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THE RELATIVE IMPORTANCE OF SOME CHARACTERS TO SEED YIELD OF WHITE LUPIN AS AFFECTED BY PLANTING DATES AND PLANT DENSITIES

EL-Sayad, Z. S.[*]; F. Ashmawy [**]; Sabah M. Attia[*] and R. E. EL-Lithy[*]
*** Legume Dept., Field Crop Research Institute, ARC**
**** Central Lab. for Design and Statistical Analysis Research, ARC**

ABSTRACT

Seed yield of white lupin (*Lupinus albus L.)* varies greatly with planting date and plant density. Four field experiments were carried out to investigate and explain the effect of planting date and plant density on yield and its components in the old land and new reclaimed soil. White lupin Giza-1 variety was planted in a split-plot design with four replicates, in the four experiments, at the Research stations of Shandaweel representing the old land and Ismailia representing the new land. The experimental treatments were three planting dates (1st, 15th and 30th of November) and four plant densities (11, 17, 22 and 33 plants/m^2). Simple correlation and stepwise regression analysis were used to find out the relationship between yield and its components and to assess their relative contributions to the seed yield.

At Shandaweel, delaying planting date from 1st up to 30th of November significantly decreased all the studied characters. Increasing plant density up to 22 plants/m^2 significantly increased plant height and seed yield/fed. Number of pods and seed yield/plant were significantly decreased by increasing plant density from 11 up to 33 plants/m^2, whereas 100 seed weight significantly increased by increasing plant density up to 33 plants/m^2. Density of 11 plants/m^2 gave the highest values for number of branches/plant and number of seeds/pod. Interaction between planting dates and plant densities was not Significant regarding all the studied characters.

At Ismailia, the studied characters were significantly affected by planting date, giving their highest values by planting lupin early on 1st of November. Plant density significantly affected all the studied characters except 100-seed weight. Seed yield/fed and plant height were significantly increased by increasing plant density from 11 up to 33 plants/m^2 . Number of branches, pods and seed yield/plant were significantly decreased by increasing plant density. The highest number of seeds/pod was recorded by planting 11 plants/m^2. The studied characters were significantly affected by the interaction of planting date X plant density except number of branches/ plant.

There was highly significant and positive correlation between seed yield/plant and each of plant height, number of branches, pods/plant and 100-seed weight at both Shandaweel and Ismailia. Number of pods/plant, 100-seed weight, number of branches/plant and number of seeds/pod were the most important contributing characters to the seed yield at Shandaweel (R^2 = 72.99 %). At Ismailia, Number of pods/plant and plant height were accepted variables as significantly contributors to the variability of the seed yield (R^2 = 82.11%). The results cleared that number of pods/plant was the most important character to the variation of seed yield where it accounted for 55.55 % and 80.36 % to the total variation in the seed yield at Shandaweel and Ismailia, respectively.

INTRODUCTION

Lupin (*Lupiuns albus* L.) is considered one of the leguminous crops with the greatest potential because of the high protein content of its seeds, and its adaptation to poor soils and dry climates. Lupin seeds can be used on a large scale after getting rid of its poisonous alkaloids. Investigations of human feeding indicated that the alkaloid-free lupins have a nutritional quality which is as good as soybean and superior to that of other legumes.

Planting date is an important factor that affects the timing and duration of the vegetative and reproductive stages. Effect of planting date and plant densities on lupin has been studied by a number of researchers.

In a 3-yr investigation by Oplinger and Martinka (1991), at two locations in Wisconsin, USA, the early planting dates provided the highest yield. Lower yields of spring-sown white lupin were obtained in Minnesota for extremely early planting compared with late plantings (Putnam *et al.* 1993). Reiad *et al.* (1993) in Egypt, reported that lupin plants sown on 15th of October were higher in number of pods/plant, number of seeds/pod, seed weight/plant and seed yield/fed compared with those planted on 1st of November, 15th of November and 1st of December. In Canada, Faluyi *et al.* (1997) found, in a 2-yr study, that early sowing of lupin resulted in greater yields than later sowing in both years of the study.

Plant density plays a major role in yield improvement of white lupin. Changes in plant density alter the structure and size of the canopy and affect seed yield and its components. The results obtained by Reiad *et al.* (1993) in Egypt, indicated that plant height, number of branches/plant, number of seeds/pod, dry weight/plant and straw yield/plant increased by increasing the distance between rows up to 40 cm, while sowing at a distance of 20 and 30 cm produced more pods/plant, seed and straw yield/fed. In Spain**,** Lopez - Bellido *et al.* (2000) reported that seed yield of lupin exhibited no significant differences among the studied densities (20, 40 and 60 plants/ m^2). They also found that number of pods/plant decreased with increasing plant density, whereas number of seeds/pod remained unaltered.

