DETERMINATION OF OPTIMUM SEED RATE ON GROWTH, YIELD AND YIELD CONTRIBUTING CHARACTERS OF LENTIL MUTANTS AT DIFFERENT AEZS IN BANGLADESH

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Abstracts

Lentil is the most popular pulse crop in terms of both area and consumer choice in Bangladesh. However, the lack of situation and cultivar specific seed rate recommendations are among the problems that constrain its productivity. Therefore, a field experiment was conducted during 2020 to determine the optimum seed rate for sowing of lentil mutants/varieties on the growth and yield contributing characters of advanced lentil lines/variety developed by Bangladesh Institute of Nuclear Agriculture (BINA). The study looked at four seeding rates: 25 kg ha^{-1}, 30 kg ha^{-1}, 35 kg ha^{-1} and 40 kg ha^{-1} on three advanced lentil mutants viz. LM-99, LM-118, LM-206-5 in comparison with one checked variety Binamasur-8. In all three locations, the seed yield of lentil mutant was notably different, with Ishurdi producing the highest seed production (2.09 t ha^{-1}). The mutant LM-99 generated the maximum seed yield (1.66 t ha^{-1}) among the several advance mutants/variety, followed by LM-118 (1.58 t ha^{-1}). Among the various seed rates, 35 kg ha^{-1} produced the highest seed yield (1.64 t ha^{-1}) in the 2020 season. The findings suggest that when another management techniques were followed correctly, the mutant line LM-99 produced the maximum yield at a seed rate of 35 kg ha^{-1}.

Key words: lentil, variety, seed rate, yield, yield components.

Introduction

Lentil (*Lens culinaris* Medik) is the second most important pulse crop based on cultivating area and production in Bangladesh but stands first in the consumer's preference in Bangladesh (Uddin *et al.,* 2008). It is an inexpensive source of protein, calories, and certain vitamins (Nourin *et al.,* 2019). It is also a main source of vegetable proteins in human diet. The protein content of lentil seeds, on an average, is around 22-34.6% while 100 g of dried lentil seeds have 340-346 calories and it is considered as poor man's meat as well as cheapest source of protein for under privileged group of people. Moreover, lentil is also a cheap source of fiber, as well as micronutrients (Crook *et al.,* 1999). Lentil being a legume crop can fix atmospheric nitrogen through root nodules by Rhizobium bacteria, which may reduce the pressure of nitrogenous fertilizer application to the crop. It is evident that pulse containing cropping pattern helped to increase the organic matter in the soil (Islam, 1988). The lentil genotypes have inbuilt potential to provide relatively good production even in stress conditions i.e., drought, frost and water logging.

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The main problem for this crop are cultivation in soils with low fertility and also have a variety of environmental stresses, such as drought, salinity, and high and low temperatures, major problem in cultivating a crop in this condition is related to the poor germination and establishment of the crop '(BARC, 1999). Some other causes responsible for low yield of lentil are use of traditional local cultivars, low plant density per unit area and poor crop management practices constituting the major ones. Use of the modern lentil cultivars and maintenance of proper plant density per unit area would thus help in increasing the yield from unit per area (Bhuiyan, 1976). It is also to be noted that the response to plant density varies among lentil genotypes/varieties depending on the seed size and growth habit of the specific cultivars (Nigussie *et al.*, 2009). Optimum plant population density is an important factor to realize the potential yields as it directly affects plant growth and development. It varies with the small to medium seed varieties (microsperma group) might be too low to obtain optimal yield. Many studies show that lentil yields are remarkably stable over a wide range of population densities. The plants are able to fill available space by initiating lateral branches and thus can compensate for poor emergence and grain yield (Selim, 1999). On the other hand, low and scattered plant populations are unable to utilize the resources efficiently and often produce low yields. As a result, it is necessary to determine the economically optimum seed rate for a broadcast sowing of lentil varieties. The aim of the present study was to investigate the effect of different treatments of seed rate on growth and yield of different genotypes of lentil under rainfed and supplemental irrigation conditions.

