THE EFFECT OF CONSERVATIVE AGRICULTURAL WORKS ON SOIL AND FIELD PLANTS AND OPTIMIZED MECHANIZATION TECHNOLOGIES
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EFECTUL LUCRĂRILOR AGRICOLE CONSERVATIVE ASUPRA SOLULUI ŞI PLANTELOR DE CÂMP ŞI TEHNOLOGII DE MECANIZARE OPTIMIZATE

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ABSTRACT

In this paper was performed a thorough analysis of the effects of the conservative system of mechanized works, minimum-till (hard disc and scarifier) and no till (direct sowing), compared to the classic system (ploughing), highlighting the influences on soil and plants, the ways to reduce the technological costs, the improvement of soil quality indices, by accumulating organic matter and increasing humus supply, the need to reduce the traffic of mechanical equipment and opportunities to reduce fuel consumption, the improvement of conditions for retaining and capitalizing water reserves in the soil, the reduction of working hours and labour requirements.

REZUMAT

În lucrarea de fata s-a realizat o analiză aprofundată a efectelor sistemului conservativ de lucrări mecanizate, minimum-till (disc greu şi scarificat) şi no till (semănatul direct), raportat la sistemul clasic (arat), evidenţiindu-se influentele asupra solului si plantelor, modalitatile de reducere a costurilor tehnologice, ameliorarea indicilor calitativi ai solului, prin acumularea materiei organice şi creşterea aprovizionării cu humus, necesitatea reducerii traficului utilajelor mecanice şi posibilitatile de reducere a consumului de carburanţi, îmbunătăţirea condiţiilor de reţinere şi valorificare a rezervelor de apă din sol, reducerea timpilor de lucru şi a necesarului de forţă de muncă.

INTRODUCTION

It can be considered that at present humanity is facing great difficulties that profoundly affect the food supply of agriculture, climatic conditions that undergo brutal changes, with sharp increases in air temperature, reduced rainfall with natural implications on plants. The current climate changes are taking place in the sense of expanding the aridisation of large agricultural areas. All these unfavourable impacts occur in the conditions of an emphasized demographic explosion *(Baltag G., 2020).*

In this context, in addition to expanding the irrigation areas, in order to ensure food security, efforts must also focus on combating the effects of drought and desertification by other means *(Dabney et al, 2001).*

Working systems for soil conservation are considered the main components of the agricultural technology for soil water conservation and soil carbon sequestration strategies and are part of Sustainable Agriculture *(Li and Chen, 1999)*. Working systems for soil conservation involve reducing the number of mechanical works to direct sowing and keeping plant debris at the soil surface in a proportion of at least 30 % (*Crismaru I., 2006; Stelian et al, 1983).* The working systems for water conservation in the soil have as objective the assurance of an aerohydric regime corresponding to the intensification of the biological activity and the balance in the solubilization of the nutrients *(Vlăduţ et al, 2014).* Thus, it is necessary to mention the initiation of afforestation and reforestation actions in many states of the world, the use of agroforestry practices adopted by farmers in some countries, in order to protect their crops and pastures, the construction of drainage networks for reduction of excess moisture and salinization *(Cooper et al, 2017).*

Even when irrigation is applied on large areas, it is and will be necessary to store and retain all the water from rainfall *(Toma et al, 1981; Scripnic and Babiciu, 1979).* Storing and retaining a single millimetre of rainfall in the soil means a saving per hectare of 10 m^3 (10 tons) of irrigation water *(Deng et al, 2005).* Conservation and management of soil water is done through specific techniques among which the proper working of soil plays an important role *(Farcas N., 2019).* Rising temperatures, melting of glaciers, increased droughts and floods are signs that climate change is intensifying over time, due to human activities, which lead to an increase in the concentration of greenhouse gases in the atmosphere *(Chen et al, 2008).* Drought and its associated phenomena, namely aridification and desertification, are, after pollution, the second biggest problem that humanity is facing in the last half century (*Shi et al, 2006).* The global expansion of these destructive phenomena is highlighted by climatic data that reveal a progressive warming of the atmosphere and a reduction in rainfall, which lead to the occurrence of drought *(Croitoru et al, 2015; Dobre et al, 2017)*. In addition to global climate change, increased drought and desertification are also due to anthropogenic pressure. Excessive logging, expanding agricultural areas and poor land management, rapid population growth and, last but not least, poverty are being considered *(Bronick and Lal, 2005; et al, 2010).*

In our country, the climatic changes are manifested by the decrease of the annual rainfall level, by an uneven distribution of them both in time and in space and especially by an outphasing of the water supply compared to the critical periods of the plants, by an increase of daytime temperatures and an intensification of spring winds. Climate change taking place in the North Bărăgan area manifests by expanding of the aridisation of large agricultural areas. Climate analyses carried out by SCDA Brăila predict an unfavourable evolution in the perspective of 2025 and 2050. It is estimated a decrease in the average multiannual rainfall from 445 mm currently to 440 mm in 2025 and 435 mm in 2050, an increase in the multiannual average temperature from 11°C currently to 11.3°C in 2025 and 11.5°C in 2050, an increase in the potential multiannual average evapotranspiration from 715 mm currently to 730 mm in 2025 and to 750 mm in 2050.

There is an increasing pressure on agriculture to find remediation solutions to ensure, through soil works, the increase of capacity to access and store water, preservation and increase of soil quality indices, finding and applying the technologies to ensure these requirements, establishing of crop structures with increased drought resistance and with the best agricultural yields (*Vlăduţ et al, 2015; Wang et al, 2003).*

Starting with the combination of different working methods, conservative tillage works include a wide range of methods, with and without furrow turning (chisel, paraplough, “goose foot” tools, disc harrows, etc.), which ends with the formation of the layer of mulch at soil surface, until the cessation of soil mechanical works according to the No-till type (zero tillage, direct sowing). (*Șandru et al, 1983; Dragan G., 1969).*

Farmers must be prepared for lifelong learning and have information on all achievements in the field. Sources of knowledge can be very diverse, starting with European farmers which apply this system and ending with the most advanced scientific papers *(Garnett et al., 2013)*. Today, it is difficult to convince that one can change the concept of farmers to switch to new unknown technologies if there are no calculations regarding the yield of sales that they will be able to argue their economic reasoning. High costs, the need for knowledge of farmers and the uncertainty of yield (green bridge effect and oscillation of crops) have led to indecision among farmers *(Toma et al., 1981).*

Innovative approaches for soil maintenance are constantly being analysed and improved. The limitation of conventional tillage works may include soil aggressive mechanical reversal, which leads to high losses of organic carbon (C), disturbance of soil biology and erosion caused by wind and water *(Reicosky D., 2015).* Many agrotechnical works were unjustly considered conservative *(Gumovschi A., 2019).* In recent years, the importance of sustainability in intensive agriculture has grown in prominence *(Crotty et al, 2017).*

Conservation techniques can preserve a limited amount of organic residue on soil surface and can create a good environment for the growth and development of agricultural crops. Conservative agriculture is beneficial as it can stop soil degradation, expand soil fertility and ensure the efficient application of natural resources, increase the productivity and help ensure food security *(Derpsch R., 2008; Ceretto C., 2007).*

Soil structure has a direct impact on several aspects of soil functioning, including: the transfer of water, solutes, fine particles and gas within the soil; the development and activity of root systems; the biological activity (*Bronick and Lal, 2005).* Stability of soil structure, often assessed by the degree of soil aggregation, strongly determines a soil’s ability to resist and recover from disturbances (e.g., tillage, erosion).

MATERIALS AND METHODS

The research works were carried out to preserve soil fertility and to increase yield quantity and quality to the main species of cultivated plants, between 2014-2018. The research was carried out in Brăila area (Brăila county) and Dăbuleni area (Dolj county) and aimed at establishing the technological elements with impact on plant cultivation and on growth of agricultural yields in dry areas and quantifying the influence of new mechanized agricultural works systems on crops as well as for preserving and conserving soil fertility. To achieve a complete picture of the approached problem, the experiments were performed in both irrigated and non-irrigated dry areas. Also, the researches aimed to highlight the influence of different technological elements (soil works, sowing, fertilization, irrigation) performed with the classic and modern working techniques, for different crops, on agricultural yields in order to highlight and promote the works with favourable technical and economic impact on drought-affected soils. It was aimed to specify the influence of microclimate modifying solutions by creating forest curtains for agricultural protection.

The synthesis of the results of the paper can contribute to the influence of the production costs in the sense of their decrease, to the promotion of the conservative systems for soil works, to the completion of the range of agricultural equipment and to the production reorientation in the construction of agricultural machines. The need to model the agricultural perimeters in order to improve the microzonal climate framework with the help of forest curtains is also aimed. The element of novelty is the promotion of the necessity concept of summing up the effects of the two groups of measures (agricultural and forestry) that are likely to improve the results of agricultural production to a greater extent and on long term.

