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Article

Performance evaluation of selected moderately stemphylium blight resistant lentil lines/varieties in yield

Md. Amirul Islam[1*], Md. Abdur Razzak[1], Maria Akter Sathi[2], Md. Atikuzzamman[1], Hera Lal Nath[1] and Mohammad Shahidul Islam[1]

[1]International Maize and Wheat Improvement Center (CIMMYT)-Bangladesh
[2]Department of Horticulture, Patuakhali Science and Technology University, Bangladesh

[*]Corresponding author: Md. Amirul Islam, CIMMYT-Bangladesh, House-10/B, Road-53, Gulshan-2, Dhaka-1212, Bangladesh. Phone: +8801735429415; E-mail: musa_amirul@yahoo.com; m.a.islam@cgiar.org

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Abstract: Blight is an important disease that cause devastating yield loss now a days. That's why, an investigation was carried out at the Regional Agricultural Research Station (RARS), Bangladesh Agriculture Research Institute (BARI), Barishal for screening of lentil germplasms against stemphylium blight in terms of yield and yield attributes. To find the best genotype, 40 moderately stemphylium resistant lentil lines/ genotypes were used and their different yield contributing characters were analysed. In this study, it has been observed that the long delay of 1st flowering was recorded in BD-5982 and BD-5996 while early flowering in BD-3927 and BARI masur-7. The highest 50% flowering days was recorded in BD-3983, BD-4024, BD-4053 etc. and lowest in BD-3922. Long maturation period of 111.5 days was recorded in BD-4024 and that of short maturity date was recorded in BD-3924 and BD-3927. The highest plant height was observed in BD-3974 and lowest was in BD-4127. The maximum number of branches per plant was observed in BD-3936 and BD-4024 and minimum was found in BD-4097. Maximum number of pods per plant was recorded in BD-3922 and minimum number of pods per plant was in BD-4053. The lowest number of seeds per pod was recorded in BD-4053. The highest 100 seed weight was recorded in BD-5986 and the lowest was observed in BD-4127. Maximum biological yield was recorded in BD-4053 and minimum was in BD-5989. The highest and lowest grain yield was recorded in BD-5983 and BD-4024, respectively. This finding will help researcher to develop new variety in near future.

Keywords: cultivars; lentil; resistant; stemphylium blight; yield

1. Introduction

Major food crops that exists in the Southeast Asia, pulses assume a vital role in improving the diet of the people because of its high nutritional esteem. It is an imperative food for immense individuals in developing countries, where it is a basic source of proteins and additionally contains the amino acid lysine, which is for the most part insufficient in food grains (Iqbal *et al*., 2006). Lentil crop positions first as consumer preference and second in terms of area (154,000 ha) and production (116,000 tons) among the pulses (Das and Kabir, 2016). Production of leading food crops i.e. rice, wheat, pulses and oilseeds – does not meet the present prerequisites of country's populace. The gap in amount and quality is increasing. Scientists are facing with the complex and urgent task of bringing the "population – food supply" equation into rational balance (Sarkar *et al.*, 2004).

Several causes are responsible for low yield of lentil of which the use of traditional local cultivars, unfavorable weather conditions (Vanderberg, 2007), different biotic and abiotic stresses (Schneider and Anderson, 2010), low plant density unit^{-1} area, weed infestation and poor crop management practices constitute the major ones (Yadav *et al.*, 2017). In Bangladesh frequently rabi rainfall is also insufficient for successful the production of lentil, because water deficit in lentil fail to develop properly on account of retardation in photosynthetic and metabolic activities resulting in decreased number of pods plant^{-1}, seeds pod^{-1} and 1000-seed weight (Hossain *et*

al., 2014). The crop also confronts sudden rise in temperature and depleting soil moisture at grain filling stage, causing forced maturity Fusarium wilt, root rot and rust diseases inflict heavy losses to the crop (Kumar *et al.*, 2013). Stemphylium blight caused by *Stemphylium* spp. is a common fungal disease of lentil, which under supportive conditions may cause noteworthy yield losses (Murray and Brennan, 2012). Impacts of stemphylium blight isn't completely clear yet in light of the fungus is an airborne pathogen (Benniza, 2005), it has caused significant yield losses to lentil production in South Asia and North America (Morrall *et al*., 2006) where it was first thought a minor disease (Bakr and Zahid, 1986; Bayaa and Erskine, 1998). It has reported that the crop yield of lentil had fundamentally negative correlation with the severity of stemphylium blight disease which is caused by *Stemphylium sarciniformis* (Sarder, 1995). However, infection can also cause seed staining, could result from infection even after early to mid-flowering. So even at a somewhat later stage, the fungus can cause economic damage (Isaacs, 2014). If the infection takes root toward harvest, however, it may potentially serve as a natural desiccant.