Materials and methods

The experiment was carried out at the Field of the BINA Sub-station, Ishurdi, Chapainawabganj and Magura during 2020-21. The edaphic and climatic conditions play a key role for the achievement of elevated production and enhanced seed quality. The climatic parameters during the growing period of lentil in different time and location are presented in Figure 1. The land is medium high having sandy loam texture soil under non-calcareous dark gray flood plain soil type with soil pH 6.7 (UNDP and FAO, 1998). The experiment was laid out in split- plot design with three replications. The study looked at four seeding rates: 25 kg ha^{-1}, 30 kg ha^{-1}, 35 kg ha^{-1} and 40 kg ha^{-1} on three advanced lentil mutants viz. LM-99, LM-118, LM-206-5 in comparison with one check variety Binamasur-8. The unit plot size was 4 m × 3 m. Row spacing is maintained in 30 cm and following continuous line sowing. The crop was sown on 16 November and harvested on last week of February in both the year. The treatments were randomly distributed to the plots within a block.

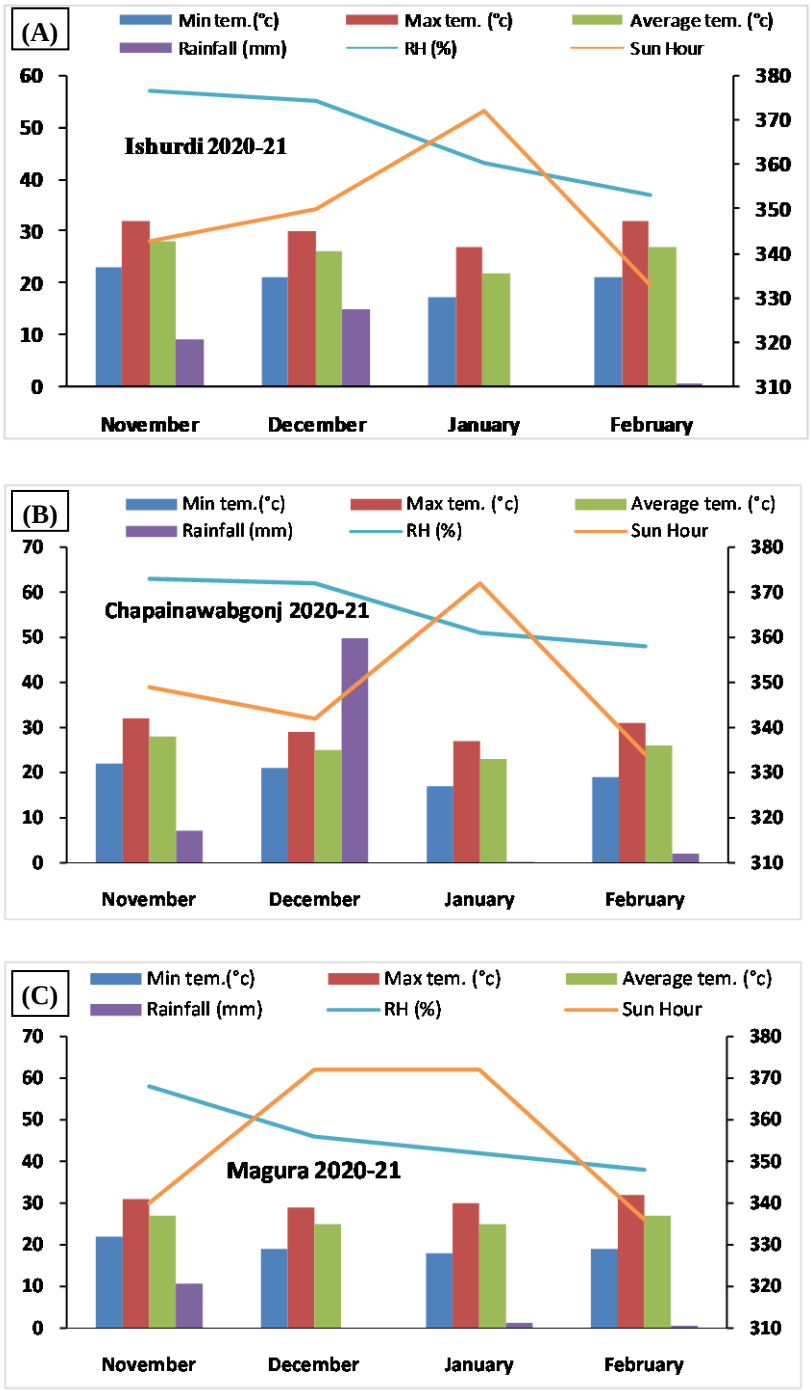

Fig. 1. The climatic parameters during the growing period of lentil in Ishurdi (a), Chapainawabganj (b) and Magura (c).

