PERFORMANCE OF PROMISING LENTIL CULTIVARS AT DIFFERENT NITROGEN RATES UNDER IRRIGATED CONDITIONS

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ABSTRACT: *Lentil is a short stature, semi erect, rabi legume crop in Pakistan. It is a main source of vegetable protein in human diet. A field study was conducted, to evaluate the effect of nitrogen application on different agro-physiological traits of three lentil cultivars. The experiment was conducted at the Agronomic Research Area, Department of Agronomy, University of Agriculture, Faisalabad, Pakistan. The experiment was laid out in randomized complete block design with three replications. Three cultivars viz Punjab Masoor (PM)-2009, NIAB Masoor (NM)-2006 and NIAB Masoor (NM)-2002) were randomized in main plots and three levels of nitrogen (13, 19 and 25 kg ha^{-1}) in sub plots. The results showed that various cultivars and nitrogen rates significantly affected the lentil growth, yield and related traits. PM-2009 performed the best under irrigated semiarid environment of Faisalabad It gave the highest seed yield (972 kg ha^{-1}). Maximum number of pods plant^{-1} (47.29), number of grains pod $^{-1}$ (1.80), 1000-seed weight (21.89 g), grain yield (877.09 kg ha^{-1}) and biological yield (3954.5 kg ha^{-1}) were recorded against 25 kg N ha^{-1}. It was concluded that sowing PM-2009 at 25 kg N ha^{-1} is best strategy enhance grain yield of lentil in Faisalabad conditions.*

Key Words: Cultivars response; Nitrogen; Lentil

INTRODUCTION

Food legumes are the inexpensive source of protein, calories, minerals and some vitamins. Legumes are fundamental components in the diet of 700 million people in the world, especially in developing countries [14]. The per capita consumption of legume in Pakistan is 15.7 kg per annum. The yield of pulse legumes in Pakistan is 0.5-0.6 t ha^{-1} [5]. Lentil (*Lens culinaris* Medik.) is an important grain legume crop in Pakistan. It is a short, semi erect, annual legume and used for human consumption. It is a main source of vegetable protein in human diet. In Pakistan, total area under lentil crop is 49 thousand hectares with total production of 29.3 thousand tons giving an average yield of 625 kg ha^{-1}. It occupies the second position among the major grain legume [10]. Average protein content of lentil seed is 22-34.6 % and 100 g of dried seeds contain 340-346 g calories, 12 % moisture, 20.2 g protein, 0.6 g fat, 65.0 g total carbohydrate, about 4 g fiber, 2.1 g ash, 68 mg Ca, 325 mg P, 7.0 mg Fe, 29 mg Na, 780 mg K, 0.46 mg thiamine, 0.33 mg riboflavin and 1.3 mg niacin. Being a legume crop, lentil can fix atmospheric nitrogen via symbiotic rhizobia in root nodules and consequently has potential in rotation for maintaining soil fertility [4].

Despite holding these merits there are so many constraints in lentil production which limit the crop production by reducing their growth and yield. Out of which misuse of fertilizer and unavailability of promising varieties of lentil are the main hindering factors, which limits the economical crop growth of lentil. Although varieties of a crop may exist somewhere else, but unavailability and high prices of inputs, old traditional methods of sowing, low plant population in the field, climate, soil, unawareness of the farmers about site specific production technology, marketing system and other agronomic factors may also affect lentil yield potential locally. Therefore, varieties may have to be tested for special local growing conditions [7]. There is also a wrong notion with farmers that this crop being a legume does not need any nutrition. Farmers usually grow lentil without any fertilizer especially without nitrogen fertilizer. Although legumes can meet their nitrogen requirements by biological nitrogen fixation, but a starter dose of nitrogen is helpful in increasing the crop yield. Nitrogen is critical element for increasing the quality of food crops. Nitrogen insufficiency can be occurred recurrently in everywhere therefore this element should be comprised as a fertilizer. Depending on the species, stage of growth and organ of plant, the amount of nitrogen required for optimum plant growth is between two to five percent of dry weight. Nitrogen is important macro element for growth of legumes. It has important role in the formation of root nodules and this opinion has an important role in nitrogen fixation. Application of suitable amount of nitrogen fertilizer in legumes increased pod number, seed number and seed weight. One of the main reasons for this problem is the inappropriate use or allocation of fertilizer [9]. The present study was, therefore, designed to determine the effect of different nitrogen levels on the agronomic traits of three cultivars of lentil under irrigated conditions of Faisalabad.

