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EFFECT OF INTERCROPPING PATTERNS ON YIELD AND ITS COMPONENTS OF BARLEY, LUPIN OR CHICKPEA GROWN IN NEWLY RECLAIMED SOIL.

Megawer, Ekram A.; A.N. Sharaan; A.M. EL-Sherif
Agron. Dept. , Fac. Agric. , Fayoum University

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ABSTRACT

During the two successive seasons of 2008/09 and 2009/10, at the experimental Farm, Faculty of Agriculture. Fayoum University, the present work was executed in sand loamy poor fertile soil .The work aim was to answer the question what the extent to which the productivity of barley, lupin and chickpea influenced by their intercropping, with the hope of raising the development of such soil. The experiment was designed through split plot arrangement in a randomized complete block with three replications. The main plots were assigned for three crops and sub plot were devoted for cropping systems, i.e., sole crop, barley/chickpea or lupin in 1:1, 2:1 and 2:2 intercropping. The obtained results showed that all barley, lupin and chickpea traits were significantly affected by intercropping patterns. Barley spikes/m2 as well as spike grains number and weight were affected by legumes species. Solid planting of each crop surpassed all intercropping patterns for almost all studied traits. The tallest lupin plant with the highest position of the first branch were obtained from 1:1 intercrop patterns, due to interspecific competition on light. All intercropping patterns resulted in harvest indices surpassed that of sole lupin planting. However, solid lupin was superior to intercrop patterns for numbers of branches and pods in addition to seed weight/plant and seed yield/feddan. But, barley /lupin of 2:2 was the best among all intercropping patterns, where it produced 93 and 60% of solid lupin seed weight/plant and yield/fed., respectively. Superiority of solid chickpea traits reflected it's more influencing by intercropping than lupin, due to greater competition of barley. Likewise lupin, the 2:2 pattern was the best combination, where it produced 95 and 50% of soled chickpea seed weight/plant and yield/fed., respectively. The greatest and heaviest barley grains/spike were obtained from barley/chickpea, while the greatest number of spikes/m2 were produced by barley/lupin, due to different legumes growth habit. Heaviest seed and harvest indices were given by 2:2 patterns. All intercropping patterns showed similar barley harvest indices surpassing that of solid planting. The combination 2:1 barley/chickpea or lupin had heaviest weight of grains/spike (103% of sole) and acceptable yield/fed (83% of solid barley). Under this combination (2:1) barley yield/fed. produced by barley/lupin followed by barley/chickpea were presented by 84 and 75%, respectively, of solid barley yield. Also under this combination pattern, the lupin and chickpea yields reached 40 and 29%, respectively, of their solid cropping. Land equivalent ratio, competitive ratio, relative crowding coefficient and aggressively results revealed that barley was stronger competitive than legumes, lupin was more competitive than chickpea, and barley was dominant and each legume crop was dominated.

INTRODUCTION

In developing countries, as in Egypt, the agricultural development is facing by several constraints concerned with limitation of soil, water and inputs, associated with continuous growth population, resulting in reduced production per capita. In addition, the farmers are frequently followed easy and old practices such as the relay sowing of crops, exhausting more land area, water and inputs. Moreover, this practice is commonly used for the principle crops which occupied most of the available old land area in Nile Valley, while other crops, of secondary importance, such as barley, lupin and chickpea are restricted in small areas (**Bult. of Agric Econ. 2008**). An alternative procedure to mitigate the effect of these constrains and to increase the acreage and production of such secondary crops is intercropped them particularly in the newly reclaimed soils. Cereal/legume intercropping system may be increase soil fertility via raising its organic content and available nitrogen fixed by legume (**Singh *et al,* 1986**), saves water and inputs requirements, reduces costly inputs and insure agricultural sustainability. It is an old and widespread practice in the low input system based on the manipulation of plant interaction to maximize their growth and productivity in addition to yearly yield stability allowing more consistent yields (**Willey, 1979**). Thereby, **Ofori and Stern** (**1987**) suggested that cereal/legume intercrop is among the most frequently used and most productive compared to monocropping, and is recognized as suitable cropping system in the developing countries especially under poor resources. They also concluded that the temporate cereal/legume intercrops is acknowledged for present and future agricultural potential. **Banik *et al* (2000)** reported that under the fragile and whimsical nature weather and degraded soil configuration offer little opportunities for stable agricultural production, monocropping can not ensure stability of production.

