EFFECT OF INTERCROPPING, WEED CONTROL TREATMENT AND THEIR INTERACTIONS ON YIELD AND ITS ATTRIBUTES OF CHICKPEA AND CANOLA

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ABSTRACT

During 1999/2000 and 2000/2001 seasons, in newly reclaimed sandy soil at the Experimental Farm of the Faculty of Agriculture at Fayoum, two field experiments were conducted to study the effect of intercropping of chickpea with canola coupled with weed control treatments on yield and its components of the two crops. Four planting patterns, i.e., intercropping chickpea : canola in 3:1 and 1:1 systems besides monoculture of each crop were applied. Five weed control methods, i.e., hoeing, butralin at 1.5, 2.5 and 3.5 L/fad besides unweeded were practiced. Randomized complete block design with three replicates was used. The plot size was 16.8 m^2 included 8 ridges, 3.5 m long and 60 cm apart. Sowing was done on Nov. 10 and 8 in the first and second season, respectively.

Data of fresh weight of annual weeds showed as expected that hoeing was more effective for eradication of broadleaf weed compared with butralin in almost all cases, but the reverse was true for narrow-leaf weeds. Canola in sole planting caused marked reduction in the weight of the total weeds. Butralin at 3.5 L/fad in the first weed sample (60 days after sowing) or at 2.5 and 3.5 L/fad in the second sample (90 days after sowing) were significantly depressed weed growth.

Regarding chickpea, the data revealed that intercropping chickpea : canola in 3:1 and 1:1 systems had equal effects and surpassed that of pure stand for plant height, 100-seed weight and seed protein (%). Pure stand and intercropping 3:1 system clearly increased those of 1:1 intercropping for number of pods and seed weight/plant, biological and seed yields/fad of chickpea. Butralin at 2.5 and 3.5 L/fad showed similar effects on seed weight/plant and seed yield/fed, but 3.5 L/fad was better for 100-seed weight, biological yield and protein (%), while 1.5 L/fad was more effective for plant height and 2.5 L/fad for branches and pods/plant. Chemical treatments were better than hoeing for branches and seed weight /plant and seed yield /fad, whereas unweeded treatment showed the lowest values for all characters. The greatest seed yield/fad was produced from butralin at 2.5 L/fad x pure stand chickpea interaction.

Concerning canola, the two intercropping patterns were better than pure stand for all characters except biological and seed yields/fad whereas the pure stand gave the highest values for both characters. Intercropping of 3:1 surpassed 1:1 system for seed weight/plant, whereas the reverse was observed for pods/plant, and both patterns had similar effects on plant height and seed oil (%). The effect of butralin at 3.5 L/fad increased that of 2.5 L/fad for seed weight/plant, 500- seed weight and seed yields/fad, and both were of similar effect on plant height, branches /plant and biological yield/fad. Chemical treatments were better than hoeing for all characters except seed oil (%). Hoeing surpassed unweeded treatment for seed weight/plant, 500-seed weight and seed yield/fad. The highest seed yield/fad was produced by butralin at 3.5 L/fad x canola sole interaction. The data indicated that the best LER was obtained from 3:1 system and the canola was dominant while chickpea was dominated component.

Key Ward: Chickpea, Canola, Intercropping, Weed control, interaction, seed yield and yield components, protein & oil .

INTRODUCTION

Canola (*Brassica napus* L.) as a new oil-crop in Egypt has an advantage after its success for winter cultivation since two decades (Sharaan, 1987), is still not included in the crop rotation applied within the Nile-Valley. On the other side, the cultivated area of chickpea (*Cicer arietinum* L.) as an important food legume, become limited in last years 14834 fad (Anonymous, 2003). This may be ascribed to their lower monitory return than other winter crops such as wheat, faba bean, clover, etc.

Newly reclaimed land in marginal areas allocated at different regions outside Nile-Valley may be the suitable place for planting such two crops, for increasing our sources of oil and protein in addition to accelerate the developing rate of this land. Both crops could be tolerate its harsh conditions, where chickpea is well adapted to warm and semi–arid climate (Shiv Raj, 1985) and canola was drought tolerant and yielded well in newly reclaimed soil (Sharaan *et al*., 2002).

