often referred as urdbean, mash kalai, black mapte etc., belongs to the family Fabaceae (Ali and Gupta, 2012). It is a major source of protein in our diet and are often referred as "poor man's meat" (Reddy, 2010). It contributes 10% of national pulse production. It is an important pulse crop, which positioned a unique status in Indian agriculture and it stands 4th in area and production among the pulses. India is its primary origin and is mainly cultivated in Asian countries including Pakistan, Myanmar and parts of Southern Asia. Nutritional and industrial values of urdbean is very popular among all pulses (Nene, 2006) [5].

Urdbean serves as a valuable livestock feed, boosting a rich nutrient profile. Abundant in protein (25 g), calcium (0.13), fat (1.3 g), phosphorus (385 mg/100 g), sodium (38 mg), potassium (983 mg), iron (42 g), fiber (0.9 g), it's a powerhouse of essential nutrients. Additionally, it contains high levels of phosphoric acid, making it a nutritious option for both animals and humans (Anonymous, 2018) [2].

There are number of insect pests belonging to different orders which cause damage to black gram among in India. They are whitefly (*Bemisia tabaci*), jassid (*Empoasca* spp.), green leafhopper (*Nephotettix* spp.), grasshopper (*Atractomorpha* spp.), blister beetle (*Mylabris pustulata*), leaf webber (*Grapholita critica*), grey weevil (*Myllocerus* spp.), tobacco caterpillar (*Spodoptera litura*), spotted pod borer (*Maruca vitrata*), hairy caterpillar (*Spilosoma obliqua*), and gram caterpillar (*Helicoverpa armigera*) (Kumar et al., 2007) [4].

Materials and Methods

The experiment was carried out during *Kharif* 2023-2024 at the Research and Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya in Raipur (C.G.), by growing a total of 40 urdbean germplasm in RBD [Randomized Block Design] design with 2 replications. The crop was sown on 25th July during *Kharif* 2023-24; maintaining a row to row and plant to plant spacing of 30 cm × 10 cm, respectively. The observations were recorded as (i) Pod damage (%), Per cent pods damaged were separated on the basis of shape and size of the hole of different pod borers in 100 randomly collected pods from each plot at the time of harvest and the nature of damage of *Helicoverpa armigera* is large round and regular holes on the pods while *Maruca vitrata* cause irregular scraping and holes on the pods. (ii) Yield Parameters: Grain yield was recorded at the time of harvest.

Afterward, the total number of pods and the number of damaged pods by pod borers on each demarcated plant were counted and converted into percentage. The percentage of pod damaged and grain yield Kg/ ha were estimated with the help of following formula:

$$\text{Pod damage (\%)} = \frac{\text{Number of infested pods}}{\text{Total Number of pods (Healthy + Damage)}} \times 100$$

$$\text{Grain yield (kg / ha)} = \frac{\text{Weight of grains in kg / plot}}{\text{Plot area in } m^2} \times 10,000$$

The percentage of pod damage at maturity of test entry is compared with that of the check cultivar in the trial. The test entries are then graded using a formula derived from Abott (1925):

$$\text{Pest Resistance (\%)} = \frac{\text{P.D. of check} - \text{P.D. of test genotypes}}{\text{P.D. check}} \times 100$$

Where,

P. D. = Mean of % pod damaged

The pest resistance percentage is then converted to 1 to 9 rating adopting the following scale:

Pest Resistance (%)	Score	Pest Resistance Rating (PRR)
100	1	Immune
75 to 99	2	Highly resistant
50 to 75	3	Resistant
25 to 50	4	Moderately resistant
10 to 25	5	Tolerant
-10 to 10	6	Equal to check
-25 to -10	7	Moderately susceptible
-50 to -25	8	Susceptible
-50 or less	9	Highly susceptible

Source: Technical program, IIPR, Kanpur, 2023

Statistical analysis

The data obtained were statistically analyzed after using the appropriate transformation. Data obtained from the population complex of pod borer larvae were converted to a square root transformation; Using the formula ($\sqrt{x} + 0.5$), data on pod and grain damage from plants were first collected and then converted to percentage. Percentage data were processed under the $\sin^{-1}$ arcsine transform ($\sqrt{x}/100$) before statistical analysis. Then these transformed data were analyzed using the analysis of variance [ANOVA] method described by Gómez and Gómez (1984). The "F" test was used at a 5 per cent level of significance. The following formulae were used for standard error, critical difference and coefficient of variance estimations:

$$C.D. = \sqrt{\frac{2EMS_R}{R}} \times t \text{ (D.F. at 5\%)}$$

Result and Discussion

(A) Screening of germplasm of urdbean against gram pod borer, *Helicoverpa armigera* (Hubner)