Several research works indicated the particular importance of plant density and planting pattern upon intercrop viability. Many studies have shown that intercrop components might utilize different edaphic and climatic growth resources more efficiently potentially supporting a great number of plants which may result in more optimum plant density than those of sole crops (**Willey and Osiru, 1972; Willey, 1979 and Ofori and Stern, 1987**). The interspecific competition, as explained early by **Goldenberg and Warner (1983)** is depend on two actions, e.g. the competitive effect and the competitive response, both intercropped species exercise these two actions on each other, and the outcome of the competition (e.g. which of them is dominant and which is dominated) is generated by the results of such interaction. As reported by **Willey (1990)** the component crops probably have differing spatial and temporal use of environmental resources. These differences affect the amount of competition between component crops that result in change in the productivity levels.

Compared with corresponding sole crops, yield advantages have been recorded in many C4 cereal/legume intercropping systems, including maize/soybean **(Metwally, 1978 and Mohamed and Nigem, 1988 and Ghaffarzaach, *et al*, 1994**), maize/faba bean (**Li, *et al*, 1999**) and sorghum/soybean (**Elmore and Jakobs, 1986 and Ghosh, *et al*, 2009**). But little and recent research works have been done using C3 cereals instead of C4 ones, for intercropping with legume and got similar yield advantages, including, wheat/field bean (**Haymes and Lee, 1999**) barley/pea (**Hauggraard–Nielsen and Jensen, 2001**), barley/faba bean (**Trydemonkundsen, *et al*, 2004**) and wheat/chickpea (**Banik, *et al*, 2006**). However among the available literature there are no intercropping researches done on the newly reclaimed poorly fertile soil.

Therefore, the present trial was designed to study the effect of different intercropping patterns of barley with either lupin or chickpea on yield and its components of each, under the conditions of newly reclaimed soil, with the hope of raising the use efficiency and development of this soil throw intercropping.

MATERIALS AND METHODS

In newly reclaimed low fertile soil at the experimental Farm of the Faculty of Agriculture, Fayoum University, a field trial was worked out during 2008 /09 and 2009 /10 winter seasons. The intended aim of this work was to study the effect of intercropping of barley with either chickpea or lupin on yield and its components of their sole and intercropped culture. Other lateral aims were in the consideration concerned with increasing the use efficiency and development of the newly reclaimed soil through intercropping of barley with legumes as crops of secondary importance.

The soil of the experimental sites, as average of the two seasons, was sand loamy in texture with pH of 7.81 and contained 10.54% CaCo3, 0.79% organic matter and 16.05ppm total nitrogen. In each season, the field was well prepared, where it ploughed twice, harrowed, ridged and then divided into plots of 3.0*3.6 m. Each plot included 6 ridges, 3m long and 60cm apart. During field preparation, 15kg P2O5 as single calcium superphosphate and 48kg K2O as potassium sulphate/feddan were added. The tested treatments were three crop species, i.e., barley (*Hordeum vulgare* L.) var. Giza126, chickpea (*Cicer arietinum* L.) var. Giza 195 and lupin (*lupinus terms* L.) var. Giza1, and four cropping systems, i.e., sole, barley/chickpea or lupin in 1:1, 2:1 and 2:2 intercropping. These twelve treatments were distributed in split plot arrangement in a randomized complete block design with three replicates. The three crops were allocated in the main plots, while the sub plots were assigned for cropping patterns. Sowing dates were Nov. 5 and 12 in the first and second seasons, respectively. Barley seed were drilled within three rows/ridge. Chickpea and lupin were seeded within the two ridge sides in hills (two seeds/hill) spaced by 10cm for chickpea and 25cm for lupin. Nitrogen fertilization the rate of 30kg N/fed. in the form of ammonium nitrate was applied, where this dose was previously considered as suitable for these crops in such soil (**Megawer, 2010**). Nitrogen fertilizer was spitted into two halves, one of each half was added before the first and the second irrigation. The other agricultural practices were done as recommendation.

