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MORPHOLOGICAL EVALUATION AND YIELD PERFORMANCE OF LENTIL GENOTYPES AGAINST *STEMPHYLIUM BLIGHT*

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Abstract

Experiment was designed to screen out lentil genotypes against *Stemphylium blight* (SB). Thirty-five test genotypes along with one moderately susceptible popular local control 'Moitree' were grown under natural epiphytotic condition in the farm of BCKV during 2020-21 and 2021-22. Genotypes wise crop phenological characters, yield and disease severity data were recorded. The result revealed, genotypes ILL10838/ILWL11/X2016S was resistant to SB with highest yield (1184.00 kg/ha) followed by 8114/10956/16-1 (1112.20 kg/ha) and IPL 220 (1072.90 kg/ha) with moderately resistant reaction. Pooled analysis of two years experimental data used to develop the model Y = 336.21 + 6.12x [R^2 = 0.86] explained that there is an increase of yield 6.12 kg/ha with every 1 unit increase in the number of pods per plant. Correlation of determination value (R^2 = 0.86) proved the feasibility of the model. Lentil genotypes ILL10838/ ILWL11/X2016S and 8114/10956/16-1 are the best suited for its cultivation and may scaled up for future breeding programme.

Introduction

Lentil (*Lens culinaris* Medikus) is the one of the most nutritious cool season pulses in India. India ranks first in area and second in production by sharing 39.79 and 22.79% of the world area and production, respectively. Lentil occupies 1.47 million ha of land in India, producing arround 1.49 million tonnes with productivity of 1017.40 kg/ha (FAOSTAT 2021). Lentil seeds are highly valued for its high content of protein 26.4%, with low content of fat and good source of minerals. Despite of its huge prospective, the productivity of lentil is compromised due to the production strategies followed by the farmers, lack of knowledge about the suitability of variety for a particular region and the occurrence of various biotic and abiotic stress at different growth stages.

Among the biotic stresses, Stemphylium blight (SB) is of major concern as it poses potential threat of total yield loss upto 62-93.4% (Mandal *et al.* 2019). *Stemphylium* attacks during flowering to early pod formation stage and causes severe defoliation. Dropped leaves act as a reservoir of spores for future infection. Upsurge of disease severity take place with the production of enormous airborne conidia responsible for secondary spread of the pathogen and was reported to cause 80 to 100% yield loss in the epidemic year (Hosen *et al.* 2009).

Several researchers have reported different fungicides to mitigate the disease (Islam *et al.* 2019; Das *et al.* 2017) but considering environmental well-being adopting chemical methods is not holistic (Javaid *et al.* 2020). One of the finest strategies to manage the disease as well as to improve the productivity is the use of resistant genotypes along with good agronomic traits of high yield for future breeding programme. Significant works had been done by several scientists to find the best performed varieties (Reja *et al.* 2017; Nalia *et al.* 2019) but till date there is no report of highly stable resistant lentil genotypes against SB.

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In this context, an experiment was set up to evaluate the best performed lentil genotypes under New Alluvial Zones of West Bengal considering its sustainability to grow in this region, yield potential and disease resistance to SB to meet the global demand for lentils.

Material and Methods

A total of thirty-five lentil genotypes were obtained from ICARDA were screened for resistance against SB along with one susceptible locally grown variety Moitree (WBL-77) as control. Henceforth the genotypes will be designated in this way.

Geno types	Genotypes entry	Genotypes	Genotypes entry	Genotypes	Genotypes entry
G1	EC 267563	G13	ILL10838/ILWL11/X2016S	G25	IC127577
G2	EC 267657	G14	10848/DPL62/8-1	G26	99/209/ILWL118-S1
G3	EC 267604	G15	7979/DPL62/7-1	G27	EC223219
G4	L-4147(ch)	G16	IC554116	G28	IPL526
G5	EC 267544A	G17	7979/DPL62/2	G29	4605/99/209/1-2
G6	EC 223219	G18	LIRL22-107/LIRL21-50-1-1-1	G30	ILL5888
G7	EC 267636	G19	FLIP2014-116L-S1	G31	8114/10956/16-1
G8	EC 267598	G20	IC14189	G32	ILL7978/ILL6037/S6
G9	EC 78408	G21	8114/10956/18-5	G33	6002/LIRL21-50-1-1-1/2-2
G10	IPL 220(ch)	G22	7978/ILWL118/2-4	G34	ILL10829 X ILWL130 (R-57)
G11	LIRL21-50-1-1-1/DPL62/12-2	G23	5588/4372/3-4	G35	ILL6002/ILL6037/X2014S
G12	EC241476	G24	EC267636	G36	WBL 77 (Moitree) Control

The experiment was carried out in the year 2020-21 and 2021-22 at "District Seed Farm", Kalyani Simanta under the aegis of Bidhan Chandra Krishi Viswavidyalaya (BCKV), WB, India. The farm is located at an altitude of 11 m msl with latitude of 22º 98′ N and longitude of 88º43′ E and it comes under New alluvial zone (NAZ) of WB which belongs to sub-humid subtropical climatic region with sandy loam type of soil.

Seeds of lentil genotypes were sown during third week of November in each year following randomized complete block design (RCBD) with 3 replications along with standard agronomic practices. Each plot comprised of 4 m row with 25 × 10 cm row-to-row and plant-to-plant spacing, respectively. The genotypes were planted in the field following infector row technique *i.e.* after each four lines of test genotypes, one line of susceptible variety (WBL 77) was planted to build disease pressure under natural epiphytotic condition.

