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RESEARCHES ON THE EFFECT OF PHYTOSANITARY TREATMENTS TO GRAIN SORGHUM IN SANDY SOIL CONDITIONS

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Abstract

*The pest and pathogens control is an essential requirement for sorghum, especially in the early stages of vegetation and at grain formation to waxi stage grain. Our results highlights the existence closely between the degree of pathogen attack and plant resistance to drought conditions. Thus, through the loss a quantity of water higher than 2.8 mmol $H_2O/m^2/s$, was registered increasing the attack produced by Hadrotrichum sorghi and Fusarium moniliforme Sheld. Significant (r = 0.595 *) and distinctly significant (r = 0.811 **) correlations between plant transpiration and the pathogens degree of attack were established. Two treatments at 4-5 leaves and 6-8 leaves with Topsin 500 SC (0.07%), had determined the lowest degree of attack produced by Hadrotrichum sorghi (17.11%) and Fusarium moniliforme Shedd (3.72%). Treatment with Calypso 480 EC, at a dose of 80 ml / ha has reduced with 81.4% the frequency of grain aphid (Schizaphis graminum) compared to untreated control. The quality of sorghum grain, respectively protein content was influenced both by the phytosanitary treatment and the climatic conditions during the growing season (high temperatures during the summer - autumn and precipitation almost nonexistent).*

Key words: *diseases, pests, grain sorghum, phytosanitary treatments, sandy soil.*

INTRODUCTION

Sorghum crop success is frequently conditioned by the occurrence of various diseases and pests, which can reduced the production potential of plant varieties and hybrids. In many cases, the production losses may be appreciable (Barbulescu, 1985).

Sorghum has a high starch, sugar and fiber, and is one most important crops energy of world's. However the attack of insect pests may cause great damage to this plant (Chunshan et al., 2011).

Research conducted on sorghum protection have led to elaboration of control methods with a rol in increase production of sorghum.

Grain sorghum is considered a drought-resistant plants and outlook for the future in dry areas in Romania (Antohe, 2007; Draghici, 2009), based on the accentuation of atmospheric and soil drought in the last period, which compels us to finding alternatives to the assortment of plants that are presently cultivated.

MATERIALS AND METHODS

The research was conducted in 2012-2013 at Research - Development Center for Field Crops on Sandy Soils, Dabuleni, and the aim was the prevention and control of the pest and diseases on grain sorghum.

Experience has been placed in subdivided parcels with 2 factors, under field conditions, on sandy soils with low natural fertility (humus from 0.38 to 0.72%, and a pH_{H2O} = 6.8-7.1).

A number of 16 phytosanitary treatment variants (systemic and contact insecticides and fungicides) were tested and compared to the untreated control (Table 1).

The phytosanitary treatments (Figure 1) were applied at two phases, as follows: treatment 1 was applied at to the 4-5 leaf stage and the second one was applied at the stage 6-8 leaf stage. Pathogens frequency, intensity and the degree of attack were determined.

Physiological determinations were carried out at the stage of grain forming, using the LCpro + Photosynthesis Portable System. Determination of the quality of sorghum grain were carried out at harvest. The results were calculated and interpreted based on statistical and mathematical functions, using analysis of variance.

Table 1. Experimental variants

A. Fungicides / concentration		B. Insecticides/dose/concentration	
Untreatedt	-	Untreated	-
Dithane M-45	0.2%	Faster 10 CE	0.03%
Shavit F72 WP	0.2%	Confidor Energy	0.1%
Topsin 500 SC	0.07%	Calypso 480 CE	80 ml/ha

Figure 1. Stage of sorghum plant vegetation for phytosanitary treatments

RESULTS AND DISCUSSIONS

The evolution of monthly temperature and precipitation during the period 2012-2013, emphasizes accentuation the drought phenomenon, compared to the annual average (Figure 2), an added reason for further research on grain sorghum, considered a drought-resistant plant with prospects for the future in drought areas in Romania.

The average monthly temperature recorded in the 2012-2013 period, from April to September, was 20.59°C, with 1.73°C higher than the annual average, and precipitation sum was 269.3 mm, by 41.2 mm less.

Of the two years studied, climatic conditions were poor in 2012 when, in the period of intensive growth and differentiation of sorghum plant productivity (June to August), 62.4 mm rainfall, and a temperature average of 24.7°C, with a maximum of 42.6°C were recorded.