Field preparation, fertilization, sowing and intercultural operation

The experimental land was first opened on October with a power tiller. Later on, the land was ploughed and cross-ploughed two times by power tiller followed by laddering to desirable tilth. All the weeds and stubble were removed and fertilizers such as urea, muriate of potash (MOP), triple super phosphate (TSP) and zinc sulphate were applied following the BINA recommended doses @ 50, 40, 40 and 10 kg ha^{-1} respectively. Seeds with 92% germination capacity were sown in line continuously having line to line maintain the distance 30 cm. Weeds were controlled by two hands weeding with niri. The stem phylum blight disease was controlled by spraying of Amister top 250 EC @ 20 ml per 5 decimal lands. The crop was harvested at full maturity on last week of February.

The observations on crop growth and yield characters were recorded at harvest and the following parameters were population m^{-2}, plant height (cm), branches $plant^{-1}$, pods $plant^{-1}$, seeds pod^{-1}, 1000 seed weight (g), seed yield (t ha^{-1}), stover yield (t ha^{-1}) and crop duration. The yield contributing characters were recorded from 5 randomly selected plants in each plot and their mean values were determined. The yields were taken plot-wise by harvesting central 10 m^2 area of each plot and then it was converted to hectare basis.

The recorded data were subjected to split-plot design of analysis of variance (ANOVA) under linear models of statistics using software statistics 10 version 8.1. Further Least Significant Difference (LSD) test was also employed to test the level of significance among different combination means (Gomez and Gomez, 1984).

Results and discussions

Effect of location

Location showed significant effect on plant population and yield. The main cause of variation of growth and yield of lentil was greatly influenced by locational effect. In the present study, the Populations m^{-2} (78.3), plant height (42.6 cm), pods $plant^{-1}$ (208.6) and seed yield was highest in Ishurdi (2.09 t ha^{-1}) followed by Magura, plant height (35.7 cm), pods $plant^{-1}$ (121.2) and seed yield (1.44 t ha^{-1}) but the branches $plant^{-1}$ (7.6) was highest in Chapainawabganj (Table 1). The result in accordance with the findings of Vlachostergios *et al*., (2021) who stated that the location effect was the main source of variation in lentil yield. Different locations were found to be suitable for each traits and breeding must be applied in locations that are characterized by a high discriminating ability and representativeness.

Effect of mutant/variety

Differential performance by the different lentil varieties may be due to genetic variability adapt ability, morphological features, and physiological factors during the cropping period. The lentil genotype LM-99 showed the highest seed yield (1.66 t ha^{-1}) and pod $plant^{-1}$ (150.6) among the mutants/variety followed by LM-118 (1.58 t ha^{-1}) but pod $plant^{-1}$ (146.9) was second highest in LM- 206-5 (Table 1). The growth duration (120 days) was shorter in all mutants compare to check Binamasur-8 (Table 1). Similar findings of

higher seed yield in lentil genotypes were reported by Singh *et al*., (2011) and Rahman *et al.,* (2013) who stated that different genotypes varied in yield and yield contributing characters due to their genetic makeup yield parameters and higher growth duration.

Effect of seed rate

Optimum plant population density is an important factor to realize the potential yields as it directly affects plant growth and development. Higher plant density may lead to severe competition between plants (Singh and Singh, 1994) and increase risk of disease and lodging of the crop, resulting in reduced grain yield (Selim, 1999). On the other hand, low and scattered plant populations are unable to utilize the resources efficiently and often produce low yields. In the present study, the seed rate 35 kg ha^{-1} produced the highest grain yield (1.64 t ha^{-1}) followed by 25 kg ha^{-1} but pod $plant^{-1}$ was highest in 25 kg ha^{-1} and lowest in 35 kg ha^{-1} among the four different seed rates (Table 1). The result was supported by Saleem *et al.,* 2012 who stated that the response of lentil to various plant densities has been variable depending upon genotype, planting time and growing conditions and showed that grain yield kept on increasing up to a seed rate of 40 kg ha^{-1} and remained static thereafter with a non-significant difference for any further increase in seed sown. Barua, (2011) reported that increasing seeding rates had a negative effect on 100-seed weight and hence on seed yield.

