STUDY ON HYDRO PHOBIA OF MAIZE SEED, AS A METHOD OF EARLIER TERMS OF SOWING

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***Abstract**: The possibility of earlier sowing of maize before the optimal time has come (12-15 ^{0}C) relieves the manufacturers, which leads to more rational use of machineries, ensures early germination and fuller use of the moisture from the winter- spring period. This opportunity is achieved through a peculiar preserving of the seeds, considered as an additional part of their pre sowing preparation or complex preparation including the pesticides. Hydro phobia represents a construction of a protective water-impermeable layer of polymers with a different thickness and different time of degradation at definite conditions. The treatment of seeds with pesticides is done separately or in conjunction with the creating of the polymer covering. The exposure of the seeds in cold and moist soil to their germination is directly dependent on the thickness of the coating and the time for its breaking under the influence of the soil microbial activity. A correlation between the surface of corn from different fractions and their mass is established. A relationship between the thickness of the polymer coating and the period's duration of its degradation is established. A function between the mass of grains, the thickness of the coating, the amount of polymer and the amount of the solvent is established. The period of stay of the seeds in the soil depends on the thickness of the coating and the time of sowing should end with the coming of minimum conditions (7-9 0C) for germination.*

***Key words:** maize, hydro phobia, polymer, coating, terms of sowing.*

INTRODUCTION

The main purpose of hyrdo phobia, as the name itself points, is to reduce the inflow of moisture into the seeds by creating a polystyrene insulation coating around their surface. Besides this, this coating has to insulate also from penetration of pathogenic micro flora into the seeds under the terms of their prolonged stay in the soil.

Hyrdo phobia during the Seventies of the 20th century was based on the use of: Chloroform – 17 liters, Polystyrene - 0,5 kilograms and Fenthioram - 2 kg per ton of maize kernel. Both ingredients are comparatively well known today and they can be supplied in industrial quantities without serious restrictions. Cloroform-trochloromethane CHCL3, Fenthioram represents a combination of chemical substances, including: 40% Thiram – presently it is used mainly for decontamination of vegetable seeds and 20% gamma-isomer of hexachlorocyclohexane (HCH), a chemical substance that was awarded a Nobel Prize because it saved people from the widely spread fleas among people, but consequently its use was banned due to found out negative effects on people and the long duration of its adverse aftereffect; and finally the last ingredient of Fenthioram is the chemical substance with 10% content of copper trichlorophenolate – a red-and-brown powder with sharp carbolic scent, which is also forbidden for independent use (KIDONIEUS, 1980; PETROVICI AND AILINCAI, 1984 SERGEEVICH, 1981).

The necessity of hydro phobia arises from land consolidation, i.e. the increase of the size of the cultivated fields, which requires more agricultural equipment with higher efficiency. Also a problem arises related to the longer time for their transportation due to the significant distances between the separate cultivated fields. The structure of the cultivated crops is changed both due to economic reasons and to the permanent change of climate caused by the cyclicity of the annual periods against the background of global warming. The increased fields sown with rapeseed due to the unlimited market and the high price led to rapeseed occupying about 2 million dca, and due to the same reasons the fields with sunflower increased to 7 million dca. Problems occurred with the correct rotation of the cultures due to the fact that both cultures do now allow subsequent sowing after it as well as one after another for a period of at least two years. Among the cereal crops, main predecessors for them are wheat and maize each having its own advantages and disadvantages. The first one is an excellent predecessor, covers large land areas, it is harvested early, but it does not allow further sowing after two subsequent years, after which the resources necessary for preserving the yields get higher and then occurs the problem with the crop rotation of rapeseed and sunflower. Maize which occupies large pieces of lands reaching 3-4 million da tends to increase, particularly in North-West Bulgaria and it is commonly used as predecessor of the main cultures and of rapeseed as well. During the years of normal distribution of rainfalls maize forms high yields, allows mono-crop cultivation, which makes it the Queen of the field (DELIBALTOVA ET AL., 2009; KIRCHEV, 2014; MATEV AND KIRCHEV, 2010).

Main aspect of the technology is the opportunity for earlier sowing which generally is related to the better use of moisture from the winter reserve and the early spring rainfalls, formation of good root system and earlier phases of growth, slower in the beginning, but much intensive with the rising temperature (SCOTT. 1989).

Hydro phobia of the seeds is an opportunity for earlier sowing of maize seeds in the cold and moist soil. Also, significant is the fact that maize sprouts endure even light short-term frost. Hydro phobia of maize seeds in industrial quantities is known and used in the 80-ies of the 20th century, but the stated prerequisites in the current economic conditions are a significant motive for its revival and further improvement. The purpose of this study was to find out the relation between the quantity of seeds and their surface with the help of which to determine the quantity of polymer necessary for their hydrophobization which might differ depending on the time of sowing and their stay in the soil.

