PESTICIDAL EFFICIENCY OF NEWLY SYNTHESIZED ORGANO-CYANIDE COMPOUNDS AGAINST CERTAIN PESTS INFESTED BEAN PLANTS.

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Abstract

Pesticidal efficiency of three locally synthesized organo-cyanide compounds were determined in both laboratory and field. The tested compounds were (A) 2- amino- 4 -methyl -4 -(2-methyl prop -1- enyl) pent -1- ene. 1,1,3,5,5 penta carbonitrile, (B) 2-cyanoacetohydrazide and (C) 2-cyanoacetamide. Compound (A) was prepared as flowable formulation contains 22.5% (Wt./V.) active ingredient (a.i). while (B) and (C) were prepared as soluble powder formulation contain 90% (Wt./Wt.) a.i. in two different composition as B_1, B_2 and C_1, C_2. Toxicity of organo-cyanide compounds was determined against spider mite *Tetranychus urticae* in the laboratory while their pesticidal efficiency against pests: soya fly, aphid, leaf miner and spider mite infested bean plants were determined under field conditions. The obtained results indicated that only compound B showed moderate toxicity effect against *T. urticae.* Results of field experiments indicated that the effect of some compounds varied from one pest to another. The following compounds showed high initial and residual effects against pests A at 2%, B_1 at 1%, B_2 at 2% against soybean fly; A at 2%, B_1 at 2% , B_2 at 2% against aphid; A at 2%, B_1 at 2% B_2 at 2% against leaf miner and B_1 at 2%, B_2 at 1% against spider mite.

INTRODUCTION

Since most of common conventional pesticides are imported, high in cost, hazard to man and animals and become less effective against pests as a results of building cross resistance in pests. Therefore efforts should be directed towards a new groups of pesticides. Previous studies indicated that cyanide is a toxic group (Gleason *et al.*, 1969). It is known since long time that functionally substituted nitriles (1-4) (3-amino propane nitrile, 2-amino-3-cyanopropanoic acid, 2-amino-5-[(1-carboxy-2-cyano ethyl) amino]-5-oxopentanic acid and malononitrile) have neurotoxic osteolathy ritic effects. These compounds inhibit generation of fungi and produce deformation in those fungi which do grow (Ressler, 1962, Ressler., *et al.*, 1963[a], Ressler *et al.*, 1963[b], Blumenthal *et al.*, 1963, Ressler *et al.*, 1969[a], Ressler *et al.*, 1969[b] and Ferris, 1970). Malononitrile has also similar biological activity. It is assumed that presence of both cyano and amino function is essential although malononitrile looks as an exception. Compounds (1-4) are rather expensive and are thus thought of utility (A, B and C) for the same

purpose as they have cyano and amino functions with spacing very similar to that in (1-3) (Ostling and oevers 1915 and Anderson *et al.*, 1961).

The present work aimed at synthesize a new organo-cyanide compounds contain both cyanide and nitrile groups, characterized by cheep cost and easily preparation from their primary parent materials, preparation of the synthesized compounds as a suitable formulation and studying both toxicity against spider mite in laboratory and their pesticidal efficiency against some pests infested beans plants in field.

MATERIALS AND METHODS

Tested materials

Three locally synthesized organo-cyanide tested were:

(A) 2- amino- 4 -methyl -4 -(2-methyl prop -1- enyl) pent -1- ene. 1,1,3,5,5 penta carbonitrile prepared by condensing an appropriate nitrile derivative with ketone in toluene containing ammonium acetate, glacial acetic acid. Isotrop system (Dean stärk apparatus) by using Ostling method (Ostling and oevers 1915).

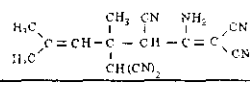
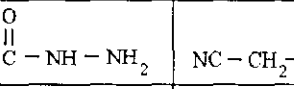
(B) 2- cyanoacetohydrazide. It was prepared by condensing cyanoacetic acid ethyl ester with hydrate derivative in toluene containing ammonium acetate and glacial acetic acid. Isotrop system by using Ostling method (Ostling and oevers 1915).

