INFLUENCE OF VARIOUS SOIL TILLAGE PRACTICES ON SUNFLOWER YIELD IN THE NORTHERN BĂRĂGAN PLAIN

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Abstract. *In the specific zonal pedo-climatic conditions, as well as the changes in local microclimates related to global warming, the modifications in cultivation technologies are important factors that have a significant impact on modern agriculture. The paper presents the results of research on the behaviour of three sunflower hybrids when cultivated in two basic tillage systems, in the pedoclimatic conditions of the Northern Bărăgan area. The implementation of new agricultural practices requires a longer period of research on the effects of basic soil operations on sunflower production and quality indicators. In the current pedoclimatic conditions of Unirea area, located in the Northern Bărăgan Plain where the experiments were conducted, the practice of basic soil operations, specifically ploughing to a depth of 30 cm, ensures higher yields with slightly improved quality indices. Additionally, the hybrids used in this study exhibited different responses to the two cultivation technologies employed. The research found that sunflowers react favourably to both classical and minimum tillage technologies. These technological changes aim to reduce the damage to the soil's structure and quality, manage resources efficiently, and reduce the environmental impact. The research results have theoretical and practical importance, revealing the significance of applied cultivation technologies in protecting the environment and soil, as well as reducing the costs associated with seed drying.*

Keywords: *agriculture, sunflower, tillage systems.*

INTRODUCTION

The management of natural resources, in agricultural systems, by correlating environmental factors with biological and technological factors, their optimization through applied agricultural practices is a priority in the conditions of practicing a sustainable and at the same time commercial agriculture [BACANU ET. AL, 2018].

Helianthus annuus, commonly known as sunflower, is a tall, annual flowering plant belonging to the *Asteraceae* Family [VRANCEANU, 2000]. It has a stout, hairy stem, and large, broad leaves. At the top of the stem, the sunflower produces a solitary flower head that can reach a diameter of 8 to 60 centimetres, consisting of numerous individual flowers arranged in a spiral. The sunflower is a plant that requires full sun to thrive. It adapts and can grow in different types of soil, but prefers well-drained, fertile soil (https://nature.berkeley.edu/news/2016/08/sunflowers-move-clock)

The sunflower has a deep, taproot system that helps it access water and nutrients from the soil. They are usually grown from seed, which can be sown directly in the field. Seeds are rich in healthy fats, protein, fibber, vitamins, and minerals (POHOATĂ, 2020). Sunflower oil is extracted from the seeds and is widely used in cooking as well as in cosmetics and industrial applications Nationally, from the perspective of agricultural potential for this crop, specialists identify six main cultivation areas based on natural conditions: the Romanian Plain, the Western Plain, and Dobrogea (chernozem soils); the Danube Floodplain; the Romanian Plain and Dobrogea (non-irrigated areas with red preluvosoils and chernozems, as well as mollic soils); the Găvanu-Burdea Plain (vertisols); the Leu-Rotunda Plain and the Plenița Plain (leached chernozems and red preluvosoils); the Jijia Plain, the Bârlad Plateau, and the Transylvanian Plain; the Moldavian Plateau, the Western Piedmonts, and the southern Getic Piedmont (URSU, 2017; URSU, 2019; VRANCEANU, 2000).

As ecological importance, the sunflower has gained popularity worldwide due to its beauty, agricultural importance, and culinary uses (ROJANSCHI,2004).

The sunflowerseed crops play a crucial role in the ecosystem as they attract bees, butterflies and other pollinators with their abundant nectar and pollen and the flower heads also provide food for birds, especially after the seeds mature and dry. Cultivation technologies, especially basic tillage, play a significant role in development plants influencing both the production and the quality indices of the seeds at the time of harvesting (LUPU, 2021).

In Braila County, sunflowers were cultivated on 18% of the arable area of the county (NATIONAL INSTITUTE OF STATISTICS, 2020) Last 3 years, the area cultivated with sunflowers was relatively constant, around 60 thousand of ha (Fig. 1).