Table 1. Mean values of different crop characteristics as affected by locations, varieties and seed rate during 2020-2021.

Treatments	Populations m^{-2} (no.)	Plant height (cm)	Branches $plant^{-1}$ (no.)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Crop duration (days)
Location(s):									
Ishurdi (L_1)	78.3	42.6	2.3	208.6	1.7	21.40	2.09	4.54	
C.nawabgang (L_2)	69.4	28.8	7.6	106.4	1.7	19.83	1.24	4.90	
Magura (L_3)	60.7	35.7	4.7	121.2	1.6	22.03	1.44	4.54	
$LSD_{0.05}$	2.9	1.5	0.6	32.7	0.1	0.39	0.16	0.26	
Mutants/Variety:									
LM-99 (V_1)	69.9	35.8	4.8	150.6	1.6	21.36	1.66	4.56	120
LM-118 (V_2)	71.2	35.0	4.9	145.4	1.7	20.74	1.58	4.72	120
LM-206-5 (V_3)	67.7	36.2	5.0	146.9	1.6	21.49	1.55	4.60	120
Binamasur-8 (V_4)	69.0	35.8	4.8	138.5	1.7	20.76	1.51	4.76	123
$LSD_{0.05}$	6.9	1.5	0.6	15.0	0.1	0.39	0.17	0.22	
Seed rate:									
25 kg ha^{-1} (S_1)	59.1	35.9	4.9	152.3	1.7	21.17	1.60	4.61	
30 kg ha^{-1} (S_2)	65.9	36.1	4.8	144.4	1.7	21.10	1.58	4.71	
35 kg ha^{-1} (S_3)	72.3	35.6	4.9	138.9	1.7	21.12	1.64	4.59	
40 kg ha^{-1} (S_4)	80.6	35.1	4.9	146.0	1.7	20.96	1.55	4.73	
$LSD_{0.05}$	3.3	1.1	0.4	10.3	0.1	0.20	0.07	0.16	

Two way interaction effect of locations, mutant and seed rates

The interaction of variety and location showed significant differences on total plant population and growth, yield contributing characters such as plant height, branches plant^{-1}, pods plant^{-1} and 1000 seed weight. The highest seed yield (2.20 t ha^{-1}) produced with Binamasur-8 followed by LM-99 (2.09 t ha^{-1}) in Ishurdi and lowest yield was produced by Binamasur-8 in Chapainawabganj (Table 2). The findings agreed with the results of Yadav *et al.,* (2007) who observed that productivity of lentil varies greatly from location to location and wide gaps between the locations due to facing the challenges of biotic and abiotic stresses which are responsible for the low productivity and stagnation in the production. Such gaps in the productivity can be minimize with the introduction of modern techniques. The interaction results of mutant/variety and seed rate revealed that the seed yield of LM-118 was the highest (1.77 t ha^{-1}) at the seed rate of 35 kg ha^{-1} followed by 40 kg ha^{-1}. The lowest yield was observed in LM-206-5 (1.36 t ha^{-1}) at 40 kg ha^{-1} seed rate (Table 2). The better performance per plant was due to better utilization of resources. The results are in conformity with the findings of Singh *et al.,* (2005); Praveen and Bhuiya, (2010) and Ilinger, (2017). The response of lentil to various plant densities has been variable depending upon genotype, planting time and growing conditions. The interaction of seed rates and location showed significant differences in the yield and related attributes. The seed yield of lentil was highest in Ishurdi at the seed rate of 25 kg ha^{-1} (2.12 t ha^{-1}) followed by 30 kg ha^{-1} (2.01 t ha^{-1}) compared to other seed rates and the yield was the lowest in Chapainawabganj at the seed rate of 30 kg ha^{-1} (1.19 t ha^{-1}) (Table 2). Despite of significantly higher growth and yield parameters plant^{-1}, the reduction in seed yield compared to higher seed rate of 35 kg ha^{-1} was mainly due to lower plant population per unit area. The results are in conformity with the findings of Saleem *et al.,* (2012) who reported positive correlation of seed yield with seed rate in appropriate area of cultivation.

Table 2. Interaction effect of location and mutants/variety, mutants/variety and seed rate, seed rates and location on yield of lentil lines in different locations.

