„PIONEER" MAIZE HYBRID PRODUCTION IN RELATIONSHIP WITH THE TANDEM „PATHOSYSTEMS – THE NEW PEST DIABROTICA VIRGIFERA VIRGIFERA LE CONTÉ", IN THE WESTERN PART OF THE COUNTRY

PRODUCȚIA HIBRIZILOR DE PORUMB „PIONEER" ÎN RELAȚIE CU TANDEMUL „PATOSISTEME – NOUL DĂUNĂTOR DIABROTICA VIRGIFERA VIRGIFERA LE CONTÉ", ÎN PARTEA DE VEST A TARII

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Abstract: *Successive to the researches performed in the experimental field from S.C. Agrogil (Sagu, Arad county), during 2006-2007, where we cultivated 8 maize hybrids, belonging to various maturity groups (extra-early, early, mid-early, mid-late), of American origin (Pioneer Al Dupont Company), we have noticed the following aspects related to their yields: - the productive amplitude of the 8 Pioneer maize hybrids, studied in the Arad region, was between 4692 kg/ha (PR 39D81) and 7459 kg/ha, achieved by the control hybrid PR 37D25; - the fungi within the maize pathosystems – Helminthosporium turcicum, Fusarium roseum and Ustilago zeae, with their parasitical effect, have determined a decrease of the average hybrid yield with 1155 kg/ha; - the new pest Diabrotica was involved, through its rhyzo-, philo- and stigmatrophic actions, with a yield decrease of 2161 kg/ha. The reduction of maize hybrid yields is due to some intrinsic (internal) and extrinsic (external) factors. The intrinsic factors belongs to the maize hybrids and it is about a lower activity of the genes involved in production and the lack of genes generating resistance to diseases and to the new pest Diabrotica. The extrinsic factors include soil, as an edaphic factor, with a low nutritive content (absence of fertilization) and the insufficient release of absorption elements, monocrop and the parasitical factor.*

Rezumat: *Din cercetările efectuate în câmpul experimental înfiinţat pe ternul S.C. Agrogil (localitatea Şagu, judeţul Arad), în anii 2006-2007, unde au fost cultivaţi 8 hibrizi de porumb, din diferite grupe de maturitate (extratimpuri, timpurii, semitimpurii şi semitardivi) de proveniență americană (Pioneer Al Dupont Company) am constatat următoarele aspecte legate de producţia acestora: - amplitudinea productivă a celor 8 hibrizi de porumb Pioneer, experimentaţi în zona Arad, a fost cuprinsă între 4692 kg/ha (PR 39D81) şi 7459 kg/ha, o producţie realizată de hibridul cu valoare de „ control " sau „martor " PR 37D25; - ciupercile din patosistemele porumbului - Helminthosporium turcicum, Fusarium roseum şi Ustilago zeae, prin efectul parazitar au determinat o scădere a producţiei medii a hibrizilor de porumb, de 1155 kg/ha ; - noul dăunător Diabrotica s-a implicat, prin activităţile rizo, filo şi stigmatrofice cu o scădere a producţiei de 2161 kg/ha; Scăderea producţiilor hibrizilor de porumb, este atribuită unor factorii intrinseci (interni) şi extrinseci (externi). Factorii intrinseci sunt ai hibrizilor de porumb şi este vorba despre o activitate mai puţin intensă a genelor implicate în producţie şi lipsa genelor care să confere rezistenţă faţă de bolii şi noul dăunător Diabrotica. Factorii extrinseci includ solul, ca factor edafic, cu un conţinut de substanţe nutritive scăzut (absenţa fertilizării) şi prin insuficienţa punere în libertate a elementelor absorbţiei, monocultura şi factorul parazita.*

Key words: *Zea mays, pathosystem, production, hybrid, Diabrotica*
Cuvinte cheie*: Zea mays, patosistem, productie, hibrid, Diabrotica*

INTRODUCTION

Maize pathosystems, considered to have economic importance because of the losses caused, according to VIORICA IACOB, E. ULEA, I. PUIU (1998), VIORICA IACOB (2003), ELENA

NAGY (2004), GH. POPESCU (2005), I. OROIAN, V. FLORIAN, L. HOLONEC (2006) are: *Zea mays – Helminthosporium turcicum* Pass. – helminthosporiosis, leaf blight or leaf spot; *Zea mays – Fusarium roseum f. cerealis* (Cke) Snyder and Hansen – fusariosis or red rot of maize stalk and ear; *Zea mays – Ustilago maydis* (Beckm.) Unger – maize smut.