(C) 2- cyanoacetamide prepared by condensing cyanoacetic acid ethyl ester with ammonium hydroxide derivative in toluene containing ammonium acetate and glacial acetic acid. Isotrop system by using Ostling method (Ostling and oevers 1915).

Molecular formula and certain physical properties of compounds A, B and C are listed in Table (1).

Since compound A is insoluble in water, therefore it was prepared as flowable formulation contains 22.5% (wt./v.) a.i. while B and C showed moderate solubility in water, therefore they were prepared as soluble powders contain 90% a.i. from the required compound, in two different compositions as B_1, B_2 and C_1, C_2.

Table 1. Molecular structure, formula and some physical properties of compounds A, B and C.

Property	Compound (A)	Compound (B)	Compound (C)
Molecular structure			
Molecular formula	$C_{15}H_{14}N_5$	$C_3H_5N_3O$	$C_3H_4N_2O$
Molecular weight	264	99.09	84.07
Crystallized from	Hot Dimethyl formamide	Hot ethanol	Hot water
Melting point	>300°C	108-110°C	121-122°C
Specific gravity	0.522	0.477	0.68
Solubility (20°C)			
Water	Insoluble	Moderate	High
Dimethyl formamid	Free	High	High
1,4 Dioxane	Free	High	High
Dimethyl sulfoxide	Free	High	High
Tetrahydrofuran	Free	Free	High
Diethyl ether	Moderate	Free	Free
Acetone	Low	Free	Free
Acetonitrile	Low	Free	Free
Alcohols	Sparsely	Moderate	Free
Colour	Pale yellow	Pale move	White
Odour	Almost odourless	Almost odourless	Almost odourless

Toxicity of the synthesized compounds against spider mite *T. urticae*:

Series of aqueous concentrations of each material were prepared in order to investigate their acaricidal activity. The direct spray technique was used as the following: Twenty adult females of *T. urticae* were transferred to the lower surface of sweet potato disc (1 inch in diameter) using fine brush. Four discs were used as four replicates for each treatment. Discs were placed upside-down on moist cotton in Petri-dishes. The disc surfaces carrying the adult females were sprayed with the aqueous solution of the tested material using a manual atomizer. Control treatment was sprayed with water. The treated females were kept under constant temperature of 25 ± 0.5°C. The mortality was counted after 24 h of spraying and corrected by Abbott's formula (1925). LC_{50}, LC_{90} and slope values were calculated according to Finney (1971) using "LdP Line"® software.

Pesticidal efficiency of the tested materials against pests infested bean plants. It was conducted in the open field according to the Egyptian Ministry of Agriculture protocol (1993). Each material was tested at three concentrations : 0.5, 1 and 2%, spraying was done using 2 liters hand sprayer on highly infested bean plants with soya fly, aphid, leafminer and spider mite at Giza region in Egypt on August,15; 2004. Infestation was assessed before spraying and then 1, 3, 5 and 7 days after spraying by collecting 10 leaves from each treatment and untreated one. Inspection was done under binocular in laboratory to determine the number of each the considered pests per leaf. The pesticidal efficiency was calculated as a reduction percentage occurred in population of each pest as a result of treatment according to

the equation adopted by Henderson and Tilton (1955). On the other hand phyto toxicity effect was determined by recording any flaming, curling or colour changes occurred in leaf of plants.

RESULTS AND DISCUSSION

1- Toxicity of the tested materials against *T. urticae*. As it is shown in Table (2) both B_1 and B_2 revealed a moderate efficacy against mite adult females. Compound B_1 showed the best acaricidal activity with LC_{50} (0.991) and LC_{90} (2.928) followed by B_2 with LC_{50} (1.612) and LC_{90} (4.974). While compounds C_1, C_2 and A didn't show any acaricidal activity within tested concentrations (4%).

Table 2. Main criterion of the toxicity lines representing the acaricidal activity of tested materials against red spider mite *Tetranychus urticae*.

