

THE RESPONSE OF TWO VARIETY OF FABA BEAN (AT FLOWERING STAGE) TO DIFFERENT CONCENTRATIONS OF ALPHA CYPERMETHRIN INSECTICIDE

Nahla Salim Hammok

Biology Department, College of Education For Pure Sciences, University of Mosul/
Iraq.

[Email: Nahlahammok@yahoo.com](mailto:Nahlahammok@yahoo.com)

ABSTRACT

The aim of the present study was to investigate the response of two types of form Faba bean *Vicia faba* L.(local and Italian), at flowering stage, to different concentration of insecticide alpha cypermethrin. Also, to study these effects on chlorophyll quantity and production of the plant. the experiment was designed according to the International Experimentation System (2x4) according to the Randomized complete Block Design (RCBD) with six replicates .The study involved two factors ; First one included two types of Faba bean (locally and Italian) , the second included different concentrations of the pesticide (distilled water, 0.05, 0.1, 0.2, mg/ml). The alpha cypermethrin pesticide lead to significant decreasing (P-value <0.05) in characteristic of chlorophyll A quantity and in crop yielding plant height, pod number/plant, seeds number/pod, pod weight (g), pod length and the total weight for each 1000 grain. Which was with direct increase of the concentration. The Italian type recorded a significant decrease in the chlorophyll A, plant height and pod weight comparing with the local type. it was obvious that the Italian type was more sensitive than the local type toward the pesticide and its negative effect is increasing with the increase of the concentration.

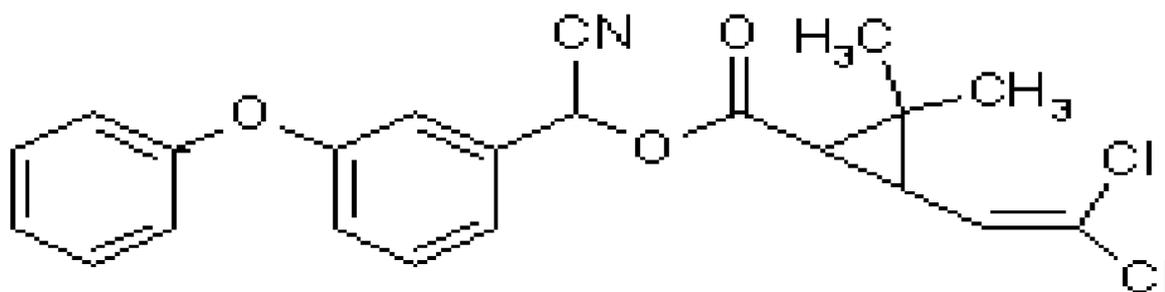
Keyword: Cypermethrin , *Vicia faba* L. , Spraying , yield ,insecticide.

Received: 24/9/ 2018, **Accepted:** 21/1/2019

INTRODUCTION

The cypermethrin is a highly active insecticide that belongs to the synthetic pyrethroid type II which contains an alpha-cyano group (Manna *et al*, 2004).

The Molecular Structure for cypermethrin and Molecular formula (OMalley, 2010)



$C_{22}H_{19}CL_2NO_3$ – Molecular formula

Cypermethrin is widely used in pest control by spraying crop fields, vegetables and fruit trees (Sharma *et al* ,2010).

The Argentine Crop Protection Association has claimed that the Cypermethrin is one of the most used insecticides for the agricultural purposes and has a use rate of 30-25 million liters in 2008-2009(Saenzet *al* ,2012).

Recent researches have shown a mutagenic and genotoxic effects in field crops and vegetables that exposed to cypermethrin. Inceer and his coworkers have observed abnormalities in mitotic division in sun flowers treated with different concentrations of cypermethrin(Inceer *et al* ,2009).

Saxena *et al.*(2005)and his colleagues recorded the formation of chromosomal aberrations in the meristems cells of the onion roots of *Allium sativum*. This was explained as a result of the mechanism of Cypermethrin pesticide, which includes it's interfere with DNA; Also, it was noted that the high concentration of the pesticide inhibits the mitotic index (MI), which is associated with stimulation of the filamentous and chromosome fissures. Moreover, Li *et al.*,(2005) observed that the superoxide dismutase (SoD) enzyme is one of the antioxidant enzyme which is a sensitive indicator and it is stimulated when the Algae is treated with cypermethrin.

