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PERFORMANCE OF SOME PROMISING WHITE LUPIN GENOTYPES AND DETERMINATION OF THE RELATIVE IMPORTANCE OF YIELD FACTORS IN NEWLY RECLAIMED LANDS

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ABSTRACT

This investigation was conducted at Ismailia and Abo-Simble Research Stations during 2000/2001 and 2001/2002 growing seasons to study the behaviour of nineteen local collected genotypes and three introduced varieties compared with the two commercial varieties (Giza-1 and Giza-2) under newly reclaimed land conditions. In addition to study the relative contributing of yield factors of white lupin. Genotypes were planted in a randomized complete block design with three replications.

Results revealed significant differences among genotypes for all studied characters. The introduced sweet determinates Kiev Mutant and Piscevoj were the earliest genotypes in number of days needed to flower and mature, but they exhibited the lowest values of seed yield at both locations. The local genotypes Belbies-9 and Family-9 were most promising for productivity and outyielded the recommended check variety Giza-1 by 22.86 and 13.88%, respectively, at Ismailia. Meantime, the local genotypes Ismailia-2 and Algeerb-2 were the most promising ones and yielded 33.78 and 32.28%, respectively, more than the recommended check variety Giza-2 at Abo-Simble. Moreover, the introduced bitter indeterminate Dijon-2 which retained its potentiality over the two different environmental conditions was superior in seed yield and represented remarkable increases of 20.88 and 38.79% over the recommended check variety Giza-1 at Ismailia and Giza-2 at Abo-Simble, respectively. Kiev Mutant and Piscevoj gave the lowest percentage of seed alkaloid, while Gerga-2 and Dijon-2 contained the highest seed alkaloid percentage.

Highly significant and positive correlation was recorded between seed yield/plant and each of days to 50% flowering, days to maturity, plant height, number of branches/plant, number of pods/plant and number of seeds/pod at both Ismailia and Abo-Simble. Meanwhile, 100-seed weight and alkaloid% were significant positive correlation with seed yield/plant at Ismailia. Plant height, number of pods/plant, number of seeds/pod and 100-seed weight were the most important contributing factors to seed yield at Ismailia (R^2 = 84.4%). At Abo-Simble, number of pods/plant, 100-seed weight, number of seeds/pod and days to maturity were accepted variables as significant contributors to the variability of the seed yield/plant (R^2 = 70.3%). According to path analysis, number of pods/plant, plant height and number of seeds/pod had the greatest direct effects towards seed yield at Ismailia. While, at Abo-Simble, number of pods/plant, 100-seed weight and number of seeds/pod proved to have the highest direct contribution to seed yield. Whereas, days to maturity showed positive indirect contribution towards seed yield variation, at both location.

INTRODUCTION

Cultivation of white lupin(*Lupinus albus* L.) was well established in classical Greek and Roman times, and may have been practiced in Egypt as early as 2000 years B. C. The agricultural and nutritional value of lupin is mainly due to the high protein content and that it belongs to the leguminous family by its ability to fix nitrogen via symbiosis with Rhizobium, thus being not only almost self supplying with one of the most expensive fertilizers, but also leaving nitrogen for the following crop as well as a good-textured and phytosanitary improved soil. (Gladstones 1970 and Rowland *et al*., 1986). Lupin could thus be grown instead of other grain legumes in regions where these cannot be grown successfully. Nevertheless, exploitation of lupin as a grain crop in Egypt has been constrained by several factors and the area cropped to white lupin has declined from 21428 feddan in 1957 to 8883 feddan in 2002*. Therefore, lupin production fails to face the increasing local consumption of the crop. Increasing crop production is one of the major targets of the agricultural policy which can be achieved by developing high yielding and early maturing varieties with adaptation to dry climatic conditions for increasing the cultivated area through newly reclaimed lands.

To improve this crop and achieve these mentioned goals, there is an essential need for a wide range of germplasm collection in addition to the genotypes available. For the germplasm collected to be of use to the plant breeder, evaluation of the collected material must be carried out and screened under different environmental conditions. Selected genotypes may be grown as they are collected or introduced, adaptability trails may be conducted in the area or they may be used as sources of new genes to improve the commercial varieties.

Several investigations had conducted lupin genotype evaluation experiments (Ibrahim *et al.,* 1966; Yassen, 1984; Hoballah, 1991; Khattab *et al.,* 1992; Nasr and Omar, 1999 and Ashrei, 2000). They found significant differences among either introduced or landrace genotypes in days to maturity, plant height, number of branches, pods and seeds per plant, seed index, seed yield and alkaloid content.

Yield is a complex character determined by several variables. Hence, it is essential to detect the characters having the greatest influence on yield and their relative contributions in yield variation. This is useful in designing and evaluating breeding programs particularly.

Direct selection of yield on individual plant basis is mostly misleading. Hence, the plant breeder attempts to improve yield indirectly through the improvement of characters associated with it. Correlation between yield and its factors is usually practiced in this regard. Positive association was observed between seed yield/plant and each of number of pods/plant, 100-seed weight, number of seeds/pod, number of branches/plant, plant height and days to flowering Ibrahim *et al*. 1966, Mourad 1991, Khattab *et al*. 1992, Espinoza *et al*. 2000 and El-Sayad *et al*. 2002). They were found that correlation was not enough to construct a prediction equation because

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several yield components have high correlated with the yield but may contribute little to precision of the prediction equation for multiple regression. Stepwise multiple regression might be the appropriate approach than multiple linear regression due to its sequence in analyzing data of such genotypes. The basis for accepting or removing 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, (1966). Hoballah (1991) and El-Sayad *et al.* (2002) found that number of pods/plant, weight of 100 seeds, number of branches/plant, number of seeds/pod and plant height were the most important yield factors in the total variation of white lupin seed yield.