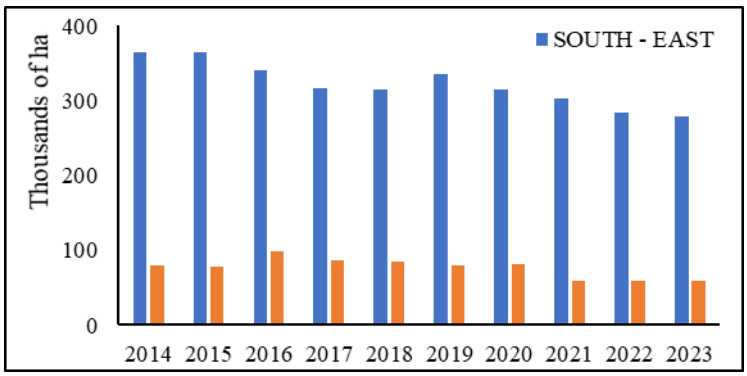

Fig.1 Area occupied by sunflowerseed crops in Brăila and Southeast Region (2024-2023)
Source: Authors, by using NATIONAL INSTITUTE OF STATISTICS (2024)

Romania holds top positions among sunflower producers, ranking first within the European Union, third in Europe after Russia and Ukraine, and fifth worldwide after Russia, Ukraine, Argentina, and China. Nationally, the agricultural area cultivated with sunflowers has been around 100,000 hectares in the past 10 years, with slight fluctuations between 2019 and 2021.

As a proportion of the total agricultural areas cultivated in Romania, sunflower crops represent about 12-15% (Figure 2).

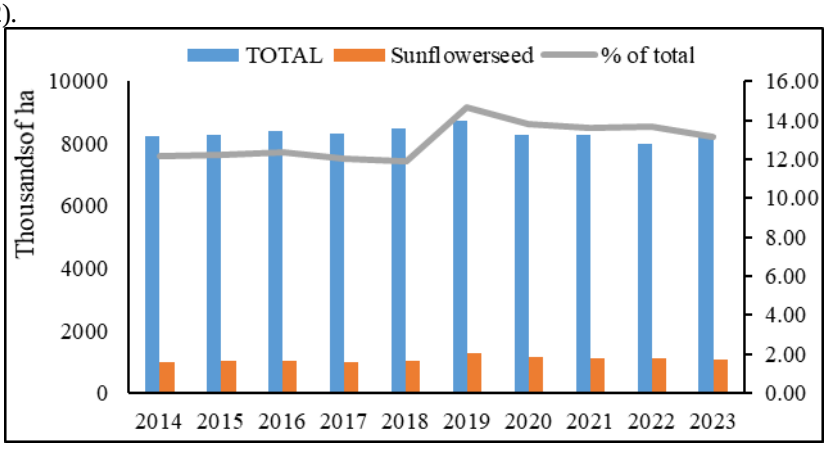

Fig. 2 Area occupied by sunflowerseed crops in Romania (2014-2023)
Source: Authors, by using 8. NATIONAL INSTITUTE OF STATISTICS [2024]

The application of different cultivation technologies can influence both plant height and production, as well as mass of 1000 grains (MMB) and harvesting humidity of sunflower seeds. The timing of sunflower seed harvesting is crucial to achieving the desired seed moisture content. If the seeds are harvested too early, they may have a higher moisture content. (GUȘ AND RUSU, 2008).

Conversely, late harvesting can result in over dried seeds with lower moisture content. Adequate timing ensures optimal seed moisture content for storage and further processing (HURDUZEU ET. AL. 2019).

Climatic conditions during the growing season can influence the moisture content of seeds (STOICA ET. AL.2018, FERTU ET AL, 2021).

