Compatibility of ~~Certain~~ Bio- and Natural Compounds with *Trichogrammaevanescens* (Westwood) ~~Release~~ for ~~Controlling~~ *Pieris rapae*management ~~on~~ inCauliflower ~~Crop~~

Abstract: The ~~compatibility~~ efficacyof ~~spraying each of the~~a bio compound,Protecto (*Bacillus thuringiensis*) and ~~the natural compound~~ botanicals extract (mixture of ginger, garlic, hot red pepper extracts and aloe vera) ~~with *Trichogramma evanescens*~~releases in the form of sprays either in combination with *Trichogramma*~~*evanescens*~~releases or as alone was evaluated in comparison to ~~the~~ an insecticide, Uphold 36% SC (Methoxyfenozide/ Spinetoram) on ~~the cabbage white butterfly~~ *Pieris rapae*~~infesting~~ oncauliflower *Brassica oleracea*. Field experiments were conducted at Atfih District, Giza Governorate, Egypt in September 2020 and October 2021. Results revealed that, ~~each~~ all~~of~~ the tested compounds ~~accompanied~~ combinedwith *Trichogramma* releases were more ~~as the most~~ effective in reducing *P. rapae* population than ~~being~~ when usedalone. *B.*~~*t.*, treatment~~*thuringiensis*with *Trichogramma* releases caused96.91% and 95.32% reduction in*Pieris*larvae larval population ~~with the values (96.91% and 95.32%)~~ in 2020 and 2021 respectively, ~~while and~~ the reduction in *Pieris*pupae pupal pupation was~~reached (~~70.87% and 71.59%~~)~~ respectively during these two trials.Similar results were observed with botanical extracts. Parasitization by *T.evanescens* ranged between 91.95-92.77% in the plots sprayed with bio- and natural compounds during the trials in two years. ~~, followed by the botanicals extract treatment with the parasitoid releases, as it caused a reduction in larvae with the values (96.31% and 94.89%) in 2020 and 2021 respectively. Also, *Pieris* pupae reduced to (77.4% and 72.63%) respectively. Results indicated that both the tested compounds permits the *Trichogramma* females to parasitize *Pieris* eggs with the rates (92.56% and 92.17%) in plots of *Trichogramma* with *Bt*., in 2020 and 2021 respectively, and (91.95% and 92.77%) in plots of *Trichogramma* with the botanicals extract in 2020 and 2021 respectively.~~ Meanwhile, the insecticide treatment was the least effective in reducing *P. rapae* population (37.85% and 47.85% respectively). ~~Generally, the results revealed~~It could be concluded that either *B. thuringiensis* or the botanicals extract could be integrated with *T. evanescens* releases for the sustainable production of ~~clean and healthy agricultural products.~~Cauliflower.

Keywords: Compatibility, *Trichogrammaevanescens*, *Bacillus thuringiensis*, ~~Botanicals~~ botanicals extract, ~~Cauliflower~~cauliflower, *Pieris rapae*, ~~Sustainable~~ sustainable Production.