Path coefficient analysis which developed by Wright (1921). It divides corre'ation coefficients into direct and indirect effects through alternate path ways Dewey and Lu, (1959). This helps to develop a suitable selection strategy. Several investigations have been made to screen such contributors and to understand their relative contributions towards white lupin seed yield. Khattab *et al.* (1992) reported that seed yield is the resultant of positive direct effects of number of seeds/pod, number of pods/plant and 100-seed weight.
The present investigation was designed to study the performance of 19 selected landraces and 3 introduced varieties compared with Giza-1 and Giza-2 in order to specify the most adapted genotypes for newly reclaimed lands of the East Delta and the South Valley environmental conditions. Also, to study the relative contribution for yield factors and construct a best prediction model between seed yield and its factors.

MATERIALS AND METHODS

Four field experiments were carried out in 2000/2001 and 2001/2002 winter seasons at Ismailia (East Delta) and Abo-Simble (South Valley) Research Stations, ARC, to evaluate a set of 24 genotypes of white lupin (*L. albus* L.). These included nineteen families, selected from 92 landraces which collected from different parts of Egypt after that have been assessed and reported elsewhere Nasr and Omar, (1999), and three introduced varieties, obtained from Australia and France, along with two commercial check cultivars (Giza-1 and Giza-2). The studied genotypes, accession number, origin and some characteristics were given in Table 1.
The experiments were laid out in a randomized complete block design with three replications. Each plot consisted of 5 ridges, three meters length with 60 cm between. Planting took place in rows (one row/ridge) with double seeded/hill, 20 cm apart. Agricultural practices were applied as usual in lupin fields. Data on number of days from sowing to 50% flowering and maturity were obtained in each plot. Also, seed yield (Ard./fed.) was recorded at harvest. The chemical analysis of the soil at both locations is presented in Table 2. Monthly temperature (maximum and minimum) and relative humidity% are displayed in Table 3.

Table 1: Accession number, origin, growth habit and alkaloid content of 24 white Lupin genotypes.

Genotypes	Accession number	Origin	Growth habit	Alkaloid content
Belbies-5	5	Sharkia	Indeterminate	bitter lupin
Belbies-8	8	Sharkia	indeterminate	bitter lupin
Ismailia-2	18	Ismailia	indeterminate	bitter lupin
Fayed-1	19	Ismailia	indeterminate	bitter lupin
Fayed-2	20	Ismailia	indeterminate	bitter lupin
Abo Soeir-1	25	Ismailia	indeterminate	bitter lupin
Abo Soeir-2	26	Ismailia	indeterminate	bitter lupin
Algeerb-2	28	Ismailia	indeterminate	bitter lupin
Beni Suef-1	33	Beni Suef	indeterminate	bitter lupin
Beni Suef-3	35	Beni Suef	indeterminate	bitter lupin
Belbies-9	79	Sharkia	indeterminate	bitter lupin
Family-9	53	Giza	indeterminate	bitter lupin
Family-11	55	Giza	indeterminate	bitter lupin
Family-16	57	Giza	indeterminate	bitter lupin
Local-12	60	Giza	indeterminate	bitter lupin
Issna-6	72	Quna	indeterminate	bitter lupin
Gerga-2	89	Sohag	indeterminate	bitter lupin
Sohag-3	94	Sohag	indeterminate	bitter lupin
Kalub-1	98	Kalubia	indeterminate	bitter lupin
Kiev Mutant	–	Ukraine	determinate	sweet lupin
Piscevoj	–	Poland	determinate	sweet lupin
Dijon-2	–	Franc	indeterminate	bitter lupin
Giza-1	–	Egypt	indeterminate	bitter lupin
Giza-2	–	Egypt	indeterminate	bitter lupin

Table 2: Chemical analysis of the soil for both experimental locations

Chemical analysis	Ismailia		Abo-Simble	
	2000/2001	2001/2002	2000/2001	2001/2002
pH	7.30	7.50	9.20	9.20
Organic matter%	0.61	0.35	0.10	0.10
$CaCO_3$%	1.80	2.40	15.00	15.00
Total nitrogen (ppm.)	30.00	27.00	16.00	20.00
Totalphosphorus (ppm.)	5.80	3.50	5.00	5.60
Total potassium(ppm.)	53.00	51.00	140.00	151.00

Table 3: Monthly meteorological records of Ismailia and Abo-Simble Locations over both seasons (2000/2001 and 2001/2002).

Month	Ismailia			Abo-Simble		
	Temperature		Relative humidity%	Temperature		Relative humidity%
	Max.	Min.		Max.	Min.	
Nov.	16.2	13.4	60.5	32.2	19.6	39.7
Dec.	18.3	10.6	59.5	27.0	13.0	44.6
Jan.	13.9	8.9	61.9	25.5	11.9	42.3
Feb.	18.0	7.5	60.4	26.5	13.9	36.4
Mar.	26.7	11.8	59.2	31.3	15.3	27.8
Apr.	28.3	14.3	55.2	37.0	22.1	29.6

At harvest, five individual plants were randomly taken from each plot to collect data on the following characters:

1 – Plant height in cm.
2 – Number of branches/plant.
3 – Number of pods/plant.
4 - Number of seeds/pod.
5 – 100-seed weight in gm.
6 – Seed yield/plant in gm.
7 – Seed yield in ard/fed was estimated on the basis of plot area ($9m^2$)
8 – Alkaloid percentage: A rapid screening test for lupin alkaloid content as Described by Ruiz(1977), was followed and alkaloid was calculated as l lupanine($C_{15}H_{24}N_2O_1$).