At harvesting, five guarded/plants were randomly chosen to determine the plant averages of legumes; plant height (cm), height to first branch (cm), number of branches, number of pods, weight of seeds (g) seed index (g) and harvest index. The studied barley traits were plant height (cm), number of grains/spike, weight of grains/spike (g), number of spikes/m2, seed index (g) and harvest index. Seed yield/fed. (ardab) was also calculated on plot basis for the three crops.

Land equivalent ratio was calculated as follows (**Willey, 1979**):

LER = (LERa + LERb) = {(Yab/Yaa) + (Yba/Ybb)}

Where LERa and LERb are the partial LER of crop barley and chickpea (or lupin), respectively.

Competitive ratio was calculated by following the formula as advocated by **Willey and Rao (1980):**

CR = CRa + CRb, CRa = {(LERa/LERb) × (Zba/Zab)},

where CRa is the competitive ratio for intercrop barley.

Relative crowding coefficient (K) was calculated following the formula (**DeWit, 1960**):

$$K = Kab \times Kba = \left[\frac{(Yab \times Zba)}{\{(Yaa - Yab) \times Zab\}}\right] \times \left[\frac{(Yab \times Zba)}{\{(Ybb - Yba) \times Zba\}}\right],$$

Where Kab and Kba are relative crowding coefficient for barley and chickpea (or lupin) intercrop, respectively.

Aggressivity (Yab) was calculated (**McGilchrist, 1965**) as:

$$Yab = \left[\frac{Yab}{\{Yaa \times Zab\}}\right] - \left[\frac{Yba}{\{Ybb \times Zba\}}\right],$$

Where Yab is the aggressivity of intercrop barley.

Yab representing the yield of intercrop a (barley) in combination with b(chickpea or lupin),Yba the yield of intercrop b (chickpea or lupin) in combination with a (barley). Zab representing the sown proportion of intercrop a (barley) in combination with b (chickpea or lupin) and Zba representing the sown proportion of intercrop b (chickpea or lupin) in combination with a (barley).

All the obtained data were subjected to analysis of variance and combined analysis (where the variance of the two seasons were homogenous) and the differences among means were determined by Duncan multiple tests, according to **Gomez and Gomz (1984**).

RESULTS AND DISCUSSION

a) Lupin

Due to the effect of intercropping patterns, all the lapin studied traits exhibited significant difference (Table1). Monocrop lupin for numbers of branches (3.0) and pods (5.0) and consequently for seed weight/plant (9.91g) and seed yield/fed (4.99). These results reflected that lupin was greatly influenced by intercropping. An indication on this effect provided by the results of 1:1 influenced by intercropping pattern were it resulted in the tallest plant (82.07) with the highest position of the first branch (44.43cm) as a direct effect of interspecific competition particularly on light. Under this pattern, lupin was underwent shading of barley canopy and exhausted most energy in elongation. Another indication of this effect of intercropping was derived from harvest index result, where all intercropping patterns had similar values (35.58-36.39) surpassed that of solid lupin (24.23), indicating that intercropped lupin consumed more assimilates during vegetative growth and less during grains filling period. These results are in agreement with those early reposted by **Jensen (1998), Carruthers, *at al* (2000), Li, *et al* (2002), Banikl, *et al* (2006) and Shehata, *et al* (2009)**. It seemed to be that barley/lupin of (2:2) ratio was the best among the three intercrop combinations where it produced the heaviest seed index (50.43g) and number of branches (2.97) similar to that of solid lupin, in addition to it was ranked as the second treatment with improved most traits. The advantage of this combination (2:2) clearly exerted in its seed weight/plant (9.18 g) and seed yield/fed (2.98 ard.) which represented 93% and 60% respectively, of solid lupin. This may be due to the complementarily effect occurred under this intercropping pattern. In this concern, **Walker and Ogindo (2003)** reported that intercropping system has higher leaf area than the sole crop of both maize and bean. Therefore, the soil surface is shaded and the canopy is more dense resulting in a lower soil surface evaporation. Thus, there is a complementary use of water recourses by both species in the intercropping systems. The results recorded herein showed that 2:1 followed by 1:1combinations were not in favour to lupin crop

Table (1): Effects of intercropping system, on seed yield and yield components of lupin (combined data over two seasons).

