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YIELDS AND QUALITY OF WHEAT AND MAIZE CULTURES UNDER THE INFLUENCE OF MANAGEMENT PRACTICES IN SOUTH AREA OF ROMANIA

Elena PARTAL

National Agricultural Research and Development Institute Fundulea, 1 Nicolae Titulescu Street, Calarasi, Romania

Corresponding author email: ela_partal@yahoo.com

Abstract

For wheat and maize the yields and quality are affected by management practices, soil and climate conditions and genetic characteristics. The research was conducted between 2019 and 2021, in the experimental field of NARDI Fundulea and the purpose of this study was to evaluate the effect of agrotechnical measures and climatic conditions on the yield and quality of wheat and corn. The experiment involved four different soil works, using three maize hybrids (Iezer, Mostistea and F423) and three wheat varieties (Glosa, Izvor and Pitar) and three fertilized options. The hight productions and good quality of wheat and maize were maximized by applying the factors in associated variants. The results showed that the crops were very significantly affected by the conditions of the year as well as most of the interactions between the factors. The conservative tillages of the soil associated with the fertilization with manure have potentiated the genetic characteristics of the crop plant, raising the final quality of the production by 5-10%, depending on the variant.

Key words*: maize, wheat, yield and quality, management practices.*

INTRODUCTION

The variation of production and quality between hybrids is determined by the genetic characteristics of the hybrid, climatic conditions and applied crop technology (Partal & Paraschivu, 2020; Paraschivu et al., 2019; Bene et al., 2014). The impact of climate change, especially drought, on agricultural yields can have varying consequences depending on the species, the crop area and the technological methods used (Donatelli et al., 2012).

High and stable production while maintaining the environment is a challenge for farmers, especially in the face of climate change. Drought followed by the rainy season can favor the conditions of manifestation of fungal diseases (Ajetomobi, 2016; Raza et al., 2019).

Technological practices in agriculture, such as genetic improvement of varieties and hybrids, fertilizer and pesticide technology, agricultural machinery and tools, and farm management have been developed through research to understand their implications for the growth and stability of agricultural yields (Kumaraswamy and Shetty, 2016; Rehman et al., 2017).

This research will review the factors that affect the yield and quality of wheat and maize crops and will provide recommendations to reduce production losses while preserving the environment.

The evolution of climatic elements has a varied influence on agricultural yields, depending on the type of soil and the technological measures applied in agricultural crops (Moss et al., 2010).

MATERIALS AND METHODS

The research on the influence of technological links on its production and quality in wheat and maize crops was performed between 2019-2021 carried out on the cambic chernozem from Fundulea, in the non-irrigated area, in a stationary experiment. Regarding the physical properties of the soil, the humus content is higher in the first 15 cm due to the former bedding and gradually decreases to depth. The soil consists of several horizons:

- Ap + Aph - 0-30 cm, clay-clay-dust with 36.5% clay and permeability 492, pH 5.9.
- Am - 30-45 cm, clay-clay with 37.3% clay, compacted, DA 1.41g / cm^3, pH 5.9.

- A/B (45-62 cm), Bv1 (62-80 cm), Bv2 (82-112 cm), Cnk1 (149-170 cm), Cnk2 (170-200 cm).

Depending on the agricultural year, the water supply of the soil is favorable for field crops, groundwater at 10-12 meters.

The experimental factors studied have the following gradations: factor A - soil work: a1 – no-tillage, a2 - disk, 3 - plow in autumn, a4 - chisel; factor B - fertilization system: b1 - unfertilized (N0P0); b2- fertilized with nitrogen and phosphorus at a dose of 90 N kg/ha + 75 kg P2O5/ha (N90P75) and b3 - fertilization with manure administered at 4 years (autumn) at a dose of 20 t/ha and factor C - variety/hybrid: wheat: c1 - Glosa, c2 - Izvor, c3 - Pitar, and maize: c1 - Iezer, c2 - Mostistea, c3 - F423.