The pathosystems mentioned above have been studied less in terms of the maize hybrid behavior to the attack caused by the pathogens specified. Yield losses caused by the pathogens within the maize ecosystems and by the new pest *Diabrotica* are quoted in the literature as following:

- in the case of the fungus *Helminthosporium turcicum* Pass., losses are up to 75% in North America (P.E. LIPPS, D. MILLS, 2002), and over 30% in Romania (EUGENIA ELIADE, 1985; VIORICA IACOB, E. ULEA, I. PUIU, 1998; ELENA NAGY, 2004);

- concerning the maize smut caused by the basidiomycotin *Ustilago maydis*, losses are up to 50% in North America (S.A. MILLER et al., 1996, M. NASIR et al., 1998) and, for our country, ANA HULEA et al., 1973, mention losses of up to 40%;

- in the case of *Fusarium roseum*, losses between 0-100% may be caused in North America; important losses have been reported in Asia (AJ. T. MOON et al., 1999), South America (K.F. RIBICHICH et al., 2000) and Europe (A. BOTTALICO, 1998); IN Romania, losses represent 10-20% (EUGENIA ELIADE, 1985; AL. BARBULESCU et al., 2002; ELENA NAGY, 2004);

- regarding the new pest *Diabrotica*, losses represent 13% in the case of the attack on silk (stigmatrophic action), which affects pollination (T. TUSKA et al., 2002) and usually attack's gravity is expressed by percentages reported to organs (50% - for roots – T.F. BRANSON, E. E. ORTMAN, 1967; IOANA GROZEA, 2006; adult' preference for leaves – phylatrophy and silk – stigmatrophy – T. TUSKA et al., 2002; IOANA GROZEA, 2003, 2006).

This informative note leads to the conclusion that the pathogens within pathosystems and also the insect *Diabrotica virgifera virgifera* Le Conté represent the pests with economic importance.

MATERIAL AND METHOD

In order to have an answer to the problems above, we have carried out some researches upon the interaction between pests and the climatic factors, much different compared to the other geographical regions of the country. For this, near Sagu, Arad county, we performed in 2006 and 2007 an experience with 8 maize hybrids, created by the American company Pioneer, namely: PR 39D81 – extra-early, PR 38R92 – early, PR 37A24, PR 37D25, PR 37M34, PR 37W05 – mid-early and PR 35P12, PR 36K67 – mid-late. The control variant is represented by the mid-early hybrid PR 37D25, about which the company Pioneer says that has a productivity of 13-14 tones/ha, with resistance to the fungus *Sorosporium sorghi*, maize head smut, without importance for our country, and with tolerance to helminthosporiosis and maize borer (*Ostrinia nubilatis*).

RESULTS AND DISSCUSION

In the case of our experience, performed under monocrop conditions (3 years), of region infested with the new pest *Diabrotica* and non-pollutant technology, namely without pesticides and chemical fertilization, hybrid yields, compared to the productive capacity presented by Pioneer Al Dupont Company, are more reduced. The decrease of maize yields is due to some intrinsic (internal) and extrinsic (external) factors.

On the whole, the parasitical factor involved in the decrease of Pioneer maize yields was represented by diseases 25.8% and the new pest *Diabrotica* 33.2%; the removal of smut (7.58%) and of the rhyzotrophic activity (also low – 7.52%) makes evident the more intense

parasitical effect of the new pest (46.1%), compared to the one caused by diseases – 35.0% - figure 1. Conclusively, the parasitical factor (pathogens – the pest *Diabrotica*) is involved in a proportion of 29.5% in the average yield decrease, and the difference of 70.5% belongs to other factors (intrinsic – hybrids and extrinsic – edaphic factors, soil). Actually, fungi within the maize pathosystems (*Helminthosporium turcicum* Pass., *Fusarium roseum* and *Ustilago zeae*) have decreased the yields achieved from the 8 Pioneer maize hybrids with 1287 kg/ha, the new pest *Diabrotica* was involved with 1656 kg/ha, the parasitical factor's effect was expressed through a yield loss of 2843 kg/ha. The non-parasitical factors were involved with a yield decrease of 2046 kg/ha (Table 1, Figure 1).