Yield is a complicated character because it is the end-product of a number of components. Therefore, finding out the cmponents having the greatest effect on the yield and their relative contributions to the variability in the yield is of major importance. Correlation, path coefficient and multiple regression are statistical methods successfully applied to determine the contribution of each attribute to the potential seed yield (Yassen, 1984; Khattab *et al.* 1992 and El-Sayad, 1997). It was found that these statistical techniques were not enough to construct a prediction equation because several yield components have high correlation with the yield but may contribute little to precision of the prediction equation. Stepwise multiple regression might be the appropriate approach due to its sequence in analyzing data of such genotypes. It develops a sequence of multiple linear regression equations in a stepwise manner. The basis for accepting or eliminating an independent variable could be stated equivalently in terms of error sum of squares reduction, coefficient of partial correlation or F^* statistic **(**Draper and Smith, 1981**).** In Egypt, Hoballah (1991) using stepwise regression analysis found that number of pods/plant and weight of 100 seeds were the most important yield components in the total variation of white lupin seed yield.

The objectives of this study were to investigate (1): the effect of planting date and plant density on yield and its components of white lupin (2):

the relationships between seed yield and its attributes to construct a prediction model as well as to estimate the relative contributions of these attributes. This will help in planning appropriate selection program for improving white lupin crop.

MATERIALS AND METHODS

Four field experiments were conducted in 1999/2000 and 2000/2001 winter seasons at two locations, Shandaweel Research Station, as an old land, and Ismailia, as a new reclaimed soil. The chemical analysis of the soil of both locations is presented in Table 1. Monthly temperature (maximum and minimum) and relative humidity are displayed in Tables 2 and 3. These experiments were carried out to study the effect of planting dates and plant densities on yield and its components of white lupin Giza 1 Cultivar. Also, to find out the relationships between yield and its components as well as to assess the relative contributions to the seed yield, using simple correlation and stepwise regression analyses. The experimental treatments were as follows:

1-Three planting dates *i.e* 1st, 15th and 30th of November.

2- Four plant populations.

a) 11 plants/m^2 obtained by planting one side of the ridge (60 cm width), in double seeded hills, 30 cm apart.

b) 17 plants/m^2 obtained by planting one side of the ridge, in double seeded hills, 20 cm apart.

c) 22 plants/m^2 obtained by planting both sides of the ridge, in double seeded hills, 30 cm apart.

d) 33 plants/m^2 obtained by planting both sides of the ridge, in double seeded hills, 20 cm apart.

A split plot design with four replications was used. Planting dates were assigned to the main plots and sub-plots contained the plant population treatments. Each sub-plot consisted of 5 ridges of 3 m long and 60 cm apart. Agricultural practices were applied as usual in lupin fields.

At harvest, ten plants were randomly chosen from each sub-plot to collect data on the following characters:

1- Plant height in cm, (X_1).
2- Number of branches/plant, (X_2).
3- Number of pods/plant,(X_3).
4- Number of seeds/pod, (X_4).
5- Seed yield/plant in gm, (Y).
6- Weight of 100 seeds in gm, (X_5).
7- Seed yield in ard/fed was estimated on the basis of plot area (9 m^2).

Table 1: Chemical analysis of the soil at the experimental locations.

Chemical analysis	Shandaweel	Ismailia
PH	7.2	7.4
Organic matter %	1.5	0.34
$CaCO_3$ %	1.3	1.2
Total nitrogen (ppm)	682	29.0
Total phosphorus (ppm)	8.9	4.8
Total potassium (ppm)	389	52.0

Table 2: Monthly meteorological records of Shandaweel location in the 1999/2000 and 2000/2001seasons.

Months	Temperature		Relative humidity %
	Maximum	Minimum	
1999/2000			
November 1999	31.8	9.4	67.0
December 1999	27.1	4.8	68.0
January 2000	23.3	3.7	67.0
February 2000	24.7	4.1	59.0
March 2000	30.1	7.1	45.0
April 2000	37.0	12.6	37.0
2000/2001			
November 2000	30.8	8.6	47.0
December 2000	25.9	5.1	50.0
January 2001	25.4	3.5	45.0
February 2001	25.8	3.4	37.0
March 2001	31.1	8.8	48.0
April 2001	36.6	15.2	33.0

Table 3: Monthly meteorological records of Ismailia location in the 1999/2000 and 2000/2001seasons.

