Reprint **ISSN 1923-7766 (Web Version)**

International Journal of Experimental Agriculture

(Int. J. Expt. Agric.)

Volume: 12	Issue: 2	September 2022

Int. J. Expt. Agric. 12(2): 5-8 (September 2022)

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An International Scientific Research Publisher

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ISSN-1923-7766 (Online)
Int. J. Expt. Agric. 12(2):5-8(September 2022)

GROWTH ANALYSIS, MORPHO-PHYSIOLOGICAL PARAMETERS AND YIELD OF LENTIL GENOTYPES

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Accepted for publication on 20 August 2022

ABSTRACT

Akter SE, Islam MT, Rahman MS (2022) Growth analysis, morpho-physiological parameters and yield of lentil genotypes. *Int. J. Expt. Agric*. 12(2), 5-8.

Lentil is an important grain legume but the average yield is low. Use of high yielding varieties of lentil and effective management may increase the lentil production. Two experiments were carried out with four genotypes *viz*., LMM-4, LMM-9, Binamasur-8 and Binamasur-12 of lentil at BINA Sub-stations Ishwardi and Chapainawabganj from November, 2021 to March, 2022. Binamasur-12 showed the highest nitrate reductase activity and chlorophyll content at 66 and 88 DAS. Nitrate reductase activity of all the lentil genotypes was higher at 66 DAS than 88 days. Crop growth rate was higher in Binamasur-8 and Binamasur-12 and LMM-9 and Relative growth rate in Binamasur-8 and LMM-9. LMM-9 produced the longest plant. The highest seed yield was produced by Binamasur-12. Crop duration of the lentil genotypes was 96-101 days.

***Key words**: CGR, RGR, nitrate reductase activity, chlorophyll, lentil yield*

INTRODUCTION

Lentil (*Lens esculenta* Medik.) popularly known as Masur, is an important grain legume in Bangladesh. It is an important pulse crop with high protein content, has the potential capacity to combat nutritional deficiencies in developing regions and countries. High temperature and water stress are significant abiotic stresses that limit production worldwide (Sehgal *et al*. 2017; Gaur *et al*. 2015). It is commonly grown under rain fed condition, conserves moisture from preceding monsoon season and usually faces water stress (Islam 2021; Islam and Ferdousi, 2006; Helali *et al*. 2002; Salam and Islam, 1994). High temperature affects crops through either: (i) above-optimum temperatures for an extended period, which increases supply of assimilates but reduces grain filling period and yield; or (ii) heat wave responses, which is a short period of high temperature (>32ºC) that causes non-recoverable reduction in grain set and yield potential (Vadez *et al.* 2012). Together these abiotic stresses, estimated to cause up to 50% yield loss per annum in pulse crops globally (Gaur *et al*. 2014). Lentil requires low temperatures during vegetative growth, while at maturity, warm temperatures required; the optimum temperature for its best growth has been reported to be 18-30ºC (Roy *et al*. 2012). Lentil is particularly sensitive to high temperature (>30ºC) during the reproductive phase, causing pod and flower abortion and significant reduction in grain yield and quality (Islam and Haque, 2020; Sita *et al*. 2017). Yield was reduced by 87% for lentils grown in pots under field conditions with high temperature during the reproductive phase (38ºC day time, 23ºC night) (Bhandari *et al*. 2016), and grain set was observed to be the most sensitive yield component (Bhandari *et al*. 2016; Gaur *et al*. 2015). In Bangladesh, lentil sowings occasionally get postponed because of the delayed harvest of the preceding crop, mostly T. Aman rice. The lentil crop is then adversely affected by the high approaching summer temperatures, leading to low grain yields and poor grain quality (Islam and Haque, 2020; Tickoo *et al*. 2005). Efforts can be made to increase area as well as yield of lentil crops by the lentil varieties adapted to different environments. So the experiment was conducted to evaluate four six lentil genotypes.