Loss of yield from stemphylium blight increased day by day. It might be minimized by screening lentil germplasm against blight pathotypes, application of fungicides etc. (Kant *et al*., 2017). So to feed the huge population and for sustainable food security, identification of blight resistant genotypes is must. Previous studies identified various lentil lines as Resistant, Moderately Resistant, Moderately Susceptible and Susceptible at different growth stages (Razzak *et al*., 2018). The present research was carried out to compare yield and yield characters of 40 moderate resistant lines of lentil and screening best genotypes for future use.

2. Materials and Methods

2.1. Experiment details

The experiment was conducted in experimental field of Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Rahmatpur, Barishal. The experiment was laid out in Randomized Complete Block Design (RCBD) with two replications. The individual plot size was 2 sq.m. (4 m × 0.5 m). Distance between two blocks was 0.5 m. Each row was 4 m long and 0.25 m wide. BARI masur-7 and a local variety was used as check. Provax-200 @ 5g/kg was used to treat lentil seed to minimize seed borne pathogen. Furrows were made with power tiller driven furrows maintaining a distance of 40 cm. Seeds were sown in the furrow using a polythene bag containing required amount for each plot. The furrows were covered with soil soon after sowing. Cultivation technique and all other intercultural operations were followed as per BARI Handbook.

2.2. Plant materials

Materials of this experiment were collected from Plant Genetic Resource Centre (PGRC) Gazipur and Pulses Research Centre (PRC), Ishurdi, Pabna. The collected seeds were stored in a well-ventilated room at room temperature immediately after receiving. Seeds were preserved in a refrigerator in the Plant Pathology laboratory followed by registration till field experiment starts.

2.3. Data collection

The crop was harvested at fully matured stage. Days to 1st flowering was recorded in number of days after sowing when 1st flowering is open. Days to 50% Flowering (DFLR) was recorded in number of days after sowing when 50% plants in the plot sets the first flower. Days to maturity (DMAT) was recorded in number of days after sowing when 90% of the plot is ready for harvest. Ten plants of each unit plots were randomly selected at maximum growth stage for recording the data on plant height, number of branches per plant, total number of pods per plant, total number of seeds per pod after harvest. Weight of 100 seeds were recorded in grams. Biological yield and grain yield of lentil lines/varieties were recorded in kg per hectare.

2.4. Analysis of data

The collected data were analyzed statistically. Analysis of variance and LSD test were done to find out the significant difference among the treatment means.

3. Results

3.1. Duration to 1st flowering, 50% flowering and maturity

Table 1 shows the remarkable variation in duration of 1st flowering, 50% flowering and maturity days in different lentil lines/varieties. Some lines/varieties were gave flower earlier and some lines/varieties took more duration. It ranged from 59 days to 63 days. The highest 1st flowering days was recorded in BD-5982 and BD-5996 followed by BD-4069 (62.5 days) and BD-4088 (62.5 days) and the lowest in BD-3927 and BARI masur-7

followed by BD-3930 (59.5 days), BD-3943, BD-3948, BD-4054 and BD-4102. Duration of 50% flowering ranged from 65 days to 70.5 days. It has been observed that the highest 50% flowering days was recorded in BD-3983, BD-4024, BD-4053, BD-4069, BD-4087, BD-4105, BD-4115, BD-5982, BD-5983 and BD-5991 and the lowest 50% flowering days was recorded in BD-3922 line followed by BD-3948 (66.50 days) and BARI masur-7 (66 days). Days to maturity ranged from 105.5 days to 111.5 days. Long duration (111.5 days) was recorded in BD-4024 followed by BD-3931 (110.5 days), BD-3983 (110.5 days), BD-3984 (110.5 days), BD-4053 (110.5 days), BD-4069 (110.5 days), and BD-5996 (110.5 days). Short duration was recorded in BD-3924 and BD-3927 followed by BD-3921 (106.0 days), BD-3922 (106.0 days), BD-3928 (106.0 days), BD-3929 (106.0 days), BD-4054(106.0 days), BD-4115 (106.0 days), BD-4134 (106.0 days).

