INFLUENCE OF NITROGEN FERTILIZER ON YIELD AND ITS COMPONENTS OF BARLEY AND LUPIN OR CHICKPEA IN SOLELY OR INTERCROPPING PLANTING UNDER THE CONDITIONS OF NEWLY RECLAIMED SOIL.

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ABSTRACT:

A field trial conducted on barley, lupin and chickpea crops was practiced in sand loamy newly reclaimed soil at the experimental farm of the Faculty of Agriculture, Fayoum University, during 2006/07 and 2007/08 seasons. This work was designed to study the effect of nitrogen fertilizer rates (15, 30 and 45 kg N/fed.) on the three crops grown as sole and intercropping (barley/chickpea and barley/lupin). A split split-plot arrangement in randomized complete block design with three replications was used. The obtained results showed that, compared with the barley/chickpea pattern, monocrop chickpea had significantly improved yielding and quality traits. Whereas, intercropping had higher seed index. Fertilization with 45% N (N_3) led to increases in vegetative and reproductive and consequently seed yield/fed. However, similar means of height to first branch and seed index were obtained from application of 30 kg N/fed. (N_2) which produced the highest harvest index. Compared with monocrop culture, barley/lupin intercropping resulted in significant increases of lupin height traits in addition its superiority for number of branches and seed index but with inferior seed weight/plant. The heaviest weight of seeds/plant and yield/fed. were obtained from soled lupin. Nitrogen application results revealed the adequacy of N_3 for lupin where it produced acceptable seed yield/fed. due to its superior number of pods and harvest index. Except seed and harvest indices all barley traits were significantly affected by intercropping in favour to soled culture. Intercropping barley produced more than half yield/fed. Compared with solid culture. Nitrogen fertilization indicated the suitability of N_2 (30 kg N/fed.) for producing improved yield insignificantly different from that of N_3. Under cropping patterns with N_2 fertilizer dose, the second yielding combinations were barley/chickpea (12.18 ard) and then barley/lupin (11.08 ard) which represented 61 and 55% of yield of soled barley fertilized with N_3. These results indicating that chickpea was of better effect than lupin on barley yielding ability and fertilization with the intermediate nitrogen dose (N_2) was quite enough for intercropping. Also, with N_2 barley/chickpea and barley/lupin yielded 49% chickpea together with 61% barley with LER of 1.15 as well as 46% lupin together with 55% barley with LER 1.21, respectively, compared with sole culture of each crop. These two intercropping –N_2 combinations increased total production by 15% and 21% respectively.

Key words: *Barley, Lupin, Chickpea, Intercropping, Nitrogen fertilizers, yield and yield components and LER.*

INTRODUCTION

Research has focused primary on the potential of C_4 cereal /legume intercrops and has demonstrated a clear yield advantages over the sole cropping for species such as maize/ field bean **(Willey and Osiru, 1972)** sorghum/pigeon pea **(Natarajan and Willey, 1980)** and maize/soybean **(Metwally, *et al,* 1988 and Abdalla, *et al.*, 1999)**. However, interspecific competition that frequently recorded in the researches was due to different factors including the nitrogen aggressiveness of C_4 cereals.

Recently, C_3 cereal/legume combinations have been emphasized to gain the intercropped advantages with low competition and high efficient utilization of inputs particularly supplied nitrogen, which probably benefit in resource - limiting conditions. Chickpea and/or Lapin as grain (pulse) legumes could be contributed to the sustainability of cropping system, through intercropping with barley, via its ability to contribute nitrogen to the system via biological N_2-fixation, and reduced fossil energy consumption in plant production. It has been well documented that an important N-transfer takes place in intercropping systems of legumes with cereals (**Landsberg, 1981**). The cereal component oftenly compete for soil nitrogen **(Caruthers, *et al,* 2000)** and this effect encourage the legume component to fix more amount of nitrogen from the atmosphere **(Hauggaard-Nielsen and Jensen 2001)**. **Sharma and Gupta (2002)** showed that N-and P-nutrition of pearl millet was greatly improved by intercropping with legume.

Intercropped of with lupin **(Gardner and Boundy, 1983 and Horst and Waschkies, 1987)** and chickpea **(Li, *et al*., 2003)** with wheat had positive contribution to macronutrients uptake in wheat grains. **Zhang and *Li,* (2003)** reported that currently intercropping is attracting increase interesting in low-input crop production systems. **Ghosh, *et al,* (2009)** suggested that the specific competition for nutrients is important and can begin early in the growth of component crops.

