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بحث مشترك (فردى تخصصى) - مجلة علمية دولية متخصصة

تأثير نظام التحميل الزراعي على تعداد منً الفول الاسود *Aphis craccivora* Koch وانتاجية محصول الفول

الملخص

تقل أنتاجية محصول الفول البلدى نتيجة الاصابة بالعديد من الآفات الحشرية، مثل: منً الفول الاسود. فى هذا البحث أجريت تجارب ميدانية خلال موسمين زراعيين في محافظة سوهاج – مصر وذلك لتحديد تأثير تحميل نبات الفول البلدى مع الكزبرة أو الحلبة أو البصل على منً الفول الأسود وأنتاجية محصول الفول. أظهرت النتائج أنخفاض تعداد المنً معنوياً ($P < 0.05$) على نبات الفول المحمل مع نبات الحلبة وذلك فى الموسم الزراعي الأول وانخفاض تعداد المنً على نبات الفول المحمل مع نبات الحلبة أو الكزبرة في موسم الزراعة الثاني مقارنة بتحميل نبات الفول مع نبات البصل أو نبات الفول بدون تحميل. من ناحية أخرى، كانت القطع التجريبية المحتوية على نبات الفول المحمل مع كثافة خفيفة من الحلبة (٢.٥ جم/م^{٢}) أفضل من الناحية المحصولية لكمية البذور والمحصول البيولوجى الناتجة من نبات الفول. **أظهرت الدراسة أن تحميل نبات الفول البلدى مع نبات الحلبة أدى الى خفض تعداد حشرات المنً على نباتات الفول وزيادة محصول البذور والمحصول البيولوجى لنبات الفول البلدى.**

Effect of intercropping agroecosystem on the population of black legume aphid, *Aphis craccivora* Koch and yield of faba bean crop

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Abstract

Faba bean yield losses due to several insect pests, such as, *Aphis craccivora* Koch. Field trials were conducted during two cropping seasons at Sohag- Egypt, to determine the effect of intercropping of faba bean with coriander, fenugreek or onion crops on *A. craccivora* population and yield of faba bean. The population of the aphids were significantly (P>0.05) lower in faba bean + fenugreek intercrop in the first cropping season and lower in faba bean + fenugreek or coriander intercrop in the second cropping season than faba bean + onion or faba bean only crop. On the other hand, treatment of faba bean + fenugreek at light density was the best from an agronomic viewpoint for faba bean seed and biological yields. **The result of the study showed that faba bean + fenugreek intercrop reduced populations of *A. craccivora* and increased the seed yield of faba bean crops.**

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Keywords: *Aphis craccivora*, faba bean, intercropping, population dynamic, yield

1. Introduction
The Faba bean (*Vicia faba* L.) is an important crop for the people in several regions of the world, including Egypt. One of the most important pests of this crop is the black legume aphid, *Aphis craccivora* Koch (Homoptera: Aphididae) [1]. It can cause heavy economic damage to faba bean both by feeding on leaves and by vectoring plant viruses [2]. Semiochemicals of companion crops can protect the crop from the insect pests. The semiochemicals produced by non-host plants deter the insect from its host crop [3]. However, one of the alternative approaches for control of this pest is to develop management systems using diversified agroecosystem. Intercropping is an ancient and traditional agronomic practice which can be explained as a system where two or more crop species are grown in the same field at the same time during a growing season [4-6]. This method is an important cultural practice in reducing pest problems in an agro ecosystem [7-9]. However, the benefits of using coriander, fenugreek or onion crops in an intercropping system for pest control have been studied. For example; faba bean and coriander were used for control of *A. craccivora* [10], faba bean and fenugreek were used for control of *Orobanche crenata* Forsk (Lamiales: Orobanchaceae) [11], mustard and onion were used for controlling the aphid, *Lipaphis erysimi* Kaltenbach (Homoptera: Aphididae) [12]. Therefore, this work was aimed to study the effects of intercropping of faba bean (*Vicia faba* L.) with light or dense densities of fenugreek (*Trigonella foenum-graceum*), coriander (*Coriandrum sativum* L.) or onion (*Allium ceba* L.) versus a pure stand of faba bean on population density of *A. craccivora*, biological yield and seed yield of faba been.