Tabel 1

Standard yield (15%) humidity of maize hybrids constituted in pathosystems in connection with the new pest Diabrotica virgifera virgifera Le Conté, in 2006

No	Hybrid	Yield per ha	Signif compare to control	*Helminthosporium turcicum*		*Fusarium roseum*	*Usti lago zeae*	*Diabrotica virgifera virgifera Le Conté*		
				F%	I%			roots	leaves	stigma
1	PR39D81	5344	000	56,51	43,33	23,14	6,72	13,78	47,7	54,02
2	PR38R92	5586	000	60,75	50,0	45,0	5,19	9,7	40,2	42,24
3	PR38A24	8158	000	46,11	33,3	21,54	0	6,32	38,79	42,81
4	PR37D25 (Mt)	8780	-	34,93	31,6	19,95	28,54	5,45	40,2	51,7
5	PR37M34	6763	000	54,63	41,6	21,45	0	7,18	40,8	55,75
6	PR37W05	7982	000	58,63	50,0	42,54	14,51	6,6	42,5	55,44
7	PR35P12	7646	000	46,85	30,0	4,79	5,66	5,96	39,0	52,29
8	PR36K67	6858	000	42,05	30,0	27,8	0	5,17	41,0	53,73
Mean average (X)		71,36		50,06	38,75	25,77	7,58	7,52	41,2	51,0
DL 5%		243		9,82	7,3	4,7	2,5	1,65	3,12	6,15
DL 1%		337		13,62	10,1	6,5	3,5	2,28	4,33	8,53
DL 0,1		468		18,92	14,0	9,0	4,9	3,17	6,02	11,85

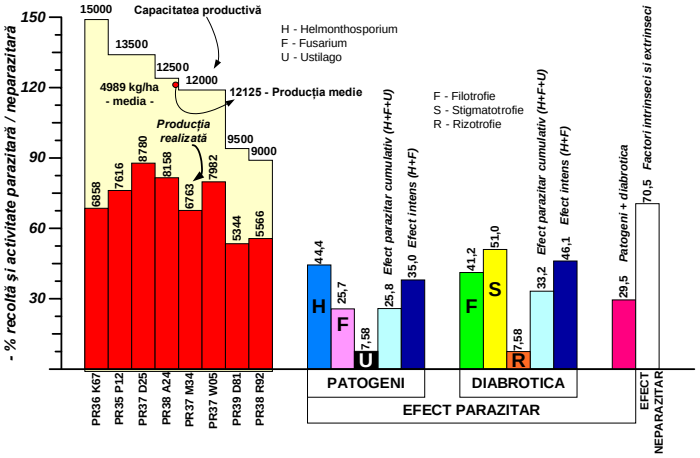

Figure 1. Yield of Pioneer maize hybrids achieved in 2006, compared to their productive capacity and the values of the parasitical and non-parasitical effect

In 2007, the control hybrid's yield was 6139 kg/ha (Table 2), 2844 kg smaller than in 2006. Compared to the maximal capacity of the Pioneer hybrids – an average of 12.125 kg/ha, the yield in 2007 was even smaller than in 2006 with 2051 kg/ha. Actually, in 2007, the average yield of the 8 experimented hybrids was smaller with 7044 kg/ha – Figure 2.