Treatments	Populations m^{-2} (no.)	Plant height (cm)	Branches plant^{-1} (no.)	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Location × Mutant/Variety:								
L_1V_1	72.6	43.1	2.3	209.6	1.7	21.86	2.09	4.45
L_1V_2	85.0	40.8	2.3	219.5	1.7	20.80	1.81	4.60
L_1V_3	75.9	44.6	2.5	213.0	1.7	21.67	1.97	4.47
L_1V_4	79.7	41.9	2.2	192.2	1.7	21.28	2.20	4.64
L_2V_1	74.0	29.1	7.4	110.4	1.7	20.26	1.43	4.76
L_2V_2	65.2	28.4	7.6	102.5	1.7	19.36	1.36	4.96
L_2V_3	66.6	28.3	7.6	105.3	1.7	20.79	1.16	4.86
L_2V_4	71.9	29.5	7.8	107.4	1.7	18.93	1.02	5.01
L_3V_1	63.2	35.1	4.7	132.0	1.6	21.96	1.45	4.45
L_3V_2	63.6	35.8	4.8	114.3	1.6	22.06	1.49	4.60
L_3V_3	60.6	35.8	4.9	122.3	1.6	22.02	1.53	4.47
L_3V_4	55.3	36.0	4.4	116.1	1.7	22.06	1.31	4.64
$LSD_{0.05}$	11.9	2.7	1.0	25.9	0.1	0.67	0.29	0.38

Table 2. Continued

Treatments	Populations m^{-2} (no.)	Plant height (cm)	Branches $plant^{-1}$ (no.)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Mutants/Variety × Seed rate:								
$V_1 S_1$	56.7	36.5	5.0	165.5	1.6	21.62	1.65	4.56
$V_1 S_2$	66.4	35.7	4.8	154.3	1.7	21.54	1.64	4.47
$V_1 S_3$	74.8	35.7	4.5	135.5	1.6	21.36	1.67	4.38
$V_1 S_4$	81.7	35.3	4.8	147.3	1.6	20.91	1.66	4.81
$V_2 S_1$	61.6	35.9	4.9	146.0	1.7	20.71	1.56	4.65
$V_2 S_2$	65.8	35.9	4.5	143.7	1.7	20.58	1.54	4.75
$V_2 S_3$	74.4	34.2	5.2	140.7	1.7	20.80	1.77	4.65
$V_2 S_4$	83.3	33.9	5.0	151.3	1.7	20.87	1.73	4.84
$V_3 S_1$	54.0	36.7	4.8	151.3	1.6	21.41	1.65	4.60
$V_3 S_2$	64.4	35.8	4.7	140.4	1.6	21.43	1.65	4.54
$V_3 S_3$	72.9	36.6	5.2	146.2	1.7	21.70	1.55	4.63
$V_3 S_4$	79.4	35.7	5.2	149.6	1.7	21.42	1.36	4.63
$V_4 S_1$	64.3	34.4	4.7	146.4	1.7	20.92	1.54	4.64
$V_4 S_2$	66.9	37.1	5.0	139.0	1.7	20.82	1.49	5.05
$V_4 S_3$	67.1	36.1	4.7	133.1	1.7	20.64	1.55	4.71
$V_4 S_4$	77.7	35.6	4.7	135.6	1.7	20.64	1.45	4.64
$LSD_{0.05}$	6.6	2.3	0.7	20.6	0.1	0.40	0.14	0.32
Seed rates × location:								
S_1L_1	62.5	43.2	2.3	224.0	1.7	21.40	2.12	4.55
S_1L_2	71.7	43.7	2.4	199.9	1.7	21.47	1.81	4.58
S_1L_3	82.5	42.8	2.4	194.3	1.8	21.49	1.97	4.46
S_2L_1	96.6	40.7	2.2	216.0	1.6	21.24	2.01	4.58
S_2L_2	57.4	28.5	7.5	106.8	1.7	19.88	1.19	4.75
S_2L_3	62.8	29.1	7.2	107.8	1.7	19.91	1.22	4.96
S_3L_1	74.6	28.6	7.8	104.5	1.7	19.92	1.41	4.86
S_3L_2	82.9	29.2	8.0	106.4	1.7	19.63	1.16	5.02
S_3L_3	57.6	36.0	4.8	126.1	1.6	22.22	1.46	4.55
S_4L_1	63.1	35.6	4.8	125.4	1.6	21.91	1.40	4.58
S_4L_2	59.8	35.5	4.6	117.7	1.6	21.96	1.44	4.46
S_4L_3	62.2	35.5	4.6	115.5	1.7	22.01	1.48	4.58
$LSD_{0.05}$	5.7	2.0	0.6	17.8	0.1	0.35	0.12	0.28

