EFFICACY OF TWO COMPATIBLE MIXTURES OF CHEMICAL AND MICROBIOLOGICAL PRODUCTS AGAINST MAIN MAIZE PESTS

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Abstract : The mixtures of insecticides and fungicides with microbiological experimental products were prepared in RDIPP laboratories based on specific procedures and tested in field conditions, in 2013, at Agricultural Research - Development Station Secuieni. The mixtures of chemicals and microbiological products used in maize seed treatment provided a better protection for plants against wire worms (*Agriotes sp.*), maize weevil (*Tanymecus dilaticollis*) and some soil and seed pathogens. The microbiological products applied in seed treatment alone did not provide adequate and reliable protection for the plants against pests and pathogens identified in culture.
Good protection provided by the experimental mixtures in seed treatment has positively influenced on maize yield

Key words: *compatible mixtures, microbiological products , seed treatment, integrated pest management*

INTRODUCTION

Integrated pest management, as specified in Directive 128 which establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides, requires a careful analysis of all available methods for plant protection and further integration of a set of appropriate measures and also to reduce or minimize risks on human health and the environment. Integrated pest management is focused on growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

In the context of the above, studies regarding the compatibility between the two chemical pesticides and the experimental microbiological formulations meet the requirements of integrated pest management.

Compatible experimental mixtures, applied as a seed and vegetation treatment induce to increase economic efficiency by reducing the number of treatments and the negative impact on environment.

MATERIAL AND METHOD

Studies regarding efficacy were performed in field conditions, in terms of the agricultural year 2012 – 2013. The compatible mixtures were tested on some major pests for maize: wireworms (*Agriotes sp.*), maize weevil (*Tanymecus dilaticollis*), soil seed dry rot (*Fusarium graminearum*), wet rot and fall of seedlings (*Pythium de Baryanum*).

The trial included nine experimental variants placed by the linear blocks method in four replicates, on an experimental plot area of 35 sq.m.

The trial variants were the following:

V1 – Unetreated control;
V2 - Imidacloprid + *Beauveria bassiana* 6,25 x 10^6 spores/g seed;
V3 - Imidacloprid + *Bacillus subtilis* OS17 – 50 gr WP/kg seed;
V4 - Imidacloprid + tiram + *Beauveria bassiana* 6,25 x 10^6 spores/g seed;
V5 - Imidacloprid + tiram + *Bacillus subtilis* OS17 – 50 gr WP/kg seed;
V6 - Chimical control – Imidacloprid;
V7 - Chimical control – Tiram + imidacloprid;
V8 – Biological control - *Beauveria bassiana* 6,25 x 10^6 spores/g seed;
V9 - Biological control - *Bacillus subtilis* OS17 – 50 gr WP/kg seed.

The trial was placed in the experimental field of the Plant Protection Laboratory , on a typical cambic chernozem soil, type with water pH of 6.29 and 2.3 humus content.

Previous plant was winter wheat.

The basic soil preparation for seedbed and culture maintenance were made according to technology of maize cultivation apropriate for the conditions in the center of Moldova, maize hybrid used for sowning was Turda Star.

The agricultural year 2012 - 2013 was characterized as a normal year in terms of temperature and precipitation. The average annual temperature was 9.1^0C , compared to the annual average of 8.7^0 C, the difference of $0,4^0$ C defines the agricultural year 2012-2013 as a "normal year".

Regarding to rainfalls, the annual amount was 548 mm, an amount equal to the annual average (Table 1), but we mention that the agricultural year 2012-2013 began with a deficit of 118.8 mm accumulated in 2011-2012 in July, August and September, that was not recovered, at which contributs and uneven distribution of rainfall in the agricultural year 2012 - 2013, when April and May were poor in precipitattions with higher temperatures of 2.2^0 C up to 2.5^0 C than multi monthly average, which negatively influenced the emergence and growth of maize plants in the early stages of vegetation.

Given all these conditions , were intensified attacks of soil and plant pests, but were lower infestation of pathogens that are transmitted through soil and seed.

RESULTS AND DISCUSSIONS

The level of soil infestation with larvae of genus *Agriotes* (wire worms) was 7 adults / sqm; exceeding the economic damage threshold (PED) which for maize is 3 adults / sqm.