The climatic conditions in 2012-2013 have created favorable environment for the infection of sorghum plant with *Hadrotrichum sorghi*, manifested on the leaves as circular spots with black center and red-brown edge.

Also, starting with the earliest phases of growth and the grain formation by the grains of wax stage, a background of the average amount of precipitations of 83.1 mm, during in the period from May to June, created a favorable short time for infection plant with *Fusarium moniliforme sorghum* (Sheld). Those infections can be influenced by high doses of nitrogen applied to cultures on sandy soils (Cojocaru Doina et al. 1994, Drăghici I., 2003).

Observations made during the growing season have signaled infestation with aphids, especially grain aphid (*Schizaphis graminum*) starting with plantlet stage, until physiological maturity (Figure 3).

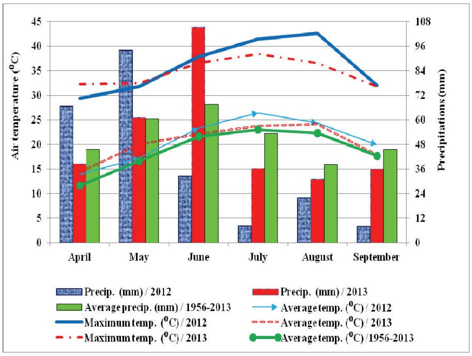


Figure 2. Evolution of climatic conditions registered in the area, on sandy soils, during sorghum vegetation period

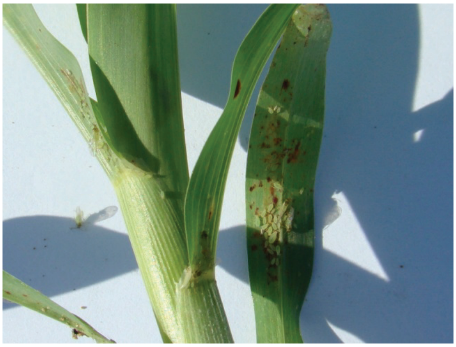


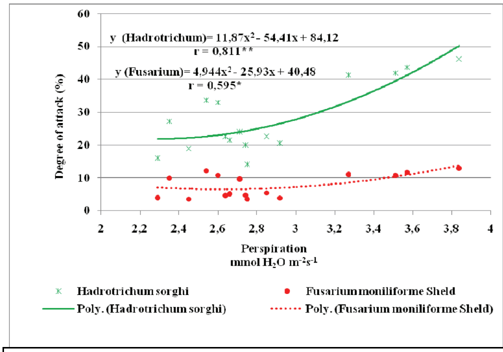
Figure 3. Sorghum plants infested with *Schizaphis graminum*

The results obtained in sorghum grain emphasizes the close relationship between the degree of attack of pathogens and plant resistance to drought conditions.

Thus, at an intense plant transpiration through the loss of a quantity of water greater than 2.8 mmol $H_2O/m^2/s$, there was an increase in the attack degree of *Hadrotrichum sorghi* and *Fusarium moniliforme*. Under the temperatures of 31.9 to 32.5°C recorded on the surface of leaf, the transpiration rate has led to an increased attack of pathogens.

Significant and distinct significant correlations between plant transpiration and the degree of attack of these pathogens have been established (Figure 4). The damage caused by foliar pathogens reduced the area for photosynthesis, which means that the plant can no longer produce enough nutrients to support the optimal growth. Also, hydration of the leaves decreased, because the quantity of water is lost by plant transpiration.

The preventive use of fungicides and insecticides leads to conservation of production and quality potential of sorghum (Table 2).



