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IDENTIFICATION OF SOME LUPINE GENOTYPES USING MORPHOLOGICAL, CHEMICAL METHODS AND YIELD COMPONENTS

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ABSTRACT

The aim of the present investigation was to evaluate yield, morphological and chemical traits differentiation tests of vegetative and reproductive organs of 25 important lupine genotypes grown under the prevailing Egyptian environmental conditions. Two field experiments were carried out in Giza Research Station, Agricultural Research Center, during 2015/2016 and 2016/2017 seasons. Morphological identification was carried out through recording a range of morphological characters as reported in the Internationally Recognized Descriptor of the International Union for Protection of new Varieties (UPOV 2002). Results indicated that differentiation existed between all genotypes for all morphological characters, except grain bitter principle, flower color of tip of carina, plant growth type and grain ornamentation. Plant height, height of node (cm), no. of branches/plant, no.of pods/plant, no.of seeds/plant, 100- seed weight (g), seed yield/plant (g), plot weight (g) and seed yield/faddan showed significant differences between all genotypes. Seven of the promising lines (8, 12, 14, 16, 17, 21 and 24) significantly surpassed the check variety and the other lines in yield and its components. The seeds chemical composition analysis showed that the genotypes differed in their composition as follows: moisture (from 8.07 to 9.26%.), protein (from 20.40 to 25.71%), crud fat (from 3.52 to 5.89%.), ash (from 2.78 to 4.24%.), crude fiber (from 11.22 to 15.65%) carbohydrate (from 43.33 to 49.53%).

Key words: lupinus Spp., Morphological identification, Yield, Seed chemical composition.

INTRODUCTION

Lupinus, commonly known as lupin or lupine (North America), is a genus of flowering plants in the legume family, *Fabaceae*. The genus includes over 200 species, with centers of diversity in North and South America. Smaller centers occur in North Africa and the Mediterranean (Drummond *et al* 2012 and Aïnouche and Bayer 1999). Seeds of various species of lupins have been used as a food for over 3000 years around the Mediterranean and for as long as 6000 years in the Andean highland. In Egypt, the lupine is known in Arabic as Termes, and is a popular street snack after being treated with several soakings of water, and then brined.

Lupine (*Lupinus* Spp.) is one of the major highland food legumes grown in Ethiopia. It is traditionally gown as intercrop with cereals and oil crops by low input farmers and is restricted to low-income classes, to times of drought (Jansen 2006). Farmers grow it as traditional undefined additive system of intercropping in which lupine used as minor crop and cereals as major crop. They grow it for the strategies to overcome the shortage of arable land and attribute several crops for diversification of crop products and for maintenance and improvement of soil fertility (Aleligne and Steven 1987).

The market for lupine seeds for human food is currently small, but researchers believe that it has great potential. Lupine seeds are considered "superior" to soybeans in certain applications and evidence is increasing for their potential health benefits. lupine seeds contain similar protein to soybean, but less fat. As a food source, they are gluten-free and high in dietary fiber, amino acids, and antioxidants, and they are considered to be prebiotic. About 85% of the world's lupin seeds are grown in Western Australia Ross (2011). To improve lupine crop and achieve the mentioned goals there is an essential need for a wide range of germplasm collection in addition to the available genotypes. Evaluation of such collected materials must be carried out and screened under different environmental conditions. Yield is a complex character determined by several variables. Hence, it is essential to indentify the characters having the greatest influence on yield and their relative contributions in yield variation. That is useful in designing planed breeding programs.

Morphological description can be expensive and time consuming process, in addition some certain characters are continuous and their expressions are affected by environmental factors (Chapman 1981). The quality of legume seeds is affected mainly by the composition of their amino acids and presence of naturally occurring toxic constituents, especially tannins. High levels of tannins decrease protein digestibility and quality of canning processes, however, processes such as soaking and cooking may affect the nutritional value of the product (Cabrera and Martin 1989 and Naczk *et al* 2001). However, successful breeding program will depend on the magnitude of genetic variation in the population. Moreover, reliable estimates of genetic and environmental variations will be helpful to estimate heritability ratio and consequently predicted genetic advance from selection.

For the above reasons, the aim of the present investigation was to evaluate yield, morphological and chemical traits differentiation tests of vegetative and reproductive organs of 25 important lupine genotypes grown under the prevailing Egyptian environmental conditions.

MATERIALS AND METHODS

The genetic materials used in this study comprised twenty four lupine (*Lupinus Spp.*) genotypes and the improved commercial variety Giza 1 obtained from the Legumes Research Department in cooperation with Seed Technology Research department at Giza, Field Crops Research Institute, Agricultural Research Center (Table 1).