Statistical procedures:

The combined data for two seasons 2000/2001 and 2001/2002 were subjected to statistical analysis of variance as described by Snedecor and Cochran(1981). Significant differences of means were detected using least significant difference test (LSD) at 0.05 level of significance.

Simple correlation coefficients, means and standard error were calculated among the studied characters as outlined by Steil and Torrie(1987).

Stepwise multiple linear regression was used. Percentage of contribution due to yield factors was estimated as applied by Draper and Smith (1966). In this procedure at each step, one variable is added to the regression equations. It is considered the one most reducing the error sum of squares. Equivalently, it is the variable that has the highest partial correlation with the dependent variable adjusted for the variable already added. Similarly, it is the variable which if added, has the highest F value in the regression analysis of variance. Moreover, other variables are forced into the regression equation and automatically removed when the values were low.

Path coefficient analysis was used as applied by Dewey and Lu (1959) and Duarte and Adams (1972). A path coefficient is simply a standardized partial regression coefficient as it measures the direct influence of independent variables upon dependent variable and permits the separation of the correlation coefficient into components of direct and indirect effects.

RESULTS AND DISCUSSION

Variation between studied genotypes:

As demonstrated in Tables 4 and 5, results obtained at Ismailia and Abo-Simble Research Stations over both seasons (2000/2001 and 2001/2002) showed significant differences existing among the tested genotypes and significant interaction between genotypes and locations on the agronomic characters, yield and its components.

A) Agronomic characters:

Data recorded on the agronomic characters (days to 50% flowering, days to maturity, plant height and number of branches/plant) for studied genotypes (Table 4) indicated wide ranges between them at both locations. The two introduced sweet determinate varieties (Kiev Mutant and Piscevoj) were the earliest genotypes in number of days needed to flower and mature at both locations, whereas they flowered at about 75 and 77 days after sowing (DAS)

Table 4: Mean performance of interaction between 24 white lupin genotypes and two experimental locations for the agronomic characters overall the two seasons (2000/2001 and 2001/2002).

Genotype	Days to 50% flowering		Days to maturity		Plant height (cm)		No. of branches/plant		Alkaloid content%
	Ismailia	Abo-Simble	Ismailia	Abo-simble	Ismailia	Abo-Simble	Ismailia	Abo-Simble	Ismailia
elbies-5	83.83	73.33	163.5	139.5	108.2	93.0	4.18	4.05	0.676
BeBlbies-8	84.00	68.67	166.3	142.0	111.2	80.3	4.27	4.27	0.721
Ismailia-2	81.83	74.33	170.0	143.2	105.5	71.3	4.07	4.25	0.483
Fayed-1	81.83	78.17	172.2	142.7	107.5	75.2	4.17	3.48	0.419
Fayed-2	80.83	74.50	167.3	139.5	111.2	81.3	4.38	4.27	0.386
Abo Soeir-1	82.83	72.83	162.3	140.0	108.8	76.5	4.27	3.95	0.368
Abo Soeir-2	81.17	77.33	164.3	142.2	110.3	89.0	4.05	3.58	0.578
Algreeb-2	83.17	73.00	172.2	137.5	114.0	87.3	4.73	3.87	0.415
Beni Suef-1	82.00	76.50	170.5	140.0	105.3	73.5	4.68	3.90	0.546
Beni Suef-3	83.00	78.17	163.7	141.2	108.3	76.8	4.28	3.52	0.414
Belbies-9	79.67	72.00	170.3	138.7	120.7	73.2	4.87	3.60	0.682
Family-9	80.67	77.50	162.8	138.8	119.5	75.3	4.10	3.70	0.690
Family-11	77.67	77.00	162.7	144.0	104.0	67.7	3.93	3.78	0.717
Family-16	82.33	72.17	163.8	141.5	100.2	69.5	3.87	3.62	0.622
Local-12	79.83	72.33	166.8	139.8	110.3	67.3	4.30	3.68	0.381
Issna-6	77.83	64.67	170.0	141.7	99.8	72.2	3.90	3.78	0.685
Gerga-2	81.83	78.33	170.2	142.3	104.2	60.3	3.95	3.42	0.751
Sohag-3	79.83	73.83	170.2	142.7	92.7	66.7	3.83	3.32	0.576
Kalub-1	81.83	74.83	169.2	141.7	103.0	71.2	4.43	3.80	0.448
Kiev Mutant	75.17	61.83	145.5	123.7	70.2	54.8	3.23	2.95	0.042
Piscevoj	76.83	61.83	146.5	122.5	63.8	52.8	3.20	2.83	0.035
Dijon-2	80.83	75.67	170.3	145.0	116.7	66.0	4.47	3.50	0.725
Giza-1	80.50	69.33	169.5	140.0	107.0	70.5	4.40	3.28	0.596
Giza-2	80.50	78.27	167.8	140.5	105.5	92.5	4.20	3.60	0.545
Mean	80.81	73.18	165.8	139.6	104.5	73.5	4.16	3.67	0.520
L. S. D at 0.05	3.897		2.586		8.506		0.303		0.038

