RESEARCHES ON THE HAIL EFFECT ON MAIZE YIELD

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Abstract. Through the studies and researches carried out in this paper, we have attempted to highlight the influence of the fall of hail of different intensities and in different vegetation phenophases on the production of maize. The hail was simulated in the 6-8 leaf stage and after pollination with a dandelion brush. In each phenophase of corn vegetation hail was simulated at three intensities: light hail (30% of the leaves have been torn), medium hail (60% of the leaves were torn) and total defoliation (all leaves were torn). The experience was placed on the farm in Livada, Satu Mare County. Following a study, it was concluded that hailstones in corn in the 6-8 leaf stage caused a 2-3 percent fall in production and hail after pollination could cause damage of over 20%.

Keywords: hail, corn, loses, production

INTRODUCTION

Currently, maize is one of the most important crop plants due to its high productivity and its multiple uses in human food, animal feed and raw material in various industries (Muntean L.S. et al., 2014). Hail is a form of solid precipitation consisting in transparent or opaque ice, of different shapes (spherical or corners), sizes (with diameters between 0.5 and 50 mm) and weight (from a few grams to more than 300 grams) (http://www.meteo.md). The hail may surprise agricultural crops in different stages of development, affecting the good course of the plant's biological cycle. Only one case of hail in a critical phase of plant development is sufficient for the entire harvest to be compromised. If hail occurs in wax milk phenophase, late mature hybrids are the most affected (Dwyer LM et al., 1994).

MATERIALS AND METHODS

In order to highlight the influence of hail fall of different intensities and various vegetation phenophases on maize production in the spring of 2016, a monofactorial experience was set up in Dumbrava, Satu-Mare County. The corn hybrid taken in the study was P9537. The hail was simulated in 6-8 leaf phenophases and after pollination with a metal wire brush. In each vegetation phenophase of corn, the hail was simulated at three intensities:

- light hail when 30% of the leaves have been torn; medium hail when 60% of the leaves have been torn; total defoliation when all leaves (100%) were torn.

Applied technology within the experience was:

- the plant prior to the corn crop was autumn wheat; in the autumn of 2016, the plowing was made on October 15 at a depth of 30 cm; in the spring of 2016, germination bed was prepared on April 21 with the cultivator and after with the combiner;

- the sowing was performed after the germination bed was prepared on April 21, 2016 at a depth of 8 cm and a density of 70000 plants per hectare. The seed was treated with Midash 600 FS (600 g / liter *imidacloprid*) for controlling wire worms. Sowing was carried

out with the 6-line precision seed drill with fertilizer and microgranulators. The amount of complex chemical fertilizers was 200 kg / ha NPK 16:16:16 commercial substance.

- weed control was done preemergent by applying Gardoprim Plus Gold 500 SC (S-*metalloclor* 312.5 g / l - *terbuthylain* 197.5 g / l) at a dose of 5 l / ha;

-harvesting took place mechanically on November 24 with the corn combine. Weighing was carried out after harvesting using the mobile scales. The results obtained from the weighing of each maize hybrid were reported on the surface of one hectare.

Determination of MMB (the mass of a thousand grains) was done according to the STAS methodology (SR 6123/99). The seed count needed to determine MMB was done manually. Manual seed count is done as follows: 8 rehearsals per 100 seeds are weighed and each reheading is weighed separately Corn production was quantified on each experimental plot at mechanized harvesting. Sketch of the experimental field is shown in Figure 1.

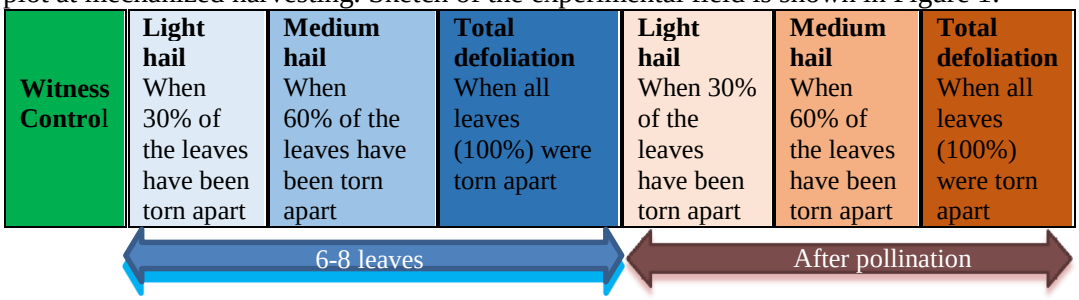

Fig.1 Sketch of the experimental field (original)

The calculations and interpretation of the results were performed according to established statistical methods such as variance analysis. For the significance of the differences, the "t" test was used with the calculation of the limit differences for significance thresholds of 5, 1 and 0.1%, as well as the Duncan multiple comparison test, in which each variant can be considered as a control for all others (ANOVA program). The soil where the experience was made is clayey-iluvial, with a pH of 6.28. Following the agrochemical chart shown in Table 1, it can be observed that the soil is poorly supplied in N. Potassium is present in the soil in large quantities and no further application is required.