Specific intercrop projects have indicated the promise of barley/ field bean **(Martin and Snydon, 1982)** and wheat/field bean **(Bulson, 1991)**. It was suggested that the temperate C_3-cereal/legume intercrops is acknowledged for present and future agricultural potential **(Ofori and Stern, 1987)**. At low fertility conditions, the competitive ability of the cereal is superior to the legume, so the latter forced to rely on its N-fixing ability **(Danso, *et al,* 1987 and Ghaley, *et al*, 2005)**. Moreover, **Deria, *et al* (2003) and Prins and Wit, (2006)** showed that in low N-soil fertility conditions, a low N supply is capable of producing a great marginal of wheat. **Hauggaard-Nielsen and Jensen, (2009)** concluded that pea/barley intercropping is a relevant cropping strategy that should be adopt when trying to optimize N_2-fixation inputs to the cropping system **Tosti and Guiducci, (2010)** Stated that in Mediterranean area, the importance of N management becomes crucial for winter cereals, as low temperatures and high autum – spring rainfall cause very low levels of available mineral N in the soil during most of the crop cycle. Thus, it is essential to search for any possible ways for changing the agriculture manner and managements including N fertilization, that should be practiced in the newly reclaimed low fertility soil in order to raise and maintain its productivity. One of the possibilities is to increase the production of C_3 crops such as barley, lupin and chickpea (those of secondary importance) as a substantial crop for food and feed, through intercropping.

Therefore, the experiment reported herein was set up to provide information on the N response of barley , lupin and chickpea as sole and intercrop planting and on how these individual responses affect the total productivity under the conditions of newly reclaimed soil.

MATERIALS AND METHODS :

Two field experiments were carried out during 2006/2007 and 2007/2008 winter seasons at the experimental farm of the Faculty of Agriculture, Fayoum University, in newly reclaimed soil. The major objectives of this work were to study the effect of nitrogen fertilization on the yield and yield components of barley (*Hordum vulgare* var. Giza 126), (*Lupins terms* L. Var. Giza 1) and chickpea (*Cicer arietinum* var. Giza 195) under sole planting of each and intercropping of barley with Lupin or chickpea as well as determine their N response and effect on the productivity. Field soil was sand – loamy in texture with 7.92 pH, ECe of 3.78 dS/m, contained 10.85% $CaCo_3$, 0.79% organic matter and 15.89 ppm total nitrogen. The preceding cropping was fallow and sunflower in the first and second seasons, respectively. After plughing and harrowing of the field, then ridged (60 cm a part) and divided into plots (3 x 2.4 m) with 4 ridges/plot. During the field preparation, 50 kg potassium sulphate (48 % K_2O) and 150 kg/fed. single superphosphate (15.5% P_2O_5) were added. The tested treatments were cropping patterns (sole planting of each crop, and barley/Lupin or chickpea intercropping)and three nitrogen fertilizer doses (15 (N_1), 30 (N_2) and 45 (N_3) kg N/fed.). A split-plot arrangement in randomized complete block design with three replications was used. The intercropping patterns of solid cultures (I_1) 2 ridges barley : 2 ridges Lupin or chickpea, viz. 50 : 50 (I_2 and I_3) and were assigned to the main plot and the nitrogen fertilizer rates were allocated in sub-plot. Lupin and chickpea seeds were inoculated by specific rhizobium the suitable immediately before sowing.

Sowing was done on November 15 in both seasons. Barley seeds were drilled into three rows above the ridge. Chickpea and Lupin were sown on the two sides of ridges in hills 10 cm apart for the former and 25 cm for the latter, with 2 seeds/hill, Number of hills were 30 and 12 hills/ridge for chickpea and Lupin, respectively. The other agricultural practices were follow as recommendations.

At harvest time, sample of 10 guarded plants was randomly taken from each plot of each crop to determine the plant mean traits, and the grain (seed) yields were calculated on plot basis as follows:.

$$\text{Yield/fed} = \text{Yield/ridge} \times \text{ridges number of crop/plot} \times \frac{4200\text{m}^2}{\text{plot area m}^2}$$

Protein content in seeds was estimated following the procedure outlined by **A.O.A.C. (1970).**

The studied traits in barley were plant height (cm), number of grains/spike weight of grain (g) /spike, number of spike/m^2, seed index (g) and harvest index. In Lupin and chickpea, the studied traits were plant height (cm), height to first branch (cm), number of branches/plant, number of pods/plant, weight of seed (g)/plant, seed index (g) and harvest index.

For barley grain yield and seed yields of each Lupin and chickpea, land equivalent ratio (LER) values were calculated according) to **(Willey, 1979)**:
LER = L barley + L Legume,
Where:

L_b = L barley = intercrop yield of barley / its pure stand yield.
L_{lup} = L lupin = intercrop yield of Lupin / its pure stand yield.
L_{ch} = L chickpea = intercrop yield of chickpea / its pure stand yield.

All the obtained data were subjected to analysis of variance, and the means were differentiated by Duncan multiple test according to **Gomez and Gomez (1984).**

RESULTS AND DISCUSSION:

a) Chickpea:

Soled chickpea traits surpassed those of its intercropped with barley. Whereas, seed protein content and harvest index did not show significant differences due to intercropping (Table 1) and Fig. (1). **Caruthers, *et al*, (2000)** reported that harvest indices of all component crops were seldom affected by intercropping. Whereas, **Thorsted, *et al* (2006)** showed that it reduced by intercropping in wheat. Compared with the barley chickpea intercropping, the chickpea monocrop culture had significantly improved numbers of branches and pods/plant, seed weight/plant and seed yield/fed. as well as seed protein content. However, intercropping was superior to monocropping for seed index, indicating the low contribution of this trait alone to yields of plant and unit area and this be attributed to larger seeds of intercrop chickpea than those of sole crop. In this concern, **Lopez-Belledo, *et al* (2004)** reported that seeds/pod and pods/plant were the yield components exerting the greatest direct effect on seed yield of chickpea, while the compensatory effect of the other yield components including seed index was very limited.

