Egypt. J. Plant Prot. Res. Inst. (2022), 5 (1): 40–46

Egyptian Journal of Plant
Protection Research Institute
www.ejppri.eg.net

Impact of aromatic plants intercropped with sugar beet on infestation by cotton leafworm, sugar beet fly and associated predators

Ibrahim, F. Khafagy ; Heba, S. Abd El-Aty and Ghada, M. Ramadan
Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

ARTICLE INFO
Article History
Received: 17 /1 /2022
Accepted: 23/ 3 /2022

Keywords

Insect pests, intercropping, sugar beet, aromatic plants, and predators.

Abstract:

The current work was carried out to study the Influence of aromatic plants; fennel (*Foeniculum vulgare*), dill (*Anethum graveolens*), coriander (*Corlandrum sativum*), and marjoram (*Majorana hortensis*) intercropped with sugar beet on the population of some insect pests and related predators in 2019/2020 and 2020/2021 seasons. Intercropping reduced damage of *Spodoptera littoralis* (Boisduval) (Lepidoptera, Noctuidae) (Eggs and larvae), and *Pegomya mixta* Villeneuve (Diptera: Anthomyiidae) (Eggs and larvae), especially in the case of fennel + sugar beet, and increased the density of associated predators. Intercropping dille + sugar beet was most attractive for *Coccinella undecimpunctata* L. (Coleoptera: Coccinellidae). Fennel intercropping with sugar beet highly increased the population of *Chrysoperla carnea* (Stephens) (Neuroptera : Chrysopidae) while intercropping coriander + sugar beet attracted *Paederus alfierii* Koch. (Coleoptera: Staphylinidae), intercropping marjoram + sugar beet was most attractive to *Scymnus* spp. (Coleoptera: Coccinellidae) . The highest density of spiders was found in the case of intercropping sugar beet with fennel, followed by sugar beet with marjoram.

Introduction

Sugar beet (*Beta vulgaris* L.) (Family: Chenopodiaceae) is an important sugar crop in Egypt. It has been introduced into the Egyptian agricultural rotation in 1982, and proved to be grown in both fertile and newly reclaimed soils (El-Khouly, 1998). In addition, sugar beet could be used as forage for livestock and for pectin production (Fouad , 2011).

Several insects attack this crop, e.g., *Pegomya mixta* Villeneuve (Diptera: Anthomyiidae) causing considerable damage to yield (Shalaby, 2001). *P. mixta* lives in leaves and eats the leaf tissue, its feeding at first creates twisting mines causing acute damage in chlorophyll content (Shaheen, 1992 and Muska, 2007). Bazazo (2019) reported that *Spodoptera littoralis* (Boisduval) (Lepidoptera, Noctuidae) may be a detrimental dangerous insect for sugar beet crop, particularly the early plantation. In this case, the insect can negatively affect the plant stand, consequently great reductions in yield, unless insecticidal control measures are applied. The numbers of *Chrysoperla carnea* (Stephens) (Neuroptera : Chrysopidae), *Coccinella undecimpunctata* L. (Coleoptera: Coccinellidae)., *Scymnus* spp. (Coleoptera: Coccinellidae), *Paederus alfierii* Koch. (Coleoptera: Staphylinidae) and *Cydonia vicina*

isis Cr. (Coleoptera: Coccinellidae) were studied on sugar beet fields by El-Khouly (2006) and Sherief *et al.* (2013).

Intercropping between different crops and their effect on the occurrence of pests is recommended in some cases. Khafagy (2011) found that intercropping of five aromatic plants + kidney beans have reduced whitefly population density. El-Naggar *et al.* (2008) reported that aphids were reduced significantly in plots treated with marjoram extract than in untreated ones.

Aromatic plants having volatile oils may overlap with the host plant location, mating feeding, and distribution and reduce pest abundance (Lu *et al*., 2007). In general, repellent plants keep insect pests off the main crop (Hjalten *et al*., 1993).

Therefore, the current work was conducted to highlight the influence of aromatic plants on infestation by cotton leafworm, sugar beet fly, and related predators on the sugar beet crop.

Materials and methods

Field experiments were carried out during two successive cropping seasons; 2019/2020 and 2020/2021 in the experimental field at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt to study the influence of aromatic plants intercropped with sugar beet (Table 1) on sugar beet infestation by cotton leafworm, *S. littoralis*, sugar beet fly *P. mixta* and associated predators.