Air temperatures at the surface of the leaf = 31.9-32.5°C
Atmospheric pressure = 1020-1021 atm

Figure 4. Correlation between plant transpiration and the degree of attack of pathogens

Table 2. Influence of phytosanitary treatments on the pest and diseases control in grain sorghum, on sandy soils

No. var.	Fungicides	Insecticides	*Hadrotrichum sorghi* (Da%)	*Fusarium moniliforme* (Da%)	*Schizaphis graminum* (F%)	Kg/ha	Difference from control Kg/ha (significance)	Protein %	Fats %
1	Untreated	Untreated	43.9	12.8	49.7	3285	Control	15.8	4.2
2		Faster 10 CE	41.85	11,7	20.4	3967.5	682.5	15.9	4.2
3		Confidor Energy	40.2	10.8	10.65	4279	994*	16.5	4.1
4		Calypso 480 CE	39.3	10.9	10.2	4284	999*	16.1	4
5	Dithane M-45	Untreated	32	11.2	49.2	4051	Control	15.4	4
6		Faster 10 CE	30.05	10.8	18.35	4810.5	759.5*	15.5	4.1
7		Confidor Energy	28.45	10	10.9	5058.5	1007.5*	16.1	4
8		Calypso 480 CE	24.05	10.5	10.25	5314	1263**	15.8	4.3
9	Shavit F72 WP	Untreated	19.2	5	45.9	4285.5	Control	16.4	4.5
10		Faster 10 CE	19.7	5.4	19.7	5218	932.5*	16.1	4.2
11		Confidor Energy	17.45	4.8	11.3	6051.5	1766***	16	4.3
12		Calypso 480 CE	18.3	4.5	8.05	6330.5	2045***	15.9	4.1
13	Topsin 500 SC	Untreated	19.45	3.9	44.95	4431	Control	15.5	3.9
14		Faster 10 CE	17.85	3.6	14.55	5357	926*	15.8	4.2
15		Confidor Energy	15	3.6	8.6	5978.5	1547.5***	16.1	4.2
16		Calypso 480 CE	16.2	3.8	7.45	6536	2105***	16.6	4.5

LSD 5% = 755.5 kg/ha
LSD 1% = 1027 kg/ha
LSD 0.1% = 1376 kg/ha

The results on the effect of the phytosanitary treatments on sorghum highlights good efficacy for the systemic products, followed by those with the dual action (systemic + contact).

Thus, Topsin 500 SC and Shavit F72WP stood out from the rest of fungicides tested to control *Hadrotrichum sorghi* and *Fusarium moniliforme* Sheld.

Good efficacy in controling *Schizaphis graminum*, were registered with Calypso 480 EC (systemic action) and Confidor Energy (systemic + contact).

The production obtained at harvest was negatively correlated with the degree and frequency of attack of the pest and pathogens.

The maximum of production (6536 kg/ha) was achieved in the variant treated with Topsin 500 SC (0.07%) + Calypso 480 EC (80 ml/ha), where the frequency and degree of attack of the pathogens and pests was minimal (Figure 5).

Figure 5. Phytosanitary treatment to sorghum with Topsin 500 SC 0.07%+ Calypso 480 CE 80 ml/ha

Treatment of sorghum during vegetation, at the 4-5 leaves and 6-8 leaves stages, with these products with systemic action, led to registration of an increased production, very significant compared to the untreated control (2105 kg/ha)

The phytosanitary treatment had positive influence on the grain quality, respectively protein and fat content. Grain quality was influenced by the treatment as well as climatic conditions during the growing season (high temperatures during the summer - autumn and precipitations almost non-existent).

The percentage of protein ranged from 15.5%, in the variant treated with Topsin 500 SC (0.07%) and no insecticide and 16.6%, in the variant treated with Topsin 500 SC (0.07%) and Calypso 480 EC (80 ml/ha).

The fat content ranged from 3.9% in the variant treated with Topsin 500 SC and no insecticide treatment and 4.5% in the variant treated with Topsin 500 SC (0.07%) + Calypso 480 EC (80 ml/ha).

The infection of sorghum with pathogenss emphasizes values of attack degree from 17.11 to 41.31% for *Hadrotrichum sorghi* and from 3.73 to 11.55% for *Fusarium moniliforme Sheld* (Figure 6).

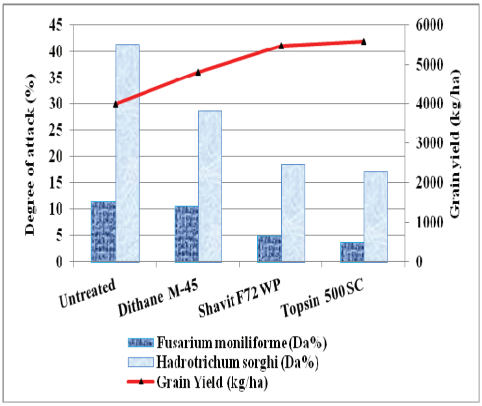


Figure 6. Influence of fungicide treatment on pathogens of grain sorghum

Compared to untreated control (41.3%, attack degree), *Hadrotrichum sorghi* infection was reduced by 54.8-58.6% was in variant with two treatments with systemic fungicide Topsin 500 SC (0.07%), or systemic + contact (Shavit F72WP (0. 2%) decreased .