The infestation of gram pod borer was measured in terms of percent pod damage (Table 1) during the harvesting stage of the crop. The germplasm differed significantly in terms of percent pod damage, which ranged from 1.00 to 5.50% (Table 1). Among the tested germplasm, the minimum pod damage by *H. armigera* was observed in germplasm LBG 1002 with 1.00%, whereas the maximum pod damage was observed in RUB 15-02 with 5.50%.

The current findings are in agreement with Chandekar *et al.*, (2022) [3], who noted that among the tested germplasm, the least pod damage by *H. armigera* was observed in germplasm DKU116 with 0.5%. The maximum pod damage was observed in germplasm BCU 20 - 10 with 9.5%.

Similarly, Vaishnav *et al.*, (2023) [9], who noted that, the germplasm differed significantly in terms of percent pod damage, which ranged from 1.0 to 8 percent. Among the tested germplasm, the minimum pod damage by *H. armigera* was observed in germplasm KPU 2061 with 1.00 percent, where the maximum pod damage was observed in germplasm IU 05-2 with 8.00 percent.

(B) Screening of germplasm of urdbean against, Spotted pod borer *Maruca vitrata* (Geyer)

Among the tested germplasm, the minimum pod damage by *M. vitrata* was observed in germplasm JLP 813-12 with 6.50%, whereas the maximum pod damage was observed in PU 1920 with 21.00%. (table 1). the germplasm showed significant difference with each other for percentage pod damage, which varied from 6.50% to 21.00%.

The current findings are in agreement with Chandekar *et al.*, (2022) [3], who noted that the germplasm showed significant differences with each other for per cent pod damage, which varied from 3.5 per cent to 26.00 per cent. Among the tested germplasm, the minimum pod damage by *M. vitrata* was observed in germplasm KUG 878 with 3.5 per cent, respectively. Whereas the maximum pod damage was observed in IPU 11-02 with 26 per cent.

Similarly, Vaishnav *et al.*, (2023) [9], who noted that, the germplasm showed significant differences with each other for percent pod damage, which varied from 4.50% to 16.50%. Among the tested germplasm, the minimum pod damage by *M. vitrata* was observed in germplasm SKNU 2005 with 4.50 percent, Whereas the maximum pod damage was observed in IPU 19- 27 with 16.5 percent.

The present findings are consistent with those of Sundararajan and Chitra (2014) [8], who reported that pod damage caused by *Maruca vitrata* ranged from 0 to 14.0 per cent germplasms, CBG 08-008 exhibited the least pod damage, while CBG 08-037 exhibited the most.

Table 1: Per cent pod damage by pod borer complex and grain yield in different germplasm of urdbean (*Kharif* 2023-24).