Furthermore,Rozsavolgyi and Horvath(2008) found that high concentrations of cypermethrin resulted in inhibition of the photosynthesis in the protoplast isolated from the pea mesophyll leaves and that the inhibition of the photosynthesis after treatment with cypermethrin was due to its mechanism which is similar to herbicides from the urea group, which is considered the enzyme Co-enzyme (A), of the target site for the interference.

Recently,Inceer and Karaismailoglu(2017) observed the occurrence of genetic toxicity and cytotoxicity in the meristems cells in the roots of Sunflower plant after treating the roots with delta methrin insecticides, which is one of the pyrethroid pesticide, at concentrations of 0.25,0.5, 2 ppm and for 24,36,48 hours. In addition, a morphological changes such as reduction of root elongation army were observed and change its color.

Due to the fact that the cypermethrin have the genotoxicity and mutagenicity effects and because of its extensive uses in the field of agriculture, the aim of the current study was to detect the changes in some of the quantitative characteristics (the quantity feature of chlorophyll) and the feature of Faba bean crop (local and Italian) after spraying with cypermethrin during the period of flowering at different concentrations. Also, to study the relationship of these changes to the sensitivity of the Faba bean types and increase the concentration by the farmers of Faba bean crops.

MATERIALS AND METHODS

This study included two factors: the first used two types of Faba bean *Vicia faba* L. (Local and Italian) which were obtained from the field crops research department/ Nineveh (Mosul-Rashidiya) , The second factor included different concentrations of alpha cypermethrin pesticide which were (Distilled water as control, 0.05, 0.1, 0.2 mg/ml).

The study was carried out in the wired house of the Faculty of Education / Life Science Department during the winter season 2012-2013. Also, the experiment was

designed according to the International Experimentation System (2x4) according to the Randomized complete Block Design(RCBD) with six replicates. Healthy and homogenous grains were selected for planting. The land was prepared and plowed twice (mid and end of October) by deep plowing, softened and settled by hand and then divided into six equal sections (2.2 x 3 m) per replication.

The grains were planted in a light mixed soil (sand 38.12%, silt 41.13%, clay 20.15%, organic matter 0.98 %, and pH = 8.25) on 16/11/2012 .

The cultivation was performed in the form of lines and each line included a treatment and the distance between the lines was 20 cm and the distance between grains in the same line was 7.5 cm \pm 1 cm. 25 seeds were planted for each treatment. After the seed germination and the plant reached to the flowering stage, (1/3/2013) the flowers were sprayed with different concentrations of alpha cypermethrin using plastic sprayer in a form of lines and each line representing specific concentration. Lines were separated by wooden barriers and three replicates were used for each type (local, Italian).The chlorophyll a and b quantity in the leaves in all treated plants was measured after two weeks from spraying date in accordance to (Parry et al.,2009).

When the podmaturated,it was directly harvested. Plants were eradicated from the roots and each plant was covered and separated by a sheet of paper. Each group of plant for each treated concentration (10 plants for each treatment concentration) and each replicate was bundled and transferred to the lab for further analysis.The analysis included: plant height (cm), pod number/plant, seeds number/pod, pod weight (g), pod length (cm) and the total weight for each 1000 grain(g).

Data analysis was performed according to the Randomized complete Block Design (RCBD) (Dawod and Abdulyas,1990). Moreover, Duncan test was used to compare averages at P-value < 0.05. The analysis was conducted according to the statistical program SAS(Anter, 2010).

Results and discussion

The results in table (1) revealed that there was statistically significant reduction in the chlorophyll A quantity in the leaves after two weeks of the cypermethrin spraying. The reduction was at higher level at the higher concentration of the pesticide.

This significant reduction could be due to the fact that the pyrethroids contain chemical compounds interfere with the electron transmission chain in photosynthesis process and it was showed that inhibition in the photosynthetic process by the side chain of the halogens of the cypermethrin (Bader and Schaler,1996). Also, Fidalgo *et al.* (1993) mentioned that the re-spraying of potato plants with deltamethrin pesticide (pyrethroids pesticide) showed phenotypic changes represented by high content of chlorophyll in the thylakoid, and all corrugated sheets, small starch grains, decrease in the size of green plastids, and increase in ribosomal activity.