MATERIALS AND METHODS

An experiment was conducted to evaluate the effect of nitrogen rates (13, 19 and 25 kg ha^{-1}) on different agronomic traits of three lentil cultivars (Punjab Masoor-2009, NIAB Masoor-2006 and NIAB Masoor-2002) at Agronomic Research Area, University of Agriculture Faisalabad (Latitude 31° 26 N, longitude 73° 60 E) during the Rabi seasons of 2009-2010. The chemical properties of the soil of experimental site are given in Table 1. The experiment was

laid out in Split Plot Design having three replications. The crop was sown in 30 cm a part rows with a net plot size of 1.2 m x 6 m having 4 rows plot^{-1}. Lentil cultivars were kept in main plots and nitrogen rates in sub plots. The Crop was sown in the last week of October with the help of single row hand drill. The field was irrigated 15 days before planting lentil and plowed at a time when the field was in proper moisture condition. Two plowing followed by planking were made to make a desirable seed bed for there up planting. Crop was sown on 30 cm spaced using a seed rate of 30 kg ha^{-1}. Nitrogen and phosphorus was applied in the form of Urea and DAP. Full dose of nitrogen and Phosphorous fertilizer was applied at sowing. All other cultural practices such as hoeing, irrigation and plant protection measures will be kept normal for all the treatments. Weather condition of the experimental site is given in table 2.

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Final harvest

Half plot was harvested and a sub sample of 10 plants was taken for the determination of different yield components. All plants were threshed mechanically for the estimation of plot yield and converted into t ha^{-1}. Similarly harvest index (HI) of each plot was calculated according to the following formula.

HI = (Grain yield/Biological yield) x100

All the data obtained were analyzed statistically by employing the Fisher's analysis of variance technique and significant of treatment means was tested using least significance difference (LSD) test at 5% probability level [15].

RESULTS AND DISCUSSION

Weather

The average temperature ranged from 11.1 °C to 23.5 °C during the growing season of crop. Average rainfall during the season was 3.91 mm and it was maximum in February and March (Table 1). Solar radiation was 6.3 M J m^{-2} day^{-1} in the month of November which decreased and then gradually increased up to the month of April, having the value of 09.0 M J m^{-2} day^{-1}.

Number of branches plant $^{-1}$

Branching plays a vital role in enhancing the yield of a plant. Basically it is a genetic character but is also influenced by environmental factors. Data pertaining to number of branches per plant presented in table 3 indicated that the effect of nitrogen levels on number of branches per plant of lentil cultivars was significant. Application of 25 kg N ha^{-1} produced the highest number of branches per plant (12.6). The lowest number of branches per plant (8.30) was recorded from the crop grown with the application of 13 kg ha^{-1}. N_2 (19 kg ha^{-1}) produced the number of branches (9.87) that is followed by the N_3 (25 kg N ha^{-1}). In case of cultivars the number of branches per plant differed significantly. Cultivar NIAB Masoor(NM)-2006 produced the maximum number of branches per plant (11.32) followed by NM -2002 and PM-2009, producing 10.28 and 8.62 number of branches per plant respectively. The variation in the number of branches plant^{-1} occurred due to different genetic makeup of the cultivars(1) reported the similar results about the number of branches plant^{-1} in their experiment. The interactive effect of lentil *(Lens culinaris* Medic.) cultivars and fertilizer levels on number of branches was non significant.

Number of pods plant^{-1}

The number of pods per plant is very important and key factor in determining the yield performance of leguminous crops. Data regarding number of pods per plant presented in table 3. Data revealed that nitrogen levels significantly affect the number of pods plant^{-1} of lentil cultivars. Application of 25 kg N ha^{-1} (N_2) produced the maximum number of pods plant^{-1} (47.29) followed by N_2 (19 kg N ha^{-1}) and N_1 (13 N kg ha$_{-1}$) producing 43.93 and 40.04 number of pods per plant, respectively. These results are almost the same as were reported by Iqbal (1996) and Haider (1995). Different cultivars of lentil produced significantly different number of pods plant^{-1}. The highest number of pods plant^{-1} (48.29) was produced by cultivar NIAB Masoor-2006 while the lowest number of pods plant^{-1} (41.27) was recorded in case of Punjab Masoor-2009. While NIAB Masoor-2002 produced (42.89) the number of pods plant^{-1} which is statistically at par with the number of pods plant^{-1} produced by the cultivar Punjab Masoor-2009. It happened due to different genetic potential of the genotypes for this parameter. These results are similar to those reported by [11]. The interactive effect of fertilizer levels and cultivars was found to be non-significant.