Table 1. Name and origin of studied lupine genotypes.

Serial No.	Genotypes	Origin
1	Fakous 3	Sharkia - Egypt
2	Fakous 4	Sharkia- Egypt
3	Ismailia 1	Ismailia- Egypt
4	Ismailia 2	Ismailia- Egypt
5	Fayed 1	Ismailia- Egypt
6	Fayed 3	Ismailia- Egypt
7	Kantara 2	Ismailia- Egypt
8	Ismailia 3	Ismailia- Egypt
9	Abo-Soeir 1	Ismailia- Egypt
10	Abo-Soeir 2	Ismailia- Egypt
11	Algeerb 1	Ismailia- Egypt
12	Algeerb 2	Ismailia- Egypt
13	Meet ghmer	Dakahlia- Egypt
14	badrashein	Giza- Egypt
15	El-Aiat	Giza- Egypt
16	Beni salh	Fayoum- Egypt
17	Beni Suef 1	Beni soef- Egypt
18	Beni Suef 3	Beni Soef- Egypt
19	El-Minia	El-Minia- Egypt
20	Aswan 1	Aswan- Egypt
21	Sohag	Sohag- Egypt
22	Kiev Mutant	Australia
23	Butter Cup	Australia
24	Piscovij	Australia
Giza 1	Giza 1	Egypt

Two field experiments were carried out in Giza research station, Agricultural Research Center, Egypt during 2016/2017 and 2017/2018 growing seasons.

The experimental design was a Randomized Complete Block with three replicates. Experimental plot consisted of three ridges 3 m long, 60 cm apart, with single seeded hills, 20 cm apart in one side of ridge. Seeds were sown on ridges, in the second week of Nov., in the two seasons.

Statistical analysis

Statistical analysis of the obtained data was carried out for analysis of variance according to Snedecor and Cochran (1994) using computer Statistical programe MSTAT-C. Means were compared by the L.S.D. values at 5% level.

Morphological identification

The identification of the following morphological characters was conducted using the procedures of UPOV (The International Union for the Protection of New Varieties of Plant). Grain bitter principle, plant height three weeks after seedling, plant growth habit at flower bud stage, leaf green color at 1st flower bud stage, stem anthocyanin, plant height at beginning of flowering, plant height of insertion of 1st inflorescence at green ripening , central leaflet length, central leaflet width, flower color of wings, flower color of tip of carina, plant growth type, pod length, grain ornamentation, grain color of ornamentation , grain ornamentation distribution, grain density of ornamentation, 100 seed weight, time of flower beginning and time of green ripening.

The decimal code for the growth stage of legume according to Tottman (1987) was also used to standardize the growth stages of varieties during morphological description and identification.

Seed yield and its related characteristics

At harvest, ten guarded plants were taken randomly from the central row to estimate and measure: plant height (cm), height of first nod (cm), number of branches per plant, no.of pods per plant, number of seeds per plant, seed yield per plant (g), 100-seed weight (g), plot seed weight (g) and seed yield per faddan (kg).

Chemical characters

After harvest, the moisture content, crude protein, oil content, ash and crude fiber in seed samples were determined by the standard methods detailed (AOAC 2000). The carbohydrate content was determined as the weight difference using moisture, crude protein, lipids and ash content data. Each sample was analyzed in triplicate and the values were then averaged.

RESULTS AND DISCUSSION

Morphological characters

The data in Tables (2 and 4) indicated that the grain bitter principle was present, flower color of tip of carina was blue black, plant growth type was indeterminate and grain ornamentation was present of all lupine lines and check variety.

Results in Table (2) indicated that the plant height at three weeks after seedling emergence was medium in all genotypes, except for the genotypes numbers 3, 10 and 13, which were short, and lines 19, 21, 23, 24 and Giza 1 variety which were tall. While, plant growth habit at flower bud stage for all lupine genotypes was between prostrate and spreading. Leaf green color at flower bud stage was between medium and dark in all genotypes, except lines14 and 18, which were light. On the other hand, stem anthocyanin coloration at flower bud stage of all genotypes was between weak, medium and strong, whereas for line 12 only it was very strong.

Concerning plant height at beginning of flowering and plant height at green ripening stage (Table 3) the data revealed that all lupine genotypes were different in both characters between short, medium and tall whereas

Table 2. Morphological characteristics of the studied Lupine genotypes across 2015/2016 and 2016/2017 growing seasons.