Observations on SB severity was recorded at weekly intervals just after the appearance of the symptoms up to one week before harvest. Based on the percentage of infection in each genotype, grouping was done following 1-9 scale. Six distinct groups denoted as 0= immune (no infection); 1= resistant (less than 10% foliage infection); 3= moderately resistant (30 % foliage infection); 5= moderately susceptible (50% foliage infection); 7= susceptible (70% foliage infection); and 9 = Highly susceptible (greater than 70% foliage infection) Mandal *et al.* (2019). The formula used to calculate the disease severity is given below:

$$\text{Disease severity} = \frac{\sum[\text{No of plants/scale} \times \text{scale value}]}{\text{Total number of observation} \times \text{highest scale}} \times 100$$

Area under the disease progress curve (AUDPC) is used to quantify the disease over the period of time as per the formula given by Campbell and Madden (1990).

$$\text{AUDPC} = \sum_{i=1}^{n-1} \left(\frac{\text{Yi} + \text{Yi+l}}{2}\right)(t_{i+1} - t_i)$$

where, yi = disease severity at the i^{th} observation, ti = time in days at the i^{th} observation and n = total number of observations

For studying the morphological characters, three superior plants from each line were chosen and tagged. Data on the morphological traits *i.e.* number of primary branches, secondary branches, plant height, days to flowering when the 1st flower open, days to 50% flowering (when 50% plants in the row sets the first flower), days to maturity (when 90% of the row is ready for harvest), pods per plant, seeds per pod, 100-seed weight (g) and seed yield (kg/ha) were noted from the tagged plants.

Five plants were randomly chosen and tagged from each genotype for scoring disease severity. Data collection was started just after the initiation of the disease at an interval of 7 days and continued upto one week before harvest. Yield data were recorded plot wise and converted into seed yield.

Microsoft Excel 2013 and Genstat Version 15.1.0.8035 were used for ANOVA preparation, means comparison, correlation and regression analysis whereas, GraphPad Prism 9.3.0.4 was used for data visualization.

Results and Discussion

Among the thirty-six lentil varieties characterized phenologically grown during rabi seasons showed significant difference in terms of plant height, number of primary branches, number of secondary branches, days to 50% flowering and days to maturity (Table 1). Plant height ranged from 41.97 to 53.57 cm and 35.90 to 62.27 cm in both the experimental years, respectively. Pooled mean over the two experimental years showed that the tallest plant is G34 (56.47 cm) and shortest plant is G5 (39.32cm).

The first branching of the plant is counted as the primary branch of the plant. Most of the genotypes produced two primary branches yet only a few lines produced three primary branches. Number of primary branches per plant varied by 2 to 3.33. The highest number of branches per plant was observed in G8, and control (3.33). Pooled data exhibited maximum number of primary branches in the control variety G36 (3.17) (Table 1).

In the year 2020-21, the number of secondary branches per plant ranged from 12.67 to 18.33 and significant lowest number of secondary branches recorded in G3 (12.67) and highest in G23 and G29 (18.33). In the year 2021-22, significant lowest number of secondary branches per plant recorded in control G36 (8.33) but highest number of secondary branches produced in G10 (21.66). Pooled data revealed maximum number of secondary branches per plant was in the genotypes G5 (18.83) and minimum in G3 (12.33) (Table 1).

Significant level of variation was noted in days to 50% flowering. In both the years, the genotypes took 73-83 days to attain 50% flowering. Owing to the pooled analysis, the genotypes G30 and G12 took maximum days *i.e.* 83 days to reach 50% flowering followed by G33, and G35 (82 days) whereas the control G36 was the fastest, took only 74 days (Table 1).

Table 1. Morphological and phenological traits of lentil genotypes during 2020-21 and 2021-22 under New Alluvial Zones of West Bengal.