2. Material and Methods
2.1. Experimental design and field management
A 2-year field experiment was carried out in 2012/2013 and 2013/2014 seasons at Alkawthar Farm of Faculty of Agriculture, Sohag University, Egypt. The Farm top-soil (0 – 30 cm) was sandy loam with pH 8.1 (1:2), having 8000 ppm N, 8 ppm P and 230 ppm K. The experimental area was divided into 8.4 m^2 subplots; each had 4 ridges, 3.5 m length and 0.6 m width. The experimental design was randomized complete block (R.C.B.) in a split plot arrangement with three replicates according to [13]. The main plots were assigned to intercropping treatments while the densities (light and dense) of intercropped crops were in the subplots. Seeds of cv. Improved Giza-3 faba bean were planted on 11 and 20 December in 2012 and 2013, respectively. Hills of 20 cm in between on both sides of each ridge were planted with three seeds each. Three weeks later seedlings were thinned to two plants per hill.

In the same day of seeding faba bean seeds of balady coriander, cv. Giza-30 fenugreek at a rate of 2.5 and 5 g/m^2 for light and dense population, respectively were drilled in 3 cm deep furrow on the top of each ridge, But seedlings of 50 days old of cv. Shandaweel-1 onion were transplanted with one seedling at 12.5 and 25 cm (for dense and light) in between on the top of each ridge. Irrigation and fertilisation were the same over all subplots as practiced at the Farm. Experimental plots were almost kept free from weeds by hand hoeing twice and pulling up except broom rape (*Orobanche crenata*) which negatively affected growth of faba bean plants in the first season, so we excluded the data of its dry matter and seed, and yield.

2.2. Assessment of aphid populations
Aphid populations of *A. craccivora* were investigated in all the plots during the two seasons. The number of aphids from 10 randomly plants of each plot was counted weekly until harvest.

2.3. Collection of agronomic parameters
At harvest, surrounded faba bean plants on 4 m^2 from each subplot were collected and kept in open air and sunny place for two weeks to measure faba bean biological and seed yields and harvest index.

2.4. Statistical analysis
The data collected from this work were subjected to analysis of variance followed by Fisher's L.S.D. test. Significance level of 0.05 was used.