Under these conditions the percentage of emerged plants was 81% for the untreated control, and between 85% and 96% for the treated variants , the frequency of wire worms attack to seeds was 19% in the untreated control, and between 4% and 15% for the treated variants (table 2). The lowest attacks on seeds being sprouting were on the chemically treated variants with Imidachloprid alone or with biological product. Atack frequency on grains being sprouting for only biological product treated variants was similar with the untreated control (table 2).

Agriotes larvae attack continued up to stage of 4-6 leaves of maize plants when the frequency at the base of plants was 6% for untreated control, 3 - 5% for the variants treated only biological and 1-2%, for variants treated with insecticide (table 2).

The percentage of saved plants at 25 days after emergence ranged from 93-95% for the insecticides treated variants , 82% the only biological treated variants, compared to 75% saved plants in untreated control, the differences between the percentage of saved treated plants and untreated control were very significant in case of treatment with insecticide + fungicide + biological product and significant for only biological treated variants (table 2).

Regarding the attack of the maize weevil (*Tanymecus dilaticollis*) at an average density of 9 adults /sqm, the frequency of attacked plants was 42% to the untreated control and between 21% and 40% to treated variants (table 3).

The attack level ranged between 0.42% and 2.78% for treated variants, compared to 3.05% as recorded to untreated control. Differences of attack level between treated variants and untreated control were highly negative significant for variants treated with mixture between insecticide, fungicide and biological product and negatively significant for variants treated only with biological products (table 3).

Soil and seed pathogens attack (*Fusarium graminearum* and *Pythium de Baryanum*) was reduced, in terms of agriculture year of 2012 to 2013, attack frequency being 1.54% (*Fusarium graminearum*) and 0.8% (*Pythium de Baryanum*) for untreated control and ranged between 0.0% and 1.46% for treated variants (table 3).

Maize yield was 6047 kg / ha grain for the untreated control and between 6820 kg / ha and 8210 kg / ha for treated variants.

Yield differences were highly significant between treated variants and untreated control and significant between the variants treated only with biological products and untreated control (table 4).

CONCLUSIONS

Compatible mixtures of chemicals and microbiological products applied in maize seed treatment provided a better protection of plants against wire worms (*Agriotes* sp.), maize weevil (*Tanymecus dilaticollis*) attack and some soil and seed pathogens, too.

Microbiological products applied alone in seed treatment did not provide adequate and reliable protection against attack of pests and pathogens identified in culture.

Good protection provided by seed treatment with the experimental mixtures had positive influence in maize production.

Table 1. Weather data recorded at A.D.R.S Secuieni in the agricultural year of 2012 - 2013

Specifications		2012			2013									
		X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	MED
Temp °C	First decade	14,6	8,6	-1,6	-7,0	-0,3	0,1	6,8	18,9	17,5	20,0	23,0	16,1	
	Second decade	10,2	3,0	-7,4	-3,7	-2,6	2,5	10,4	18,3	21,6	20,1	21,1	15,4	
	Third decade	8,1	3,6	-7,1	-4,4	-0,2	-0,1	17,2	16,2	20,7	21,4	18,0	11,2	
	Monthly average	10,8	5,1	-5,4	-5,0	-1,1	0,8	11,5	17,7	19,9	20,5	20,6	14,2	9,1
	Multianualy average	9,1	3,4	-1,8	-3,9	-2,2	2,5	9,3	15,3	18,7	20,2	19,3	14,7	8,7
	Abaterea	1,7	1,7	-3,6	-1,1	1,1	-1,7	2,2	2,4	1,2	0,3	1,3	-0,5	0,4
Precip mm	First decade	7,0	3,8	23,3	2,5	5,0	2,0	19,6	1,0	51,4	39,0	0,4	1,4	
	Second decade	10,0	9,6	12,1	4,2	9,0	4,2	18,0	1,6	18,2	8,6	3,8	33,6	
	Third decade	6,8	2,4	0,0	7,5	14,8	27,2	0,6	48,8	76,4	28,8	37,8	7,6	
	Monthly amount	23,8	15,8	35,4	14,2	28,8	33,4	38,2	51,4	146,0	76,4	42,0	42,6	548,0
	Multianualy average	35,2	28,1	26,3	21,0	19,4	24,8	46,3	64,8	85,0	86,0	64,0	47,1	548,0
	Abaterea	-11,4	-12,3	9,1	-6,8	9,4	8,6	-8,1	-13,4	61,0	-9,6	-22,0	-4,5	0,0
TEMP. °C AIR	*MONTHLY MINIMUM*	-1,4	-3,7	-20,8	-21,2	-12,4	-9,7	-1,7	6,7	8,7	9,3	9,7	4,1	
	MONTHLY MAXIMUM	29,6	20,3	6,6	5,4	8,7	15,2	31,8	32,0	33,9	34,3	32,6	27,0	
TEMP. °C SOIL	*MONTHLY MINIMUM*	1,1	-2,8	-21,2	-22,1	-13,9	-7,8	-1,7	7,2	11,7	10,6	11,7	6,7	

