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Effect of Planting Times Growth and Yield of White Lupen (*Lupinus albus* L.)

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ABSTRACT

The aim of this study was to investigate the effects of different sowing times on growth and yield characters of white lupine (*Lupinus albus* L.). The experiment was carried out in the Field Crops Experimen Station at Eyyubiye campus of Harran University during 2017-2018 semi-arid season. In the study, four different sowing times (30 October, 15 November, 30 November and 15 December) were evaluated in randomized complete blocks design with 4 replications. The results revealed that the impact of different sowing times on fresh herb and hay yield, 100 seed weight (gr) and seed yield of white lupine plant was statistically significant, but did not impact on crude protein, hay, crude protein in the seed, plant height and number of branches per plant. Overall, the results suggested that white lupen planted at the end of November could successfully be grown in Şanlıurfa conditions.

Key words: Crude protein, *Lupinus albus* L, Sowing date, White Lupen, Yield.

INTRODUCTION

Lupine fruits are widely cultivated and evaluated in different ways in Germany, Poland, Portugal, Hungary, Denmark, Netherlands, France, Italy, Spain, South Africa, New Zealand, South America and the southern states of the United States. Generally, lupines show good adaptation in the places, where soybean, broad bean, chickpea, lentil and other legume seeds do not grow (Blanco, 1990). Due to the weak pasture areas in our region (Seydosoglu and Kokten, 2019; Seydosoglu *et al.,* 2019), forage crops are of great importance (Kokten *et al.,* 2018; Kokten *et al.,* 2019). The aims of this study to investigate the impacts of different sowing times on the herb, hay and seed production potentials and yield components of white lupine in Sanliurfa ecological conditions.

MATERIALS AND METHODS

This experiment was carried out in the field crops research area of Harran University in Eyyübiye Campus of Þanlýurfa, Turkey in 2017 as winter crop. The lupine (white lupine) seeds (*Lupinus albus* L.) used in the study, which was the population obtained from the growers who grow white lupine in and around Antalya.

For the analysis of soil, samples were taken from 0-30 cm depth in the experimental field, average contents of organic matter, $CaCO_3$, plant available phosphorus and potassium were 1.23%, 5.40%, 3.60 kg da^{-1} and 9.3 kg da^{-1} (da = meters), respectively. Overall, soils were high in lime and potassium contents, whereas poor in organic matter and phosphorus contents. The soil of the experimental area is clay in texture and pH slightly alkaline.

During experimental period, the lowest average temperature was 5.5°C in January and the highest average temperature was 33.0°C in June. According to the long terms average temperature values, the lowest average temperature was 5.7°C in January and the highest average temperature was 28.2°C in June. While the amount of rainfall was 17.1 mm in October, 4.5 times higher rainfall was observed in November and December. The plants did not get enough rainfall in spring season. In April and May, which were the flowering and pod set times of crops, rainfall amounts were 49.6 and 25.6 mm, respectively.

The research trial was conducted in the growing season of 2017 on the field crops research area of Eyyubiye campus that represents the ecological conditions of the Harran plain in the province of Şanlıurfa. The experiment was carried out in a randomized complete block design with 4 replications. The crop was planted as per the different sowing times of October 15, November 15, November 30 and December 15, respectively. Accordingly, each block was consisted of 4 plots with 6 rows. Plot size was 70×20 cm, row length was 5 m and each parcel area was set as $5 \times 0.7 \times 6 = 21.0$ m^2. Calculating 15 kg seed per decares; 315 g of each parcel, 53.0 g of white lupine (*Lupinus albus* L.) seeds were used in each row. In the experiment, the parcels were fertilized with 4 kg pure (available) N and 8 kg pure (available) P_2O_5 decares (Okuyucu *et al.,* 2004). In the harvest operations, the first and last rows of each parcel together with the first and last 50 cm portions of each parcel were discarded as border effect and the remaining area

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($4 \times 1.4 \times 2 = 11.2$ m^2) was determined as harvesting area. The observations and measurements related to the characters to be evaluated were made in this area. Half of the trial plot (2 rows) was harvested for observations of hay yield and the other half (2 rows) was harvested for observations about seed yield. Harvesting of white lupines were performed at the end of flowering and when the lower beans begin to ripen for green grass; while for seed, it was performed when beans get yellowish and ripen.