High temperatures and low humidity can speed up the drying process, resulting in lower seed moisture. Conversely, cooler, wetter conditions can slow down the drying process, which can result in higher seed moisture (CANARACHE,1999)

After harvest, sunflower seeds are usually dried to reduce their moisture content to a level suitable for storage and processing.

MATERIALS AND METHODS

The experiences were established in the town of Unirea, Brăila county, on the land of the commercial company ACNID CONSULT SRL. Unirea city is in the eastern part of the Romanian Plain, in the northeaster sector of the Braila Plain, occupying a central position within Braila County (https://www.unirea-braila.ro/comuna/relieful-si-vegetatia, Accessed 02.04. 2020 (Fig. no. 3).

In summer, due to the insolation, the temperature of the soil surface rises, evapotranspiration intensifies, and the humidity is maintained between the wilting coefficient and the middle of the active humidity, a fact that determines the need for irrigation (CANARACHE, 1999).

Fig. 3 Brăila County Map
Source: https://pe-harta.ro/braila/ .

Fig. 4. Aspects from the experimental field
Source: Authors, own contribution

The experiments were established in the spring of 2023 on a plot of land belonging to the c SC ACNID SRL Company by using two variants of basic land works (V1 the classic culture system - plowing at 30 cm and V2 the minimum soil processing system with the Cizel plow at 28 cm (fig. no. 4). The experiment was organized using three sunflower hybrids from different companies, all belonging to the same maturity group, ensuring that

the seeds of all three hybrids reach maturity approximately at the same time, according to (JITAREANU, 2020) (Fig. no. 5).

Organizing experiences

V1 (PLOWING AT 30 CM)										V2 (CIZEL AT 28 CM)								
P64LE137			IMERIA			TECADRA SU				P64LE137			IMERIA			TECADRA SU		
R1	R2	R3	R1	R2	R3	R1	R2	R3	ALLEY	R1	R2	R3	R1	R2	R3	R1	R2	R3
R3	R1	R2	R3	R1	R2	R3	R1	R2		R3	R2	R1	R3	R1	R2	R3	R1	R2
R2	R3	R1	R2	R3	R1	R2	R3	R1		R2	R3	R1	R2	R3	R1	R2	R3	R1
R1	R2	R3	R1	R2	R3	R1	R2	R3		R1	R2	R3	R1	R2	R3	R1	R2	R3

Fig. 5. The experimental field

The classic system, ploughing, which is a common practice in conventional tillage systems, involves the inversion of soil layers using a plow or similar equipment (URSU, A, 2017). Minimum tillage technology refers to an agricultural practice that aims to reduce soil disturbance and improve soil health by minimizing the intensity and frequency of tillage operations. In the case of experience, the work was carried out with the chisel at 28 cm. (https://www.syngenta.ro/product/seed/nk-brio)

Each variant was sown in three repetitions. Sowing was done on April 7, the same day for both variants, at a distance between rows of 70 cm, the length of the rows being 10 m. Maintenance works were carried out, consisting of fertilization with 180 Kg/ha of ammonium nitrate administered together with the mechanical harrow.

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The biological material used are sunflower hybrids were used in the experiment: NK Brio belonging to the Syngenta company, the Imeria CS hybrid belonging to the Caussade Semences company (https://istis.ro/image/data/download/catalog-oficial/CATALOG_2016.pdf.) and the P64LE137 hybrid belonging to the Corteva company (https://www.corteva.ro/produse-si-solutii/seminte-corteva/floarea-soarelui.html)

NK Brio is a semi-early hybrid with high tolerance to water stress and very good resistance to shaking and breaking. The Imeria CS hybrid responds well to classic and intensive technologies, having a good behaviour in different sowing periods, being suitable for both early and late sowing. The start in vegetation is excellent, continuing with a very good behaviour, already at the 8-leaf stage you can see the differentiation from other sunflower hybrids in terms of the vigour and robust appearance of the whole plant, characteristics that offer very good resistance when falling and breaking.