at Ismailia, and about 62 (DAS) at Abo-Simble as well as they matured at about 146 and 147 (DAS) at Ismailia, and about 124 and 123 (DAS) at Abo-Simble. On the other hand, the introduced bitter indeterminate variety Dijon-2 and two Egyptian commercial varieties Giza-1 and Giza-2 were considered as late genotypes in flowering and maturity at both locations. They flowered at about 81 (DAS) at Ismailia, and within 69 to 78 (DAS) at Abo-Simble. They matured within 168 to 170 (DAS) at Ismailia, and within 140 to 145 (DAS) at Abo-Simble. All genotypes on the average were clearly earlier in flowering and maturity at Abo-Simble than at Ismailia and this is mainly due to the high temperature during the growing season at Abo-Simble.

The sweet varieties Kiev Mutant and Piscevoj behaved as determinate genotypes, whereas they recorded the lowest values of plant height and branches number either at Ismailia or at Abo-Simble location. On the contrary, Belbies-9, Family-9 and Dijon-2 showed the highest values of plant height being 120.7, 119.5 and 116.7 cm, respectively, at Ismailia as well as Belbies-5, Abo-Soeir-2 and Giza-2 gave the highest values in this character being 93.0, 89.0 and 92.5 cm, respectively, at Abo-Simble. Moreover, Belbies-9 and Algeerb-2, at Ismailia, as well as Belbies-8 and Fayed-2, at Abo-Simble, produced the highest number of branches/plant compared to the other genotypes and the check varieties (Giza-1 and Giza-2). All genotypes on the average at Ismailia were taller by about 42%, and had higher number of branches/plant by 13.4% than that at Abo-Simble. This is mainly due to the soil at Abo-Simble was virgin with high pH (9.2) and high Ca CO_3 (15%). Tang *et al.,* (1995) reported that high soil pH and / or high Ca CO_3 are the primary factors restricting the growth of lupin plants. The variation from location to location in the agronomic characters of a given genotype is mainly due to the differences of the environmental conditions.Meanwhile, the variation among tested genotypes at the same location attributed to the genetic variation among these genotypes. These results are in harmony with those obtained by Khattab *et al.*, (1992) and Julier *et al.* (1995). They reported that genotypes reacted differently between locations.

B) Yield and yield components:

Means of yield and its components for studied genotypes in Table, 5 showed great variation in number of pods/plant, seeds/pod, 100-seed weight and seed yield/plant. The lowest yield/plant obtained at the two locations was in the sweet lupin cv. Kiev Mutant and Piscevoj, whereas they gave 16.48 and 13.50 g at Ismailia as well as 8.5 and 8.03 g at Abo-Simble. However they had relatively high weight of 100-seed being 30.33 and 30.19 g at Ismailia as well as 23.90 and 23.50 g at Abo-Simble. They also gave the lowest number of pods/plant and number of seeds/pod. On the other side, the highest seed yield/plant obtained at both locations was in the introduced bitter variety Dijon-2, whereas it produced 37.33 g at Ismailia and 14.88 g at Abo-Simble. Dijon-2 had almost higher number of pods/plant and seeds/pod as well as 100-seed weight at both locations. At Ismailia, the local genotypes Belbies-9 and Family-9 which gave high number of pods/plant (34.00 and 32.67) and high number of seeds/pod (3.9 and 3.7) as well as high weight of 100-seed (31.27 and 32.33 g) produced higher seed yield/plant (36.67 and 36.33 g) than that

Table 5: Mean performance of interaction between 24 white lupin genotypes and two experimental locations for yield and its components overall the two seasons (2000/2001 and 2001/2002).

Genotype	No. of pods/plant		No. of seeds/pod		100-seed weight (g)		Seed yield/plant (g)		Seed yield (Ard./fed)	
	Ismailia	Abo-Simble	Ismailia	Abo-imble	Ismailia	Abo-Simble	Ismailia	Abo-imble	Ismailia	Abo-Simble
elbies-5	29.17	19.52	3.82	4.92	27.05	12.72	30.55	11.61	5.148	2.874
BeBlbies-8	29.50	20.60	3.63	3.91	29.05	17.04	28.43	12.70	4.376	3.034
Ismailia-2	30.83	16.05	3.85	4.88	28.45	21.78	32.75	15.32	5.060	3.921
Fayed-1	30.67	18.37	3.60	4.77	29.88	19.47	31.50	14.54	4.734	3.674
Fayed-2	30.00	18.55	3.65	4.14	29.93	19.27	29.80	13.77	4.548	3.378
Abo Soeir-1	34.00	17.27	3.63	4.11	28.90	16.66	36.00	11.15	4.806	2.815
Abo Soeir-2	29.67	18.35	3.65	3.63	29.18	16.69	30.50	10.76	5.158	2.687
Algreeb-2	32.00	16.62	3.53	4.66	31.63	21.20	32.17	15.20	5.881	3.877
Beni Suef-1	29.67	13.25	3.52	4.29	30.20	21.59	32.50	11.35	4.998	2.929
Beni Suef-3	31.50	9.42	3.58	4.72	29.75	23.55	31.00	11.39	4.849	2.614
Belbies-9	32.67	12.95	3.88	4.20	31.27	24.85	36.67	13.49	6.708	3.571
Family-9	31.17	12.90	3.65	4.12	32.33	19.55	36.33	10.08	6.218	2.646
Family-11	31.67	14.13	3.63	4.53	28.98	20.08	30.17	12.23	4.589	2.953
Family-16	25.67	14.32	3.71	4.33	30.25	20.52	28.17	11.04	5.041	2.763
Local-12	32.27	13.58	3.60	4.44	29.10	17.88	31.90	9.90	4.942	2.713
Issna-6	22.83	13.20	3.85	4.70	31.80	18.15	26.83	11.17	5.300	2.852
Gerga-2	34.60	10.47	3.45	3.99	29.23	26.81	29.42	11.10	5.346	2.805
Sohag-3	24.67	13.85	3.48	4.49	31.88	19.12	27.63	11.36	4.983	3.076
Kalub-1	31.33	16.53	3.52	4.30	29.98	15.12	29.08	9.86	5.568	2.591
Kiev Mutant	16.73	8.58	3.38	3.93	30.33	23.90	16.48	8.50	2.745	2.170
Piscevoj	15.13	7.50	3.33	4.03	30.19	23.50	13.50	8.03	2.077	2.060
Dijon-2	32.33	16.80	3.73	4.06	32.58	24.92	37.33	14.88	6.588	4.068
Giza-1	25.67	11.33	3.90	4.60	31.38	21.28	30.33	10.64	5.460	2.882
Giza-2	25.17	15.27	3.48	4.16	30.62	18.08	28.17	10.89	4.848	2.931
Mean	28.70	14.57	3.63	4.33	30.17	20.16	29.89	11.71	4.999	2.995
L. S. D at 0.05	1.775		0.217		1.156		1.699		0.398	

