EFFECT OF SEEDING RATE ON LENTIL (*LENS CULINARIS* MEDIK) SEED YIELD UNDER RAINFED CONDITIONS

Ashiq Saleem, Muhammad Ashraf Zahid, Habib Iqbal Javed*, M Ansar**, Asghar Ali, Rashid Saleem* and Noor Saleem***

ABSTRACT:-The objective of this study was to investigate the effect of various sowing rates on seed yield of lentil. Field experiments were conducted for three consecutive years (2001-02 to 2003-04) at the National Agricultural Research Centre (NARC), Islamabad, Pakistan during the lentil growing season. An improved medium-grain size (1000-grain weight. around 25 g) variety Masoor 93 (18-12 x ILLP 4400) was used in these experiments. Eleven seeding rates i.e., 14.0, 21.25, 28.50, 35.75, 43.0, 50.25, 57.50, 64.75, 72.0, 79.25 and 86.50 kgha^{-1} were evaluated in the study. Results of the three-year study showed that grain yield kept on increasing up to a seed rate of 43 kgha^{-1} and remained static thereafter with a non-significant difference for any further increase in seed sown. The existing seed rate of 20 kgha^{-1} in lentil is seemingly not sufficient to obtain optimum yield. On average, about 2-2.5-fold increase in seed rate of lentil under rainfed conditions can be safely recommended.

Key Words: Lentil; Variety; Seeding Rates; Crop Yield; Yield Components; Pakistan.

INTRODUCTION

Lentil is an important *rabi* (cool-season) grain legume grown in Pakistan. The seeds are rich in protein with average concentration of 26%. The estimated land area under lentil has approximately halved in the last 25 years (Figure 1). In Pakistan, lentil planting constitutes only 3% of the total area of pulses with 2.5% share in total production (GoP, 2006). To meet domestic requirements, the government is presently importing more than 35000t of lentil annually. Punjab is the leading province of lentil cultivation with 65% of the total national area and production. Nearly 75% of the Punjab area lies in the districts of Chakwal, Rawalpindi, Narowal, Gujrat, and Sialkot. Sindh, Khyber Pakhtunkhwa and Balochistan contribute 14%, 14% and 7% of the area, respectively.

Optimum plant population density is an important factor to realize the potential yields as it directly affects plant growth and development. The sowing rate of 20 kgha^{-1} usually recommended for 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

* *Crop Sciences Institute, National Agricultural Research Centre, Islamabad, Pakistan.*
** *PMAS-Arid Agriculture University, Rawalpindi, Pakistan.*
*** *University of Haripur, Haripur, Pakistan.*
Corresponding author: agro_ashiqsaleem@yahoo.com

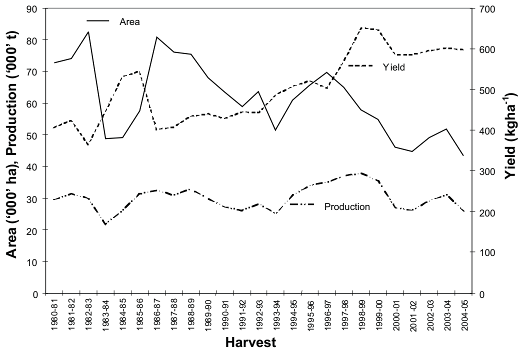

Figure 1. Trends of lentil area, production and yield in Pakistan during last 25 years

Source: GoP,2006

and thin stands (Muehlbauer, 1973; Morrison and Muehlbauer, 1986). Muehlbauer (1973) estimated 90 plants m^{-2} as the optimum plant density for lentil in Washington State, USA. Another study from the same region recommended the seeding rates for Palouse farmers as 67-79 kg ha^{-1} for the most commonly grown cultivar 'Brewer' (Morrison and Muehlbauer, 1986). Siddique (1998) suggest that, in south-western Australia, lentil yields improved by increasing sowing rates beyond those currently practiced in southern Australia (100-125 plants m^{-2}). According to those workers, a density of about 150 plants m^{-2}, using a sowing rate of approximately 90-110 $kgha^{-1}$, was recommended, depending on seed size and germination percentage of the seed. Even higher sowing rates might be optimum where growing conditions are unfavorable and individual plant growth is limited.

Higher plant density may lead to severe competition between plants (Singh and Singh, 2002), 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. The present study was designed to determine the appropriate plant density for maximum economic yield of lentil under rainfed conditions of Islamabad and adjacent areas.

