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# LENTIL (*Lens Culinaris* Medic.) YIELDS IN ERZURUM IN RELATION TO SOWING DENSITY

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**SUMMARY :** *Seed and above ground biomass yields of lentil cv. Kışlık Kırmızı -51 were investigated in relation to sowing density (50, 65, 85 and 125 kg seed/ha) under dry conditions in 1988, 1989 and 1990 in Erzurum.*

*Although increasing sowing density resulted in high yields, seed yield increased only marginally after 85 kg seed/ha seeding rate. But straw and above ground biomass yields were the highest at 125 kgseed/ha. Higher HI and greater 1000-grain weight compansated yield disadvantages at lower plant densities. Data are discussed in relation to lentil yields.*

## ERZURUM ŞARTLARINDA EKİM SIKLIĞININ MERCİMEĞİN (LENS CULİNARİS MEDİC.) VERİMİNE ETKİSİ

**ÖZET :** *Ekim sıklığının Kışlık Kırmızı-51 mercimek çeşidinin tane ve toplam (tane-saman) verimi üzerine etkisi Erzurum kıraç koşullarında 1988, 1989 and 1990 yıllarında araştırılmıştır.*

*Hem tane hem de toplam verim artan ekim dozuna bağlı olarak artmıştır. Bununla birlikte tane veriminde 85 kg tohum/ha ekim dozundan sonra çok az artış olmuştur.*

*Yüksek hasat indeksi ve artan 1000-tane ağırlığı düşük ekim dozlarında verimde azalmayı telafi etmiştir.*

*Sonuçlar mercimeğin verimi açısından tartışılmıştır.*

## INTRODUCTION

Lentil is among few legume species adapted well to dry conditions in traditional rainfed cereal based farming System in Turkey. Due to extensive

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*grovernment support for the production of lentils in order to reduce large areas left annually to fallow, its acreage and production have sharply increased over the last decade (Annon., 1990). However, long term national yields increased only marginally (Annon., 1965, , 1985 and 1991). Short plant structure unsuitable to 1combining and inadequate agronomic and management practices applied by farmens as well as low levels of research devoted to the species not proportional to its market potential could be cited as chief factors in stagnant yields.*

*Optimum seeding rates to obtain required number of plant population in the field are first pre-requisite for high yields. This work tries to investigate the possiblity of increasing seed yield through optimum seeding rates.*

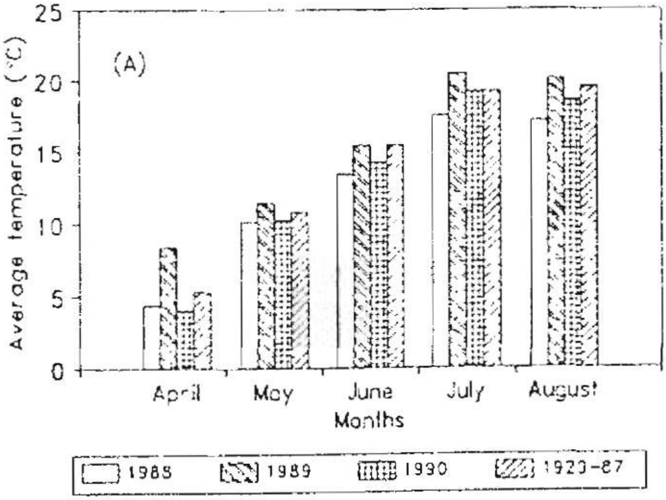
## MATERIAL AND METHODS

An experiment was conducted in order to incestigate the yield of lentil cv Kışlık Kırmızı-51 in relation to sowing density (50, 65, 85 and 125 kg/ha to give 350, 400, 450 and 500 seed/$m^2$), phosphorus fertilisation (0, 40, 80 and 120 kg $P_2O_5$/ha) and Rhizobium inoculation (control, only Rhizobum inoculation, 20 kg N/ha application and Rhizobium inoculation plus 20 kg N/ha) with four replicates in compeletely randomised blocks arranged in a factorial design in 1988, 1989 and 1990. The experiment was conducted on The University of Atatürk farm in Erzurum using lentil ev. Kışlık Kırmızı-51 with no irrigation. Climatic records obtained from the meteorological station at a distance of less than 500 m from experimental site are presented in figure 1.

The trial utilized 5x1.2 m plots containing 6 rows. Row spacing was 20 cm. Sowing was carried out with a precision drill at a depth of 3-4 cm between 21-26 April following ploughing and disc-harrowing. In order to prevent contamination through drill Rhizobium dressed seeds were sown after non-dressed seeds. Plants in middle 3.6 $m^2$ of the plots were harvested at full maturity between 20-25 July. Throughout the season weed control was achieved manually when required. The soil was a loamy-sand with a Ph of 7.6. $CaCO_3$, $P_2O_5$ and organic matter of the soil were 0.70 %, 54 kg/ha and 1.2 % respectively.

The data in relation to feniliser application and Rhizobium inoculation are presented else where.

Lentil cv. Kışlık Kırmızı-51 (Tosun and Eser, 1978) is a nationally registered small seedded cultivar.



