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Compatibility and Synergism of Certain Insecticides for Control of Thrips (*Thripstabacia*) on Onion (*Allium cepa* L.) Plants in the Field

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ABSTRACT

The field studies were conducted to evaluate the bio-efficacy of certain insecticides (spinosad, Indoxacarb, chlorpyriphos, chlorfenapyr and emamectin benzoate) against *Thripstabacia*, and their chemical compatibility when combination with mancozeb as fungicidesand spray against *Thripstabacia*onthe Onion field during 2018season. Physical compatibility of insecticides and mancozeb as fungicides was recorded under the laboratory conditions by taking observations on color, solubility, appearance and pH etc. The results appearance that, spinosad was the superior in reduction percentage infestation with thrips followed by chlorfenapyr, emamectin benzoate, indoxacarb and chlorpyriphos, respectively. The average reduction percentages after spray were 81.5% for spinosad, 72.1% for chlorfenapyr, 66% for emamectin benzoate, 60.1 % for indoxacarb and 55.0 for chlorpyriphos, respectively. The mancozeb addition as fungicides and Tween80 to all tests compounded gave synergism for all insecticide against *T.tabacia* and Physical compatibility of test insecticide and mancozeb combinations were seen under laboratory conditions. Phytotoxicity symptoms were never observed when insecticides applied alone or their combinations with mancozeb as fungicides on Onion crop compared over control.

INTRODUCTION

The onion (*Allium cepa L.*) is the most important vegetable crop and is grown all over the world. It is called "queen of the kitchen" and is used all the year round. (Patel *et al.,* 2009).Insecticides are a major tool for thrips control, but this strategy is inadequate and unsustainable (Manianiа*et al.,*2003) because the thrips have developed resistance to various groups of insecticides (Lebedev *et al.,*2013). A pesticide mixture is a combination of two or more pesticides into a single spray solution applied simultaneously (Cloyd 2011). Combined applications of insecticides and fungicides or adjuvants may result either in antagonism (incompatible) or synergism (compatible) between them (Duta *et al.,* 2017). Compatible means, no negative effects on crops when it is combinedly applied with different pesticides which can be physically mixed together. Incompatible refers to the reaction of pesticides that cannot be combined safely without impairing the effectiveness of one or more of the chemicals. Incompatibility of pesticides leads to plant injury, or causing developing undesirable chemical or physical properties (Prakash, 1992). There are two basic types of incompatibility: physical and chemical. It is possible to become one or both from the same mix. Chemical incompatibility includes the breakdown and loss of effectiveness of more or one products in the spray tank and possible formation of one or more new chemicals that are insoluble or phytotoxic. Physical incompatibility involves an unstable mixture that settles out, flocculates foams excessively or disperses poorly and decreases efficiency and affects the clogging of sprayer nozzles and screens. This type of incompatibility may result from the use of soft, hard, cold water and fertilizer solutions for mixing (Amin *et al.,* 2013). As most of the pesticides are specifically toxic either to disease causing pathogen, insect pest or management of both with any single pesticide is not practicable. Therefore it is necessary to mix an insecticide with the fungicide and apply on a crop. Application of more or two chemicals can save labour, time, energy and equipment cost provided there are no adverse effects on the plant, non-target organisms and on the efficacy of the chemicals in combating the problems (Lakshminarayana and Subbaratnam, 2000). Respondents indicated a wide-variety of pesticide mixtures including two, three, and four-way combinations (Cloyd, 2009). Many of the binary mixtures reportedly used contained at least one pesticide either not registered or known to be not effective against adult western flower thrips. The objectives of this study were 1.Evaluate the efficacy of currently used binary and tertiary pesticide mixtures against the western flower thrips under field conditions.2.Examine compatibility and phytotoxicity of the most commonly used binary pesticide mixtures against western flower thrips based on survey results.

MATERIALS AND METHODS

The experiment to evaluate different insecticides for the control of thrips on onions was carried out at during 2018 season in open onion field at Faculty of Agriculture AL-Azhar University, Assuit, Egypt.