The same treatment reduced with 57.3-67.7% the attack degree of *Fusarium moniliforme* Sheld, compared to untreated, .

The production realized in the phytosanitary treatment options ranged within the limits 5471.5-5575.5 kg/ha.

An important role in the stability of of sorghum yields is the control of *Schizaphis graminum*, favored by the climatic conditions of the area.

Application of phytosanitary treatments with insecticides has reduced with 60 to 85.8% the frequency of attack this pest, compared with untreated control where of attack frequency was 48.27% (Figure 7).

The lowest frequency values (8.99 to 10.36%) of *Schizaphis graminum* was recorded when treated with Calypso 480 (80 ml/ha) and with Confidor Energy (0.1%). These results were positively correlated with grain yield obtained (5342-5600 kg/ha).

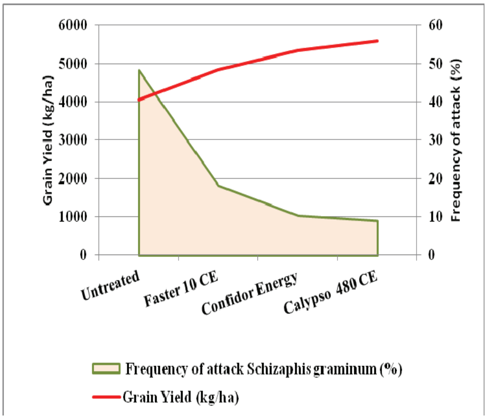


Figure 7. Influence of insecticide treatment on aphids in grain sorghum

The relationship between production and the degree and frequency of attack (Figure 8), highlighted distinct significant negative correlation: r = - 795 ** (*Hadrotrichum sorghi* x Production), r = - 0.705 ** (*Fusarium moniliforme* x Production), r = - 0.694 ** (*Schizaphis graminum* x Production).

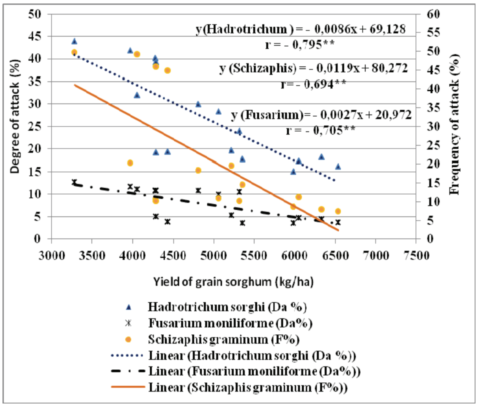


Figure 8. Correlations between the sorghum grain yield and the degree and frequency of attack of the pest agents

CONCLUSIONS

Preventive use of fungicides and insecticides leads to conservation of production and quality potential of sorghum. The degree attack of *Fusarium moniliforme* Shedd and *Hadrotrichum sorghi* on sorghum plants are positively correlated with plant transpiration, in significantly distinct and significantly (r = 0.811 **, r = 0.595 *).

The maximum of production (6536 kg/ha) was achieved in the variant treated with Topsin 500 SC in concentration of 0.07% + Calypso 480 EC at a dose of 80 ml / ha, where the degree and frequency of attack of pathogens and pests was minimal.

The application of two phytosanitary treatments with Topsin 500 SC (0.07%) or Shavit F72 WP (0.2%) at 4-5 leaf and 6-8 leaf stages has reduced the degree of attack of *Hadrotrichum sorghi* with 54.8-58.6% compared to control and with 57.3 to 67.7% degree of attack of *Fusarium moniliforme.*

Frequency of *Schizaphis graminum* was reduced by 60 to 85.8%, compared to the untreated control, by the application of two phytosanitary treatments with Calypso 480 EC (80 ml/ha) or Confidor Energy (0.1%).

The production obtained of grain sorghum was correlated negatively, significantly distinct with degree and frequency attack of pest agents.

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