Genotypes	Plant height (cm)			No. of primary branches			No. of secondary branches			Days to 50% flowering (DAS)			Days to maturity (DAS)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
G1	47.83^{a-d}	46.97^{e-l}	47.40^{c-h}	2.67^{ab}	2.67^{cd}	2.67^{b-e}	17^{abc}	15.67^{ghi}	16.33^{d-i}	78^{cde}	77^{b-h}	78^{d-l}	110^{abc}	110^{abc}	110^{ab}
G2	52.30^{cd}	47.23^{e-m}	49.77^{c-k}	3.00^{ab}	3.00^{d}	3.00^{de}	16.67^{abc}	20.33^{jk}	18.50^{hi}	78^{a-e}	80^{e-l}	79^{f-p}	110^{abc}	110^{abc}	110^{ab}
G3	46.77^{a-d}	45.87^{e-k}	46.32^{b-f}	3.00^{ab}	2.33^{bcd}	2.67^{b-e}	16.67^{abc}	13.67^{c-h}	15.17^{b-g}	79^{c-f}	75^{abc}	77^{c-j}	112^{a-d}	112^{a-d}	113^{efg}
G4	44.83^{abc}	38.97^{abc}	41.90^{ab}	3.00^{ab}	2.33^{bcd}	2.67^{b-e}	13.33^{abc}	20.33^{jk}	16.83^{e-i}	80^{def}	78^{c-j}	79^{g-p}	113^{cde}	113^{cde}	113^{d-g}
G5	42.73^{ab}	35.90^{a}	39.32^{a}	2.67^{ab}	2.67^{cd}	2.67^{b-e}	17.33^{abc}	20.33^{jk}	18.83^{i}	78^{b-e}	81^{i-n}	80^{i-q}	112^{a-d}	112^{a-d}	112^{a-f}
G6	49.33^{a-d}	43.77^{c-g}	46.55^{b-g}	2.00^{a}	2.00^{abc}	2.00^{ab}	17.33^{abc}	16.33^{hi}	16.83^{e-i}	78^{b-e}	76^{a-d}	77^{b-i}	111^{a-d}	111^{a-d}	110^{a-d}
G7	48.00^{abcd}	42.70^{b-e}	45.35^{b-e}	2.67^{ab}	2.00^{abc}	2.33^{a-d}	15.33^{abc}	14.33^{e-h}	14.83^{a-g}	75^{a-d}	80^{e-l}	77^{c-k}	111^{a-d}	111^{a-d}	110^{a-d}
G8	48.10^{a-d}	44.97^{d-j}	46.53^{b-g}	3.33^{b}	2.33^{bcd}	2.83^{cde}	16.33^{abc}	13.67^{c-h}	15^{ab-g}	80^{ef}	80^{e-l}	80^{j-q}	112^{a-d}	112^{a-d}	112^{a-g}
G9	45.87^{a-d}	44.30^{c-h}	45.08^{bcd}	2.67^{ab}	2.33^{bcd}	2.5^{b-e}	18^{bc}	14.00^{d-h}	16.00^{c-h}	73^{ab}	75^{abc}	74^{ab}	111^{a-d}	111^{a-d}	111^{a-e}
G10	43.00^{ab}	59.80^{rs}	51.40^{f-l}	2.67^{ab}	2.67^{cd}	2.67^{b-e}	15.33^{abc}	21.67^{k}	18.50^{hi}	74^{abc}	75^{abc}	75^{abc}	110^{a-d}	110^{a-d}	111^{a-e}
G11	41.97^{a}	53.70^{n-q}	47.83^{c-h}	3.00^{ab}	2.00^{abc}	2.5^{b-e}	14.33^{abc}	13.00^{b-g}	13.67^{a-d}	75^{a-d}	76^{a-f}	76^{a-f}	109^{ab}	109^{ab}	110^{ab}
G12	49.13^{a-d}	50.90^{j-n}	50.02^{d-k}	3.00^{ab}	2.67^{cd}	2.83^{cde}	18^{bc}	16.33^{hi}	17.17^{ghi}	77^{a-e}	83^{ln}	80^{k-q}	111^{a-d}	111^{a-d}	113^{c-g}
G13	51.10^{bcd}	57.83^{p-s}	54.47^{klm}	2.00^{a}	2.33^{a}	2.17^{a}	13.33^{abc}	15.33^{f-i}	14.33^{a-f}	77^{a-e}	78^{c-j}	78^{d-m}	110^{a-d}	110^{a-d}	111^{a-e}
G14	47.67^{abcd}	53.27^{m-p}	50.47^{e-k}	2.33^{ab}	2.67^{cd}	2.5^{b-e}	13^{ab}	13.67^{c-h}	13.33^{abc}	73^{a}	80^{f-n}	77^{b-h}	110^{a-d}	110^{a-d}	111^{a-e}
G15	46.03^{a-d}	37.40^{ab}	41.72^{ab}	3.00^{ab}	2.00^{abc}	2.5^{b-e}	16^{abc}	18.00^{ij}	17.00^{f-i}	78^{a-e}	81^{i-n}	79^{h-q}	110^{a-d}	110^{a-d}	112^{a-g}
G16	49.00^{a-d}	51.90^{k-o}	50.45^{e-k}	2.33^{ab}	2.33^{bcd}	2.33^{a-d}	17.33^{abc}	19.33^{jk}	18.33^{hi}	75^{a-d}	80^{e-m}	78^{d-k}	109^{ab}	109^{ab}	111^{a-e}
G17	46.10^{a-d}	50.13^{h-n}	48.12^{c-h}	2.33^{ab}	2.34^{ab}	2.00^{ab}	17^{abc}	13.33^{b-h}	15.17^{a-g}	77^{a-e}	76^{a-e}	77^{b-i}	110^{a-d}	110^{a-d}	110^{abc}
G18	47.23^{a-d}	50.63^{i-n}	48.93^{c-j}	2.33^{ab}	2.67^{cd}	2.50^{b-e}	17.33^{abc}	19.33^{jk}	18.33^{hi}	76^{a-e}	78^{c-j}	77^{b-j}	110^{a-d}	110^{a-d}	110^{abc}