1. Sampling technique

The experiment was followed by Randomized Complete Block Design (RCBD) with six treatments and three repeats at both sites. The treatments are listed in Table(1). The pesticide doses used in this study were based on the label recommendation rate. The insecticides were obtained from Shoura company for Pesticides and Chemicals, Cairo, Egypt.

Table 1. The tested compounds witch used in the study

No	Trade name	Active Ingredients	Rat/Fed.
		Insecticides	
1	Tracer 48% EC	spinosad	60 ml
2	Vanty	chlorfenapyr21 % SC	150 ml
3	Speedo	emamectinbenzoate	120gm
4	Flax	indoxacarb	60 ml
5	Tak	chlorpyriphos 48 % E.C	1Liter
		Fungicides	
1	DithaneM-45 80 WP	(mancozeb)	750gm
3	Control		

The net plot size for each treatment was 10x8 m. The onion nursery of the same cultivar was sown in mid-October and transplanted on attaining the age of 45 days to the ridges. The ridges were 30 cm apart with two rows of onion plants at their tops. These rows were 20 cm apart from each other with a 10-cm plant to plant distance. All agronomic practices were kept the same for all the treatments except applications of the insecticides to be tested for the control of thrips.In other trails same insecticides were used with tween80 as

surfactant at the rate of 0.5ml/l of water was used for the study.in the last addtative mancozeb by 0.5 ml/l for testes insecticide with spray. For the control of onion blotch was also applied uniformly to all the treatments.In vitrostudies were carried out in the laboratory of the Plant Protection Department, Faculty of Agriculture AL-AZahr University Assiut. The general laboratorytechniques were followed the tested compounds witch used in the study were mixed with mancozeb to test physical compatibility viz., colour, solubility, appearance, pH etc.under laboratory conditions.10 ml from one insecticide and put in 100ml water and addition 10 ml from mancozeb. Pre-treatment with tests insecticide, population data of onion thrips were recorded at regular weekly intervals from ten randomly selected plants in each replicate and the numbers of thrips present in each treatment were visually counted and averaged to obtain the mean population for each replicate (Din *et al.*2016).insecticidal application was given as soon as ETL of onion thrips (5-10 thrips/plant) was reached (Tadele and Mulugeta,2.14).

Spraying was done in the early morning hours to avoid the mid day heat. For recording observations five plants were randomly selected labeled in each experimental plot. The pre-count was recorded one day before application of treatments. After the application of treatments the observations were recorded at 3, 7, 10 and 14 DAS. Reduction (%) was calculated according to Henderson and Tilton's equation (1955).Collected data were analyzed statistically for analysis of variance to determine the significant difference among the treatments. All statistical analyses were conducted using MSTAT-C software v.11.0.

RESULTS AND DISCUSSION

1. Efficacy of certain insecticide applied alone against *T. tabaci* in the onion filed.

Data in Table (2) show that, all of the insecticides assured the control of onion thrips at various degrees of significances over the untreated check. The population of thrips (both nymphs and adults) per plant a day before application of treatments in different treatments was uniform which ranged from 16.1 to 16.6. Efficacy of insecticide treatments decreased with increase in data collecting interval. Spinosad was the superior followed bychlorfenapyr,emamectin benzoate, indoxacarb and chlorpyriphos, respectively. The average reduction percentages after spray were 81.5, 72.1,66.0, 60.1, 55.0 % forspinosad, chlorfenapyr, emamectin benzoate, indoxacarband chlorpyriphos, respectively.These results are in agreement with those results obtained by Zezlina and Blazic (2003) reported highest efficiency of activesubstance spinosad and abamectin for control of *Thripstabaci* on onion. Kadam*et al.,* (2012) conducted experiment on bio-efficacy of insecticides against thrips, *Scirtothrips dorsalis*(H.) infesting pomegranate fruits with five treatments. Spinosad was the most effective treatment at 14 DAS and on par with fipronil followed by lambda cyhalothrin and imidacloprid. All the treatments were superior to control thrips/fruit).Vanisree,(2017). Evaluation of certain new insecticides against the population of thrips, *S.dorsalis* (Hood) on chillies, The results were showed that, the most effective treatment was spinosad reduction in population of *S. dorsalis* over control and was significantly superior over all the other treatments. The next best treatment was diafenthiuron in reduction population and was significantly superior to the rest of the treatments. The next best treatments were pymetrozine and fipronil being on par with more than 85% reduction in population over untreated check. The other treatments that followed in the descending order of efficacy were imidacloprid, chlorfenapyr, clothianidin,vertimec and emamectin benzoate. Among the treatments, indoxacarb and flubendiamide were found to be the least effective with less than 52% mean reduction in population over control. However, all the treatments were effective and significant in reducing the population of *S. dorsalis* over control after spraying.