MATERIALS AND METHOD

Field experiments were conducted for three years (2001-02, 2002-03 and 2003-04) at National Agricultural Research Centre, Islamabad, using an improved variety, Masoor 93 (18-12 x ILLP 4400) belongs to microsperma group. The same 11 seed rates/plant popu-lations (Table I) were evaluated each year. Masoor 93 has a 1000-seed weight of approximately 25 g. Individual plots consisted of four , 4 m long and 30 cm apart rows. Seed for each row was weighed separately and sown using a single row hand drill. The experiments were sown in the first week of November each year using randomized complete block design (RCBD) each with three replications. Weeds were manually removed twice during the crop span. No fertilizer or pesticide was applied considering the soil and plant health. Mean monthly rainfall received during the crop season in each of the three years was 15, 50 and 58 mm, respectively. At maturity, in the first week of May, the central two rows of each plot were harvested, sun-dried and threshed for yield data. Comprehensive measures were adopted to avoid seed losses during the process of drying and threshing. The data were subjected to analysis of variance (ANOVA) using MSTATC computer software. Means were compared using a least significant difference (LSD) test at the 5% level of probability.

RESULTS AND DISCUSSION

Seed yields of lentil (cv. Masoor 93) for the three year experiments revealed that during the first year (2001-02), a seed rate of about 36 kg ha^{-1} (estimated plant population of 1.25 m ha^{-1}) produced an economical yield (1204 kgha^{-1}). Some higher seed rates produced higher seed yields but the subsequent increases in yield were not significant, and therefore not cost effective (Table 1). Comparatively low yields were obtained due to extremely limited rainfall during this year. In the second year of the study, similar grain yields were obtained with sowing rates of 43-86 kgha^{-1}. Although the maximum yield was obtained with a seed rate of 50 kg ha^{-1}, this yield was comparable with the one from the lower seed rate of 43 kg ha^{-1}. In the third year of the experiment seed yields varied in a fashion

Table 1. Grain yield of lentil (Masoor 93) in the 3-year experiment as affected by different seed rates

Seed rate (kg ha^{-1})	Grain yield (kg ha^{-1}) 2001-02	2002-03	2003-04	Mean
14.00	780 e	1033 e	1058 e	957 d
21.25	748 e	1147 de	1413 de	1103 cd
28.50	909 de	1293 cd	1463 cde	1222 c
35.75	1204 abc	1216 cd	1469 cde	1296 bc
43.00	1164 bc	1431 ab	1986 abc	1527 a
50.25	1049 cd	1535 a	1996 ab	1527 a
57.50	1243 ab	1472 ab	1883 abcd	1533 a
64.75	1259 ab	1430 ab	1879 abcd	1523 a
72.00	1347 a	1474 ab	1914 abcd	1578 a
79.25	1181 abc	1376 abc	1924 abcd	1494 ab
86.50	1325 ab	1419 ab	2093 a	1612 a
LSD (P=0.05)	150	182	527	220
CV (%)	8	8	18	10

similar to the second year, where statistically similar yields were obtained from seed rates of 43 - 86 kg ha^{-1}.

The yields averaged over three years for each sowing rate (Figure 2)

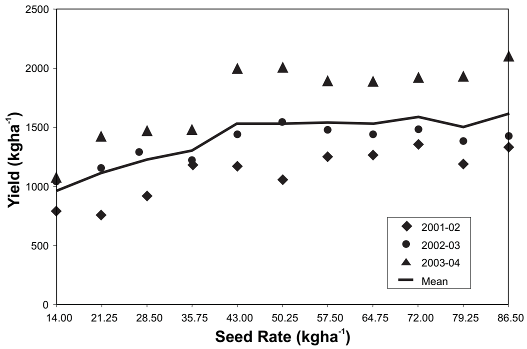

Figure 2. Grain yield of lentil as affected by different seed rates

strongly support the above connotation wherein yields did not significantly increase above a seed rate of 43 kg ha^{-1}. It is also clear from the economic analysis (Figure 3) that the

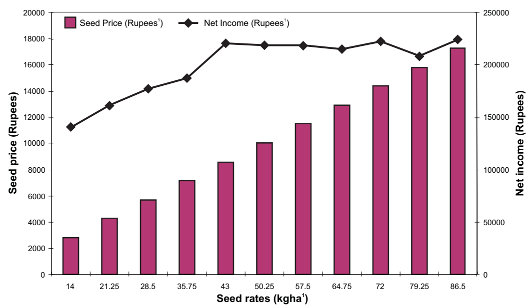

Figure 3. Economic analysis for different seed rates of lentil

net income from 43 to 86 kg ha^{-1} seed is almost similar. In the light of this economic analysis, 43 kgha^{-1} seed rate can safely be recommended to the farmers of rainfed areas. This finding is in consonance with that of Singh and Singh (2002) who observed that a seed rate of 45 kg ha^{-1}

produced a higher yield than a seed rate of 30 $kgha^{-1}$. Singh and Verma (1999) also reported that a seed rate of 45 $kgha^{-1}$ in lentil gave significant yield increases over seed rates of 30 and 60 $kgha^{-1}$. Tripathi and Singh (1987) at Pantnagar, India found that the small-seeded lentil genotype (Pant L 406) gave the highest yield (2.29 t ha^{-1}) at a seeding rate of 40 kg ha^{-1} as compared to a seed rate of 20 $kgha^{-1}$ (giving 0.72 tha^{-1}). According to that study, an increase in seed rate beyond 40 $kgha^{-1}$ led to significant losses in yield. Borah (1996) reported that increasing seeding rates had a negative effect on 100-seed weight and hence on seed yield. Singh et al. (2002) observed that, on average, sowing rates of 60 and 80 $kgha^{-1}$ increased the grain yield by 17% and 15%, respectively over 40 $kgha^{-1}$. Saxena and Yadav (1976) reported that, on the basis of plant density studies and sowing rate trials, the optimum sowing rate for small-seeded lentils under Indian conditions was around 40 $kgha^{-1}$.