3. Results and Discussion
3.1. Effects of intercropping system on population of *Aphis craccivora*
The effects of intercropping system on population of *A. craccivora* are shown in Figure 1 and Table 1. The population dynamic of aphids in both seasons of observed were similar. In both 2013 and 2014, first aphids were registered in the end of December 2013 and beginning January 2014, respectively. The maximum number of aphids was reached in end of February and beginning of March in 2013 and 2014 seasons, respectively. On the other hand, the population dynamic of *A. craccivora* dramatically had two clearly peaks in the second year. A smaller peak was beginning in end of January with a drastic decline at the middle of February followed by a bigger second peak of abundance in beginning of March. During both seasons highest number of aphids per tiller was recorded in control plot as compared to treated plots (Figure 1 and Table 1). Intercropping significantly was reduced aphid population in the both cropping seasons. In the two seasons, the population being consistently lower in faba been + dense cv. Giza-30 fenugreek intercrop than other treatments. In the two seasons, Giza-30 fenugreek was the most effective treatment hence it supported lowest number of aphids (76.12±9.37 and 34.90±3.03) followed by Giza-30 fenugreek with light rate (89.39±0.94 and 44.62±1.46), coriander [(dense 103.23±4.92 and 45.92±3.54) light (104.43±2.75 and 47.44±5.19)] and onion [dense (126.44±4.06 and 55.67±4.92) and light (122.44±4.54 and 59.26±14.15)]. However aphid populations between the two rates (dense and light) in the two seasons were not significantly different from each other. The present study showed that intercropping faba beans planted with densely or lightly of fenugreek or coriander plants reduces *A. craccivora* infestation and damage of beans by significant but relatively small amounts. In a critical review of studies on herbivore population response to diversified agroecosystems showed that diversified agroecosystems may be beneficial via ''bottom-up" or ''top-down" effects in pest suppression. The population density of insect pests in polycultures was lower in 52%, higher in 15%, equal in 13% and variable in 20% of the studies in comparing to monocultures [14]. Several mechanisms are responsible for this effect such as physical obstruction, visual camouflage, masking of host plant odors, repellent chemicals, altering the profiles of the host plant odors, and reduced host plant quality [15-17]. Volatile chemical constituents may attract or repel insects from distance, while other chemicals, may stimulate or deter feeding or egg laying. While chemical factor in non-hosts contributing to crop protection in intercrops are more likely to be transferable to monocultures than physical factor, such as camouflage; the latter may sometimes be modified sufficiently to permit their adoption in modern temperate cropping patterns. An example of this concerns the effects on the visual response of aphids [18]. The importance of intercropping as a method of reducing aphid attack on several crops has been reported. For instance, [19] reported that mixed cropping of cowpea with sorghum reduced infestation by aphids and thrips but increase pod borer and pod sucking bug populations. Sinthananthem *et al.* (1990) [20] and Ogenga-Latigo *et al.* (1992) [21] reported that intercropping cowpea with maize reduced the incidence of *Aphid fabae* on cowpea than on cowpea only. Straw and mustard (*Sinapis alba* L.) mulches can reduce aphid populations by up to 80% and 75%, respectively, and are particularly effective during the early colonization period when plants are small [22]. Aphid colonization of lupins and wireworm infestation of sunflowers are also reduced when planted directly into cereal stubble [23, 24] and while this effect has not been directly shown in faba bean it is recommended practice in Australia [25]. Furthermore, various studies have shown that variations in herbivore load in polycultures compared to monocultures increase the abundance of natural enemies [21, 26].

Table 1: Comparison of mean number of aphid *Aphis craccivora* per plant on faba bean intercropping with dense or light of coriander fenugreek or onion or for 2012/2013 and 2013/2014 seasons.

Treatments		Mean No. of aphids/plant ± SE	
		Season 2012/2013	Season 2013/2014
Giza 3 Improve	-	136.33±9.39a	71.61±3.08 a
Giza 3 Improve+ coriander	Dense	103.23±4.92	45.92±3.54
	Light	104.43±2.75	47.44±5.19
	Mean	103.83 b	46.86 c
Giza 3 Improve+ fenugreek	Dense	76.12±9.37	34.90±3.03
	Light	89.39±0.94	44.62±1.46
	Mean	82.76 c	39.76 c
Giza 3 Improve+ onion	Dense	126.44±4.06	55.67±4.92
	Light	122.44±4.54	59.26±14.15
	Mean	124.44 a	57.46 b
L.S.D. 5% A		14.91	9.70
B		n.s.	n.s.
L.S.D. 5% AB		13.59	21.32