The hybrid P64LE137 is a semi-early hybrid with the best tolerance to drought and heat in Romania, very well adapted to local conditions, with exceptional productivity (improved agronomic characters and resistance to the main crop diseases, and exceptional results in difficult growing conditions, as well as in very favourable years).

Research methodology in laboratory for determining qualitative indices.

Seed moisture is expressed as a percentage of the initial weight of the specified sample and represents the loss of mass of the seeds by drying them in the oven. For each hybrid immediately after harvesting, the moisture determination was carried out, so that the external temperature and the existing temperature in the storage space do not influence the values of this analysis. It was made according to the SR standard by drying in an oven (IRS, 1999]. The working sample, consisting of 100 g of sunflower, was homogenized and then 2 samples of 5 g each were extracted from each sample, samples that were evenly distributed in two ampoules.

Moisture expressed in mass percentage is calculated according to the formula (1):

$$U\ (\%)=((M2-M3/(M2-M1))*100 \qquad (1)$$

where:

U% - moisture percentage

M1 – the mass of the ampoule with the cap, in grams.

M2 - the mass of the ampoule with the cap and contents before drying, in grams.

M3 - mass of vial with cap and contents after drying, in grams (IRS,1999).

Determination of the mass of 1,000 seeds (MMB). It was performed on seeds harvested from the field, according to the standard and expressed in Grams (IRS, 1999).

RESULTS AND DISCUSSIONS

During the vegetation period, the determination of the plant size and the obtained production were carried out, and for the seeds, the determination of humidity and MMB was carried out at the time of harvesting. Analysing the determinations made at the height of the plants, it was found that all the plants grown in ploughed land were taller than those grown in the land worked with the chisel. In the Imeria CS hybrid, the biggest height differences were found between the plants grown in the two culture systems, classic (with plow) and minimal (with Cizel). The plants cultivated in ploughing were 6 cm higher than those cultivated in the field worked with Cizel at 28 cm. (fig. no. 6).

The biggest difference was determined in the NK Brio hybrid, where it was found that in the plants cultivated in the classic system, the average production per ha was 120 kg higher than the average production obtained from the plants cultivated in the minimum work system. (fig. No. 7)

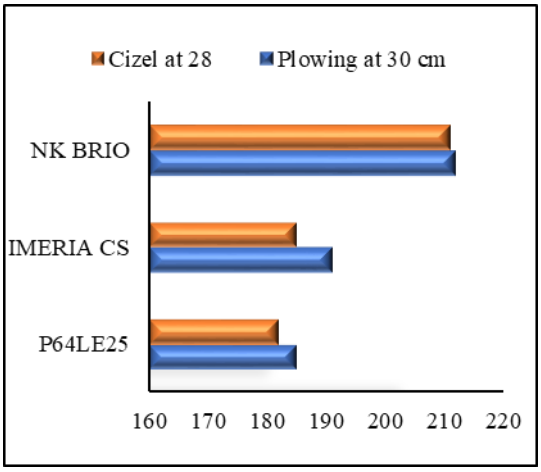

Fig. 6. The height of the plant (2023)
Source: Authors, own contribution

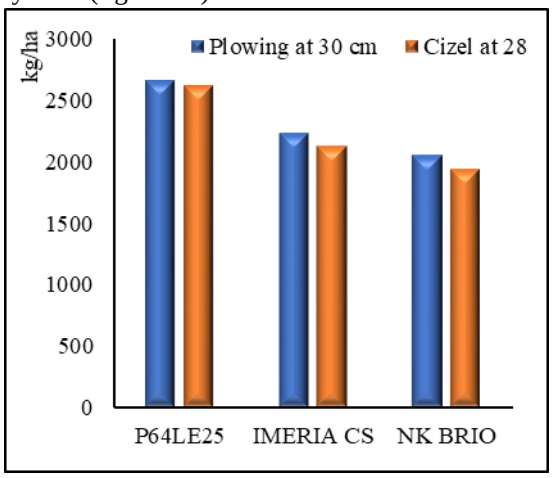

Fig. 7. The sunflower production (2023)
Source: Authors, own contribution

The moisture analysis revealed that the seeds harvested from the plants cultivated in the land worked with the Cizel at 25 cm had a lower moisture at harvest compared to the seeds harvested from the plants cultivated in the fall ploughed land. The biggest difference in humidity was found in the hybrid NK Brio, of three percent.