Table (1): Effect of intercropping systems on seed yield and yield components of chickpea (combined data over two seasons).

Traits / Treatment	Plant height (cm)	Height to 1st branch (cm)	No. of branches /plant	No. of pods/ Plant	Weight of seeds /plant (g)	Seed Index (g)	Seed yield /Fed. (Ardab)*	Harvesting index	Protein percentage
Solid chickpea (I_1)	57.36a	6.71	3.55a	32.15a	3.91a	13.14b	3.14a	18.27	19.27
Barley : chickpea 2:2 (I_2)	56.33b	6.75	2.95b	25.60b	3.40b	13.59a	1.55b	18.71	19.07

*Ardab = 150 Kg

Results presented in Table (2) show that, except for protein content percentage in chickpea seeds, all the other studied traits were significantly influenced by nitrogen fertilization rates. Insignificant effect of nitrogen doses on protein content may be due to that the trait was mainly dependent upon the crop N_2-fixing and/or partially on least amount of nitrogen in the rhizosphere. This result supported that previously reported by **Deria *et al* (2003)** who showed that a low in supply is capable for improving seed protein content. **Lopez-bellido, *et al* (2004)** reported that N fertilization did not appear to affect chickpea N_2-fixation. Fertilization with 45 kg N/fed. (N_3) led to increases in plant height, height to the first branch, numbers of branches and pods/plant as well as seed weight/plant, seed index and consequently seed yield/feddan. Similar means of height to first branch and seed index were obtained from application of 30 kg N/fed. (N_2) which produced the highest harvest index, indicating the low response of the later trail to high N rate. **Tijani-Eniola *et al* (2000)** found that 30 kg N/ha had comparable effect with 60 kg N/ha and produced 10% increment in soybean height and 32% in seed yield. The lowest nitrogen dose (N_1) resulted in inferior means or all studied traits

Table (2): Effect of nitrogen levels on yield and yield components of chickpea (combined data over two seasons).

Traits / Level treatment	Plant height (cm)	Height to 1st branch (cm)	No. of branches /plant	No. of pods/ Plant	Weight of seeds/ plant (g)	Seed Index (g)	Seed yield /Fed. (Ardab)	Harvesting index	Protein percentage
15 kg nitrogen (N_1)	55.02c	5.44b	2.70c	22.77c	3.25c	12.90b	2.02c	15.72c	19.09
30 kg nitrogen (N_2)	56.80b	7.44a	3.29b	26.89b	3.52b	13.53a	2.30b	22.17a	19.23
45 kg nitrogen (N_3)	58.71a	7.32a	3.76a	36.97a	4.20a	13.67a	2.73a	17.60b	19.20

Dual-interaction between nitrogen doses and cropping patterns exhibited significant differences in all studied traits (Table 3). The highest seed yield/fed. (3.65 ard.) was obtained from monocrop chickpea (I_1) fertilized with the highest N dose (N_3) as a result of positive effect of superior plant height (60.70 cm) number of branches (4.27 br.) number of pods (39.4 p) seed index (13.67 g) and seed weight /plant (4.85 g). However, intercropped chickpea (I_2) fertilized with 30 kg N/fed. (N_2) showed harvest index superior to that of I_1N_3 interaction. The highest position of the first branch (8.45 cm) was obtained by I_2N_3 with insignificant difference from that of I_1N_2, indicating that the trait was less affected by intercropping and N fertilization. This I_1N_2 interaction surpassed other combinations for seed protein content, revealing again non-response of protein to high nitrogen fertilization. It was observed that, under any N fertilization rate, intercropping decreased numbers of branches and pods/ plant and resulted in inferior seed yield per both plant and feddan. Intercropped chickpea fertilized with 45 kg N/fed. (N_3) that ranked as the best yielding among the intercropping combinations, Fig. (2) produced seed yield/fed (1.80 ard.) reached about half (49.32%) of sole chickpea (3.65 ard.) in addition to its acceptable number of pods, seed weight/plant and seed index. These results indicating that N_3 was adequate for barley/chickpea intercropping.

Table (3): Effect of intercropping systems and nitrogen level interactions on yield and yield components of chickpea (combined data over two seasons).

Traits / Treatment	Plant height (cm)	Height to 1st branch (cm)	No. of branches /plant	No. of pods/ Plant	Weight of Seeds /plant (g)	Seed Index (g)	Seed yield /Fed. (Ardab)	Harvesting index	Protein percentage
I_1N_1	54.17d	5.77cd	2.70e	26.10d	3.12f	12.27b	2.81c	17.24c	19.19ab
I_1N_2	57.20b	8.17a	3.68b	30.95c	3.77b	13.48a	2.95b	20.11b	19.37a
I_1N_3	60.70a	6.18bc	4.27a	39.40a	4.85a	13.67a	3.65a	17.47c	19.26ab
I_2N_1	55.87c	5.10d	2.70e	19.43f	3.37d	13.53a	1.22f	14.19d	18.99c
I_2N_2	56.40bc	6.70b	2.90d	22.83e	3.27e	13.58a	1.64e	24.23a	19.08bc
I_2N_3	56.72bc	8.45a	3.25c	34.53b	3.55c	13.67a	1.80d	17.72c	19.14bc

b) Lupin:

Compared with monocrop culture (I_1), intercropping Lupin with barley (I_2) led to significant increases Lupin plant height (78.29 cm) and height to the first branch (42.13 cm) due to severe competition on light (Table 4).

