INFLUENCE OF SOWING DATES, PLANT SPACINGS, CULTIVARS AND THEIR INTERACTIONS ON WILT DISEASE INCIDENCE, SEED YIELD AND YIELD COMPONENTS OF LUPIN

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ABSTRACT

Two field trials were carried out at the Experimental Farm (Demo), Fac. Agric. at Fayoum, during 2001/2002 and 2002/2003 seasons to study the effects of three sowing dates (S) i.e., Nov. 1, 15 & 30, three intra–row spacing (D) i.e, 25, 30 & 35 cm and two lupin cultivars (V) i.e., Giza 1 & Giza 2, on yield, yield components and wilt disease. Soil type of the experimental site was sandy with pH, ECe, $CaCO_3$ and organic matter of 8.1, 3.41 ds/m, 8.9% and 0.68%, respectively. RCBD in split–split plot design with three replications was used. The plot size was 10.5 m^2.

All studied characters were significantly affected by sowing date. Early sowing on Nov. 1 gave the highest values for yield and yield components except seed and harvest indices, and lowest values of infection percentage and disease severity, compared with the other two dates.

Except number of branches, all the rest characters were considerably influenced by intra-row spacing. The widest plant spacing (35 cm) caused marked increases in numbers of pods and seeds/plant, seed weight/plant, and seed index. Also, 35cm plant distance resulted in least wilt infection percentage and disease severity. While, the narrowest spacing (25 cm) produced the tallest plants and the greatest seed yield/faddan.

The tested cultivars exhibited significant differences for number of pods/plant, number and weight of seeds/plant towards G2 cv. as well as seed index towards G1 cv. whereas, the two cultivars showed similar means of the remainder characters including disease ones.

Various significant interaction effects were detected. Plant height, numbers of pods and seeds/plant, seed weight/plant and seed yield/faddan were affected by SV, SD, DV & SDV interactions. Number of branches and harvest index were influenced by SD, DV & SDV interactions. SV & SDV interaction were of significant effects on seed index. While, disease severity was affected only by SD interaction.

This study indicated that the best combination among the three main factors, to produce high seed yield with least wilt damage, is early sowing of G. 1 cv. on Nov.1 with 30 cm intra-row spacing.

INTRODUCTION

White lupin includes two cultivated forms, with the same number of chromosomes, i.e., *Lupinus albas* L. and *L. termis* Forsik (Hondelman, 1984). The latter form had been cultivated in Egypt since ancient time as one of the oldest grain Legumes which has considerable potential nutrition due to its high seed protein (35-45%) and oil content (10-15%). However, its seeds are widely used as snack after poilling and soaking for several days in flow water to leach out the alkaloids and make it suitable for human taste. Also, some medicinal and industrial purposes of the plants and seeds were reported (Mohamed *et al.*, 1991). Moreover, literatures had been recorded its ability not only to grow well in poor soils but also to improve them because of its efficient N fixation system, in addition to its ability to improve soil permeability and increase water storage and makes the overall farming practices more profitable (Lopez Bellido and Fuentes, 1990; Hamblin *et al.*, 1993 and Julier *et al.*, 1994).

Nevertheless, its contribution to the Egyptian grain legumes is still restricted because of its limited exploitation, its poorly competition to other winter crops within Nile Valley and Delta, and susceptibility of its common cultivars to wilt disease, which considered the most serious faba bean disease causing drastic losses in seed yield. Thus, planting improved lupin cultivars in newly reclaimed area under adjusted cultural practices such as sowing dates and plant population density suitable for producing high yield and controling wilt disease would be resulted in raising the crop production and avoidance of yield losses caused by wilt pathogen.

Unfortunately, the available information concerned with the effect of sowing date on local lupin growth, yield and wilt incidence are limited. Schield *et al.* (1996) in UK, reported that the highest seed yield was obtained by sowing lupin in early of September. Late sowing resulted in weather restricted the number of main-stem leaves, first order lateral branches and decreased plant height and yield potential. While, Sharma *et al.* (1994) in India, obtained the highest seed yield from sowing field pea on the first of November. However, Paz–Rodriguez *et al.* (2001) indicated that sowing date had a significant effect on biomass but not on seed yield of lupin.