Number of grains pod $^{-1}$

Number of grains pod^{-1} is an important factor that is directly related in determining the yield of leguminous crops. Basically this is a genetic character but may also be affected by the environmental conditions and agronomics practices. Data regarding number of grains pod^{-1} is given in table 3 showed that the effect of different nitrogen levels on number of grains pod^{-1} was significant. N_3 (25 kg N ha^{-1}) produced the maximum number of seeds pod^{-1} (1.80), while N_2 (19 kg ha^{-1}) produced (1.72) the number of seeds pod^{-1} which is statistically at par with number of seeds pod^{-1} (1.62) produced by the application of 13 kg N ha^{-1}. These results are in conformity, with those obtained by Ali *et al*.,[2]. Among cultivars Punjab Masoor-2009 produced the highest number of seeds pod^{-1} (1.821) as compared with NIAB Masoor-2006 and NIAB Masoor-2002 which produced 1.65 and 1.68 number of seeds pod^{-1} respectively. It means that the number of seeds pod^{-1} is a genetically controlled character and the difference among genotypes was due to their different genetic ability for this parameter. Similar results also reported by Jan and Nawabzada [9].

1000-seed weight (g)

The seed test weight is a very important factor for the determination of final crop yield. Data presented in table 3 indicated significant effect of nitrogen fertilizer on 1000 seed weight of lentil cultivars. The highest thousand seed weight (21.89 g) was produced when the crop was fertilized with 25 kg N ha^{-1} as against the lowest (18.43 g) in plots supplied with the application of N_1 (13 kg N ha^{-1}). Almost Similar results were reported by Jan and Nawabzada [9] and Hussain [7]. Different cultivars of lentil also showed the significant differences regarding thousand seed weight. The highest thousand seed weight (20.37 g) was produced by

cultivar Punjab Masoor-2009 as compared with NIAB Masoor-2006 and NIAB Masoor-2002 which produced 19.30 g and 18.84 g 1000 seed weight respectively. The variation in the seed weight of cultivars under study occurred due to various genetic potential of the varieties for this character. These results are in conformity, with those obtained by Ali *et al.,* (1994)[2]. The interaction between nitrogen levels and lentil cultivars was found non significant.

Grain yield (kg ha^{-1})

Grain yield is a function of combined effect of individual yield components, which are

influenced by various agronomic practices and environmental factors. Thus any variation in them is liable to bring about a change in seed yield. The data regarding seed yield kg ha^{-1} given in table 3 revealed that different nitrogen levels significantly affected the grain yield of lentil cultivars. Maximum grain yield (877.09 kg ha^{-1}) of lentil was recorded with the application of 25 kg N ha^{-1} while minimum seed yield (777.74 kg ha^{-1}) was produced at N_1 (13 kg N ha^{-1}). While with the application of N_2 (19 kg N ha^{-1}) produced the grain yield of 843.27 kg ha^{-1} .These results are in conformity, with those reported by Hussain (2002)[7] and Jan and Nawabzada (2004)[9]. Punjab Masoor-2009 produced the highest seed yield (971.86 kg ha^{-1}) as compared with NIAB Masoor-2006 and NIAB Masoor-2002 those produced 780.93 kg and 745.30 kg grain yield ha^{-1} respectively. These both results are at par with each other. The difference in seed yields ha^{-1} occurred due to different genetic potential of the various genotypes for this parameter. Mandal and Majmudar (2001) [12] and Reddy and Ahlawat (2001) [13] reported the similar results for grain yield kg ha^{-1}.