Intercropped Lupin had also greatest number of branches (2.78 br.) as well as heaviest seed index (47.11 g), but with inferior seed weight/ plant (5.81g). The later trait (7.57 g/plant) and consequently the highest seed yield/fed. (4.79 ard.) was obtained from soled Lupin fig. (1). The early establishment of symbiotic N_2-fixation of legume support a high growth rate during early stages is among important features of intercropping **(Hauggaard-Nielsen and Jensen, 2001)**, but seed yield is dependent upon the assimilates accumulation during seed filling period **(Thorsted, *et al*, 2006).** In addition to seed yield/fed., I_1 (42.94%) surpassed I_2 (42.66%) treatment for protein content. The legume component has typically suffured competition from the cereal, producing lower yields in the intercropping than sole cropping and one documented effect of adding nitrogen had been a further depression in yield because of greater competition from increased cereal growth **(Ofori and Stern, 1987 and Siame, *et al*., 1998),** in addition, Lupin had less flexible response to intercropping **(Carruthers, *et al*, 2000)**. It is worth to note that seed yield/fed. of intercropped Lupin (2.22 ard.) did not reach half (46.35%) of its sole cropping (4.79 ard.), indicating the preponderance of intercropping chickpea (which produced about half of its sole yield) over Lupin with barley. **Hauggaard-Nietsen and Jensen, 2001)** found that intercropped pea seed production was reduced to less than half compared to sole pea due to competitive interaction.

Table (4): Effect of intercropping systems on seed yield and yield components of lupin (combined data over two seasons).

Traits / Level treatment	Plant height (cm)	Height to 1st branch (cm)	No. of branches /plant	No. of pods/ Plant	Weight of seeds/ plant (g)	Seed Index (g)	Seed yield /Fed. (Ardab)*	Harvesting Index	Protein percentage
Solid lupin (I_1)	74.30b	40.88b	2.70b	4.75	7.57b	45.36b	4.79a	24.16b	42.94a
Barley : lupin 2 : 2 (I_2)	78.29a	42.13a	2.78a	4.64	5.81a	47.11a	2.22b	28.31a	42.66b

***Ardab = 150 Kg**

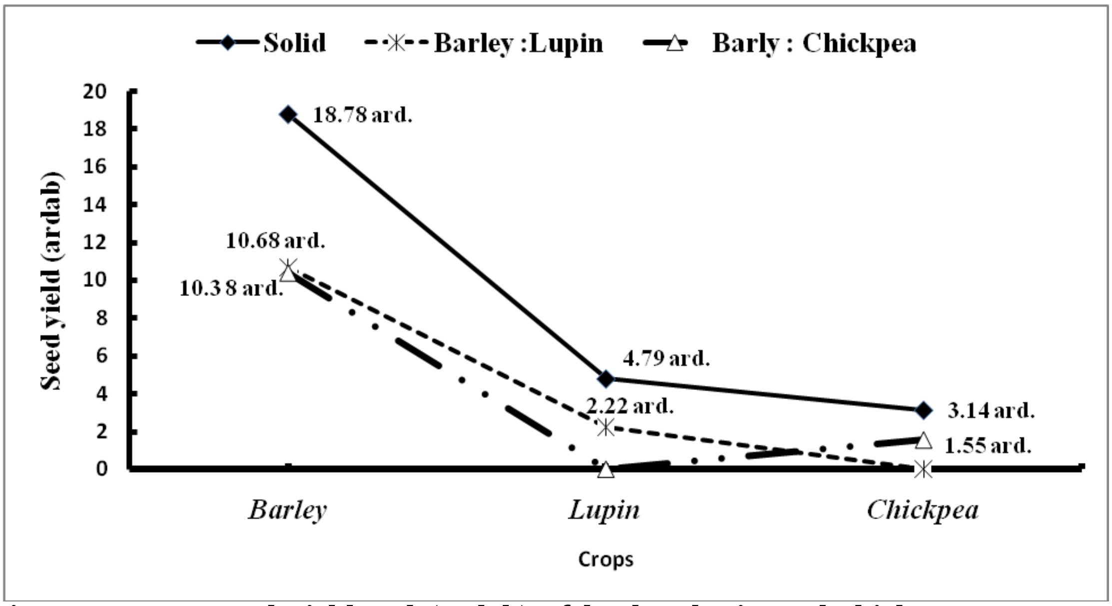

Fig. 1. Average seed yield/Fed (ardab) of barley, lupin and chickpea as affected by different intercropping system over two seasons.