1- Introduction

~~Conservation of the environment must be ranked first before the effectiveness of any synthetic or natural compound used for pests' control. The current agricultures~~Agriculture~~are affected~~faces~~by many~~several challenges like~~rapid exploitation of~~ the natural resources ~~rapid exploitation~~, the huge use of insecticides and the sudden changes in the global climate, in addition to the need for the production of safe, pesticides-free agricultural products mainly the edible vegetables. All ~~that~~ thesechallenges push researchers and those responsible for public health to work on new, safe, available and eco-friendly alternatives to the synthetic pesticides for suppressing pests invading agricultural crops [36]. One of ~~those~~ theimportant ~~vegetables~~ vegetablecrops is the cauliflower ~~crop~~ (*Brassica oleracea*) ~~Family: Brassicaceae,which comprises many crops of nutritive, healthy and economic benefits, like cauliflower, broccoli, cabbage, collard, kale, mustard and rape [10]. Cauliflower has valuable nutritional facts; it is rich in the anti-oxidant compounds and carotenoids which help in the prevention of different kinds of dangerous diseases. Also, it is rich in vitamins C and B6; it comprises water, carbohydrates, and protein, potassium and dietary fibers with low dietary minerals [13] and [34]. That~~This~~economically~~ important ~~and economic~~ crop is seriously attacked by the ~~serious~~ cabbage white butterfly *Pieris rapae* L. (Family: Pieridae). The pest is the most abundant during all the seasons, where the female lays solitary, yellowish eggs, hatching into nasty, green larvae which considered the most serious and destructive stage causing great economic loss in the yield [20] and [5]. ~~Once farmers noticed the presence of *Pieris* larvae, they immediately controlled it with abroad~~Continuous application of broad spectrum ~~of~~ synthetic insecticides~~,~~ hasresulted in the development of the pest resistance, destruction of beneficial insects and contamination for the environment [6]. ~~Nowadays~~Currently, great attention has been ~~directed~~ drawn to the use of ~~the~~ various biological agents such as the parasitoids and ~~the beneficial pathogenic microorganisms~~entomopathogens~~to be applied~~ instead of ~~the~~ synthetic insecticides[37] , [15], [14] and [16]. ~~*Trichogramma* parasitoids, the egg parasitoids (Family: Trichogrammatidae), are minute wasps, have the ability of pest specify, host finding and a self-increasing population effect [23]. Its tiny female parasitizes many lepidopteron eggs, resulting in destroying and regulating those pests population [24] and [35]. For that,~~ *Trichogramma*~~parasitoids~~ parasitoids are considered the most efficient and ~~promise~~ promisingorganisms in biological control programs [46]. As the damage caused by *P. rapae*

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reduces the crop production, ~~so,~~ the intervention with *Trichogramma* parasitoids with compatible bio and natural compounds is imperative to conserve ~~Trichogramma parasitoids~~naturally occurring bioagents and to ~~maintain~~ harvesthealthy and safe ~~products~~produce. The entomopathogen *Bacillus thuringiensis* ~~are specific pathogens for lepidopteron larvae, it~~ is considered as an efficient biological control agent resulting in significant reduction in the pest and ~~the~~ in the use of~~used~~ chemical insecticides [2]. ~~Taking into consideration the severity caused by chemical insecticides, natural alternatives as certain plant products could be considered as natural pesticides [9] and [29]. The plant kingdom comprises certain plants possess insecticidal properties [12], so the~~The components of abotanical~~s~~ extract [39~~]~~] such as~~which is a prepared mixture of~~ ginger, garlic, and hot red pepper~~,extracts with~~and aloe vera~~. Each ingredient of that mixture~~ possess an insecticidal effect against many insects [32],[43],[30] and [21]. ~~However, this~~The botanicals mixture was found to be effective against certain pests [39]~~but also; it~~and was safe ~~on to~~*Trichogramma~~T.~~ *evanescens*Westwood~~developmental stages~~ under laboratory conditions [40]. ~~In earlier studies t~~The integration of the parasitoids with bio and natural compounds was earlier evaluated ~~as those of~~by[31~~] and~~] and[26~~] who~~] who found that, ~~*Trichogramma T.* evanescens~~ with *B. thuringiensis* was effective against *Helicoverpazea~~s~~*Boddie~~(Lepidoptera: Noctuidae)~~ and *Ostrinianubilalis* (Hubner)~~European corn borer~~. ~~So, because~~ Because of the legal restrictions on the edible fresh vegetables~~,~~ and the periodical~~ly~~ sprays of different insecticides ~~on cauliflower pests mainly *P. rapae*,different~~ alternatives ~~to the synthetic insecticides~~ have to be~~been~~ introduced to suppress *P. rapae*~~that serious pest~~. Therefore, this work was carried out to evaluate the efficacy of *B. thuringiensis* ~~and~~ ,the botanicals mixture extract and ~~their integration~~ combinations with *T. evanescens* releases against *P. rapae* infesting cauliflower crop.~~to ensure sustainability production of that important, healthy and economic crop with the preservation of the natural enemies and the agricultural ecosystem.~~