Genotypes	Grain bitter principle	Plant height at three weeks after seedling emergence	Plant growth habit at flower bud stage	Leaf green color at flower bud stage	Stem anthocyanin coloration at flower bud stage
1	Present	Medium	Spreading	Medium	Medium
2	Present	Medium	Spreading	Medium	Weak
3	Present	Short	Spreading	Medium	Weak
4	Present	Medium	Prostrate	Medium	Weak
5	Present	Medium	Prostrate	Medium	Weak
6	Present	Medium	Prostrate	Medium	Weak
7	Present	Medium	Prostrate	Dark	Medium
8	Present	Medium	Spreading	Medium	Weak
9	Present	Medium	Spreading	Medium	Strong
10	Present	Short	Spreading	Dark	Strong
11	Present	Medium	Prostrate	Dark	Strong
12	Present	Medium	Spreading	Dark	Very strong
13	Present	Short	Spreading	Medium	Medium
14	Present	Medium	Spreading	Light	Strong
15	Present	Medium	Prostrate	Medium	Medium
16	Present	Medium	Spreading	Medium	Medium
17	Present	Medium	Spreading	Dark	Weak
18	Present	Medium	Spreading	Light	Strong
19	Present	Tall	Prostrate	Medium	Strong
20	Present	Medium	Spreading	Dark	Strong
21	Present	Tall	Spreading	Medium	Strong
22	Present	Medium	Spreading	Medium	Weak
23	Present	Tall	Spreading	Dark	Strong
24	Present	Tall	Prostrate	Dark	Strong
Giza 1	Present	Tall	Prostrate	Dark	Strong

Table 3. Morphological characteristics of the studied Lupine genotypes across 2015/2016 and 2016/2017 growing season.

Genotypes	Plant height at beginning of flowering	Plant height at green ripening stage	Central leaflet length	Central leaflet width	Flower color of wings
1	Short	Short	Medium	Narrow	Bluish White
2	Tall	Short	Long	Narrow	Bluish White
3	Short	Very Short	Long	Narrow	Bluish White
4	Short	Medium	Long	Narrow	Violet
5	Medium	Short	Long	Very Narrow	Bluish White
6	Tall	Medium	Medium	Narrow	Bluish White
7	Medium	Medium	Medium	Narrow	Violet
8	Short	Medium	Long	Narrow	Bluish White
9	Medium	Medium	Medium	Narrow	Bluish White
10	Short	Short	Long	Narrow	Bluish White
11	Medium	Medium	Medium	Narrow	Bluish White
12	Short	Short	Medium	Very Narrow	Bluish White
13	Short	Medium	Medium	Narrow	Bluish White
14	Medium	Short	Medium	Narrow	Pink
15	Tall	Medium	Medium	Narrow	Bluish White
16	Tall	Tall	Medium	Narrow	Bluish White
17	Medium	Medium	Long	Narrow	Bluish White
18	Tall	Medium	Long	Narrow	Blue
19	Tall	Short	Long	Narrow	Blue
20	Medium	Medium	Medium	Narrow	Bluish White
21	Tall	Short	Long	Narrow	Pink
22	Tall	Medium	Long	Very Narrow	Bluish White
23	Tall	Medium	Medium	Narrow	Bluish White
24	Tall	Short	Long	Narrow	Bluish White
Giza 1	Medium	Short	Long	Narrow	Bluish White

Table 4. Morphological characteristics of the studied Lupine genotypes across 2015/2016 and 2016/2017 growing seasons.

Genotypes	Flower color of tip of carina	Plant growth type	Pod length	Grain ornamentation	Grain color of ornamentation
1	Blue black	Indeterminate	Medium	Present	Beige
2	Blue black	Indeterminate	Medium	Present	Multicolored
3	Blue black	Indeterminate	Medium	Present	Beige
4	Blue black	Indeterminate	Medium	Present	Beige
5	Blue black	Indeterminate	Short	Present	Beige
6	Blue black	Indeterminate	Medium	Present	Multicolored
7	Blue black	Indeterminate	Short	Present	Beige Light
8	Blue black	Indeterminate	Medium	Present	Multicolored
9	Blue black	Indeterminate	Medium	Present	Beige
10	Blue black	Indeterminate	Medium	Present	Multicolored
11	Blue black	Indeterminate	Medium	Present	Beige Light
12	Blue black	Indeterminate	Medium	Present	Beige
13	Blue black	Indeterminate	Medium	Present	Beige
14	Blue black	Indeterminate	Medium	Present	Multicolored
15	Blue black	Indeterminate	Medium	Present	Beige
16	Blue black	Indeterminate	Medium	Present	Beige
17	Blue black	Indeterminate	Long	Present	Beige
18	Blue black	Indeterminate	Medium	Present	Beige
19	Blue black	Indeterminate	Medium	Present	Beige
20	Blue black	Indeterminate	Medium	Present	Beige
21	Blue black	Indeterminate	Long	Present	Beige
22	Blue black	Indeterminate	Long	Present	Beige
23	Blue black	Indeterminate	Medium	Present	Beige
24	Blue black	Indeterminate	Medium	Present	Beige Light
Giza 1	Blue black	Indeterminate	Medium	Present	Beige