3.2. Plant height

Marked variation was noticed in respect of plant height. The tested 40 lines/ varieties were showed significant difference to each other (Table 1) in the field condition. The plant height ranged from 28.50 cm to 47.80 cm while the tallest plant was recorded in BD-3974 followed by BD-4102 (46.70 cm) and BARI masur-7 (45.50 cm) and the shortest plant was recorded in BD-4127 followed by BD-5982 (29.40 cm) and BD-3972 (30.10 cm). Most of the lines/varieties were smaller than the check variety (Table 1).

3.3. Number of branches plant^{-1}, pods per plant and seeds per pod

There had an appreciable variation among number of branches of plant, pods per plant and seeds per pod. It was found that most of the lines/verities gave two to three primary branches yet only two lines gave maximum (3.70) primary branches in average viz. BD-3936 and BD-4024 followed by BD-3921(3.65), BD-3922(3.55). Minimum number of branches per plant was recorded in BD-4097 (2.40) followed by BARI masur-7 (2.60) and Local check (2.60) (Table 1). Number of pods ranged from 37.50 to 98.80 while minimum number of pods was recorded in BD-4053 followed by BD-4134(39.60) and maximum number of pods was recorded in BD-3922 followed by BARI masur-7 (91.90). Number of seeds per pod ranged from 1.75 to 2.00 where the lowest number of seeds per pod was recorded in BD-4053 followed by BD-4024 (1.80), BD-3930 (1.90), BD-3948 (1.90), BD-3972 (1.90), BD-3974 (1.90) and BD-4127 (1.90) and rest of the lines bear the highest number of seeds (2.0) per pod (Table 2).

3.4. 100 seed weight (g)

In respect of 100 seed weight marked variation has been found. The hundred seed weight under different lines/ verities ranged from 1.00 g to 2.10 g while the highest weight was recorded in BD-5986 followed by BD-3972 (1.45 g), BD-3984 (1.45 g), BD-4102 (1.45 g), BD-4105 (1.45 g), BD-5983 (1.45 g) and BARI masur-7 and the lowest 100 seed weight was recorded in BD-4127 followed by BD-3927 (1.05 g), BD-3932 (1.10 g), BD-5996 (1.10g) (Table 2).

3.5. Biological yield

Biological yield of different lines showed significant variation and ranged from 747.20 kg ha^{-1} to 1567 kg ha^{-1} while the highest biological yield was recorded in BD-4053 followed by BD-4054 (1556 kg ha^{-1}), BD-3943(1447 kg ha^{-1}), BD-4024 (1439 kg ha^{-1}), BD-3921(1381 kg ha^{-1}), BD-4023 (1342 kg ha^{-1}), BD-3974 (1303 kg ha^{-1}) and the lowest value recorded in BD-5989 followed by BD-3984 (752.80 kg ha^{-1}), and BD-3930 (847.20 kg ha^{-1}) (Table 2).

3.6. Grain yield

The grain yield per hectare differ significantly from one to another under field condition (Table 2). The yield ranged from 488.90 kg ha^{-1} to 1389.00 kg ha^{-1} while the highest grain yield was recorded in BD-5983 followed by BD-5989 (1278 kg ha^{-1}) and BD-5992 (1261 kg ha^{-1}) and the lowest yield weight was recorded in BD-4024 followed by BD-3972 (533.30 kg ha^{-1}) and BD-3921 (577.80 kg ha^{-1}).

Table 1. Days to 1st flowering, days to 50% flowering, days to maturity, plant height and no. of branches plant^{-1} of 40 lentil lines/varieties under natural field condition during 2011-12 at RARS, BARI, Rahmatpur, Barishal.