2-Materials and Methods

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~~This experiment was established to~~Experiments were carried out to evaluate the integration of ~~releasing~~*T. evanescens* Westwood releases with certain bio and natural compounds ~~comparing with synthetic insecticide aiming at suppressing~~for the management of*P. rapae*~~population infesting~~on cauliflower.Comparisons were made with an insecticide. ~~crop.~~ Preparation of the botanicals extract and the rearing processes were carried out at the *Trichogramma* Mass Rearing Laboratory of Fayoum Governorate, Plant Protection Research Institute, Agricultural Research Center,Egypt.

2.1. Rearing T. evanescens~~Techniques~~

The rearing of the host *Sitotrogacerealella* and the parasitoid *T. evanescens* were conducted at 25±2°C and 70±5% R.H.The host *S. cerealella* Olivier was reared as the modification of [17].The parasitoid was multiplied on *S. cerealella*~~moths rearing is reared first to produce the~~ eggs.~~in which *Trichogramma* parasitoid will develop~~

~~*2.2. Rearing the host Sitotroga cerealella*~~

~~*The host S. cerealella Olivier was reared as the modification of [17].*~~

~~*2.3. Rearing T. evanescens parasitoids*~~

~~*As described by[1], fresh S. cerealella eggs were distributed on self-adhesive paper, then parasitoids released on that eggs in glass jars and provided with a droplet of cane honey as nutrition for the adults. The jars were covered with cloth wrapped cotton, tied well by rubber bands. The egg cards replaced daily to avoid super parasitism.*~~

2.42. Preparations of the botanicals extract

~~(According to [39]~~

The botanicals extract was ~~prepared~~ prepared as per the methods described by [39].~~to be used in this work as a biocide for *P. rapae* larvae.~~ About one kilogram of garlic bulbs, dry hot pepper, fresh ginger rhizomes were cleaned, ground well, soaked in ten liters water for 48-72 h~~,~~and ~~,filtered?~~Then refined and squeezed well. ~~~~About one kilogram of aloe vera~~leaves~~ leaves werecut into small pieces, ~~blinded~~ blendedand added to the filtrate ~~and~~ . This mixture was diluted to 100 liters water for spraying.

2.53. Field experiments

Field experiments were carried out at Atfih District, Giza Governorate,Egypt in ~~2020 and 2021~~ cauliflower~~growing~~ seasons of 2020 and 2021 ~~of cauliflower crop~~. The experimental ~~area~~wascarried out as completely randomized block design~~,~~ with six treatments and the control with three ~~replicates~~replications ~~per each~~. Each replicate was ¾ feddan and each plot was separated with three rows as a buffer zone from the adjacent plot to reduce~~d~~ interference of the treatments. The experimental plots were planted with cauliflower seedlings (Colonia variety) on 25th September. Each plot had 10 rows of cauliflower plants which was 50 cm a side within the rows. Plants were inspected for the presence of eggs, larvae and pupae of *P. rapae* every 10 days until harvest on 5th December. ~~*P. rapae eggs, larvae and pupae were counted before any treatment.*~~Pre-treatment population count was ~~randomly~~maderandomly from half of the ~~plants~~ rows. ~~Colored paper cards were tied with p~~Plants had eggs of *P. rapae* was marked with coloured paper cards.~~.~~ Larvae and pupae were also counted. The first release of *T. evanescens* was done after 20 days of transplanting the seedlings~~. The parasitoids were held in hard~~ Hard paper envelopes housing the parasitoids were ~~and it was~~ hung ~~inside~~ in the canopy of the cauliflower plants at the rate of 60 envelopes/ feddan (about 90000 parasitoids/each release). Each envelope had three pieces of different developmental stages of *T.*

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evanescens. The envelopes were hung every 10 days at the sunset. Normal cultivation practices were ~~accomplished~~ followedin cauliflower field.