The experiments have five repetitions in a randomized block system; The plot size for maize experiment was 56.0 m^2 (4 rows x 20 m long x 70 cm distance between rows) and for wheat the main plots are 240 m^2 (30 m x 8 m) and the sub-plots 48 m2 (6 m x 8 m). During the experiment, all the technological links were observed, so that the precursor plant for both crops was the pea, from a rotation of 4 years. The determinations regarding the quality of the seeds were performed as follows: for the hectolitre weight - HW - with the help of the hectoliter balance for cereals Model ML-HECTO 100, and for the weight of one thousand grains - WTG - with the help of the Kern EMB 500 precision balance.

Processed and interpreted statistically according to the method of analysis of variance.

Meteorological data were recorded at the NARDI Fundulea weather station and varied widely during the experimentation period especially depending on the distribution of precipitation during the vegetation period.

RESULTS AND DISCUSSIONS

Climatic aspects

The experimentation period recorded notable differences from one year to another due to the amount and periodic distribution of precipitation.

In 2019, the months with the lowest rainfall were 6.2 mm in September, compared to the 48.5 mm multiannual average and August with 12.6 mm compared to the 49.7 mm multiannual average. The greatest amount of precipitation occurred in July, with 87.4 mm, about 16.3 mm above the multiannual average. Regarding the thermal regime, between June and September, the recorded values show that the average monthly temperatures were higher than the multiannual average, in June by 2.8ºC above the multiannual average (Table 1).

The year 2020 was dry, with accentuated water deficit and high temperatures, compared to the multiannual average. Precipitation from sowing to maturity was insufficient to cover the water needs of the crops. The months with the lowest rainfall were 5.4 mm compared to 49.7 mm and July with 34.2 mm compared to 71.1 mm. Higher than average annual temperatures have exacerbated the drought. The average temperatures recorded in the agricultural year 2020 were 2.6ºC higher than the multiannual average.

In 2021, a normal year in terms of water quantities recorded, but with an uneven distribution, especially in July, August and September. The temperatures registered a difference of 1.2ºC compared to the multiannual average. The climatic data obtained were corroborated with the elements followed during the vegetation period of the crops.

Table 1. The meteorological parameters in the experimental period (Fundulea, 2019-2021)

Years/Months		Jan	Febr	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total/ Average
Precipitations (mm)	2019	53.8	21.4	22.4	51.4	124	74.6	87.4	12.6	6.2	38.2	33.2	16.2	541.4
	2020	2.0	16.6	29.8	14.0	57.8	68.4	34.2	5.4	68.6	24.0	20.0	77.6	423.2
	2021	77.0	16.2	59.0	31.0	57.6	135	21.2	24.2	4.0	56.4	33.8	37.6	553.2
50 years average		**35.1**	**32.0**	**37.4**	**45.1**	**62.5**	**74.9**	**71.1**	**49.7**	**48.5**	**42.3**	**42.0**	**43.7**	**584.3**
Temperatures (°C)	2019	-1.1	3.8	9.3	11.2	17.2	23.6	22.9	24.7	19.3	12.0	11.0	4.0	13.2
	2020	0.9	5.2	8.3	12.4	16.8	21.8	25.1	25.5	20.8	12.8	6.2	4.0	13.5
	2021	1.6	3.2	5.1	9.7	17.2	21.1	25.3	24.2	17.3	10.2	7.7	2.6	12.1
50 years average		**-2.4**	**-0.4**	**4.9**	**11.3**	**17.0**	**20.8**	**22.7**	**22.3**	**17.3**	**11.3**	**5.4**	**0.1**	**10.9**

Yield and quality of wheat

Wheat cultivation has changed at the production level under the direct influence of the applied technological variants. Thus, in 2020, 2871 kg/ha were obtained for the no-tillage control variant, thus becoming the lowest production in the factor graduation series. The basic tillage of the land by discussion recorded a production of 3579 kg/ha, with 708 kg more compared to the no-tillage control variant. The basic tillage variant for plowing recorded a production of 4590 kg/ha with 1719 kg over the control variant, thus becoming the best variant. The work of the soil with the chisel registered a production of 3968 kg/ha with 1097 kg/ha over the uncultivated control variant (Table 2).

The fertilization system showed a significant variation, so that the non-fertilized control variant registered a production of 3185 kg, thus becoming the lowest production in the series of factor graduations. Fertilization of the crop with $N_{90}P_{75}$ resulted in a production of 4615 kg/ha with 1430 kg (or 34.1%) over the control. The application of manure at a dose of 20 t/ha determined a production of 4490 kg/ha with 40.9% above the value recorded by the control.