Intercropping as one of the most applicable farming system in many developing countries for crop diversification and enhancing the land unit area benefit, is preferable for growing these two crops. In this regard, Panwar *et al*. (1987) reported that growing of Indian mustard as an intercrop in chickpea is a common practice. Other intercropping systems of chickpea with sorghum (Hilli and Kalkarni, 1988), with wheat, safflower or linseed (Autkar *et al*., 1991) and with mustard, safflower, or linseed (Bhatnagar *et al*., 1991).

Chickpea and canola, however, are poor competitors with weeds especially at early growth stages. Slow growth rate during the seedling stage, in addition to a relatively sparse optimal plant population (such as under intercropping), causes an open and small crop canopy and increases the chance for growth weed which cause most crop yield damage, and consequently requires season-long weed management. Mechanical and chemical weed control were applied by several investigators. Hand–weeding effect was equal to those of some herbicides for controling weeds (Hilli and Kalkarni, 1988) especially if done early (Balyan *et al*., 1989). The reduction in crop seed yield was different depending upon the accompanied weed spp. (Paradkar *et al*., 1997). Chemical weed control efficiency was varied according to the applied herbicides (Singh and Singh, 1997; Bhalla *et al*., 1998 and Kantar *et al*., 1999). Schoafs and Entz (2000) described intercropping as an accepted option for integrated weed management particularly in farming systems with low external inputs.

The present investigation may be one of the preliminary studies concerned with intercropping chickpea and canola, as an attempt to find a chance for incorporation them in the local cultivation in order to increase the sources of edible oil and protein essential for our increasing demand. Therefore, some intercropping patterns of chickpea and canola coupled with some chemical and mechanical weed control treatments were investigated.

MATERIALS AND METHODS

Two field experiments were conducted in 1999/2000 and 2000/2001 seasons at “Demo” Experimental Farm, Faculty of Agriculture at Fayoum, in newly reclaimed sand soil under flood irrigation system. In each experiment, the treatments comprised from the combinations between two intercropping patterns beside solid planting and five weed control treatments were used to study their effects on seed yield and yield attributes of chickpea (Giza 88 cv.) and canola genotype (H2 line). The canola genotype is a promising selected line originated from “Canola 104 x Hanna” cross, and handled by bulk selection for seven generations (Sharaan and Ghallab, 2002).

The four planting patterns used were (1) planting one ridge of chickpea (grown on both sides) in alternation with one ridge of canola (grown on one side) i.e. 1:1

intercropping system. This provides 100% total population (50% component population for each crop). (2) planting three ridges of chickpea (each grown on both sides) in alternation with one ridge of canola (grown on one side) i.e. 3:1 intercropping system. This provides 100% total population (75% component population of chickpea and 25% component population of canola). (3) solid planting of chickpea (each ridge grown on both sides), and (4) solid planting of canola (each ridge grown on one side). Meantime, the two component crops were intercropped using the same ridges and within ridge spacing as in their respective sole systems i.e., 10 x 60 cm for chickpea and 10 x 60 cm in canola case. The five weed control treatments were: Butralin (Amex 48% EC) at 1.5, 2.5 and 3.5 liter /faddan, hand hoeing twice in addition to unweeded (control) treatment. Butralin (Amex 48% EC, 4-(1,1- dimethylethyl) -N- (1-methylpropyl) - 2,6 - dinitrobenzenamine) treatments were used as pre-emergence application (immediately before sowing irrigation). Hoeing was done at 35 and 65 days plant ages.

The combination treatments were arranged in a randomized complete block design with three replications. Experimental plot size was 16.8 m^2 (8 ridges, 3.5 m long and 60 cm apart). Chickpea and canola were planted on November 8 and 10, in the first and second season, respectively. Other cultural practices for growing the two crops were followed as recommended. During growing season, annual weeds were handly pulled from 1 m^2 from middle of each plot twice at 60 and 90 days after sowing. The weeds associated with the two crops, in the two seasons, were; *Beta vulgaris* L., *Ammi majus* L., *Chenopodium murale* L., *Sonchus oleraceus* L., *Euphorbia peplus* L., *Avena fatua* L., *Setaria Viridis* L. and *Lolium temulentum* L. fresh weights of broad and narrow leaf weeds were determined at the two ages.

