EVALUATING HAIL STORM DAMAGE TO CORN PRODUCTIVITY

EVALUAREA DAUNELOR PROVOCATE DE FURTUNI ÎNSOȚITE DE GRINDINĂ ASUPRA PRODUCTIVITĂȚII PORUMBULUI

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Abstract. *In Romania, more than half of hail storm are in the period from May to July. They are responsible for small losses of productions they occur in the early stages of vegetation. Significant losses occur when hail storm occur during flowering-silking period. James V. Vorst appreciates that monetary losses caused by hail storm reach $ 52 million annually in the USA. Starting from this consideration, but also in terms of attracting attention on providing corn crops, in the spring of 2015 we established a two-way experience, in Lovrin, Timisoara. The first experimental factor, corn cultivar has been represented by 18 maize hybrids of FAO 350-550 maturity groups. The second factor was the degree of defoliation on plants corn produced artificially in various stages of vegetation. Results indicate losses of up to 5% when maize has six leaves, 1-10% when corn has 10 leaves, of 9-62% during flowering-silking and 6-41% when milk line was distinguishable.*
Key words: hail storm, enable recovery, corn, productivity

Rezumat. *În Romania, peste jumătate din ploile însoțite de grindină sunt în perioada Mai – Iulie. Acestea sunt responsabile de pierderi de producții mici cand apar în primele faze de vegetație. Pierderile semnificative apar atunci cand ploile însoțite de grindină apar în perioada înflorit-mătăsit. James V. Vorst aprecia că pierderile băneşti provocate de ploile cu grinidină ajung la $52 milioane dolari anual numai în SUA. Plecând de la acest considerent, dar şi din prisma atragerii atenției asupra asigurării culturilor, în primavara anului 2015 am înființat o experiență bifactorială, în localitatea Lovrin, Timişoara. Cultivarul de porumb reprezentat de 18 hibrizi de porumb din grupele de maturitate FAO 350-550 au reprezentat primul factor. Al doilea factor a fost reprezentat de gradul de defoliere produs artificial asupra plantelor de porumb, în diferite stadii de vegetație. Rezultatele indică pierderi de până la 5% când porumbul are 6 frunze, de 1-10% când porumbul are 10 frunze, de 9-62% în perioada înflorit-mătăsit şi de 6-41% când se poate distinge linia de lapte.*
Cuvinte cheie: grindină, capacitate refacere, porumb, producție

INTRODUCTION

Conform to Klein and Shapiro, 2011, corn plants are not affected or less affected by hail storm just after vegetative emergence (VE). At VE stage, the

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growing point is still in the soil and remain there for at least 3 weeks (up to 5-7 fully visible leaves, V5-V7). About 3 weeks after emergence, all nodes and internodes plant are developed; growing point is above ground due internodes elongation. In the next 4-5 weeks, the growth rate is faster and also increasing the vulnerability of plants when rain with hail (Lauer, 2014).

During silky-flowered when developing reproductive organs occurs, rain hail can destroy in whole culture, the risk is 100% when the tassel is broken (Mangen and Peter, 2001; Lee, 2007). After pollination has occurred, risk of loss of production decreases as the plants approaching physiological maturity (Thomison, 2013). After physiological maturity plants begin to lose water of the grain, the risk is very low, except torrential rains accompanied by hail very large ear that can lead to detachment from the plant (Nielsen *et al.*, 2015).

According to Hicks and Naeve, 2009, in Minnesota more that $ 10 million is spent annually to insure crops against heavy hail. Losses farmers varies from year to year, but insurers pay $ 6 million in compensation for farmers who losses. The effect of hail not only affects production in a certain percentage, but may even reach the decision to sow again if it is required.

MATERIAL AND METHOD

Hybrids analyzed are from group of maturity FAO 260-510. Of these, 15 hybrids are dent grain and 3 are flint grain. At the 15% moisture were harvested 10 cobs of each variant for analyzing biometric cob (ear lenght, no of rows/ear and ear diameter). The yield values has been evaluated at 14% moisture in t/ha.

For each of the studies hybrids were scored for the number of days from vegetative emergence to flowering – silking and number of days from vegetative emergence to milk line apparition.

The experimental protocol on ice storm simulated on corn it was as follow:

1. Transitions field at the each V stage of developement to simulate a ice storm. Using a commercial cnife, we exfoliated all leaves visible at that moment.
2. For each variant we made the same protocol, trying to simulate the real ice storm.
3. The experimental variants are ice storm simulated at:
   V1 – 6 visible leaves (V6)
   V2 – 10 visible leaves (V10)
   V3 – flowering – silking time
   V4 – milk line apparition.