The plant height and the number of branches per plant were determined by taking average measurements of 10 randomly selected plants from each plot between soil surfaces and last bud in cm. The weights of each plot were determined by weighing their green weights in the field conditions. 500 g of green grass samples harvested from each parcel were taken and dried in a oven at 70°C for 48 hours and hay yields of each parcel were determined by weighting dried weed samples. After harvesting plants from each parcel, seeds were dried and 100 seed weight and seed yields were calculated. The yield values determined per plot were converted to yield per decares. Plant samples taken from dry grass were milled in a mill with a sieve diameter of 1 mm and used for analysis. The Kjeldahl method was used to determine the nitrogen (N) content of the samples. The crude protein ratio was calculated by multiplying the nitrogen ratio by 6.25 (AOAC, 1990).

The data obtained at the end of the study were evaluated using JMP statistical package program and LSD test was used to determine the significance level of the differences between the means.

RESULTS AND DISCUSSION

Plant characteristics, green grass and hay yields and quality characteristics of lupen sown at different sowing dates under the ecological conditions of the Harran plain of Şanlıurfa province in the winter season of 2017, are presented in Table 1 and 2.

Plant height (cm)

There is no significant difference in average plant height due to different sowing times, the highest plant height of 30.46 cm was found in 30 October sowing crop (Table 1). Various studies conducted on different lupen genotypes in different ecologies reported the plant height of 38.70-91.70 cm (Okuyucu *et al.,* 2004; Georgieva *et al.,* 2018; Kosev and Vasileva, 2019). The lower height recorded in this study could be due to the low rainfall during the vegetation period and planting in the autumn.

Number of branches (per plant^{-1})

The different sowing times did not influence significantly on the number of branches per plant. However, the maximum number of branches per plant of 2.79 was recorded in the crop December 15 sowing (Table 1).

There are different studies on white lupen, which is a one-year legume forage plant from the same family in different ecologies and different genotypes. In Diyarbakır, Seydoşoğlu *et al.* (2015) in his study reported main stems of the bitter vetch as 1.87- 2.53 pieces plant^{-1}. The variation in the findings of this study and findings of other studies could be to the conditions of upbringing.

Green grass yield (kg da^{-1})

Green grass yield of lupine was found to be statistically significant with the sowing at different times. It can be observed that average green grass yield varied between 611.21-1178.57 kg da^{-1}, the highest was observed in October 30 sowing and the lowest was found in October 15 sowing (Table 1).

The different studies were conducted with different lupine genotypes in different ecologies and reported different amount of green grass yield vary from 3640-5420 kg da^{-1} in Brazil (Badina, 1972), 3000-6000 kg da^{-1} in Russia (Khrenikov, 1972) and 2193-8448 kg da^{-1} in Izmir (Okuyucu *et al.,* 2004). The lower yield obtained in the this study than the previous studies might be due to the different genotypes used, soil characteristics and precipitation received during the crop season.

Dry hay yield (kg da^{-1})

The dry matter yields were varied statistically significant under different sowing times (Table 1). It was seen that average hay yield varied between 172.65-358.77 kg da^{-1}. The highest hay yield of 358.77 and 323.86 kg da^{-1}) were recorded in 30 November and 30 October parcels.

Okuyucu *et al.,* (2004) conducted study in İzmir reported that the dry matter yield of lupens was of 288-1057 kg da^{-1}. There are different studies on white lupen, which is a one-year legume forage plant from the same family. Seydoşoğlu

Table 1: Growth and yield characters as affected by different sowing times.

Sowing time	Plant height (cm)	Number of branches per plant	Green hayyield (kg da^{-1})	Dry hay yield (kg da^{-1})
30 October	30.46	2.67	1178.57a	323.86a
15 November	30.05	2.37	799.31bc	224.51b
30 November	26.79	2.38	1132.20ab	358.77a
15 December	25.72	2.79	611.21c	172.65b
Mean	28.25	2.56	930.33	269.95
LSD	NS	NS	351.18**	94.70**

Different letters in a column indicate significant differences ($p<0.05$) among different sowing times.

** Significant at $p \leq 0.01$; NS- Non-significant.

Table 2: Seed yield and quality parameters of lupen as affected by different sowing times.