The response of lentil to various plant densities has been variable depending upon genotype, planting time and growing conditions. Ahlawat et al. (1982) found that from Ist December planting, seed rates of 40 and 60 $kgha^{-1}$ gave similar yields, but 15th and 30th December plantings gave markedly higher yields from the seed rate of 60 $kgha^{-1}$. The studies in Washington State, USA (Muehlbauer, 1973) and Saskatchewan, Canada (Slinkard, 1976) noted that a sowing rate of about 50 $kgha^{-1}$ would be optimum for the large seeded cultivars grown there. High yields (1817 $kgha^{-1}$) in lentil were obtained for early sowing and high plant density (120 plants m^{-2}) in Jordan (Turk et al., 2003). Samadi and Peighambari (2000) in Karaj, Iran found that for lentil cv. Ziba optimum sowing time was December and best seed rate was 60-65 $kgha^{-1}$.

In view of the results of the study and subsequent discussion focusing on the region, it is concluded that a seed rate of 40-45 $kgha^{-1}$ for small to medium grain size lentil varieties should be used by the farmers to increase the yield of this important pulse crop.

LITERATURE CITED

Ahlawat, I. P. S. Singh, A. and Saraf, C.S. 1982. Yield of lentil cultivars as affected by date and rate of seeding under late sown conditions. Indian J. Agron. 27(3): 259-262.

Borah, U. K. 1996. Response of lentil genotypes to seed rates under rainfed conditions. J. Agric. Sci. Soc. North-East India. 9(1): 92.

GoP, 2006. Agricultural Statistics of Pakistan, Economic Wing, Ministry of Food, Agriculture and Livestock, Government of Pakistan. Islamabad. p. 50-51.

Morrison, K. L. and Muehlbauer, F.J. 1986. `Brewer` lentils. U. S. Department of Agriculture, Agriculture Research Services, Technical Bulletin No.1408.

Muehlbauer, F. J. 1973. Seeding rates for 'Tekoa' lentils. Washington Agricultural Experimental Station Circular No. 565. p.3

Samadi, B Y. and Peighambari, S.A. 2000. Effect of sowing dates and seed rate on agronomic characteristics of lentil (*Lens culinaris*) in Karaj. Iranian J. Agric. Sci. 31(4): 667-675.

Saxena, M. C. and Yadav. D.S. 1976. Agronomic studies on lentil under sub-tropical conditions of Pantnagar, India. Lens, 3, 17-26.

Selim, M. M. 1999. Response of lentil (*Lens culinaris* Medik) plants to sowing methods and seed rate grown under new reclaimed sandy soil conditions. Egyptian J. Agron. 20(1-2): 153-163.

Siddique, K. H. M. Loss, S.P. Regan, K.L. and Pritchard, D.L. 1998. Adaptation of lentil (*Lens culinaris* Medik.) to short season Mediterranean type environment: Response to sowing rates. Australian J. Agric. Res. 49(7): 1057-1066.

Singh, K. N. Bali, A.S. Ganai, B.A. and Hasan, B.1994. Optimum spacing and seed rate for lentil (*Lens culinaris*) varieties. Indian J. Agron. 44(3): 584-587.

Singh R. M. and Verma, N.P. 1999. Effect of seeding rate and row spacing on the yield and quality of lentil (*Lens culinaris*) varieties. Indian J. Agron. 44(3): 584-587.

Singh, A K. and Singh, N.P. 2002. Performance of bold-seeded lentil varieties under varying seed rates in normal and late sown conditions. Indian J. Agron. 47(2): 227-230.

Singh, J. P. Sandeep, S. Kedar, P. and Verma, S.N. 2002. Effect of sowing method, seed rate and fertilizer on grain yield of lentil. Progr. Agric. 2(2): 187-188.

Slinkard, A. E. 1976. Lentil seeding rate studies in Saskatchewan. Lens, 3: 32-33.

Tripathi, N. C. and Singh, N.P. 1987. Response of lentil cultivars to spacing and seeding rate. Indian J. Agron. 32(1): 1-3.

Turk, M. A. Tawaha, A.M. and El-Shatnawi, M.K.J. 2003. Response of lentil (*Lens culinaris* Medik) to plant density, sowing date, phosphorus fertilization and ethephon application in the absence of moisture stress. J. Agron. Crop. Sci. 189: 1-6.