RESULTS AND DISCUSSIONS

Evaluating the results on the number of days from VE to flowering-silking, in V3 and V4, it was considered more logical treating them together (silking date has not varied in the case of these variants). Given this, we can confirm that heavy hail in vegetative phases lead to more activity of auxins stimulate cellular developement. Thus, until 6 leaves visible (V1), flowering-silking date is up to 1.5 days earlier than in V2 and up to 3.5 days compared with V3 and V4.

Interesting results were obtained and concerning occurrence of milk line apparition. Thus, in embodiments where the hail storm was simulated at 6 leave visible, the hybrids were developed line of the milk to about 106 days from the VE, while to the control in this case (V4) was 118 days. The difference 12 days is the influence of heavy hail in the development of accelerated plant to reach physiological maturity. The overall conclusion in this case is that as the rains hail occur early during vegetative, the development time further shortens. The conclusion is confirmed by the results in variants V2 and V3, 108 days and 114 days, and also by Robertson *et al.*, 2011.

Regarding moisture at harvest time it is observed as no significant differences between variants V1, V2 and V3. Instead, rain accompanied by hail in the phase of developing the milk line, leading to faster loss of moisture of the grain, the average difference beiing about 7%.

Stem lignification in stalks may explain the plants lodging in V4, which is the percentage of plants fallen is 2.25%. However, the data is interesting in that the plants develop a sensitivity in 6-10 leaves phase (V1 and V2, where the percentage of lodging is 17% and 26%. Generative period corresponds to a downward trend of this factor, the registered values in V3 and V4.

We will not focus more on the cobs biometric indicators in time to harvest, but conclude that the differences between variants are not significant in terms of the number of rows of kernels/cob and its diameter. In terms of length ear, general trend is observed with a rain hail delayed.

Regarding the production capacity, the most important indicator to watch in this experience, we find that the rains accompanied by hail at 10 leaves visible (V2) and during flowering-silking (V3) are the most damaging (there is a risk of a production diminished when the tassel is full destroyed).

Direct proportion to the period of bloom is the production obtained in that shortening the vegetative lead to an extension of the generative period. Obviously, productions can be much lower compared to checks where such rain occurs during milk line apparition.

According to literature and especially the results obtained by Balas Baconschi *et all*, 2015, late hyrids exceed productions of early hybrids, and dent hybrids are more yieldy than flint ones.

Table 1

Evaluating the silking – flowering date and milk line apparition from VE, harvest moisture and lodging plants at harvest time

Genotype	FAO	Silking date			Milk line (days from VE)				Harvest moisture (%)				Lodging plants (%)			
		V1	V2	V3-V4	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4
Hyb1S	290	58	60	62	105	107	113	117	19,8	20,4	21,6	15,7	16,1	25,3	8,4	4,3
Hyb2E	350	59	61	64	107	108	115	119	20,4	20,2	20,8	12,9	16,7	25,9	7,6	1,5
Hyb3P	350	60	61	65	108	109	116	120	20,2	20	20,6	12,7	16,5	25,7	7,4	1,3
Hyb4L	380	61	62	64	107	110	115	119	20,8	20,6	21,2	13,3	17,1	26,3	8	1,9
Hyb5D	450	57	60	63	106	106	114	118	18,8	18,6	19,2	11,3	15,1	24,3	6	0,1
Hyb6O	430	58	61	62	105	107	113	117	20,7	20,5	21,1	13,2	17	26,2	7,9	1,8
Hyb7M	400	60	63	61	104	109	112	116	21,8	21,6	22,2	14,3	18,1	27,3	9	2,9
Hyb8SA	490	58	61	60	103	107	111	115	20,2	17,7	15,8	10,6	16,5	25,7	2,6	0,8
Hyb9M	400	59	63	60	103	108	111	115	22,1	21,9	22,5	14,6	18,4	27,6	9,3	3,2
Hyb10P	310	61	62	61	104	110	112	116	21,5	22,1	23,3	17,4	17,8	27	10,1	6
Hyb11K	350	59	63	63	106	108	114	118	21,8	21,6	22,2	14,3	18,1	27,3	9	2,9
Hyb12M	400	60	62	65	108	109	120	120	21,4	21,2	21,8	13,9	17,7	26,9	8,6	2,5
Hyb13O	400	63	63	66	109	112	117	121	22,2	22	22,6	14,7	18,5	27,7	9,4	3,3
Hyb14A	490	59	63	65	108	108	116	120	21,7	19,2	17,3	12,1	18	27,2	4,1	0,7
Hyb15L	510	58	61	67	110	107	118	122	20,7	18,2	16,3	11,1	17	26,2	3,1	0,3
Hyb16C	260	56	60	62	105	105	116	117	18,9	19,5	20,7	14,8	15,2	24,4	7,5	3,4
Hyb17E	350	60	60	64	107	109	115	119	19,1	18,9	19,5	11,6	15,4	24,6	6,3	0,2
Hyb18R	340	62	61	63	106	111	114	118	19	19,6	20,8	14,9	15,3	24,5	7,6	3,5