The complex experiments took place in two ameliorating situations, both non-irrigated and irrigated and in four points of work located in two dry areas, with representative pedoclimatic conditions, respectively: field experiments at CE Chiscani in irrigated regime and in non-irrigated regime, on plain and chernozemic soils, at CE IMB in irrigated and non-irrigated regime, on meadow and clay soils, at CE Dăbuleni for plain and sandy soils. Seven experimental crops were used: wheat, corn, sunflower, soybeans in Brăila and rye, beans, sorghum for grains in Dăbuleni. A complex experimental system was applied, with experiences aiming crops structure, basic soil works, densities and sowing times and also experiments regarding crops structure, fertilization system with assortments, doses and times of application of mineral and organic fertilizers. In the planning phase of the activities included in the study, actions were performed regarding the choice of representative experimental points, conception and design of the experimental plan, by establishing the experimental scheme (Figure 1).

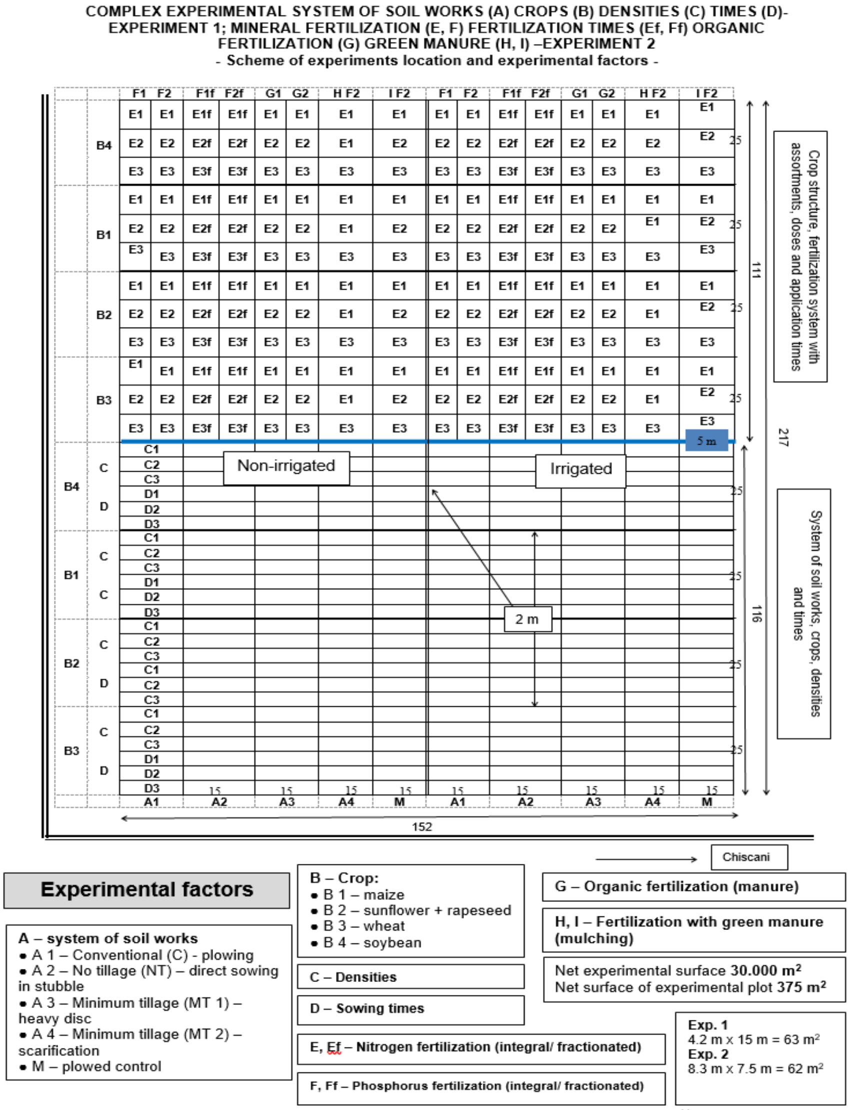

Fig. 1 - Scheme of the complex experimental field in the Chiscani - Brăila Experimental Centre

By sizing and arranging the plots in correlation with the flow of technological and experimental works, experimental sheets were prepared, the structure of crops and crop rotation in the experimental perimeters were established, designing of agricultural technologies for experimental crops and drawing up the calendar of technical and technological works for mounting and conducting field experiments were made.

During the research, 4 types of mechanized works were studied:

1. classic system (A1) – application of basic soil works with the plough;
2. no-tillage system (A2) – performing the sowing works directly in the stubble;
3. minimum-tillage system 1 (A3) – application of basic soil works with heavy disc;
4. minimum-tillage system 2 (A4) - application of the basic soil works with scarifier.

Table 1 presents the aggregates used to perform the basic soil works both in the plain and in the meadow, respectively: Belarus 820 tractor + M 3 reversible plough for ploughing work, Belarus 820 tractor + Gaspardo Nina 300 seeder, equipped with disc coulters for no-tillage work with direct sowing in the stubble, the John Deere 8200 tractor + Kuhn Discover XM2 heavy disc in the plain and the Horsch Joker 8 RT heavy disc in the meadow, for the minimum-tillage work 1 and the John Deere 8200 tractor + the Strom Terraland 3000 scarifier in the plain and the Alpego Super Craker scarifier in the meadow, at the minimum-tillage work 2.

Table 1

The systems of mechanized works researched at experimental fields in Chiscani and Great Island of Brăila

Systems of mechanized works	Aggregates used for the execution of basic soil works in CE Chiscani	Aggregates used for the execution of basic soil works in CE Great Island of Brăila
A1 – Classic system – application of basic soil works with the plough	Belarus-820 tractor + reversible plough M-3	Belarus-820 tractor + reversible plough M-3
A2 – No-tillage system – performing the sowing works directly in the stubble	Belarus-820 tractor + Gaspardo Nina 300 seeder equipped with disc coulters	Belarus-820 tractor + Gaspardo Nina 300 seeder equipped with disc coulters
A3 – Minimum-tillage system (1) – application of basic soil works with heavy disc	John Deere-8200 tractor + Kuhn Discover XM2 heavy disc	John Deere-8200 tractor + Horsch Joker 8 RT heavy disc
A4 – Minimum-tillage system (2) - application of basic soil works with scarifier	John Deere-8200 tractor + Strom Terraland 3000 scarifier	John Deere-8200 tractor + Alpego Super Craker scarifier

RESULTS

The effect of systems of mechanized works on soils

➢ ***The effect of systems of mechanized works on soil physical and hydrophysical indices***

The researched systems of mechanized works, ploughing (classic system), the two types of minimum tillage (heavy disc and scarification), by mobilizing the soil in optimal conditions had a beneficial effect on some physical and hydrophysical indices of the soil, ensuring their positive evolution.

Thus, the apparent density in the 0 - 50 cm layer was slightly reduced both in the plain from 1.15 g/cm^3 to 1.12 g/cm^3, and in the meadow from 1.24 g/cm^3 to 1.21 g/cm^3 for all basic soil works, excepting the no-till work. The hydrophysical indices in the 0 - 50 cm layer underwent a slight improvement, the field capacity increasing from 24.5 to 24.7 % in the plain and from 33.5 % to 33.8 % in the meadow. Also, soil fertility indices remained within the same quality categories.

➢ ***The effect of systems of mechanized works on soil compaction***

To establish the compaction effect achieved on each hectare, by passing with tractors and agricultural equipment to perform all technological works, basic soil works including seedbed preparation, soil herbicide, sowing, basic and phase fertilizer, herbicide in vegetation, phytosanitary treatments, harvesting, determinations were performed on each experimental crop. Important differences were highlighted on the sum of passes with tractors and agricultural equipment, expressed by the trampled area (in ha) per cultivated hectare, for the 4 types of researched systems of mechanized works.

The strong impact on soil compaction is achieved by the ploughing work on the classic mechanization system, the minimum-till and especially no-till systems determining an essential diminished impact compared to the classic system. Thus, in the plain for wheat ROP, the total surface of the passes that compact the soil, compared to the control ploughed plot, through the works performed on 1 ha, represented 54 % for no-till, 66 % for heavy disc and 73 % for scarifier, as presented in Table 2.