Name	Con. %	Observed mortality %	LC_{50} %	LC_{90} %	Slope
B_1	0.25	6.25	0.991 (0.823-1.223)	2.928	2.723
	0.50	25.00			
	1.00	37.21			
	2.00	86.36			
B_2	0.50	6.38	1.612 (1.336-1964)	4.974	2.619
	1.00	38.64			
	2.00	51.16			
	4.00	86.96			
C_1	0.50	0.00	-	-	-
	1.00	0.00			
	2.00	0.00			
	4.00	0.00			
C_2	0.50	0.00	-	-	-
	1.00	0.00			
	2.00	0.00			
	4.00	0.00			
A	0.50	0.00	-	-	-
	1.00	0.00			
	2.00	0.00			
	4.00	0.00			

2- Pesticidal efficiency of the tested materials against pests infested bean plants. Results in Tables (3, 4, 5 and 6) showed that the efficiency of the compounds are different according to the target pest. The results could be divided to the following:

- failed to show successful initial effect or residual effect for concentrations gave less than 70% reduction in initial effect and less than 40% reduction in residual effect.

- Second to show initial effect but failed to show residual effect for those gave less than or equal 70% reduction in residual effect.

Succeeded in both initial and residual effects for those gave more than 70% reduction in initial and more than 40% reduction in residual effects. Compounds at their effective concentrations could be recommended for controlling pests as the following:

B_1 at 1% and B_2 at 2% for controlling bean fly; A at 2%, B_1 at 2% and B_2 at 2% for controlling aphid; A at 2%, B_1 at 2% and B_2 at 2% for controlling leafminer; B_1 at 2% and B_2 at 2% for controlling spider mite. Field observations indicated that no phytotoxic effect was observed for the tested materials against beans plants.

The effect of the tested compounds against pests could be referred to the presence of cyano group which was reported to be toxic group (Gleason *et al.*, 1969 and Tomlin, 1994). To conclude our research when combined with previous literature reports conclude on activity of amino-propionitrile and also aryl hydrazono mesoxal onitrile would lead to conclude that cyano compounds with β-nitrogen moiety should have this activity (Ressler *et al.*, 1963[a] and Blumenthal *et al.*, 1963). In most likely that possible existence of both amino and cyano functions in a E-conformation is prerequisites for this activity as β-aminonitriles with fixed or preferred E-conformation do not show such activity as no biological activity for acylhydrazone of ethyl cyanoacetate has never been observed (Ressler *et al.*, 1969[a]) and (Ferris, 1970). The observed activities of compounds may be related to that existence of β-aminonitrile moiety in these compounds (Ferris, 1970).

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Table 3. Pesticidal efficiency of the tested materials against soybean fly.

Treatment	Con. %	Pre-treatment	Initial effect after 1 day		Residual effect No. / leaf after					
			No.	R.	3 days	5 days	7 days	Total	Mean	R%
A	0.5	26.6	18.8	35.8	19.4	40.4	48.6	108.4	36.1	2.0
	1	21.6	6.0	74.8	17.0	30.8	40.5	88.3	29.4	1.7
	2	20.2	1.0	95.5	14.4	26.4	30.1	70.9	23.6	15.6
B_1	0.5	11.2	7.8	36.7	10.4	15.8	20.3	46.5	15.5	0.2
	1	18.6	3.6	82.4	7.2	18.0	22.0	47.2	15.7	39.0
	2	16.6	1.6	91.2	1.0	4.6	6.2	11.8	3.9	82.9
B_2	0.5	15.0	6.2	62.4	18.6	20.8	22.7	62.1	20.7	0.5
	1	12.4	2.6	81.0	10.2	15.2	23.2	48.6	16.2	5.8
	2	14.6	1.1	93.2	5.4	11.6	14.0	31.0	10.3	49.0
C_1	0.5	33.2	23.6	35.4	35.0	40.8	60.2	136.0	45.3	1.5
	1	28.6	29.4	6.6	27.8	45.8	58.1	131.7	43.9	-10.7
	2	25.0	16.2	41.1	22.4	35.0	39.6	97 0	32.3	6.7
C_2	0.5	17.1	13.8	26.7	15.2	20.2	34.3	69.7	23.2	2.0
	1	28.1	9.6	69.0	24.8	41.2	48.0	114.0	38.0	2.5
	2	13.2	4.4	69.7	14.4	17.6	19.2	51.2	17.1	6.8
Untreated		32.16	35.4	0.00	41.28	43.92	48.6	133.8	44.6	0

Table 4. Pesticidal efficiency of the tested materials against red spider mite.