Months	Temperature		Relative Humidity %
	Maximum	Minimum	
1999/2000			
November 1999	15.8	12.8	61.0
December 1999	16.4	8.8	63.0
January 2000	13.3	9.9	63.6
February 2000	13.9	6.6	62.2
March 2000	27.8	10.1	60.5
April 2000	31.1	14.1	54.0
2000/2001			
November 2000	16.5	13.5	59.6
December 2000	22.0	12.1	56.0
January 2001	13.8	7.8	60.4
February 2001	22.5	8.4	58.4
March 2001	25.3	12.9	57.9
April 2001	23.5	14.9	56.4

Statistical procedures:

1- Data were subjected to analysis of variance as outlined by Snedecor and Cochran (1981). Significant differences of means were detected using least significant difference test (LSD) at 5% level of significance.

2- Simple correlation analysis: Simple correlation coefficients between pairs of traits were computed to find out the relationship between the studied characters.

3- Stepwise multiple linear regression analysis:

Stepwise multiple regression analysis was used to identify the effective yield components, as independent variables, which significantly contribute to the total variability in the seed yield as a dependent variable. This procedure develops a sequence of multiple regression models in a stepwise manner. One variable is added to the regression model at each step. The added variable is the one that causes the greatest reduction in the error sum of squares, it is also the variable which has highest partial correlation with the dependent variable for fixed values of those variables already added, and is the variable that has the highest F value. Analysis of stepwise regression was applied according to the method outlined by Draper and Smith (1981).

Correlation and stepwise analyses were applied to the data over both seasons of 1999/2000 and 2000/2001 for each location (Shandaweel and Ismailia). The dependent variable was seed yield/plant and the predictor variables (X_i) were as mentioned above.

RESULTS AND DISCUSSION

Results of yield and its components for white lupin as affected by planting dates and plant densities over both seasons of 1999/2000 and 2000/2001 at Shandaweel and Ismailia are presented in Tables 4 and 5.

Effect of planting dates:

Planting dates markedly affected yield and its components of white lupin, at Shandaweel and Ismailia. Results in Tables 4 and 5 showed that all studied characters significantly increased by planting lupin on November first followed by 15th of Nov. and 30th of Nov.

At Shandaweel, early planting of lupin on the first of Nov. surpassed planting on 15th of Nov. and 30th of Nov. by 4.6 % and 21.80 % for plant height, 10.20 % and 23.5 % for number of branches/plant, 4.70 % and 35.4 % for number of pods/plant, 2.7 % and 10.05 % for number of seeds/pod, 23.68 % and 70.33 % for seed yield/plant, 17.27 % and 26.27 % for 100-seed weight and 35.91 % and 114.29 % for seed yield/fed, (Table 4).

At Ismailia, the results presented in Table 5 showed quite clear and significant differences between planting dates and the superiority of early planting (Nov.1st) was clearly demonstrated. Planting on Nov.1st outyielded planting on 15th and 30th of Nov. by 11.87 % and 33.28 % for plant height, 3.92 % and 12.11 % for number of branches/plant, 15.23 % and 40.35 % for number of pods/plant, 2.13 % and 13.51 % for number of seeds/pod, 22.40 % and 66.55 % for seed yield/plant, 5.47 % and 12.59 % for 100-seed weight and 15.26 % and 60.63 % for seed yield/fed.

From the previous results it is clear that the optimum planting date for white lupin is 1st of Nov. followed by Nov. 15th and a serious reduction in lupin growth could be expected by delaying planting to Nov. 30th. These results are mainly due to the favorable climatic conditions when lupin is planted on 1st of Nov. where its plants will achieve their maximum growth and to utilize the climatic conditions which are considered as optimal for white lupin. These findings are in agreement with those obtained by Oplinger and Martinka (1991), Reiad *et al.* (1993) and Faluyi *et al.* (1997).

Results of all studied characters as affected by planting date at Shandaweel surpassed those of Ismailia (Tables 4 and 5). That is due to that the soil at Ismailia is new reclaimed soil which is still poor in nutritional elements especially organic matter (Table 1). And also due to the favorable climatic conditions at Shandaweel compared with Ismailia (Tables 2 and 3).

4 5Effect of plant densities:

Data presented in Tables 4 and 5 clearly showed that plant densities significantly affected seed yield of white lupin and its components at Shandaweel and Ismailia except 100-seed weight.