Biological yield (kg ha^{-1})

The production of total biomass and its distribution between economic and straw yield is a matter of great concern for the evaluation of the performance of a crop plant. Biological yield (BY) is the total biomass produced by plant on dry matter accumulation basis, as a result of environmental conditions and soil nutrients uptake by the plant. In general, the effect of nitrogen fertilizer was primitive and linear in the production of biological yield. According to the data presented in table 3 that different fertilizer levels significantly affected the biological yield of lentil. The maximum plant biomass (3954.5 kg ha^{-1}) of lentil was produced with the application of 25 kg N ha^{-1} which was statistically at par with the total biological yield (3808.7 kg ha^{-1}) produced when the crop was fertilized with N2 (19 kg N ha^{-1}).The minimum biomass (3655.3 kg ha^{-1}) was recorded with the application of N_1 (50 % of recommended, 13 kg ha^{-1}). Iqbal (1996) [8] and Hussain (2002) [7] reported the similar results. Lentil cultivar's also showed the significant differences in respect of total biological yield. Lentil cultivar NIAB Masoor-2006 produced the highest biological yield (3889.3 kg ha^{-1}) as against the lowest biological yield (3740 kg ha^{-1}) produced by cultivar Punjab Masoor-2009. The difference was due to genetic variations among the cultivars for this parameter. The interactive effect of fertilizer levels and cultivars on biological yield of lentil was non-significant.

Harvest index (%)

Harvest index is actually the measure of physiological efficiency of a crop plant to convert photo-synthates into the economically important parts of the plant. Data presented in table 3 indicated that the nitrogen levels significantly affected the harvest index of lentil crop. Maximum harvest index value (22.99 %) was calculated from the crop fertilized with 19 kg N ha^{-1} (N_2) while the lowest (20.23 %) for the crop grown with the application of N_1 (13 N kg ha^{-1}) which is at par with the harvest index (21.02 %) produced by the application of N_3 (25 kg N ha$_{-1}$). It means that higher nitrogen dose contributed to more vegetative growth and less net return. So, it is the wastage of resources. N_2 gave us the maximum return. Bakhtiar *et al.,* (1992) [3] and Mandal and Majmudar (2001) [12] found almost the similar results. Regarding cultivars, the results were also significant in case of harvest index. Cultivar Punjab Masoor-2009 showed the highest value (26.98 %) of harvest index as compared with NIAB Masoor-2006 and NIAB Masoor-2002 with harvest index values of 22.22 % and 19.54 % respectively. Different genotypes had different genetic potential to convert photosynthate into economically important parts of the plant. These results are similar to the findings of Hussain (2002)[9].

Table 1. Monthly mean weather conditions during crop growth season

Month	Mean Temp. (^{o}C)	Mean R.H (%)	Rainfall (mm)
November	18.2	4.7	0.7
December	14.5	64.4	0.0
January	11.1	82.3	0.8
February	15.7	62.7	11.9
March	23.5	57.5	8.8
April	29.9	36.8	1.3

Table 2: Mean comparison of yield and yield components under different lentil cultivars and N levels.

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Treatments	Branches plant $^{-1}$	No. of pods plant^{-1}	No.of grains pod $^{-1}$	1000-seed weight (g)	Grain yield (kg ha^{-1})	Biological yield kg ha^{-1}	Harvest index (%)
N-levels							
13 kg ha^{-1}	8.30 c	40.04 c	1.62 b	18.43 c	777.74 c	3655.55 c	20.30 b
19 kg ha^{-1}	9.87 c	43.93 b	1.72 b	19.57 b	843.27 b	3808.70 b	22.99 a
25 kg ha^{-1}	12.06 a	47.29 a	1.80 a	21.26 a	877.09 a	3954.50 a	21.02 b
LSD 5 %	0.56	0.97	0.055	0.857	27.22	169.09	1.00
Significance	*	*	*	*	*	*	*
Cultivars							
PM-2009	8.62 c	41.27 b	1.80 a	20.37 a	971.86 a	3740.80 b	25.82 a
NM-2006	11.32 a	48.29 a	1.65 c	19.34 b	780.93 b	3889.30 a	20.22 b
NM-2002	10.28 b	42.76 b	1.68 b	18.46 c	745.30 b	3773.6 b	19.54 b
LSD 5 %	0.196	3.97	0.064	0.754	42.81	112.03	0.755
Significance	*	*	*	*	*	*	*
Interaction	NS	NS	NS	NS	NS	NS	NS
Mean	10.07	38.93	1.71	19.57	832.69	3803.74	21.64

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