Traits / Treatments	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
Barley: Lupin 1:1 (I_1)	82.07a	44.43a	2.73b	4.27bc	8.95c	45.37c	2.39c	35.58a
Barley: Lupin 2:1 (I_2)	76.73b	43.03b	2.60b	4.10c	7.33d	41.93d	1.99d	36.39a
Barley: Lupin 2:2 (I_3)	76.53b	41.92b	2.97a	4.43b	9.18b	50.43a	2.98b	36.14a
Solid lupin (I_4)	77.93ab	40.43c	3.00a	5.00a	9.91a	48.30b	4.99a	24.53b

*Ardab = 150 Kg

b) Chickpea

Data in Table (2) show that the cropping patterns significantly affected all chickpea traits without exception. Solid planting of chickpea resulted in the tallest plant (37.95cm) bearing the greatest numbers of branches (3.67) and pods (30.97), the heaviest seed index (14.38g) and consequently the highest seed weight/plant (3.83g) and seed yield/fed. (3.12ard).These results clearly reflected the great influence of intercropping on chickpea owing to its weakness competition to barley on edaphic and climatic resources. Greater competition ability of barley when intercropped with pea **(Huaggaard-Nielsen and Jensen, 2001)** and of wheat when intercropped with chickpea **(Banik, *et al* 2006)** may be attributed to that cereals take up nutrients, especially N, mainly during the vegetative growth stage and associated vigorous growth may cause shading of the legume and thereby reduce its growth during later growth stages resulting in low yielding ability. The intercropping pattern of 1:1 showed only the highest position of the first branch, due to strong competition. It is interesting to note that the barley/chickpea intercropping pattern of 2:2 ratio was the best combination for all trails, in addition to taller fruiting zone, where it produced seed yield/plant of 3.64g and seed yield /fed of 1.57 ard., which represented 95% and 50%, respectively, compared to solid chickpea. However, 2:1 intercropping pattern was the worst for all traits due to dense shading.

From the lupin and chickpea above mentioned results, it could be concluded that, soled planting of each crop surpassed their intercropping with barley for almost all studied traits, the 2:2 intercropping pattern was the best combination for both legumes, and under this combination lupin was better yielding than chickpea due to stronger competition of lupin to barley than chickpea

Table(2): Effects of intercropping system, on seed yield and yield components of chickpea (combined data over two seasons).

Traits / Treatments	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
Barley: chickpea 1:1 (I_1)	56.58 b	10.80a	2.70c	22.22c	2.82c	12.40 c	1.38b	17.77c
Barley: chickpea 2:1 (I_2)	51.73 c	6.90c	2.90d	21.65c	2.64d	12.38 c	0.91c	16.30d
Barley: chickpea 2:2 (I_3)	56.83 b	6.88c	3.08b	24.83b	3.64b	13.20 b	1.57b	23.49a
Solid chickpea (I_4)	57.95 a	8.13b	3.67a	30.97a	3.83a	14.38 a	3.12a	21.14b

*Ardab = 150 Kg

c) Barley

Due to different legume crops, barley plant height, number of grains/spike and their weight as well as number of spikes/m2 showed significant difference (Table 3). The greatest number of grains/spike (53.1) and the heaviest weight of them (3.249) were obtained from barley intercropped with chickpea, while the greatest number of spikes/m2 was produced by barley intercropped with lupin. This may be ascribed to shorter height of chickpea plants than those of lupin, which gave barley a relevant conditions to grow well and increased its ability to accumulate more assimilates during grain filling period when intercropped with chickpea. However, when barley intercropped with lupin, the interspecific competition was higher and most of barley assimilates were exhausted in developing growth and reproductive organs like spikes, irrespective of source-sink capacity. These results are in line with those previously reported by **Carruthers, *et al* (2000), Li, *et al* (2002), Walker and Oingo, (2003) and Banik *et al* (2006)**. Seed index, seed yield/fed, and harvest index did not show any significant differences due to legume crop effect.

