EVOLUTION OF WINTER WHEAT CROP UNDER THE INFLUENCE OF AGROTEHNICAL MEASURES AND CLIMATE CHANGES

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Abstract

In the context of climate change, crop technologies must be updated and adapted by identifying and implementing new technological links regarding: soil tillages, the fertilization system, the previous plant, which will contribute to significantly reducing the negative impact of climate change on production and quality for wheat crop. The relationship production - quality - technology highlighted the negative influence of excessive temperatures and deficient precipitation in important stages in the evolution of plants. Wheat yield and quality are affected by management practices, climate conditions and genetic characteristics. The research was carried out in the period 2019 – 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. The experiment involved three different soil works and four fertilized options. Yields and quality were maximized by associated factors. Soil conservation works associated with manure fertilization increase production values and final quality by 5-10%, depending on the variant.

***Key words**: wheat, agrotehnical links, production, quality*

INTRODUCTION

The improvement of culture technologies and their adaptation to the new climate context, by identifying, recommending and implementing new links regarding soil works, the fertilization system contributes to the significant reduction of the negative impact of climate change on the production and quality performance of the main field crops and their integration into conventional culture technologies. The impact of climate changes, especially pedological and atmospheric drought, on yields can have varied consequences depending on the plant, the crop area and the technological links applied to the crop. The variation in production and quality between varieties is determined by its genetic characteristics and its possibilities of adapting to the environment (Paraschivu et al., 2019; Bene et al., 2014, Donatelli et al., 2012).

Obtaining a high and stable production, while maintaining the protection for the environment and the soil, represents a challenge for research, in the current context of climate change. Long periods of drought followed by rains can favor the conditions for the manifestation of diseases and the appearance of pests (Ajetomobi, 2016; Raza et al, 2019, Paraschivu et al., 2021). Technological links applied to agricultural crops, such as genetic improvement of varieties, fertilizer and pesticide technology, agricultural machinery and equipment have been developed through research precisely to understand their implications on the growth and development of crop plants and the stability of final productions and its quality

(Kumaraswamy and Shetty, 2016); Rehman et al., 2017).
The temperatures and precipitation have a decisive influence on agricultural yields, depending on the type of soil and the technological measures applied in agricultural crops (Moss et al., 2010).
The research is of particular importance in maintaining the stability and increasing the productive level of the fields and implicitly the quality of the production, the preservation and protection of the environment, and last but not least the reduction of inputs in agriculture.

MATERIALS AND METHODS

The research on the influence of technological links on its production and quality in wheat 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 / cm³, pH 5.9.
- A/B (45-62 cm), Bv1 (62-80 cm), Bv2 (82-112 cm), Cnk1 (149-170 cm), Cnk2 (170-200 cm).

The experimental factors studied have the following gradations: factor A - soil work: a1 – plow at 20-25 cm, a2 - disk, 3 - chisel; factor B - fertilization system: b1 - unfertilized (N0P0); b2- fertilization with manure administered at 4 years (autumn) at a dose of 20 t / ha and b3 - fertilized with nitrogen and phosphorus at a dose of 90 N kg / ha + 75 kg P2O5 / ha (N90P75), b4 - fertilized with nitrogen and phosphorus at a dose of 90 N kg / ha + 75 kg P2O5 / ha (N90P75) + S20 and factor C – previous plant: c1 - maize, c2 – alfalfa.
The experiments have five repetitions in a randomized block system; The plot size for wheat are 240 m2 (30 m x 8 m) and the sub-plots 48 m2 (6 m x 8 m). 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 ANOVA.
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 the differences from one year to another due to the amount and periodic distribution of precipitation (Table 1).
In 2019, the months with the lowest rainfall were September with 6.2 mm against the multi-year average of 48.5 mm and August with 12.6 mm against the multi-year average of 49.7 mm. The highest amount of precipitation was in July with 87.4 mm, 16.3 mm above the multi-year average. Regarding the thermal regime, in the period from June to September, the values show that the monthly averages were higher than multiannual average, in June by 2.8oC above the multiannual average.
The year 2020 was dry, with accentuated water deficit and high temperatures, compared to the multiannual average. 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 accentuated the drought. The average temperatures recorded in the agricultural year 2020 were 2.6^{o}C 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 1.2^{o}C compared to the multiannual average.

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 (oC)	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**

Yields and quality of wheat

The production recorded differences under the influence of the applied technology. In 2019, the control variant with plowing + disk achieved a production of 4022 kg, thus becoming the highest production in the series of factor graduations. Tillage with chisel + disk led to a production of 3899 kg/ha with 123 kg (or 3.0%) below the values of the control variant. The disk variant had a production of 3020 kg/ha, 24.9% below the value of the control.