S. No.	Germplasm	Pod damage (%)		Total% pod damage by pod borers	PRR	Grain yield (kg/ha)
		<i>H. armigera</i>	<i>M. vitrata</i>			
1	Azad Urd 1	2.50 (9.05)	20.50 (26.83)	23.00 (28.56)	6	317.77
2	BU 2021-3	1.50 (6.93)	13.50 (21.52)	15.00 (22.77)	4	501.63
3	DBG 90	3.50 (10.75)	17.50 (24.72)	21.00 (27.26)	6	393.97
4	IPU 13-3	4.50 (12.22)	14.00 (21.95)	18.50 (25.45)	5	409.38
5	IPU 18-02	5.00 (12.85)	13.00 (21.11)	18.00 (25.09)	5	424.90
6	IPU 2-43	1.50 (6.93)	13.50 (21.47)	15.00 (22.73)	4	463.13
7	IPU 94-1	3.00 (9.83)	14.50 (22.30)	17.50 (24.61)	5	451.03
8	IUF 311	3.00 (9.97)	19.50 (26.15)	22.50 (28.27)	6	304.78
9	IUF 312	2.50 (9.05)	16.50 (23.90)	19.00 (25.80)	6	405.12
10	JLPU 813-12	1.50 (6.93)	6.50 (14.67)	8.00 (16.39)	3	633.48
11	Kota Urd 4	3.00 (9.83)	8.00 (16.42)	11.00 (19.34)	4	550.73
12	Kota Urd 5	3.00 (9.97)	20.50 (26.83)	23.50 (28.95)	7	245.37
13	KPU 22-1	2.00 (7.85)	18.50 (25.42)	20.50 (26.83)	6	403.35
14	KPU 405	3.00 (9.83)	19.00 (25.77)	22.00 (27.94)	6	320.73
15	KU 21-10	2.50 (9.05)	17.00 (24.30)	19.50 (26.15)	6	401.32
16	KU 96-3	3.00 (9.97)	19.00 (25.64)	22.00 (27.82)	6	328.28
17	KUG 1027	3.50 (10.75)	20.50 (26.87)	24.00 (29.28)	7	312.97
18	KUG 1069	2.50 (9.05)	10.50 (18.86)	13.00 (21.07)	4	501.87
19	KUG 479	5.00 (12.85)	9.50 (17.89)	15.50 (22.40)	4	434.18
20	KUG 941	3.00 (9.83)	15.50 (23.11)	18.50 (25.37)	5	441.68
21	LBG 1002	1.00 (5.74)	8.50 (16.94)	9.50 (17.94)	3	652.08
22	LBG 787	2.50 (9.05)	19.50 (26.15)	22.00 (27.94)	6	316.52
23	LBG 1001	2.50 (9.05)	7.50 (15.81)	10.00 (18.34)	3	501.98
24	MBG 1134	3.00 (9.83)	18.00 (25.06)	21.00 (27.21)	6	386.07
25	MBG 1123	3.50 (10.75)	15.50 (23.15)	19.00 (25.80)	6	405.03
26	PU 10	4.00 (11.44)	19.50 (26.11)	23.50 (28.95)	7	240.40
27	PU 12	2.50 (9.05)	7.50 (15.88)	10.00 (18.43)	3	522.75
28	PU 1920	3.00 (9.83)	21.00 (27.24)	23.50 (28.69)	7	230.83
29	PU 1921	2.50 (9.05)	17.50 (24.54)	20.00 (26.45)	6	376.85
30	PU 2018	2.50 (9.05)	17.00 (24.26)	19.50 (26.15)	6	380.98
31	PU 2021	3.00 (9.83)	17.00 (24.33)	20.00 (26.55)	6	375.28
32	PU 31	3.00 (9.83)	20.50 (26.63)	23.50 (28.69)	7	258.52
33	RVSU 22-11	4.00 (11.44)	8.00 (16.30)	12.00 (20.24)	4	486.37
34	RVSU 22-12	2.00 (7.85)	19.50 (26.15)	21.50 (27.60)	6	341.98
35	TPU 4	3.50 (10.75)	8.00 (16.39)	11.50 (19.78)	4	494.07
36	VBG 20-008	4.50 (12.22)	16.50 (23.84)	21.00 (27.21)	6	328.85
37	VBG 20-100	3.50 (10.75)	14.50 (22.35)	18.00 (25.06)	5	419.27
38	VCN 11	4.50 (12.22)	12.50 (20.66)	17.00 (24.33)	5	411.80
39	RUB 15-02	5.50 (13.54)	11.50 (19.78)	17.00 (24.30)	5	466.92
40	Barkha (S.C)	2.50 (9.05)	18.50 (25.45)	21.00 (27.24)	6	372.18
	C.D at 5%	3.49	5.57	5.47		85.08
	SE (m)	1.22	1.94	1.91		29.63
	C.V	17.45	12.16	10.78		10.34

Figure in parenthesis () are angular transformed value, S. C. = Susceptible check

Table 2: Reaction of urdbean germplasm against pod borers during *Kharif* 2023-24.