Several lupin investigators have been shown that plant density is considered as an effective cultural practice influenced yield and its components. Denser plant population produced tallest plants (Abo-Shetaia, 1990 and Dracup *et al.*, 2000) and greatest seed yield/unit area (Lhamby *et al.,* 1988; Putman *et al.,* 1992; Bakeer, 1998 and Hoballah *et al.*, 2001). While, the thin plant density resulted in greater numbers of branches (Abo-Shetaia, 1990 and Mokhtar, 2002) and pods/plant (Abo-Shetaia, 1990; Lopez Bellido *et al.,* 2000; Dracup *et al.*, 2000 and Mokhtar, 2002). Number of seeds /pod (Dracup *et al.*, 2000) and seed weight/plant (Agenbag and Van – Rooyen, 1992 and Mokhtar, 2002) were decreased in dense plant population, whereas Abo–Shetaia, 1990 reported that the two characters, in addition to 100 seed weight, were increased by increasing plant density. Number of seeds/plant and seed index (Mokhtar, 2002) were lower in dense than in thin plant population.

Wilt pathogen, i.e, *Fusarium oxysporum* f.sp. *Lupini* is a serious soil–borne fungus attacks lupin plants from seedling to mature stages (Abdel–Kader, 1983) and causes up to 70% yield loss (Osman *et al.*, 1983). Chun and Maric (1989), Sharma *et al.* (1994) and Sarkar *et al.* (1998) reported that late sowing caused higher wilt incidence than early one, whereas the reverse was found in faba bean by Salih and Ageeb (1987). Under dense planting, wilt incidence found to be increased coupled with high ratios of dead plants at 15 and 90 day ages (Bakeer, 1998). On the contrary, Salih and Ageeb (1987) reported that incidence of wilt were decreased by increasing plant density. However, Chun and Maric (1989) recorded insignificant effect of plant density on wilt incidence. Kharbanda and Tewari (1996) suggested that through suitable adjustments in cultural practices, it is possible to modify the environment or the host so that conditions become unfavourable for one or more pathogens and subsequent disease development.

The present investigation was designed to study the effects of sowing dates, plant density, cultivars, and their interactions on yield, yield components and prevalence of wilt disease of lupin grown in newly reclaimed land under field naturally infested with wilt pathogen.

MATERIALS AND METHODS

Two field experiments were carried out at Experimental Farm (Demo), Fac. of Agric. at Fayoum, Cairo Univ., during 2001/2002 and 2002/2003 seasons to study the effects of three sowing dates (1 , 15 and 30

Nov.), three plant spacings between hills within ridges (25, 30 and 35 cm) and two lupin varieties (Giza 1 and Giza 2) on yield, yield components and wilt disease.

The soil type of the experimental site was sandy in texture with pH value of 8.1, ECe of 3.41 ds/m, $CaCO_3$ of 8.9% and organic matter of 0.68%. Monthly means of climatic factors for Fayoum region are recorded in Table (1).

The two experiments were conducted in Randomized Complete Block Design, in split-split – plot arrangement, with three replications, where sowing dates were assigned to the main plots, plant spacing were laid out in the sub-plots and varieties were allocated in the sub-sub plots. Each sub-sub plot area was 10.5 m^2 (five ridges, 60 cm width and 3.5 m length). The preceding crop of ground nut in both seasons. Lupin seeds, which previously inoculated with the specific *Rhizobium*, were sown seeds in hills at two side of the ridge, and immediately irrigated. The normal cultural practices for growing lupin plants were followed as usual.

At 90 days age, percentage of disease plants and disease severity were estimated according to the following formula:

Percentage of disease plants = $(n/N) * 100$. Where n = number of the disease plants and N= the whole examined plants in each replicate

Disease severity = $\{\Sigma (n_i * V_i)/(NV)\} * 100$. Where n_i = number of plants in each category, Vi = disease category, N = number of the total examined (inspected) plants and V = the highest disease category. To estimated disease severity, 25 plants/treatments were carefully inspected and grouped into categories according to linear scale from 1 – 9 (Bhatti and Kraft, 1992) as show in Table (2).

Table (1): Monthly means of climatic factors for Fayoum region in 2001/2002 and 2002/2003 seasons.