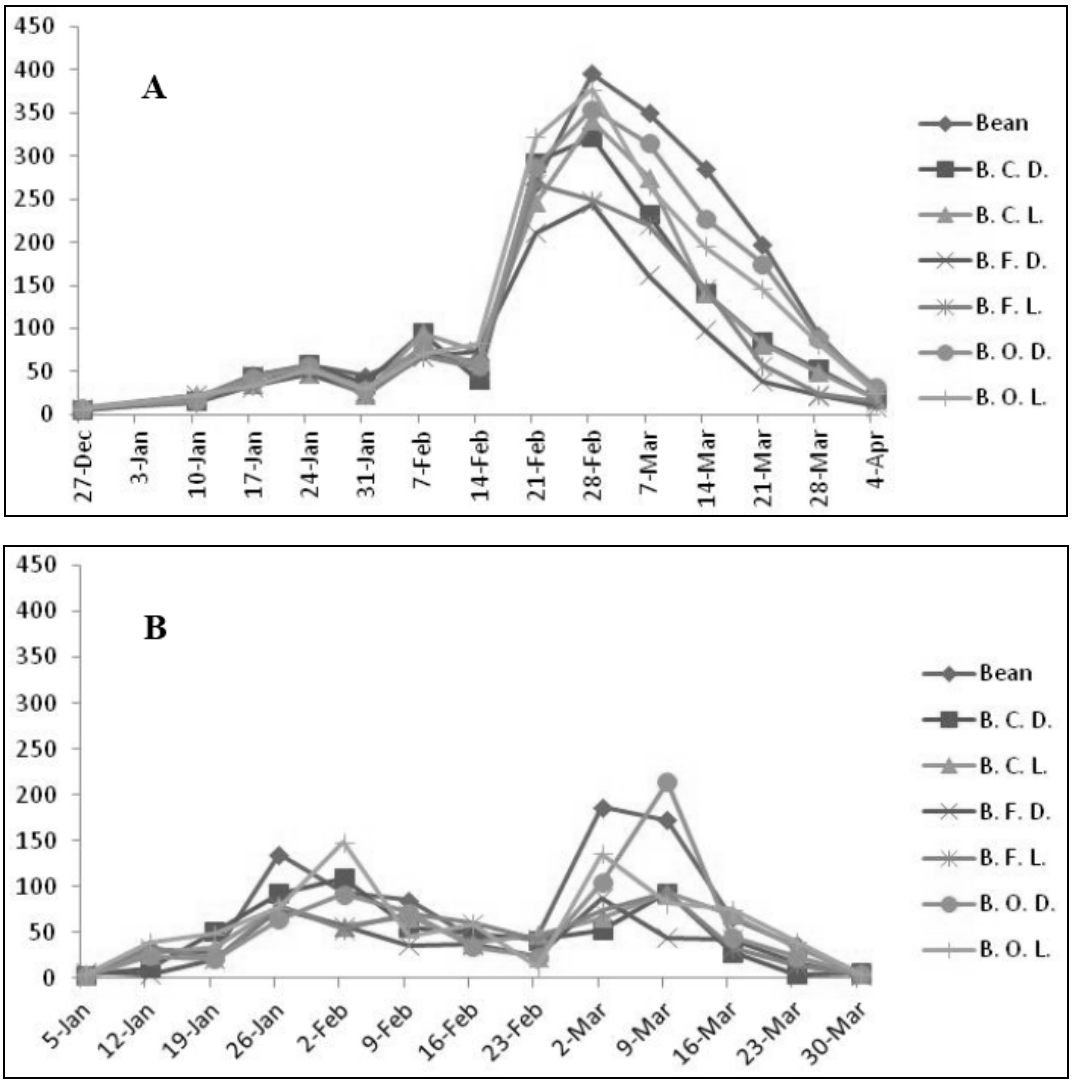

Fig 1: Population dynamics of *Aphis craccivora* population coexisting on *Vicia faba*, for A) 2012/2013 season, and B) 2013/2014 season.