In the maize crop, compared to the ploughed control plot, the total surface of the passes that compacts the soil, made by works on 1 ha represented 57% for no-till, 69% for heavy disc and 75% for scarifier. In the sunflower crop, compared to the ploughed control plot, the total surface of the passes that compacts the soil made on 1 ha represented 57% for no-till, 69% for heavy disc and 75% for scarifier. In the soybean crop, compared to the ploughed control plot, the total surface of the passes that compacts the soil made on 1 ha represented 58% for no-till, 69% for heavy disc and 75% for scarifier.In the meadow, for the same crops (wheat, maize, sunflower and soybeans), the passes with tractors and agricultural equipment on total technology applied to crops showed diminished values compared to the classic mechanization system (with ploughing), at a level of 53-56% (depending on crop type) at no-till, 62-65% at minimum till 1 (heavy disc) and 70-72% at minimum till 2 (scarified), as presented in Table 3. The differentiated and lower values of the compacted soil surfaces through the passes with the equipment in the meadow compared to the plain with approx. 4 % is due to the types of equipment used for minimum till, heavy disc and scarification works.

Table 2

The effect of the system of mechanized works on soil compaction through the passes of agricultural equipment in the experimental field Chiscani

Specification	Achieved technology; Inputs quantity; M.U	Wheat					Maize					Sunflower					Soybean				
		Exp. 1 – System of soil works, crop structure, densities and seeding times					Exp. 1 – System of soil works, crop structure, densities and seeding times					Exp. 1 – System of soil works, crop structure, densities and seeding times					Exp. 1 – System of soil works, crop structure, densities and seeding times				
		Compacted surface by working a ha of soil [ha]	Share of compaction in total crop technology (%)				Compacted surface by working a ha of soil [ha]	Share of compaction in the total work system and crop technology (%)				Compacted surface by working a ha of soil [ha]	Share of compaction in the total work system and crop technology (%)				Compacted surface by working a ha of soil [ha]	Share of compaction in the total work system and crop technology (%)			
			A1	A2	A3	A4		A1	A2	A3	A4		A1	A2	A3	A4		A1	A2	A3	A4
Work - Basic fertilization	-Fertilization, Belarus 820 tractor + MA-3,5	0.06	3	5	4	4	0,06	3	4	4	3	0.06	3	4	4	3	0.06	3	4	4	3
Chopping of vegetable debris		0	0	0	0	0	0	0	0	0	0	0	0.44	0	0	0	0	0	0	0	0
Soil works	Types of soil works: A1- ploughing 25 cm: Belarus 820 tractor + reversible plough, 22.10.2016	0.88	41	0	0	0	0.88	38	0	0	0	0.88	38	0	0	0	0.88	38	0	0	0
	A2-no till: direct sowing in meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A3-heavy disc: John Deere 8200 (220 HP) tractor + KUHN Discover XM2 heavy disc, 2.10.2016	0.23	0	0	15	0	0.23	0	0	14	0	0.23	0	0	14	0	0.23	0	0	14	0
	A4-scarification: John Deere 8200 (220 HP) tractor + Strom Terraland 3000 scarifier (l=3,0 m. H=0,6 m, 5 knives), 24.10.2016	0.36	0	0	0	22	0.36	0	0	0	20	0.36	0	0	0	20	0.36	0	0	0	20
Seedbed preparation	-discing + harrowing: Belarus 820 tractor + GD 3,2 + GCR 1,7	0	0	0	0	0	0.25	11	17	15	14	0.25	11	17	15	14	0.25	11	17	15	14
	-combiner: Belarus 820 tractor + CTT 30.03.2017 combiner	0	0	0	0	0	0.20	9	14	12	11	0.2	9	14	12	11	0.2	9	14	12	11
	- cutting: Belarus 820 tractor + Maschio Gaspardo cutter	0.26	12	21	17	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Work - Soil herbicide	- Soil herbicidation, Belarus 820 tractor + MET-1200	0.06	3	5	4	4	0.06	3	4	4	3	0.06	3	4	4	3	0.06	3	4	4	3
Work - Sowing	-Sowing, Belarus 820 tractor + Gaspardo Nina 300 seeder	0.26	12	21	17	16	0	0	0	0	0	0	0	0	0	0	0.26	11	18	15	14
	-Sowing, Belarus 820 tractor + SPC-6	0	0	0	0	0	0.22	9	15	13	12	0.22	9	15	13	12	0	0	0	0	0
Work – Phase fertilization	- Phase fertilization, Belarus 820 tractor + MA-3,2	0.06	3	5	4	4	0.06	3	4	4	3	0.06	3	4	4	3	0.06	3	4	4	3
Work - Herbicide in vegetation	- Herbicidation in vegetation, Belarus 820 tractor + MET-1200	0.05	2	4	3	3	0.05	2	3	3	3	0.05	2	3	3	3	0.05	2	3	3	3
Work - Treatments	-Treatments, Belarus 820 tractor + MET-1200	0.05	2	4	3	3	0.05	2	3	3	3	0.05	2	3	3	3	0.05	2	3	3	3
Other works	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	Block 1 – non-irrigated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Block 2 – irrigated: watering I-600 m^3/ha, 21-23.07.2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting	Harvesting: 19-20.09.2017	0.24	11	19	16	15	0.24	10	17	14	13	0.24	10	17	14	13	0.24	10	17	14	13
TOTAL	A1-ploughing (ha; %) Mt.	**1.92 100%**	**100**	-	-	-	**2.07 100%**	**100**	-	-	-	**2.07 100%**	**100**	-	-	-	**2.12 100%**	**100**	-	-	-
	A2-no-till (ha; %)	**1.04 53%**	-	**100**	-	-	**1.19 57%**	-	**100**	-	-	**1.19 57%**	-	**100**	-	-	**1.24 57%**	-	**100**	-	-
	A3-heavy disc (ha; %)	**1.27 62%**	-	-	**100**	-	**1.42 69%**	-	-	**100**	-	**1.42 69%**	-	-	**100**	-	**1.47 69%**	-	-	**100**	-
	A4-scarified (ha; %)	**1.40 70%**	-	-	-	**100**	**1.55 75%**	-	-	-	**100**	**1.55 75%**	-	-	-	**100**	**1.60 75%**	-	-	-	**100**

Table 3

The effect of the system of mechanized works on soil compaction through the passes with the agricultural equipment on the experimental field IMB

Specification	Achieved technology; Inputs quantity; M.U	Wheat					Maize					Sunflower					Soybean				
		Exp. 1 – System of soil works, crop structure, densities and seeding times					Exp. 1 – System of soil works, crop structure, densities and seeding times					Exp. 1 – System of soil works, crop structure, densities and seeding times					Exp. 1 – System of soil works, crop structure, densities and seeding times				
		Compacted surface by working a ha of soil [ha]	Share of compaction in total crop technology (%)				Compacted surface by working a ha of soil [ha]	Share of compaction in the total work system and crop technology (%)				Compacted surface by working a ha of soil [ha]	Share of compaction in the total work system and crop technology (%)				Compacted surface by working a ha of soil [ha]	Share of compaction in the total work system and crop technology (%)			
			A1	A2	A3	A4		A1	A2	A3	A4		A1	A2	A3	A4		A1	A2	A3	A4
Work - Basic fertilization	-Fertilization, Belarus 820 tractor + MA-3,5	*0.06*	4	8	7	6	*0.06*	6	5	4	4	*0.06*	6	5	4	4	*0.06*	3	5	4	4
Chopping of vegetable debris		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soil works	Types of soil works: A1-ploughing 25 cm: Belarus 820 tractor + reversible plough, 22.10.2016	0.88	55	0	0	0	0.88	38	0	0	0	0.88	38	0	0	0	0.88	44	0	0	0
	A2-no-till: direct sowing in meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A3-heavy disc: John Deere 8200 (220 HP) tractor + KUHN Discover XM2 heavy disc, 2.10.2016	0.18	0	0	20	0	0.18	0	0	14	0	0.18	0	0	14	0	0.8	0	0	14	0
	A4-scarification: John Deere 8200 (220 HP) tractor + Strom Terraland 3000 scarifier (l=3.0 m. H=0.6 m, 5 knives), 24.10.2016	0.32	0	0	0	31	0.32	0	0	0	20	0.32	0	0	0	20	0.32	0	0	0	22
Seedbed preparation	- discing + harrowing: Belarus 820 + GD 3,2 + GCR 1,7 tractor	0	0	0	0	0	*0.25*	13	23	20	17	*0.25*	13	23	20	17	*0.25*	12	22	19	17
	-combiner: Belarus 820 tractor + CTT 30.03.2017 combiner	0	0	0	0	0	*0.20*	10	18	16	14	*0.20*	10	18	16	14	*0.20*	9	17	15	14
	-discing: Belarus 820 tractor + Maschio Gaspardo disc	*0.26*	12	21	17	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Work - Soil herbicide	- Soil herbicide, Belarus 820 + MET-1200 tractor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Work - Sowing	-Sowing, Belarus 820 tractor + Gaspardo Nina 300 seeder	*0.26*	16	36	29	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-Sowing, Belarus 820 + SPC-6 tractor	0	0	0	0	0	*0.19*	9	15	13	12	*0.19*	9	15	13	12	0	0	0	0	0
Work – Phase fertilization	- Phase fertilization, Belarus 820 + MA-3,2 tractor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*0.22*	11	19	17	15
Work - Herbicide in vegetation	- Herbicide in vegetation, Belarus 820 + MET-1200 tractor	*0.06*	4	8	7	6	*0.06*	6	5	4	4	*0.06*	6	5	4	4	*0.06*	3	5	4	4
Work - Treatments	-Treatments, Belarus 820 + MET-1200 tractor	*0.05*	3	7	6	5	*0.05*	2	4	3	3	*0.05*	2	4	3	3	*0.05*	2	4	2	3
Other works	-	*0.05*	3	7	6	5	*0.05*	2	4	3	3	*0.05*	2	4	3	3	*0.05*	2	4	2	3
Irrigation	Block 1 – non-irrigated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Block 2 – irrigated: wetting I-600 m^3/ha, 21-23.07.2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting	Harvesting: 19-20.09.2017	*0.24*	15	33	26	23	*0.24*	12	22	19	17	*0.24*	12	22	19	17	*0.24*	12	21	18	16
	A1-ploughing (ha; %) Mt.	**1.86 100%**	100	-	-	-	**1.98 100%**	100	-	-	-	**1.98 100%**	100	-	-	-	**2.01 100%**	100	-	-	-
	A2-no-till (ha; %)	**0.98 53%**	-	100	-	-	**1.10 56%**	-	100	-	-	**1.10 56%**	-	100	-	-	**1.13 56%**	-	100	-	-
	A3- heavy disc (ha; %)	**1.16 62%**	-	-	100	-	**1.28 65%**	-	-	100	-	**1.28 65%**	-	-	100	-	**1.31 65%**	-	-	100	-
	A4-scarifier (ha; %)	**1,30 70%**	-	-	-	100	**1,42 71%**	-	-	-	100	**1,42 71%**	-	-	-	100	**1,45 72%**	-	-	-	100