An area of one feddan was prepared and divided into 5 strips, each was 840 m^2. Each strip was divided into four replicates each was (210 m^2) in RCB design. Sugar beet cultivar Faten was cultivated on 15th September in both seasons, as 2-3 seeds per hill. The seeds were sown on the northern side of rows (60 cm width) at a distance of 25 cm. On the southern side, four aromatic plants, fennel, dill, coriander, and marjoram were planted. All agricultural practices regarding the timing of plantation, varieties, and sampling techniques were followed as recommended.

Weekly Samples were taken 30 days after cultivation and continued till the harvest time. Each sample consisted of 10 plants, randomly chosen, from each plot. Samples were examined on the two leaf surfaces with the aid of a Lens and recorded in the field for *S. littoralis* (Eggs and larvae), *P. mixta* (Eggs and larvae), *C. undecimpunctata* (Larvae and adults), *C. carnea* (Larvae and adults), *P. alfierii* (Adults), *Scymnus* spp. (Larvae and adults), and true spiders (Spiderlings and adults).

Statistical Analysis

Reduction % = infestation in control (untreated) - infestation in treatments/ infestation in control × 100. Data were subjected to ANOVA and any significant differences among the mean of the treatments according to Duncan's (1955) method through SPSS Statistics (2015) computer program.

Table (1): Aromatic plants intercropped with sugar beet.

No.	Common name	Scientific name	Plant family
1	**Fennel**	*Foeniculum vulgare*	Umbelliferae
2	**Dill**	*Anethum graveolens*	Umbelliferae
3	**Coriander**	*Corlandrum sativum*	Umbelliferae
4	**Marjoram**	*Majorana hortensis*	Labiatae

Results and discussion

1. Impact of intercropping aromatic plants with sugar beet on *Spodoptera littoralis* infestation:

1.1. Mean number of laid eggs on sugar beet plants:

Data in Table (2) show the influence of aromatic plants intercropped with sugar beet on the number of *S. littoralis* laid eggs and larvae on sugar beet plants. In 2019/20, solid sugar beet plants (control)

received the highest number of cotton leafworm eggs (841.25 eggs /10 plants) compared to sugar beet intercropped with aromatic plants that received 20.75 - 199.75 eggs /10 plants. Thus, intercropping aromatic plants with sugar beet significantly achieved a 76.26 - 97.53 % reduction in *S. littoralis* eggs. In 2020/2021 season, almost the results were the same as the first season.

Table (2): Mean number and reduction percentage of *Spodoptera littoralis* eggs /10 sugar beet plants under the intercropping system.

Intercropping pattern	2019/20 season		2020/21 season	
	Mean No. eggs	Reduction %	Mean No. eggs	Reduction %
Sugar beet +Fennel	20.75 e	97.53	26.25 e	96.86
Sugar beet +Dill	55.50 d	93.40	65.00 d	92.24
Sugar beet +Coriander	99.75 c	88.14	93.75 c	88.80
Sugar beet +Marjoram	199.75 b	76.26	215.75 b	74.23
Solid sugar beet	841.25a	-	837.25 a	-

Means bearing the same small letters within a column are not significantly different at the 5% level by DMRT.

1.2. Mean number of larvae on sugar beet plants:

In 2019/2020 and 2020/2021 seasons (Table 3), solid sugar beet had the highest larval population; 388.75 and 403.75 larvae/ 10 plants, respectively. The second rank of the larval population was detected on the sugar beet + marjoram intercropping pattern; with values of 101.50 and 122.50 larvae / 10 plants in the first and second seasons, respectively. The third rank of the larval population was found on the sugar beet+ coriander intercropping pattern. On the other hand, the least larval population was detected on sugar beet+ fennel intercropping, as this pattern achieved the highest reduction in *S. littoralis* larval population; 98.20 and 97.15% reduction, in the first and second seasons, respectively. The differences among intercropping patterns were significant.

Table (3): Mean number and reduction percentage of *Spodoptera littoralis* larvae/ 10 sugar beet plants under intercropping system.

Intercropping pattern	2019/20 season		2020/21 season	
	Mean No. of Larvae	Reduction % of Larvae	Mean No. of Larvae	Reduction % of Larvae
Sugar beet +Fennel	7.00 e	98.20	11.50 e	97.15
Sugar beet +Dill	33.75 d	91.32	42.25 d	89.54
Sugar beet +Coriander	74.25 c	80.90	82.00 c	79.69
Sugar beet +Marjoram	101.50 b	73.89	122.50 b	69.66
Solid sugar beet	388.75 a	-	403.75 a	-

Means bearing the same small letters within a column are not significantly different at the 5% level by DMRT.