As shown in Table (5), all the studied Lupin traits, except seed protein content, were significantly affected by nitrogen fertilization rates. Application of 45 kg N/fed (N_3) gave the highest means of all traits except number of branches/plant, seed weight/plant and seed index. These three exception traits were superior when 30 kg N/fed (N_2) was applied. As shown above in chickpea, the protein content of Lupin seeds did not affect by increasing nitrogen dose due to its independence open N_2-fixing and /or low N application **(Deria, *et al*, 2003 and Lopez- Bellido *et al*, 2004).** These results revealed the adequacy of N_3 fertilization for Lupin, where it produced acceptable seed yield (4.06 ard./fed) due to its superior number of pods and harvest index, with improved quality (42.95% protein). **Ghaley, *et al*, (2005)** reported that N_2-fixing ability enabled legume to grow well with the help of N dose.

Table (5): Effect of nitrogen levels on seed yield and yield components of lupin (combined data over two seasons).

Traits / Level treatment	Plant height (cm)	Height to 1st branches (cm)	No. of branch /plant	No. of pods/ Plant	Weight of seeds/plant (g)	Seed Index (g)	Seed yield /Fed. (Ardab)	Harvesting Index	Protein percentage
15 kg nitrogen (N1)	70.50c	40.97b	2.49c	4.20c	5.01c	44.51c	2.67c	24.76b	42.89
30 kg nitrogen (N2)	74.90b	40.20b	3.06a	4.45b	7.81a	48.54a	3.80b	24.70b	42.56
45 kg nitrogen (N_3)	83.50a	43.35a	2.67b	5.44a	7.27b	45.66b	4.06a	29.26a	42.95

Interaction between cropping patterns and nitrogen fertilizer rates showed significant differences among different combinations for all studied traits (Table 6). Sole lupin (I_1) when fertilized with 45 kg N/fed (N_3) was superior for number of pods/plant (5.77 p) and seed yield/fed (5.88 ard.) Fig. (2) with highest protein content (43.30%) indicating the importance of pods number as effective contributor to seed yield. However, sole Lupin fertilized with 30 kg N/fed (N_2) resulted in the heaviest weight of seeds/plant (9.16 g). Barley/ Lupin intercropping fertilized with N_2 was superior for number of branches/plant and seed index. The tallest plants with highest position of the first branch and largest harvest index were obtained from intercropped Lupin fertilized with the highest N dose (I_2N_3). The data showed that I_2N_2 produced seed yield/fed (2.71 ard.) lesser than half (46.09%) of that of I_1N_3 combination (5.88 ard), revealing that Lupin was greatly negatively influenced by intercropping with barley, compared to chickpea under the same N dose.

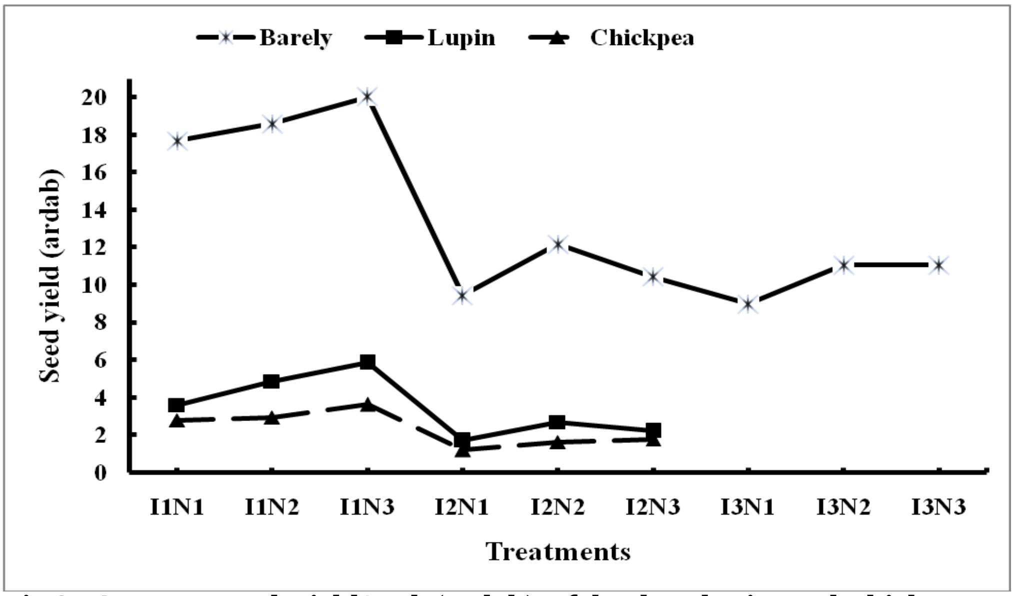

Fig.2. Average seed yield/Fed (ardab) of barley, lupin and chickpea as affected by different treatments (intercropping and nitrogen levels interactions) over two seasons

Table (6): Effect of intercropping systems and nitrogen level interactions on yield and yield components of lupin (combined data over two seasons).