G19	49.63^{a-d}	39.53^{a-d}	44.58^{bc}	2.67^{ab}	2.33^{bcd}	2.50^{b-e}	17.67^{abc}	14.33^{e-h}	16.00^{c-h}	79^{def}	77^{b-i}	78^{e-p}	112^{a-d}	112^{a-d}	111^{a-e}
G20	45.63^{a-d}	49.03^{f-n}	47.33^{c-h}	2.33^{ab}	2.00^{abc}	2.17^{abc}	15.67^{abc}	11.67^{b-e}	13.67^{a-d}	78^{b-e}	75^{abc}	76^{a-g}	112^{a-d}	112^{a-d}	110^{abc}
G21	48.27^{a-d}	43.70^{c-f}	45.98^{b-e}	2.67^{ab}	2.33^{bcd}	2.5^{b-e}	15^{abc}	10.67^{abc}	12.83^{ab}	76^{a-e}	77^{b-i}	77^{b-i}	108^{a}	108^{a}	111^{a-e}
G22	45.47^{a-d}	52.00^{l-o}	48.73^{c-i}	2.67^{ab}	2.67^{cd}	2.67^{b-e}	15^{abc}	10.33^{ab}	12.67^{ab}	79^{def}	79^{d-k}	79^{h-q}	111^{a-d}	111^{a-d}	111^{a-e}
G23	48.17^{a-d}	59.90^{rs}	54.03^{j-m}	2.00^{a}	2.33^{bcd}	2.17^{abc}	18.33^{c}	10.33^{ab}	14.33^{a-f}	75^{a-d}	80^{g-n}	78^{d-n}	111^{a-d}	111^{a-d}	113^{efg}
G24	44.27^{abc}	58.30^{p-s}	51.28^{f-l}	2.33^{ab}	3.00^{d}	2.67^{b-e}	16^{abc}	15.67^{ghi}	15.83^{c-h}	76^{a-e}	77^{b-h}	77^{b-h}	112^{bcd}	112^{bcd}	113^{d-g}
G25	45.30^{a-d}	62.27^{s}	53.78^{i-m}	2.00^{a}	3.00^{d}	2.50^{b-e}	15.33^{abc}	10.33^{ab}	12.83^{ab}	77^{a-e}	73^{a}	75^{a-d}	112^{a-d}	112^{a-d}	111^{a-e}
G26	46.93^{a-d}	44.47^{c-h}	45.7^{b-e}	2.33^{ab}	3.00^{d}	2.67^{b-e}	14.33^{abc}	11.33^{a-e}	12.83^{ab}	77^{a-e}	74^{ab}	76^{a-e}	116^{e}	116^{e}	115^{g}
G27	44.30^{abc}	50.03^{h-n}	47.17^{c-h}	2.33^{ab}	2.00^{abc}	2.17^{abc}	14.33^{abc}	11^{abcd}	12.67^{ab}	79^{def}	76^{a-f}	78^{d-o}	110^{a-d}	110^{a-d}	112^{a-g}
G28	47.37^{a-d}	44.60^{c-i}	45.98^{b-e}	3.00^{ab}	2.33^{bcd}	2.67^{b-e}	14.67^{abc}	10.67^{abc}	12.67^{ab}	80^{ef}	81^{h-n}	81^{l-q}	110^{a-d}	110^{a-d}	111^{a-e}
G29	49.47^{a-d}	54.10^{n-r}	51.78^{g-m}	2.33^{ab}	2.00^{abc}	2.17^{abc}	18.33^{c}	15.67^{ghi}	17.00^{f-i}	74^{abc}	82^{k-n}	78^{e-p}	111^{a-d}	111^{a-d}	113^{d-g}
G30	46.83^{a-d}	49.67^{f-n}	48.25^{c-h}	2.67^{ab}	2.67^{cd}	2.67^{b-e}	14.67^{abc}	13.33^{b-h}	14.00^{a-d}	83^{f}	81^{h-n}	82^{q}	112^{bcd}	112^{bcd}	113^{d-g}
G31	49.03^{a-d}	44.60^{c-i}	46.82^{b-g}	3.00^{ab}	2.00^{abc}	2.5^{b-e}	12.67^{a}	15.00^{fghi}	13.83^{a-d}	77^{a-e}	77^{a-g}	77^{b-i}	110^{a-d}	110^{a-d}	109^{a}
G32	46.63^{a-d}	57.53^{o-s}	52.08^{h-m}	2.33^{ab}	3.00^{d}	2.67^{b-e}	14.33^{abc}	10.33^{ab}	12.33^{a}	76^{a-e}	75^{abc}	76^{a-f}	112^{a-d}	112^{a-d}	112^{a-g}
G33	46.73^{a-d}	45.17^{d-j}	45.95^{b-e}	2.67^{ab}	2.33^{bcd}	2.50^{b-e}	15.00^{abc}	13.33^{b-h}	14.17^{a-e}	80^{def}	82^{j-n}	81^{pq}	112^{bcd}	112^{bcd}	113^{d-g}
G34	53.57^{d}	59.33^{qrs}	56.45^{m}	2.33^{ab}	3.00^{d}	2.67^{b-e}	15.67^{abc}	12.33^{b-f}	14.00^{a-d}	80^{def}	80^{g-n}	80^{j-q}	112^{a-d}	112^{a-d}	112^{b-g}
G35	50.00^{a-d}	61.57^{s}	55.78^{lm}	3.00^{ab}	2.67^{cd}	2.83^{cde}	16.67^{abc}	10.33^{ab}	13.50^{abc}	81^{ef}	81^{h-n}	81^{npq}	114de	114de	114^{fg}
G36 (Control)	48.8^{a-d}	49.88^{g-n}	49.34^{c-k}	3.33^{b}	3.00^{d}	3.17^{e}	16.67^{abc}	8.33^{a}	12.50^{ab}	73^{ab}	74^{ab}	74^{a}	110^{a-d}	110^{a-d}	110^{ab}
SEM±	2.48	1.81	1.52	0.36	0.25	0.22	1.47	0.93	0.81	1.41	1.09	0.83	1.12	0.67	0.783
CD (α=0.05)	6.99	5.11	4.29	1.02	0.72	0.62	4.15	2.61	2.30	3.92	3.06	2.34	3.15	1.88	2.207
CV	9.1	6.3	5.5	23.9	18.1	15.2	16.1	11.2	9.4	3.1	2.4	1.8	1.7	1.0	1.2