Month	2001/2002				2002/2003			
	Temperature C°			R.H%	Temperature C°			R.H %
	Max.	Min.	Mean		Max.	Min.	Mean	
October	31.6	19.6	25.6	60.00	32.40	20.10	26.30	61.00
November	27.90	13.95	20.93	60.70	28.80	14.40	21.60	60.00
December	22.9	9.60	16.30	62.00	23.30	9.60	16.50	62.00
January	20.60	8.40	14.70	66.00	24.00	9.20	16.60	62.00
February	24.10	10.3	17.20	36.00	21.80	7.60	14.70	58.00
March	24.40	9.50	16.90	62.00	24.30	9.40	16.80	58.00
April	30.80	14.70	22.80	56.00	32.70	15.40	24.10	53.00
May	35.60	17.90	26.75	52.10	38.50	20.20	29.35	50.42

Table (2): Disease severity rating scale

Rating	Description (wilt)
1	No visible symptoms (a healthy plant)
3	Very few discolored leaves (less than 10%): limited discoloration of root tissue
5	Approximately 11 – 25% of leaves and branches show chlorosis; small lesions on root with slight vascular discoloration
7	Approximately 26 – 50% of leaves and branches show wilting, chlorosis and limited necrosis; plant stunted; vascular discoloration more prominent
9	More than 51% of leaves and branches show wilting, and necrosis; extensive vascular discoloration; plant death

* Number 2, 4, 6 and 8 were assigned to plants showing symptoms between the appropriate odd number rating.

At harvest time, a random sample of ten plants was taken from each sub-sub plot to determine plant height (cm) and yield components characters i.e. numbers of branches, pods and seeds/plant, weight of seeds/plant (g) and seed index (g). Economic yield (kg/fad.) was determined based on yield/plot area.

Data were statistically analyzed according to the procedures of ANOVA of the split-split plot design outlined by **Gomez and Gomez (1984).** Test of homogeneity of the data was applied, and then combined analysis of variance was performed over the two seasons. Least significant difference (LSD) test at 5% level of probability was used to compare the treatment means.

RESULTS

All of the studied characters were significantly affected by sowing date (Table 3). The early sowing on Nov.1 was superior to the other two dates on Nov. 15 and 30 for yield and yield components except seed and harvest indices. The intermediate or late sowing date gave higher seed index than that of the early sowing. Both values of harvest index of the earliest and latest sowing dates markedly increased that of the intermediate one. Sowing on Nov. 15 resulted in taller plants, heavier weight of seeds/plant and larger seed yield/fad compared to those of the latest date on Nov. 30. On the other hand, infection percentage and disease severity were greatly influenced by sowing dates. The earliest date ranked as the first effective date decreasing disease incidence followed by the intermediate date, and both surpassed the late sowing date which caused the highest values for the two characters. These results revealed that early sowing on No. 1 was the best for producing high seed yield with least wilt disease incidence.

Except for number of branches, the other rest of the characters were significantly affected by intra-row spacing, or plant density (D). The widest distance between plants (35 cm) caused significant increases in number of pods/plant and seeds/plant as well as seeds weight/plant and seed index, compared to those of the narrowest one (25 cm). While there were insignificant differences between 30 and 35 cm for number of pods/plant and seed index and disease traits. Harvest index value of 30 cm was the lowest, compared to those of 35 and 25 cm. On the other hand, narrowest spacing (25 cm) or highest plant density produced taller plants (with significant difference) and the greater seed yield/faddan than those of 30 and 35 cm, but the differences between 30 and 35 cm for both characters were insignificant. These results revealed that sowing with 30 cm intra-row spacing may be preferable for obtaining satisfied economic yield with least disease damages.

The two tested cultivars (V) exhibited significant differences for number of pods/plant, number and weight of seeds/plant, toward G.2 cultivar, as well as seed index, toward G.1 cultivar. While, the differences between the two cultivars for the other characters did not reach to the significance level, indicating their genetic relation.

SxV interaction effect was significant on plant height and number of pods/plant, where G. 2 when sown early on Nov. 1 gave the highest values. It also affected number of seeds/plant, seed weight/plant and seed yield/fad, where G. 1 with early sowing on Nov. 1 produced the largest number and weight of seeds and heaviest seed yield. Also, seed and harvest indices were affected by S x D interaction, where the highest two indices were obtained from G1 sown on Nov. 30 (Table 4).