Tabel 2

Standard yield (15%) humidity of maize hybrids constituted in pathosystems in connection with the new pest *Diabrotica virgifera virgifera Le Conté*, in 2007

No	Hybrid	Yield per ha	Signif compare to control	*Helminthosporium turcicum*		*Fusarium roseum*	*Ustilago zeae*	*Diabrotica virgifera virgifera Le Conté*		
				F%	I%			roots	leaves	stigma
1	PR39D81	4040,0	000	93,6	46,6	52,46	11,5	56,03	81,0	96,2
2	PR38R92	4128,3	000	83,12	43,3	45,33	7,8	52,29	65,4	90,4
3	PR38A24	5876,6	00	89,1	40,0	42,6	18,1	47,98	62,1	91,0
4	PR37D25 (Mt)	6139,6	-	81,35	36,6	37,13	11,0	33,61	60,0	88,4
5	PR37M34	4834,0	000	88,35	43,3	41,6	18,3	45,68	64,2	92,7
6	PR37W05	5618,3	000	88,25	43,3	43,6	15,2	49,71	65,2	91,1
7	PR35P12	5266,0	000	73,75	33,3	55,73	15,1	19,81	67,1	94,2
8	PR36K67	4748,0	000	77,51	33,3	55,33	15,7	22,69	69,0	94,7
Mean average (X)		5081,45		84,39	40,0	46,74	14,0	40,75	65,5	92,3
DL 5%		178,5		7,85	9,89	7,38	4,82	4,90	4,79	4,06
DL 1%		247,90		10,89	13,71	10,23	6,68	6,78	6,89	5,63
DL 0,1		344,40		15,13	19,05	14,21	9,28	9,42	9,42	7,84

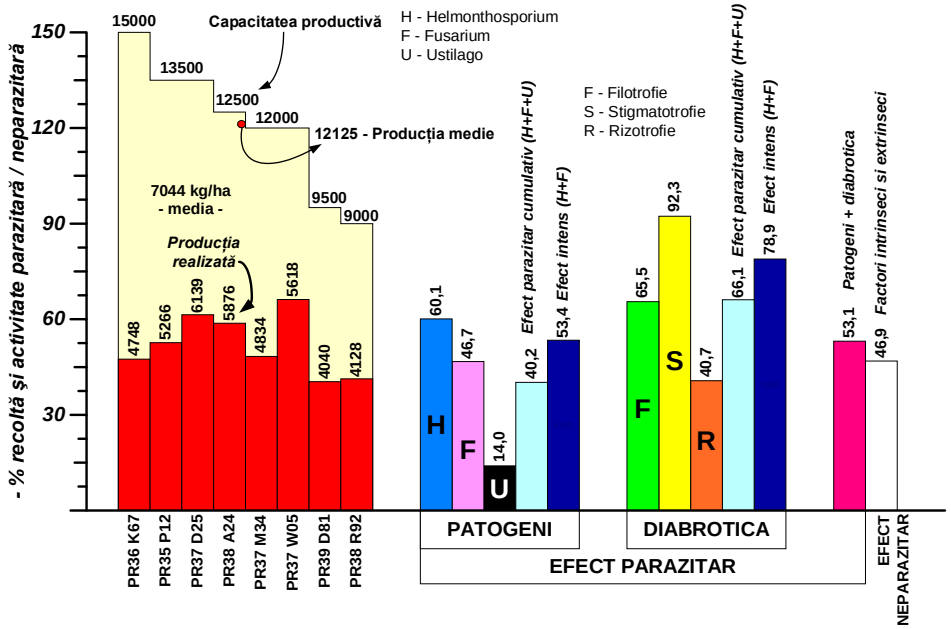

Figure 2 Yield of Pioneer maize hybrids achieved in 2007, compared to their productive capacity and the values of the parasitical and non-parasitical effect