of the recommended check variety Giza-1 (30.33 g). Meantime, the highest number of pods/plant (20.6) of the local genotype Belbies-8, at Abo-Simble, did not compensate the reduction of its seed size (17.04 g) and its number of seeds/pod (3.9) in producing high seed yield per plant, whereas it gave only 12.7 g. Additionally, Ismialia-2 and Algeerb-2 which exhibited high estimates of pods number/plant (16.05 and 16.62) and number of seeds/pod (4.9 and 4.7) as well as 100-seed weight (21.78 and 21.20 g) produced the highest values of seed yield/plant (15.32 and 15.20 g) compared to 10.89 g for the recommended cheek variety Giza-2 at Abo-Simble location.

The superiority of the above mentioned genotypes in seed yield/plant which was due to the high values of some their yield components reflected on their yield productivity. Whereas they recorded the highest estimates of seed yield (ardab/feddan) and representing significant increases over the check varieties and the other studied genotypes. the results in Table, 5 revealed that Dijon-2, Belbies-9 and Family-9 were the most promising genotypes at Ismailia and outyielded the recommended variety Giza-1 by 20.88, 22.86 and 13.88 %, respectively, Whereas they produced almost 6.6, 6.7 and 6.2 (ardab/feddan), respectively, compared to 5.5 (ardab/feddan) for Giza-1. Meantime, Dijon-2, Ismailia-2 and Algeerb-2 were the most promising genotypes at Abo-Simble and outyielded the recommended variety Giza-2 by 38.79, 33.78 and 32.28 %, respectively. Whereas they gave almost 4.1, 3.9 and 3.9 (ardab/feddan), respectively, compared to 2.9 (ardab/feddan) for Giza-2. Noteworthy is that, Dijon-2 exhibited wide adaptation, since it was superior in seed yield and retained its potentiality over the two different environmental conditions. Seed yield was greatly affected by the variation of soil characters and fertility, therefore all genotypes produced clearly higher seed yield at Ismailia than that at Abo-Simble, since the soil at Abo-Simble was calcareous with low organic matter. Tang *et al.* (1995) stated that, increasing $CaCO_3$ rates increases soil pH, decreases plant growth and induces iron chlorosis in *Lupinus albus*.

It is evident that some of genotypes retained their ranking performance over both locations, while the rest of them fluctuated from Ismailia to Abo-Simble environment. In general, the indeterminate genotypes performed better than the determinate ones, as indicated by the higher seed yield. Similar trend was reported by Yassen,(1984); Hoballah,(1991) and Ashrei (2000).

C) Alkaloid content:

The alkaloid content is the most important seed quality, differed significantly among the studied genotypes at Ismailia (Table 4). The introduced sweet varieties Kiev Mutant and Piscevoj gave the lowest percentage of seed alkaloid (0.042 and 0.035), respectively, which made them valuable as forage crops and for protein concentrates. On the contrary, Gerga-2 and Dijon-2 contained the highest alkaloid percentage (0.751 and 0.725), respectively, comparing to the check varieties Giza-1 and Giza-2 which had alkaloid content of 0.596 and 0.545%, respectively. These findings are in general agreement with those found by Yassen (1984) and Hoballah (1991).