The treatments were: Releasing *T. evanescens* alone, spraying *B. thuringiensis* alone, spraying the botanicals extract alone, ~~releasing~~combination of*T. evanescens* with *B. thuringiensis*, ~~releasing~~ combination of*T. evanescens* with the botanicals extract, the chemical insecticide Uphold 36% SC and the control~~s~~ (~~had neither release of *T. evanescens* nor any compound sprays, so damaged cauliflower plants quickly increased~~without any treatment). Back motor sprayer (Agranomodo- China) of 20 liters was used for spraying the compounds.Unparasitized and parasitized *Pieris* eggs, number of both larvae and pupae of *P. rapae* were the criteria used for the evaluation of ~~T. evanescens release as alone or in combination with B. thuringiensis or with the botanicals extract or the chemical insecticide spraying~~the treatments. ~~In case of~~Upon appearance ~~*Pieris*~~of *Pieris* larvae ~~presence~~, ~~it was immediately sprayed~~ sprays of with the tested compounds were applied in the early morning with the recommended rates as following:

1) *Bacillus thuringiensis* subsp*kurstaki* 9.4% WP at the rate of 300 gm~~.~~/200 L. (Product of Plant Protection Research InstituteAgricultural Research Center, Egypt.)
2) The prepared botanicals extract at the rate of 1L/100L.
3) Uphold 36% SC at the rate 250cm/200L. (Commonly used by farmers in the neighboring fields in case of heavy infestation with the pest)

~~4) Back motor sprayer (Agranomodo- China) of 20 liters was used for spraying the compounds.~~

2.64. Data collection and statistical analysis

The ~~obtained~~ *Pieris* eggs collected from the plots were observed every 10 days to record the parasitism ~~induction~~ (the black color of the eggs). The ~~evaluation~~ efficacyof the treatments wasassessed ~~based on~~through the percent reduction of *Pieris* ~~infestation~~population ~~percentages~~. It was calculated according to [18].

$$Reductionpercentage = \left[11 - \left(\frac{Populationofpestaftertreatment}{Populationofpestbeforetreatment} \times \frac{Populationincontrolbeforetreatment}{Populationincontrolaftertreatment}\right)\right] \times 100$$

Obtained data of treated plots were compared with those of Uphold insecticide and control plots. ~~All s~~Statistical analysis was carried out by IBM-SPSS for windows (v.25). Variance Analysis (ANOVA) was used to process the obtained data. Duncan's multiple range test~~s~~[7]. was used for separation of means [41].

~~3.13.~~ Results

3.1. Efficiency of tested compounds on P. rapae

a. Reduction percentages of P. rapae larvae

The bio compound *B. thuringiensis*~~was significantly effective as~~ combined with *T. evanescens* releaseswas significantly more effective in reducing *P. rapae* larvae population in 2020 and 2021($P<0.05$) with reduction percentages of 96.91% and 95.32% respectively~~,~~. This wasfollowed by the natural compound the botanicals extract ~~accompanied with~~combined with the parasitoids releases ~~with~~ causing the reduction in *Pieris* larvae population ~~of~~ by 96.31% and 94.89% in 2020 and 2021 respectively. The chemical insecticide Uphold was the least effective compound in reducing the larvae population with respective reductions of 37.85% and 47.85%. (Figure 1, 3).