Were weighed before and after filling, they placed in the oven at the temperature of 103^0C and dried for 1 hour.

Fig. 8. Vials with seed
Source: Authors, own contribution

The moisture analysis revealed that the seeds harvested from the plants cultivated in the land worked with the Cizel at 25 cm had a lower moisture at harvest compared to the seeds harvested from the plants cultivated in the fall harvested land. The biggest difference in humidity was found in the hybrid NK Brio, of three percent (Fig. no. 9).

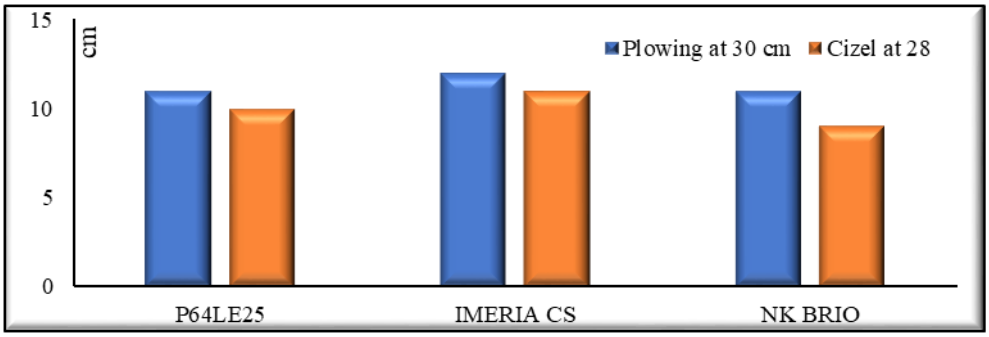

Fig. 9. Sunflower seed moisture, different samples
Source: Authors, own contribution

For the determination of MMB from the harvested production, four repetitions of 100 seeds each were taken at random, then totalled and weighed in grams, with a precision analytical balance (Fig. no. 10, 11).

Fig. 10. Sunflower seed samples
Source: Authors, own contribution

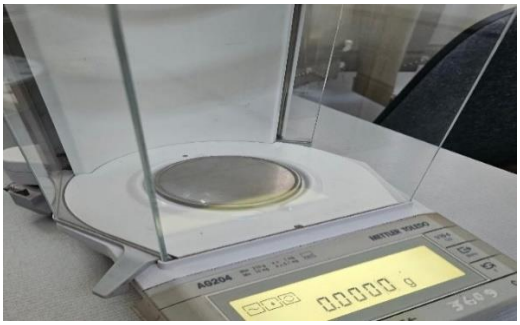

Fig. 11. Analytical balance used in research
Source: Authors, own contribution

Analysing the results obtained when determining the MMB, it was found that the seeds obtained from the land where the ploughing was carried out at 30 cm had a slightly higher MMB than the seeds harvested from the land where the basic work was carried out with the Cizel (fig. no.12).