*Same alphabets followed by mean are not significantly different from each other.

Table 2. Yield attributes of lentil genotypes during 2020-21 and 2021-22 under New Alluvial Zones of West Bengal.

Genotypes	No. of pods/ plant			No. of seeds/ pod			Pod length (cm)			100 seed weight (g)			Yield (kg/ha)			Increase in yield %
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	
G1	102.67^{j}	106.00^{lm}	104.30^{j}	1.67^{a}	1.67^{bc}	1.67^{bc}	2.27^{ab}	2.07^{b-e}	2.07^{c-g}	3.07^{a-i}	2.42^{ghi}	2.75^{c-f}	957.80^{cde}	967.30^{v}	962.50^{ghi}	0.34
G2	99.33^{i}	105.30^{kl}	102.30^{i}	2.00^{a}	2.00^{c}	2.00^{c}	2.13^{ab}	2.03^{b-e}	2.03^{b-f}	2.97^{a-i}	2.51^{g-j}	2.74^{c-f}	941.00^{bc}	957.10^{t}	949.00^{g}	-
G3	92.00^{fg}	92.70^{de}	92.30^{d}	2.00^{a}	2.00^{c}	2.00^{c}	2.10^{ab}	2.03^{b-e}	2.03^{b-e}	2.42^{a-e}	2.01^{ab}	2.22^{abc}	905.90^{ab}	914.90^{m}	910.40^{def}	-
G4	85.00^{a}	88.70^{ab}	86.80^{a}	1.67^{a}	2.00^{c}	1.83^{bc}	2.13^{ab}	1.97^{b-e}	1.97^{b-e}	2.07^{a}	2.09^{bc}	2.08^{a}	884.70^{a}	883.50^{a}	884.10^{a}	-
G5	94.33^{gh}	99.70^{i}	97.00^{fg}	1.67^{a}	1.33^{ab}	1.5^{ab}	2.13^{ab}	2.03^{b-e}	2.03^{b-f}	2.58^{a-f}	2.41^{fgh}	2.5^{a-e}	911.50^{ab}	906.40^{h}	908.90^{def}	-
G6	90.00^{cef}	95.30^{f}	92.70^{d}	1.67^{a}	1.67^{bc}	1.67^{bc}	2.33^{b}	2.07^{b-e}	2.07^{d-g}	2.35^{a-d}	3.09^{lm}	2.72^{b-f}	902.50^{ab}	903.40^{g}	903.00^{a-f}	-
G7	105.67^{klm}	108.00^{no}	106.80^{k}	2.00^{a}	1.00^{a}	1.5^{ab}	2.17^{ab}	2.07^{b-e}	2.07^{b-g}	3.25^{b-i}	2.16^{bcd}	2.7^{b-f}	959.20^{cde}	954.00^{r}	956.60^{gh}	-
G8	92.67^{fgh}	93.30^{e}	93.00^{d}	2.00^{a}	2.00^{c}	2.00^{c}	2.13^{ab}	1.80^{b}	1.80^{bc}	2.45^{a-e}	1.88^{a}	2.17^{ab}	905.40^{ab}	913.90^{l}	909.70^{def}	-
G9	87.00^{abc}	91.30^{cd}	89.20^{b}	1.67^{a}	2.00^{c}	1.83^{bc}	2.20^{ab}	1.93^{b-e}	1.93^{b-e}	2.1^{ab}	2.17^{b-e}	2.14^{a}	885.10^{a}	900.80^{e}	892.90^{a-d}	-
G10	111.67^{pq}	113.70^{pq}	112.70^{mn}	2.00^{a}	1.00^{a}	1.5^{ab}	2.13^{ab}	1.87^{bcd}	1.87^{bcd}	3.62^{f-i}	3.22^{mn}	3.42^{g-j}	1053.40^{g}	1092.40^{F}	1072.90^{n}	11.85
G11	113.33^{qr}	113.30^{p}	113.30^{n}	2.00^{a}	2.00^{c}	2.00^{c}	2.33^{b}	2.03^{b-e}	2.03^{d-g}	3.84^{hi}	2.66^{jk}	3.25^{f-i}	1067.30^{g}	1002.30^{C}	1034.80^{m}	7.88
G12	91.67^{fg}	90.70^{c}	91.20^{cd}	1.67^{a}	1.33^{ab}	1.5^{ab}	1.97^{a}	2.07^{b-e}	2.07^{b-e}	2.51^{a-f}	2.08^{bc}	2.3^{a-d}	904.50^{ab}	909.00^{i}	906.70^{b-f}	-
G13	118.00^{t}	119.30^{s}	118.70^{p}	1.67^{a}	2.00^{c}	1.83^{bc}	2.10^{ab}	2.07^{b-e}	2.08^{b-f}	5.96^{j}	5.84^{s}	5.9^{l}	1160.40^{i}	1207.50^{h}	1184.00^{p}	23.44
G14	110.33^{op}	115.00^{q}	112.70^{mn}	1.33^{a}	1.00^{a}	1.17^{a}	2.17^{ab}	2.00^{b-e}	2.00^{b-f}	3.96^{i}	2.97^{l}	3.46^{g-j}	993.60^{ef}	991.00^{B}	992.30^{kl}	3.45
G15	88.33^{b-e}	90.70^{c}	89.50^{bc}	2.00^{a}	2.00^{c}	2.00^{c}	2.20^{ab}	2.07^{b-e}	2.07^{b-g}	2.21^{abc}	3.93^{q}	3.07^{fg}	896.10^{a}	897.00^{d}	896.50^{a-e}	-
G16	94.00^{gh}	96.70^{fg}	95.30^{ef}	2.00^{a}	1.67^{bc}	1.83^{bc}	2.20^{ab}	1.93^{b-e}	1.93^{b-e}	2.61^{a-f}	4.23^{r}	3.42^{g-j}	909.90^{ab}	910.60^{k}	910.30^{def}	-
G17	114.67^{rs}	118.30^{rs}	116.50^{o}	2.00^{a}	1.00^{a}	1.5^{ab}	2.13^{ab}	2.00^{b-e}	2.00^{bcde}	3.95^{i}	3.52^{o}	3.74^{ijk}	1073.50^{gh}	1010.00^{D}	1041.70^{m}	8.60
G18	109.00^{nop}	112.30^{p}	110.70^{l}	2.00^{a}	2.00^{c}	2.00^{c}	2.13^{ab}	2.10^{c-f}	2.10^{b-g}	3.91^{i}	4.22^{r}	4.06^{k}	994.30^{ef}	1010.50^{E}	1002.40^{l}	4.50