All of the studied traits exhibited significant differences as effect of different cropping patterns (Table3). Soled barley produced the highest values of plant height (99.9cm), number of grains/spike (54.48), number of spikes/m^2 (281.67) and seed yield/fed (18.12 ard.). Higher monocropped barley or wheat relative to their intercropping with legumes was currently deleted by several authors **(Haymes and Lee, 1999; Li, *et al* 2002; Walker and Ogindo, 2003 and Banik, *et al* 2006). Whereas, Midya, *et al* (2005)** found that intercropped wheat was higher yielding than its monocropped culture because intercropping exploited resources more efficient. However, the heaviest seed index (5.98g) and the highest harvest index (28.20) were obtained from 2:2 combinations. The superiority of these two traits under this combination may be attributed to advantage exploitation of resource or to the legume effect on nutrition of barley or to facilitate interaction in this intercropping pattern. These interpretations support those reported by **Midya, *et al* (2005) and Banik, *et al* (2006)**. Like the above case of lupin, all intercropping patterns showed similar barley harvest index values (27.77-28.20) surpassed that of soled barley (23.96) duo to facilitated interaction and the effect of legume and barley nutrition, particularly during grain filling period. In this concern, **Funkai and Trenbath (1993)** stated that harvest index indicates the amount of biomass allocated to grains, thus providing an indication of the plant ability to partition resources between vegetative and reproductive structure. **Carruthers, *et al* (2000)** suggested that harvest index of all crop components were seldom affected and added that resource partitioning is only affected by the intercropping when competition is severe. It is surprising to detect that the barley/legume of 2:1 combination produced the heaviest weight of gains/spike (3.48g) surpassing that of soled barley, in addition to acceptable seed yield/fed. (15.12ard.). These two traits represented 103 and 83% of those of soled barley. Thereby, 2:1 combination was the best intercropping pattern for barley production.

Table (3): Effects of crops, intercropping systems and its interactions on yield and 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 /Fed. (ardab)*	Harvesting index
Crops							
Lupin (C1)	94.88	52.32b	3.11b	271.25a	5.69	14.01	26.74
Chickpea (C2)	95.99	53.10a	3.24a	255.25b	5.70	13.69	27.20
Intercropping							
1:1 (I_1)	93.77	51.18c	2.87d	252.50c	5.42c	10.64d	27.77a
2:1 (I_2)	97.43	53.42b	3.48a	269.83b	5.72b	15.12b	27.95a
2:2 (I_3)	90.64	51.75c	2.99c	249.00d	5.98a	11.52c	28.20a
Solid barley (I_4)	99.90	54.48a	3.37b	281.67a	5.66b	18.12a	23.96b
Crop x Intercropping Interaction							
barley : lupin (1:1)	98.20	53.50c	3.01de	242.33f	5.37c	9.55f	25.74e
barley : lupin (2:1)	95.97	50.10d	3.23c	294.00a	5.68abc	15.92c	28.41b
barley : lupin (2:2)	93.30	50.17d	2.96e	253.00e	5.93abc	11.53e	26.81cd
barley:	89.33f	48.87e	2.73f	262.67d	5.47bc	11.74e	29.81a
barley:	98.88	56.73a	3.72a	245.67f	5.75ab	14.31d	27.48c
barley: chickpea	87.98	53.33c	3.03de	245.00f	6.03a	11.51e	29.60a
Solid barley	92.05	55.50b	3.25c	295.67b	5.77ab	19.05a	26.00de

*Ardab = 120 Kg

In regard to crop x intercropping interaction (Table 3), it was observed that the tallest barley plant was obtained from barley/chickpea of 2:1 ratio (98.88cm) without significant difference from that of barley/lupine of 1:1 ratio (98.20cm). Barley/chickpea of 2:1 ratio showed also the highest position of the first branch (56.73cm) with improved fruiting zone length and heaviest weight of grains/spike (3.72g), as well as improved seed index (5.75g) comparable to the highest one of barley/chickpea of 2:2 ratio. These results confirmed the above mentioned results. However, barley/chickpea of 1:1 was superior for only harvest index. Solid barley produced the greatest seed yield/fed (19.05ard) surpassing all intercropping patterns. But barley seed yield/fed produce by barley/lupin of 2:1 (15.92ard) following by that of barley/chickpea of same ratio (14.31ard) were represented by 84 and 75% of soled barley yield, indicating the adequacy of 2:1 combination for barley production in intercropping with these legumes, particularly with lupin. Under this combination, the lupin and chickpea yields reached 40 and 29%, respectively, of their solid cropping.