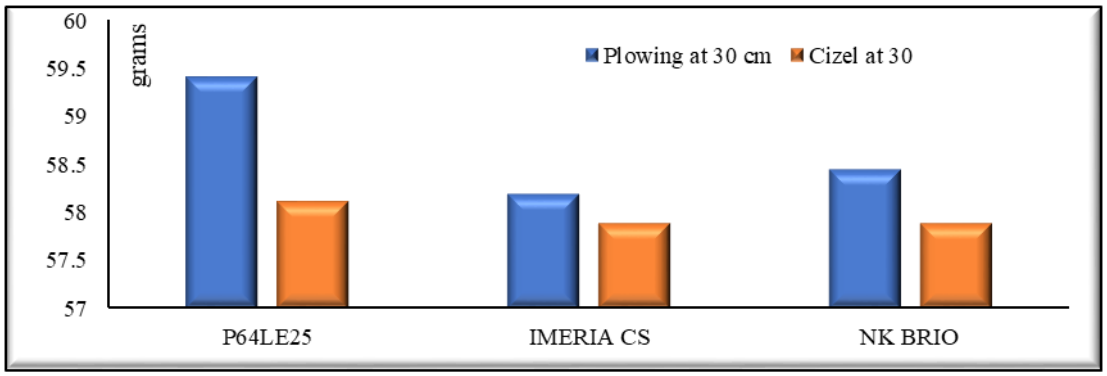

Fig. 12. Results of MMB analysis
Source: Authors, own contribution

The largest difference of 0.56 g between the two variants was found in the hybrid NK Brio, with the variant harvested from the ploughed land having a MMB of 58.45 g compared to 57.89 g for the variant harvested from the land worked with the Cizel

CONCLUSIONS

The implementation of new agricultural practices requires a longer period of research on the effects of basic soil operations on sunflower production and quality indicators. In the current pedoclimatic conditions of Unirea area, located in the Northern Bărăgan Plain where the experiments were conducted, the practice of basic soil operations, specifically ploughing to a depth of 30 cm, ensures higher yields with slightly improved quality indices. Additionally, the hybrids used in this study exhibited different responses to the two cultivation technologies employed. The hybrid P63LE25 showed minimal differences between the two treatments in both yield and moisture content (MMB).

It is noteworthy that the impact of ploughing on sunflower seed moisture at harvest can vary depending on factors such as soil type, climate (JITĂREANU, 2020), crop management practices, and local conditions. Minimum tillage practices reduce the use of heavy machinery and mitigate soil compaction compared to conventional methods.

Conversely, according to other research conducted for this purpose, a transition period of 5-7 years is necessary for the conservation agriculture system to achieve balance, with potential lower productivity in the initial years. (HURDUZEU, ET.AL, 2019) Based on the results obtained, it is recommended to continue research in the Unirea area of Braila County over several years to gather precise information that will assist farmers in selecting the most suitable technology for their farms.

BIBLIOGRAPHY

BĂCANU (ȘERBAN), C., STOICA (DINCA), C., ION, I.M, STANCIU, S., 2018, Remarks on the Use of Fertilisers and the Soil Quality in Brăila County, Romania, 31st IBIMA Conference: Innovation Management and Education Excellence through Vision 2020 (Milan, Italy, April 25-26, 2018), Ed. Soliman, K.S., ISBN:978-0-9998551-0-2, Vols. I–XI, pp. 3590-3598, available https://apps.webofknowledge.com/full_record.do?product=WOS&search_mode=GeneralSearch&qid=1&SID=E2UXWnELhrh9PUAUwIc&page=1&doc=33.

CANARACHE, A., 1999, Diferenţierea sistemelor de lucrare a solului în funcţie de condiţiile de sol şi teren din România., Editura Cluj-Napoca, vol.II, pag. 215-223

FERTU, C., DOBROTĂ, L.M., BALASAN, D.L., STANCIU, S., 2021, Monitoring the Vegetation of Agricultural Crops by using Drones and Remote Sensing - Comparative Presentation, Scientific Papers-Series Management Economic Engineering in Agriculture and Rural Development, eISSN 2285-3952, 21(2), pp. 249-254, available https://www.webofscience.com/wos/woscc/full-record/WOS:000664986400030.

GUȘ, P., RUSU, T., 2008, Sistemele neconvenţionale de lucrare a solului, alternative agrotehnice şi economice pentru agricultura durabilă, available, https://www.usamvcluj.ro/SMDT/Volum%20simpozion/1%20Gus%20Petru.pdf.