Pest Resistance Rating (PRR)	Categories	Total% Pod damage by pod borers	Grain yield (kg / ha)	No. of germplasm	Germplasm
1	Immune	-	-	-	-
2	Highly resistant	-	-	-	-
3	Resistant	8.00-10.00	501.98-652.08	4	JLPU 813-12, LBG 1002, LBG 1001, PU 12.
4	Moderately resistant	11.00- 15.00	434.18-550.73	7	BU 2021-3, IPU 2-43, Kota Urd 4, KUG 1069 KUG 479, RVSU 22-11, TPU 4.
5	Tolerant	17.00- 18.50	409.38-466.92	7	IPU 13-3, IPU 18-02, IPU 94-1, KUG 941, VBG 20-100, VBN 11, RUB 15-02.
6	Equal to check	19.00 - 23.00	304.78-405.12	17	Azad Urd 1, DBG 90, IUF 311, IUF 312 KPU 22-1, KPU 405, KU 21-10, KU 96-3 LBG 787, MBG 1134, MBG 1123, PU 1921, PU 2018, PU 2021, RVSU 22-12, VBG 20-008, Barkha susceptible check.
7	Moderately susceptible	23.50- 24.50	230.83-312.97	5	Kota Urd 5, KUG 1027, PU 10, PU 1920, PU 31.
8	Susceptible	-	-	-	-
9	Highly susceptible	-	-	-	-



Plate 1: Pod damage by gram pod borer, *Helicoverpa armigera*.



Plate 2: Pod damage by spotted pod borer, *Maruca vitrata*.

(C) Reaction of urdbean germplasm against pod borer complex, (*H. armigera* and *M. vitrata*) during kharif 2023-24

The forty urdbean germplasm were screened to check the resistance and susceptibility against *H. armigera* and *M. vitrata*. The statistical analyzed data present in Table 2. Among all the 40 germplasm of urdbean none of the germplasm was found immune and highly resistant with respect to pod damage against *H. armigera* and *M. vitrata* in urdbean. Whereas, 4 germplasm viz., JLP 813-12, LBG 1002, LBG 1001, PU 12. were categorized as resistant with per cent pod damage of 8.00 to 10.00 percent. The 7 germplasm viz., BU 2021-3, IPU 2-43, Kota Urd 4, KUG 1069, KUG 479, RVSU 22-11, TPU 4. were categorized as moderately resistant. With 11.00 to 15.00 percent pod damage and seven germplasm viz., IPU 13-3, IPU 18-02, IPU 94-1, KUG 941, VBG 20-100, VBN 11, RUB 15-02. were categorized as tolerant with 17.00 to 18.50 percent pod damage. However, 17 germplasm viz., Azad Urd 1, DBG 90, IUF 311, IUF 312, KPU 22-1, KPU 405, KU 21-10, KU 96-3, LBG 787, MBG 1134, MBG 1123, PU 1921, PU 2018, PU 2021, RVSU 22-12, VBG 20-008, Barkha (susceptible check). were categorized equal to check with 19.00 to 23.00 percent pod damage, whereas five germplasm viz., Kota Urd 5, KUG 1027, PU 10, PU 1920, PU 31 were categorized as moderately

susceptible with 23.50 to 24.50 per cent pod damage. Among all the 40 germplasm of urdbean none of the germplasm was found susceptible and highly susceptible with respect to pod damage against *H. armigera* and *M. vitrata* in urdbean.

The current findings are consistent with those of Nigam *et al.*, (2022), who observed significant differences among the twelve blackgram germplasms, with pod damage by *H. armigera* ranging from 7.21% to 24.06%. The germplasm IU 03-52 exhibited the minimum pod damage at 7.21%, followed by IU 2021-1 and IU 02-4, with 8.40% and 11.12% damage, respectively. These germplasms were categorized under resistant category (R). Whereas, nine germplasms viz., IU 2021-2, IU 05-2, IU 2021-3, IU 03-22-4, Indira Urd- 1, IU 08-2, IU 02-6, KU 96-3 and IU 02-1-3 with 12.53, 14.57, 14.96, 17.51, 19.21, 21.45, 21.99, 22.85 and 24.06 percent pod damage respectively, categorized under moderately resistant category (MR). The data grain damage were recorded at the time of harvest and it was recorded minimum in IU 03-52 with 6.47 per cent followed by IU 2021-1, IU 02-4, IU 2021-2, IU 05-2, IU 2021-3, IU 03-22-4, Indira Urd-1, IU 08-2, IU 02-6, KU 96-3 with 6.80, 7.15, 7.22, 8.22, 8.99, 9.22, 9.57, 9.88, 10.09, and 11.16 per cent respectively, whereas maximum grain damage was recorded in IU 02-1-3 with 11.90 percent.