Treatment	Con. %	Pre-treatment	Initial effect after 1 day		Residual effect No. / leaf after					
			No.	R.	3 days	5 days	7 days	Total	Mean	R%
A	0.5	43.6	9.6	79.6	39.6	55.0	61.0	155.6	51.9	6.89
	1	38.6	12.6	69.7	32.0	47.4	53.2	132.6	44.2	10.37
	2	36.2	8.6	77.9	20.6	37.6	46.3	104.5	34.8	24.68
B1	0.5	31.8	14.2	58.5	28.4	39.0	45.0	112.4	37.5	7.78
	1	25.4	11.2	59.1	18.6	26.2	32.1	76.9	25.6	21.01
	2	35.6	6.4	83.3	9.4	14.8	17.3	41.5	13.8	69.58
B2	0.5	36.6	12.4	68.5	19.3	28.4	33.5	81.2	27.1	42.11
	1	35.4	8.4	78.0	12.6	19.0	22.3	53.9	18.0	60.27
	2	38.2	7.2	82.5	6.8	12.0	15.1	33.9	11.3	76.85
C1	0.5	41.0	43.2	2.2	38.6	52.2	66.1	156.9	52.3	0.15
	1	33.2	35.0	2.1	35.8	40.8	45.3	121.9	40.6	4.20
	2	35.4	13.4	64.9	34.2	46.4	50.8	131.4	43.8	3.15
C2	0.5	33.1	25.0	29.9	30.8	40.2	50.0	121.0	40.3	4.62
	1	45.2	20.2	58.5	36.8	52.2	65.2	154.2	51.4	10.99
	2	38.0	12.4	69.7	25.6	41.0	44.3	110.9	37.0	23.86
Untreated		43.52	46.88	0.00	52	54.6	60.2	166.8	55.6	0.00

Table 5. Pesticidal efficiency of the tested materials against aphid.

Treatment	Con. %	Pre-treatment	Initial effect after 1 day		Residual effect No. / leaf after					
			No.	R.	3 days	5 days	7 days	Total	Mean	R%
A	0.5	15.0	8.4	48.03	15.4	20.4	25.3	61.1	20.4	7.98
	1	16.8	3.0	83.43	12.0	21.4	28.1	61.5	20.5	17.30
	2	17.0	1.0	94.54	6.6	15.4	19.2	41.2	13.7	45.25
B1	0.5	11.0	11.4	3.83	9.4	16.8	18.3	44.5	14.8	8.61
	1	6.2	6.9	-3.28	5.8	9.0	10.2	25.0	8.3	8.91
	2	13.8	3.6	75.79	1.2	4.4	5.2	10.8	3.6	82.32
B2	0.5	15.0	5.8	64.12	12.4	23.2	28.1	63.7	21.2	4.07
	1	7.2	1.8	76.80	4.6	12.2	15.0	31.8	10.6	0.23
	2	15.2	0.5	96.95	3.8	8.6	9.0	21.4	7.1	68.20
C1	0.5	14.0	14.8	1.90	16.4	20.0	24.0	60.4	20.1	2.54
	1	17.0	17.6	3.92	19.8	24.8	30.3	74.9	25.0	0.47
	2	16.6	17.0	4.96	16.4	24.0	27.1	67.5	22.5	8.14
C2	0.5	21.0	22.1	2.34	25.2	29.8	35.4	90.4	30.1	2.76
	1	24.4	22.3	15.19	20.4	28.2	35.7	84.3	28.1	21.95
	2	14.0	12.2	19.13	10.4	14.6	38.0	63.0	21.0	-1.66
Untreated		18.56	20	0.00	24.8	27.36	30	82.16	27.387	0.00

Table 6. Pesticidal efficiency of the tested materials against leaf miner.