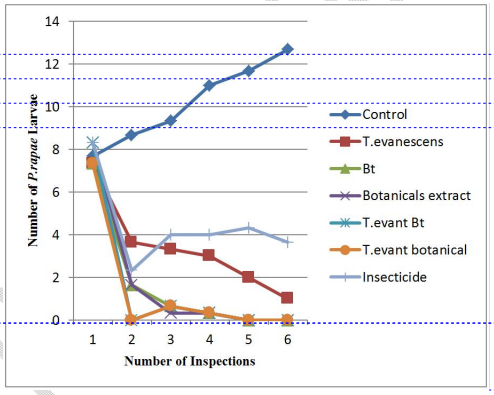

Figure 1. *~~Evolution~~ Population of Prapae~~Larvae~~ larvae on Cauliflower ~~Plants in tested treatments plots and control~~ in 2020 growing season.*

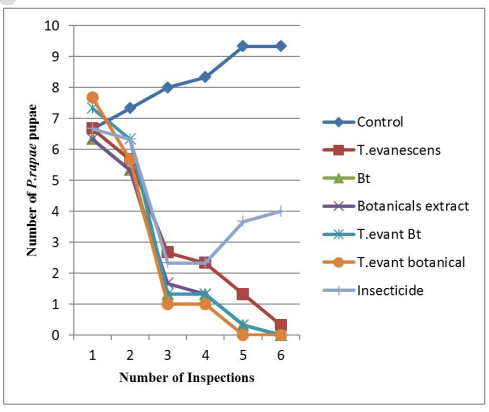

Figure2.*~~Evolution~~ Population of ofP.rapae pupae on Cauliflower ~~Plants in tested treatments plots and controls~~ in 2020 growing season.*

b. Reduction percentages of P. rapae pupae

The tested compounds ~~were~~ significantly differed in its effectiveness against the population density of *P. rapae* pupae ($P<0.05$). The botanicals extract accompanied with *T. evanescens* releases was effective in reducing pupae of *P. rapae* on cauliflower plants in 2020 and 2021 growing

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seasons with reduction percentages of 77.4% and 72.63% respectively, followed by the treatment of combination of *B. thuringiensis* with *Trichogramma* releases with reduction of 70.87% and 71.59% in 2020 and 2021 respectively. The least reductionsof 26.12% and 14.04%in *P. rapae*~~pupae~~ pupal populationin 2020 and 2021 respectively~~was 26.12% and 14.04% in 2020 and 2021 respectively~~ w~~as~~ere recorded ~~with~~ in plots sprayed withthe chemical insecticide Uphold. (Figure 2, 4)

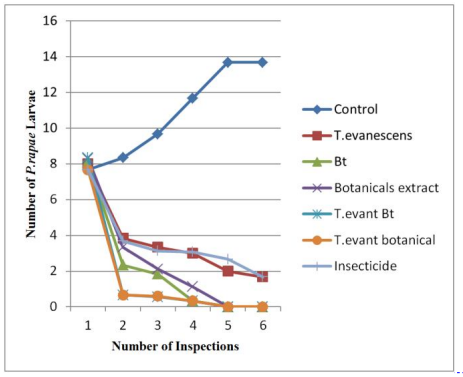

Figure 3. ~~*Evolution*~~ *Population of P.rapae Larvae on Cauliflower* ~~*Plants in tested treatments plots and control*~~ *in 2021 growing season*~~s~~.

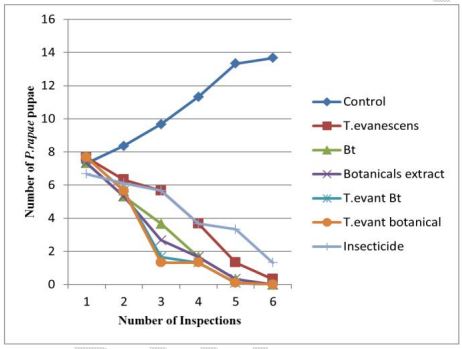

Figure4. ~~*Evolution*~~ *Population of P.rapaepupae on Cauliflower* ~~*Plants in treatments plots and controls in 2021 growing season.*~~

Table1. ~~*Evolution of P.rapae eggs numbers with parasitism Percentages by*~~*Parasitim by T.evanesces on* ~~*P.rapae eggs Cauliflower plants in treatments plots and the controls*~~ ***(2020).***