Basic statistics and correlation study:

Data of simple correlation coefficient matrix, means and standard error over both seasons (2000/2001 and 2001/2002) at Ismailia and Abo Simble are shown in Tables 6 and 7. Results indicated that similar relation between seed yield/plant and its factors at the two locations. Data clearly showed that days to 50% flowering, days to maturity, plant height, number of branches and pods/plant, number of seeds/pod and alkaloid% at Ismailia, had highly significant influence on seed yield/plant with R values being 0.540, 0.511, 0.848, 0.718, 0.814, 0.507 and 0.375, respectively at Ismailia, being 0.258, 0.421, 0.313, 0.391, 0.484 and 0.286, for the mentioned characters, respectively at Abo-Simble. 100-seed weight was significantly correlated with seed yield/plant at Ismailia with R value of 0.186. Another correlation worthy of some attention is that between days to 50% flowering and each of days to maturity (R = 0.216 and 0.532), plant height (R = 0.586 and 0.248), number of branches/plant (R = 0.534 and 0.240) number of pods/plant (R = 0.485 and 0.286) at both locations, respectively, and number of seeds/pod at Ismailia (R = 0.413). Days to maturity had highly significant or significant positive correlation with each of plant height (R = 0.546 and 0.315), number of branches/plant (r value 0.563 and 0.405), number of pods/plant (R = 0.496 and 0.483), number of seeds/pod (R = 0.212 and 0.171), alkaloid% at Ismailia with (R = 0.596). On the other hand, highly significant negative correlation was recorded between days to maturity with 100-seed weight at Abo-Simble with R value -0.263. The association between plant height and each of number of branches and pods/plant, number of seeds/pod at the two locations was positive and highly significant, as same as, between plant height and alkaloid% at Ismailia. But it was negative and highly significant between plant height and 100-seed weight at Abo-Simble (Tables 6 and 7). On the other hand, number of branches/plant was highly significant and positively correlated with number of pods/plant and number of seeds/pod. The values of correlation coefficients were 0.688 and 0.393 at Ismailia, being 0.602 and 0.349 at Abo-Simble, respectively. There was highly significant and positive correlation between alkaloid% and each of number of branches and pods/plant and number of seeds/pod with R values being 0.326, 0.372 and 0.264 respectively, at Ismailia. 100-seed weight recorded highly significant negative correlation with number of branches and pods/plant and number of seeds/pod. The values of correlation coefficients were -0.429, -0.629 and -0.348, respectively at Abo-Simble, Moreover, positive and significant or highly significant correlation coefficients (R value = 0.158 and 0.225) existed between number of pods/plant and number of seeds/pod at Abo-Simble and Ismailia, respectively.

These results are in general agreement with those obtained by Yassen (1984), Khattab *et al* (1992), El-Sayad (1997), Ashrei (2000) and El-Sayad *et al.* (2002)

Stepwise multiple linear regression analysis:

Stepwise multiple linear regression analysis was used to identify the accepted yield factors and their relative contributions in predicting seed yield

TABLE 6.7

Table 6: Simple correlation coefficients, mean and standard error in white lupin over both seasons (2000/2001 and 2001/2002) at Ismailia.

Characters	X1	X2	X3	X4	X5	X6	X7	X8	Y
Days to 50% flowering(X1)	1.000								
Days to maturity(X2)	0.216**	1.000							
Plant height in cm(X3)	0.586**	0.546**	1.000						
No. of branches/plant(X4)	0.534**	0.563**	0.767**	1.000					
No. of pods/plant(X5)	0.485**	0.496**	0.786**	0.688**	1.000				
No. of seeds/pod(X6)	0.413**	0.212**	0.459**	0.393**	0.225**	1.000			
100-seed weight(X7)	-0.010	0.126	0.121	0.142	-0.114	0.149	1.000		
Alkaloid%(X8)	0.141	0.596**	0.459**	0.326**	0.372**	0.264**	0.047	1.000	
Seed yield/plant(Y)	0.540**	0.511**	0.848**	0.718**	0.814**	0.507**	0.186*	0.375**	1.000
Mean	80.806	165.75	104.49	4.157	28.704	3.628	30.165	0.521	29.885
Standard error	0.397	0.601	1.430	0.042	0.536	0.023	0.160	0.016	0.622

* and ** significant at 0.05 and 0.01 level of significance, respectively.

Table 7: Simple correlation coefficients, mean and standard error in white lupin over both seasons (2000/2001 and 2001/2002) at Abo-Simble.

Characters	X1	X2	X3	X4	X5	X6	X7	Y
Days to 50% flowering(X1)	1.000							
Days to maturity(X2)	0.532**	1.000						
Plant height in cm(X3)	0.248**	0.315**	1.000					
No. of branches/plant(X4)	0.240**	0.405**	0.543**	1.000				
No. of pods/plant(X5)	0.286**	0.483**	0.611**	0.602**	1.000			
No. of seeds/pod(X6)	0.064	0.171*	0.267**	0.349**	0.158*	1.000		
100-seed weight(X7)	-0.066	-0.263**	-0.494**	-0.429**	-0.629**	-0.348**	1.000	
Seed yield/plant(Y)	0.258**	0.421**	0.313**	0.391**	0.484**	0.286**	0.110	1.000
Mean	73.181	139.604	73.514	3.667	14.567	4.330	20.157	11.706
Standard error	0.517	0.494	1.131	0.046	0.345	0.049	0.350	0.193

* and ** significant at 0.05 and 0.01 level of significance, respectively.

over all two seasons (2000/2001 and 2001/2002) at Ismailia and Abo-Simble are presented in Tables 8 and 9.

At Isamialia, the accepted factors had the highest coefficient of multiple determination with the yield adjusted for factors already added. The best prediction equation is formulated as follows:

$$Y = -44.829 + 0.12\ X3 + 0.658\ X5 + 5.978\ X6 + 0.715\ X7$$

(with standard error of estimate being 2.98)

According to this equation 84.5% of the total variability in seed yield could be linearly related to accepted yield factors. Those were plant height (X3), number of pods/plant (X5), number of seeds/pod (X6) and 100-seed weight (X7). Those variables were responsible for 71.9%, 66.26%, 25.7% and 3.46%, respectively of yield variance. The other four variables were removed variables because their contribution was insignificant. Those variables were days to 50% flowering, days to maturity, number of branches/plant and alkaloid%.