MATERIALS AND METHODS

Two experiments were conducted at BINA sub-stations Ishwardi and Chapainawabganj from November, 2021 to March, 2022. Two mutants (LMM-4 and LMM-9) and two varieties (Binamasur-8 and Binamasur-12) were used as planting material. The lentil mutants were developed in the project “Developing plant ideo type of lentil, mungbean, sesame and tomato for high yield, quality and stress tolerance under changing climate” of Crop Physiology Division, BINA, Mymensingh. The experiments were laid out in a Randomized Complete Block with three replications. The row to row distance was 40 cm and plant to plant distance was 5 cm. Recommended dose of fertilizers was applied and other cultural practices were followed as and when required. Five plants were selected randomly at 66 and 88 days after sowing (DAS) and data on the total dry matter and SPAD value were recorded. Nitrate reductase (NRase) was estimated at 66 and 88 DAS according to the method suggested by (Smarrelli and Campbell, 1983). Chlorophyll content was estimated at 66 and 88 DAS according to the method suggested by (Arnon 1949). Crop Growth Rate (CGR) was calculated by the following formula was suggested by (Radford 1967). The CGR explains the dry matter accumulated per unit land area per unit time ($gm^{-2}day^{-1}$).

$$CGR = \frac{(W_2 - W_1)}{\rho\,(t_2 - t_1)}$$

Where, W_1 and W_2 are whole plant dry weight at time $t_1 - t_2$ respectively
ρ is the ground area on which W_1 and W_2 are recorded.

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Relative Growth Rate (RGR) was calculated by the following formula was coined by (Radford 1967). Relative Growth Rate (RGR) expresses the total plant dry weight increase in a time interval in relation to the initial weight or Dry matter increment per unit biomass per unit time or grams of dry weight increase per gram of dry weight and expressed as unit dry weight / unit dry weight / unit time (g g^{-1} day^{-1}).

$$RGR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

Where, W_1 and W_2 are whole plant dry weight at t_1 and t_2 respectively

t_1 and $t_2$are time interval in days

At maturity five plants were selected randomly from each plot and yield contributing characters were recorded. The data were analyzed following MSTAT-C package and the mean differences were compared by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Nitrate reductase activity and SPAD (Chlorophyll) data at 66 and 88 DAS are shown in Table1. In Ishwardi, nitrate reductase activity of all the lentil genotypes was higher at 66 DAS than 88 days. This means plants convert more NO_3 to NO_2 at vegetative stage than maturity stage. The highest nitrate reductase activity was found in Binamasur-12 at 66 and 88 DAS. The lentil genotypes significantly varied in chorophyll content at 66 and 88 66 DAS. Binamasur-12 showed the highest chlorophyll content at 66 and 88 DAS. Nitrate reductase activity and SPAD (Chlorophyll) reading are almost similar in Chapainawabganj. Here LMM-9 and Binamasur-12 showed higher nitrate reductase activity and chlorophyll content in leaves. The results agree with Islam *et al*. 1993.

Table 1. Nitrate reductase activity and total chlorophyll content in leaves of four lentil genotypes grown at BINA Sub-stations Ishwardi and Chapainawabganj during 2021-22

Genotype	**NRA (µmolNO_2 g^{-1} fwh^{-1})**		**SPAD reading (Chlorophyll)**	
	BINA Sub-station Ishwardi			
	66 DAS	88 DAS	66 DAS	88 DAS
LMM-4	0.58b	0.13b	32.11d	29.61c
LMM-9	0.62b	0.12b	36.50b	32.92b
Binamasur-8	0.46c	0.11b	33.93c	31.43b
Binamasur-12	0.76a	0.18a	39.37a	36.87a
	BINA Sub-station Chapainawabganj			
	66 DAS	88 DAS	66 DAS	88 DAS
LMM-4	0.49b	0.20c	27.73b	28.01c
LMM-9	0.52a	0.28a	32.83a	31.83a
Binamasur-8	0.47c	0.21c	27.83b	29.40bc
Binamasur-12	0.54a	0.25b	30.50ab	31.00ab

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Crop growth rate (CGR) was higher in Binamasur-8 and Binamasur-12 in Ishwardi and LMM-9 and Binamasur-12 in Chapainawabganj (Table 2). Crop growth rate is affected by a range of factors including temperature, levels of solar radiation, water and nutrient supply, crop, cultivar and its age. These factors influence the size and efficiency of leaf canopy and hence the ability of crop to convert solar energy into economic growth. In this experiment, CGR was measured at 66-88 DAS of growing season. At later stage due to mutual shading, aging and falling leaves, crop growth rate is drastically reduced.