The fertilization system showed a significant variation, so the non-fertilized control variant recorded a production of 2850 kg/ha. The application of manure 20 t/ha led to a production of 4010 kg/ha, 40.7% more compared to the unfertilized control, and the version with $N_{100}P_{80}$ achieved 3940 kg/ha, 38.2% more than the control. The application of a fertilization with $N_{100}P_{80}$ + S_{20} achieved the highest value of production, 4133 kg/ha, with 45.0% above the control, becoming the best option in the series of graduations.

The production data according to the gradations of the factor C - previous plant, show us that in the control version, with maize as the previous plant, 3600 kg/ha were obtained, and in the version with alfalfa, 4120 kg/ha were obtained, with 14,4% more.

Table 2. Production results obtained for wheat crop in 2019

Specification variantă	Producţion /Diference			HW		WTG	
	(kg.ha)	(%)	Semnific.	Kg/hl	%	g	%
A. Soil tillages							
A1 - Mt	4022	100.0	0	79.1	100.0	45.7	100.0
A2	3899	96.9	-123	79.1	100.0	45.5	99.6
A3	3020	75.1	-1002*	78.3	99.0	45.0	98.2
DL (kg/ha / kg/hl / g)	DL= (P 5%= 591 /P 1% = 1105 / P 0,1% = 1922)			DL = (0.74 /1.24 /2.30)		DL= (1.11 / 1.73/3.31)	
B. Crop fertilization							
B1 - Mt	2850	100.0	0	78.0	100.0	45.0	100.0
B2	4010	140.7	1160**	79.4	101.8*	45.4	100.9
B3	3940	138.2	1090**	79.4	101.8*	45.2	100.4
B4	4133	145.0	1283**	79.5	101.9*	45.5	101.1*
DL (kg/ha)	DL= (P 5%= 625 /P 1% = 1085 /P 0,1% = 1990)			DL= (0.70/1.11 /2.23)		DL= (1.04/ 2.11 /3.35)	
C. Previous plant							
C1 - Mt	3600	100.0	0	78.0	100.0	45.2	100.0
C2	4120	114.4	520	79.4	101.8**	45.7	101.1*
DL (kg/ha)	P 5%= (641 /P 1% = 1111,1 /P 0,1% = 2020)			DL= (0.73 / 1.19 / 2,31)		DL= (1.12 / 2.15 / 3.28)	

The hectolitric weight registered different values depending on the grading of the factors.The highest values were recorded the soil tillage by plowing, 79.1 kg/hl.

Fertilization of the crop led to obtaining a maximum value of 79.4 kg/hl for the variant with the application of manure 20 t/ha (Figure 1).

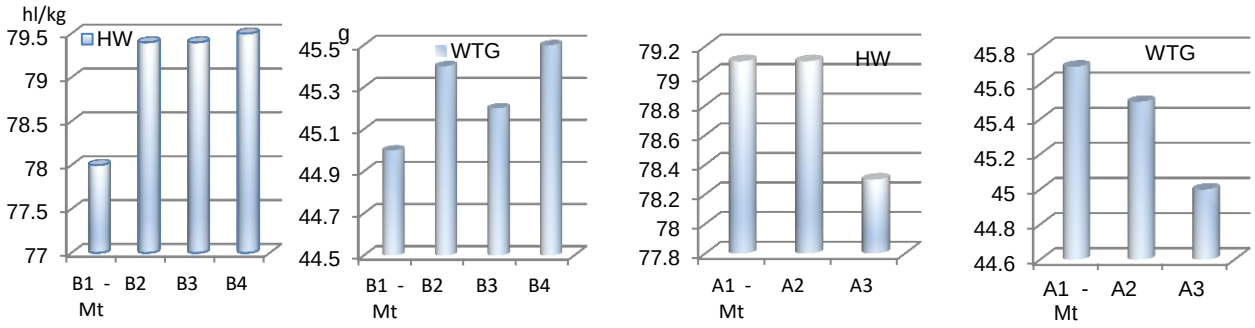

Figure 1. The influence of the factors on the HW and WTS in 2019

In 2020, the plowing + disk control variant obtained a production of 3800 kg, thus becoming the highest output in the factor grading series. Chisel + disk tillage resulted in a production of 3655 kg/ha 132 kg (or 3.2%) below the values of the control variant. The disc variant had a production of 2965 kg/ha.