L_1 = Ishurdi; L_2 = Chapainawabganj; L_3 = Magura; V_1 = LM-99-8; V_2 = LM-118-9; V_3 = LM- 206-5; V_3 = Binamasur-8; S_1 = 30 kg ha^{-1}; S_2 = 35 kg ha^{-1}; S_3 = 40 kg ha^{-1} and S_4 = 45 kg ha^{-1}

Cumulative interaction effect of locations, mutant and seed rates

The interaction of location, varieties and seed rate effect seriously on yield and growth attribute of lentil. The maximum seed yield (2.18 t ha^{-1}) was obtained from the location Ishurdi with the mutant LM-138-3 (V_1) at seed rate of 30 kg ha^{-1} followed by Chapainawabganj with LM-99 at the seed rate 30 kg ha^{-1} (2.10 t ha^{-1}). The lowest seed yield (0.63 t ha^{-1}) was observed in Ishurdi with the mutant LM-206-5 at the seed rate of 30 kg ha^{-1} (Table 3). This might be due to optimum combination of location, genotype and higher seed rate (plant population). The significantly higher performance of individual effect of locations, genotype and seed rate also contributed significantly to the higher yield. These findings are in agreement with the results of Choubey *et al.,* (2013) and Ouji *et al.,* (2016) who found that the seed rate of 120 seeds/m^2 was found to be the best for lentil production.

Table 3. Interaction effect of location, mutants/variety and seed rate on yield of lentil in different locations.

Treatments	Populations m^{-2} (no.)	Plant height (cm)	Branches $plant^{-1}$ (no.)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Location× Mutants/Variety × Seed rates:								
$L_1V_1S_1$	61.9	44.7	2.3	256.3	1.7	21.84	1.91	4.51
$L_2V_1S_1$	67.0	43.3	2.7	194.7	1.7	21.99	1.97	4.36
$L_3V_1S_1$	75.0	43.0	2.4	175.7	1.8	21.94	1.87	4.29
$L_1V_1S_2$	86.5	41.3	1.8	211.7	1.5	21.65	2.01	4.65
$L_2V_1S_2$	67.3	43.3	2.6	213.3	1.6	20.66	2.10	4.57
$L_3V_1S_2$	76.0	41.7	2.1	213.7	1.8	20.83	2.05	4.64
$L_1V_1S_3$	91.3	39.7	2.5	210.0	1.8	21.23	2.01	4.51
$L_2V_1S_3$	105.3	38.3	2.2	241.0	1.6	20.48	2.07	4.69
$L_3V_1S_3$	57.7	46.0	2.1	217.0	1.6	21.70	2.05	4.55
$L_1V_1S_4$	72.7	45.0	2.3	197.7	1.7	21.62	2.01	4.38
$L_2V_1S_4$	80.3	45.3	2.7	208.3	1.7	21.76	1.73	4.47
$L_3V_1S_4$	93.0	42.0	2.7	229.0	1.7	21.59	1.77	4.50
$L_1V_2S_1$	63.0	38.7	2.1	209.3	1.7	21.40	2.02	4.54
$L_2V_2S_1$	71.0	44.7	2.5	193.7	1.6	21.44	2.01	4.93
$L_3V_2S_1$	83.3	43.3	1.9	183.3	1.7	21.04	2.07	4.58
$L_1V_2S_2$	101.5	41.0	2.2	182.3	1.7	21.24	2.18	4.50
$L_2V_2S_2$	48.7	29.5	7.7	110.0	1.7	20.98	1.39	4.65
$L_3V_2S_2$	65.3	29.7	7.1	111.7	1.7	20.60	1.42	4.70
$L_1V_2S_3$	87.3	28.7	6.7	112.0	1.6	20.29	1.44	4.57
$L_2V_2S_3$	94.7	28.6	7.9	107.7	1.7	19.17	1.46	5.11
$L_3V_2S_3$	57.3	28.3	7.5	103.7	1.8	19.03	1.17	4.82
$L_1V_2S_4$	55.0	29.7	6.3	104.1	1.7	19.11	1.27	4.98
$L_2V_2S_4$	68.7	26.6	8.4	100.3	1.7	19.27	1.51	4.92
$L_3V_2S_4$	79.7	29.0	8.1	101.8	1.7	20.03	1.50	5.14