At harvest time, which done for the crops at the same time, ten guarded plants were randomly chosen from the inner ridges of each crop in each plot to determine the average of plant characters, i.e., plant height (cm), number of branches, number of pods and seed weight/plant (g) and seed index (g). Biological yield (above ground biomass yield, t/fad) and seed yield (Kg/fad) were calculated on the plot bases as follows:

$$\text{Yield/fad of ch.} = \text{Yield/ridge of ch. x no. of ridges of ch./plot x } \frac{4200\,m^2}{\text{plot area } m^2}$$

$$\text{Yield/fad of ca.} = \text{Yield/ridge of ca. x no. of ridges of ca./plot x } \frac{4200\,m^2}{\text{plot area } m^2}$$

Seed protein content (%) in chickpea and seed canola oil content (%) were estimated as an average of two seed samples randomly taken from each plot yield. Analysis of variance and LSD values were done according to Gomez and Gomez (1984).

Competitive relationships and land use efficiency were expressed by calculation of land equivalent ratio (LER) following the equation of De Wit and Den bergh (1965) and aggressivity (A) following the equation of Mc Gilchrist (1965), using the data of seed yield /faddan of the two crops.

LER = $L_{ch} + L_{ca}$, where

L_{ch} = L chickpea = intercrop yield of chickpea / its pure stand yield

L_{ca} = L canola = intercrop yield of canola / its pure stand yield, and

$A_{ch} = [Y_{ch\ ca} / (Y_{ch} \times Z_{ch\ ca})] – [Y_{ca\ ch} / (Y_{ca} \times Z_{ca\ ch})]$

$A_{ca} = [Y_{ca\ ch} / (Y_{ca} \times Z_{ca\ ch})] – [Y_{ch\ ca} / (Y_{ch} \times Z_{ch\ ca})]$

where

Y_{ch} = pure stand yield of chickpea., Y_{ca} = pure stand yield of canola, $Y_{ch\ ca}$ = intercropped yield of chickpea (in combination with canola), $Y_{ca\ ch}$ = intercropped yield of canola (in combination with chickpea), $Z_{ch\ ca}$ = sown proportion of chickpea cropped with canola, $Z_{ca\ ch}$ = sown proportion of canola cropped with chickpea.

RESULTS AND DISCUSSIONS

Weeds :

The data presented in Table 1 show that the fresh weights of grass weeds were higher than those of broadleaf weeds associated with all intercropping patterns in the two samples, indicating the greater aggressivity of the grasses especially with advanced plant ages of the two crops. In this concern Paradkar *et al*., (1997) who graded the weeds according its damaging effects on crop growth and yield in the order of ; *Cichorium intybus* (53.5-60.7%), *Phalaris minor* (37.7 – 69.1%) , *Vicia sativa* (9.7-30.0%) and *Chenopodium album* (17.8 – 27.4% yield reduction).

It was noticed that hoeing treatment was more effective for eradication of broadleaf weeds compared with butralin in all cases except monoculture chickpea and 3:1 intercropping in the first sample. Effectiveness of mechanical weeding was early reported by Bhalla *et al*., (1998) who obtained the greatest weed control efficiency under hand weeding once followed by pre-emergence application of herbicides. On the other hand, the reverse was true for narrow-leaf weeds where butralin treatments showed more effective weed control compared with hoeing treatment.