Sl. No.	Name of lines/varieties	Days to 1st flowering	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches plant^{-1}
1	BD-3921	61.00 ab	67.50 b-f	106.0 h	35.95 i-l	3.65 ab
2	BD-3922	60.00 ab	65.50 f	106.0 gh	37.75 d-f	3.55 a-c
3	BD-3924	62.00 ab	68.50 a-e	105.5 h	36.00 h-l	3.00 c-g
4	BD-3927	59.00 b	67.00 c-f	105.5 h	40.50 c	3.50 a-c
5	BD-3928	61.00 ab	68.50 a-e	106.0 gh	32.80 o-r	2.80 e-h
6	BD-3929	60.50 ab	68.00 a-f	106.0 gh	35.10 k-n	3.00 c-g
7	BD-3930	59.50 ab	67.50 b-f	109.5 b-d	32.10 qr	3.40 a-d
8	BD-3931	60.00 ab	69.50 a-c	110.5 ab	37.7 d-f	2.80 e-h
9	BD-3932	61.00 ab	68.00 a-f	108.0 c-g	33.10 o-r	3.40 a-d
10	BD-3936	61.50 ab	69.50 a-c	107.0 e-h	37.70 d-f	3.70 a
11	BD-3943	59.50 ab	67.00 c-f	109.0 b-e	37.60 d-g	2.80 e-h
12	BD-3948	59.50 ab	66.50 d-f	106.5 f-h	34.25 m-o	2.80 e-h
13	BD-3972	60.00 ab	68.50 a-e	108.0 c-g	30.10 s	3.10 b-g
14	BD-3974	61.50 ab	69.50 a-c	109.5 b-d	47.80 a	3.05 c-g
15	BD-3983	61.00 ab	70.50 a	110.5 ab	37.55 d-g	2.80 e-h
16	BD-3984	60.00 ab	69.50 a-c	110.5 ab	36.10 g-l	3.50 a-c
17	BD-4023	60.00 ab	69.50 a-c	109.5 b-d	37.20 e-i	3.15 a-g
18	BD-4024	61.00 ab	70.50 a	111.5 a	34.70 l-n	3.70 a
19	BD-4053	61.50 ab	70.50 a	110.5 ab	32.25 qr	2.80 e-h
20	BD-4054	59.50 ab	70.00 ab	106.0 gh	38.80 d	3.50 a-c
21	BD-4069	62.50 ab	70.50 a	110.5 ab	36.60 f-k	3.30 a-e
22	BD-4087	61.00 ab	70.50 a	108.5 c-f	35.50 j-n	3.00 c-g
23	BD-4088	62.50 ab	69.50 a-c	106.5 f-h	31.90 qr	3.10 b-g
24	BD-4095	60.00 ab	69.00 a-d	107.5 d-h	38.50 de	3.50 a-c
25	BD-4097	61.00 ab	70.00 ab	110.0 a-c	37.00 e-j	2.40 h
26	BD-4102	59.50 ab	70.00 ab	108.0 c-g	46.70 ab	2.80 e-h
27	BD-4105	61.00 ab	70.50 a	108.5 b-f	37.80 d-f	3.20 a-f
28	BD-4115	62.00 ab	70.50 a	106.0 h	37.50 d-h	2.90 d-h
29	BD-4127	61.50 ab	69.00 a-d	108.5 b-f	28.50 t	3.00 c-g
30	BD-4134	62.00 ab	70.00 ab	106.0 gh	33.20 o-q	3.20 a-f
31	BD-5982	63.00 a	70.50 a	107.5 d-h	29.40 st	3.10 b-g
32	BD-5983	61.50 ab	70.50 a	110.0 a-c	34.00 n-p	3.00 c-g
33	BD-5986	62.00 ab	70.00 ab	108.5 b-f	31.60 r	3.50 a-c
34	BD-5989	60.00 ab	70.00 ab	108.0 d-g	35.90 i-l	3.30 a-e
35	BD-5991	60.50 ab	70.50 a	107.5 d-h	34.30 m-o	2.80 e-h
36	BD-5992	62.00 ab	69.50 a-c	110.0 a-c	32.60 p-r	3.40 a-d
37	BD-5993	60.50 ab	70.00 ab	108.5 b-f	35.70 i-m	2.70 f-h
38	BD-5996	63.00 a	69.50 a-c	110.5 ab	32.30 qr	3.50 a-c
39	BARI masur-7	59.00 b	66.00 ef	108.0 c-g	45.50 b	2.60 gh
40	Local check	60.00 ab	67.50 b-f	108.0 d-g	41.75 c	2.60 gh
LSD (0.05)		2.89	2.17	1.67	1.33	0.49
CV (%)		2.35	1.55	0.76	1.83	7.70

Table 2. No. of pods plant^{-1}, no. of seeds plant^{-1} and 100 seed weight (g), biological yield and yield of 40 lentil lines/varieties under natural field condition.