G19	107.67^{mno}	108.70^{o}	108.20^{k}	1.67^{a}	2.00^{c}	1.83^{bc}	2.13^{ab}	1.37^{a}	1.37^{a}	3.43^{d-i}	2.74^{k}	3.08^{fg}	975.20^{c-f}	970.70^{w}	973.00^{hij}	1.43
G20	104^{jkl}	102.70^{j}	103.30^{ij}	1.67^{a}	2.00^{c}	1.83^{bc}	2.20^{ab}	2.20^{ef}	2.20^{d-g}	3.11^{a-i}	3.25^{mn}	3.18^{fgh}	964.10^{c-f}	983.50^{z}	973.80^{h-k}	1.52
G21	95.33^{h}	97.70^{g}	96.50^{efg}	2.00^{a}	2.00^{c}	2.00^{c}	2.17^{ab}	1.83^{bc}	1.83^{bcd}	2.66^{a-f}	2.32^{d-g}	2.49^{a-e}	914.60^{ab}	921.70^{q}	918.20^{f}	-
G22	87.00^{a-d}	88.70^{ab}	87.80^{ab}	2.00^{a}	2.00^{c}	2.00^{c}	2.30^{b}	2.13^{def}	2.13^{efg}	2.15^{ab}	3.37^{no}	2.76^{c-f}	887.80^{a}	887.00^{b}	887.40^{ab}	-
G23	102.33^{j}	1070^{mn}	104.70^{j}	1.67^{a}	2.00^{c}	1.83^{bc}	2.20^{ab}	1.87^{bcd}	1.87^{b-e}	3.22^{a-i}	2.35^{efg}	2.79^{def}	953.70^{cd}	956.70^{s}	955.20^{gh}	-
G24	94.00^{gh}	95.70^{f}	94.80^{e}	2.00^{a}	2.00^{c}	2.00^{c}	2.13^{ab}	2.03^{b-e}	2.03^{b-f}	2.63^{a-f}	3.03^{l}	2.83^{def}	911.60^{ab}	919.00^{o}	915.30^{ef}	-
G25	95.33^{h}	99.30^{hi}	97.30^{g}	2.00^{a}	2.00^{c}	2.00^{c}	2.20^{ab}	1.97^{b-e}	1.97^{b-f}	2.75^{a-h}	3.37^{no}	3.06^{fg}	915.40^{ab}	917.7.00^{n}	916.50^{ef}	-
G26	106.67^{lmn}	109.70^{o}	108.20^{k}	2.00^{a}	2.00^{c}	2.00^{c}	2.23^{ab}	1.87^{bcd}	1.87^{b-e}	3.52^{e-i}	2.6^{ijk}	3.06^{fg}	984.80^{def}	977.00^{x}	980.90^{ijk}	2.26
G27	103.00^{jk}	92.70^{de}	97.80^{g}	1.67^{a}	2.00^{c}	1.83^{bc}	2.23^{ab}	1.9^{bcd}	1.90^{b-e}	3.03^{a-i}	3.94^{q}	3.49^{g-j}	962.40^{c-f}	961.90^{u}	962.10^{ghi}	0.30
G28	108.33^{mno}	109.00^{o}	108.70^{k}	1.67^{a}	1.33^{ab}	1.5^{ab}	2.07^{ab}	1.83^{bc}	1.83^{b}	3.81^{ghi}	3.93^{q}	3.87^{jk}	994.30^{ef}	987.90^{A}	991.10^{jkl}	3.32
G29	94.67^{gh}	98.00^{gh}	96.30^{efg}	2.00^{a}	2.00^{c}	2.00^{c}	2.20^{ab}	2.00^{b-e}	2.00^{b-g}	2.71^{a-h}	2.23^{c-f}	2.47^{a-e}	916.00^{ab}	920.80^{p}	918.40^{f}	-
G30	90.00^{c-f}	93.30^{e}	91.70^{d}	1.67^{a}	2.00^{c}	1.83^{bc}	2.20^{ab}	1.97^{b-e}	1.97^{b-f}	2.39^{a-e}	2.59^{h-k}	2.49^{a-e}	897.60^{a}	902.80^{f}	900.20^{a-f}	-
G31	116.67st	117.00^{r}	116.80^{o}	1.67^{a}	2.00^{c}	1.83^{bc}	2.27^{ab}	2.33^{fg}	2.33^{g}	3.92^{i}	3.72^{p}	3.82^{jk}	1107.40^{h}	1117.00^{G}	1112.20^{o}	15.95
G32	106.67^{lmn}	109.00^{o}	107.80^{k}	1.67^{a}	2.00^{c}	1.83^{bc}	2.17^{ab}	1.9^{bcd}	1.90^{b-e}	3.32^{c-i}	2.61^{ijk}	2.96^{efg}	963.80^{c-f}	982.00^{y}	972.90^{hij}	1.42
G33	86.00^{ab}	87.70^{a}	86.80^{a}	2.00^{a}	2.00^{c}	2.00^{c}	2.23^{ab}	1.93^{b-e}	1.93^{b-f}	2.94^{a-i}	2.62^{jk}	2.78^{def}	886.40^{a}	891.20^{c}	888.80^{abc}	-
G34	89.67^{c-f}	89.70^{bc}	89.70^{bc}	1.67^{a}	2.00^{c}	1.83^{bc}	2.30^{b}	1.93^{b-e}	1.93^{b-g}	2.29^{abcd}	3.09^{lm}	2.69^{b-f}	902.20^{ab}	909.90^{j}	906.10^{b-f}	-
G35	95.67^{h}	104.30^{k}	100.00^{h}	2.00^{a}	1.33^{ab}	1.67^{bc}	2.07^{ab}	2.50^{g}	2.50^{fg}	2.69^{a-g}	3.81^{pq}	3.25^{f-i}	905.00^{ab}	910.90^{k}	907.90^{c-f}	-
G36 (Control)	109.67^{nop}	112.70^{p}	111.20^{lm}	1.67^{a}	2.00^{c}	1.83^{bc}	2.13^{ab}	1.93^{b-e}	1.93^{b-e}	3.93^{i}	3.35^{no}	3.64^{h-k}	1001.00^{f}	917.50^{n}	959.20^{gh}	0.00
SEM±	0.98	0.78	0.64	0.24	0.17	0.13	0.09	0.079	0.060	0.33	0.06	0.17	2.08	1.96	6.03	-
CD(α=0.05)	2.76	1.57	1.71	3.67	2.45	1.35	2.61	2.23	1.69	1.03	0.171	1.47	4.08	3.27	8.01	-
CV	11.7	12.9	11.42	21.8	14.2	11.9	7.4	6.9	5.0	8.7	3.5	9.5	12.2	13.12	14.1	-