Relative growth rate (RGR) was higher in Binamasur-8 in Ishwardi and LMM-9 in Chapainawabganj (Table 2). Relative growth rate, the growth rate in terms of the size increase per unit time is expressed. Decreasing the Relative growth rate of plants during the growing season due to increased structure tissue is metabolically active tissue of the structure. Also shading leaves and lower leaves age also affects the size of the loss. In this experiment, RGR was measured at 66-88 DAS.

Table 2. Crop growth rate and Relative growth rate of four lentil genotypes at BINA Sub-stations Ishwardi and Chapainawabganj

Genotype	**Crop growth rate at 66-88 DAS (mg $m^{-2}day^{-1}$)**	**Relative growth rate at 66-88 DAS (mg$g^{-1}day^{-1}$)**
	BINA Sub-station Ishwardi	
LMM-4	443.59b	34.29b
LMM-9	369.43c	26.97c
Binamasur-8	550.32a	41.44a
Binamasur-12	533.42a	33.69b
	BINA Sub-station Chapainawabganj	
LMM-4	355.56b	49.36c
LMM-9	494.16a	59.38a
Binamasur-8	296.53c	52.27bc
Binamasur-12	483.32a	53.51b

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

At BINA Sub-station Ishwardi, LMM-9 produced the longest plant and Binamasur-12 produced the shortest (Table 3). Number of branch had no significant difference among the genotypes. LMM-9 produced the highest number of pods plant^{-1} and Binamasur-8 had the lowest. Binamasur-12 produced the highest number of seeds pod^{-1} followed by Binamasur-8. Binamasur-8 showed the highest 1000-seed weight (21.90 g). Crop duration was higher in LMM-9. The highest seed yield was produced by Binamasur-12 (2.23 tha^{-1}). At BINA sub-station Chapainawabganj, Binamasur-12 produced the highest plant height (39.60 cm) and number of branch plant^{-1} (3.40) (Table 4). Binamasur-12 showed the highest seed yield. Higher yield of this variety was due to its higher number of pods plant^{-1} and 1000-seed weight. The results agree with Islam *et al*. 1998; Islam and Rahman, 2021.

Table 3. Morphological attributes and yield of four lentil genotypes at BINA Sub-station Ishwardi

Genotype	Plant height (cm)	Branches Plant^{-1}(no.)	Pods Plant^{-1}(no.)	Seeds Pod^{-1}(no.)	1000-seed wt. (g)	Days to maturity	Seed yield (tha^{-1})
LMM-4	42.47ab	2.47a	167.62c	1.63b	21.03b	98.00b	2.19ab
LMM-9	44.60a	2.33a	178.53a	1.70b	19.90c	101.33a	2.16ab
Binamasur-8	44.27ab	2.33a	145.82d	1.77ab	21.90a	98.00b	1.98b
Binamasur-12	38.80b	2.67a	173.49b	1.94a	20.96b	99.00ab	2.23a

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 4. Morphological attributes and yield of four lentil genotypes at BINA Sub-station Chapainawabganj

Genotype	Plant height (cm)	Branches plant^{-1}(no.)	Pods plant^{-1}(no.)	Seeds pod^{-1}(no.)	1000- seed wt. (g)	Days to maturity	Seed yield (tha^{-1})
LMM-4	37.93ab	3.06ab	205.04b	1.75a	19.28bc	101.00a	2.16b
LMM-9	35.33b	3.20ab	193.24c	1.69b	18.76c	96.00b	2.09c
Binamasur-8	37.80ab	2.87b	164.40d	1.62c	19.78b	101.00a	1.78d
Binamasur-12	39.60a	3.40a	219.63a	1.69b	20.97a	99.00a	2.25a

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

CONCLUSION

Binamasur-12 showed the highest nitrate reductase activity and chlorophyll content at 66 and 88 DAS. Nitrate reductase activity of all the lentil genotypes was higher at 66 DAS than 88 days. Crop growth rate was higher in Binamasur-8 and Binamasur-12 and LMM-9 and Relative growth rate in Binamasur-8 and LMM-9. LMM-9 produced the longest plant. The highest seed yield was produced by Binamasur-12. Crop duration of the lentil genotypes was 96-101 days.

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