Mohaptra *et al.*(2003) studied the effects of cypermthrin on the photosyntheticpigments of bacteria Cyanobacterium*Anabaena doliolum*Bhar.they declared that the chlorophyllA, Carotenoids, phycobiliprotein and fluorescence were destroyed after exposing to period of (45min-30 hours) of the pesticide at concentrations 20 and 50 mM. ;They also noted that the photosynthetic system decreased with the increase of the concentration of cypermethrin pesticide and the length of exposure period and that the bacteria showed no recovery from the pesticide

intensity after 30 hours of exposure. Additionally, studies showed that high concentration pyrethroids including cypermethrin had inhibitory effects on photosynthetic system of the protoplast isolated from mesophyll leaves of different plants (Rozsavolgyi and Horvath ,2008 ; Bader andSchular,1996). Whereas, the effects were non-significant on the chlorophyll B quantity in the leaves. This was in agreement with a study achieved by(Mohaptraet *al*, 2003).

Table (1) The effect of spraying different concentrations of cypermethrin on the chlorophyll quantity A and B of Faba bean types after two weeks of the spraying date.

| concentrations of cypermethrin (mg/ml) | chlorophyll quantity (mg/g) tissue | |
|---|--|-------|
| | A | B |
| Distilled water(control) | 0.25a | 0.12a |
| 0.05 | 0.22ab | 0.08a |
| 0.1 | 0.23ab | 0.07a |
| 0.2 | 0.20b | 0.10a |

Different letters shows the significant differences at p 0.05 according to Duncan test Multi-range at each characteristic.

As it is shown in table(2), there was a significant reduction in chlorophyll a quantity for Italian type comparing with local type after two weeks of treatment. This is an evidence of the variable sensitivity of this characteristic in these types toward this pesticide. In this regards, Ahmed *et al.*,2003 emphasized that the pesticide not only kill the insect, but also results in a biochemical changes to the treated yields. He compared the activity of three pesticides, including cypermethrin, on two types of corn.The types showed a difference in their response to the three tested pesticides. Moreover, the cypermethrin resulted in reduction in carbohydrates which are organic compounds produced in plants as a result of photosynthesis. The reduction in synthesis these compounds are an evidence of the effects of the pesticide on the photosynthesis. While, there was no significant decrease of the chlorophyll B quantity.

Table (2) The effect of Faba bean plant types (Local and Italian) on the chlorophyll a and b quantity after two weeks of spraying with cypermethrin.

| Types | Chlorophyll quantity (mg/g tissue) | |
|---------|-------------------------------------|-------|
| | A | B |
| Local | 0.24a | 0.09a |
| Italian | 0.21b | 0.09a |

Different letters show the significant differences at p 0.05 according to Duncan test Multi-range at each characteristic .

It is obvious from table (3) that there was a significant effect at P-value 0.05 between Faba bean types (Local and Italian) and the cypermethrin concentrations on the chlorophyll A quantity. The quantity of chlorophyll A decreased significantly at different concentrations of cypermethrin for both types of the Faba bean. However, the interfering of cypermethrin concentrations and Faba bean types was non-significant for the chlorophyll B quantity.

The significant interaction is an evidence of the harmful effects of the pesticide. Furthermore, the pigments are used as a biological marker when the plants, including the algae, are exposed to the pesticides Couderchet and Vernet, (2003) ; Li *et al.* (2005) found that the Algae *Scenedesmus obliquus* was affected by the cypermethrin and the high concentrations of this pesticide had led to inhibition of the growth of this algae and also the metabolism of pigments .

Table (3) The effect of interaction between of cypermethrin concentrations Faba bean types (Local and Italian) on the chlorophyll A and B quantity after two weeks of spraying.

| Types | concentrations of cypermethrin (mg/ml) | Chlorophyll quantity(mg/g tissue) | |
|---------|--|-----------------------------------|-------|
| | | A | B |
| Local | (control) | 7.97a | 0.12a |
| | 0.05 | 2.58cd | 0.09a |
| | 0.1 | 2.95c | 0.09a |
| | 0.2 | 2.26d | 0.08a |
| Italian | (control) | 5.60b | 0.12a |
| | 0.05 | 2.90cd | 0.07a |
| | 0.1 | 2.98c | 0.06a |
| | 0.2 | 2.40cd | 0.12a |

Different letters show the significant differences at p 0.05 according to Duncan test Multi-range at each characteristic.

The data from table (4) shows the significant decrease of the plant height, pod numbers/plant, seeds numbers/pod, pod weight, pod length (cm), weight of 1000 seeds (g) at the harvesting time at P-Value 0.05.