The effect of S x D interaction was significant on plant height, where the tallest plants were obtained from early sowing on Nov. 1 coupled with 25 or 30 cm plant distance. It showed marked effects on numbers of branches and pods/plant and economic yield (kg/fad) where the highest values were produced by early sowing on Nov. 1 coupled with 30 cm inta-row spacing. Also, it affected number and weigh of seeds/plant and disease severity, where the largest number and heaviest seeds and least severity of disease, were observed from early sowing with 35 cm distances. Harvest index was among the characters affected by SD interaction and the its highest value was from sowing on Nov. 30 with 35 cm distances (Table 5).

Significant effect of D x V interaction was detected for plant height and number of branches where the tallest and heavy branching were obtained by sowing G. 1 with 25 cm intra-row spacing. Number and weight of seeds/plant were also affected by DV interaction, and the highest values was noted (Table 6) from sowing G. 2 with 35 cm plant-to- plant distance. Other effective DV interaction were observed for number of pods (by sowing G2 with 30 cm) and economic yield (by sowing G. 1 with 30 cm intra-row spacing).

As shown in Table (7), all of the studied characters, except the two disease ones, were significantly affected by S x D x V interaction. Concerning plant height and number of branches, the highest values were obtained from early sowing of G. 1 on Nov.1 with 25 cm hill distances. This second order interaction also affected numbers of pods and seeds/ plant and seed weight/plant where the largest number and the heaviest seeds were obtained by early sowing of G. 2 on Nov. 1 with the widest plant distance of 35 cm. In addition, seed index (by sowing G. 1 on the latest date with the widest plant spacing) and harvest index (by the same cultivar and date but with 20 cm plant distance) were affected by SDV interaction. Seed yield/faddan was affected by this interaction, and the greatest yield was produced from early sowing of G. 1 on Nov.1 with intra- row spacing of 30 cm. This result confirmed the above-mentioned conclusion based on the results of the main factors.

DISCUSSION

The obtained results indicated that all studied characters were significantly affected by sowing date toward the early date of Nov. 1. Seed and harvest indices were the only two exceptions, where the second and third dates for seed index and the first and third dates for harvest index were the best. Seed yield /fad (kg) of early sowing on Nov. 1 surpassed those of Nov. 15 and 30 by 154.7 and 182.9%, respectively. This result is in full agreement with that obtained by Sharma *et al.* (1994). The high yielding crop of the early sowing may be attributed to its superiority in numbers of branches, pods and seeds/plant (Table 3) and consequently seed weight/ plant which outyielded those of Nov. 15 and 30 by 79.9 and 97.3%, respectively. Superiority of early sowing may be due to prevailance of favourable climatic factors such as temperature and light energy, especially under the conditions of the experimental site which allocated marginal to desert, and this provide the plant full chance to develop well canopy and biomass and increased its capacity to absorb enough of water and nutrients, and consequently possessed more effective productive organs. In connection with this, Julier and Huyghe (1993) considered that the well developed plant canopy coupled with number of leaves as the most important physiological characters for lupin yield because it determine other major yield attributes.

Concerning seed index, sowings on Nov. 15 and 30 exhibited higher values than that of early sowing. This may be ascribed to increase numbers of branches; pods and seeds produced from these two late sowing date, and the amount of photosynthesis and dry matter were partitioned and transferred to less number of fruiting organs especially seeds which become larger and heavier than those of the early sowing. So, seed indices of latter sowing dates were higher than that of early sowing date. This result supports those reported by Mokhtar (2000).

The data listed in Table (3) show that all studied characters were significantly affected by intra-row spacing, reflecting the importance of plant density for lupin growth, yield, yield components and wilt disease incidence. Several lupin studies supported these results (Lhamby *et al.*, 1988; Putman *et al.*, 1992; Agenberg and Van-Rooyen, 1992; Hoballah *et al*., 2000 and Mokhtar, 2002).

The data revealed that sowing with widest plant spacing of 35 cm (low density) was resulted in marked increases for individual plant yield and all of its components, but decreased plant height and seed yield/faddan. The reverse was true in denser populations. This could be interpritted on the bases that, under thin plant density there is low plant-to-plant competition for available solar energy intercept by foliages, water and nutrients, and this resulted in low seed yield/unit area as a result of decreased number of plants. These results are in line with those reported by Lhamby *et al*. (1988), Putman *et al.* (1992), Dracup *et al.* (2000), Hoballah *et al.* (2001) and Mokhtar (2002). The present results indicated that sowing lupin at 30 cm intra–row spacing was suitable to produce improved seed yield with least disease damage caused by wilt pathogen.