MATERIAL AND METHODS

Decontaminated maize seeds are used, of the hybrid F-38 by the company Pioneer, with fraction of the kernels 3.5 and 4.5 mm /Table 1. and Function /. By wrapping the kernels with aluminum foil and then by superimposing their imprints on the foil over graph paper we determine their surface. In order to make a correction of the measurements the entire quantity of seeds is immersed in water, the water displacement is equated to a dense sphere that shows the surface.

Five samples have been studied, repeated two times, each consisting of 10 kernels, which weight and surface were measured, from two fractions. The calculated quantity of polystyrene is dissolved in chloroform and while constantly stirring the seeds in a chamber, it is added to them. The exposure takes from five to fifty minutes depending on the necessary quantity and it is related to the time of stirring and homogenization. The time for preparation depends also on the size of the solvent which subsequently we lose due to the fact that the chamber is opened while the stirring continues until the evaporation of the solvent. Its optimal amount will be determined by further studies related also to the drying of the prepared material. Sowing is made in the end of February and beginning of March with soil temperature of -3-4 C0 reaching for short periods from 3 to 5 C0, a period during which from ten years we usually have eight or nine with suitable sowing conditions.

RESULTS AND DISCUSSION

Moistened samples soaked for 24 hours are set to germinate – treated and untreated seeds. After a period of 20 days at temperature regime of about -3, -4 ^{0} C they are inserted in thermostat at temperature of 12-15 degrees. The seeds treated with polystyrene in the beginning after the third day and in the end of the eighth day are not germinating, except in the cases when some of them might not be very well coated and admit water. Regarding the untreated seeds the germination rate is 95-97 %. After 20 days' stay in a refrigerator in a container at +50 C with high humidity of 80-90 %, the germination rate of the untreated seeds is reduced and we notice signs of rotting, while in the same time we do not observe any germination of the treated seeds. When putting the seeds in planters with moist soil and at low temperature, the untreated seeds for 20 days' period at temperatures of -3,-4^{0} C rot - 30-50 % of them, while the treated ones preserve low germination rate of about 20-30 %, without rotting seeds. In the conditions of the soil the germination rate of the treated seeds at the end of the period, on the 30th day starts to increase on the basis of the starting destruction of the polystyrene coating. On the 30th day after the sowing the germination rate reaches 75% while this percentage is only 25% for the untreated sown seeds.

Table 1.

Biometrics of the maize seeds.

	Weight / g /	Surface /mm^2/	Weight / g /	Surface /mm^2/	Weight / g /	Surface /mm^2/	Weight / g /	Surface /mm^2/	Weight / g /	Surface /mm^2/
Sample №	I		II		III		IV		V	
1	0,38	469	0,43	427	0,38	411	0,45	460	0,42	539
2	0,40	683	0,43	326	0,41	471	0,38	433	0,35	521
3	0,34	549	0,40	399	0,31	394	0,33	547	0,44	545
4	0,44	558	0,33	404	0,37	244	0,36	506	0,39	534
5	0,37	437	0,42	408	0,39	453	0,36	580	0,40	561
6	0,37	378	0,43	479	0,39	459	0,37	513	0,45	531
7	0,42	258	0,34	340	0,43	289	0,37	459	0,43	486
8	0,33	416	0,40	314	0,38	422	0,42	584	0,45	559
9	0,40	326	0,42	432	0,42	494	0,27	260	0,34	479
10	0,40	449	0,34	398	0,36	286	0,39	421	0,34	522
Total	3,85	4522	3,94	3927	3,84	3923	3,70	4763	3,91	5277
Average	0,385	452,2	0,394	397,2	0,384	392,3	0,370	476,3	0,391	527,7
Sample №	I		II		III		IV		V	
1	0,41	454	0,38	580	0,41	425	0,41	589	0,43	483
2	0,43	451	0,42	591	0,38	336	0,36	409	0,37	376
3	0,51	527	0,36	577	0,36	375	0,45	503	0,36	402
4	0,41	465	0,41	461	0,43	322	0,43	275	0,41	511
5	0,41	531	0,32	382	0,41	464	0,34	368	0,46	563
6	0,37	400	0,38	579	0,40	338	0,39	411	0,37	448
7	0,39	527	0,35	374	0,35	275	0,35	330	0,45	412
8	0,36	567	0,39	489	0,39	275	0,46	344	0,35	385
9	0,35	295	0,34	307	0,43	319	0,47	477	0,44	403
10	0,43	387	0,39	535	0,41	247	0,44	401	0,43	396
Total	4,07	4704	3,74	4875	3,97	3376	4,10	4089	4,07	4379
Average	0,407	470,4	0,374	487,5	0,397	337,6	0,410	408,9	0,407	437,9