T.evanescens			***B.thuringiensis***			**Botanicals extract**			***T.evanescens*+Bt**			***T.evanescens*+botanicals extract**			**Insecticide**			**Control**		
unp.	**P.**	**%Paras**	**unp.**	**P.**	**%Paras**	**unp.**	**P.**	**%Paras**	**unp.**	**P.**	**%Paras**	**unp.**	**P.**	**%Paras**	**unp.**	**P.**	**%Paras**	**unp.**	**P.**	**%Paras**
7.663	0	0	8.33	-	-	8	0	0	8.67	0	-	8.33	0	0	8	-	-	7.66	-	-
	8.66	74.27	5.67	0	0	5.66	0	0	2.33	9	79.44	2.33	9	79.44	8.67	0	0	9.33	0	0
2	12.33	86.04	6.33	0	0	6.67	0	0	2	12.33	86.04	2.33	11.33	82.94	9.33	0	0	10.33	0	0
0.67	12.33	94.85	5.67	0	0	6	0	0	0.33	12	97.32	0.33	12.33	97.39	9.33	0	0	10.67	0	0
0	12.33	100	6	0	0	6	0	0	0	13	100	0	13	100	9	0	0	13.33	0	0

~~*tested*~~*in 2021 growing season.*

c. Parasitism percentage

There was no parasitism rate recorded before any treatment in 2020 and 2021~~, consequently, with~~With the successive releases of *T. evanescens*, increase in the parasitism ~~percentages raised~~was observed in parasitoid-released plots ~~of releasing the parasitoids~~. Results presented in Tables 1, 2 revealed that~~,the treatment of releasing the plots treated with~~*T. evanescens*~~accompanied with~~and *B. thuringiensis*~~raised~~ hadthe ~~P. rapae eggs parasitism by~~parasitism rates of 92.56% (2020) and 92.17% (2021). Also, *T. evanescens* releases with the botanicals extract recorded parasitism rates of 91.95% (2020) and 92.77% (2021). Results revealed that~~,~~ releases of *Trichogramma* parasitoids ~~only~~ alonewithout any compound recorded parasitism rates of 91.03% (2020) and 89.99% (2021). The remaining treatments plots showed no parasitism rate as there no released parasitoids~~.~~ (Tables 1, ~~2~~)2) proving no natural parasitism.

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0	13.33	100	2	0	0	1.67	0	0	0	13	100	0	13	100	9.33	0	0	12.67	0	0
2.22	9.83	91.03	5.67	0	0	5.67	0	0	2.22	11.87	92.56	2.22	11.73	91.95	8.94	0	0	10.67	0	0

Table2.Table1 Parasitism by T.evanesces on P.rapae eggs Evolution of P.rapae eggs numbers with parasitism Percentages by T.evanesces on Cauliflower plants in treatments plots and the controls (2021).

T.evanescens			*B.thuringiensis*			Botanicals extract			*T.evanescens*+Bt			*T.evanescens*+botanicals extract			Insecticide			Control		
unp.	P.	%Paras	unp.	P.	%Paras	unp.	P.	%Paras	unp.	P.	%Paras	unp.	P.	%Paras	unp.	P.	%Paras	unp.	P.	%Paras
8.33	-	-	7.67	-	-	8	0	0	8.33	-	-	7.67	-	-	7.67	-	-	7.33	-	-
3.33	7.67	69.73	7.33	0	0	7.67	0	0	2.67	8.33	75.73	2.33	8.67	78.82	8.33	0	0	9.67	0	0
2.67	13.11	83.08	7.11	0	0	8.33	0	0	2.03	13.33	86.78	2	13.67	87.24	9.67	0	0	11.33	0	0
0.33	15.33	97.89	6.67	0	0	5.67	0	0	0.23	13.67	98.35	0.33	14.67	97.8	11.33	0	0	15.03	0	0
0	15.76	100	7.33	0	0	6.67	0	0	0	15.33	100	0	15.67	100	13	0	0	18	0	0
0	16.33	100	7.33	0	0	7.67	0	0	0	16.67	100	0	16.33	100	13.67	0	0	19	0	0
2.44	13.62	90.14	7.24	0	0	7.34	0	0	2.21	13.47	92.17	2.01	13.8	92.77	10.61	0	0	13.39	0	0