Data in Table 1 reveal that, in the two vegetative samples, canola sole planting caused significant reduction in fresh weight of the total weeds followed by intercropping chickpea with canola in 1:1 system. In regard to chemical treatments, it was found on average that application of butralin at the rate of 3.5 L/fad significantly depressed weed growth compared with other weed control treatments and caused 82.47% reduction in fresh weight of the total weeds until 60 days of crop age. While in the second sample, butralin at the rates of 2.5 and 3.5 L/fad (without significant differences) were effective treatments against the total weeds, where it caused 72.91 and 76.10% reduction, respectively. These findings indicated that 2.5 L/fad of butralin may be satisfied for the total weed control. On the average of almost all cases, butralin at the three used rates had higher weed control percentages for the total weeds in both samples, than hoeing and unweeded treatments. Concerning the interaction between intercropping and weed control methods, the lowest value (34.68 g/m^2) of fresh weight of the total weeds was obtained from canola monoculture x butralin at the rate of 3.5 L/fad treatment in the first sample. The corresponding value (193.18 g/m^2) in the second sample was obtained from the interaction between intercropping chickpea with canola (in 1:1 system) with butralin at the rate of 3.5 L/fad.

Chickpea characters :

The data presented in Table 2 show that all of the studied characters were significantly affected by intercropping patterns, weed control treatments and their interaction, except number of branches/plant which was insignificantly influenced by intercropping.

In regard to plant height, intercropping of chickpea with canola in 3:1 and 1:1 systems gave taller chickpea plants than its monoculture. This result may be due to the chickpea in the intercropping was suffered from canola competition on light and consequently its plants were taller than those of chickpea in pure stand. Chemical weed control by butralin at 1.5 and 2.5 L/fad tended to increase chickpea plant height more than that of 3.5 L/fad and hoeing treatments. The tallest plant (83.97cm) was produced from the interaction between intercropping of 3:1 system with butralin at 1.5 L/fad.

The greatest number of branches /plant was obtained from butralin at 2.5 L/fad which surpassed those of all other chemical and mechanical weeding control. Whereas, the untreated treatment showed the lowest number of branches. The effective interacting treatment gave the greatest branches number (4.2) was intercropping of 3: 1 system coupled with butralin at 2.5 L /fad.

Intercropping of 3:1 system as well as chickpea grown in pure stand gave similar number of pods/plant, whereas 1:1 intercropping produced the lowest pods number. Weeding control with butralin at 2.5 L/fad resulted in higher number of pods than both butralin at 3.5 L/fad and hoeing treatments, and all surpassed that of unweeded treatment. Dastgheib *et al*., (1995) and Skrobakova (1998) supported this result where they concluded that pre-emergence application of herbicides provided an effective level of weed control and improved yield components such as branches and pods. The interaction of butralin at 2.5 L/fad with chickpea monoculture gave the greatest number (23.13) of pods/plant.

Chickpea in pure stand and when intercropped with canola in 3:1 system produced the highest seed weight/plant, whereas 1:1 intercropping pattern gave the lowest value. Butralin at either 3.5 or 2.5 L/fad out yielded that of 1.5 L/fad, and all were of higher seed weights /plant than that of hoeing treatment, while the unweeded one gave the lowest weight. Singh and Singh (1997) obtained highest seed weight/plant from the high level of one (1.5 kg/ha Pendimethalin) out of three herbicides tested by them, while its low level (1.0 kg/ha) was of equal effect on weeds as that of hoeing, and all treatments were more effective compared with unweeded treatment. The interaction of butralin at 3.5 L/fad with monoculture chickpea resulted in the highest (4.52 g) seed weight/plant.

The heaviest 100-seed weight was produced by chickpea grown in pure stand followed by intercropping of 1:1 and 3:1 systems. Controlling weeds by butralin at 3.5 L/fad gave heavier weight of 100-seed than those of all other control weed methods, and all surpassed that of unweeded treatment. Butralin at 3.5 L/Fad x monoculture chickpea interaction gave the heaviest (22.3 g) weight of 100-seeds. These results are in line with those previously reported by Singh and Singh (1997).

Chickpea grown in pure stand as well as intercropping of chickpea and canola in 3:1 system produced biological yield /fad higher than that of 1:1 system. This character showed similar influence by weed control treatment as mentioned above for 100-seed weight. The greatest biological yield/fad (3.35 t) was produced by the interaction between butralin at 3.5 L/fad with monoculture chickpea. These results are in harmony with those obtained by Hilli and Kalkarni (1988), Verma *et al*. (1989) and Singh and Singh (1997).