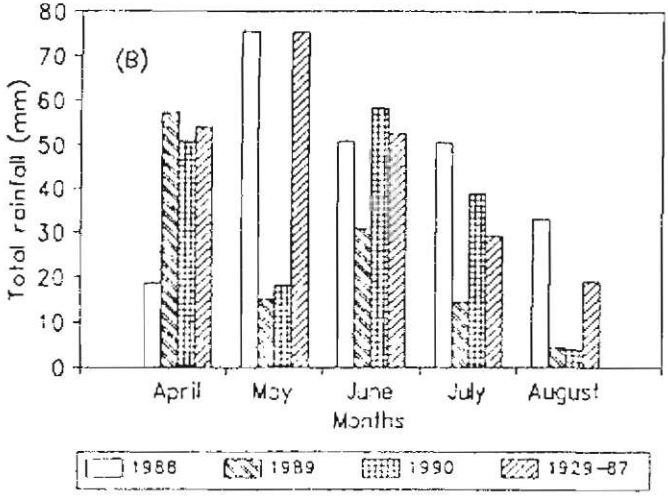




Figure 1. Average temperature (°C) (a) and total rainfall (mm) (b) during plant growth period at experimental site

### Observations made and data analysis

Following observation were made on each plot. Plant height (cm), the number of branches and pods per plant and the number of seeds per pod were recorded on ten plant samples taken randomly from the middle rows of each plot. Seed yield and above ground biomass yield (Seed plus straw yield) per plot were recorded after harvesting and threshing. 1000-grain weight on four samples from each plot were also counted. Crude protein content of seed was analyzed using Kjeldahl method. Harvest index was also calculated as the proportion of seed yield to above ground biomass yield.

All data were subject to analysis of variance using the MSTATC statistical paekage and correlations were made between the parameters recorded. Means were separated according to LSD Test.

## RESULTS

Sowing density affected seed and straw yields as well as above ground biomass in three years (Figure 2). Greater seeding rates resulted in higher yields ($P<0.001$) although second year yields were lower (Figure 2) due to adverse climatic conditions prevailed in 1989 (e.q. Higher temperatures and less rainfall) compared

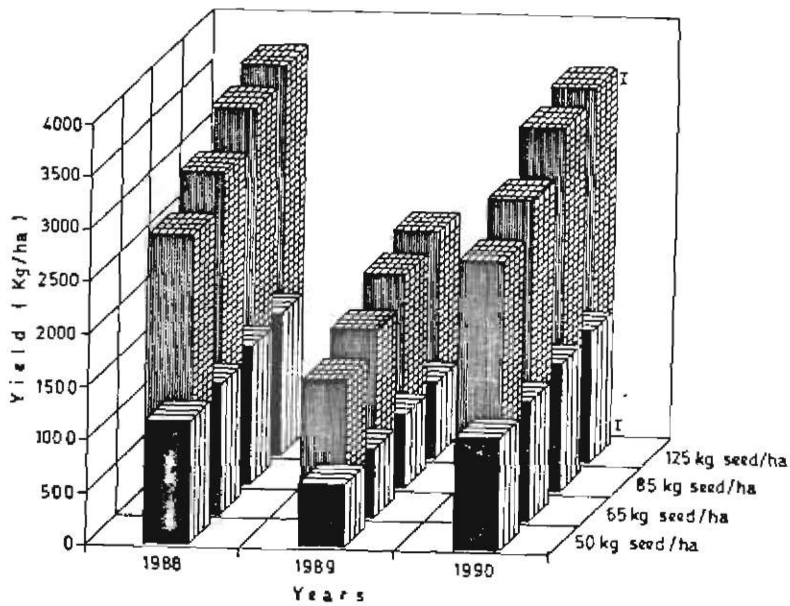



Figure 2. Seed ( ) and above ground biomass yield ( ) of lentil cv. Kışlık Kırmızı - 51 in relation to sowing density in 19i88, 1989 and 1990 in the field. Bars represent LSD at 1 %.

Table 1. Yield Components of Lentil cv. Kışlık Kırmızı-51 in Relation to Different Sowing Densities as a Mean of Three Years (1988-90) in the Field.

| Yield Components | Sowing density (kg/ha) | | | | |
|---|---|---|---|---|---|
| | 50 | 65 | 85 | 125 | LSD at 1 % |
| Protein content (%, DM) | 22.3 | 23.7 | 25.2 | 25.7 | 0.15 |
| Harvest Index (%) | 39.4 | 37.0 | 35.9 | 35.3 | 1.65 |
| Nu. of Branches per plant | 1.8 | 2.0 | 2.2 | 2.1 | 0.03 |
| Nu. of pods per plant | 16.6 | 17.8 | 18.5 | 18.2 | 0.26 |
| Nu. of seeds per pod | 1.9 | 2.1 | 2.2 | 2.1 | 0.03 |
| 1000-grain weight (gr) | 33.0 | 31.1 | 28.4 | 16.7 | 1.18 |
| Plant height (cm) | 21.9 | 23.6 | 25.8 | 25.9 | 0.26 |

with long term average (Figure 1 a and b). At the highest sowing density (i. e. 125 kg seed/ha) seed and above' ground biomass yields were 1115.1 and 3138 kg/ha compared with 930 and 2429 kg/ha at the lowest sowing density (50 kg seed/ha) respectively (Figure 2). The increase in straw yield was also in line with seed yield. However, especially after 85 kg seed/ha seeding rate, yield gain was only marginal.