At Shandaweel, the results displayed in Table 4 clearly showed that seed yield/fed increased as plant densities increased from 11 up to 22 plants/m^2. Density of 22 plants/m^2 gave the highest value being 6.50 ard/fed recording significant increase compared with densities of 11 and 17 plants/m^2, respectively but insignificant increase compared with 33 plants/m^2. Similarly, increasing plant density up to 22 plants/m^2 significantly increased plant height. On the other hand, number of pods and seed yield/plant significantly decreased by increasing plant population. The highest number of pods/plant (16.71) was recorded by planting 11 plants/m^2 which also gave the highest seed yield/plant (18.56 gm). Weight of 100 seeds was significantly affected by plant densities. It increased by increasing plant densities up to 33 plants/m^2. Density of 11 plants/m^2 gave the highest value of number of branches/plant followed by densities of 22, 17 and 33 plants/m^2, respectively. Number of seeds/pod was significantly affected by plant population. The highest number of seeds/pod was recorded by planting 11 plants/m^2 followed by 22, 33 and 17 plants/m^2, respectively.

At Ismailia, seed yield and its components were significantly affected by plant populations except 100-seed weight, (Table 5). Increasing plant population from 11 plants/m^2 to 17, 22 and 33 plants/m^2 significantly increased seed yield/fed. Planting 33 plants/m^2 gave the highest value of seed yield being 5.53 ard/fed followed by densities of 22, 17 and 11 plants/m^2, respectively. The same trend was found regarding plant height but without significant difference between 22 and 33 plants/m^2. On the other hand, increasing plant population densities significantly decreased each of number of branches, pods and seed yield/plant. The highest values of these characters were recorded by using density of 11 plants/m^2 being 4.12, 15.58 and 18.21, respectively. Number of seeds/pod was significantly affected by plant densities. The highest number of seeds/pod was obtained by planting 11 plants/m^2 being 3.37 followed by densities of 22, 17 and 33 plants/m^2, (Table 5). Similar results were reported by Reiad *et al.* (1993) and Lopez-Bellido *et al.* (2000).

The results of plant densities at Ismailia showed clear effect on seed yield/fed. That is because lupin was planted in new reclaimed soil at Ismailia which is less in fertility compared with the old land at Shandaweel (Table 1).

Interaction effect:

Results of the effect of interaction between planting dates and plant populations on yield and its components of white lupin at Shandaweel and Ismailia are shown in Tables 4 and 5.

Planting dates X plant densities interaction significantly affected all studied characters at Ismailia except number of branches/plant (Table 5). Seed yield/fed increased significantly as plant densities increased under the three dates of planting. The highest yield of seeds/fed (6.26 ard.) was obtained by planting lupin on the 1st of Nov, using 33 plants/m^2, whereas planting on Nov. 30th using density of 11 plants/m^2 recorded the lowest seed yield/fed being 2.71 ard. Significant decrease was observed as plant populations increased in the three planting dates regarding number of pods and seed yield/plant. The highest number of pods and seed yield/plant being 18.63 and 23.25 gm, respectively were performed by planting lupin on Nov. 1st using 11 plants/m^2. Planting on Nov. 30th using density of 33 plants/m^2 gave the lowest number of pods (9.63) and seed yield/plant (9.00 gm). The highest values of plant height and number of seeds/pod were 156.25 cm and 3.54, which were performed by planting on Nov. 1st using 22 plants/m^2. planting on 30th of Nov. using density of 11 plants/m^2 gave the shortest plants (108.63) while the lowest number of seeds/pod (2.69) was recorded by planting 33 plants/m^2. Weight of 100 seeds gave the highest value (31.84 gm) by early planting on 1st Nov. using 33 plants/m^2 while delaying planting to 30th of Nov. with density of 11 plants/m^2 performed the lowest 100-seed weight being 27.41 gm.

Interaction between planting dates and plant densities did not significantly affect the studied characters at Shandaweel (Table 4).

From the previous results, it could be concluded that higher seed yield of lupin could be obtained by planting on the first of November using 22 plants/m^2 at Shandaweel and 33 plants/m^2 at Ismailia.

Correlation study:

Simple correlation coefficient between seed yield/plant and its components at Shandaweel and Ismailia are presented in Tables 6 and 7. Similar relations were observed between yield and its components at the two locations. The results indicated that there was highly significant and positive correlation between seed yield/plant and each of plant height (r = 0.5680 and 0.6319), number of branches/plant (r = 0.7257 and 0.5990), number of pods/plant (r = 0.7454 and 0.8965) and 100-seed weight (r = 0.3690 and 0.4265). Number of seeds/pod highly significantly and positively correlated with seed yield/plant at Ismailia with r value being 0.3154. Highly significant and positive correlation was observed between plant height and each of number of branches and pods/plant and weight of 100 seeds. The values of r were 0.5347, 0.4810 and 0.3153, respectively at Shandaweel, being 0.2917, 0.5631 and 0.5865 for the mentioned characters, respectively at Ismailia. Number of branches/plant significantly and positively correlated with number of pods/plant and 100-seed weight at Shandaweel with r values of 0.6569 and 0.2556, respectively. At Ismailia, the association between number of branches/plant and each of number of pods/plant, number of seeds/pod and weight of 100 seeds was positive and highly significant, (Table 7).