The current findings are consistent with those of Vaishnav *et al.*, (2023)^[9] who observed the 51 germplasm of urdbean no germplasm was found immune, highly resistant and resistant with respect to pod damage against *H. armigera* and *Maruca vitrata* in urdbean. Whereas, 5 germplasm viz., Jammu Urdbean 1, KUG 878, PU 1920, SKNU 2005, KU 96-3 were categorized as moderately resistant with per cent pod damage of 8.00 to 11.00 percent and 230.00 to 340.00 grain yield (kg/ha). The 7 germplasm viz., IPU 11-02, KUG 1043, LBG 941, MBG 1133, RVSU 22-10, SVU 6, VBG 19-010 were categorized as tolerant with 11.50 to 13.50 per cent pod damage and 215.00 to 420.00 grain yield (kg / ha). However, 17 germplasm viz., AKU 16-13, BDU 2021-2, IPU 18-02, IPU 2-1-3, IPU 94-1, JAUG 2 (GAU 4), KPU 2061, KU 20-12, KUG 479, KUG 941, LBG 787, OBG 102, PU 10, PU 12, PU 31, SKAU -UB-3, Barkha were categorized as equal to check with 14.00 to 16.50 per cent pod damage and 188.00 - 351.67 grain yield (kg / ha). The 13 germplasm viz., Daftari 471, JLP 0014, JLP 819-18, KPU 20-54, KPU 405, PU 1804, PU 1921, RVSU 22-6, RU 03- 52, SKNU 1809, VBG 20- 011, RUG 59, NUL 7 were categorized as moderately susceptible with 17.00 to 18.50 per cent pod damage and 166.67 to 335.00 grain yield (kg / ha). The 9 germplasm viz., BCU 20-26, IPU 19-27, IPU 2-43, IU 05-2, IU 92-14, LBG 752, OBG 41, SBC 51, Shekhar -3 (KU 309) were categorized as susceptible with 19.00 to 22.00 per cent pod damage and 188.33 to 290.00 grain yield (kg / ha). Among all the 40 germplasm of urdbean no germplasm was found highly susceptible with respect to pod damage against *H. armigera* and *Maruca vitrata* in urdbean.

Grain Yield

The grain yield of different urdbean germplasms ranged from 230.83 kg/ha to 652.08 kg/ha. The germplasm LBG 1002 produced the highest grain yield with a yield of 652.08 kg/ha, followed by germplasm JLP 813-12 with a yield of 633.33 kg/ha. Whereas germplasm PU 1920 had lowest grain yield as 230.83 kg/ha followed by germplasm PU 10 as 240.40 kg/ha (Table 1).

These findings are in agreement with Chandekar *et al.*, (2022) [3], who reported that the highest grain yield was obtained from the germplasm RVSU 21-2 (754.83 kg/ha), followed by LBG 787 (741.67 kg/ha). The germplasm Daftri 471 had the lowest grain yield (448.33 kg/ha), followed by the germplasm IPU 19-9 (485 kg/ha). Similarly, Vaishnav *et al.* (2023) [9] who reported that the maximum grain yield was obtained by the germplasm MBG 1133 (420.00 kg/ha), followed by LBG 941 (398.33.00 kg/ha). In contrast, germplasm JLP 819-18 has the lowest grain yield (166.67 kg/ha), followed by germplasm PU 31 (178.33 kg/ha).

Conclusion

A number of criteria were used to assess, the resistance of 40 germplasm, including grain yield and the percentage of pod damage. Significant variations among the analyzed germplasm were noted during the screening process. The pod borers that had the least impact on the germplasms LBG 1002 and JLP 813-12 in terms of pod damage were *Helicoverpa armigera* and *Maruca vitrata*. Maximum grain yield was produced by genotype LBG 1002, while the lowest grain yield was produced by germplasm PU1920.

Among the 40 urdbean germplasm screened 4 germplasm are categorized under resistant category followed by 7 germplasm under moderately resistant category, 7 germplasm are categorized under tolerant category, 17 germplasm under equal to check, and 5 germplasm are categorized under moderately susceptible. None of the germplasm was found to be under immune, highly resistant, susceptible and highly susceptible category.

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