The fertilization system showed a significant variation, so the unfertilized variant recorded a production of 2505 kg/ha. The application of manure 20 t/ha led to a production of 3377 kg/ha, 31.9% more than the unfertilized variant, and $N_{100}P_{80}$ achieved 3100 kg/ha, 28.9% more than the control. The application of a fertilization with $N_{100}P_{80}$ + S_{20} achieved the highest production value, 3495 kg/ha, with 38.9% above the control, becoming the best variant in the grading series.

The production data according to the gradations of previous plant, show us that in the control version, with the previous maize culture, 3100 kg/ha were obtained, and in the variant with alfalfa 3660 kg/ha. were obtained, 9.9% more.

Table 3. Production results obtained for wheat crop in 2020

Specification variantă	Producţion /Diference			HW		WTG	
	(kg.ha)	(%)	Semnific.	Kg/hl	%	g	%
A. Soil tillages							
A1 - Mt	3800	100.0	0	76.1	100.0	43.7	100.0
A2	3655	96.8	-132	76.0	99.8	43.4	99.3
A3	2965	70.9	-1230	75.2	98.8	43.2	98.8
DL (kg/ha / kg/hl / g)	DL= (P 5%= 490 /P 1% = 850 / P 0,1% = 1460)			DL = (0.52 /1.01 /2.00)		DL= (1.01 / 1.49/3.04)	
B. Crop fertilization							
B1 - Mt	2505	100.0	0	75.0	100.0	43.0	100.0
B2	3377	131.9	1005*	76.4	101.9**	43.6	101.4*
B3	3100	128.9	910	76.3	101.7**	43.1	100.2
B4	3495	138.9	1194**	76.4	101.9**	43.6	101.4*
DL (kg/ha)	DL= (P 5%= 466 /P 1% = 877 /P 0,1% = 1645)			DL= (0.60 /1.02 /2.14)		DL= (1.03/ 2.22 /3.21)	
C. Previous plant							
C1 - Mt	3100	100.0	0	75.1	100.0	43.1	100.0
C2	3660	109.9	350	76.3	101.6**	43.5	100.9
DL (kg/ha)	P 5%= (490 /P 1% = 981 /P 0,1% = 1785)			DL= (0.72 / 1.13 / 2,28)		DL= (1.04 / 2.21 / 3.12)	

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 plowing, 76.1 kg / hl.

Fertilization of the crop led to obtaining a maximum value of 76.4 kg/hl for the variant with the application of manure 20 t/ha - application to previous culture (Figure 2).

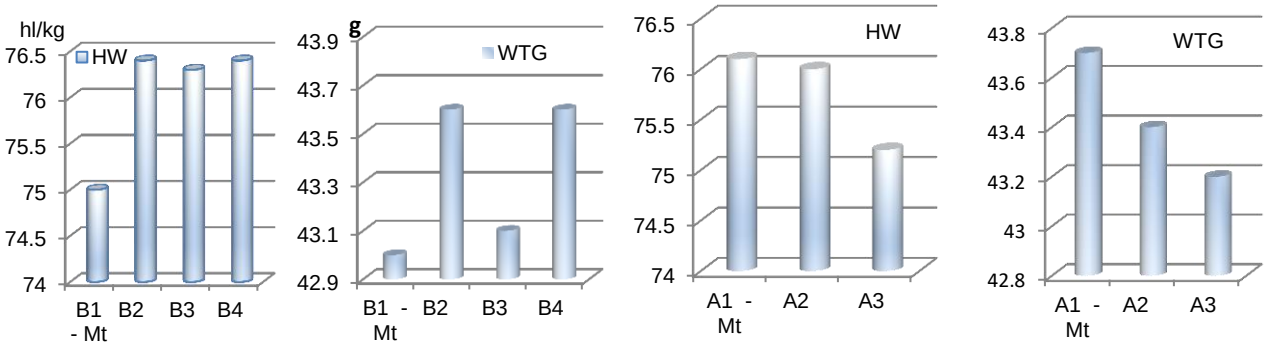

Figure 2. The influence of the factors on the HW and WTS in 2020

In 2021, the control variant with plowing + disk achieved a production of 4220 kg, thus becoming the highest production in the series of factor graduations. Tillage with chisel + disk led to a production of 4088 kg/ha, 132 kg (or 3.2%) below the values of the control variant. The disk variant had a production of 2990 kg/ha, 29.1% below the value of the control variant.