➢ ***The effect of systems of mechanized works on agricultural yields***

As it results from the situation of yields made in experimental crops (Table 4-6) in conventional (classic) and unconventional mechanization systems, conservative (no-till and minimum till), crop yields responded to environmental conditions (climate, soil), technological conditions and improving conditions (application of irrigation).

Table 4

The impact of mechanization systems on agricultural yields to autumn crops, in Brăila, kg/ha

Specification	**Locations**	**Classic system types**	**No-till system types**	**Minimum-till system types (with disc)**	**Minimum-till system types (with scarifier)**
Wheat yield	Non-irrigated, Chiscani	5.950	6.645	5.391	5731
	Irrigated, Chiscani	7.153	7.518	7.455	8.019
	Average Chiscani	**6.522**	**7.081**	**6.418**	**6.845**
		100 %	**108 %**	**98 %**	**105 %**
	Non-irrigated, IMB	5.628	5.881	5.518	6.333
	Irrigated, IMB	6.538	6.772	7.313	7.246
	Average IMB	**6.083**	**6.327**	**6.415**	**6.789**
		100 %	**104 %**	**105 %**	**112 %**
Average		**6.317**	**6.704**	**6.416**	**6.817**
		100 %	**106 %**	**102 %**	**108 %**

Table 5

The impact of mechanization systems on agricultural yields to spring crops, in Brăila, kg/ha

Specification	**Locations**	**Classic system types (ploughing)**	**No-till system types**	**Minimum-till system types (with disc)**	**Minimum-till system types (with scarifier)**
Maize yield	Non-irrigated, Chiscani	8.318	7.439	6.930	6.715
	Irrigated, Chiscani	13.540	13.642	14.115	12.860
	Average Chiscani	**10.929**	**10.540**	**10.522**	**9.787**
		100 %	**96 %**	**96 %**	**89 %**
	Non-irrigated, IMB	9.891	8.865	9.475	8.962
	Irrigated, IMB	10.014	9.648	11.368	12.346
	Average IMB	**9.952**	**9.256**	**10.556**	**10.654**
		100 %	**93 %**	**106 %**	**107 %**
Average		**10.441**	**9.898**	**10.539**	**10.221**
		100 %	**95 %**	**101 %**	**98 %**
Sunflower yield	Non-irrigated, Chiscani	3.868	2.864	2.933	3.139
	Irrigated, Chiscani	4.196	3.617	3.378	3.761
	Average Chiscani	**4.032**	**3.240**	**3.155**	**3.450**
		100 %	**80 %**	**78 %**	**85 %**
	Non-irrigated, IMB	3.947	3.998	4.139	3.975
	Irrigated, IMB	4.327	4.023	4.223	4.444
	Average IMB	**4137**	**4010**	**4181**	**4209**
		100 %	**97 %**	**101 %**	**102 %**
Average		**4.084**	**3.625**	**3.668**	**3.830**
		100 %	**89 %**	**90 %**	**95 %**
Soybean yield	Non-irrigated, Chiscani	1.546	1.707	1.630	1.630
	Irrigated, Chiscani	4.083	3.913	3.770	3.711
	Average Chiscani	**2814**	**2810**	**2700**	**2670**
		100 %	**100 %**	**96 %**	**95 %**
	Non-irrigated, IMB	2.614	2.669	2.632	3.600
	Irrigated, IMB	3.422	3.952	4.310	3.789
	Average IMB	**3018**	**3310**	**3471**	**3694**
		100 %	**109 %**	**115 %**	**122 %**
Average		**2.916**	**3.060**	**3.085**	**3.182**
		100 %	**105 %**	**106 %**	**109 %**

Table 6

The impact of mechanization systems on agricultural yields in Dăbuleni, kg/ha

Specification	Locations	Classic system types (ploughing)	Minimum-till system types (with disc)	Minimum-till system types (with scarifier)
Rye yield	Dăbuleni	3141	2791	2866
		100 %	83 %	86 %
Sorghum yield	Dăbuleni	7384	7196	7321
		100 %	97 %	99 %
Beans yield	Dăbuleni	3499	2175	2197
		100 %	62 %	63 %

The non-conventional (conservative) system of mechanized works was located at yield levels compared to the classic level, in the 4 experimental crops in a percentage of 89-109% in Brăila and 62-99% in Dăbuleni, and the beneficial effect on soil and environment as well as the economic effect prevailed.

Regarding the effect of the mechanization systems applied on the agricultural yields for the conditions from North Bărăgan, Brăila, on plain and meadow and on the sands from Dăbuleni, the following conclusions can be presented:

- for North Bărăgan area in the plain (SCDA Brăila), for wheat cultivation, the average yields showed values at classic system (ploughing) of 6522 kg/ha (100%), at no-till 7081 kg/ha (108 %), at minimum-till system (heavy disc) 6418 kg/ha (98%), respectively at minimum-till system (scarification) 6845 kg/ha (105%);
- in the meadow (SCDA Brăila), for wheat cultivation, the average yields had the following values: for classic work (ploughing) 6083 kg/ha (100%), for no-till 6327 kg/ha (104%), for minimum-till system (heavy disc) 6415 kg/ha, (105%), respectively for minimum-till system (scarification) 6789 kg/ha (112%);
- average plain-meadow, for wheat cultivation, the yield for classic work (ploughing) was 6317 kg/ha (100%), for no-till 6704 kg/ha (106%), for minimum-till system (heavy disc) 6416 kg/ha (102%), respectively for minimum-till (scarification) 6817 kg/ha (108%);
- for North Bărăgan area in the plain (SCDA Brăila), for maize cultivation, the yields presented the average values for the classic work (ploughing) of 10929 kg/ha (100%), for no-till 10540 kg/ha (96%), for minimum-till system (heavy disc) 10522 kg/ha (96%), respectively for minimum-till system (scarification) 9787 kg/ha (89%);
- in the meadow (SCDA Brăila), for maize crop, the average yield for the classic work (ploughing) was 9952 kg/ha (100%), for no-till work 9256 kg/ha (93%), for minimum-till system (heavy disc) 10556 kg/ha, (106%), respectively for minimum-till system (scarification) 10654 kg/ha (107%);
- average plain-meadow, for maize cultivation, the average yield for classic work (ploughing) 10441 kg/ha (100%), for no-till works 9898 kg/ha (104%), for minimum-till system (heavy disc) 10539 kg/ha (101%), respectively for minimum-till system (scarification) 10221 kg/ha (98%);
- for North Bărăgan in the plain (SCDA Brăila), for sunflower crop, the yields compared to those for the classic work (ploughing) were 4032 kg/ha (100%), for no-till works 3240 kg/ha (80%), for minimum-till system (heavy disc) 3155 kg/ha (78%), respectively for minimum-till system (scarification) 3450 kg/ha (85%);
- in meadow (SCDA Brăila), for sunflower crop, the average yield for classic work (ploughing) was 4137 kg/ha (100%), for no-till works 4010 kg/ha (97%), for minimum-till system (heavy disc) 4181 kg/ha (101%), respectively for minimum-till system (scarification) 4209 kg/ha (102%);
- average meadow-plain for sunflower crop, the yield on classic work (ploughing) was 4084 kg/ha (100%), for no-till works 3625 kg/ha (89%), for minimum-till system (heavy disc) 3668 kg/ha (90%), respectively for minimum-till system (scarification) 3830 kg/ha (95%);
- for North Bărăgan area in the plain (SCDA Brăila), for soybean crop the yield for the classic work (ploughing) was 2814 kg/ha (100%), for no-till 2810 kg/ha (100%), for minimum-till system (heavy disc) 2700 kg/ha (96%), respectively for minimum-till system (scarification) 2670 kg/ha (95%);
- in the meadow (SCDA Brăila), for soybean crop, the average yield for the classic work (ploughing) was 3018 kg/ha (100%), for no-till works 3310 kg/ha (109%), for minimum-till system (heavy disc) 3471 kg/ha (115%), respectively for minimum-till system (scarification) 3694 kg/ha (122%);
- average plain-meadow for soybean crop, the average yield for classic work (ploughing) was 2916 kg/ha (100%), for no-till works 3060 kg/ha (105%), for minimum-till system (heavy disc) 3085 kg/ha (106%), respectively for minimum-till system (scarification) 3182 kg/ha (109%);
- in the sands from Dăbuleni for the rye crop, the average yield at the classic work (ploughing) was 3.141 kg/ha (100%), for minimum-till system (heavy disc) 2.791 kg/ha (83%), respectively for minimum-till system (scarification) 2866 kg/ha (86%);
- for sorghum crop, the average yield for the classic work (ploughing) was 7384 kg/ha (100%), for minimum-till system (heavy disc) 7196 kg/ha (97%), respectively for minimum-till system (scarification) 7321 kg/ha (99%);

- for bean crop, the average yield for the classic work (ploughing) was 3499 kg/ha (100%), for minimum-till system (heavy disc) 2175 kg/ha (62%), respectively for minimum-till system (scarification) 2197 kg/ha (63%);

➢ ***The effect of irrigation on agricultural yields, within the conservative systems of mechanized works***

In the agricultural year 2017-2018, spring crops have faced an acute water deficit as they entered the warm period of the year, especially in the conditions of the accentuated lack of water from rainfall and the manifestation of the pedological drought. Under these conditions, irrigation had a particularly beneficial role, the watering applied during July and August ensuring special yields related to the conditions of non-application of irrigation. The yields for irrigated maize crop with values of 12860-14115 kg/ha in the plain and 9648-12346 kg/ha in the meadow obviously exceeded the non-irrigated yields for all systems of soil works, which reached 6715-8318 kg/ha in the plain and 8865-9991 kg/ha in the meadow (Table 7).

Table 7

The effect of irrigation on agricultural yields for maize and soybean crops in the plains and meadows

Crop		Meadow				Plain			
		Ploughing	No-till	Heavy disc	Scarification	Ploughing	No-till	Heavy disc	Scarification
Maize	Non-irrigated	8.318 100 %	7.439 100 %	6.930 100 %	6.715 100 %	9.991 100%	8.865 100 %	9.475 100 %	8.962 100 %
	Irrigated	13.540 162 %	13.642 183 %	14.115 204 %	12.860 191 %	10.172 102%	9.648 109 %	11.638 123 %	12.346 138 %
Soybean	Non-irrigated	1.546 100 %	1.707 100 %	1.630 100 %	1.630 100 %	2.614 100%	2.669 100 %	2.632 100 %	3.600 100 %
	Irrigated	4.083 264 %	3.913 229 %	3.770 231 %	3.711 228 %	3.422 132%	3.952 130 %	4.310 164 %	3.789 105 %

The ratio between the irrigated and non-irrigated work systems has values of 1.83-2.04 in the plain and 1.02-1.38 in the meadow. It should be noted that for non-irrigated maize, the yields reported were higher in the meadow by approx. 1200-2100 kg/ha compared to the plain, attesting the beneficial effect of the groundwater intake on the meadow soils. Similarly, in the irrigated soybean crop with values in the irrigated regime of 3711-4083 kg/ha in the plains and 3422-4310 kg/ha in the meadow, the non-irrigated yields were obviously exceeded in all soil works systems, which reached 1546-1707 kg/ha in the plain and 2614-3600 kg/ha in the meadow. The irrigated - non-irrigated ratio has values of 2.28-2.64 in the plain and 1.05-1.64 in the meadow, but the yields for non-irrigated in the meadow exceed those in the plain by 1000-2000 kg/ha, attesting also the beneficial effect of groundwater intake for this crop.

The effect of systems of mechanized works on productivity and fuel consumption of agricultural equipment

➢ ***The effect of systems of mechanized works on agricultural equipment productivity***

In order to emphasize the productivity of the agricultural equipment, a parameter was used that represents the time necessary to carry out a work on one ha (in hours/ha), as it is presented in Table 8. The time required for the application of the experimental technology to the agricultural crops on 1 ha resulted by summing and comparing the cumulated times for all the applied works. It differs greatly depending on the intensity of the mechanical intervention performed on the soil, varying from the control plough (on average for wheat, maize and soybean crops), as follows: at no-till 61% with the highest productivity, followed by lower productivities at minimum-till (heavy disc) 67% and at minimum-till (scarifier) 72%.

Table 8

Productivity of agricultural equipment within the researched systems of mechanized works

Time required (hours) for the application of the technology experimental crops, on 1 ha									
Crop	Location	Types of applied systems of works							
		A1 ploughing		A2 no-till		A3 minimum-till (heavy disc)		A4 minimum-till (scarifier)	
		hours/ha	%	hours/ha	%	hours/ha	%	hours/ha	%
Wheat	CE Chiscani	7.69	100	5.34	69	5.62	73	6.14	80
	CE IMB	7.69	100	5.34	69	5.66	74	5.87	76
Maize	CE Chiscani	6.62	100	4.27	65	4.65	70	5.07	77
	CE IMB	4.89	100	2.54	52	2.86	58	3.07	63
Sunflower	CE Chiscani	5.51	100	3.16	57	3.44	62	3.96	72
	CE IMB	4.32	100	1.97	46	2.29	53	2.50	58
Soybeans	CE Chiscani	6.16	100	3.81	62	4.09	66	4.61	75
	CE IMB	5.91	100	3.56	60	4.13	70	4.09	69
Media		**6.10**	**100**	**3.75**	**61**	**4.09**	**67**	**4.41**	**72**

➢ ***The effect of mechanized works systems on fuel consumption***

The fuel consumption on total crop technology for the types of mechanized works attests obvious differences of the conservative works (no till and minimum-till), compared to the classic ploughing work. Thus, the fuel consumption per hectare, average on the 4 experimental crops for the control work (ploughing) totalled 61.3 l/ha, at the no-till work 35.8 l/ha, representing 57% of the control, for the minimum-till (heavy disc) 46.5 l/ha, representing 75% of the control and for the minimum-till work (scarifier) 55.3 l/ha representing 90% of the control, according to the data in Table 9.

Table 9

Fuel consumption on total technology of experimental crops

Crop	Location	Types of applied systems of works							
		A1 - ploughing		A2 – no-till		A3 – minimum-till (heavy disc)		A3 – Minimum-till (scarifier)	
		l/ha	%	l/ha	%	l/ha	%	l/ha	%
Wheat	CE Chiscani	62.6	100	37.1	59	47.6	76	57.1	91
	CE IMB	75.1	100	49.6	66	60.6	81	68.6	91
Maize	CE Chiscani	69.2	100	43.7	63	54.2	78	63.7	92
	CE IMB	56.6	100	30.9	55	41.9	74	49.9	88
Sunflower	CE Chiscani	49.9	100	24.5	49	34.9	70	44.5	89
	CE IMB	39.7	100	14.2	36	25.2	64	33.2	84
Soybeans	CE Chiscani	68.6	100	43.1	63	53.6	78	63.1	92
	CE IMB	68.9	100	43.4	63	54.4	79	62.4	91
Average		61.3	100	35.8	57	46.5	75	55.3	90

Characterization of basic soil works in terms of water conservation in soil, plains and meadows (CE Chiscani, CE IMB). Regarding the effect of the system for basic soil works on the moisture regime under the wheat crop in the plain, as well as in the meadow, the small differences of moisture determined on the 4 types of the soil works system (no-till, minimum-till 1 (heavy disc), minimum-till 2 (scarifier) and ploughing) can be highlighted. In the plain, in the soil layer between 0-25 cm, the ascending order of the basic works of the soil regarding the degree of water retention accessed from the initial reserves of the soil and from rainfall is as follows: scarified, ploughed, heavy disc, no-till, according to the data in Table 10.