3.2. Effects of intercropping system on agronomic characters

The data in (Table 2) showed that the biological yield of faba bean intercropped with fenugreek did not significantly differ from solid faba bean. Meanwhile, intercropping either coriander or onion with faba bean reduced its biological yield. The highest value of faba bean biological yield was obtained from pure stand (individual) faba bean treatment. The negative effect of onion on the total dry mass of faba bean might be due to the competition between the two crops on soil water and nutrients. It is known that the competition among plants is being stronger under condition of shortage of water and nutrients and other factors affecting plant growth. And this was true under this experiment site of desert land. The allelopathic substances exudates by coriander plants are nominated to be the reason of the negative effect on faba bean growth and biological yield [27-29]. Intercropping fenugreek with faba bean treatment produced the higher faba bean seed yield/fed. Compared to other treatments, which significantly had the same affects. Fenugreek is a legume crop can lives in symbiosis with *Rhizobium meliloti* soil bacteria that fixes atmospheric N and make N more available in rhizosphere zoon. This might reduce the competition between plants of both crops and in turn enhances faba bean seed yield. Since the value of harvest index (H.I.) depends on the quantities of seed and biological yields, so it was expected that its values will increase with increasing of seed yield, and/or decreasing of biological yield. This was evident with treatments of intercropping fenugreek or onion with faba bean [30, 31]. Treatment of intercropping coriander with faba bean caused a significant increase in number of branches compared to fenugreek plus faba bean treatment. The stronger shoot growth size of fenugreek compared to the shoot size of the both onion and coriander might be the reason for decreasing the number of branches/plant of faba bean when intercropped with fenugreek. Number of pods/plant is one of seed components of faba bean. Faba bean plants growth in pure stand produced the highest number (5.57) of pods/plant, followed by that of fenugreek intercropping treatment (4.93). Meanwhile, onion intercropping treatment produced the least number of pods/plant (4.23). The highest number of seeds per pod (3.27) was produced by coriander intercropping treatment. Yet, onion treatment yielded the least number of seeds per pod (2.95). Faba bean grown alone treatment resulted in the highest seeds weight/plant (7.63 g) with significant differences between it and all other intercropped treatments which affected negatively on weight of seeds per plant. Results in (Table 2) showed that the light density of coriander, fenugreek and onion was associated with the higher values compared to the dense planting. This was clear for most faba bean studied traits except for harvest index and seeds number/pod in coriander intercropping treatment. The result of H.I. with light coriander

intercropped treatment was expected to be lower than that of dense one. This might be due to the biological yield of light one was more increased than the seed yield of the same treatment did. This important result leads to the fact that light density gave more space for faba bean plants to grow better and to produce more yield [32, 33].

Table 2: Faba bean biological and seed yield/fed, harvest index, number of branches/plant and pods/plant, seeds number/pod, and seed weight/ plant as affected by intercropping with coriander, fenugreek and onion at dense and light planting.

Treatments		Parameters (Means±SE)						
		Biological yield/fed (Kg)	Seed yield/fed (Kg)	Harvest index	Branches/plant (no.)	Pods/plant (no.)	Seeds/pod (no.)	Seeds weight/ plant (g)
Giza 3 Improve	-	2097.32±3.02a	664.81±43.06 b	31.68±2.01b	2.43±0.002ab	5.57±0.16a	3.17±0.04ab	7.63±0.05 a
Giza 3 Improve+ coriander	Dense	1686.83±12.75	653.7±21.03	38.75±0.64	2.50±0.12	4.47±0.26	3.33±0.07	6.55±0.13
	Light	1984.50±25.49	730.41±43.65	36.79±2.26	2.77±0.03	5.00±0.1	3.20±0.17	7.31±0.25
	Mean	1835.66b	692.09ab	37.77ab	2.63a	4.73bc	3.27a	6.93bc
Giza 3 Improve+ fenugreek	Dense	1766.57±1.60	678.04±4.46	38.38±0.33	2.37±0.07	4.90±0.15	2.93±0.18	6.24±0.23
	Light	2290.26±161	880.90±23.58	38.70±1.70	2.40±0.06	4.97±0.26	3.20±0.06	7.92±0.23
	Mean	2028.42[a]	779.47a	38.54a	2.39 b	4.93ab	3.07ab	7.08 b
Giza 3 Improve+ onion	Dense	1756.65±62.14	663.71±22.94	37.97±2.66	2.50±0.12	4.07±0.22	2.83±0.07	5.82±0.20
	Light	1899.98±8.02	777.26±37.60	40.89±1.81	2.60±0.06	4.40±0.17	3.07±0.09	7.23±0.58
Mean		1828.31b	720.48ab	39.43a	2.55ab	4.23c	2.95b	6.53c
L.S.D. 5% A		161.88	107.35	6.46	0.22	0.63	0.27	0.49
B		*	*	*	*	n.s.	n.s.	*
L.S.D. 5% AB		189.96	47.45	3.30	0.19	0.56	0.34	0.96

4. Conclusion

In conclusion, the findings of this study shows that faba bean plus fenugreek or coriander intercrop reduced populations of *A. craccivora* of faba bean but more investigation is needed to verify witch stimulants visual or chemicals in the fenugreek or coriander have effect on the population of *A. craccivora*. From the agronomic viewpoint intercropping of fenugreek at light density with faba bean plants in such condition similar to this experiment was the best treatment for bean yield.