Tablo 2. Correlation Coefficients (r) Among the Yield Components Investigated of Lentil cv. Kışlık Kırmızı-51 in Relation to Different Sowing Density as of the Pool of 1988, 1989 and 1990 in the Field.

| Yield Components | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|
| Plant height (cm)(1) | 0.11 | 0.54*** | 0.67*** | -0.05 | -0.17 | 0.56*** | 0.48*** | 0.69*** |
| Nu. of braches per | | 0.55*** | 0.49*** | 0.18 | 0.20* | 0.025 | 0.41*** | 0.40*** |
| Nu. of pods per plant (3) | | | 0.79** | 0.05 | 0.21* | 0.00 | 0.66 *** | 0.84** |
| Nu. of seeds per pod (4) | | | | 0.05 | 0.21* | 0.05 | 0.71 *** | 0.91** |
| Harvest Index (%) (5) | | | | | 0.20* | -0.13 | 0.67 *** | 0.03 |
| 1000-grain weight (gf (6) | | | | | | -0.43*** | 0.17 | 0.06 |
| Protein content (%, DM) (7) | | | | | | | -0.05 | 0.05 |
| Seed yield (Kg/ha) (8) | | | | | | | | 0.76*** |
| Total biomass yield (kg/ha) (9) | | | | | | | | |

* Significant at 5 %, ** Significant at 0.1 % and *** Significant at 0.01 %.

Higher HI and greater 1000-grain weight compansated the yield disadvantages and lower plant densities (Table 1). Seed yield was positively correlated withi the yield components investigated except with 1000-grain weight and protein content (Table 2).

## DISCUSSION

High grain yields requires optimum seeding rates to obtain an optimum plant population in the field. Response of lentils to sowing density may vary, depending on genotype and growing conditions (Saxena, 1981). Higher plant densities may result in significant yield increases under conditions that are conducive to restrictid vegetative growth and with cultivars having limited phasticity (Saxena, 19881). In contrast, under favourable edaphic and climatic conditions yield responses of lentils may not be proportional to increases in sowing rates.

Evidence from other studies suggests that in spring sowing under similar conditions high yields were obtained from high seed rates and in narrow spacing, depending on edaphic conditions and genotype. For dry areas of West Asia, the optimum sowing rates are 60 to 80 kg seed/ha for small seeded and 120-160 kg seed/ha for large seeded cultivars (Saxena, 1981). In USA (Muehlbauver, 1973) and Canada (Slinkard, 1976) a sowing rate of about 50 kg/ha was recommended for the large seeded cultivars. Maximum seed yields were also obtained in 15 cm between row spacing, irrespective of seed size, in USA (Wilson and Teare, 1972) and in Canada (Ali-Khan and Kiehn, 1989). Furthermore, the highest yields were obtained at 450 seed/$m^2$ in Bulgaria (Petkova, 1987) and at 10x10 row spacing (30 kg seed/ha) under polish conditions (Pawlowski et al. 1988). In Ankara conditions tosun and Eser (1978) recommended 20 cm row spacing to give 225-250 plants /$m^2$ for large seeded "Kışlık -Pul 11" and 325-350 plants/$m^2$ for small seeded "Kışlık kırmızı 51". Higher seed yields were related to leaf area and branches, of which canopy closure is a function (Wilson and Teare, 1972) because fully developed canopy can intercept most of the incident radiation (McKenzie and Hill, 1991).

In our trials yields of cv. "Kışlık Kırmızı 51" (Tosun and Eser, 1978) were not proportional to increases in sowing rates although seed yield increased from 930 kg/ha at 50 kg seed/ha to 1115 kg/ha at 125 kg seed/ha. Yields increased only marginally after 85 kg seed/ha.

Lower harvest indices and smaller 1000-grain weights at higher sowing rates appeared to counter balanced increases in pods /plant, the number of rgains per pod and plant height (Table 1). No discernable lodging was observed at higher plant densities. Nonetheless, protein content of seed increased as sowing rates increased

(Table 1). Total biomass yield, on the other hand, increased with increasing sowing rates (Figure 2). Seed yield, being positively correlated with total biomass yield ($r = 0.76$, $P < 0.001$) (Table 2), may suggest that higher levels of canopy closure at high seeding rates facilitated maximum interception of solar aradiation and consequently higher seed yield was produced (McKenzie and Hill, 1991). However, higher sowing rates than 85 kg seed/ha for spring sown cv. "Kışlık Kırmızı 51" may not be justified as marginal increases in seed yield can be balanced by higher levels of vegetative growth.

In conclusion, a seed rate of 85 kg seed/ha for seed is advised for small seeded lentil cultivars such as "Kışlık Kırmızı 51" under conditions similar to Erzurum plateau. Higher rates of sowing than 85 kg seed/ha could be justified when high straw yields were aimed for animal feeding.

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