Table 1

Values of soil quality indices in the field of research

pH	P mobil A-L ppm	K mobil A-L Ppm	Humus %	V %	IN
6,28	63	400	1,86	70,6	1,75

The average monthly crop temperature of maize was 20 degrees Celsius with a difference of 3.2^0 C from the multiannual average. The warmest month was July with an average temperature of $23\ ^0$ C (Table 2)

Table 2

Thermal regime ° C, (Dumbrava, Satu Mare County, 2016)

Month	IV	V	VI	VII	VIII	IX	Average
Monthly average	14,4	17,3	23,0	24,0	22,7	18.6	20,0
Multi-annual average	10,4	15,8	18,9	20,5	19,8	15.4	16,8
Difference	+4,0	+1,5	+4,1	**+3,5**	**+2,9**	+3.2	+3,2

The amount of precipitation during the growing period of maize was 413,3 mm with a deviation of 5.8 mm versus multi-annual. The rainfall in April ensured the uniform appearance of corn. The most rainy month was July when rainfall was 122.4 mm (Table 3).

Table 3

Rainfall regime mm (Dumbrava, Satu Mare County, 2016)

Month	IV	V	VI	VII	VIII	IX	Sum
Monthly Amount	45,8	48,10	122,4	66,2	53,7	77,1	413,3
Multi-annual amount	19,9	74,1	92,2	82,7	75,5	63,1	407,5
Difference	+25,9	-26,0	+30,2	**-16,5**	**+21,8**	+14.0	+5,8

RESULTS AND DISCUSSION

Results on the number of rows of corn bob on cob. The number of rows of corn bob is a morphologic character very well-genetic determined. It seems that the ice fall of the hail does not affect the number of rows of corn bob / cobs. Interpreting the results through variance analysis and the Duncan test, there is no statistically ensured difference in the number of rows of corn bob / cobs (Table 4).

Table 4

Influence of hail of various intensities on the number of rows of corn bob, (Dumbrava, Satu Mare County, 2016)

Graduation	Nr. rows of grains	Percent	Difer./Semnific	The Duncan test
Witness (Control)	16,33	100	Mt	A
Light hail in 6-8 leaf pheochosis	16,00	104	-0,33^{-}	A
Medium hail in the 6-8 leaf phenophase	15,33	100	-1,00^{-}	A
Defoliation in 6-8 leaf phases	16,00	104	-0,33^{-}	A
Light hail after pollination	16,00	104	-0,33^{-}	A
Medium hail after pollination	16,00	104	-0,33^{-}	A
Defoliation after pollination	14,67	96	-1,67^{-}	A
DL (p 5%)			1,27	1,27-1,40
DL (p 1%)			1,81	
DL (p 0,1%)			2,62	

Results on MMB (the mass of a thousand grains)**.** MMB is influenced both by the fall of hail in the 6-8 leaf vegetation phenophase and also after pollination phenophase. The hail, irrespective of the intensity after pollination, produces very significant negative differences of MMB compared to the control (Table 5).

Results on the production of grains (corn bob). Production is affected differently by the fall of hail. Hailstones in the 6-8 leaf phenophase cause small differences in production, differences that are not statistically ensured either by variance analysis or by the Duncan test. The mild and medium hail after pollination leads to distinctly significant negative production differences compared to the witness (control), and a strong hail falling into the same phenophase of vegetation produces very significant negative differences (Table 6).

Table 5

Influence of hail of various intensities on maize production, (Dumbrava, Satu Mare County, 2016)

Graduation	MMB (g/ha)	Percent	Difer./Semnific.	The Duncan test
Witness (Control)	362,67	100	Mt	A
Light hail in 6-8 leaf pheochosis	361,67	99,7	-1,00-	B
Medium hail in the 6-8 leaf phenophase	323,33	89,2	-39,33^{000}	C
Defoliation in 6-8 leaf phases	262,67	72,4	-100,00^{000}	C
Light hail after pollination	238,00	65,6	-124,67^{000}	D
Medium hail after pollination	259,67	71,6	-103.00^{000}	E
Defoliation after pollination	222,67	61,4	-140.00^{000}	E
DL (p 5%)			12,33	12,32-13,76
DL (p 1%)			17,30	
DL (p 0,1%)			24,43	

Table 6

The influence of hail of various intensities on the production of corn, Dumbrava, Satu Mare County, 2016

Graduation	Production (kg/ha)	Percent	Difer./Semnific.	The Duncan test
Witness (Control)	11.383,33	100	Mt.	C
Light hail in 6-8 leaf pheochosis	11.059,00	97,2	-324,33^{-}	C
Medium hail in the 6-8 leaf phenophase	11.149,67	97,9	-233,67^{-}	C
Defoliation in 6-8 leaf phases	11.131,0	97,8	-252,33^{-}	C
Light hail after pollination	10.251,67	90,1	-1.131,67^{00}	B
Medium hail after pollination	10.233,00	89,9	-1.150,33^{00}	B
Defoliation after pollination	9.255,67	81,3	-2.127,67^{000}	A
DL (p 5%)			602,65	602,06-672,43
DL (p 1%)			845,92	
DL (p 0,1%)			1.194,24	

RESULTS AND DISCUSSION

The pedro-climatic conditions of Livada, Satu Mare County, are favorable for the cultivation of maize, producing yields of over 11 t / ha, even under hail conditions in the 6 to 8 leaf stage. Hail causes important damage when it falls in advanced stages of vegetation, compared with the phase of 6-8 leaves, when the corn plant foliage is restored. In crops of maize after pollination, in a mild and medium hail, distinctly significant production differences were obtained, and in the case of a strong hail (complete defoliation) the production differences were very significant. Hail fall on corn in the 6-8 leaf stage caused a drop in production that 2-3 percent, and hail after pollination can cause damage of over 20%. The number of rows of corn bob is a morphologic character very well-genetic determined, so the hail fall does not affect that characteristic of maize. MMB is influenced both by the fall of hail in 6-8 leaf vegetation stages and by its fall after pollination.

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