Table10

Characterization of basic soil works in terms of soil water conservation in the plains and meadows (CE Chiscani, CE IMB)

Location	Systems of mechanized work	A1 (plough)	A2 (no-till)	A3 (heavy disc)	A4 (scarifier)
CE Chiscani	Average soil moisture during vegetation (% gravitational)	18.1	18.9	18.5	18.1
	Degree of water conservation in the soil (%)	100	104	102	100
CE IMB	Average soil moisture during vegetation (% gravitational)	31.9	33.0	32.7	31.5
	Degree of water conservation in the soil (%)	100	103	102	99
Dăbuleni	Average soil moisture during vegetation (% gravitational)	15.6	-	13.4	14.5
	Degree of water conservation in the soil (%)	100	-	86	93

The same distribution of water reserves specified for soil layer between 0-25 cm deep, depending on the basic soil works, is kept for layer 0-50 cm and largely in layer 0-100 cm. Analysis of moisture reserves in the meadow on all the basic works of the soil on the soil layer between 0-25 cm for wheat cultivation, as well as on the other deeper layers 0-50 cm and 0-100 cm, for the periods after sowing, during the vegetation period and at harvest, attests small differences between the basic soil works in terms of water retention capacity, attesting the rich water regime of the meadow soil ensured by a substantial groundwater intake, together with the climatic water intake, and the ranking order of accessed water retention degree is the same as in the plain: scarified, ploughed, heavy disc, no-till.

➢ ***The effect of systems of mechanized works on the economic result of agricultural crops***

The economic effect is a result of the achieved yield, correlated with the natural, ameliorative and technological framework in which the systems of mechanized works have a significant share. Regarding the economic effect, the financial result on the types of soil works, resulted in the following:

❖ for wheat crop, on plain, the financial result is: 1911 RON/ha (100 %) for the classic system, for no-till 2500 RON/ha (130%), for heavy disc 1912 RON/ha (100%) and for scarification 1988 RON/ha (104%), according to Table 11.

Table 11

The effect of systems of mechanized works on the economic result in wheat crop

Economic effect (financial result), RON/ha					
Specification	Location	A1 Plough	A2 No-till	A3 Minimum-till (heavy disc)	A3 Minimum-till (scarifier)
Wheat	Non-irrigated Chiscani	1.502	2.203	1.210	1.178
	Irrigated Chiscani	2.320	2.797	2.614	2.798
	Average Chiscani	**1.911**	**2.500**	**1.912**	**1.988**
		100 %	**130 %**	**100 %**	**104 %**
	Non-irrigated IMB	1.469	1.854	1.467	1.898
	Irrigated IMB	2.011	2.460	2.688	2.864
	Average IMB	**1.740**	**2.157**	**2.077**	**2.381**
		100 %	**124 %**	**119 %**	**137 %**
Average		**1.825**	**2.328**	**1.994**	**2.184**
		100 %	**127 %**	**109 %**	**120 %**

- for wheat crop, in the meadow, the financial result is: 1740 RON/ha (100%) for the classic system, for no-till 2157 RON/ha (124%), for heavy disc 2077 RON/ha (119%), respectively for scarification 2381 RON/ha (137%);
- average plain - meadow wheat crop presents financial results of: 1825 RON/ha (100%) for the classic system, for no-till 2328 RON/ha (127%), for heavy disc 1994 RON/ha (109%), respectively for scarification 2184 RON/ha (120%);
- for maize crop in the plain, the financial result is: 3820 RON/ha (100%) for the classic system, for no-till 4339 RON/ha (114%), for heavy disc 3208 RON/ha (84%), respectively for scarification 3090 RON/ha (81%), as presented in Table 12;
- for maize crop in the meadow, the financial result is: 3923 RON/ha (100%) for the classic system, for no-till 4026 RON/ha (103%), for heavy disc 3730 RON/ha (95%), respectively for scarification 3615 RON/ha (93%);
- average plain - meadow maize crop presents the following financial results: 3871 RON/ha (100%) for the classic system, for no-till 4182 RON/ha (107%), for heavy disc 3469 RON/ha (90%), respectively for scarification 3352 RON/ha (87%);

Table 12

The effect of systems of mechanized works on the economic result in maize, sunflower and soy crops

Economic effect (financial result), RON/ha					
Specification	Location	A1 - Plough	A2 – No-till	A3 – Minimum-till (heavy disc)	A3 – Minimum-till (scarifier)
Maize	Non-irrigated Chiscani	1.773	2.746	2.531	2.274
	Irrigated Chiscani	5.867	5.933	3.885	3.906
	Average Chiscani	**3.820**	**4.339**	**3.208**	**3.090**
		100 %	**114 %**	**84 %**	**81 %**
	Non-irrigated IMB	2.150	2.172	2.837	2.261
	Irrigated IMB	4.295	5.881	4.624	4.969
	Average IMB	**3.923**	**4.026**	**3.730**	**3.615**
		100 %	**103 %**	**95 %**	**93 %**
Average		**3.871**	**4.128**	**3.469**	**3.352**
		100 %	**107 %**	**90 %**	**87 %**
Sunflower	Non-irrigated Chiscani	2.468	1.586	1.028	2.147
	Irrigated Chiscani	2.674	2.180	1.907	2.002
	Average Chiscani	**2.572**	**1.883**	**1.468**	**2.074**
		100 %	**73 %**	**57 %**	**81 %**
	Non-irrigated IMB	2.758	2.612	3.199	2.275
	Irrigated IMB	1.904	2.362	2.689	3.213
	Average IMB	**2.331**	**2.487**	**2.944**	**2.744**
		100 %	**107 %**	**126 %**	**117 %**
Average		**2.451**	**2.185**	**2.206**	**2.409**
		100 %	**89 %**	**90 %**	**98 %**
Soybeans	Non-irrigated Chiscani	-38	701	-205	-636
	Irrigated Chiscani	2.485	3.657	2.387	3.589
	Average Chiscani	**1.223**	**2.180**	**1.091**	**1.476**
		100 %	**178 %**	**90 %**	**121 %**
	Non-irrigated IMB	1.170	1.060	1.131	3.070
	Irrigated IMB	2.791	4.480	4.280	3.703
	Average IMB	**1.980**	**2.770**	**2.706**	**3.386**
		100 %	**140 %**	**136 %**	**171 %**
Average		**1.602**	**2.474**	**1.898**	**2.431**
		100 %	**154 %**	**118 %**	**152 %**

- for sunflower crop in plain, the financial results are: 2571 RON/ha (100%) for the classic system, for no-till 1883 RON/ha (73%), for heavy disc 1468 RON/ha (57%), respectively for scarification 2075 RON/ha (81%);
- for sunflower crop in meadow, the financial results are: 2330 RON/ha (100%) for the classic system, for no-till 2487 RON/ha (107%), for the heavy disc 2,944 RON/ha (126%), respectively for scarification 2744 RON/ha (117%);
- average plain - meadow for sunflower crop presents the following financial results: 2451 RON/ha (100 %) for the classic system, for no-till 2185 RON/ha (89%), for heavy disc 2206 RON/ha (90%), respectively for scarification 2409 RON/ha (98%);
- for soybean crop in the plain, the financial results are: 1223 RON/ha (100%) for the classic system, for no-till 2180 RON/ha (178%), for heavy disc 1091 RON/ha (90%), respectively for scarification 1476 RON/ha (121%);
- for soybean crop in meadow, the financial results are: 1980 RON/ha (100%) for the classic system, for no-till 2769 RON/ha (140%), for heavy disc 2705 RON/ha (136%), respectively for scarification 3386 RON/ha (171%);
- average plain-meadow for soybean crop presents the following financial results: 1602 RON/ha (100%) for the classic system, for no-till 2474 RON/ha (154%), for heavy disc 1898 RON/ha (118%), respectively for scarification 2431 RON/ha (152%).

➢ **The effect of existing agroforestry curtains on agricultural crops**

In order to obtain information on the effect of agroforestry curtains on protected crops, observations were made in some perimeters equipped with agroforestry arrangements for the protection of agricultural crops (Figure 2).