2. Effect of intercropping aromatic plants with sugar beet on *Pegomya mixta* infestation:

2.1. Mean number of laid eggs on sugar beet plants:

All intercropping patterns significantly reduced the numbers of *P. mixta* eggs laid on sugar beet leaves as compared to solid sugar beet which received 176.25 eggs / 10 plants (Table 4). The best combination was sugar beet+ dill as the eggs were reduced by 88.51 and 87.48 % in the first and second seasons, respectively. The second rank was that fennel intercropped + sugar beet, with 82.41 and 80.82 % egg reductions, in 2019/2020 and 2020/2021 seasons, respectively. However, the combination of sugar beet + marjoram appeared as the least efficient intercropping pattern with 61.70% and 60.27 % egg reduction in two seasons, respectively.

Table (4): Mean number and reduction percentage of *Pegomya mixta* eggs / 10 sugar beet plants under the intercropping system.

Intercropping pattern	2019/2020 season		2020/2021 season	
	Mean No. of eggs	Reduction %	Mean No. of eggs	Reduction %
Sugar beet +Fennel	31.00 d	82.41	35.25 d	80.82
Sugar beet +Dill	20.25 e	88.51	23.00 e	87.48
Sugar beet +Coriander	40.75 c	76.88	44.25 c	75.92
Sugar beet +Marjoram	67.50 b	61.70	73.00 b	60.27
Solid sugar beet	176.25 a	-	183.75 a	-

Means bearing the same small letters within a column are not significantly different at the 5% level by DMRT

2.2. Mean number of larvae on sugar beet plants:

Data in Table (5) show that solid sugar beet harbored significantly the highest population of *P. mixta* larvae in two seasons; 166.25 and 170.75 larvae / 10 plants of sugar beet, respectively. Sugar beet + marjoram intercropping pattern occupied the second rank of larvae in sugar beet leaves; 55.00 and 59.25 larvae / 10 plants in 2019/2020 and 2020/2021 seasons, respectively. However, the most efficient intercropping pattern in reducing the pest larvae in sugar beet leaves was sugar beet + dill; 92.93 and 91.80 % larval population reductions in 2019/2020 and 2020/ 2021, respectively.

Table (5): Mean number and reduction percentage of *Pegomya mixta* larvae/ 10 sugar beet plants field under intercropping system.

Intercropping pattern	2019/20 season		2020/21 season	
	Mean No. of Larvae	Reduction % of Larvae	Mean No. of Larvae	Reduction % of Larvae
Sugar beet +Fennel	18.25 d	89.02	20.25 d	88.14
Sugar beet +Dill	11.75 e	92.93	14.00 e	91.80
Sugar beet +Coriander	32.50 c	80.45	33.75 c	80.23
Sugar beet +Marjoram	55.00 b	66.92	59.25 b	65.30
Solid sugar beet	166.25 a	-	170.75 a	-

Means bearing the same small letters within a column are not significantly different at the 5% level by DMRT.

3. Influence of intercropping aromatic plants with sugar beet on predatory population:

Sugar beet intercropping with aromatic plants significantly encouraged all considered predators and true spiders compared with solid sugar beet (Table 6). In 2019/ 2020 season, the highest populations of *C. carnea*; 68.00 and 55.25 individuals / 10 plants were obtained with sugar beet + fennel and sugar beet + dill intercropping patterns, respectively.

The number of *C. undecimpunctata* was highest with sugar beet +dill and sugar beet + fennel, followed by sugar beet + coriander, but it was low in plots of solid sugar beet and sugar beet + marjoram pattern. The highest densities of *P. alfierii* were detected with sugar beet + coriander and sugar beet + fennel, with values of 63.75 and 48.25 individuals /10 plants, respectively. The highest densities of *Scymnus* spp., 60.25 and 49.75 individuals /10 plants were obtained with sugar beet + marjoram followed by sugar beet + coriander intercropping pattern, respectively.

The true spider populations proved to be highest in the case of sugar beet + fennel (62.75), followed by sugar beet + marjoram (52.25 spiderlings and adults /10 plants). The highest number of spiders were found in plots with solid sugar beet, followed by sugar beet intercropped with coriander. Other intercropping patterns resulted in

intermediate population densities of true spiders. Predatory population densities in 2020 /2021 season took a trend similar to that of 2019 / 2020 season.