d) Competition relations:

Land equivalent ratio (LER) values calculated for barley under any intercropping pattern were higher than those of legume, indicating the stronger competition of barley compared to legume. LERs of barley/lupin (0.836) and barley/chickpea (0.832) of the same ratio (2:1) were the highest, confirmed the above mentioned results concerned with reliability of 2:1 ratio for intercropped barley. The total LERs were in the range of 1.235 for barley /Lupin of 2:1 ratio to 1.125 and 1.124 for barley/chickpea of 1:1 and 2:1 respectively, reflecting again the adequacy of 2:1 combination, and indicating that intercropping, can be increased the total productivity by 24 to 13% compared with sole planting of each crop. Also, 2:2 barley/chickpea pattern showed LER value of 1.17. It was observed that all intercropping patterns, except 1:1 barley/lupin due to severe competition, resulted in LERs more than one indicating yield advantage over monocrop due to better land utilization (Fig.1). These results are in harmony with those of **Haymes and Lee (1999), Banike, *et al* (2006) and Shahata, *et al*.(2009).**

Competitive Ratio (CR) showed that barley was more competitive to chickpea than to lupin. The highest value (8.557) of barley/chickpea followed by that of barley/lupin (6.287) were obtained under the same intercropping pattern of 2:1 ratio, reflecting the stronger competitive effect of barley than legume and lesser competitive ability of chickpea than lupin (Fig.2).

Relative crowding coefficients (K) revealed again the superiority of 2:1 pattern of intercropping barley with either lupin or chickpea, followed by those of 2:2 one. While barley/legume of 1:1 ratio resulted in the lowest value (Fig.3). This was attributed to effectual competition of barley, were its K coefficients were very high to those of legumes.

Aggressivily of intercrop barley on legumes was pronounced especially under 2:1 intercropping pattern of barley with lupin and 1:1 pattern of barley/chickpea. The aggressivity values of barely were positive, were as those of legumes were negative, revealing the prevailing effect of barley. Finally, all competition relations indicated that barley was dominant and legumes were dominated (Fig.4).

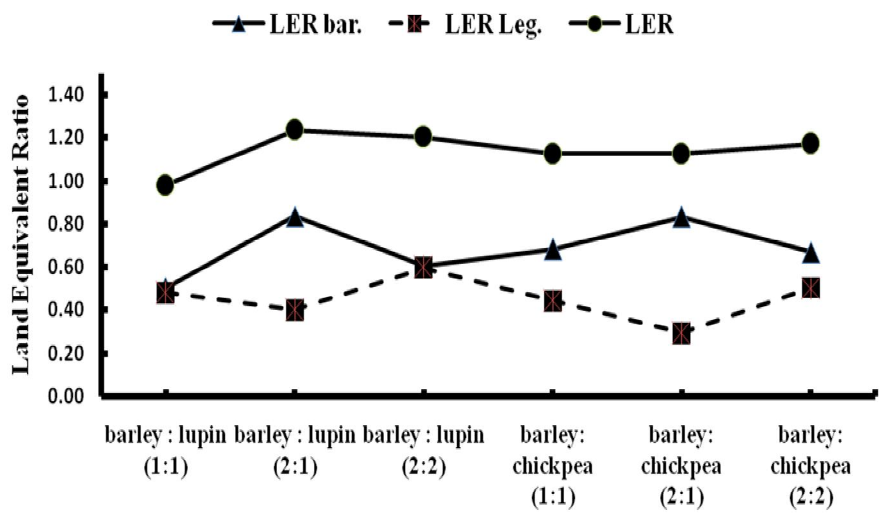

Fig1. Land equivalent ratio (LER) in barley–chickpea and barley–lupin intercropping pattern.