Table 2

Evaluating the yeild, ear lenght, no of orows/ear and ear diameter

Genotype	FAO	YIELD (q/ha)				EAR LENGTH (cm)				NO OF ROWS/EAR				EAR DIAMETER (cm)			
		V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4
Hyb1S	290	7,59	6,52	5,41	8,45	21	20,9	22,6	27,2	16	18	18	18	41	41,5	44,4	44,8
Hyb2E	350	7,78	6,68	6,04	8,1	18,2	21,8	23,5	28	16	18	18	18	44,7	44,7	47,5	47,5
Hyb3P	350	7,15	6,54	6,22	7,81	18	20,8	24,6	27,3	16	18	18	18	41,9	43,5	43,9	46,8
Hyb4L	380	8,1	7,21	6,84	8	18,6	21,4	25,2	29,4	16	20	20	22	45,1	45,2	45,7	46,9
Hyb5D	450	9,52	8,41	7,94	9,51	16,6	19	27,5	28,7	18	18	20	20	46,4	47	49,5	50,4
Hyb6O	430	8,14	7,34	6,81	8,68	18,5	22,5	27,4	29,7	18	18	20	20	43,7	43,6	47,6	48
Hyb7M	400	9,82	8,65	7,48	10,14	19,6	23,7	28,4	29,9	16	18	18	20	42,7	42,5	48	48,1
Hyb8SA	490	9,68	9,12	8,49	11,43	15,9	23,4	25,4	30,1	18	18	20	20	40,3	42,4	47,3	49,5
Hyb9M	400	8,72	7,81	7,19	8,4	19,9	22,8	26,5	30,4	16	18	18	20	44	44	47,2	47,2
Hyb10P	310	7,75	7,64	6,89	8,06	22,7	24,1	24,9	28,4	16	18	18	18	44,7	44,7	45,1	45
Hyb11K	350	5,11	4,12	3,78	5,5	19,6	24	26,8	28,6	16	18	18	18	43,8	44,5	44,6	46,7
Hyb12M	400	8,33	8,14	7,34	9,01	19,2	23,1	24,8	29,7	18	20	20	20	45,1	45,6	47,5	48,3
Hyb13O	400	8,64	7,87	7,02	9,11	20	23	26,7	31,2	18	20	22	22	41,4	42,5	42,9	46,8
Hyb14A	490	8,34	7,58	6,86	8,48	17,4	23,1	25,3	32,5	18	18	20	20	44,6	43,5	45,8	46,2
Hyb15L	510	11,3	9,48	8,79	12,7	16,4	24,4	24,9	33,8	18	18	20	20	45,7	46,5	49,8	51,2
Hyb16C	260	6,61	6,5	5,75	6,92	20,1	21,4	26,8	26,8	16	18	18	18	40,2	41,8	44,8	43,9
Hyb17E	350	8,61	7,51	6,87	8,93	16,9	24,5	27,1	29	16	18	18	18	42,8	45,2	45,7	46,8
Hyb18R	340	8,63	8,52	7,77	8,94	20,2	23,8	27,2	28,6	16	18	18	18	44,1	42,7	46,5	46,2

CONCLUSIONS

1. In terms of the ice storm simulation, also in differentiating the genotypesm the data obtained after one year of experimentatin has been conclusive. The commercial hybrids tested reacted differently for yield, silking date and milk line apparition.

2. We can easly see that in V4 for yield are the best values. A ice storm at flowering – silking time is the whorst for corn and we thik that the results are not really with reallity, because in our simulated we did not touch the panicle, male inflorescence, which can be distoyed 100% in a strong ice storm. We can easly differentiantg the values in stage 6 and 10 visible leaves and we can conclude that the effect of ice stor m in these situatiion are not very big influenced in yield.

3. Very interesting results are for moisture harvest and lodging plants. We scored that in V1 and V2 variants are the hihest values for lodging plants; it means that the ice storm can induce a succeptibility for lodging and harvest moisture compare with other situations.

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