Sl. No.	Name of lines/varieties	No. of pods plant^{-1}	No. of seeds plant^{-1}	100 seed wt. (g)	Biological yield (kg ha^{-1})	Yield (kg ha^{-1})
1	BD-3921	44.90 tu	2.00 a	1.15 d-f	1381.00 c	577.80 q-s
2	BD-3922	98.80 a	2.00 a	1.40 bc	1153.00 f-i	916.70 e-j
3	BD-3924	69.40 g	2.00 a	1.35 b-d	1192.00 f	811.10 j-m
4	BD-3927	50.80 o-q	2.00 a	1.05 f	1133.00 g-j	866.70 g-k
5	BD-3928	58.70 i-l	2.00 a	1.30 be	1097.00 i-k	933.30 e-i
6	BD-3929	49.50 p-r	2.00 a	1.35 b-d	1183.00 fg	905.60 f-j
7	BD-3930	47.00 r-t	1.90 ab	1.35 b-d	847.20 p	822.20 i-m
8	BD-3931	61.00 h-k	2.00 a	1.40 bc	1061.00 kl	1028.00 c-e
9	BD-3932	54.20 m-o	2.00 a	1.10 ef	1131.00 g-j	972.20 d-g
10	BD-3936	57.90 j-m	2.00 a	1.40 bc	1089.00 jk	672.20 o-q
11	BD-3943	57.70 k-m	2.00 a	1.35 b-d	1447.00 b	1028.00 c-e
12	BD-3948	74.70 f	1.90 ab	1.40 bc	1183.00 fg	1028.00 c-e
13	BD-3972	51.60 n-q	1.90 ab	1.45 b	1008.00 m	533.30 rs
14	BD-3974	78.60 de	1.90 ab	1.20 c-f	1303.00 de	1094.00 c
15	BD-3983	51.70 n-q	2.00 a	1.20 c-f	1175.00 fg	788.90 k-n
16	BD-3984	54.90 l-n	2.00 a	1.45 b	752.80 q	722.20 m-o
17	BD-4023	62.10 hi	2.00 a	1.35 b-d	1342.00 cd	788.90 k-n
18	BD-4024	73.20 f	1.80 ab	1.35 b-d	1439.00 b	488.90 s
19	BD-4053	37.50 w	1.75 b	1.40 bc	1567.00 a	1006.00 c-f
20	BD-4054	80.70 d	2.00 a	1.35 b-d	1556.00 a	833.30 h-m
21	BD-4069	55.10 l-n	2.00 a	1.40 bc	902.80 no	966.70 d-g
22	BD-4087	64.60 h	2.00 a	1.35 b-d	1158.00 f-h	944.40 e-h
23	BD-4088	48.90 q-s	2.00 a	1.30 b-e	1172.00 f-h	616.70 p-r
24	BD-4095	61.00 h-k	2.00 a	1.35 b-d	1267.00 e	688.90 n-p
25	BD-4097	61.60 h-k	2.00 a	1.35 b-d	1183.00 fg	750.00 l-o
26	BD-4102	61.80 h-j	2.00 a	1.45 b	1153.00 f-i	827.80 i-m
27	BD-4105	44.85 tu	2.00 a	1.45 b	1083.00 jk	972.20 d-g
28	BD-4115	52.15 n-q	2.00 a	1.30 b-e	1014.00 lm	944.40 e-h
29	BD-4127	41.50 uv	1.90 ab	1.00 f	969.40 m	827.80 i-m
30	BD-4134	39.60 vw	2.00 a	1.35 b-d	919.40 n	1089.00 c
31	BD-5982	81.10 d	2.00 a	1.30 b-e	833.30 p	788.90 k-n
32	BD-5983	53.50 no	2.00 a	1.45 b	1139.00 f-j	1389.00 a
33	BD-5986	61.20 h-k	2.00 a	2.10 a	1094.00 jk	972.20 d-g
34	BD-5989	75.50 ef	2.00 a	1.30 b-e	747.20 q	1278.00 b
35	BD-5991	53.10 n-p	2.00 a	1.35 b-d	861.10 op	788.90 k-n
36	BD-5992	45.60 st	2.00 a	1.35 b-d	900.00 no	1261.00 b
37	BD-5993	60.60 h-k	2.00 a	1.35 b-d	1117.00 h-k	927.80 e-i
38	BD-5996	63.75 h	2.00 a	1.10 ef	1069.00 k	1000.80 c-f
39	BARI masur-7	91.90 b	2.00 a	1.45 b	1180.60 fg	1067.00 cd
40	Local check	87.55 c	2.00 a	1.35 b-d	1083.30 jk	844.40 h-l
LSD (0.05)		3.44	0.18	0.19	8.66	96.24
CV (%)		2.81	4.43	7.24	5.32	5.32