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6. References

1. Salman AMA, Abdel-Moniem ASH, Obiadallac AH. Influence of Certain Agricultural Practices on the Black Legume Aphid, *Aphis craccivora* Koch, Infesting Broad Bean Crops and the Relation between the Infestation and Yield of Plants in Upper Egypt. Archives of Phytopathology and Plant Protection 2007; 40:395-405.
2. Hull R. Spread of Groundnut Rosette Virus by *Aphis craccivora* (Koch). Nature 1964; 202:213-214.
3. Bai SX, Wang ZY, He KL, Im D-J. Olfactory response of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) to volatiles emitted by mungbean plants. Agricultural Sciences in China 2011; 10:560-565.
4. Ofori F, Stern WR. Cereal-legume intercropping systems. Adv. Agronomy 1987; 41:41-90.
5. Agegnehu G, Ghizaw A, Sinebo W. Yield performance and land-use efficiency of barley and faba bean mixed cropping in Ethiopian high lands. European Journal of Agronomy. 2006; 25:202-207.
6. Eskandari H, Ghanbari A. Environmental resource consumption in wheat and bean intercropping: Comparison of nutrient uptake and light interception. Notulae Scientia Biologicae. 2010; 2(3):100-103.
7. Konar A, Singh NJ, Paul R. Influence of intercropping on population dynamics of major insect pests and vectors of potato. Journal of Entomological Research. 2010; 34:151-154.
8. Suresh R, Sunder S, Pramod M. Effect of intercrops on the temporal parasitization of Helicoverpa armigera (Hub.) by larval parasitoid, Campoletis chlorideae Uchida in tomato. Environment and Ecology. 2010; 28:2485-2489.
9. Vaiyapuri K, Amanullah MM, Rajendran K, Sathyamoorthi K. Intercropping unconventional green manures in cotton: An organic approach for multiple benefits: a review. Asian Journal of Plant Sciences. 2010; 9:223-226.
10. Rizk AM. Effect of Strip-Management on the Population of the Aphid, *Aphis craccivora* Koch and its Associated Predators by Intercropping Faba bean, *Vicia faba* L. with Coriander, *Coriandrum sativum* L. Egyptian journal of biological pest control. 2011; 21:81-87.
11. Bakheit BR, Allam AY, Galal AH. Intercropping Faba Bean with some Legume Crops for Control of *Orobanche crenata*. Acta Agronomica Hungarica 2002; 50:1-6.
12. Sarker PK, Rahman MM, Das BC. Effect of Intercropping of Mustard with Onion and Garlic on Aphid Population and Yield. Journal of biological science 2007; 15:35-40.
13. Gomez, KA, Gomez AA. Statistical procedures for agricultural research (2 ed.). John wiley and sons, New York, 1984; 680.
14. Andow DA. Vegetational Diversity and Arthropod Population Response, Annual Review of Entomology 1991; 36:561-586.
15. Van Lenteren JC. Sustainable and Safe Crop Protection: a Reality? in: P.A. Oomen, R. Forster, G.B. Lewis (Eds.), Proceedings 50th International Symposium on Crop