line 3 was very short for plant height at green ripening stage. Also, central leaflet length was medium and long in all lupine genotypes. Moreover, central leaflet width was Narrow for all the tested lupine genotypes except, for lines 5, 12 and 22, which were very narrow. Data in Table (3) showed that the flower color of wings varied for all lupine genotypes between bluish white, violet, blue and pink.

Results in Table (4) showed narrow variation among lupine genotypes for pod length at maturity, which ranged between short, medium and long. While, data show wide variation among lupine genotypes for grain color of ornamentation character from multicolored, beige to beige light.

Data in Table (5) indicated that the grain distribution of ornamentation was eyebrow, ventral and total in different genotypes. However, grain density of ornamentation for genotypes was dense, medium, sparse and very sparse.

Table 5. Morphological characteristics of the studied Lupine genotypes across 2015/2016 and 2016/2017 growing seasons.

Genotypes	Grain distribution of ornamentation	Grain density of ornamentation (excluding varieties with eyebrow only)	Grain 100 seed weight (harvested seed)	Time of beginning of flowering	Time of green ripening
1	Total with Eyebrow	Sparse	High	Early	Early
2	Ventral	Medium	Medium	Early	Very Early
3	Total with Eyebrow	Medium	Low	Medium	Very Early
4	Ventral	Very Sparse	Medium	Medium	Early
5	Total with Eyebrow	Sparse	Medium	Early	Very Early
6	Ventral	Very Sparse	Low	Early	Very Late
7	Total with Eyebrow	Medium	Medium	Medium	Very Late
8	Total	Sparse	Medium	Early	Very Late
9	Total with Eyebrow	Dense	Medium	Early	Very Late
10	Total	Medium	Low	Medium	Late
11	Total with Eyebrow	Dense	High	Medium	Very Late
12	Total with Eyebrow	Medium	High	Medium	Early
13	Ventral	Sparse	Medium	Late	Early
14	Total	Medium	Medium	Medium	Early
15	Ventral	Medium	Medium	Medium	Very Early
16	Ventral	Sparse	Medium	Medium	Very Early
17	Total with Eyebrow	Medium	High	Early	Very Early
18	Ventral	Sparse	High	Early	Very Late
19	Ventral	Sparse	High	Medium	Very Late
20	Ventral	Very Sparse	Medium	Medium	Medium
21	Total with Eyebrow	Very Dense	Very high	Early	Very Early
22	Ventral	Sparse	Medium	Early	Very Early
23	Ventral	Medium	High	Early	Very Early
24	Ventral	Sparse	Medium	Early	Very Early
Giza 1	Total with eyebrow	Dense	Medium	Early	Early

Wide variation of genotypes was observed for 100-seed weight, between low, medium and high except line 21, which was very high. In addition, time of beginning of flowering was early and medium for all genotypes except line 13 which was late. For Time of green ripening character, all studied lupine genotypes were very early, early and medium, except line 10 which was late.