The variety with the highest production was Pitar, with 3350 kg/ha, followed by Glosa with 3280 kg/ha, in the conditions of 2020. The Izvor variety obtained an average production of 3220 kg/ha, with 60 kg under the control variant -Glosa variety.

Table 2. Production results obtained for wheat crop in 2020

Variant	Production/Diference			HW		WTS	
	(kg/ha)	(%)	Semnific.	kg/hl	%	g	%
A. Soil tillages							
A1 - Mt	2871	100.0	0	77.0	100.0	45.0	100.0
A2	3579	124.6	708*	78.0	101.3	45.2	100.4
A3	3968	138.2	1097**	78.1	101.4	45.2	100.4
A4	4590	159.8	1719**	78.6	102.1	45.3	100.7
DL (kg/ha / kg/hl / g)	DL= (P 5%= 698 /P 1% = 1103 / P 0.1% = 1922)			DL = (0.69 /1.09 /2.07)		DL= (1.20 / 1.99/3.41)	
B. Fertilization type							
B1 - Mt	3185	100.0	0	77.0	100.0	45.0	100.0
B2	4615	134.1	1430**	78.4	101.8	45.3	100.7
B3	4490	140.9	1305**	78.5	101.9	45.2	100.4
DL (kg/ha / kg/hl / g)	DL= (P 5%= 674.2 /P 1% = 1000.2 /P 0,1% = 1866)			DL= (0.71 /1.15 /2.24)		DL= (1.23/ 2.03 /3.50)	
C. Varieties / Hybrids							
C1 - Mt	3280	100.0	0	77.0	100.0	45.0	100.0
C2	3220	98.0	-60	78.4	101.8	45.3	100.7
C3	3350	102.1	70	78.4	101.8	45.0	100.0
DL (kg/ha / kg/hl / g)	P 5% = (583.5 /P 1% = 992.1 /P 0.1% = 1688.0)			DL= (0.77 / 1.23 / 2,18)		DL= (1.18 / 2.01 / 3.22)	

The hectolitre weight registered different values depending on the grading of the factors. The highest values were recorded for the version with soil tillage by autumn plowing, 78.6 kg/hl.

Fertilization of the crop led to obtaining a maximum value of 78.5 kg/hl for the variant with the application of manure 20 t/ha (Figure 1).

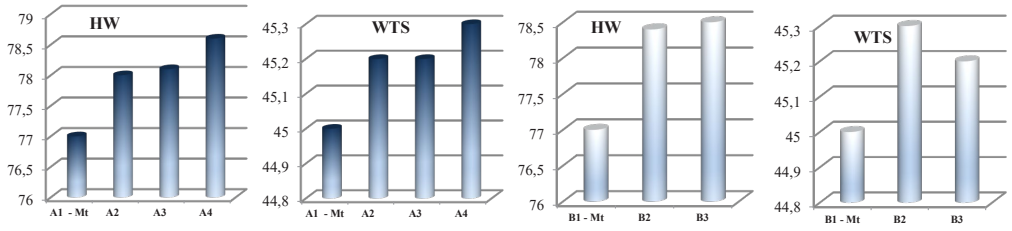

Figure 1. The influence of the factors on the HW and WTS in 2020

In the conditions of 2021, the no-tillage control variant obtained 2510 kg/ha, thus becoming the lowest production in the series of factor graduations. The basic tillage of the disk was 3497 kg/ha, 987 kg more than the no-tillage control. The basic tillage variant for plowing recorded a production of 4306 kg/ha with 1796 kg over the control variant, thus becoming the best variant. The tillage with a chisel registered a production of 4128 kg/ha with 1618 kg/ha over the no-tillage control variant (Table 3).

The fertilization system showed an important variation, so that the unfertilized control variant registered a production of 2822 kg, thus becoming the lowest production in the series of factor graduations. Fertilization of the crop with $N_{90}P_{75}$ led to a production of 3850 kg/ha with 1028 kg (or 34.1%) over the control. The application of manure at a dose of 20 t/ha resulted in a production of 4071 kg/ha with 44.3% recorded by the witness.