Table 2.Toxicity of certain insecticide after applied alone against *T. tabaci* in the onion filed.

Insecticides	Percent reductionof infestation of *T. tabaci* after indicated days					Average reduction
	Pre-spray count	3day	7day	10 day	14day	
Spinosad	8.1	1	4	10	15	
	*R%	93.2	80.8	73.0	79.1	81.5
Chlorfenapyr	8	2	6	13.2	23	
	*R%	86.2	70.8	64.0	67.5	72.1
Emamectin benzoate	8.1	2.5	8	15.3	28	
	*R%	82.9	61.5	58.7	61.0	66.0
Indoxacarb	8.1	3	9	21	28	
	*R%	79.5	56.7	43.4	61.0	60.1
Chlorpyriphos	8.1	3.5	9.5	24	32	
	*R%	76.1	54.3	35.3	55.1	55.3
Control	8.3	15	21.3	38	73.5	-

2.Influence of Tween 80 addition by 0.5% as emulsifabile material on the bio-efficacy of insecticides against thrips in Onion filed.

Data in Table (3). Show that, Effect of Tween 80 addition by 0.5% as emulsifier material on the toxicity of spinosad, indoxacarb, chlorfenapyr, emamectin benzoate and chlorpyriphos against thrips in Onion filed. spinosad was the superior followed by chlorfenapyr, emamectin benzoate, indoxacarb and chlorpyriphos, respectively.The average reduction percentages for the spray were 90.2, 84.1, 75.5, 70.1 and 64.2%, respectively.The impact of surfactants in improving the efficacy of insecticides has been reported by earlier workers (Yu *et al*., 2009 ;Nault*et al.,*2013). (Gangwar, *et al*.. 2016).decided that,one of principle problem in onion thrips control is themobile stages of thrips which are found mainly in thenarrow space between inner leaves, where spray coverageis difficult to accomplish. Besides this the leaf surface ofonion is waxy and smooth which does not allow theinsecticide to adhere properly and spread or the spraydroplets were roll off on the surface of the leaves due tothis the residual effect of insecticide is less. Use of surfactant with insecticides is the best way to combat theabove problem.

Table 3. Toxicity of certain insecticide after applied with Tween80as surfactant at the rate of 0.5 ml/l against *T. tabaci* in the onion filed.

Insecticides	Percent reduction of infestation of *T. tabaci* after indicated days					Average reduction
	Pre-spray count	3day	7day	10day	14day	
spinosad	6	1	1.5	4	12	
	*R%	91.2	92.7	91.6	85.3	90.2
chlorfenapyr	6	1	2	8	23	
	*R%	91.2	90.2	83.3	71.8	84.1
emamectin benzoate	6.1	1.5	2.5	13.5	34	
	*R%	87.1	88.0	72.2	59.0	75.5
indoxacarb	6.2	2	3.5	15	47	
	*R%	83.0	83.4	69.6	44.3	70.1
chlorpyriphos	6.1	2.5	4.7	17	53	
	*R%	78.4	77.4	65.0	36.1	64.2
Control	6.1	11.6	20.8	48.6	83	-