Traits / Level treatment	Plant height (cm)	Height to 1st branch (cm)	No. of branches /plant	No. of pods/ Plant	Weight of seeds/plant (g)	Seed Index (g)	Seed yield /Fed. (Ardab)	Harvesting Index	Protein percentage
I_1N_1	68.07d	40.67b	2.57cd	3.90e	5.12e	46.75b	3.61c	22.30d	42.87ab
I_1N_2	73.77c	40.6b	2.82b	4.57c	9.16a	44.10d	4.89b	23.52d	42.64b
I_1N_3	81.07b	41.37b	2.7bc	5.77a	8.43b	45.23c	5.88a	26.66c	43.30a
I_2N_1	72.92c	41.27b	2.4d	4.5cd	4.89e	42.27e	1.72f	27.21b	42.9ab
I_2N_2	76.03c	39.8b	3.3a	4.33d	6.45c	52.97a	2.71d	25.87c	42.47b
I_2N_3	85.93a	45.33a	2.63bc	5.10b	6.10d	46.08bc	2.24e	31.86a	42.60b

C) Barley:

Data listed in Table (7) show that cropping patterns significantly affected all barley traits except seed and harvest indices. The two exception traits may be attributed to decreased assimilates accumulation during grain filling (**Weiner, 2004 and Thorsted *et al*, 2006).** Grain yield of the intercropped barley either with chickpea (10.38) or lupin (10.68 ard) was more than half (55% and 57%, respectively) of that of monoculture barley (18.78ard), indicating that barley yield was affected by intercropping but with different magnitude owing to chickpea or Lupin fig. (1). In addition to grain yield, the effect of the two legumes was significantly different on grain weight/barley plant, where Lupin effect was better than that of chickpea. Intercropping winter wheat and clover resulted in wheat grain yield decrease of 10-25 % compared with sole wheat crop. The yield reduction was likely caused by interspecific competition for light during vegetative growth and for soil water deficit during grain filling (**Thorsted, *et al*, 2006**). However, **Hauggaard-Nielsen and Jensen, (2001)** reported that barley was stronger competitor in the intercrop and, as a result, its intercropped grain yield was similar to its sole cropping. The two tested legumes showed insignificant differences for barley plant height, number of grains/spike, number of spikes/m^2.

Table(7): Effect of intercropping systems on yield components of barley (combined data over two seasons).

Traits / Treatments	Plant height (cm)	No. of grains /spike	Weight of grains / spike	No. of spikes/ m^2	Seed Index (g)	grain Yield /Fad. (ardab)*	Harvesting Index
Solid barley (I_1)	97.10a	54.11a	3.18ab	258.56a	5.74	18.78a	25.79a
Barley : Lupin(2:2) (I_2)	96.31b	52.16b	3.22a	255.00b	5.65	10.68b	27.31a
Barley:Chickpea(2:2) (I_3)	96.60ab	52.67b	3.14b	256.78b	5.70	10.38c	26.11a

***Ardab = 120 Kg**

Nitrogen fertilizer rates had significant effect on all barley traits without exception (Table 8). The highest dose (N_3) increased plant height (98.98 cm) and number of grains/spike (57.53 g). As previously reported, barley is much more competitive for soil mineral N than pea **(Jensen, 1996)** most likely as a consequences of the foster and deeper root growth of barley **(Bellestas, *et al*, 2003)** in addition to that high level of N application increased barley growth at early stage **(Torsted, *et al*, 2006).** The highest values of grain weight/plant (3.29 g), number of spickes/m^2 (265.67 sp.) were showed with N_3 fertilization, while seed index (5.77 g) and grain yield /fed (13.96 ard) were produced by application of the intermediate N dose (N_2) similar to that of N_3 (5.73 g) and (13.85 ard) for the respective two traits, reflecting the importance of spike number/m^2 and seed index as effectual yield components, and affirmed that N_2 dose was enough for barley fertilization to produce improved yield. It interesting to note that intercropped barley responded to nitrogen fertilization at the both rate of N_2 and N_3 without significant differences, due to the positive effect of legume on barley productivity in such newly reclaimed soil, and from economic point of view the N_2 dose is preferable.

Table (8): Effect of nitrogen levels on yield components of barley (combined data over two seasons).

Traits / Treatments	Plant height (cm)	No. of grains /spike	Weight of grains / spike	No. of spikes/m^2	Seed Index (g)	grain Yield /Fad. (ardab)	Harvesting Index
15 kg nitrogen (N1)	95.14b	46.92c	3.01b	240.11b	5.59b	12.04b	24.13c
30 kg nitrogen (N2)	95.90b	54.50b	3.25a	264.56a	5.77a	13.96a	27.98a
45 kg nitrogen (N_3)	98.98a	57.53a	3.29a	265.67a	5.73a	13.85a	27.10b

Dual-interaction results, i.e., sole barley (I_1) with N, barley/ Lupin (I_2) with N, and barley/chickpea with N, are presented in Table (9). Soled barley (I_1) plants were the tallest when fertilized with 30 (N_2) or 45 (N_3) kg N/fed. The later combination (I_1N_3) had greatest number of spikes/m^2 (280.67 sp.), seed index (5.80g), grain yield/fed (20.05ard.) and comparable plant height with that of I_1N_2 interaction.