Wheat crop production data according to factor C graduations - the variety shows that the Glosa control variant recorded a production of 2550 kg, thus becoming the lowest production in the factor graduation series. The Izvor variety led to a production of 3520 kg/ha with 970 kg (or 38%) over the control, and the Pitar variety at 3480 kg/ha with 930 kg over the control (36.4%).

Tabel 3. Production results obtained for wheat crop in 2021

Variant	Production /Diference			HW		WTS	
	(kg/ha)	(%)	Semnif.	kg/hl	%	g	%
A. Soil tillages							
A1 - Mt	2510	100.0	0	76.0	100.0	44.0	100.0
A2	3497	139.3	987*	77.0	101.3	44.2	100.4
A3	4128	164.5	1618**	77.1	101.4	44.2	100.4
A4	4306	171.6	1796**	77.6	102.1	44.3	100.7
DL (kg/ha / kg/hl / g)	DL= (P 5%= 788 /P 1% = 1204 / P 0.1% = 2100)			DL = (0.60 /1.01 /2.00)		DL= (1.10 / 1.89/3.21)	
B. Fertilization type							
B1 - Mt	2822	100.0	0	76.0	100.0	44.0	100.0
B2	3850	136.4	1028*	77.4	101.8	44.3	100.7
B3	4071	144.3	1249**	77.5	101.9	44.2	100.4
DL (kg/ha / kg/hl / g)	DL= (P 5%= 624.2 /P 1% = 1122 /P 0.1% = 1906)			DL= (0.69 /1.05 /2.13)		DL= (1.13/ 2.11 /3.30)	
C. Varieties / Hybrids							
C1 - Mt	2550	100.0	0	76.0	100.0	44.0	100.0
C2	3520	138.0	970*	77.4	101.8	44.3	100.7
C3	3480	136.4	930*	77.3	101.5	44.3	100.7
DL (kg/ha / kg/hl / g)	P 5%= (620 /P 1% = 1102 /P 0.1% = 1855)			DL= (0.70 / 1.20 / 2.27)		DL= (1.18 / 2.24 / 3.20)	

The hectolitre weight registered different values depending on the grading of the factors. The highest values were recorded for the version with soil tillage by autumn plowing, 77.6 kg/hl.

Fertilization of the crop led to obtaining a maximum value of 77.5 kg/hl for the variant with the application of manure 20 t/ha - application to previous culture (Figure 2).

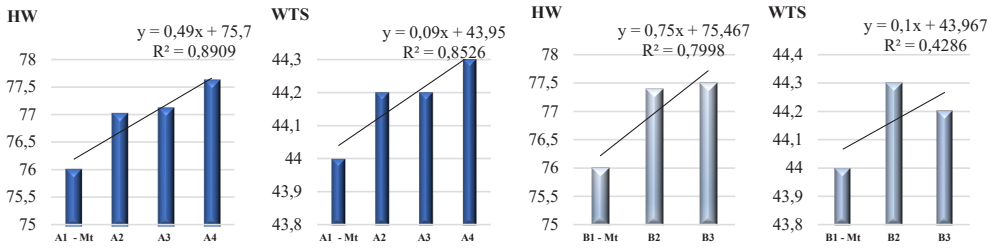

Figure 2. The influence of the factors on the HW and WTS in 2021

Yield and quality of maize

The maize crop registered variations in production level under the direct influence of the applied technological variants. In the conditions of 2020, for the no-tillage control variant, 4130 kg/ha were obtained, thus becoming the lowest production in the factor graduation series. The basic tillage of the disking recorded a production of 6000 kg/ha, with 1870 kg more compared to the unworked control. The basic tillage variant for plowing recorded a production of 6200 kg/ha with 2070 kg over the control variant, thus becoming the best variant. The work of the soil with the chisel registered a production of 5950 kg/ha with 1820 kg/ha over the no-tillage control variant, being equal to the value of 6000 kg/ha registered by the disk option (Table 4).

Regarding the fertilization system: the non-fertilized control variant registered a production of 4050 kg, thus becoming the lowest production in the series of factor graduations. Fertilization of the crop with $N_{90}P_{75}$ resulted in a production of 6344 kg/ha with 2294 kg (or 56.6%) over the control. The application of manure in a dose of 20 t/ha determined a production of 5625 kg ha by 38.8% over the value registered by the non-fertilized control variant.