In regard to cultivars, significant differences were detected in only four characters, i.e., numbers of pods and seeds/plant, seed weight/plant and harvest index (Table 3). This result reflects great similarity of behaviour and performance of the two cultivars which may be due to that both were initially bred from related genetic sources.

Except for infection percentage, all the studied characters were significantly affected by one, two, three, or four kinds of interaction effects.

Plant height, numbers of pods and seeds/plant, seed weight/plant and seed yield/faddan were affected by all four kinds of interaction. i.e., SV, SD, DV and SDV (Tables 4-7). Number of branches and harvest index were markedly influenced by all kinds except SV and DV respectively. SV and SDV interaction effects were significant for seed index. While, disease severity was affected only by SD interaction. Based on these results, it might be noted that the characters which are quantitative in its nature exhibited more kinds of interaction while those of simple inherited nature showed less kinds, where the former characters are greater influenced by environmental factors and environment-genotype interaction than the latter ones. It was also observed that the trend of these interactions was associated with early sowing on Nov. 1 of G. 1 cultivars with 25-30 cm plant distances, indicating the importance of these treatment for producing improved lupin yield and quality.

Concerning wilt disease, it should be noted that the effect of sowing date on wilt incidence, caused by *Fusarium oxysporum* f. sp. *lupini*, had not been studied extensively and this may be give the present study some advantages. As shown in Table (3), infection percentage and disease severity were considerably influenced by sowing dates. Early sowing on Nov. 1 characterized by least value, where the intermediate sowing date (Nov. 15) and the latest date (Nov. 30) increased those of the early one by 1.5 and 68.8% for infection percentage and 3.1 and 50.7% for disease severity. It is worthly noting that the increasing percentages of the early sowing date over the intermediate one were low and insignificant, indicating that the climatic conditions were unfavourable for the pathogen (Table 1). These results are in agreement with those reported by Chun and Maric (1989) and Sarkar *et al.* (1998) who suggested that early sowing resulted in lowest wilt incidence. However, Salih and Ageeb (1987) found that wilt incidence was decreased with late sowing. The present results revealed that late sowing provide a favourable environment encourage the pathogen virulence, while the reverse was true with early sowing which may also control other disease. Connection to this, Kharabanda and Tewari (1996) stated that adjusting the time of sowing to avoid high levels of inoculum or conditions conducive for development of a particular disease may be result in reduced severity of several diseases, and then lead to avoid yield reduction caused by these disease.

Both infection percentage and disease severity were significantly affected by intra-row spacing or plant population density. The widest plant distance of 35 cm (thin density) led to least values, which decreased by 6.2 and 55.6% for infection (%) and by 6.4 and 36.9% for disease index compared with those of 30 and 25 cm distances, respectively (Table 3). These results are logic because increasing plant distance decreased the pathogen ability to spread on a large scale and may be due to gave a good chance for the soil borne fungi to attack plants, because there are more crowded and increasing of soil moisture around the crowded roots. Singh *et al.* (1990) reported that wilt spread from primary infection spots of faba bean plants was common at 15 cm spacing and less so at 25 cm, while it not occurred at 30 cm spacing. Bakeer (1998) found that wilt incidence was increased coupled with high ratio of dead faba bean plants at 15 and 90 day ages in dense plant population. However, Salih and Ageeb (1987) suggested that incidence of wilt was decreased by increasing plant density. While, Chun and Maric (1989) recorded insignificant effect of plant density on wilt incidence. This fluctuation among the previous results, whether were in line with the present study or not, may be explained on the bases that the wilt disease (caused by soil- borne fungus) is greatly depend on edaphic and climatic conditions of the experimental sites as well as the tested genetic materials.