*Same alphabets followed by mean are not significantly different from each other.

Days to maturity of all the test lines and control variety ranged from 109-116 days. According to pooled data the maximum days to maturity was recorded in G26 (115 days) followed by G35 (114 days) and the lowest 109 days in G31 (Table 1).

The test genotypes differed significantly in respect to yield and yield variants. In both the years highest number of pods per plant was recorded in G13 (118.0 to 119.30) and G31(114.67 to 118.30). Pooled data inferred highest number of pods producing plant *i.e.* genotype G13 (118.60) followed by G31(116.80) (Table 2).

The number of seed per pod was recorded after harvesting by counting seed in each pod from three superior plants in every lines. The number of seeds per pod varied among the genotypes from 1.33 to 2.00. Pooled analysis revealed, highest number (2.0) of seeds in G13 genotypes out of 35 lentil genotypes tested (Table 2).

Test weight in terms of 100 seeds also differed significantly that ranged from 2.07 to 5.96g and 1.88 to 5.84g in the first and second year of the experiments, respectively. Pooled data showed highest test weight in the genotype G13 (5.09g) (Table 2).

Yield potentiality of these varieties varied significantly from 884.70 to 1160.40 kg/ha and 883.50 to 1207.50 kg/ha, respectively during 2020-21 and 2021-22. Based on pooled data, yield potentiality of G13 ranked first (1184.00 kg/ha) followed by G31 (1112.20 kg/ha). Yield obtained from the control variety Moitree (WBL 77) was 959.20 kg/ha (Table 2).

According to pooled value among the 35 genotypes G13 (23.44%) showed the highest percentage of yield followed by G31 with 15.95% yield advantage (Table 2).

Similar experiments were carried out by Reja *et al.* (2017) and Ghosh *et al.* (2019) and their research result are in corroboration with the present research findings.

In this study, germplasms were screened over two seasons, PDI and AUDPC were estimated as well as grouped presented in Table 3. PDI of SB varied from 10.67 to 74.33 in the year 2020-21 and 10.33 to 72.33 in 2021-22 (Table 3).

Two years pooled mean was used to screen out the lentil cultivars according to their disease reaction and presented in Table 4. The data revealed that out of 35 lentil genotypes tested no one showed immune reaction under NAZ of WB rather only one genotypes G13 counted resistant reaction (R) with disease score '1'. Five genotypes, G31, G17, G10, G11 and G18 were found to be moderately resistant (MR) with disease score '3' and fifteen genotypes categorized under moderately susceptible (MS). Twelve entries and the control variety (Moitree) scored as susceptible (S) with 70% foliar damage while three genotypes were recorded highly susceptible (HS) (Table 4).

Owing to the pooled data, the genotype G13 (141.17) was found to be most desirable with lowest AUDPC value followed by G17 (145.83). The findings are supported by the study of Islama *et al.* (2020). They confirmed that the lentil lines differed significantly in respect of agronomic traits and yield parameters.

Correlation determined between different morphological parameters and yield to find out the major yield attributing characters. Here, correlation co-efficient value (r) was determined and r-value showed strongest relationship between number of pods per plant and the seed yield with r value = 0.89 followed by 100 seed weight r = 0.82.

Regression equation was developed to establish the relationship between number of pods per plant vs yield of lentil in the two consecutive experimental years and pooled analysis were also performed. The result revealed positive significant correlation between the two variables, confirmed by high co-efficient of determination value of R^2 close to 1 *i.e.* 0.86.

Table 3. Disease reaction of 36 lentil genotypes against Stemphylium blight measured in the form of PDI and AUDPC during 2020-21 and 2021-22.