Table 3. Continued

Treatments	Populations m^{-2} (no.)	Plant height (cm)	Branches $plant^{-1}$ (no.)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
$L_1V_3S_1$	52.3	27.5	7.6	104.9	1.7	20.70	1.27	4.71
$L_2V_3S_1$	57.3	26.9	7.2	104.3	1.7	20.85	1.35	4.88
$L_3V_3S_1$	76.0	29.6	7.7	105.3	1.7	21.19	1.40	4.95
$L_1V_3S_2$	80.7	29.1	7.9	106.8	1.8	20.41	0.63	4.89
$L_2V_3S_2$	71.3	28.5	7.1	108.5	1.7	18.80	0.94	4.82
$L_3V_3S_2$	73.3	30.1	7.9	111.0	1.7	19.08	0.83	5.30
$L_1V_3S_3$	66.3	29.3	8.3	100.5	1.7	18.94	1.27	4.98
$L_2V_3S_3$	76.7	30.0	8.0	109.3	1.8	18.89	1.03	4.93
$L_3V_3S_3$	59.6	35.3	5.1	130.1	1.4	22.04	1.41	4.51
$L_1V_3S_4$	67.0	34.0	4.6	156.4	1.7	22.04	1.40	4.36
$L_2V_3S_4$	62.1	35.4	4.5	118.8	1.5	21.85	1.46	4.29
$L_3V_3S_3$	64.1	35.8	4.7	122.5	1.7	21.91	1.51	4.65
$L_1V_4S_1$	60.0	36.2	4.7	121.1	1.7	22.45	1.43	4.57
$L_2V_4S_1$	66.3	36.5	5.2	113.3	1.6	21.80	1.30	4.64
$L_3V_4S_1$	63.1	36.3	4.7	111.7	1.6	21.90	1.62	4.51
$L_1V_4S_2$	64.9	34.5	4.7	111.2	1.7	22.09	1.61	4.69
$L_2V_4S_2$	52.1	36.6	4.6	131.9	1.7	21.83	1.43	4.55
$L_3V_4S_2$	63.1	35.5	4.7	119.3	1.4	21.83	1.50	4.38
$L_1V_4S_3$	62.5	35.0	5.2	124.9	1.6	22.16	1.53	4.47
$L_2V_4S_3$	64.7	36.0	5.1	113.1	1.5	22.26	1.67	4.50
$L_3V_4S_3$	58.6	36.1	4.9	121.3	1.6	22.57	1.55	4.54
$L_1V_4S_4$	56.3	36.6	4.6	112.5	1.7	21.95	1.41	4.93
$L_2V_4S_4$	51.5	35.6	3.9	115.5	1.8	21.93	1.13	4.58
$L_3V_4S_4$	55.0	35.7	4.0	115.0	1.7	21.80	1.14	4.50
$LSD_{0.05}$	5.7	4.0	1.3	35.7	0.2	0.70	0.25	0.55
CV%	7.5	8.8	5.8	7.1	9.7	3.23	9.56	7.25

L_1 = Ishurdi; L_2 = Chapainawabganj; L_3 = Magura; V_1 = LM-99-8; V_2 = LM-118-9; V_3 = LM- 206-5; V_3 = Binamasur-8; S_1 = 30 kg ha^{-1}; S_2 = 35 kg ha^{-1}; S_3 = 40 kg ha^{-1} and S_4 = 45 kg ha^{-1}

Conclusions

It was concluded that the LM-99 advanced mutant/varieties produced the highest seed yield in Ishurdi station among the several advance mutants with a seed rate of 35 kg ha^{-1}. In terms of yield and duration, it has outperformed the check variety in all three locations. The two remaining mutants LM-118 and LM-206-5 also performed better than check Binamashur-8 in case of yield and the location Magura performed better after the Ishurdi in Bangladesh. The development of new commercial lentil varieties for the lentil favored area particularly in Ishurdi and Magura, could be aided by the promising mutant LM-99.

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