The obvious reduction of the mentioned characteristics could be due to the pesticide effects on the photosynthesis process (Fidalgo *et al.* , 1993 ;Bader and Schaler,1996 ;Conderchet and vernet , 2003;Mohaptra *et al* , 2003 ; Li *et al.* , 2005 ;; Rozsavolgyi and Horvath ,2008)and the division process and the growth of the plant (especially the meristem tissues for stem, root and leaves) that represent the growth parts for the plant (Saxena *et al.* ,2005 ; Inceer *et al* ,2009 ; Inceer and Karaismailoglu ,2017).

The effects of the pesticide on the plant height is in agree with Cox , (1996) who pointed that the pesticide effect on the cells division and then stop the growth that leads to decrease its height . Also, the reduction of the root system and vegetative structure reached to 30-40% respectively at concentration of 0.1 (which is the recommended

concentration for plant use). Also, the production of plant was reduced with the increasing of the concentration.

In this study, the reduction of pod numbers/plant, seeds number/pod, pod weight, pod length, weight of 1000 seeds is with agree with another study performed by Siddigui and Ahmed , (2006). He recorded a significant reduction at flowering stage and the stage of fruiting. In addition, he showed that the concentrations of cypermethrin had negative effects on growth of soybean plant at different stages of the vegetative phase, flowering phase and late phase of the fruit holding stage. The effects of the pesticide started from concentration 0.50 g/L and increased with increasing of the concentration to 0.75g/L. Also, decreasing of protein quantity and lipids were noted with the increasing of the concentration.

Our results are in agreement with study performed by Ahmed *et al* , (2003). These compounds are produced by the plant as a nutrition for the plant and the extra amount will be stored a starch. The reduction of these compounds will lead to decreasing of plant growth (the weight of 1000 seeds will decrease with the decrease of stored starch) that represents dry matter accumulation of pod.

The reduction of the previous characteristics of the plant will reflect on the yield production as these characteristics represent an important signs for the plant production.

Table (4) The effect of different concentrations of cypermethrin on the characteristics and its components of Faba bean (Local and Italian).

| concentrations of cypermethrin (mg/ml) | plant height (cm) | pod number s/plant | Seed number s/pod | pod weightg)(| pod length (cm) | weight of1000s eeds (g) |
|--|-------------------|--------------------|-------------------|----------------|-----------------|-------------------------|
| (control) | 90.88a | 5.10a | 5.32a | 6.79a | 13.38a | 103.03 a |
| % 0.05 | 73.42b | 1.48b | 2.92b | 2.74bc | 8.96b | 73.84b |
| % 0.1 | 76.62b | 1.60b | 2.87b | 2.97b | 8.88b | 80.85b |
| %0.2 | 72.67b | 1.70b | 2.25c | 2.33c | 7.25c | 72.75b |

Different letters shows the significant differences at P-Value 0.05 according to Duncan test Multi-range at each characteristic .

The data in table (5) revealed significant differences between the two types (Local and Italian) on the height of the plant and pod weight. The plant height and the pod weight were reduced in Italian type as compared with local type. Whereas, the differences in other characteristics were non-significant between the two types. This result is in agreement with a study performed by Ahmed , (2003) who showed that there were significant differences between the three types of maize in their biological response to the cypermethrin pesticide.

Table(5) The effect of Faba bean types on the charectristics and its components.

| TYPE | plant height (CM) | pod number s /plant | Seed number s/pod | pod weight(g) | pod length (cm) | weight of1000 seeds (g) |
|---------|-------------------|---------------------|-------------------|---------------|-----------------|-------------------------|
| Local | 84.68a | 2.65a | 3.44a | 3.94a | 9.70a | 87.03a |
| Italian | 72.12b | 2.29a | 3.23a | 3.47b | 9.53a | 78.21a |

Different letters show the significant differences at P-Value 0.05 according to Duncan test Multi-range at each characteristic.