Table 8: Accepted yield factors according to stepwise multiple linear regression And their relative contribution in white lupin seed yield variance over both Seasons (2000/2001 and 2001/2002) at Ismailia.

Accepted yield factors	Regression Coefficient	Standard Error	Partial R^2%	Comm-ulative R^2%
Plant height (X3)	0.120**	0.028	71.90	71.9
No. of pods/plant (X5)	0.658**	0.069	66.26	77.6
No. of seeds/pod (X6)	5.978**	1.034	25.70	81.5
100-seed weight (X7)	0.715**	0.139	3.46	84.4

Intercept = - 44.829
R^2 for accepted yield factors = 84.4%
R^2 for removed yield factors = 0.1%
R^2 for all studied yield factors = 84.5%
Standard error of estimate = 2.9866
**** significant at 0.01 level of significance.**

At Abo-Simble, results indicated that number of pods/plant (X5), 100-seed weight (X7), number of seeds/pod (X6) and days to maturity (X2) were accepted yield factors as significant contributors to the total variance of the seed yield. The relative contribution for all yield factors explained 70.85% of the total variation in seed yield, and 0.55% could be due to eliminated variables namely, days to 50% flowering, plant height and number of branches/plant. 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, X5, (R^2 = 56.11%), 100-seed weight, X7, (R^2 = 56.56%), number of seeds/pod, X6, (R^2 = 33.51%) and days to maturity, X2, (R^2 = 5.13%). The prediction equation was:

$$Y = -20.09 + 0.494\ X5 + 0.469\ X7 + 1.658\ X6 + 0.057\ X2$$

This equation had the highest R^2 (70.3%) and lowest standard error of estimate being 1.279. These results are partially with those obtained by Hoballah (1991) and El-Sayad *et al.* (2002).

Table 9: Accepted yield factors according to stepwise multiple linear regression and their relative contribution in white lupin seed yield variance over both seasons (2000/2001 and 2001/2002) at Abo-Simble

Accepted yield factors	Regression coefficient	Standard Error	Partial R^2%	Comm-ulative R^2%
No. of pods/plant(X5)	0.494**	0.037	56.11	23.47
100-seed weight(X7)	0.469**	0.035	56.56	52.04
No. of seeds/pod(X6)	1.658**	0.198	33.51	68.69
Days to maturity (X2)	0.057**	0.021	5.13	70.30

Intercept = - 20.0934
R^2 for accepted yield factors = 70.30%
R^2 for removed yield factors = 0.55%
R^2 for all studied yield factors = 70.85%
Standard error of estimate = 1.2791
** Significant at 0.01 level of significance.

Path coefficient analysis:

Path coefficient analysis was used to determine the relative importance of direct and indirect for accepted yield factors which resulted from stepwise multiple linear regression at two locations.

At Ismailia, the results of path coefficient analysis are presented in Table, 10 shows that number of pods/plant had the greatest direct effects towards seed yield(66.67%) followed by plant height and number of seeds/pod(15.73% and 10.56%, respectively), On the other word, 100-seed weight had the lowest direct effect to seed yield variation(7.04%). The results also clarified that plant height and number of pods/plant followed by number of seeds/pod had the highest indirect contribution to seed yield variation.

Table 10: Direct and indirect effects for accepted yield factors of white lupin at Ismailia according to path analysis and percentage of direct effect.

Characters	Direct effect	Indirect effect	Total contribution	Direct effect%
Plant height	0.076	0.158	0.234	15.735**
No. of pods/plant	0.322	0.139	0.462	66.667**
No. of seeds/pod	0.051	0.063	0.114	10.559**
100-seed weight	0.034	0.0002	0.034	7.039**
Coefficient of determination R^2			84.4	

* And ** denote significant at 0.05 and 0.01 level of significance, respectively.

At Abo-Simble, results of direct and indirect effects of yield factors and their relative importance to the seed yield are given in Table 11. Results revealed that, number of pods/plant showed maximum direct effect towards seed yield/plant recording the highest relative contribution of 45.9% from the total variation of seed yield. 100-seed yield ranked second recording 42.55% followed by number of seeds/pod that accounted for 10.3%. The results also cleared that, 100-seed weight and number of pods/plant had the highest negative indirect effects, While, days to maturity had the lowest value in this respect (1.24%). These results are in general agreement with those reported by Khattab *et al.* (1992).

Table 11: Direct and indirect effects for accepted yield factors of white lupin at Abo Simble according to path analysis and percentage of direct effect.

Characters	Direct effect	Indirect effect	Total contribution	Direct effect%
Days to maturity	0.021	0.041	0.062	1.236**
No. of pods/plant	0.780	-0.353	0.427	45.909**
No. of seeds/pod	0.175	-0.055	0.120	10.300**
100-seed weight	0.723	-0.629	0.094	42.554**
Coefficient of determination R^2			70.3	

* And ** denote significant at 0.05 and 0.01 level of significance, respectively.

Generally, it could be concluded that the local genotypes Belbies-9 and Family-9 are most promising for productivity at East Delta region as well as the local genotypes Ismailia-2 and Algeerb-2 are most promising for productivity at South Valley region. Moreover, the introduced variety Dijon-2 proved to be the most adaptable genotype for East Delta and South Valley (Toshky) conditions, since it produced the highest seed yield (ardab/feddan) at both locations. Moreover, efficient selection for obtaining higher seed yield of white lupin should be based mainly on higher number of pods/plant.