Table 6: Simple correlation coefficients between seed yield/plant and its components in white lupin over both 99/2000 and 2000/2001 seasons at Shandaweel Research Station.

Characters		X_1	X_2	X_3	X_4	X_5
Plant height	X_1	1.0000				
Number of branches/plant	X_2	0.5347**	1.0000			
Number of pods/plant	X_3	0.4810**	0.6569**	1.0000		
Number of seeds/pod	X_4	0.0877	0.0822	-0.0121	1.0000	
100 – seed weight	X_5	0.3153**	0.2566*	0.0643	0.0484	1.0000
Seed yield/plant	Y	0.5680**	0.7257**	0.7454**	0.1635	0.3690**

*** Significant at 0.05 level of significance.**
**** Significant at 0.01 level of significance.**

Table 7: Simple correlation coefficients between seed yield/plant and its components in white lupin over both 99/2000 and 2000/2001 seasons at Ismailia Research Station.

Characters		X_1	X_2	X_3	X_4	X_5
Plant height	X_1	1.0000				
Number of branches/plant	X_2	0.2917**	1.0000			
Number of pods/plant	X_3	0.5631**	0.6445**	1.0000		
Number of seeds/pod	X_4	0.3722**	0.3915**	0.3648**	1.0000	
100 – seed weight	X_5	0.5865**	0.3870**	0.4312**	0.3794**	1.0000
Seed yield/plant	Y	0.6319**	0.5990**	0.8965**	0.3154**	0.4265**

*** Significant at 0.05 level of significance.**
**** Significant at 0.01 level of significance.**

There was highly significant and positive correlation between number of pods/plant and both number of seeds/pod and 100-seed weight at Ismailia with r values being 0.3648 and 0.4312, respectively. Number of seeds/pod was found to be highly significant and positively correlated with 100-seed weight at Ismailia with value of r being 0.3794. These findings were in agreement with the results obtained by Yassen (1984), Khattab *et al.* (1992) and El–Sayad (1997).

Stepwise analysis:

Stepwise multiple regression analysis was used to identify the most important contributing characters to variation in seed yield of white lupin. Characters explaining seed yield using stepwise multiple regression analysis over both seasons of 99/2000 and 2000/2001 at Shandaweel and Ismailia are shown in Tables 8 and 9.

At Shandaweel, the results clearly indicate that four characters out of five were accepted as significantly contributing characters to seed yield variation. These accepted characters were number of pods/plant (X_3), 100–seed weight (X_5), number of branches/plant (X_2) and number of seeds/pod (X_4). The results showed that 73.55 % of the total variability in the seed yield could be linearly related to the studied characters, 72.99 % of the total yield variation could be attributed to the characters included into the model and 0.56 % could be due to eliminated character which is plant height. The characters included into the model could be arranged, according to their partial R^2, in a descending order as follows: number of pods/plant, x_3, (R^2=55.55 %), 100-seed weight, x_5, (R^2=10.36 %), number of branches/plant, x_2, (R^2=5.33 %) and number of seeds/pod, x_4, (R_2=1.75 %). The best prediction equation that had highest value of R^2 being 72.99 % and lowest standard error of estimate (2.54) was

$$Y = - 14.10 + 2.57 x2 + 0.66 x3 + 1.06 x4 + 0.23 x5$$

Table 8: Characters explaining seed yield of white lupin using stepwise multiple linear regression analysis over both seasons of 99/2000 and 2000/2001 at Shandaweel Research Station.

Characters		Regression Coefficient	STD Error	Prob.	Comm-ulative R^2 %*	Partial R^2 %
Number of pods/plant	X3	0.6639	0.0911	0.0000	55.55	55.55
100 – seed weight	X5	0.2258	0.0512	0.0001	65.91	10.36
Number of branches/plant	X2	2.5694	0.6512	0.0002	71.24	5.33
Number of seeds/pod	X4	1.0593	0.4368	0.0173	72.99	1.75

Intercept = - 14.10
*** R^2 for accepted characters = 72.99 %**
*** R^2 for eliminated characters = 0.56 %**
*** R^2 for all studied characters = 73.55 %**
Standard error of estimate = 2.54

At Ismailia, results indicated that number of pods/plant and plant height were accepted characters as significantly contributors to the total variance of the seed yield. 82.11 % of the total variation in the seed yield could be attributed to the characters included into the model and 0.53 % could be due to eliminated variables namely: Number of branches/plant, number of seeds/pod and 100-seed weight. All the studied characters accounted for 82.64 % in the total variation of the seed yield. The most important contributing character in the total variability of lupin seed yield was number of pods/plant (R^2 = 80.36 %) followed by plant height (R^2 = 1.75 %). The best prediction equation was

$$Y = 11.08 + 0.05 X1 + 1.48 X3$$

This equation had the highest R^2 (82.11 %) and lowest standard error of estimate being 2.40.