3. Influence of mancozeb addition by 0.5 % on the bio-efficacy of insecticides against thrips in Onion filed.

From table (4) noticed that, influence of mancozeb addition by 0.5 % on the bio-efficacy of insecticides against thrips in Onion filed. The results revealed that, treatments consisting of combination of insecticides and mancozeb and were significantly superior to control. Synergistic effect was evident when these insecticides and fungicides were mixed and there was improved control over individual application of chemicals was noticed. From this study, it is evident that tank mixing of fungicides with insecticides did not reduce the efficacy of the insecticide against thrips. Hence, they are compatible with each other for spray application to control the thrips. maximum percent reduction intensity was by spinosad and Minimum control of thrips were achieved in the treatment of, chlorpyriphos (69.2%).These findings are inconformity with the findings of Maniania and Sithanantham, (2003) reported that in all the trials, thrips density and damage were significantly lower in the fungal andchemical insecticide treatments compared with the untreated control.

Table 4. Influence of mancozeb addition by 0.5 % on the bio-efficacy of insecticides against thrips at Onion filed.

Insecticides	Percent reductionof infestation of *T. tabaci* after indicated days					Average reduction
	Pre-spray count	3day	7day	10 day	14day	
spinosad +mancozeb	6.9	0.5	1.2	4.5	12.6	
	*R%	96.6	95.6	92.3	86.4	92.7
chlorfenapyr +mancozeb	7	0.98	2	7.1	19.9	
	*R%	93.3	92.8	88	78.8	88.2
emamectin benzoate+mancozeb	6.9	1	4	11.3	36.2	
	*R%	93.1	85.3	80.6	60.9	80.0
indoxacarb +mancozeb	6.8	1.5	6.5	14.2	42.6	
	*R%	89.5	75.8	75.2	53.3	73.4
chlorpyriphos + mancozeb	6.9	2	7	16.3	51.3	
	*R%	86.2	74.4	71.9	44.6	69.2
Control	6.9	14.5	27.3	58.1	92.6	-

4. Evaluation of Physical and Chemical Compatibility of Tank mix Pesticides and its Phytotoxicity on the Onion filed.

In the present experiment, five insecticides and one fungicides were evaluated for their physical and chemical compatibility were studied under laboratory conditionsvarious parameters like color, solubility, appearance, pH etc were studied by combining insecticides and fungicides. table (5) revealed that, in the case of spinosad, chlorfenapyr, chlorpyriphos, emamectin benzoate and mancozeb the color were milky white, Pale white, milky white,color less and yellow, respectively, and readily soluble when stirred except emamectin benzoate and mancozeb, $_{P}H$ were 8.0, 8.27, 7.97,7.60 and 7.4,respectively, the sedimentation was 15 ml to mancozeb only and not phytotoxicity was founded or sedimentation with other insecticide after mixture with water alone.Where pale yellow color was noticed and pH were7.4 and 7.7 when spinosad and chlorpyriphos mixed with mancozeb. Chlorfenapyr and emamectinbenzoate,the color were light yellow and brick red, and ph were (8.1 and 7.55) respectively, when mixed with mancozeb. Not phytotoxicity were founded and sedimentation was 15 ml with all insecticide when mixed with mancozeb. Smooth mixture, combined well after stirring and precipitate observed and no clumps. The insecticide was readily soluble with except emamectin benzoate when mixed with mancozeb.Shaila (2010) conducted experiments on compatibility of insecticides viz., abamectin, emamectin benzoate, novaluron and lufenuron with fungicides viz., mancozeb, chlorthalonil and carbendazim and reported that the wettability and emulsion stability of the insecticides remain unchanged when mixed with the fungicides.