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سلوك بعض التراكيب الوراثية المبشرة للترمس والأهمية النسبية لبعض مكونات محصول البذور فى الأراضى الجديدة

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أجرى هذا البحث بمحطتى البحوث الزراعية بالإسماعيلية وأبوسمبل خلال الموسمين الزراعيين ٢٠٠٠/٢٠٠١ و ٢٠٠١/٢٠٠٢ لدراسة سلوك ١٩ سلالة محلية منتخبة من الأصول الوراثية و٣ أصناف مستورده مقارنة بالصنفين جيزة -١وجيزة -٢ باستخدام تصميم القطاعات كاملة العشوائية فى ثلاث مكررات وقد درست العلاقة بين المحصول وأهم عوامله باستخدام الانحدار المرحلى المتعدد كما تم دراسة الأهمية النسبية لكل مكون منها فى تباين المحصول والتى يجب أن يأخذها المربى فى اعتباره عند تصميم برامج تربية لزيادة محصول البذور .

أظهرت النتائج أن هناك فروق معنوية بين السلالات من حيث عدد الأيام حتى التزهير والنضج ومحصول البذور ومكوناته بالإضافة إلى محتوي البذور من القلويدات المرة. وتشير نتائج الدراسة أن الصنفين المستوردين محدودى النمو من الترمس الحلو Piscevoj , Kiev Mutant كانتا أكثر السلالات تبكيرا فى التزهير والنضج بينما كانت أقلها من حيث محصول البذور للنبات وللفدان فى كلا الموقعين، بينما تفوقت السلالات المحلية بلبيس -٩ والعائلة -٩ تحت الظروف البيئية لمنطقة الاسماعيلية وأعطت زيادة فى المحصول بنسبة ٢٢,٨٦ و ١٣,٨٨% على التوالى مقارنة بمحصول الصنف الموصي به (جيزة -١) فى حين تفوقت السلالات المحلية الاسماعيلية -٢ والجرب -٢ تحت الظروف البيئية لمنطقة أبوسمبل (توشكى) وأعطت زيادة فى المحصول بنسبة ٣٣,٧٨ و٣٢,٢٨% على التوالى مقارنة بمحصول الصنف الموصى به (جيزة -٢). وقد احتفظ الصنف المستورد Dijon-2 بتفوقه تحت الظروف البيئية المختلفة حيث أعطى زيادة فى المحصول بنسبة ٢٠,٨٨% مقارنة بالصنف الموصى به (جيزة -١) فى الإسماعيلية وبنسبة ٣٨,٧٩% مقارنة بالصنف الموصى به (جيزة -٢) فى منطقة أبوسمبل (توشكى). وقد أشارت النتائج أيضا أن الأصنافKiev Mutant , Piscevoj احتوت بذورها على أقل نسبة قلويدات ، بينما احتوت بذور السلالة جرب-٢ و الصنف Dijon-2 على أعلي نسبة قلويدات .

دلت نتائج تحليل الارتباط البسيط لوجود ارتباط موجب عالى المعنوية بين محصول بذور النبات وكل من عدد الأيام حتى تزهير ٥٠% من النباتات وعدد الأيام من الزراعة حتى النضج وطول النبات وعدد فروع النبات وعدد قرون النبات وعدد بذور القرن فى كل من الاسماعيلية وأبو سمبل، أما وزن ١٠٠ بذرة ونسبة القلويدات بالبذرة فكان ارتباطها معنويا وموجب بمنطقة الاسماعيلية فقط.

أوضحت نتائج تحليل الانحدار المتعدد المرحلى أن أهم مكونات المحصول المساهمة فى تباين محصول بذور النبات بمنطقة الاسماعيليةهى: طول النبات وعدد قرون النبات وعدد بذور القرن ووزن ١٠٠ بذرة حيث ساهمت بحوالى ٨٤,٤ % من تباين المحصول بينما فى منطقة أبوسمبل كانت صفات عددقرون النبات ووزن ١٠٠ بذرة وعدد بذور القرن بالاضافة لعدد الأيام من الزراعة حتي النضج هى أعلى المكونات اسهاما فى المحصول بنسبة ٧٠,٣ % من تباين محصول البذور.

ومن نتائج تحليل معامل المرور يتضح أن عدد قرون النبات وطول النبات وعدد بذور القرن لها تأثير مباشر وغير مباشر عال على المحصول فى منطقة الإسماعيلية. بينما فى منطقة أبوسمبل كان لعدد قرون النبات ووزن ١٠٠ بذرة وعدد بذور القرن التأثير المباشر الأكبر بينما كان تأثير عدد الأيام حتى النضج على محصول البذور غير مباشر .

ومن النتائج السابقة يمكن التوصية بزراعة السلالات بلبيس-٩ والعائلة-٩ بمنطقة شرق الدلتا بينما يوصى بزراعة السلالات إسماعيلية-٢ والجرب-٢ بجنوب الوادى (توشكى) والمناطق ، فى حين أثبت الصنف المستورد Dijon-2 تفوقه فى كلا المنطقتين. كانت صفة عدد قرون النبات أكثر مكونات المحصول تأثيرا على محصول البذور لذا يجب أن تؤخذ هذه الصفة فى الاعتبار عند الانتخاب لتحسين محصول الترمس.