Monoculture chickpea and intercropping of 3:1 system produced seed yield/fad surpassed that of 1:1 intercropping. This result was similar to the above observed corresponding ones for branches and seed weight/plant and biological yield/fad, indicating their dependence on each other, and also reflecting the weak competition of chickpea relative to that of canola. Seed yield/fad resulted from butralin at 2.5 L/fad (247.99 kg) and at 3.5 L/fad (242.38 kg) were higher than that of 1.5 L/fad (221.28 kg) and all surpassed that of hoeing (169.04 kg), whereas the unweeded treatment gave the lowest (144.17 kg) seed yield/fad. Interaction between butralin at 2.5 L/fad and pure stand chickpea resulted in the greatest (372.50 kg) seed yield/fad.

Concerning seed protein percentage, the two intercropping patterns (1:1 and 3:1) had higher percentages than that of pure stand. Butralin at 3.5 L/fad was significantly raised more than those of both 1.5 and 2.5 L/fad, and all showed higher percentages than those of hoeing and unweeded treatments. It is worth to note that in most of the aforementioned characters, the interaction between unweeded treatment and intercropping of 1:1 system produced the lowest values.

Canola characters :

Significant differences due to intercropping patterns, weed control methods and their interactions were detected for all studied canola characters, except few cases. Insignificant effects of intercropping on number of branches/plant and 500-seed weight as well as weed control treatment on number of branches were the exceptions (Table 3).

Plant height of both 3:1 and 1:1 cropping systems was taller than that of canola monoculture. This may be attributed to the presence of weeds with higher level in intercropping patterns than in pure stand (Table 1) and consequently the intercropped plants were under competition with weeds on light and resulted in taller plants than those of monoculture. Butralin at 2.5 and 3.5 L/fad gave the tallest plants, but 3.5 L/Fad showed plant height similar to that of 1.5 L/fad which had plant height equal to that of unweeded (control) treatment. Whereas, hoeing caused shortening in plant height. The interaction between 3:1 intercropping and butralin at 1.5 L/fad gave the tallest (158.75 cm) plant height. Branches/plant was affected only by weed control treatments, where butralin at 3.5 and 2.5 L/fad produced the highest number of branches followed by that of 1.5 L/fad which had branches in similar number to that of hoeing treatment, and the latter did not differ from that of unweeded treatment.

Number of pods/plant of 1:1 cropping system was greater (by 7.5%) than that of 3:1 system one which had number higher (15.2%) than that of canola monoculture. It was observed that number of pods was gradually decreased by decreasing butralin quantity, where its number of 3.5 L/fad was higher by (22.9%) than that of 2.5 L/fad which had higher number (by 11.8%) than that of 1.5 L /fad. The latter surpassed (by 16.7%) hoeing treatment which had increased number (by 14.5%) compared with unweeded treatment. The interaction between 3.5 L/fad with 1:1 system intercropping resulted in the greatest (313.90) pods number.

In regard to seed weight /plant, intercropping of 3:1 system produced seed weight/plant higher (by 7.9%) than that of 1:1 ridge intercropping which increased that of canola monoculture by 21.2%. Similar results were obtained by Mehta *et al*., (1990) and Patel *et al*., (1991) who indicated that intercropping chickpea with mustard in 3:1 and 4:1 improved seed yield /plant compared with other row ratio intercropping or pure stand of mustard. Changing in the weed control treatments, from butralin at 3.5, 2.5 and 1.5 L/fad, hoeing to unweeded showed gradual decreases in seed weight/plant by 25.4, 12.5, 28.2 and 12.9 %. This trend was similar to that observed for number of pods, indicating their equal responses to herbicides and may be their association. The interaction between butralin at 3.5 L/fad and 1:1 system gave the heaviest (18.27 g) seed weight/plant.