The obtained results of morphological characteristics of genotypes under study are in agreement with many investigators, who studied different morphological characteristics for lupine genotypes identification. For instance, four lupine species are reported as cultigens in the world include *L. albus*, L., *L. angustifolius* L., *L. leutus L. and L.mutabilis* L. (Kurzbaum *et al* 2008). These species are called white lupine, narrow-leafed (blue) lupine, yellow lupine and pearl lupine, respectively (ARC 2009).White lupine, wild and cultivated types are highly variable (Jansen 2006). The wild type (subsp. *graecus*) (Jansen 2006) is found in southeastern Europe and western Asia. The petals are dark violet and seed pods shatter at maturity. Seed are small and mottled brown with an impermeable seed coat. The flowers are white to violet with the upper lip being entire and the lower lip entire or slightly 3-toothed.White lupine can produce high seed yields. They are indeterminate plants and managing main stem racemes results in improved yield (Clapham *et al* 2000). Payne (1979) found that seeds of the same cultivar may vary in shape due to the position of the seed in the seed pod and may be influenced by environmental conditions during the pod filling stage of development. Therefore, while seed size, shape and coat bloom can be used to form a general option about the identify of a sample, they should not be used in critical evaluation. Higgins and Vans (1983) described thirty four cultivars of field beans using 10 continuous plant characters mainly stem length, stem number, leaflet length, leaflet breadth , number of days from sowing to first flower , pod length, pod breadth, number of seeds plus ovule and 100-seed weight. However, their results allowed only a limited extension of the initial classification of field bean cultivars, it had been possible to provide comparative cultivars descriptions Mudzana *et al* (1995) studied plant morphology of faba bean like testa color, growth types, plant height at maturiety, number of branching and presence or absence of anthocyanin colouration, number of days to 50% flowering, flower length and extent of anthocyanin colouration, pod length and number of seed/pod). Naguib (2000) evaluated morphological characters for identification of some faba bean varieties by using qualitative characters like seed coat color and quantative characters like leaflet characters, number of flower, plant height and pod characters. This study indicated that these characters are important descriptor for discrimination among different faba bean genotypes.Investigated morphological characters for identification of some lentil genotypes by Mersal and Abbas (2005). Some morphological traits can be used to identify between lentil genotypes such as, ground colour of testa, plant height, flowering and maturity time, 100- seed weight and seed yield (g/m^2). But some morphological traits were not enough to differentiate between lentil genotypes such as seedlings stem pigmentation where it was present in all genotypes.

Yield and yield components

Table (6) shows the effect of different lupine genotypes on the means of yield and its components, across two seasons (2015/2016 and 2016/2017).

Table 6. Mean performance of some lupine genotypes for plant height and yield components across 2015/2016 and 2016/2017 seasons.

Genotypes	Plant height (cm)	Plant height from nod (cm)	No. of branches /plant	No. of pods/plant	No. of seeds /plant
1	130.3	60.3	3.5	19.3	58.1
2	117.5	47.5	3.5	17.5	52.8
3	108.3	38.3	2.3	14.3	38.2
4	124.3	54.3	4.1	15.3	48.8
5	119.7	49.7	3.1	13.3	33.7
6	125.0	55.0	3.1	12.0	26.0
7	123.3	53.3	3.1	18.3	59.3
8	131.6	61.6	3.3	18.6	62.5
9	124.1	54.1	2.8	13.3	39.9
10	120.7	50.7	3.0	12.5	22.6
11	122.7	52.7	3.3	16.3	43.9
12	113.0	43.0	2.3	23.5	82.8
13	123.9	53.9	3.3	16.2	59.7
14	118.2	48.2	3.0	15.8	77.3
15	129.1	59.1	3.8	16.8	73.8
16	141.0	71.0	3.8	16.6	48.7
17	135.7	65.7	3.8	20.1	55.5
18	126.7	56.7	3.1	23.1	38.5
19	117.4	47.4	2.6	18.6	45.4
20	131.7	61.7	3.3	14.6	65.0
21	115.7	45.7	2.5	19.3	54.8
22	127.7	57.7	3.0	21.1	62.2
23	130.9	60.9	3.3	20.5	59.5
24	115.9	45.9	2.8	17.8	57.1
Giza 1	118.3	48.3	2.0	18.5	56.4
LSD	5.15	3.15	0.177	3.25	6.62

Plant height

Means of plant height show significant different response to the studied genotypes. Lines No. 1, 8, 16, 17, 20 and 23 exerted taller lupine plants comparable with other lines as well as the check variety. This was true in both seasons. Whereas, the shorter genotypes were lines No. 3, 12, 21 and 24. This indicates that the plant height was much under control of the genetic background of lupine genotypes.

Plant height from node (cm)

Data in Table (6), indicated that the studied lupine genotypes exhibited significant differences in height of node which ranged from 38.3 to 71.0 g. Lines No. 1, 8, 16, 17, 20 and 23 significantly surpassed all the other lines and check variety. On the other hand, lines No. 3 and 12 gave the shortest height of node (cm).

Number of branches /plant

Number of branches/plant of lupine genotypes under investigation shows significant differences. Lines No. 1, 2, 4, 15, 16 and 17 appeared to have more number of branches/plant than the other genotypes, but the lowest number of branches was exhibited by lines No.3, 12 and Giza 1.