Fig. 2 - Satellite view of the agroforestry curtain from the Albina location, researched in the project

The observations on the effect of an agroforestry curtain from the location of Albina village, Brăila county, regarding the preservation of the protective layer of snow on the field attested the specific conditions of low intensity of solid rainfall in the winter of 2015-2016, which determined the deposition of a reduced snow layer of 5-7 cm in the shelter of the curtain. Analysing the values of penetration resistance with the portable penetrometer, it can be seen that these values are higher in the snow accumulation area with increased moisture values during the cold period, the field works contributing to a more accentuated soil compaction.

➢ ***Designing of agroforestry curtains on the SCDA land in the Big Island of Brăila***

In order to improve the much more unfavourable climatic environment in the meadow compared to the plain in the very dry years, in the Big Island of Brăila, on the territory of the research resort was designed a network of curtains for agroforestry protection of agricultural crops (Figure 3).

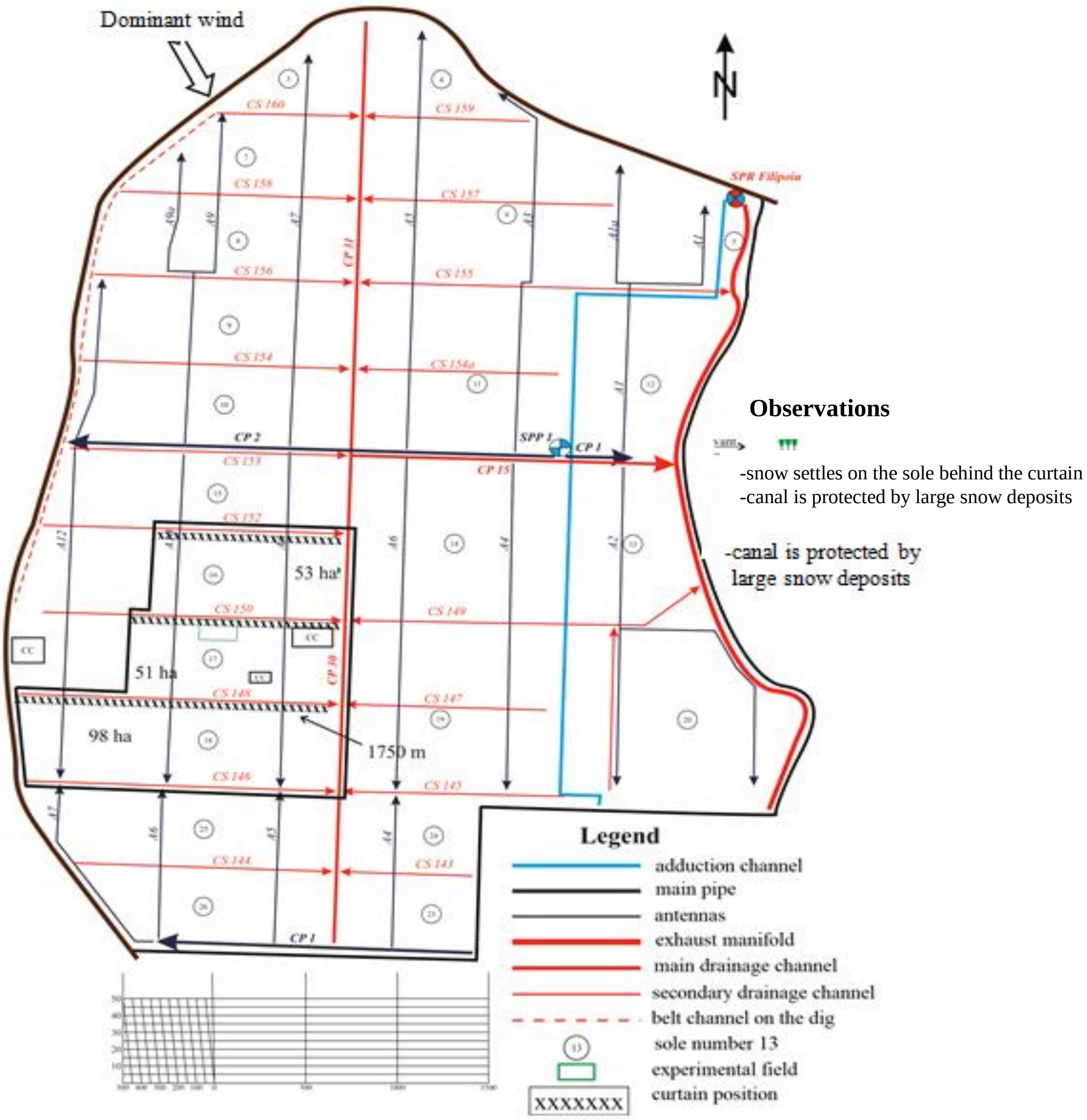

Fig. 3 - Network of agroforestry curtains designed in the Big Island of Brăila

Among the technical parameters of the curtain network, there are: east-west direction, perpendicular to the direction of the prevailing wind, the composition of 3 curtain lines totalling a length of 3950 m, spaced at 500 m, with a width of 8 m and with acacia forest species.

Elaboration of optimal technologies to combat the effects of drought on experimental crops

Based on the performed research, it was possible to develop optimal technologies to combat the effects of drought on experienced crops with elements argued by increased agricultural yields and superior economic results (Tables 13 and 14).

➢ ***Optimal technological elements for wheat crop argued by increased yield (p) and superior economic effects (e)***

1) Fertilization:
- Basic fertilization with complex fertilizers in full dose of 40 kg/ha s.a. (arg. P + e);
- Phase fertilization with urea at a dose of 100 kg/ha s.a. applied fractionally (1/2 autumn and 1/2 spring) (arg. p + e);
- Organic fertilization with manure 10 t/ha (arg. p+e).

2) Soil works:
- Ploughing (arg. p);
- Direct sowing in the field -no-till (arg. e);
- Scarification (arg. p);

Table 13

Optimal technology to combat the effects of drought on straw crops

Specification	Optimal technology for combating the effects of drought on experimental autumn crops with variants argued by yield and economic results - *Wheat*		
	Achieved technology; Amount of inputs; M.U	**Yield arguments**	**Economic arguments**
Basic fertilization with complex fertilizers 18.46.0	Fractional doses of phosphorus; Variant F1f: 20 kg/ha s.a, (*43.4 kg/ha r.s.*), autumn 20 kg/ha s.a, (*43.4 kg/ha r.s.*), spring	xx	xx
	Variant G: Manure autumn; G1 – *10 t/ha*	xx	xx
Soil works	-*ploughing 25 cm*: Belarus 820 tractor + reversible plough	xx	-
	-no-till: direct sowing	-	xx
	-*scarification*: John Deere 8200 (220 HP) tractor + Strom Terraland 3000 scarifier (l=3.00 m. H=0.60 m, 5 knives)	xx	-
Sowing	-Equipment: Belarus 820 tractor + Gaspardo Nina 300 seeder -Sowing densities: 500 bg/m^2 (*280 kg/ha*)	x	x
Phase fertilization with urea	-Variant E 2: *100 kg/ha a.s.* (*217.3 kg/ha* r.s.)	xx	xx
Herbicide in vegetation	Primstar *1.5 g/ha;* Hudson *0.5 l/ha*	x	x
Treatment for diseases	Artea *0.4 l/ha*	x	x
Pest treatment	-	x	x
Irrigation	-	x	x
Harvesting	*Harvesting* with self-propelled combine	x	x

xx - experimentally argued technological element
x - current technological element

Optimal technological elements for spring crops

1) Basic fertilization with complex fertilizers:
- *Maize,* dose 40 kg/ha, integral + fractionated (arg. p+e);
- Organic fertilization with manure 10 t/ha (arg. p+e);
- *Sunflower* and *soybeans*, dose 80 kg/ha integral, 40 kg/ha fractionated (arg. e);

2) Phase fertilization with urea:
- *Maize,* dose 150 kg/ha s.a., integral (arg. p.);
- *Sunflower*, dose 50 kg/ha, integral + fractionated (arg. p), 100 kg/ha fractionated (arg. p+e);
- *Soya*, dose 100 kg/ha, integral + fractionated (arg. p+e);

3) Soil works:
- *Maize* - ploughing (arg. p+e); direct sowing (arg. e); heavy disc (arg. e);
- *Sunflower* – ploughing and scarification (arg. e);
- *Soybeans* – ploughing + heavy disc (arg. p+e); direct sowing (arg. e).