Table (6): Mean Number of predators in case of sole and aromatic plants intercropped with sugar beet

Intercropping pattern	*Chrysoperla carnea*	*Coccinella undecimpunctata*	*Paederus alferii*	*Scymnus* spp.	True spider
Mean number during 2019/20 season					
Sugar beet +Fennel	68.00 a	59.50 b	48.25 b	43.50 c	62.75 a
Sugar beet +Dill	55.25 b	77.75 a	27.25 d	21.00 d	43.25 c
Sugar beet	31.50 c	38.00 c	63.75 a	49.75 b	27.55 d
+Coriander	26.25 d	24.30 d	42.00 c	60.25 a	52.25 b
Sugar beet	15.00 e	13.25 e	11.40 e	5.00 e	22.30 e
+Marjoram					
Solid sugar beet					
Mean number during 2020/21 season					
Sugar beet +Fennel	64.50 a	58.25 b	52.25 b	45.00 c	68.50 a
Sugar beet +Dill	52.75 b	65.50 a	30.75 d	23.50 d	49.25 c
Sugar beet	29.25 c	31.25 c	68.25 a	52.75 b	33.75 d
+Coriander	22.5 d	21.00 d	45.25 c	61.00 a	63.00 b
Sugar beet	13.25 e	12.00 e	13.00 e	7.50 e	27.50 e
+Marjoram					
Solid sugar beet					

Means bearing the same small letters within a column are not significantly different at the 5% level by DMRT.

The current results showed that intercropping aromatic plants with sugar beet reduced the population of *P. mixta* compared to solid sugar beet. It was also clear that aromatic plants were most attractive to predators than solid sugar beet. These results are in line with those of other authors who proved that intercropping increases the predatory populations (Khafagy, 2015). Khafagy *et al.*(2020) found that intercropping of sugar beet + four aromatic plants increased the number of predatory insects and true spiders compared with sole sugar beet and reduced the infestation percentage with *Cassida vittata* Vill. (Coleoptera: Chrysomelidae) (All stages), especially in the case of intercropping coriander + sugar beet. El-Gobary *et al.* (2014) found that okra plants intercropped with aromatic plants increased the associated numbers of predators and reduced *Helicoverpa armigera* (Hübner) (Lepidoptera:Noctuidae) compared to control (Solid okra). Companion flowering plants have been used in different cropping systems to enhance the number of natural enemies (Begum *et al*., 2006). The abundance of main natural enemies of aphids (Hoverflies, lacewings, and ladybirds) and syrphids richness was greatly enhanced in tailored flower strips compared with sole potato. This increased the average number of eggs deposited by syrphids and lacewings by 127 and 48%, respectively, and reduced the number of aphids by 75% in adjacent potato crops (Tschumi *et al*., 2016). The increase in the population of natural enemies was attributed to supplying access to nectar-producing plants such as alyssum (*Lobularia maritima* L.). Zytynska *et al.* (2021) hypothesized that the flowers themselves would be important for general natural enemy recruitment, as they are considered as a nectar resource for many of the adult parasitoid/predators. Overall, companion flowering plants with some crops are recommended to activate predators (Jonsson *et al*., 2008). A literature survey showed that 68 (53%) of the total of 130 natural enemy species had a higher population density

in polycultures compared to monocultures (Andow, 1991). However, floral planting studies often focus on how flowering plants attract natural enemies rather than the whole ecological system (Hatt *et al*., 2019).

References

Andow, D. A. (1991): Vegetational diversity and arthropod population response. Annu. Rev. Entomol., 36 (1): 561-586.

Bazazo, K. G. (2019): The role of cotton leafworm control with certain insecticides in increasing sugar beet crop productivity. Zagazig, J. Agric. Res., 46(6): 2229-2238.

Begum, M.; Gurr, G. M.; Wratten, S. D.; Hedberg, P. R. and Nicol, H. I. (2006): Using selective food plants to maximize biological control of vineyard pests. J. Appl. Ecol., 43 (3): 547-554.

Duncan, D. B. (1955): Multiple Ranges and Multiple F. test. Biometrics, 11: 1-24.