Number of pods/plant

Results in Table (6) indicated that lupine genotypes were significantly different in number of pods/plant, ranging from 12.00 to 23.50. The best lines for this trait were No. 12, 17, 18, 22 and 23. On the other hand, lines No. 5, 6, 9 and10 gave the lowest number of pods /plant.

Number of seeds/plant

Results recorded in Table (6) indicated that lupine lines and check variety were significantly different in number of seeds/plant in the two seasons. The means for this trait ranged from 22.60 (line 10) to 82.80 (line 12) in both growing seasons. Lines No. 12, 14 and 15 exceeded the others. On the contrary, lines no. 6 and 10 had the lowest number of seeds/plant in both seasons. This indicates that number of seeds/plant was affected much by genetic makeup and lines No. 12, 14 and 15 are considered the best.

Seed yield/plant

The data in Table (7), indicated that the studied lupine genotypes exhibited significant differences in seed yield/plant which ranged from 8.3 to 29.1 g. Lines No. 8, 12, 14, 16, 17, 21 and 24 significantly surpassed all the other lines and check variety. In the contrary, lines No. 6 and 10 gave the lowest seed yield / plant.

Seed index

Data in Table (7) for seed index (100-seed weight) showed that significant variation was found among genotypes in both seasons, indicating the existence of a wide genetic variation among these genotypes. Averaged values for this trait ranged from 25.30 to 43.00 g. Line No. 21 surpassed significantly the others followed by 11, 12, 17, 18, 19 and 23, while lines No. 3, 6 and 10 gave the lowest values for seed index as compared with all studied lupine genotypes.

Table 7. Mean performance of some lupine genotypes for yield and its components across 2015/2016 and 2016/2017 seasons.

Genotypes	Seed yield/plant (g)	100-Seed weight (g)	Seed yield/plot (g)	Seed yield/faddan (kg)
1	24.1	30.4	235.0	3655.0
2	22.5	35.9	240.0	3733.9
3	16.6	27.2	255.0	3967.2
4	17.5	32.5	270.0	4199.5
5	22.4	31.2	354.9	5521.2
6	11.1	25.3	599.9	9331.8
7	23.5	34.6	419.9	6532.3
8	27.7	34.4	375.0	5833.9
9	19.5	32.5	360.0	5600.5
10	8.3	29.9	264.9	4121.2
11	24.5	38.0	530.0	8243.9
12	27.2	37.2	489.9	7621.2
13	25.0	32.7	545.0	8477.3
14	28.8	32.8	855.0	13300.5
15	25.2	33.4	944.9	14698.4
16	27.0	35.3	804.9	12520.1
17	29.1	39.8	599.9	9332.3
18	22.5	37.5	685.0	10655.0
19	24.7	37.6	860.0	13377.3
20	25.0	30.4	915.0	14233.9
21	28.0	43.0	809.9	12598.4
22	23.4	34.9	1084.9	16876.7
23	25.4	37.6	795.0	12366.1
24	27.3	33.9	979.9	15242.9
Giza 1	26.7	31.2	194.9	3032.3
LSD	3.28	3.30	0.47	7.2

Seed yield per plot (g)

Data present in Table (7) showed the plot seed weight (g) of the studied lupine seeds. The highest values were recorded for lupine lines No. 15, 20, 22 and 24, whereas the lowest plot seed weight (g) was found for lupine genotypes 1, 2, 3, 4, 10 and Giza 1.

Seed yield per faddan

Results recorded in Table (7) cleared that lupine lines and check variety were significantly different in faddan yield in the two seasons. The means for this trait ranged from 3032.3 (Giza 1) to 16876.7 (line 22) in both growing seasons. Lines No. 15, 20, 22 and 24 exceeded the others. On the contrary, Giza 1 and line No. 1, 2 and 3 had the lowest Faddan yield in both seasons.

These results are similar to those reported byLara-Rivera et al., (2017) who found that analyses of variance for the lupine varieties revealed significant differences ($P<0.05$) for number of pods per plant, weight of 1000 seeds, and grain yield. Raza and jqrnsgard (2005) evaluated the cultivars Giza 1 and Giza 2, and exotic germplasm for seed yield and major morphological characteristics. The cultivars showed low differences in growth and development. There were significant differences among cultivars in yield components. The results further suggest that the local landraces germplasm may be an important source of alleles for shortening the vegetative period, reducing plant height, as well as for improving some yield components. These germplasm lines will be useful as genetic stock for exploitation in a breeding programme.Wide variation was observed for phenological (dates of main stem and branch flowering, date of end of flowering and date of maturity), morphological (numbers of branch orders, branches and leaves) and seed characters (seed yield, mean seed weight, number of seeds/m^2) by (Julier *et al* 1995).White lupine breeders are selecting for accessions that grow rapidly, alkaloid-free, disease resistant, high-yielding, alkaline-tolerant, frost tolerant, dwarf cultivars, and well adapted to specific local ecological conditions (Jansen 2006).