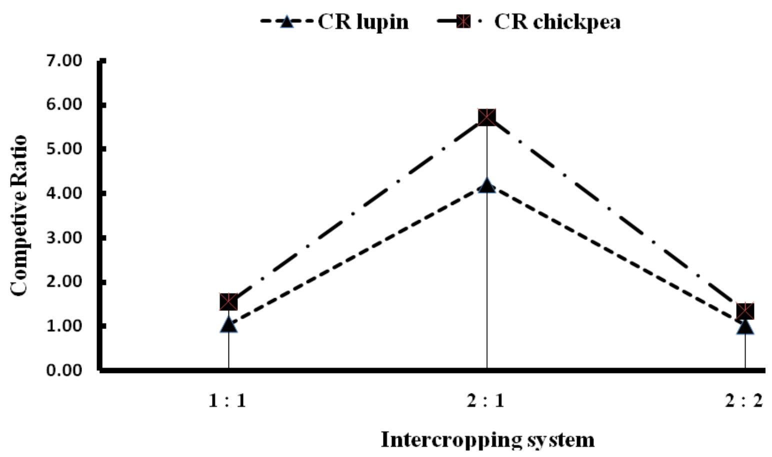

Fig2. Competitive ratios (CR) in barley–chickpea and barley–lupin intercropping pattern.

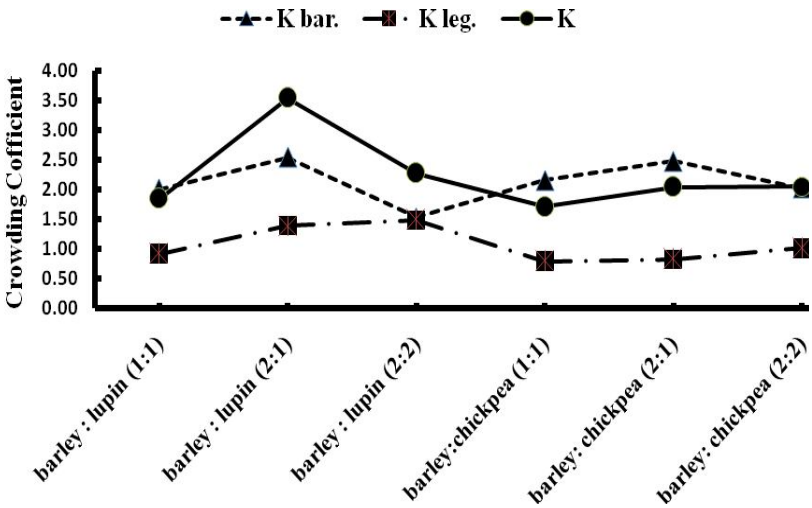

Fig3. Relative crowding coefficient (K) in barley–chickpea and barley–lupin intercropping pattern.

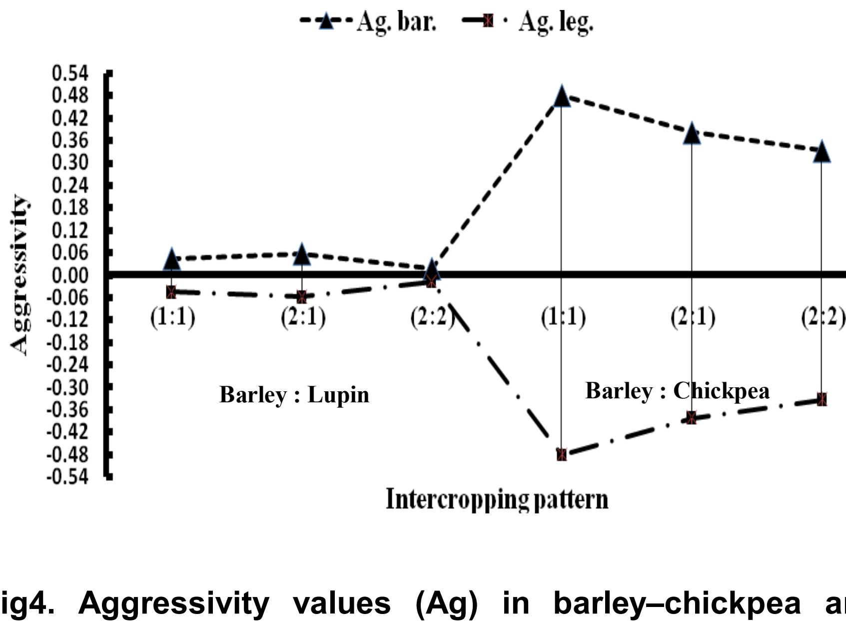

Fig4. Aggressivity values (Ag) in barley–chickpea and barley–lupin intercropping pattern.