$\mathbf{X_{ave}} = X_1+X_2+....X_n = \mathbf{0{,}3919\ /g/}$

$\mathbf{У_{ave}} = У_1+У_2+.....У_n = \mathbf{438{,}35\ /mm^2/}$

$$\boldsymbol{\delta_x} = \frac{(X_{ave}-X_1)^2+(X_{ave}-X_2)^2+(X_{ave}-X_n)^2}{n.(n-1)} = \mathbf{0.0004614\ /g/}$$

$$\boldsymbol{\delta_y} = \frac{(У_{ave}-У_1)^2+(У_{cave}-У_2)^2+(У_{ave}-У_n)^2}{n.(n-1)} = \mathbf{1{,}6586392/mm^2/}$$

y=ax+b

Table 2.

Thickness of the coating as a function of the weight and surface of the kernels.

A	B	C	D	E	F	G
			C*1000 /(1000000/B)		E/1000000	D/A/F*1000
mm^2/1kernel	gram /1 kernel	Polystyrene [kg] /1 ton kernel	Polystyrene [gr] /1 kernel	Polystyrene [gram/dm^3]	Polystyrene [gram/mm^3]	H[mkm] coating thickness in micrometers
226	0,34	**2**	0,00068	1061	0,001061	**2,8**
260	0,33	**2**	0,00066	1061	0,001061	**2,4**
261	0,32	**2**	0,00064	1061	0,001061	**2,3**
265	0,31	**2**	0,00062	1061	0,001061	**2,2**
267	0,3	**2**	0,0006	1061	0,001061	**2,1**
282	0,32	**2**	0,00064	1061	0,001061	**2,1**
292	0,31	**2**	0,00062	1061	0,001061	**2,0**
263	0,28	**2**	0,00056	1061	0,001061	**2,0**
249	0,29	**2**	0,00058	1061	0,001061	**2,2**
274	0,31	**2**	0,00062	1061	0,001061	**2,1**
262	0,32	**2**	0,00064	1061	0,001061	**2,3**
283	0,33	**2**	0,00066	1061	0,001061	**2,2**
267	0,33	**2**	0,00066	1061	0,001061	**2,3**
294	0,36	**2**	0,00072	1061	0,001061	**2,3**
281	0,34	**2**	0,00068	1061	0,001061	**2,3**
281	0,31	**2**	0,00062	1061	0,001061	**2,1**
290	0,36	**2**	0,00072	1061	0,001061	**2,3**
274	0,33	**2**	0,00066	1061	0,001061	**2,3**
269	0,32	**2**	0,00064	1061	0,001061	**2,2**
269	0,33	**2**	0,00066	1061	0,001061	**2,3**

**Only the values of columns 1, 2 and 3 are variable.*

legend

A= mm^2/1 grain

B=gr/1 grain

C= polystyrene for 1 t

D=C*B/1000= polystyrene for 1 kg

E=factor 1061 polystyrene/ gr/dm^3

F=factor 1.061polystyrene gr/cm^3

G=C*B/mm^2 on 1 grain* polystyrene gr on cm^3

G= polystyrene for 1 t* gr.grain/mm^2 grain* polystyrene gr /cm^3

H (mkm) –coating thickness in micrometers

We found out the average weight of the kernel and its surface which are presented by the limits of the average values at P - 5%, 1% and 0.1%, which are respectively: 0.318 - 0.392; 0.390 - 0.393; 0.391 - 0.394 g and the respective surface within the limits : 43.51 - 48.62; 43.41 - 44.26; 43.29 - 44.38mm^2 .

We found out the thickness of the polystyrene coating when using different quantities of polystyrene per 1 ton of kernels and a function of the thickness of the coating depending on the surface of the kernel.

The measured germination rate of moistened untreated and treated seeds set to germinate, after the end of the period of stay at low temperature and its increase to 15 ^{0} C, as well as those set to germinate as a control batch show the following results:

Untreated with a period of stay at low temperature - 57 %

Treated with a period of stay at low temperature - 75 %

Untreated, set to germinate as a control batch - 98 %
The limits /LSD/ of the average values are calculated at P- 5% and 1%.
A correlation analysis of the results was done according to Duncan.

CONCLUSIONS

There is an opportunity to make a hydrophobization coating of the seeds with different thickness depending on their weight, surface and the duration of their stay in cold and moist soil.

There is an opportunity for very early sowing, in which case the plants are rooted earlier and their growth happens faster, while in the same time they utilize better the winter reserve of moist and the early spring rainfalls.

The seeds subjected to hydrophobization endure much better the low temperatures compared to the untreated ones, in all germination conditions at reduced temperature.

A function was found out that helps to determine the different thickness of the polystyrene coating in the cases of different quantities of the treated seeds and their surface.

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