Cultivars showed similar values for both disease characters (Table 3), confirming their similar genetic background and both did not bred for wilt tolerance although the pathogen was well known as the most serious disease attack lupin (Abdel-Kader, 1983). Disadvantage of breeding wilt tolerant cultivars was perhaps depended on the information that alkaloid cultivars are commonly wilt tolerant. But, in fact, this is not enough and should be incorporate the resistance genes within our cultivars structure. Kuptsov *et al.* (2000) from their genetical analysis of lupin materials, suggested that wilt resistance was conditioned by two genes. More recently, El-Sayed and El-Bagoury (2002) obtained five mutant lines promising for *Fusarium* wilt resistance. The present data showed that only disease severity was significantly affected by SD interaction, where early sowing with 35 cm plant distance gave least value (Table 5).

In sum, the aforementioned discussion for the main factors and their interactions revealed that, the best combination among them to produce high seed yield with least wilt injuries is early sowing of G. 1 cultivar on Nov. 1 with 30 cm intra-row spacing.

Table (3): Effect of sowing date, plant spacing and varieties on yield and its components and disease characters of lupin (average of combined data over 2001/2002 and 2002/2003 seasons).

Factor \ Character		Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /plant	Weight of seeds /plant (g)	Seed index (g)	Economic yield/fad. (kg)	Harvest index	Infection percentage	Disease severity
Sowing dates (S)	1 Nov.	79.56	4.87	8.28	29.13	11.62	37.93	525.31	24.11	16.71	21.50
	15 Nov.	58.46	3.42	4.99	16.74	6.46	39.53	206.22	19.18	16.96	22.17
	30 Nov.	60.86	3.45	4.78	16.24	5.89	39.47	185.66	25.36	28.20	32.40
Plant spacing (D)	25 cm	67.92	4.02	5.60	19.81	7.87	38.21	275.60	22.91	26.61	30.33
	30 cm	65.50	3.93	6.31	20.12	7.78	39.62	327.39	22.02	18.16	23.58
	35 cm	65.46	3.79	6.15	22.19	8.32	39.10	314.19	23.72	17.10	22.16
Varieties (V)	G. 1	66.16	3.95	5.74	19.46	7.77	39.25	307.16	23.86	20.37	25.09
	G. 2	66.43	3.88	6.30	21.95	8.21	38.70	304.30	21.90	20.88	25.63
LSD at 5% for S		**1.64**	**0.27**	**0.26**	**0.82**	**0.39**	**0.94**	**27.36**	**2.34**	**1.13**	**1.18**
LSD at 5% for D		**1.05**	**n.s**	**0.30**	**0.69**	**0.32**	**0.87**	**20.12**	**1.31**	**0.85**	**1.33**
LSD at 5% for V		**n.s**	**n.s**	**0.16**	**0.57**	**0.25**	**n.s**	**n.s.**	**1.44**	**n.s**	**n.s**

Table (4): Effect of sowing date(S) x varieties (V) interaction on yield and its components and disease characters of lupin (average of combined data over 2001/2002 and 2002/2003 seasons).

Factor \ Character S	V	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /plant	Weight of seeds /plant(g)	Seed index (g)	Economic yield/fad. (kg)	Harvest index	Infection percentage	Disease severity
1 Nov.	G. 1	78.49	4.94	7.79	26.16	10.90	37.08	513.06	24.19	16.49	21.31
	G. 2	80.62	4.80	8.77	32.11	12.34	38.79	537.56	24.02	16.93	21.69
15 Nov.	G. 1	57.84	3.33	4.98	17.14	6.73	39.88	228.94	19.03	16.72	22.15
	G. 2	59.09	3.50	5.01	16.33	6.19	39.17	183.50	19.32	17.19	22.19
30 Nov.	G. 1	62.14	3.56	4.46	15.07	5.67	40.79	179.48	28.36	27.89	31.80
	G. 2	59.58	3.33	5.11	17.41	6.11	38.15	191.83	22.36	28.51	32.99
LSD at 5% for S x V		**2.30**	**n.s**	**0.27**	**0.99**	**0.44**	**1.05**	**26.24**	**2.50**	**n.s**	**n.s**

Table(5): Effect of sowing date(S) x plant spacing(D) interaction on yield and its components and disease characters of lupin (average of combined data over 2001/2002 and 2002/2003 seasons).