Table 9: Characters explaining seed yield of white lupin using stepwise regression analysis over 99/2000 and 2000/2001 seasons at Ismailia Research Station.

Characters		Regression Coefficient	STD Error	Prob.	Comm-ulative R^2 %*	Partial R^2 %
Number of pods/plant	X3	1.4783	0.0973	0.0000	80.36	80.36
Plant height	X1	0.0500	0.0166	0.0034	82.11	1.75

Intercept = -11.0873
*** R^2 for accepted characters = 82.11 %**
*** R^2 for eliminated characters = 0.53 %**
*** R^2 for all studied characters = 82.64 %**
Standard error of estimate = 2.40

Comparing the results of stepwise at Shandaweel (Table 8) and Ismailia (Table 9), it is observed that number of accepted characters included into the model at Shandaweel was higher than that of Ismailia although the value of R^2 of Ismailia was higher than that of Shandaweel. This is might be due to the environmental conditions since the soil in Ismailia is new reclaimed soil and it is still poor in nutritional elements and organic matter but Shandaweel has more fertile soil than Ismailia, (Table 1).

Generally, it could be concluded that obtaining higher seed yield of white lupin should be based on higher number of pods/plant. This result is in rough agreement with the results reported by Hoballah (1991), Khattab *et al.*(1992) and El-Sayad (1997).

REFERENCES

Draper, N. R. and H. Smith (1981). Applied regression analysis. John wiley and Sons, NY, pp 407.

EL–Sayad, Z. S. (1997). Breeding studies on lupin for some important economical characters. Ph. D. Thesis, Fac. Agric. Al-Azhar Univ., Cairo, Egypt.

Faluyi, M. A.; F. Zhang; S. Leibovitch and D. L. Smith (1997). White lupin growth, yield and yield components in Eastern Canada : Influence of Management. Agron. J., 89 : 781 - 788.

Hoballah, A. A. (1991). Breeding for seed yield, its components and quality traits in white lupin. Ph. D. Thesis, Fac. Agric., Cairo Univ., Cairo, Egypt.

Khattab, A. M.; S. A. Khalil and B. M. B. Rabeia (1992). Variation and path coefficient analysis for some quantitative characters in lupin (*Lupinus termis*). Egypt. J. Agric. Res., 70 (4): 1263 – 1272.

Lopez–Bellido, L.; M. Fuentes and J. E. Castillo (2000). Growth and yield of white lupin under Mediterranean conditions: Effect of plant density. Agron. J., 92 : 200 – 205 .

Oplinger, E. S. and M. J. Martinka (1991). Planting date, row width and seeding rate influence on lupin. P.71-75. In prospects for lupin in North America. Proc. Symp, sponsored by Ctr. for Alternative Plant and Animal products, St.Paul. MN, 21-22 Mar. 1991, Univ. of Minn. St. Paul.

Putnam, D. H.; S. R. Simmons and L. L. Hardman (1993). Vernalization and seeding effects on yield and yield components of white lupin. Crop Sci., 33:1076-1083.

Reiad, M. Sh.; M. Yasein and R. Th. Abdrabu (1993). Influence of row spacing and sowing date on growth and yield of white lupin (*Lupinus albus* L). 4^{th} Conf. Agric. Dev. Res., Ain Shams. Cairo, Feb. 13-18.

Snedecor, G. W. and W. G. Cochran (1981). Statistical Methods. 7^{th} Ed., Iowa State Univ. Press, Ames, Iowa, USA.

Yassen, H. S. (1984). Breeding studies on *L. termis* Forsk. M. Sc. Thesis, Fac. of Agric., Al–Azhar Univ., Cairo, Egypt.