Table (6)Theintraction between cypermethrin concentrations and Faba bean types on the charectristics and its yield components.

| Types | concentrations of cypermethrin (mg/ml) | plant height (cm) | pod numbers /plant | Seed numbers/pod | pod weight (g) | pod length (cm) | weight of1000 seeds(g) |
|---------|--|-------------------|--------------------|------------------|----------------|-----------------|------------------------|
| Local | (control) | 98.33a | 5.23a | 5.50a | 7.97a | 13.31a | 115.61a |
| | 0.05 | 80.47b | 1.70b | 2.90b | 2.58cd | 9.20b | 77.78b |
| | 0.1 | 80.77b | 1.67b | 2.97b | 2.95c | 9.28b | 83.64b |
| | 0.2 | 79.13b | 2.00b | 2.40bc | 2.26d | 7.02d | 71.10b |
| Italian | (control) | 83.43b | 4.97a | 5.13a | 5.60b | 13.45a | 90.46b |
| | 0.05 | 66.37c | 1.27b | 2.93b | 2.90cd | 8.72cb | 69.90b |
| | 0.1 | 72.47c | 1.53b | 2.77bc | 2.98c | 8.48bcd | 78.06b |
| | 0.2 | 66.20c | 1.40b | 2.10c | 2.40cd | 7.48cd | 74.41b |

Different letters show the significant differences at P-Value 0.05 according to Duncan test Multi-range at each characteristic .

The data in table(6) revealed that there was a significant intractionbetween the two types of *Vicia faba* L. (locally and Italian) and concentrations of cypermethrinthat were used in all thestudied.These significantintraction(between the Italian and local types) and the concentrations show harmful effect of pesticide on the studied

(production characteristics) for both types and their sensitivity toward the pesticide. The table 6 shows reduction in the characteristics at concentrations (0.05, 0.01, 0.1 mg/ml) and the effects started at the low concentrations. Also, it is observed that the reduction increased for all features for both types with the increasing of the concentrations. This reduction may be due to the photosynthetic system, and the present of free radicals that damage the proteins, carbohydrates, amino acids, nucleic acids, lipids and fibers that represent the dray material stored in the seeds. Also, the effects on the divisions has affected on the numbers of theflower buds (Mohaptraet *al* , 2003 ; Li *et al.*2005 ; Sharma *et al* , 2010 ; Inceer and Karaismailoglu , 2017).

Conclusion

It is deduced from results of the current study that the treating with the cypermethrin pesticide has affected on the quantity and productscharacteristics for the *Viciafaba* for both types during the flowering period. The effects were started at the low concentrations (lower than recommended). Therefore, it is recommendedthat the farm do not increase the concentrations and the accurate application for the concentrations of the pesticide. This leads to reduce the effects on the production of thecrop yield and this will help in archive both aims which are the increasing of the productions and kill the insects. Also, to reduce the negative effects of the pesticide to other organism such as the animal of human.

استجابة صنفين من نبات الباقلاء لتراكيز مختلفة من مبيد الحشرات ألفا سايبيرمثرين (خلال فترة التزهير).

نهلة سالم حموك

قسم علوم الحياة /كلية التربية للعلوم الصرفة /جامعة الموصل

[Email: Nahlahammok@yahoo.com](mailto:Nahlahammok@yahoo.com)

الخلاصة

تهدف الدراسة الحالية الى الكشف عن استجابة صنفين من نبات الباقلاء *Vicia faba* L. خلال فترة التزهير لتراكيز مختلفة من مبيد الحشرات ألفا سايبيرمثرين (CPM) وتأثير ذلك على صفة كمية الكلورفيل والانتاجية . صممت التجربة بنظام التجارب العاملية (2x4) وفق تصميم القطاعات العشوائية الكاملة (RCBD) بستة مكررات و قد تضمنت الدراسة عاملين الاول هو الصنفين من نبات الباقلاء (المحلي والايطالي) أما العامل الثاني شمل أربعة تراكيز مختلفة من المبيد (ماء مقطر ، 0.05 ، 0.1 ، 0.2 ملي غرام /مل). أدى رش نبات الباقلاء بتراكيز مبيد الفاسايبيرمثرين الى احداث انخفاض معنوي عند مستوى احتمال (0.05) في صفة كمية الكلورفيل A، ارتفاع النبات، عدد القرنات /نبات، عدد البذور/ قرنة، وزن القرنة، طول القرنة، ووزن 1000 بذرة مع زيادة التركيز. كما سجل الصنف الايطالي انخفاضا معنويا في صفة كمية الكلورفيل A وارتفاع النبات ووزن القرنة مقارنة بالصنف المحلي. لوحظ أن الصنف الايطالي اكثر حساسية من الصنف المحلي للمبيد المستخدم ويزداد التأثير السلبي بزيادة التركيز.

المفاتيح الدالة: السايبرمثرين، الباقلاء، رش، الحاصل، مبيد حشري

تاريخ تسلّم البحث 2018/9/24، وقبوله 2019/1/21

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