The non-fertilized control variant recorded a production of 3150 kg/ha. The application of manure 20 t/ha led to a production of 4155 kg/ha, 31.9% more compared to the unfertilized control, and the version with $N_{100}P_{80}$ achieved 4060 kg/ha, 28.9% more than the control. The application of a fertilization with $N_{100}P_{80}$ + S_{20} achieved the highest production value, 4344 kg/ha, with 38.9% over the control variant, becoming the best option in the series of graduations.

The production data according to the graduations of factor C - previous plant, show us the control variant, with previous maize plant, 3520 kg/ha were obtained, and the variant with alfalfa, 3900 kg/ha were obtained, 9.9% more.

Table 4. Production results obtained for wheat crop in 2021

Specification variantă	Producţion /Diference			HW		WTG	
	(kg.ha)	(%)	Semnific.	Kg/hl	%	g	%
A. Soil tillages							
A1 - Mt	4220	100.0	0	78.0	100.0	44.8	100.0
A2	4088	96.8	-132	78.0	100.0	44.6	99.6
A3	2990	70.9	-1230	77.1	98.8	44.0	98.2
DL (kg/ha / kg/hl / g)	DL= (P 5%= 604 /P 1% = 1088 / P 0,1% = 1862)			DL = (0.71 /1.17 /2.20)		DL= (1.08 / 1.69/3.11)	
B. Crop fertilization							
B1 - Mt	3150	100.0	0	77.0	100.0	44.0	100.0
B2	4155	131.9	1005*	78.6	102.1	44.3	100.7
B3	4060	128.9	910	78.5	101.9	44.2	100.5
B4	4344	138.9	1194**	78.6	102.0	44.6	101.4*
DL (kg/ha)	DL= (P 5%= 614 /P 1% = 1022 /P 0,1% = 1912)			DL= (0.68 /1.09 /2.20)		DL= (1.03/ 2.08 /3.31)	
C. Previous plant							
C1 - Mt	3550	100.0	0	77.0	100.0	44.1	100.0
C2	3900	109.9	350	78.3	101.7**	44.6	101.1*
DL (kg/ha)	P 5%= (591 /P 1% = 1081,1 /P 0,1% = 1799,0)			DL= (0.72 / 1.13 / 2,28)		DL= (1.09 / 2.11 / 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 plowing, 78.0 kg/hl.

Fertilization of the crop led to obtaining a maximum value of 78.6 kg/hl for the variant with the application of manure 20 t/ha - application to previous culture (Figure 3).

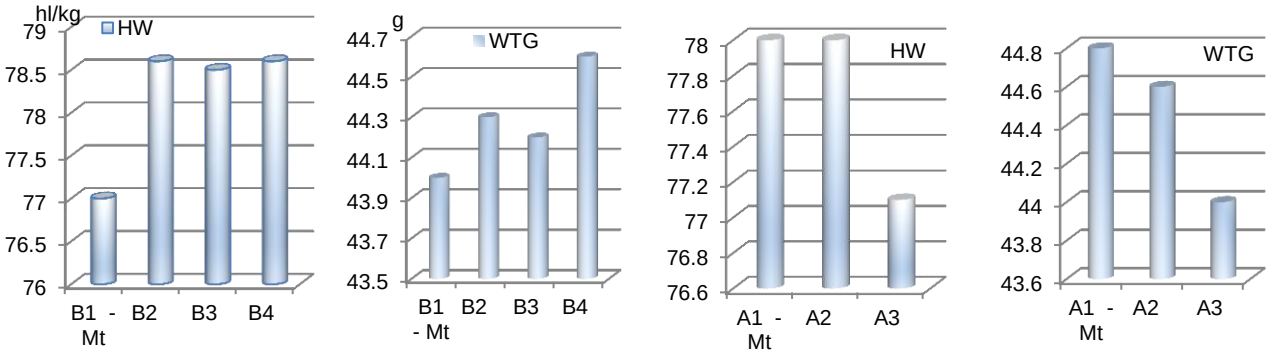

Figure 3. The influence of the factors on the HW and WTS in 2021

CONCLUSIONS

The technological links have contributed sustainably to the growth and stability of yields and its quality.

Taking into account the technology applied to wheat, the following technological links were noted: tillage by chisel + disk, which came close in terms of value to plowing and justified its economic importance, by reducing expenses and good production; fertilization with manure in a dose of 20 t/ha or with $N_{100}P_{80}$ + S_{20} justifies its importance by improving soil properties over time, stable production and high quality; alfalfa as the previous plant ensures stable production and high quality and creates the conditions for reduced weeding of the soil.

The shortage of precipitation or their uneven distribution and high temperatures led to the installation of drought, which affected the emergence and vegetation period of plants and the production from a quantitative and qualitative point of view.

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