The yield data for maize crop according to factor C graduations show that the Iezer hybrid recorded a production of 5400 kg/ha, the Mostistea hybrid achieved an increase of 8.3%, ie 450 kg/ha compared to the control, and the hybrid F423 registered 6000 kg/ha, with 11.1% over the control.

Tabel 4. Production results obtained for maize crop in 2020

Variant	Production /Diference			HW		WTS	
	(kg/ha)	(%)	Semnific.	kg/hl	%	g	%
A. Soil tillages							
A1 - Mt	4130	100.0	0	70.7	100.0	265.5	100.0
A2	6000	145.9	1870 **	71.2	100.7	285.1	107.5
A3	5950	143.9	1820 **	71.3	100.8	281.3	105.9
A4	6200	149.9	2070 ***	71.3	100.8	285.2	107.4
DL (kg/ha / kg/hl / g)	DL= (P 5%= 671.9 /P 1% = 1112.0 / P 0.1% = 2081)			DL = (2.24 /3.99 /6.92)		DL= (11.48 / 18.99/35.54)	
B. Fertilization type							
B1 - Mt	4050	100	0	70.4	100.0	249.5	100.0
B2	6344	156.6	2294***	71.1	100.9	291.2	116.7**
B3	5625	138.8	1575 ***	71.8	101.9	303.0	121.4**
DL (kg/ha / kg/hl / g)	DL= (P 5%= 374.2 /P 1% = 619.2 /P 0.1% = 1159)			DL= (3.88 /6.43 /12.03)		DL= (68.61/ 113.5 /212.5)	
C. Varieties / Hybrids							
C1 - Mt	5400	100.0	0	69.9	100.0	233.3	100.0
C2	5850	108.3	450	72.6	103.8**	270.0	115.7
C3	6000	111.1	600*	72.8	104.1**	270.0	115.7
DL (kg/ha / kg/hl / g)	P 5% = (483.5 /P 1% = 732.1 /P 0.1% = 1176.0)			DL= (1.77 / 2.93 / 5.48)		DL= (35.6 / 58.91 / 110.3)	

The hectolitre weight registered the highest values were recorded for the version with the hybrid F423, with 72.8 kg/hl.

Fertilization of the crop led to obtaining a maximum value of 71.8 kg/hl for the variant with application of manure 20 t/ha (Figure 3).

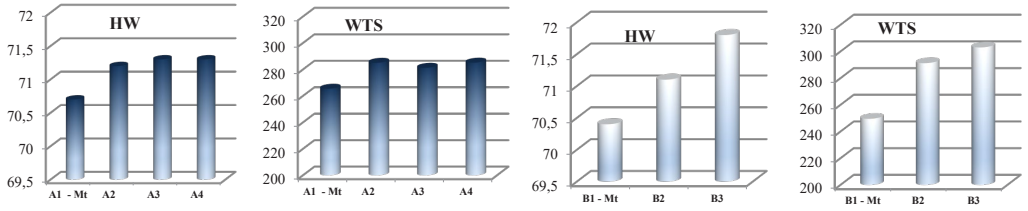

Figure 3. The influence of the factors on the HW and WTS in 2021

In the conditions of 2021, the no-tillage control variant registered 3100 kg/ha, thus becoming the lowest production in the factor graduation series. The basic tillage of the tillage recorded a production of 4560 kg/ha, with 1460 kg more compared to the unworked control. control, thus becoming the best variant (Table 5).

The production data for maize crop according to the B factor graduations - crop fertilization, show us that the unfertilized control variant registered a production of 3020 kg, thus becoming the lowest production in the factor graduation series. Fertilization of the crop with $N_{90}P_{75}$ resulted in a yield of 5522 kg/ha with 2502 kg (or 82.8%) above the control. The application of manure at a dose of 20 t/ha determined a production of 5620 kg/ha with 86.1% above the value recorded by the control option.

Regarding the hybrid, the data show that the Iezer control variant registered a production of 4800 kg/ha, the variant with the Mostistea hybrid achieved an increase of 26.7%, ie 1280 kg/ha compared to the control, and the F423 hybrid reached 6000 kg/ha, 25% above the value recorded by the witness variant.