Concerning the weight of 500-seeds, weed control treatment showed trend similar to that above observed for pods and seed weight /plant, indicating their dependence, where butralin at 3.5 L/fad gave the highest 500-seed weight followed by 2.5 and 1.5 L/fad, hoeing and unweeded with significant differences between each sequential pairs calculated as 6.8, 5.7, 13.3 and 10.9%. The interaction between butralin at 2.5 L/fad and 3:1 system intercropping produced the heaviest (2.06 g) weight of 500-seed.

Biological yield/fad produced by canola grown in pure stand was greater (by 46.3%) than that of 1:1 intercropping which outyielded that of 3:1 intercropping (by 65.7%). These results are in agreement with that reported by Patel *et al*., (1991) who obtained the highest biological yield from pure stand. Butralin at 3.5 L/fad produced higher (by 6.6%) than that of 2.5 L/fad which surpassed that of 1.5 L/fad (by 8.9%). The latter showed biological yield similar to that of hoeing treatment. The greatest biological yield (8.37 t) was produced by interaction between canola monoculture with 3.5 L butralin/fad.

Also, seed yield /fad produced by canola grown in pure stand was greater (by 87.0%) than that of 1:1 system which outyielded that of 3:1 system (by 76.6%). Intercropping chickpea with mustard in 3:1 or 4:1 row ratios were economically higher than their pure stands (Kumar and Singh, 1987; Mehta *et al*., 1990 and Autkar *et al*., 1991). However, Patel *et al*., (1991) obtained the highest yield from monoculture of mustard. Weed control treatment showed Weed control treatment showed trend similar to that above discussed for number of pods, seed weight /plant and 500-seed weight, indicating their positive interrelationships. Interaction of butralin at 3.5 L/fad with canola pure stand produced the heaviest (1106.5 kg) seed yield/fad.

Intercropping of 3:1 system and pure stand of canola showed similar seed oil percentages and both surpassed that of 1:1 system. Unweeded treatment gave oil percentage lower that those of all other weed control methods. Interaction between butralin at 3.5 L/fad and canola monoculture gave the highest (46.13%) oil percentage.

Competition relations:

Land equivalent ratio (LER) is the most frequently used index of biological advantage which place the component crops on a relative and directly comparable basis. It is defined as the relative land area that would be required for sole crops to produce the yields achieved in intercropping (Weil and McFadden, 1991). The data in Table 4 could be indicated that the LER (L_{ch} + L_{ca}) most suitable intercropping pattern was 3:1 system where it gave the highest value (1.05). This shows that the actual productivity was higher than the expected productivity when chickpea was intercropped with canola. Also, the highest value of LER was obtained by hoeing treatment under 3:1 intercropping system. In this concern, Batnagar *et al*., (1991) and Singh and Yadav (1992) obtained the highest LER from intercropping chickpea with mustared in 2:1 and 4:1 row ratio, respectively. Concerning aggressivity, the positive (A_{ca}) values for canola vs. the negative ones for chickpea indicated that canola was dominant and chickpea was dominated component, this was clearly in 1:1 vs. 3:1 systems. The higher value of aggresivity for chickpea and canola were obtained under 3:1 system with butralin 3.5 L/fad. followed by 2.5 L/fad.

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تأثير التحميل وطرق مقاومة الحشائش والتفاعل بينهما على المحصول ومكوناته للحمص والكانولا

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اجريت تجربتان حقليتان خلال موسمي ١٩٩٩/٢٠٠٠ ، ٢٠٠٠/٢٠٠١ في ارض رملية حديثة الاستزراع بمزرعة كلية الزراعة بالفيوم لدراسة تحميل محصول الحمص بمحصول الكانولا ومقاومة

الحشائش على المحصول ومكوناته للمحصولين المحملين . وقد طبق نظامين للتحميل هما: التحميل بنسبة ٣خطوط حمص إلى خط كانولا ، وخط واحد حمص إلى خط كانولا بالإضافة إلى زراعة كل من المحصولين منفردا كما استخدمت خمس معاملات لمقاومة الحشائش هى :العزيق ،وثلاث تركيزات من مبيد البيوترالين هى ١,٥، ٢,٥، ٣,٥ لتر للفدان بالاضافه إلى الكنترول (بدون معاملة). وكان التصميم المستخدم هو القطاعات الكاملة العشوائية في ثلاث مكررات وكانت أهم النتائج هي:

- اظهر الوزن الغض للحشائش الحولية أن معاملة العزيق كانت أكثر إبادة للحشائش العريضة الأوراق مقارنة بمعاملات المبيد في كل الحالات فيما عدا زراعة الحمص منفردا والتحميل بنظام ٣:١ ، بينما كانت النتيجة عكسية في حالة الحشائش ضيقة الأوراق. أدت زراعة الكانولا منفردة الي نقص واضح في وزن الحشائش الكلية. كما تأثر نمو الحشائش معنويا بالمبيد بعدل ٣,٥ لتر/فدان في العينة الأولي ، ٢,٥، ٣,٥ لتر/فدان بدون معنوية بالعينة الثانية مقارنة بالمعاملات الأخرى.
- اظهر تحميل الحمص بالكانولا بالنظامين ٣:١ ، ١:١ تأثيرا متساويا وتفوق علي الزراعة المنفردة في صفات ارتفاع النبات ، وزن ١٠٠ بذرة ، نسبة البروتين بالبذور كما أظهرت الزراعة المنفردة والتحميل بنظام ٣:١ زيادة واضحة علي التحميل بنظام ١:١ في صفات عدد القرون علي النبات ووزن بذور النبات، والمحصول البيولوجى ، ومحصول البذور للفدان وذلك بالنسبة لمحصول الحمص.
- أظهرت المعاملة بالمبيد بمعدل ٢,٥، ٣,٥ لتر/فدان تأثيرا متشابها علي محصول البذور للنبات ومحصول البذور للفدان كما تفوقت المعاملة بمعدل ٣,٥ لتر/فدان في وزن ال١٠٠ بذرة والمحصول البيولوجى والنسبة المئوية للبروتين بينما تفوق المعدل ١,٥ لتر/فدان في ارتفاع النبات والمعدل ٢,٥ لتر/فدان فى عدد الفروع والقرون علي النبات. أظهرت المعاملات الكيماوية تفوقا في عدد الفروع ومحصول البذرة للنبات ومحصول البذرة للفدان مقارنة بالعزيق ونتجت اقل قيم لكل الصفات من الكنترول. أعطت معاملة الحمص المنزرع منفردا مع المبيد بمعدل ٢,٥ لتر/فدان اعلي محصول بذرة للفدان.
- كما اظهر نظامي التحميل تفوقا في قيم جميع الصفات المدروسة علي محصول الكانولا مقارنة بزراعته منفردا فيما عدا صفتى المحصول البيولوجى ومحصول البذور/فدان حيث أعطت الزراعة المنفردة أعلي القيم لهاتين الصفتين. وتفوق التحميل بنظام ٣:١ علي نظام ١:١ في وزن بذور النبات بينما كان العكس صحيح بالنسبة لعدد قرون النبات واظهر نظامي التحميل تأثيرا متساويا علي ارتفاع النبات ونسبة الزيت في بذرة الكانولا.
- تفوقت المعاملة بالمبيد بمعدل ٣,٥ لتر/فدان علي ٢,٥ لتر/فدان في وزن بذور النبات ووزن ال٥٠٠ بذرة ومحصول البذور للفدان وتساوي تأثيرهما علي ارتفاع النبات، وعدد الفروع للنبات، والمحصول البيولوجى. وكانت المعاملات الكيماوية أفضل من العزيق في جميع الصفات فيما عدا نسبة الزيت في البذرة. أيضا تفوقت معاملة العزيق علي الكنترول في وزن بذور النبات ووزن ال٥٠٠ بذرة ومحصول البذرة للفدان.كما أعطي التفاعل بين المعاملة بالمبيد بمعدل ٣,٥ لتر/فدان والزراعة المنفردة اعلي محصول بذرة للفدان.
- أمكن الحصول علي اعلي مكافيء ارضي من التحميل بنظام ٣:١ وكان محصول الكانولا سائدا في النمو.