4. 3.2Discussion

The impacts of any integration between synthetic or natural compounds with biological controlling agents like *Trichogramma* parasitoids on that bio-agent mustthe latter should be considered. The present workin 2020 and 2021 growing seasons indicates that incorporating either *B. thuringiensis* or the botanicals mixture extract might be compatible with *T. evanescens* for suppressing *P. rapae* populations infesting cauliflower plantations in 2020 and 2021 growing seasons. Obtained results revealed that releasing *T. evanescens* with *B. thuringiensis* could suppress *P. rapae* larvae and pupae populations and resulted in the highest parasitism rates of *Pieris* eggs than those treated by releasing *Trichogramma* parasitoids as alone, that's because *Trichogramma* females parasitizes fresh eggs of the pest and *B. thuringiensis* kills larvae of the pest. Our results are consistence in concurrencewith those of [27] who evaluated releasing *Trichogramma* parasitoids with and without *B. thuringiensis*; their results confirmed that releasing only *Trichogramma* parasitoids only was less effective than releasing them with *B. thuringiensis* for controlling Lepidopteron pests. Also, [42] supported our observations with their work on controlling *P. rapae* in organic cabbage crop, . they They reported that,*B. thuringiensis* with *Trichogramma* releases was the most effective treatment as it caused high parasitism rate of *Pieris*eggs with a remarkable reduction in larvae populations which resulting in a significant increase in the crop yield over the treatment with *Trichogramma* alone or controls. Other authors worked on the combination combined use of different species of *Trichogramma* parasitoids with and *B. thuringiensis* on different crops aiming at the control of different Lepidopteron pests, . as those of, [26]who evaluatedproved high efficiency ofthe combination of *T. nubilalis* and *Bt.*, for controlling *Ostirnianubilalis*H. (Lepidoptera: Pyralidae) infesting sweet corn. . the results of their work showed high efficiency in reducing the pest population with the recommendation of the integration of *Trichogramma* parasitoids with *Bt.* [44] who reported that, the The combination of *T. evanescens* with Agerin (*B. thuringiensis*) was highly effective against *Cryptoblabesgnidiella* Mill infesting grape orchards as it caused the highest parasitism in the honey dew moth with the highest mortality for its larvae than those with the parasitoids only[44]. .[3]investigated the efficiency of two species of *Trichogramma* parasitoids in combination of *B. thuringiensis* to control *T. absoluta* infesting tomato in greenhouse, they reported that *B. thuringiensis* was not harmful for the parasitoids as recorded fromproven by the highest parasitism rates. investigated the efficiency ofof two species of *Trichogramma* parasitoids in combination of *B. thuringiensis* to controlon*T. utaabsoluta* infesting tomato in greenhouse. . they[33] who evaluated the effectiveness of *T. evanescens* Westwood as alone or combined with *B. thuringiensis* var. Kurstaki for controlling*Cydia pomonella* (L.) in apple plantations, they reported that *T. evanescens* was highly effective on suppressing the *Cydiapomonella* (L.) in apple plantationspest populations when the parasitoid releases was were combined with *B. thuringiensis* than their releasing alone or than spraying *Bt* aloneeither of the agents beingusedalone[33]. The obtained results from the current study revealed that *B. thuringiensis* had no bad adverseeffect on *Trichogramma*parasitoids efficiency. Earlier studies agreed with our findings as those of [19] who studied the effect of *B. thuringiensis* on *Trichogramma ostriniae* (Peng and Chen) to produce an eco-friendly control strategy. They stated that, the combination of *Trichogrammaostriniae* (Peng and Chen) *Trichogramma* and *Bt*decreased reduced significantly the pest population significantlyover any either of thebio agent alone. [25]evaluated the effectsfound that amongof *B. thuringiensis*,