Table 2. Results in control of wire worms (*Agriotes sp.*) using seed treatment with the experimental mixtures

Var.	Experimental variant	P% plante răsărite	F% seed attack	F% plant attack 3–5 leaves	P% saved plants	Semnif. P% saved
V1	Martor netratat	81	19	6	75	mt.
V2	Imidacloprid + *Beauveria bassiana*	95	5	2	93	XXX
V3	Imidacloprid + *Bacillus subtilis* OS 17	95	5	2	93	XXX
V4	Imidacloprid + Tiram + *Beauveria bassiana*	96	4	1	95	XXX
V5	Imidacloprid + Tiram + *Bacillus subtilis* OS 17	97	3	2	95	XXX
V6	Imidacloprid	95	5	2	93	XXX
V7	Imidacloprid + Tiram	96	4	2	94	XXX
V8	*Beauveria bassiana*	87	13	5	82	X
V9	*Bacillus subtilis* OS 17	85	15	3	82	X
	LD 5% =	3,7%	2,9%	1,68%	3,3%	
	1% =	4,9	4,1	2,15	7,5	
	0,1% =	6,3	5,7	3,3	9,4	

Density of *Agriotes larvae* = 7 specimens/sqm.

Table 3. Results in control of maize weevil (*Tanymecus dilaticollis*) and some soil and seed pathogens

Crt. No.	Variants	*Tanymecus dilaticollis*					F% atack	
		F%	I%	Ga%	Dif. GA%	Semnif.	*Fusarium graminearum*	*Pythium de Baryanum*
V1	Unetreated control	42	7,26	3,05	mt.	mt.	1,54	0,8
V2	Imidacloprid + *Beauveria bassiana*	23	2,09	0,48	- 2,57	000	1,12	0,6
V3	Imidacloprid + *Bacllus subtilis* OS 17	24	2,16	0,52	- 2,53	000	1,20	0,5
V4	Imidacloprid + Tiram + *Beauveria bassiana*	22	1,93	0,42	- 2,63	000	0,04	0,0
V5	Imidacloprid + Tiram + *Bacllus subtilis* OS 17	23	2,12	0,49	- 2,56	000	0,02	0,0
V6	Imidacloprid	22	2,09	0,46	- 2,59	000	1,04	0,7
V7	Imidacloprid + Tiram	21	2,18	0,46	- 2,59	000	0,00	0,0
V8	*Beauveria bassiana*	40	6,94	2,78	- 0,27	-	1,34	0,6
V9	*Bacllus subtilis* OS 17	39	7,08	2,76	- 0,29	-	1,46	0,7

LD 5% = 0,54%
1% = 0,81%
0,1% = 1,5%

Density of *Tanymecus dilaticollis* adults = 9 specimens/sqm.

Table 4. Influence of some compatible mixtures on maize yield

crt. no.	Variants	Absolute grains yield kg/ha	Relative yield %	Diff. of prod. with untreated control kg/ha	Semnif.
V1	Martor netratat	6047	100	mt.	mt.
V2	Imidacloprid + *Beauveria bassiana*	8170	135	2123	XXX
V3	Imidacloprid + *Bacllus subtilis* OS 17	8150	135	2103	XXX
V4	Imidacloprid + Tiram + *Beauveria bassiana*	8200	136	2153	XXX
V5	Imidacloprid + Tiram + *Bacllus subtilis* OS 17	8180	135	2133	XXX
V6	Imidacloprid	8170	135	2123	XXX
V7	Imidacloprid + Tiram	8210	136	2163	XXX
V8	*Beauveria bassiana*	6820	113	773	X
V9	*Bacllus subtilis* OS 17	6830	113	783	X

DL 5% = 569 kg/ha
1% = 794
0,1% = 936

REFERENCES

Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009

Guidelines on Efficacy Evaluation for the Registration of Plant Protection Products, 2006, Food and Agriculture Organization of United Nations, International Code of Conduct on the Distribution and Use of Pesticides