الأهمية النسبية لبعض صفات محصول بذور الترمس الأبيض تحت تأثير مواعيد زراعة و كثافات نباتية مختلفة

زغلول سيد الصياد * ، فتحى عشماوى** ، صباح محمد عطية* ، رأفت عزت الليثى*
* قسم بحوث المحاصيل البقولية – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية
** المعمل المركزى لبحوث التصميم والتحليل الأحصائى - مركز البحوث الزراعية

أقيمت أربع تجارب حقلية خلال موسمى (١٩٩٩/٢٠٠٠) و (٢٠٠٠ / ٢٠٠١) فى محطتى البحوث الزراعية بكل من شندويل ممثلة للأراضى القديمة والأسماعيلية ممثلة للأراضى الجديدة وذلك لدراسة تأثير مواعيد الزراعة (أول نوفمبر – ١٥ نوفمبر – ٣٠ نوفمبر) والكثافة النباتية (١١ ، ١٧ ، ٢٢ ، ٣٣ نبات / م٢) على محصول الترمس ومكوناته (الصنف جيزة ١) باستخدام تصميم القطع المنشقة مرة واحدة فى أربع مكررات وقد درست العلاقة بين محصول البذور ومكوناته بإستخدام معامل الأرتباط البسيط كما درست المساهمة النسبية لمكونات محصول البذور بأستخدام أسلوب الأنحدار المتعدد المرحلى .

أوضحت النتائج فى منطقة شندويل أن الزراعة فى أول نوفمبر أدت إلى زيادة محصول البذور للفدان والنبات وطول النبات وعدد الأفرع والقرون للنبات وعدد بذور القرن ووزن ١٠٠ بذرة زيادة معنوية فى منطقة شندويل . كما أن زيادة الكثافة النباتية حتى ٢٢ نبات /م٢ أدت إلى زيادة كلا من محصول بذور الفدان وطول النبات زيادة معنوية وأشارت النتائج أيضا إلى أن زيادة الكثافة النباتيه من ١١ إلى ٣٣ نبات /م٢ أدت إلى حدوث نقصا معنويا فى كلا من عدد القرون ومحصول البذور للنبات فى حين زادت معنويا صفة وزن ١٠٠ بذرة بزيادة الكثافة إلى ٣٣ نبات /م٢ . سجلت صفتا عدد أفرع النبات وعدد بذور القرن أعلى القيم بزراعة ١١ نبات /م٢ . لم يؤثر التفاعل بين ميعاد الزراعة والكثافة النباتية معنويا على الصفات تحت الدراسة فى منطقة شندويل .

بالنسبة لمنطقة الأسماعيلية أوضحت النتائج أن الصفات تحت الدراسة تأثرت معنويا بميعاد الزراعة حيث أعطت هذة الصفات أعلى القيم بالزراعة المبكرة فى أول نوفمبر مقارنة بالزراعة فى ١٥ نوفمبر و٣٠ نوفمبر . أثرت الكثافة النباتية تأثيرا معنويا على جميع الصفات تحت الدراسة عدا صفة وزن ١٠٠ بذرة . زاد محصول بذور الفدان وطول النبات زيادة معنوية بزيادة الكثافة النباتية حتى ٣٣ نبات /م٢ بينما نقص كل من عدد الأفرع والقرون ومحصول البذور للنبات بزيادة الكثافة النباتية . أعطت الكثافة ١١ نبات/م٢ أعلى عدد للبذ ور فى القرن . تأثرت معنويا الصفات تحت الدراسة فى منطقة الأسماعيلية بالتفاعل بين ميعاد الزراعة والكثافة النباتية ما عدا صفة عدد أفرع النبات التى لم تتأثر معنويا بهذا التفاعل .

دلت نتائج تحليل الارتباط البسيط على وجود ارتباط عالى المعنوية وموجب بين محصول بذور النبات وكل من طول النبات وعدد الأفرع والقرون للنبات ووزن ١٠٠ بذرة .

أوضحت نتائج تحليل الأنحدار المتعدد المرحلى أن أكثر الصفات اسهاما فى تباين محصول بذور النبات فى منطقة شندويل هى عدد قرون النبات ووزن ١٠٠ بذرة وعدد أفرع النبات وعدد بذور القرن حيث ساهمت هذة الصفات بحوالى ٧٢,٩٩ % فى تباين المحصول بينما كانت صفتا عدد القرون للنبات وطول النبات هى أعلى الصفات أسهاما فى المحصول بالنسبة لمنطقة الأسماعيلية حيث ساهمت هاتان الصفتان بحوالى ٨٢,١١ % فى تباين محصول بذور النبات . كما أوضحت نتائج تحليل الأنحدار المتعدد المرحلى أن صفة عدد قرون النبات أعلى الصفات أسهاما فى تباين المحصول حيث ساهمت بحوالى ٥٥,٥٥ % ، ٨٠,٣٦ % فى شندويل والأسماعيلية على الترتيب لذا يجب أن تؤخذ هذة الصفة فى الأعتبار عند الأنتخاب لتحسين انتاجية محصول الترمس .

Table 4: Effect of planting dates, plant densities and their interactions on yield and its components of white lupin at Shandaweel. (Combined data over 1999/2000 and 2000/2001seasons).