Table (9): Effect of intercropping systems and nitrogen levels interactions on seed yield and seed yield components of barley (combined data for two seasons).

Traits / Treatments	Plant height (cm)	No. of grains /spike	Weight of grains / spike	No. of spikes/m^2	Seed Index (g)	grain Yield /Fad. (ardab)	Harvesting Index
I_1N_1	91.47f	49.42e	3.02de	242.33e	5.78a	17.68b	24.29e
I_1N_2	100.13a	55.17c	3.43b	252.67d	5.65b	18.61b	26.13d
I_1N_3	99.7a	57.75b	3.10d	280.67a	5.8a	20.05a	26.95bc
I_2N_1	95.52c	41.33f	3.04de	236.33f	5.47d	9.44e	26.27cd
I_2N_2	94.38d	54.83c	3.09b	275.67b	5.85a	12.18c	28.96a
I_2N_3	99.03ab	60.33a	3.53a	253.00d	5.62bc	10.43d	26.71cd
I_3N_1	98.43cb	50.00e	2.96e	241.67e	5.52cd	8.99f	21.84f
I_3N_2	93.18e	53.5d	3.23c	265.33c	5.82a	11.08d	28.85a
I_3N_3	98.2b	54.50c	3.24c	263.33c	5.77a	11.06d	27.65b

Barley/Lupin (I_2) fertilized with 30 kg N/fed (I_2N_2 combination) showed the highest values of seed index (5.85 g) and harvest index (28.96) similar to those exhibited by barley / chickpea (I_3) fertilized with the same N dose (I_3N_2) indicating similar effect of both legumes on the two traits. Barley/ Lupin (I_2) fertilized with N_3 (I_2N_3 combination) had plant height insignificantly different from the tallest one (produced by I_1N_2), in addition the greatest number of grain/spike (60.33g) and heaviest weight of grain /spike (3.53 g). It is obvious that barley traits in intercropping with chickpea were inferior to those when intercropped with Lupin, except seed and harvest indices produced by I_3N_2 which were insignificantly different from those of I_2N_2, and seed index given by I_3N_3 that was of comparable value to that of I_2N_2. It is worth to note that, under cropping patterns with N_2 fertilizer the second yielding combinations were barley/chickpea (12.18 ard) and then barley/lupin (11.08 ard) which represented 61% and 55% of yield of soled barley fertilized with N_3. These results indicating that chickpea was of better effect than lupin on barley yielding ability and fertilization with nitrogen dose (N_2) was quite enough for intercropping.

D) Land equivalent ratio (LER):

Based LERs calculated for the three tested crops Fig. (3) it was observed that lupin in all intercropping x N combinations, except with N_3, was greater competitive than chickpea, revealing different response of the two legumes to intercropping with barley. Both legume crops had higher LER values than those of barley under any N level, reflecting their stronger competitive than barley. This may be attributed to their N_2-fixing ability as well as to the response of barley to nitrogen application up to only N_2. Consequently, the legume crops seemed to be dominant while barley appeared to be dominated. **Tosti and Guiducce (2010)** reported that legume tended to be dominant and exerted a high competitive effect towards wheat which was not capable of a suitable competitive response. The total LERs were ranged from 0.94 for barley/chickpea with N_1 and barley/Lupin with N_3 to 1.21 for barley/Lupin with N_2. The later combination is preferable where it caused 21% increase in production/ unit area during one season of intercropping, followed by that of barley/chickpea with N_2 that caused 15% increase in production.

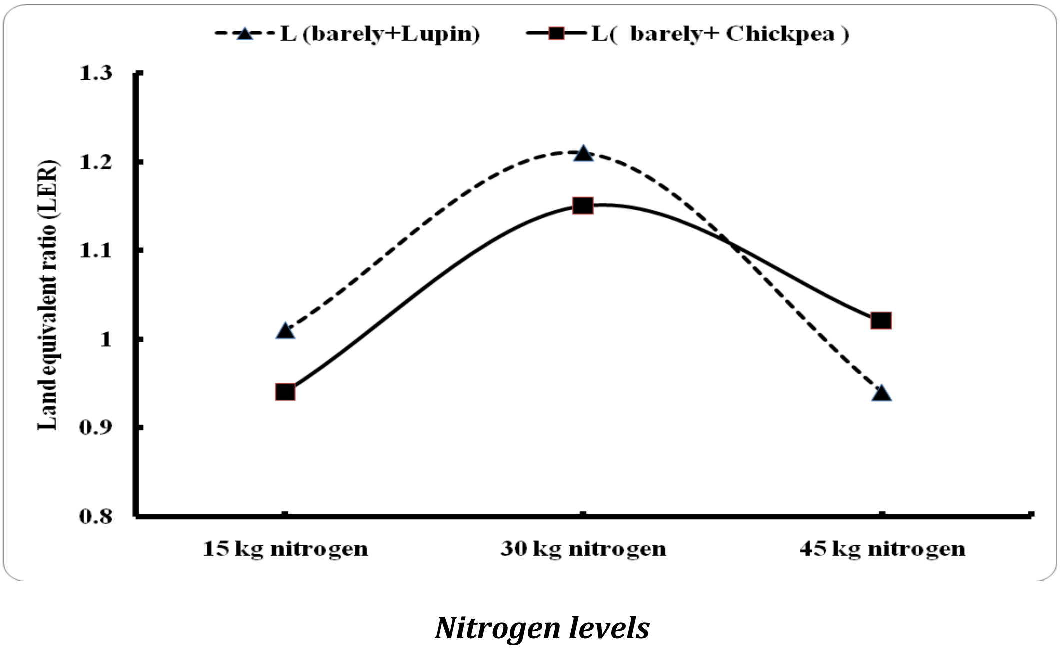

Fig.3. Land equivalent ratio (LER) in barley–chickpea and barley–lupin intercropping system