1. Phytotoxic Compatibility

From the table (5) it is evident that no phytotoxic symptoms were seen in any combination treatments. When insecticides and fungicides were applied individually at recommended dose showed no phytotoxicity symptoms. Similar results were also reported for control of Onion insect pests by application of spinosad, chlorfenapyr, indoxacarb,chlorpyriphos,andemamectin benzoate with mancozeb atpre-flowering and post flowering stages Vidhyadhari (2016) concluded that spinosad in combination with all the fungicides/bactericide *viz.,* copper oxychloride, metalaxyl MZ and streptocycline was effective against aphids. Among spinosad combinations spinosad + metalaxyl MZ was most effective compared to other two combinations and also recorded highest yield.

Table 5. Physical and chemical compatibility of insecticides and fungicides under in *vitro* and phytotoxic effect on Onion.

Treatments	Color	Sedimentation (ml)	Solubility/Compatibility Parameters	pH	Phytotoxicity
Spinosad	Milky white	0.0	Readily soluble when stirred	8.0	No
Chlorfenapyr	Pale white	0.0	Readily soluble when stirred	8.27	No
Chlorpyriphos	Milky white	0.0	Readily soluble when stirred	7.97	No
Emamectin benzoate	Color less	0.0	Not readily soluble	7.60	No
mancozeb	Yellow	15.0	Not readily soluble and moderate	7.4	No
Spinosad+ mancozeb	Pale yellow	15.0	Smooth mixture, combined wellafter stirring and precipitateobserved and no clumps.	7.4	No
Chlorfenapyr + mancozeb	Light yellow	15.0	Smooth mixture, combined wellafter stirring and precipitateobserved and no clumps.	8.01	No
chlorpyriphos+ mancozeb	Pale yellow	15.0	Smooth mixture, combined wellafter stirring and precipitateobserved and no clumps.	7.7	No
Emamectin Benzoate + mancozeb	Brick red	15.0	Not readily soluble and moderateprecipitation was observed and noclumps	7.55	No

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توافق وتنشيط بعض المبيدات الحشرية لمكافحة التربس علي نباتات البصل فى الحقل

ربيـــع عـلـى إمام عـلـى

قسم وقاية النبات ـ كلية الزراعة ـ جامعة الأزهر بأسيوط

اجريت هذة التجربة فى مزرعة ومعمل كلية الزراعة جامعة الازهر ـ فرع اسيوط على محصول البصل لدراسة تاثيرمبيدات (الاسبينوساد- شالنجر ـ ايماكتين بنزوات- اندوكسكارب وكلوربيرفوس) والتي تستخدم فى مكافحة التربس كافة رئيسية لمحصول البصل فى الحقل.كذلك دراسة تاثير اضافة مادة توين ٨٠ كاحد المواد المنشطة لهذة المبيدات بالاضافة دراسة تاثير اضافة المانكوزيب كاحد المبيدات الفطرية على فاعلية هذة المبيدات الحشرية فى مكافحة التربس. واخيرا دراسة تاثير اضافة المانكوزيب على الخواص الفيزيائية للمبيدات الحشرية وسمية هذة المبيدات بعد الاضافة على نباتات البصل فى الحقل وكانت النتائج كالتالى اعطى مبيد الاسبينوساد اعلى نسبة خفض بالاصابة بالتربس وتلاه بعد ذلك مبيد شالنجر ـ ايماكتين بنزوات- اندوكسكارب واخيرامبيد الكلوربيرفوس.ادى اضافة مبيد المانكوزيب كمبيد فطري الى زيادة فعالية هذة المبيدات على مكافحة التربس فى محصول البصل فى الحقل وكان هناك توافق بين هذة المبيدات والمانكوزيب ولم يحدث اى سمية على النبات اوتغير فى الخواص الفيزيائية او الكيميائية لهذة المبيدات عند خلطها مع المانكوزيب ولذلك يمكن القول باضافة مبيد المانكوزيب لهذة المبيدات فى الحقل لزيادة فعالية هذة المبيدات فى مكافحة التربس فى محصول البصل.