Table 14

Optimal technology to combat the effects of drought on maize, sunflower and soybean crops

Technological elements	Maize			Sunflower			Soybeans		
	Achieved technology; Amount of inputs; M.U	Yield arguments	Economic arguments	Achieved technology; Amount of inputs; M.U	Yield arguments	Economic arguments	Achieved technology; Amount of inputs; M.U	Yield arguments	Economic arguments
Basic fertilization with complex fertilizers 18.46.0	Variant F 1: 40 kg/ha s.a. *(86.9 kg/ha r.s.)*, autumn	xx	xx	Variant F 1: 40 kg/ha a.s. *(86.9 kg/ha r.s.)*, autumn	-	-	Variant F 1: 40 kg/ha a.s. *(86.9 kg/ha r.s.)*, autumn	-	-
	Variant F 2: 80 kg/ha a.s. *(173.9 kg/ha r.s.)*, autumn	-	-	Variant F 2: 80 kg/ha a.s. *(173.9 kg/ha r.s.)*, autumn	xx	-	Variant F 2: 80 kg/ha a.s.*(173.9 kg/ha r.s.),* autumn	xx	xx
	Variant F1f: *20 kg/ha* a.s. autumn *20 kg/ha* a.s. spring	xx	xx	Variant F1f: *20 kg/ha* autumn *20 kg/ha* a.s. spring	xx	-	Variant F1f: *20 kg/ha* a.s. autumn *20 kg/ha* a.s. spring	xx	xx
	Variant F2f: *40 kg/ha a.s. autumn* *40 kg/ha* a.s. spring	-	-	Variant F2f: *40 kg/ha* a.s. autumn *40 kg/ha* a.s. spring	-	-	Variant F2f: *40 kg/ha* a.s. autumn *40 kg/ha* a.s. spring	-	-
	Manure – *10 t/ha*	xx	xx	Manure – *10 t/ha*	-		Manure – *10 t/ha*	-	-
	Manure – *20 t/ha*	-	-	Manure – *20 t/ha*	-	-	Manure – *20 t/ha*	-	-
Soil works	-*ploughing 25 cm*, Belarus 820 tractor + reversible plough	xx	xx	-*ploughing 25 cm*, Belarus 820 tractor + reversible plough	xx	-	-*ploughing 25 cm*, Belarus 820 tractor + reversible plough	xx	xx
	-*no-till* - direct sowing in unprocessed soil	-	xx	-*no-till* – direct sowing in unprocessed soil	-	-	-*no-till*– direct sowing in unprocessed soil	-	xx
	-*heavy disc* – John Deere tractor (220 HP) + KHUN Discover XM2 heavy disc	xx	-	- *heavy disc* – John Deere tractor (220 HP) + KHUN Discover XM2 heavy disc	-	-	- *heavy disc* – John Deere tractor (220 HP) + KHUN Discover XM2 heavy disc	xx	xx
	-*scarification* - John Deere 8800 tractor (220 HP) with Storm Terraland 3000 scarifier (l=3.00	-	-	-*scarification* - John Deere 8800 tractor (220 HP) with Storm Terraland 3000 scarifier (l=3.00	xx	-	-*scarification* - John Deere 8800 tractor (220 HP) with Storm Terraland 3000 scarifier (l=3.00	-	-

Technological elements	Maize			Sunflower			Soybeans		
	Achieved technology; Amount of inputs; M.U	**Yield arguments**	**Economic arguments**	**Achieved technology; Amount of inputs; M.U**	**Yield arguments**	**Economic arguments**	**Achieved technology; Amount of inputs; M.U**	**Yield arguments**	**Economic arguments**
	m, H=0.60 m, 5 knives)			m, H=0.60 m, 5 knives)			m, H=0.60 m, 5 knives)		
	Seedbed preparation: -*discing+ harrowing*, Belarus 820 tractor + GD 3.2 + GCR 1.7	x	-	Seedbed preparation: -*discing+ harrowing*, Belarus 820 tractor + GD 3.2 + GCR 1.7	-	-	Seedbed preparation: -*discing+ harrowing*, Belarus 820 tractor + GD 3.2 + GCR 1.7	-	-
	-*combiner*, Belarus 820 tractor + CCT	x	-	-*combiner*, Belarus 820 tractor + CCT	-	-	-*combiner*, Belarus 820 tractor + CCT	-	-
Soil herbicide	-	-	-	Clinic *2.5 l/ha*	-	-	-	-	-
Sowing	-Equipment –Belarus 820 tractor + SPC-6 -Sowing distance: 70 cm -Sowing depth: 5 cm -Sowing densities: 65 thousand bg/ha (*20 kg/ha*)	x	x	-Equipment –Belarus 820 tractor + Haldrup SP 35 - Sowing distance: 70 cm - Sowing depth: 4 cm - Sowing densities: 60 thousand bg/ha (*4 kg/ha*)	x	x	-Equipment –Belarus 820 tractor + Haldrup SP 35 - Sowing distance: 70 cm - Sowing depth: 4 cm - Sowing densities: 60 bg/ha (*90 kg/ha*)	-	-
Phase fertilization with urea	-Variant E 1 – 50 kg/ha a.s. (*108.6 kg/ha*)	-	-	-Variant E 1 – 50 kg/ha a.s. (*108.6 kg/ha*)	xx	-	-Variant E 1 – 50 kg/ha a.s. (*108.6 kg/ha*)	-	-
	-Variant E 2 – 100 kg/ha a.s. (*217.3 kg/ha*)	-	-	-Variant E 2 – 100 kg/ha a.s. (*217.3 kg/ha*)	-	-	-Variant E 2 – 100 kg/ha a.s. (*217.3 kg/ha*)	xx	xx
	-Variant E 3 – 150 kg/ha s.a (*326 kg/ha*)	xx	-	-Variant E 3 – 150 kg/ha s.a (*326 kg/ha*)	-	xx	-Variant E 3 – 150 kg/ha s.a (*326 kg/ha*)	-	-
	Variant E 1f – 25 kg/ha a.s. (*54.3 kg/ha*)	-	-	Variant E 1f – 25 kg/ha a.s. (*54.3 kg/ha*)	xx	-	Variant E 1f – 25 kg/ha a.s. (*54.3 kg/ha*)	-	xx
	-Variant E 2f – 50 kg/ha a.s. (*108.6 kg/ha*)	-	-	-Variant E 2f – 50 kg/ha a.s. (*108.6 kg/ha*)	-	xx	-Variant E 2f – 50 kg/ha a.s. (*108.6 kg/ha*)	xx	-
	-Variant E 3f – 75 kg/ha a.s. (*163 kg/ha*)	-	-	-Variant E 3f – 75 kg/ha a.s. (*163 kg/ha*)	-	-	-Variant E 3f – 75 kg/ha a.s. (*163 kg/ha*)	-	-
Herbicide in vegetation	Mistral *0.25 l/ha* Casper *1.4 kg/ha* Eucarol *0.5 l/ha*	x	x	Pulsar *1.2 l/ha* (Listego) Fusilade *1 l/ha*	x	x	Pulsar *1.2 l/ha* Fusilade Forte *1.5 l/ha* Dash *1.5 l/ha*	x	x
Irrigation	-1 wetting of 600 m^3/ha	x	x	-1 wetting of 600 m^3/ha	x	x	-1 wetting of 600 m^3/ha	x	x
Harvesting	*Harvesting*	x	x	*Harvesting*	x	x	*Harvesting*	x	x

xx - experimentally argued technological element
x - current technological element

CONCLUSIONS

1. The climate change taking place in the North Bărăgan area manifests by increased aridisation of large agricultural areas, so that through performed studies, SCDA Brăila predicts that these soil and climatic conditions will have an unfavourable evolution in the perspective of 2025 and 2050. An average decrease in multiannual rainfall is currently estimated from 445 mm to 440 mm in 2025 and 435 mm in 2050; an increase in the multiannual average temperature from 11^{o}C at present to 11.3^{o}C in 2025 and to 11.5^{o}C in 2050; an increase in the potential multiannual average evapotranspiration from 715 mm at present to 730 mm in 2025 and to 750 mm in 2050.
2. In drought conditions, the actions to counteract the negative effects are subscribed to some anthropic interventions of general character, which include the whole range of agropedoameliorative and agrophytotechnical measures necessary for the achievement of production cycle in the agricultural system.
3. The high variability of climatic parameters that take place during a year creates different conditions for plant growth and development in correlation with these situations, which is why separating the influence of mechanical works on agricultural crops is quite difficult to achieve over a short period of time for several years.
4. In terms of the effect of the system of basic soil works on moisture regime under crops in plain, as well as in meadow, the small differences of moisture determined on the 4 variants of soil works system (no-till, minimum-till 1 (heavy disc), minimum-till 2 (scarifier) and ploughing) can be highlighted. The main advantage of conservative works is mainly soil protection and increasing its fertility, which are factors of profitability.
5. In terms of the effect of fertilization on soil water conservation, it is recommended to apply integral norms in the case of low working width management machines and fractional norms in the case of long working width management machines, simultaneously with the same route, and to achieve increased productions, it is recommended to combine the administration variants depending on the sole crop.

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