Protection, Gent, Belgium, 1998, 409-413.
16. Finch S, Collier RH. Host Plant Selection by Insects-A theory Based on Appropriate/Inappropriate Landings" by Pest Insects in Cruciferous Plants, Entomologia Experimentalis et Applicata 2000; 96:91-102.
17. Hooks CRR, Johnson MW. Impact of Agricultural Diversification on the Insect Community of Cruciferous Crops. Crop Protection 2003; 22:223-238.
18. Perrin RM, Phillips ML. Some Effects of Mixed Cropping on the Population Dynamics of Insect Pests. Experimental Entomology 1978; 24:385-393.
19. Nampala P, Ogenga-Latigo MW, Kyamanywa S, Adipala E, Oyobo N, Jackai LEN. Potential Impact of Intercropping on Major Cowpea Field Pests in Uganda. African Crop Science Journal 2002; 10:335-344.
20. Sinthananthem S, Sohati PH, Kaunatyan J, Haciwa HC. Preliminary Studies of Bean Aphids Management in Zambia. *Proceedings of the 9th Bean Research Workshop* Held Between at Sokoine University of Agriculture, Morogoro Tanzania. September, 1990.
21. Ogenga-Latigo MW, Ampofo JKO, Balidawa CW. Influence of Maize Row Spacing on Infestation and Damage of Intercropped Beans by Beans Aphids (*Aphis fabae* Scop.) 1. Incidence of Aphids. Field Crop Research. 1992; 30:111-121.
22. Heimbach U. Reduzierung des Blattlausbefalls durch Mulchsaatverfahren in Ackerbohne [Reduction of aphid numbers by using mulching techniques in broad beans]. Mitt. Die Deutsche Gesellschaft für allgemeine und angewandte Entomologie. 2001; 13:253-256.
23. Berlandier FA, Bwye AM. Cultural practices to control aphid landing in narrow-leafed lupin crops in Western Australia. In: Zalucki, M.P., Drew, R.A.I., White, G.G. (Eds.), Proc. 6th Australasian Appl. Entomol. Res. Conf., Pest Management: Future Challenges, University of Queensland Press, Brisbane, Australia. 1998; 1:289-293.
24. Bwye AM, Jones RAC, Proudlove W. Effects of different cultural practices on spread of cucumber mosaic virus in narrow-leafed lupins (Lupinus angustifolius). Australian Journal of Agricultural Research. 1999; 50:985-996.
25. Schwinghamer M, Schelg M, Moore K, Kumri S, Srivastava M, Wratten K *et al*. The Virus Situation in Chickpea, Faba Bean and Canola in New South Wales and Southern Queensland. In: Anon. (Ed.) Update of Research in Progress at the Tamworth Agricultural Institute. New South Wales Department of Agriculture, Tamworth, Australia, 2003, 44-47.
26. Kyamanywa S, Baliddawa CW, Ampofo KJO. Effect of maize plant on colonization of cowpea plant by bean flower thrips, Megalurothrips sjostedti. Entomologia Experimentalis et Applicata. 1993; 69(1):61-68.
27. Dhima KV, Vasilakoglou IB, Gatsis ThD, Panou-Philotheou E, Eleftherohorinos IG. Effects of Aromatic Plants Incorporated as Green Manure on Weed and Maize Development. Field Crops Research. 2009; 110:235-241.
28. Sharangi AB. In Search of Allelopathy from Common Alliaceae Crops from Managing Weeds in Coriander: an Overview. International Journal of Agriculture Research. 2011; 6:209-217.
29. Iqbal MZ, Ahmed L, Shafiq M, Athar M. Allelopathic Effects of Red Pepper (*Capsicum annuum* L.) and Coriander (*Coriandrum sativum* L.) on Early Seedling Growth of Wheat (*Triticum aestivum* L.). Advances in Environmental Research 2015; 4:1-15.
30. Megawer EA; Sharaan AN, El-Sherif AM. Effect of Intercropping Patterns on Yield and its Components of Barley, Lupin or Chickpea Grown in Newly Reclaimed Soil. Egyptian journal of Basic and Applied Sciences. 2010; 25:437-452.
31. Abdalla AA, El Naim AM, Ahmed MF, Taha MB. Biological yield and harvest index of faba bean (*Vicia faba* L.) as affected by different agro-ecological environments. World Journal of Agricultural Research. 2015; 3:78-82.
32. Prasad RB, Brook RM. Effect of varying maize densities on intercropped maize and soybean in Nepal. Experimental Agriculture 2005; 41:365-382.
33. Muoneke CO, Ogwuche MAO, Kalu BA. Effect of Maize Planting Density on the Performance of Maize/Soybean Intercropping System in a Guinea Savannah Agroecosystem. African Journal of Agricultural Research. 2007; 2:667-677.