Seed chemical composition

The gross seed chemical composition analysis (on dry matter basis) of 25 lupine genotypes under study is given in Table (8). All genotypes differed significantly in all seed chemical characters.

Moisture content

Moisture content ranged from 8.07 to 9.26%. The highest value was recorded by lines No. 4, 7, 11, 14 and 15, while the lowest one for lines No.1, 18 and 23.

Crude protein

Results in Table (8) show that the lines 3, 9, 14, 17 and 20 were the highest in protein content (25.02, 25.21, 25.71, 25.33 and 25.30%, respectively), while lines 12 and 24 gave the lowest value (21.43 and 20.40%, respectively). Seed proteins are deficient in some amino acids that are essential for humans and other mono-gastric animals, so, the most economic approach is through breeding programs to develop promising genotypes with high yield, quality and good agronomic performance.

Crude fat

Seed crude fat content values of lupine genotypes under study are presented in Table (8). Results showed that the highest values of fat content were obtained for genotypes 1 (5.27%), 2 (5.02%), 3 (5.09%), 4(5.89%), 10(5.61%) and Giza 1(5.30%). While, the lowest value was found in lines No. 15(3.81%) and 18 (3.52%).

Table 8. Seed chemical composition of some lupine genotypes across 2015/2016 and 2016/2017 seasons.

Genotypes	Moisture%	Crude protein%	Crude fat%	Crude fibers%	Ash%	Total carbohydrate%
1	8.07	23.59	5.27	13.41	3.14	46.31
2	8.27	24.22	5.02	11.54	3.92	47.01
3	8.27	25.02	5.09	12.16	3.24	46.82
4	8.63	23.62	5.89	11.22	3.47	48.22
5	8.52	22.02	4.46	13.16	4.16	47.96
6	8.38	22.17	4.29	12.78	3.25	48.92
7	8.61	23.21	4.57	14.22	3.82	46.08
8	8.31	23.69	4.89	12.25	3.41	47.85
9	8.25	25.21	4.34	14.31	4.15	44.33
10	8.30	24.67	5.61	13.10	3.65	44.64
11	8.62	23.24	4.28	14.27	3.25	46.74
12	8.29	21.43	4.13	14.14	3.54	48.57
13	8.28	24.19	4.62	14.40	3.69	45.33
14	9.26	25.71	4.63	13.20	4.16	43.33
15	8.68	23.19	3.81	15.27	3.87	45.21
16	8.50	24.17	4.27	13.25	3.59	46.61
17	8.23	25.33	4.30	14.53	2.78	45.54
18	8.19	22.17	3.52	13.19	4.18	48.75
19	8.44	23.24	4.44	15.33	3.80	45.12
20	8.56	25.30	4.23	15.65	2.93	44.04
21	8.56	24.34	4.30	12.67	2.85	48.04
22	8.30	24.20	4.42	14.31	3.52	45.54
23	8.17	22.10	4.31	12.40	4.24	49.53
24	8.39	20.40	4.57	14.89	2.79	49.37
Giza 1	8.26	22.90	5.30	14.53	3.46	45.87
LSD	0.516	0.664	0.50	0.60	0.503	0.50

Crude fiber

Data present in Table (8) showed the crude fiber content of the tested lupine seeds. The highest crude fiber content was recorded for lupine No. 15(15.27%), 19(15.33%) and 20(15.65%) whereas the lowest crude fiber content was found for lupine seeds of lines No. 2 (11.54%) and 4 (11.22%).

Ash

Seed Ash content values of lupine genotypes under study are presented in Table (8). Results indicated that the highest value of Ash content was obtained for lines No. 5(4.16%), 9(4.15%), 14(4.16%), 18(4.18%) and 23(4.24%) while, the lowest value was found in lines No. 17(2.78%), 20 (2.93%), 21(2.85%) and 24(2.79%).

Total carbohydrates

Carbohydrates contents of lupine genotypes under study are presented in Table (8). Results indicated that the lines No. 6(48.92%), 23(49.53%) and 24(49.37%) showed the highest value, however the lowest carbohydrate content was obtained in seeds of lines No. 9(44.33%), 10(44.64%), 14(43.33%) and 20(44.04%). Carbohydrate content for seeds of the other genotypes ranged between the previously mentioned limits, i.e. the highest and the lowest values.