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deltamethrin and ~~spinosad~~Spinosad, only *Bt* was harmless to~~on~~ the immature developmental stages of *T. cacoeciae*Marchal, *T. bourarache*Pintureau and *T. evanescens* Westwood in pomegranate orchard~~, they reported that deltamethrin and spinosad were harmful to the immature developmental stages of the parasitoid and *B. thuringiensis* was harmless towards the immature stages of the parasitoids. [4]evaluated the effects of *B. thuringiensis* Kurstaki with honey as a nutrition diet for *T. evanescens* adults on its efficiency; they reported that s~~S~~pore~~s~~ mixture of *B. thuringiensis*~~had no~~did not affect~~bad effects on~~ the parasitization performance or longevity of the *T. evanescens* adults[4]~~parasitoids~~. ~~Also~~Similarly, [38]~~who evaluated certain bio and chemical compounds on the efficiency of *T. evanescens* under laboratory conditions and her results revealed~~found that *B. thuringiensis* was safe ~~and had no bad impacts on the fitness components of~~to the*T. evanescens*parasitoid, ~~in addition, she controlled *T. absoluta*~~infesting tomato fields at Fayoum Governorate, Egypt, ~~by releasing *T. evanescens* with spraying *B. thuringiensis*~~and was able to suppress ~~the populations density of~~ *T. absoluta*infesting tomato fields at Fayoum Governorate, Egyptby releasing *T. evanescens*~~with~~and spraying *B. thuringiensis*~~.~~ The present study declared that, the use of *B. thuringiensis* as alone recoded reduction in *Pieris* larvae and pupae populations. Our findings are consistent with an earlier ~~study~~ studiesby [45~~],~~],[22~~] and~~],[11] and [28]who reported that *B. thuringiensis* ~~with different concentrations~~ wereas significantly effective against *Pieris* larvae *P. brassicae*~~(L.) larvae with 100% mortality after 2-6 days of the treatment, [28] who found that *B. thuringiensis* could control *Pieris* larvae in Cole plantations in Alabama. W~~while~~,~~ [8]~~evaluated certain compounds aiming at the reduction of *P. rapae* larvae populations on cabbage plantations and~~ reported that Bio Guard (*B. thuringiensis*) was the least effective compound against *P.rapae*.

In this work, ~~the second tested compound was the botanicals extract, it is a mixture of certain natural plants extracts; the obtained results revealed that,~~ the combination of the botanicals extract with *T. evanescens* releases ~~was not an impediment to *Trichogramma* females to parasitize *Pieris* eggs,~~did not affect the parasitism despite its lethal effect on *Pieris* larvae~~. The results of *T. evanescens* with the botanicals extract revealed that high parasitism rates with remarkable reduction in *Pieris* larvae and pupae populations. From the safety prospective,~~[40]~~agreed with our findings when they evaluated the botanicals extract on the fitness components of *T. evanescens* under laboratory conditions, they~~ reported that the botanicals extract was safe ~~on~~ to~~the emergence, fecundity and the general productivity of the~~ ~~resulting~~*T. evanescens*~~parasitoids, however, t~~The same botanicals extract had a bio pesticide property [39], ~~as they evaluated it to control~~effective against mango scale insect and was recommended~~ it~~ as safe ~~and~~ ,easy prepared extract and an alternative to synthetic insecticides.

~~4~~5- Conclusion,

Either*B. thuringiensis*~~or~~ ~~or~~the botanicals extract in combination with *T. evanescens* releases~~had~~ has thepotential~~s~~ to suppress *P.rapae* populations on cauliflower plants~~ with *T. evanescens* releases.So each of the bio compound *B. thuringiensis* or the botanicals extract was promising and could be integrated with the releases of *T. evanescens*~~and could be used as alternative~~s for synthetic insecticides~~ for controlling *P. rapae*.~~

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