HURDUZEU, GH., GAVRILESCU, C., KEVORCHIAN, C., 2019, Riscurile în agricultura României Economie Agroalimentara si Dezvoltare Rurală într-o Perspectivă Regională, Editura Academiei Române, pp..47

JITĂREANU, G., 2020, Tratat de Agrotehnică, Editura Ion Ionescu de la Brad, Iași

LUPU, C., 2021, Influenţa lucrării de bază a solului asupra producţiei de grâu şi a unor însuşiri ale solului în condiţiile de la S.C.D.A.. Secuieni available https://www.incda-fundulea.ro/anale/78.2/78.7.pdf.

NATIONAL INSTITUTE OF STATISTICS, 2024, Area and Crop Production, Tempo online, http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table.

NATIONAL INSTITUTE OF STATISTICS, 2020, Ancheta structural in agricultură, Date pe macroregiuni și județe, available https://insse.ro/cms/ro/content/ancheta-structurala-agricultura.

POHOAȚĂ, P., 2020, Dezvoltarea durabilă, Strategii si Politici Europene de Dezvoltare Durabila, Note de curs, Universitatea Alexandru Ioan Cuza Iaşi, Centrul de Studii Europene, available https://docplayer.fr/40169149-Strategii-si-politici-europene-de-dezvoltare-durabila-prof-dr-ion-pohoata.html.

ROJANSCHI, V., 2004, Evaluarea impactului ecologic și auditul de mediu, Editura ASE

STOICA (DINCA), C., BĂCANU (ȘERBAN), C., ION (DUMITRIU), I.M., STANCIU, S., 2018, Research on the Need for Rational Use of Irrigation Water in the North Baragan Plain in the Context of Global Climatic Changes, Proceedings of The 32 IBIMA Conference: Vision 2020: Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth, (Seville, Spain, Nov. 15-16, 2018), Ed. Soliman, K.S., ISBN:978-0-9998551-1-9, Vols. I–X, pp. 5401-5410, available https://apps.webofknowledge.com/full_record.do?product=WOS&search_mode=GeneralSearch&qid=1&SID=E2UXWnELhrh9PUAUwIc&page=1&doc=47.

URSU, A, 2017, Cercetari privind eficiența economică a sistemelor de productie convențională și ecologică în contextual aplicării măsurilor de politică agricolă în România, in Economie agroalimentara si dezvoltare rurală într-o perspectivă regională, Ed Academiei Române, pg.237

URSU, A., 2019, Sisteme concurențiale de agricultură : agricultura convențională versus agricultura ecologică, Piețele Agricole și Spațiul Rural în Contextual Modernizării si Simplificării Politicii Agricole Comune, Editura Academiei Române, pg.237
VRÂNCEANU, A.V., 2000, Floarea soarelui hibridă, Ed CERES, pg. 141.
*** Metodica VAU, available http://istis.ro/image/data/download/publicatii/MetodicaVAU.pdf.
***CORTEVA Catalog produse, available https://www.corteva.ro/produse-si-solutii/seminte-corteva/floarea-soarelui.html.
***Catalogul oficial al plantelor de cultura, available https://istis.ro/image/data/download/catalog-oficial/CATALOG_2016.pdf.
*** https://www.syngenta.ro/product/seed/nk-brio
***Relieful si vegetația Com. Unirea, available https://www.unirea-braila.ro/comuna/relieful-si-vegetatia, Accessed 02.04. 2020
*** How Sunflowers Move to Follow the Sun, available https://nature.berkeley.edu/news/2016/08/sunflowers-move-clock.
***Determinarea umidității semințelor, Institutul Român de Standardizare (IRS) Standard Român, 1999, SR6124-1
***Determinarea masei a 1000 semințe, Institutul Român de Standardizare (IRS), Standard Român, 1999, SR 6123-