Factor S	D	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /plant	Weight of seeds /plant (g)	Seed index (g)	Economic yield/fad. (kg)	Harvest index	Infection percentage	Disease severity
1 Nov.	25 cm	82.20	4.75	7.22	26.72	10.83	37.05	473.42	25.24	22.99	27.53
	30 cm	81.27	5.30	9.08	28.65	11.75	38.35	595.33	22.73	13.98	19.78
	35 cm	75.20	4.57	8.53	32.03	12.27	38.40	507.17	24.35	13.18	17.18
15 Nov.	25 cm	58.42	3.48	4.75	16.42	6.46	38.09	209.92	18.04	23.39	28.31
	30 cm	53.78	3.15	4.65	14.77	5.61	40.69	176.58	18.01	14.77	19.80
	35 cm	63.20	3.62	5.58	19.03	7.32	39.79	232.17	21.13	12.71	18.41
30 Nov.	25 cm	63.13	3.83	4.83	16.28	6.33	39.49	143.47	25.08	33.45	35.15
	30 cm	61.47	3.33	5.18	16.93	5.97	39.83	210.25	25.32	25.73	31.17
	35 cm	57.98	3.18	4.33	15.50	5.37	39.10	203.25	25.68	25.43	30.88
LSD at 5% for S x D		**1.81**	**0.36**	**0.51**	**1.20**	**0.56**	**n.s**	**34.86**	**2.29**	**n.s**	**2.31**

Table (6): Effect of plant spacing (D) x varieties (V) interaction on yield and its components and disease characters of lupin (average of combined data over 2001/2002 and 2002/2003 seasons).

Factor D	V	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /plant	Weight of seeds /plant (g)	Seed index (g)	Economic yield/fad. (kg)	Harvest index	Infection percentage	Disease severity
25 cm	G. 1	68.67	4.28	5.66	20.01	8.06	38.63	247.76	24.91	26.08	30.45
	G. 2	67.17	3.77	5.54	19.60	7.68	37.79	303.44	20.90	27.14	30.21
30 cm	G. 1	64.24	4.02	5.78	18.43	7.43	39.68	346.28	22.91	18.12	23.54
	G. 2	66.77	3.83	6.83	21.80	8.12	39.57	308.50	21.13	18.19	23.62
35 cm	G. 1	65.57	3.54	5.79	19.92	7.81	39.45	327.44	23.77	16.90	21.26
	G. 2	65.36	4.03	6.51	24.46	8.83	38.74	300.94	23.67	17.30	23.05
LSD at 5% for D x V		**2.30**	**0.30**	**0.27**	**0.99**	**0.44**	**n.s**	**26.24**	**n.s**	**n.s**	**n.s**

Table (7): Effect of sowing date (S) x plant spacing (D) x varieties (V) interaction on yield and its components and disease characters of lupin (average of combined data over 2001/2002 and 2002/2003 seasons).

S (Factor)	D	V (Character)	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /plant	Weight of seeds /plant (g)	Seed index (g)	Economic yield/fad. (kg)	Harvest index	Infection percentage	Disease severity
1 Nov.	25 cm	G. 1	83.67	5.53	7.10	25.77	10.62	35.67	394.17	25.75	22.77	27.68
		G. 2	80.73	3.97	7.33	27.67	11.04	38.43	552.67	24.73	23.22	27.37
	30 cm	G. 1	79.30	5.50	8.87	27.27	11.76	38.05	624.00	23.88	14.57	19.97
		G. 1	83.23	5.10	9.30	30.03	11.74	38.65	566.67	21.57	13.38	19.60
	35 cm	G. 1	72.50	3.80	7.40	25.43	10.31	37.52	521.00	22.95	12.15	16.27
		G. 2	77.90	5.33	9.67	38.63	14.24	39.28	493.33	25.75	14.20	18.10
15 Nov.	25 cm	G. 1	59.03	3.40	5.47	19.57	7.75	39.57	221.83	20.67	23.13	28.88
		G. 2	57.80	3.57	4.03	13.27	5.16	36.62	198.00	16.13	23.65	27.73
	30 cm	G. 1	51.12	3.10	3.90	13.30	4.95	40.23	203.00	15.53	14.50	19.98
		G. 2	56.43	3.20	5.40	16.23	6.27	41.15	150.17	20.48	15.03	19.62
	35 cm	G. 1	63.37	3.50	5.57	18.57	7.49	39.85	262.00	20.90	12.53	17.58
		G. 2	63.03	3.73	5.60	19.50	7.15	39.73	202.33	21.35	12.88	19.23
30 Nov.	25 cm	G. 1	63.30	3.90	4.40	14.70	5.81	40.65	127.27	28.32	32.35	34.78
		G. 2	62.97	3.77	5.27	17.87	6.85	38.33	159.67	21.83	34.55	35.52
	30 cm	G. 1	62.30	3.47	4.57	14.73	5.58	40.75	211.83	29.30	25.28	30.68
		G. 2	60.63	3.20	5.80	19.13	6.37	38.90	208.67	21.33	26.17	31.65
	35 cm	G. 1	60.83	3.33	4.40	15.77	5.63	40.98	199.33	27.45	26.03	29.93
		G. 2	55.13	3.03	4.27	15.23	5.11	37.22	207.17	23.90	24.82	31.82
LSD at 5% for S x D x v			**3.98**	**0.51**	**0.47**	**1.71**	**0.76**	**1.83**	**45.45**	**4.33**	**n.s**	**n.s**