Characters / Treatments	Plant height (Cm)	Number of branches/ Plant	Number of pods/plant	Number of seeds/pod	Seed yield/plant (gm)	100 – seed weight (gm)	Seed yield (ard/fed)
Planting dates (s)							
1st of Novebr	175.66	4.21	15.81	3.83	20.32	36.19	8.25
15th of November	167.97	3.82	15.10	3.73	16.43	30.86	6.07
30th of November	145.00	3.41	11.68	3.48	11.93	28.66	3.85
L.S.D	6.77	0.23	0.96	0.34	1.38	2.37	0.60
Plant densities (D)							
11 plants/m^2	158.38	4.13	16.71	3.86	18.56	30.35	5.44
17 plants/m^2	164.58	3.73	14.25	3.56	16.47	31.12	5.99
22 plants/m^2	166.25	3.82	13.78	3.70	15.27	32.59	6.50
33 plants/m^2	162.29	3.58	12.05	3.60	14.60	33.56	6.30
L.S.D	4.75	0.20	1.52	0.29	1.48	2.50	0.41
Interactios							
S_1 X D_1	169.50	4.65	18.98	4.05	23.63	34.44	7.53
S_1 X D_2	176.25	3.99	14.58	3.95	20.19	34.23	8.10
S_1 X D_3	181.88	4.28	15.88	3.72	18.48	36.32	8.73
S_1 X D_4	175.00	3.93	13.83	3.58	18.98	39.78	8.65
S_2 X D_1	164.38	4.05	17.73	3.89	18.26	29.79	5.36
S_2 X D_2	168.13	3.79	16.18	3.43	16.81	31.21	6.03
S_2 X D_3	170.63	3.80	13.90	3.96	15.64	32.27	6.66
S_2 X D_4	168.75	3.64	12.61	3.63	15.01	30.16	6.24
S_3X D_1	141.25	3.69	13.43	3.64	13.77	26.82	3.44
S_3X D_2	149.38	3.40	12.00	3.28	12.42	27.91	3.83
S_3X D_3	146.25	3.38	11.55	3.41	11.70	29.17	4.12
S_3X D_4	143.13	3.18	9.73	3.60	9.81	30.75	4.00
L.S.D	NS	NS	NS	NS	NS	NS	NS

Table 5: Effect of planting dates, plant densities and their interactions on yield and its components of white lupin at Ismailia. (Combined data over both seasons of 1999/2000 and 2000/2001).

Characters / Treatments	Plant height (cm)	Number of branches/ Plant	Number of pods/plant	Number of seeds/pod	Seed yield/plant (gm)	100 – seed weight (gm)	Seed yield (ard/fed)
Planting dates (s)							
1st of November	153.06	3.98	15.13	3.36	18.47	31.04	5.59
15th oNovember	136.81	3.83	13.13	3.29	15.09	29.43	4.85
30th of November	114.84	3.55	10.78	2.96	11.09	27.57	3.48
L.S.D	3.59	0.21	0.80	0.10	1.04	0.79	0.28
Plant densities (D)							
11 plants/m^2	130.33	4.12	15.58	3.37	18.21	29.20	3.66
17 plants/m^2	132.75	3.87	13.29	3.12	16.00	29.44	4.33
22 plants/m^2	138.13	3.75	12.33	3.28	14.42	29.78	5.04
33 plants/m^2	138.42	3.40	10.83	3.05	10.92	28.97	5.53
L.S.D	2.41	0.15	0.57	0.11	0.77	NS	0.22
Interactions							
S_1 X D_1	149.13	4.38	18.63	3.44	23.25	30.95	4.68
S_1 X D_2	153.13	4.06	15.38	3.20	20.50	30.73	5.29
S_1 X D_3	156.25	3.93	14.13	3.54	17.50	30.65	6.15
S_1 X D_4	153.75	3.54	12.38	3.26	12.63	31.84	6.26
S_2 X D_1	133.25	4.16	16.00	3.40	18.50	29.24	3.59
S_2 X D_2	135.38	3.91	13.63	3.18	15.88	30.10	4.41
S_2 X D_3	139.38	3.78	12.38	3.38	14.88	30.76	5.28
S_2 X D_4	139.25	3.45	10.50	3.21	11.13	27.63	6.12
S_3X D_1	108.63	3.81	12.13	3.26	12.88	27.41	2.71
S_3X D_2	109.75	3.64	10.88	2.98	11.63	27.49	3.29

$S_3X\,D_3$	118.75	3.54	10.50	2.91	10.88	27.94	3.70
$S_3X\,D_4$	122.25	3.21	9.63	2.69	9.00	27.45	4.22
L.S.D	4.18	NS	0.98	0.19	1.33	1.22	0.38