Tabel 5. Production results obtained for maize crop in 2021

Variant	Production /Diference			HW		WTS	
	(kg/ha)	(%)	Semnif.	kg/hl	%	g	%
A. Soil tillages							
A1 - Mt	3100	100.0	0	69.6	100.0	254.4	100.0
A2	4560	147.0	1460 **	70.0	100.6	274.0	107.7
A3	5000	161.3	1900 **	70.1	100.7	270.2	106.2
A4	5188	167.4	2088 ***	70.1	100.7	274.1	107.7
DL (kg/ha / kg/hl / g)	DL= (P 5%= 675 /P 1% = 1122 / P 0.1% = 2059)			DL = (2.31 /3.56 /7.05)		DL= (13.56 / 21.55/36,88)	
B. Fertilization type							
B1 - Mt	3020	100	0	70.4	100.0	248.5	100.0
B2	5522	182.8	2502***	71.1	100.9	290.2	116.7**
B3	5620	186.1	2600 ***	71.8	101.9	302.0	121.5**
DL (kg/ha / kg/hl / g)	DL= (P 5%= 362/P 1% = 752 /P 0.1% = 1277)			DL= (3.88 /6.43 /12.03)		DL= (68.20/ 114.6 /221.6)	
C. Varieties / Hybrids							
C1 - Mt	4800	100.0	0	68.9	100.0	223.3	100.0
C2	6080	126.7	1280 ***	71.6	103.9**	260.0	116.4
C3	6000	125.0	1200**	71.3	103.4**	258.3	115.6
DL (kg/ha / kg/hl / g)	P 5%= (499.2 /P 1% = 787.2 /P 0,1% = 1210.0)			DL= (1.77 / 2.90 / 5.44)		DL= (36.3 / 59.25 / 112.3)	

The hectolitre weight registered different values depending on the grading of the factors. Fertilization of the crop led to obtaining a maximum value of 71.8 kg/hl for the variant with the application of manure 20 t/ha and 71.1 kg/hl for the $N_{90}P_{75}$ variant (Figure 4).

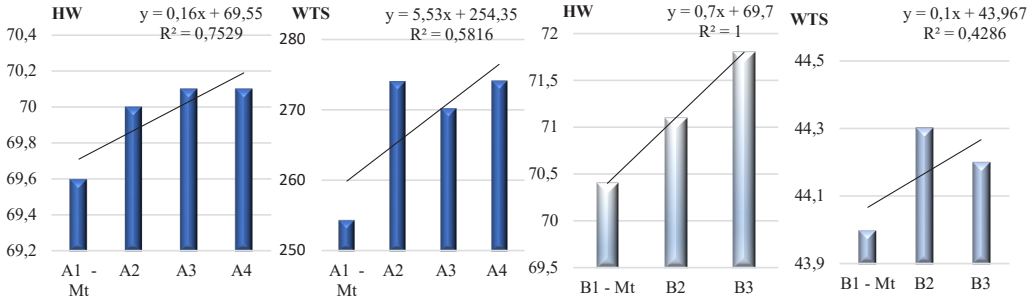

Figure 4. The influence of the factors on the HW and WTS in 2021

CONCLUSIONS

Management practices have sustainably increased yields and quality, while facilitating the maintenance of crop adaptability. The promotion of varieties and hybrids with unfavorable climate resistance and high and stable yields in a limited humidity environment requires the combination of conventional and unconventional technological methods.

In the conditions of the chernozem in the Southern Plain, in the successful application of the minimum works, the technology with the loosening works without turning the furrow made with the chisel or the work of the soil with the disk achieves high and stable productions close to the plowing variant and much more efficient compared to the no-tillage variant.

It is recommended that the basic work of soil with the chisel be carried out alternately (at 3-4 years) with autumn plowing, considering a series of advantages that it brings to the soil, and last but not least to the productivity of crops in the two systems working, conventional and conservative.

In both crops, fertilization with manure at a dose of 20 t/ha which justifies its importance by improving the properties of the soil over time, and fertilizing crops with NP contributes to increasing final production.

The variety / hybrid manifests its genetic potential depending on the technology applied and the climatic conditions. For the wheat crop, Izvor and Pitar varieties stood out with high yields, and for maize crop, the Mostistea hybrid.

In order to ensure food security and maintain the production and quality of agricultural crops, interdisciplinary research is needed to find viable solutions to all environmental and technological challenges.

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