Genotypes	Disease severity (PDI)			Total AUDPC			Disease reaction
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	
G1	42.33 (40.59)	42.33 (40.59)	42.33 (40.59)	499.33	500.50	499.92	MS
G2	43.33 (41.17)	43.33 (41.17)	43.33 (41.17)	537.83	544.83	541.33	MS
G3	52.67 (46.53)	54.00 (47.29)	53.33 (46.91)	585.67	589.17	587.42	S
G4	72.33 (58.26)	71.67 (57.84)	72.00 (58.05)	945.00	957.83	951.42	HS
G5	57.00 (49.02)	56.33 (48.64)	56.67 (48.83)	781.67	767.67	774.67	S
G6	60.00 (50.77)	60.67 (51.16)	60.33 (50.96)	1004.5	991.67	998.08	S
G7	41.00 (39.82)	42.00 (40.40)	41.50 (40.11)	494.67	480.67	487.67	MS
G8	55.67 (48.26)	54.33 (47.48)	55.00 (47.87)	743.17	749.00	746.08	S
G9	60.33 (50.96)	61.00 (51.35)	60.67 (51.16)	640.50	644.00	642.25	S
G10	16.67(24.10)	17.00 (24.35)	16.83 (24.22)	233.33	234.50	233.92	MR
G11	16.67 (24.10)	17.33 (24.60)	17.00 (24.35)	199.50	204.17	201.83	MR
G12	58.00 (49.60)	58.67 (49.99)	58.33 (49.80)	472.50	463.17	467.83	S
G13	10.67 (19.07)	10.33 (18.75)	10.50 (18.91)	145.83	136.50	141.17	R
G14	36.00 (36.87)	33.67 (35.47)	34.83 (36.17)	308.00	302.17	305.08	MS
G15	64.00 (53.13)	61.67 (51.75)	62.83 (52.43)	865.67	838.83	852.25	S
G16	59.00 (50.18)	59.00 (50.18)	59.00 (50.18)	627.67	630.00	628.83	S
G17	11.67 (19.98)	12.33 (20.56)	12.00 (20.27)	145.83	145.83	145.83	MR
G18	17.00 (24.35)	20.00 (26.57)	18.50 (25.47)	257.83	274.17	266.00	MR
G19	46.67 (43.09)	44.33 (41.74)	45.50 (42.42)	611.33	611.33	611.33	MS
G20	49.00 (44.43)	46.67 (43.09)	47.83 (43.76)	604.33	568.17	586.25	MS
G21	57.33 (49.22)	58.00 (49.60)	57.67 (49.41)	718.67	732.67	725.67	S
G22	71.67 (57.84)	72.33 (58.26)	72.00 (58.05)	808.50	796.83	802.67	HS
G23	51.00 (45.57)	46.67 (43.09)	48.83 (44.33)	694.17	679.00	686.58	MS
G24	46.33 (42.90)	49.33 (44.62)	47.83 (43.76)	707.00	731.50	719.25	MS
G25	46.67 (43.09)	46.67 (43.09)	46.67 (43.09)	640.50	645.17	642.83	MS
G26	33.33 (35.26)	33.33 (35.26)	33.33 (35.26)	430.50	424.67	427.58	MS
G27	41.33 (40.01)	40.00 (39.23)	40.67 (39.62)	527.33	515.67	521.50	MS
G28	35.00 (36.27)	34.00 (35.67)	34.50 (35.97)	579.83	567.00	573.42	MS
G29	48.33 (44.04)	46.67 (43.09)	47.50 (43.57)	682.50	652.17	667.33	MS
G30	60.67 (51.16)	60.00 (50.77)	60.33 (50.96)	802.67	784.00	793.33	S
G31	11.33 (19.67)	11.00 (19.37)	11.17 (19.52)	163.33	154.00	158.67	MR
G32	43.33 (41.17)	44.00 (41.55)	43.67 (41.36)	498.17	492.33	495.25	MS
G33	74.33 (59.56)	72.33 (58.26)	73.33 (58.91)	973.00	954.33	963.67	HS
G34	60.67 (51.16)	59.67 (50.58)	60.17 (50.87)	619.50	619.50	619.50	S
G35	50.67 (45.38)	46.00 (42.71)	48.33 (44.04)	553.00	522.67	537.83	MS
G36	42.33 (40.59)	62.33 (52.14)	63.67 (52.93)	819.00	789.83	804.42	S
SEM±	1.48	0.64	0.81	12.99	8.31	1.82	-
CD (α=0.05)	4.18	1.80	2.26	36.63	23.43	5.08	-
CV	5.55	2.41	4.29	3.87	2.50	3.27	-

*Numbers inside the parenthesis are Arcsine transformed values.

The equation demonstrated that with the increase in number of pods per plant, the yield of the crop also increases. Based on the pooled analysis, the prediction equation established is Y= 336.21 + 6.12 X, [R2 = 0.86] which means that the attainable yield would be 336.21 kg/ha but could be increased by 6.12 kg/ha with every 1 unit increase in pod yield. High co-efficient of determination value. R^2 =0.86 represent the acceptability of the result (Fig. 1).

Table 4. Disease scale and grouping of lentil genotypes on the basis of reactions to the Stemphylium blight for pooled data during 2020-21 and 2021-22.

Scale	Disease severity percent	Disease reaction	Number of genotypes	Name of the genotypes
0	No infection	Immune (I)	0	00
1	Below 10% foliage affected	Resistant (R)	1	G13
3	30% foliage affected	Moderately resistant (MR)	5	G31, G17, G10, G11, G18
5	50% foliage affected	Moderately susceptible (MS)	15	G26, G28, G14, G27, G7, G1, G2, G32, G19, G25, G29, G20, G24, G35, G23
7	70% foliage affected	Susceptible (S)	12	G3, G8, G5, G21, G12, G16, G34, G6, G30, G9, G15, G36 (Control)
9	Above 70% foliage affected	Highly susceptible (HS)	3	G4, G22, G33

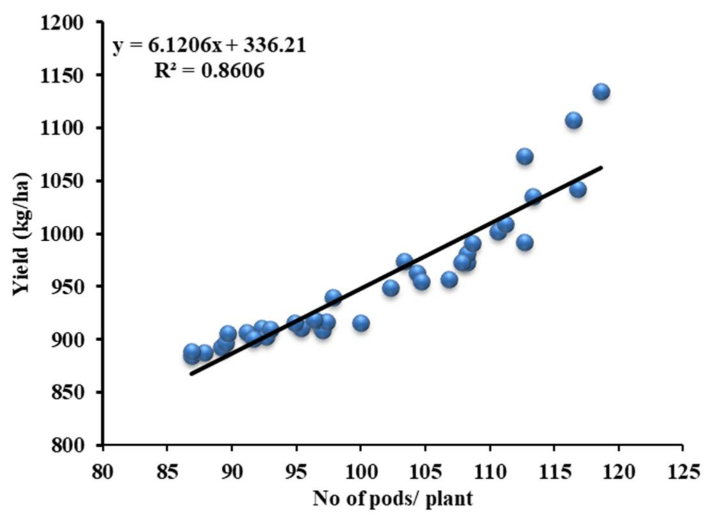

Fig. 1. Linear regression equation and corresponding regression line for number of pods and seed yield in lentil genotypes in pooled analysis.

Based on yield, disease resistance and other characters evaluated, lentil genotypes G13 (ILL10838/ILWL11/X2016S) and G31 (8114/10956/16-1) were found to be promising for its cultivation in the NAZ of WB and can be included in the future breeding programme.

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