Sowing time	Seed yield (kg da^{-1})	100-seedweight (g)	Protien in grass hay (%)	Seed protein (%)
30 October	185.39b	13.23a	17.34	32.60
15 November	209.90a	9.43b	19.53	30.79
30 November	212.57a	11.77ab	18.29	31.46
15 December	208.92a	9.99ab	16.85	34.86
Mean	204.20	1.10	18.00	32.42
LSD	11.36**	3.51*	NS	NS

Different letters in a column indicate significant differences ($p<0.05$) among different sowing times.
*Significant at P≤0.05; **Significant at P≤0.01; NS- Non-significant.

et al. (2015) reported that hay yield of pea genotypes was obtained as 330.67-767.38 kg da^{-1}. It is thought that genotype and environment are the reasons of similarities or differences between the results of this study and other studies.

Seed yield (kg da^{-1})

As shown in Table 3, the highest seed yields were obtained in 30 November, 15 November and 15 December sowing of 212.57, 209.90 and 208.92 kg da^{-1}, respectively, while the lowest seed yield 185.39 kg da^{-1} was recorded in 30 October sowing.

The study conducted by Okuyucu *et al.* (2004) reported the seed yield of 184-280 kg da^{-1} of lupens in İzmir. There are also different studies conducted for seed yield of grass pea, a one-year legume forage plant in the same family of white lupen. Seydoþoðlu *et al.* (2015) found the seed yield of grass pea genotypes ranging from 181.00 to 269.83 kg da^{-1} in Diyarbakır. Seed yield is a quantitative character that is highly affected by environmental conditions. High seed yields in southeastern Anatolia conditions may be due to ecological and genotypic differences in experiments.

100-seed weight (g)

100-seed weight (g) of white lupen varied between 9.43-13.23 g but highest was observed in October 30 sowing (Table 2). There were three different groups among different sowing times for 100 seed weight of white lupen.

There were different studies conducted on white lupine, which was one year of legume forage plants and with others in the same family. According to Georgieva *et al*. (2018), the weight of 1000-seeds of white lupen in Pleven was 174.50-322.18 g. Seydoşoğlu *et al*. (2015) recorded the weight of 1000-seed grass pea was 99.88-141.71 g in Diyarbakir.

The reason for the similarity or inconsistency between the results of this study and the findings of other researchers was due to the diffrent sowing times and the locations of studies.

The crude protein in dry grass

Although, there was no differences in average values of crude protein content of hay with different sowings, numerically, the highest crude protein in hay was observed of 19.53% in the November 15 planting time. The average crude protein of hay recorded in different sowings was 18.00% (Table 2).

The studies conducted on lupen in different ecologies were determined the crude protein content in hay. In France, Gatel (1994) measured the proportion of protein in the vegetable parts of lupine as 17.00-22.27%. Protein content in lupines in Konya was found as 28.0-47.6% (Hakkı *et al*., 2007). The protein differences between genotypes may be due to leaf stem ratio and growth stage. In other words, crude protein of genotypes, which have high leaf ratio, also have higher crude protein (Yucel *et al*. 2012).

The crude protein obtained in this study was lower than the reported by earlier researchers, which may be due to the low amount of rainfall during the vegetation stage and planted in autumn.

Seed crude protein (%)

Although, the crude protein in seed did not vary due to different sowing times, however, the highest protein content was measured in December 15 sowing plots (34.86%) (Table 2). According to the result of studies carried out with white lupine (*Lupinus albus* L.) with different genotypes in different ecologies, the protein content in white lupine seeds were found to be ranging from 24.90 to 33.30%. Erbaş *et al.* (2005) found the protein content in white lupine seeds in Antalya as 32.20%. Yorgancılar *et al.* (2007) measured the protein content in the seed in the local lupen populations in Konya as 32.45%. However, Georgieva *et al.* (2018) reported the proportion of crude protein in seeds in Plevne between 24.90 and 33.30%.

CONCLUSION

When the results are evaluated as a whole, it can be suggested that white lupine can be successfully grown in the region on 30 November sowing. Once the low alkaloid lupine varieties are obtained, they can be used safely in human and animal nutrition. Lupine cultivation has some positive advantages such as improvement of soil structure, utilization of phosphorus, which will create an ideal environment for the better growth of plants, its upright form, non-cracking of fruits and having suitable form for machine harvesting. Green grasses of lupens are valuable and

delicious. Due to these listed positive characteristics, lupine cultivation needs to be examined in more detail, on that basis the cultivation should be followed for higher production of lupen.

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