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تأثير أنماط التحميل علي المحصول ومكوناتة للشعير المحمل علي الترمس او الحمص

إكرام علي مجاور ، عبد العزيز شرعان ، احمد محمد الشريف
قسم المحاصيل- كلية الزراعة – جامعة الفيوم

أجريت هذه الدراسه بمزرعة كلية الزراعه جامعة الفيوم خلال موسمي ٢٠٠٩/٢٠٠٨، ٢٠١٠/٢٠٠٩ فى ارض رمليه طميية حديثة الاستصلاح لدراسة تأثر انتاجية كلامن الشعير والترمس والحمص بتحميلهم بنظم مختلفه٠وكان التصميم المستخدم القطع المنشقه مره واحده ووزعت المعاملات عشوائيا فى ثلاث مكررات ووضعت المحاصيل الثلاثه فى القطعه الرئيسيه ونظم التحميل (الزراعه المنفرده والشعير المحمل على الترمس او على الحمص بنظم١:١، ٢:١، ٢:٢) فى القطع المنشقه ودلت النتائج على الآتى:

- تأثرت المحاصيل الثلاثه معنويا بنظم التحميل.
- عدد سنابل الشعير بالمتر المربع، وعدد ووزن حبوب السنبله تأثرت بنوع المحصول البقولى.
- الزراعه المنفرده لأى من المحاصيل الثلاثه فاق كل نظم التحميل فى غالبية الصفات ٠
- نتج من التحميل بنسبة ١:١ اطول نباتات ترمس بأعلى ارتفاع لاول فرع نتيجة اشتداد المنافسه على الضوء ٠

- كل نظم التحميل نتج عنها قيم لدليل الحصاد فاقت تلك الناتجه من الزراعه المنفرده بينما تميز الترمس المنفرد على المحمل فى عدد الافرع والقرون ومحصول النبات والفدان ٠
- الا ان التحميل بنسبة ٢:٢ أعتبر هو افضل نظم التحميل حيث نتج عنه محصول نبات ومحصول فدان يمثل ٩٣، ٦٠%على التوالى من كلاهما للترمس المنفرد٠
- تميزت صفات الزراعه المنفرده للحمص ودلت على أنه اكثر تأثرا بنظم التحميل مقارنه بالترمس كنتيجه لاختلافهما فى طبيعة وحجم النمو ٠
- وكما فى الترمس، وجد ان التحميل للشعير مع الحمص بنسبة٢:٢هو أفضل نظم التحميل حيث نتج عنه محصول نبات ومحصول فدان يمثل ٩٥، ٥٠% على التوالى من كلاهما للحمص المنفرد٠
- أكبر عدد وأعلى وزن لبذور سنبلة الشعير نتجت من الشعير المحمل بالحمص ،بينما أكبر عدد من السنابل/م٢ قد نتج من الشعير المحمل بالترمس كأثر لاختلاف المحصولين البقوليين ٠
- نظام التحميل بنسبة ٢:٢ نتج عنه أعلى دليل بذره ودليل حصاد٠
- أظهرت كل نظم التحميل قيما متماثله لدليل الحصاد فاق تلك الخاص بالشعير المنفرد٠
- نظام تحميل الشعير مع الترمس (أو الحمص) بنسبة ١:٢ نتج عنه أعلى وزن حبوب بالسنبله (١٠٣% مقارنة بالمنفرد) مع محصول الفدان (يمثل٨٣%مفارنة بالمنفرد)٠
- تحت هذا النظام (١:٢): محصول الفدان من الشعير عندما حمل على الترمس أو على الحمص بلغ ٨٤، ٧٥ % على التوالى مقارنه بمحصول الشعير المنفرد٠ وتحت هذا النظام ايضا: محصول الفدان من الترمس ومن الحمص بلغ ٤٠، ٢٩%على التوالى من زراعتهما منفردين.
- دلت قياسات التنافس غلى شدة منافسة الشعير لكلا المحصولين البقوليين، وكان الترمس اكثر مقاومه عن الحمص لهذه المنافسه، وكان الشعير سائد والمحصول البقولي مسود علية٠