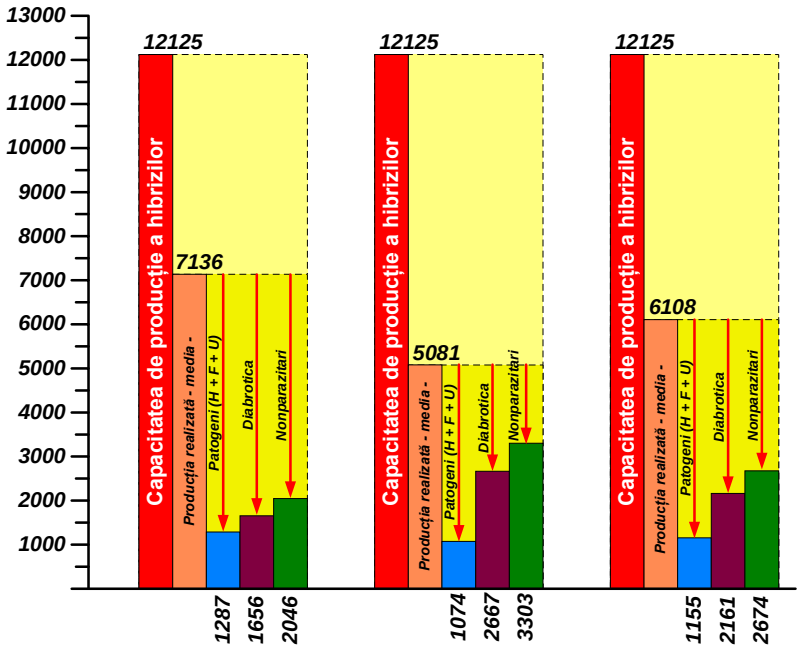

Figure 3. Involvement of pathogens, of the new pest *Diabrotica* and of the non-parasitical factors in the decrease of Pioneer hybrids' yield, in 2006 (a), 2007 (b) and the synthesis of results (c)

The causes for these smaller yields in 2007, beside the factors involved in 2006, are represented by one more year of monocrop, thermal and hidric stress during June and July and the bigger intensity of the parasitical factor (pathogens and the new pest *Diabrotica* – Table 2 and Figure 2). So, pathogens were involved in a proportion of 40.2% (*Helminthosporium* – 60.1%, *Fusarium* – 46.7% and Ustilago – only 14%). The parasitical stress caused by the tandem *Helminthosporium* + *Fusarium* was more intense – 53.4%. The new pest *Diabrotica* had a parasitical effect superior to the pathogens' one, namely 66.1%, with an average phylotrophic attack of 65.5%, stigmatrophic of 92.3% and rhyzotrophic of 40.7%. The most intense parasitical effect was generated by the stigmatrophic and phylotrophic activity of the new pest *Diabrotica*, namely 78.9%. Conclusively, the parasitical effect caused by pathogens and by the new pest *Diabrotica* decreased maize yield with an average of 53.1% and 3741 kg/ha; pathogens are involved with a yield decrease of 1074 kg/ha, and *Diabrotica* with 2667 kg/ha; the non-parasitical factor, with its intrinsic and extrinsic action expressed at 46.9%, reduced yield with an average of 3303 kg/ha; the cumulative effect of the parasitical and non-parasitical factors led to an average yield decrease of 7044 kg/ha.

CONCLUSIONS

The synthesis of results, represented in Figure 3, show the following conclusions:

- the productive amplitude of the 8 Pioneer maize hybrids, studied in Arad region, was between 4692 kg/ha (PR 39D81) and 7459 kg/ha, achieved by the control hybrid PR 37D25;

- compared to the productive hybrid capacity specified in catalogues by Pioneer Al Dupont Company (9000-15000 g/ha), the average yield was reduced with 6014 kg/ha because of the implication of two categories of factors, namely the intrinsic and extrinsic one. The fungi

within maize pathosystems – *Helminthosporium turcicum*, *Fusarium roseum* and *Ustilago zeae*, with their parasitical effect, caused an average yield decrease of 1155 kg/ha (Figure 1);

- the new pest *Diabrotica* was involved, with its rhyzo-, phylo- and stigmatrophic activities, in a yield decrease of 2161 kg/ha (Figure 3);

- because of the parasitical effect (parasitical fungi and the new pest) representing an average of 41.5%, hybrids' yield was reduced with 3316 kg/ha;

- because of the non-parasitical effect caused by the intrinsic and extrinsic factors in a proportion of 58.5%, yield was reduced with 3303 kg/ha;

- the biggest losses caused by the parasitical factor, the new pest *Diabrotica virgifera virgifera* Le Conté (an average of 2161 kg/ha, compared to the value caused by pathogens, which is more reduced, namely 1155 kg/ha).

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