Treatment	Con. %	Pre-treatment	Initial effect after 1 day		Residual effect No. / leaf after					
			No.	R.	3 days	5 days	7 days	Total	Mean	R%
A	0.5	3.6	1.6	70.67	3.8	6.8	11.3	21.9	7.3	26.73
	1	3.2	1.2	75.25	3.0	5.3	9.4	17.7	5.9	33.38
	2	2.8	1.0	76.43	2.4	4.0	5.3	11.7	3.9	49.67
B1	0.5	1.8	0.8	70.67	2.4	5.2	7.4	15.0	5.0	-0.36
	1	0.8	0.5	58.75	1.4	2.1	2.5	6.0	2.0	9.67
	2	2.4	0.2	94.50	1.0	3.0	4.1	8.1	2.7	59.35
B2	0.5	3.2	1.0	79.38	4.0	8.4	11.6	24.0	8.0	9.67
	1	3.6	0.6	89.00	3.2	8.6	9.1	20.9	7.0	30.08
	2	3.4	0.1	98.06	1.2	4.3	5.1	10.6	3.5	62.45
C1	0.5	2.3	3.0	13.91	4.0	6.2	7.8	18.0	6.0	5.74
	1	3.1	2.4	48.90	3.4	8.2	12.6	24.2	8.1	5.98
	2	2.5	1.8	52.48	2.4	6.5	8.5	17.4	5.8	16.18
C2	0.5	3.2	2.4	50.50	4.8	8.4	11.0	24.2	8.1	8.92
	1	4.0	2.1	65.35	5.0	8.3	13.1	26.4	8.8	20.51
	2	2.6	1.0	74.62	3.6	5.4	9.3	18.3	6.1	15.23
Untreated		6.6	10	0.00	14.4	19.2	21.2	54.8	18.3	0.00

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الفعل الإبادى لمركبات سيانية عضوية حديثة ضد بعض الآفات التى تصيب الفاصوليا

باسم السيد البدرى١ ، جهاد محمد موسى٢ ، إيهاب مصطفى بكر٢

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تم تقييم الفعل السام لثلاثة مركبات عضوية تحتوى على السيانيد وهى: المركب (أ) ٢-أمينو-٤-ميثيل-٤-(٢مثيل بروب-١-انيل) بنت-١-اين-١و١و٣و٥و٥ بنتا كاربونتريل و مركب (ب) ٢-سيانو أسيتوهيدرازيد و ومركب (جـ) ٢-سيانو أسيتاميد. تم تحضير المركب أ على صورة مستحضر قابل للتدفق بتركيز ٢٢,٥% بينما تم تحضير المركبين ب، جـ في صورة مسحوق قابل للذوبان بتركيز ٩٠% و ذلك في صورتين مختلفتين ب١، ب٢ و كذلك جـ١،جـ٢ . اختبرت فعالية هذه المركبات معملياً ضد العنكبوت الأحمر كذلك تم إختبار فعاليتها حقلياً ضد كل من ذبابة الفاصوليا و المن و صانعة الأنفاق و العنكبوت الأحمر على نباتات الفاصوليا. أظهرت نتائج التجارب المعملية فعالية معقولة للمركب ب ضد العنكبوت الأحمر بينما لم يظهر المركبين أ و جـ أى فعالية تجاه العنكبوت الأحمر. بينما أظهرت نتائج التجارب الحقلية إختلافاً بين فعالية المركبات محل الدراسة على الآفات المختلفة. فقد أظهر كل من المركبات أ و ب٢ عند تركيز ٢% و ب١ عند تركيز ١% فعالية فورية عالية ضد ذبابة الفاصوليا بينما أظهر المركبات أ، ب١، ب٢ عند تركيز ٢% فعالية فورية عالية ضد المن و صانعات الأنفاق. كذلك أظهر المركبين ب١ عند تركيز ٢% و ب٢ عند تركيز ١%فعالية واضحة ضد العنكبوت الأحمر.