El-Gobary, A.; Khafagy, I. F. and Somaa, H. M. (2014): The role of three intercropping aromatic plants in reducing the American cotton bollworm, *Helicoverpa armigera* (HUB.) infestation and its associated predators on okra, *Abelmoschus esulentus* (L.). Egypt. J. Plant. Pro. Res., 2(4):1-9.

El-Khouly, M. I. I. (1998): Ecological studies and control of the tortoise beetle, *Cassida vittata* Villers in sugar beet ecosystem. Ph.D. Thesis, Fac. Agric, Al-Azhar University.

El-Khouly, M. I. I. (2006): Population fluctuations of the beet fly, *Pegomyia mixta* Vill. and the tortoise beetle. *Cassida vittata* (Vill) in relation to certain associated natural enemies in sugar beet fields at Kafr El-Sheikh Governorate. Egypt. J. Biolo. Pest Control, 16(1): 311-321.

El-Naggar, A. A. M.; El-Naggar, H. and Fawakhry, F. M. (2008): Physiological studies on growth and flowering of *Cyprus papyrus*, L. Effect of growing media and water requirements. Alex. J. Agric. Res., 49(3): 93-105.

Fouad, H. A. M. (2011): Control of some pests infesting sugar beet at Sharkia Governorate. M. Thesis, Fac. Agric, Mansoura Univ., 172 pp. Fac. of Agric. Kafr El – Sheikh, Tanta University.????

Hatt, S.; Uytenbroeck, R.; Lopes, T.; Mouchon, P.; Osawa, N.; Piqueray, J.; Monty, A. and Francis, F. (2019): Identification of flower functional traits affecting abundance of generalist predators in perennial multiple species wildflower strips. Arthropod- Plant Interactions, 13: 127–137.

Hjalten, J.; Danell, K. and Lundberg, P. (1993): Herbivore avoidance by association. Oikos, 128: 125-131.

Jonsson, M.; Wratten, S. D.; Landis, D. A. and Gurr, G. M. (2008): Recent advances in conservation biological control of arthropods by arthropods. Biol. Control, 45(2): 172-175.

Khafagy, I. F. I. (2011): Promising role of some aromatic plants for the management of *Bemisia tabaci*. Ph.D. Thesis, Fac. Agric., Kafr El-Sheikh University.

Khafagy, I. F. I. (2015): The role of some aromatic plants

intercropping on *Tuta absoluta* infestation and the associated predators on tomato. Egypt. J. Plant Prot. Res., 3(2): 38-54.

Khafagy, I. F.; Samy, M. A. and Hamza, A. M. (2020): Intercropping of some aromatic plants with sugar beet, its effects on the tortoise beetle *Cassida vittata* Vill. infestation, appearance predators and sugar beet yield. J. of Plant Prot. and Path., Mansoura Univ.,11 (2):455-461.

Lu, W.; Hou, M. L.; Wen, J. H. and Li, J.W. (2007): Effects of plant volatiles on herbivorous insects. Plant Prot., 33: 7-11.

Muska, F. (2007): Damaging presence of aphids on sugar beet and beet in Czech Republic - Historical summary until 2005. (LISTY CUKROV REPAR), 123(9-10):284-287.

Shaheen, F. A. H. (1992): Efficiency of field spray insecticides against some sugar beet pests, in relation to their effect on yield and sugar content. J. Agric. Sci. Mansoura. Univ., 17(11): 3642-3647.

Shalaby, G.A.M. (2001): Ecological studies on some important sugar-beet pests and natural enemies and their control. Ph. D. Thesis, Fac. of Agric, Kafr El-Sheikh, Tanta university.

Sherief, E. A. H.; Said, A. A. A.; Shaheen, F. A. H. and Fouad, H. A. M. (2013): Population fluctuation of certain pests and their associated predator insects on sugar beet in Sharkia governorate, Egypt. Egypt. J. Agric. Res., 91 (1): 139-150.

SPSS Statistics (2015): IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

Tschumi, M.; Albrecht, M.; Collatz, J.; Dubsky, V.; Entling, M. H.; Najar- Rodriguez, A. J. and Jacot, K. (2016): Tailored flower strips pro-mote natural enemy biodiversity and pest control in potato crops. Journal of Applied Ecology, 53: 1169–1176.

Zytynska, S. E.; Eicher, M.; Fahle, R. and Weisser, W. W. (2021): Effect of flower identity and diversity on reducing aphid populations via natural enemy communities. Journal of Ecology and Evolution, 11:18434–18445.