4. Discussion

It was observed that the tested lentil lines/verities differed significantly in respect of plant height, number of pods per plant, number of branches per plant, 100 seed weight and yield. The variation of the materials in respect of above parameters may be due to i) Stemphylium blight diseases reaction to the respective materials. ii) genetic constitution and variation of materials and iii) environmental effect of the growing period in the field. The findings of the study is closely related with the study of Islam and Shaikh (1978), Sarwer *et al*. (1982), Saraf *et al*. (1985), Zaman *et al*. (1989). They reported that the lentil line differed significantly in respect of agronomic traits and yield parameters. Regarding the variation in yield of lentil due to Stemphylium blight was observed that the lines/verities differed significantly from one to another. This variation may be due to i) the effect of *Stemphylium botryosum* on formation of pod. ii) variations of genetic make up of lentil lines/verities

and iii) growing conditions of plants. Bakr (1993), Mwakutuy (2002), Neubauer (1998) reported yield reduction of lentil due to Stemphylium blight. They were described that yield reduction of lentil increased with the increasing of Stemphylium blight disease severity.

With the findings of the present study it may be concluded that the materials of lentil that showed resistant reaction in November-2011 to April-2012 to *S. botryosum* need to be tested for furthers conformation of the result of this study. In the experimental period it was concluded that after harvesting of all lines/varieties it can be seen that nine lines/varieties were gave highest yield 1028 to 1389 (kg ha^{-1}) viz. BD-3931, BD-3943, BD-3948, BD-3974, BD-4134, BD-5983, BD-5989, BD-5992 and BARI Masur-7.

5. Conclusions

Stemphylium blight of lentil caused by *Stemphylium botryosum* is considered now a days as one of the most important constrains of lentil production in Bangladesh. The tested lentil lines/verities differed significantly from one to another in respect of growth and yield contributing parameters. Minimum days of 1st flowering recorded in BD-3927, BARI masur-7, BD-3930, BD-3943, BD-3948, BD-4054, BD-4102 and 50% flowering recorded in BD-3922. Minimum days of maturity were recorded in BD-3924 and BD-3927. Minimum weight of 100 seeds, grain yield and biological yield recorded in the BD-5989, BD-4024, BD-5989, respectively and minimum number of branches per plant and no. of pods per plant was recorded in BD-4097 and BD-4053 respectively. The maximum no. of pods per plant and biological yield (kg/ha) was recorded in a single line/varieties BD-3922 and BD-4053; maximum days to maturity & no. of branches was found in BD-4024 and BD-3936 and weight of 100 seeds, yield in kg per hectare (grain yield) was found in BD-5986 and BD-5983 respectively. After harvesting the all of lines/varieties it can be seen that nine lines/varieties were gave highest yield (kg/ha) 1028 to 1389 (kg/ha) viz. BD-3931, BD-3943, BD-3948, BD-3974, BD-4134, BD-5983, BD-5989, BD-5992 and BARI Masur-7. From the above discussion it can be concluded that the tested lentil lines/verities differed significantly in respect of plant height, number of pods per plant, number of branches per plant, 100 seed weight & yield. So these lines/verities can be used as resistant genetic material for further study in genetic engineering to create new varieties/lines by transferring the resistant gene in high yielding local susceptible varieties.

Conflict of interest

None to declare.

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