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تأثير مواعيد ومسافات الزراعة والأصناف والتفاعل بينها علي المحصول ومكوناتة ومرض الذبول في الترمس

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أقيمت تجربتان حقليتين في مزرعة كليـــة الزراعـــة بـــالفيوم خـــلال موســـمي ٢٠٠٢/٢٠٠١ ، ٢٠٠٣/٢٠٠٢ لدراسة تأثير ثلاثة مواعيد زراعة (١ ، ١٥، ٣٠ نوفمبر) وثلاثة مسافات زراعة بين الجور (٢٥، ٣٠، ٣٥ سم) وصنفين (جيزة ١ ، جيزة ٢) علي المحصول ومكوناتة ومرض الذبول في الترمس. وكان التصميم الإحصائي المستخدم هـــو القطع المنشقة مرتين في قطاعات كاملة العشوائية بثلاثة مكررات ومساحة القطعة التجريبية ١٠,٥م^{٢}. وتم الحصول علي النتائج التالية:

بالنسبة لمواعيد الزراعة كان هناك فروق معنوية لكل الصفات المدروسة ما عـــدا دليل البذرة والحصاد، وكان الميعاد الأول اعلي في المحصول ومكوناتة واقل فـــي نـــسبة وشدة الإصابة المرضية مقارنة بالميعادين الآخرين.

وتأثرت كل الصفات ما عدا عدد الأفرع بالنبات بمسافات الزراعة حيث أعطت الزراعة علي مسافة اكبر (٣٥سم) زيادة واضحة في عدد القرون والبذور بالنبات ووزن بذور النبات ودليل البذرة ولكنها كانت اقل إصابة مرضية من حيث النسبة والشدة. أما الزراعة علي مسافة ضيقة (٢٥سم) نتج عنها نباتات أطول واعلي محصول بذرى للفدان.

أظهرت الأصناف اختلافات معنوية لعدد القرون/نبات، وعدد ووزن البذور/نبات، وذلك تجاه الصنف جيزة ٢ وصفة دليل البذرة تجاه الصنف جيزة ١. في حين اظهر الصنفين متوسطات متماثلة في باقي الصفات بما فيها الصفات المرضية.

وبالنسبة لتأثير التفاعلات المختلفة كان هناك فروق معنوية لتفاعل المواعيد × الأصناف، والمواعيد × المسافات، ومسافات الزراعة × الأصناف والتفاعل الثلاثي بينهما وذلك لصفات طول النبات، وعدد القرون، وعدد ووزن البذور/نبات، ووزن بذور النبات ومحصول الفدان. أيضا التفاعل بين مواعيد الزراعة × مسافات الزراعة، ومسافات الزراعة × الأصناف، والمواعيد × المسافات × الأصناف معنوية لصفات عدد الأفرع/نبات ودليل الحصاد. أما صفة دليل البذرة كانت معنوية للتفاعل بين المواعيد × الأصناف، والمواعيد × المسافات × الأصناف، بينما صفة شدة الإصابة بالذبول كانت معنوية فقط للتفاعل بين المواعيد × مسافات الزراعة.

وتشير هذة الدراسة إلي أن أحسن توليفة بين العوامل الثلاثة تحت الدراسة لإنتاج اعلي محصول بذرى وبأقل إصابة بمرض الذبول هى زراعة الصنف جيزة (١) في الميعاد المبكر وعلي مسافة ٣٠ سم بين الجور.