Results of the seed chemical composition of lupine genotypes under study are in agreement with those reported by Lara-Rivera *et al* (2017) who found the corresponding protein content (dry basis) ranged from 28.4 to 36.6%, ash content ranged from 3.1 to 3.5%, although no statistically significant differences were identified, values for oil concentrations (dry basis), was varied from 3.9 to 5.3%, crude fiber levels ranged from 8.1 to 15.1%, carbohydrate concentration was between (48.1 to 51.7 %). However, Sujak *et al* (2006) reported crude fiber values similar to those found in the present research (11.6-14.1%), when evaluating eight distinct varieties of lupine, in Poland. The results for carbohydrate concentration reported in this study are similar to those reported for other varieties of L. *angustifolius* (41.0-51.0%). (Sujak *et al* 2006 and Beyer *et al* 2015) also reported a mean oil concentration of 6.3% in 50 genotypes from lupine.

Lupine is a good source of nutrients, not only proteins but also lipids, dietary fiber, minerals, and vitamins (Martínez-Villaluenga *et al* 2009). There are variations in the protein content between species and cultivars as a result of the characteristics of the growing conditions and soil types (Martínez-Villaluenga *et al* 2006) from 28% to 48% (Capraro *et al* 2008).The meanvalue of crude fat in *L. albus*grown in different parts of the world is 13% (Phan *et al* 2006).The flour is a good source of macro- and micro-nutrients, protein, fat, carbohydrates, minerals, and vitamins (Yanez 1996).

Protein content of dry seed was not affected by growing environment, growing environment had significant effects on contents of total sugar, amino acids, oil, fatty acids, and minerals by (Bhardwaj *et al* 1998). Significant variation existed among 12 lupine genotypes for various traits when composition of seed produced in Virginia was evaluated.

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توصيف بعض التراكيب الوراثية من الترمس بإستخدام الطرق المورفولوجية والكيميائية ومكونات المحصول

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أجريت هذه الدراسة بمحطة بحوث الجيزة– مركز البحوث الزراعية خلال الموسمين الزراعيين ٢٠١٦/٢٠١٥ و٢٠١٦/ ٢٠١٧ بهدف تقييم وتوصيف أربع وعشرون سلالة من الترمس من قسم بحوث البقوليات بالجيزة مقارنة بالصنف المنزرع (جيزة ١) بإستخدام الصفات المورفولوجية والمحصولية والكيمائية. حيث تم تحديد الصفات المورفولوجية المميزة للأصناف تبعا لدليل التوصيف المورفولوجى لمحصول الترمس الصادر عن الاتحاد الدولى لحمايه الاصناف الحديثة (UPOV) وذلك بهدف توفير المعلومات لبرامج التربية والاستفادة منها عند تسجيلها كأصناف تجارية وحمايه حقوق المربى. وقد أشارت النتائج الى وجود اختلافات فى الصفات المورفولوجية لكل التراكيب الوراثية المنزرعة ماعدا صفة مرارة الحبة، طبيعه النمو، لون قمه زورق الزهرة ، زرقشه الحبوب، كانت جميع التراكيب الوراثية متشابهة فيما بينها فى هذه الصفات. اظهرت النتائج وجود اختلافات معنوية فى كل الصفات المحصولية (إرتفاع النبات، إرتفاع اول عقدة ، عدد الأفرع للنبات،عدد القرون للنبات،عدد البذور للنبات، محصول البذورللنبات، وزن الـ ١٠٠بذره، وزن بذور القطعة التجريبية، محصول البذورللفدان) لكل التراكيب الوراثية. وقد أشارت النتائج المتحصل عليها تفوق سبعة تراكيب وراثيه رقم (٨، ١٢، ١٤، ١٦، ١٧، ٢١، ٢٤) تفوقا معنويا عن باقى السلالات والصنف المنزرع فى معظم صفات المحصول. أوضحت نتائج التحليل الكيمائى للبذور أن نسبة الرطوبة تراوحت بين ٨.٠٧ و ٩.٢٦% بينما نسبة البروتين تراوحت بين ٢٠.٤٠ و٢٥.٧١% أما نسبة الزيت كانت مابين٣.٥٢ و ٥.٨٩% فى حين نسبه الرماد كانت بين ٢.٧٨ و ٤.٢٤% اما نتائج تحليل الألياف كانت ١١.٢٢ و١٥.٦٥% بينما نسبة الكربوهيدرات تراوحت بين ٤٣.٣٣ و ٤٩.٥٣%.