In sum, the above mentioned results revealed that 30 kg N/fed. (N_2) is considered as adequate for producing improved barley yield under the conditions of the experimented newly reclaimed soil. Also with N_2 barley/chickpea and barley/Lupin yielded 49% chickpea together with 61% barley with LER of 1.15 as well as 46% Lupin together with 55% barley with LER 1.21, respectively, compared with sole culture of each crop. These two intercropping-N_2 combinations increased the total production by 15% and 21%, respectively.

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تأثير التسميد النيتروجيني علي المحصول ومكوناتة للزراعة المنفردة اوالمحملة للشعير والترمس والحمص في الاراضي حديثة الاستصلاح

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أجريت تجربتان حقليتان على محاصيل الشعير والترمس والحمص فى أرض مستصلحة حديثا بمزرعة كلية الزراعة - جامعة الفيوم - خلال موسمي الزراعة ٢٠٠٦/٢٠٠٧، ٢٠٠٧/٢٠٠٨ لدراسة تأثير التسميد النيتروجينى بمعدلات (١٥، ٣٠، ٤٥ كجم نيتروجين/فدان) على نمو هذه المحاصيل منفردة او عند تحميل الشعير مع الترمس او الشعير مع الحمص بنظام التحميل (٢ : ٢) فى تصميم القطع المنشقه مرة واحدة ووزعت المعاملات عشوائيا فى ثلاث مكررات، واحتلت الزراعة المنفردة والمحملة القطع الرئيسية ومعدلات التسميد النيتروجينى القطع المنشقة الاولى. واظهرت النتائج ما يلــي:

* عند مقارنة الزراعة المنفردة بالمحملة للحمص مع الشعير كانت صفات المحصول والجودة معنوية واظهر التحميل قيم عالية لدليل البذرة.
* ادى التسميد بمعدل ٤٥ كجم نيتروجين/فدان زيادة وتحسين فى النمو ادت لزيادة المحصول. بينما لوحظ نفس التأثير من الجرعة الثانية ٣٠ كجم نيتروجين/فدان على ارتفاع اول فرع ثمرى ودليل البذرة واعطت اعلى دليل حصاد.
* اعطت الزراعة المحملة للشعير مع الترمس زيادة فى صفات الطول بالاضافة لعدد الافرع ودليل البذرة ونتج اعلى وزن لبذور النبات ومحصول الفدان من الزراعة المنفردة للترمس.
* اظهر اضافة معدلات النيتروجين تفوق المعدل الثالث ٤٥ كجم نيتروجين/فدان فى زراعة الترمس بانتاج محصول مناسب للفدان مع تفوق فى عدد القرون ودليل الحصاد وفيما عدا دليل الحصاد تفوقت الزراعة المنفردة معنويا لكل صفات الشعير فاعطى الشعير المحمل اكثر من ٥٠% من محصول الفدان مقارن بالزراعة المنفردة.
* اظهر المعدل الثانى (٣٠ كجم نيتروجين/فدان) تحسين فى الانتاجية بدون اختلاف معنوى مع المعدل الثالث (٤٥ كجم نيتروجين/فدان).
* اتضح ان التحميل باستخدام ٣٠ كجم نيتروجين/ للفدان أعطى الشعير المحمل مع الحمص ١٢.١٨ أردب للفدان والشعير المحمل على الترمس ١١.٠٨ أردب بنسب ٦١، ٥٥% مقارنة بالزراعة المنفردة مع الجرعة الثالثة ٤٥ كجم نيتروجين/فدان.

وبهذا تشير النتائج الى ان تأثير الحمص افضل من تأثير الترمس على الشعير مع اضافة الجرعة المتوسطة من النتروجين ٣٠ كجم نيتروجين/للفدان. وفى النهاية يتضح من النتائج السابقة ان الجرعة المتوسطة تكفى لانتاج محصول من الشعير تحت ظروف الاراضى المستصلحة حديثاً. ايضا المعدل ٣٠ كجم نيتروجين/فدان اعطى الشعير مع الحمص او مع الترمس ٤٩% حمص مع ٦١% شعير بمكافئ ارضى ١,١٥ و ٤٦% ترمس مع ٥٥% شعير بمكافئ ارضى١,٢١% مقارنة بالزراعة المنفردة لكل منهم. وهذا يعني ان التحميل مع الجرعة الثانية ادى لزيادة الانتاجية بنسبة ١٥% و ٢١% تدريجيا.