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ASPECTS REGARDING THE ECO-AWARENESS OF THE ROLE OF AGROTEXTILE SYSTEMS IN THE SUSTAINABLE DEVELOPMENT OF ROMANIA

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Abstract: *As the basic branch of our national economy, agriculture is said to be an area of particularly complex and complicated activity. Food, clothing and shelter are the three basic needs of the human being. Agriculture, branch of the basis of our national economy, has complex activity.The complexity is determined by the role of agriculture in the economic - social development and of them technical, economic and social particularities. The management of the production process is differentiated in relation to the production area where the agricultural process materializes and requires a double approach, namely: - to reduce greenhouse gas emissions / GHGs; - adaptation to the anticipated effects of climate change. The textile research are a key role in this field, and the strategic direction of the activity are interactive eco-design of textile element which can be used as systems involved in agriculture, forestry, horticulture, fishing, gardening, animal husbandry, aquaculture, agro-engineering or as individual protective equipment.Use fibre/yarns with performance characteristics, flexible technology. Classic /unconventional processing of textile structures, the principles of simultaneous engineering for multifunction agrotextilele can ensure properties required for agro textiles, such as: performance ratio, ease of transport, space saving storage, long service life, resistance to solar radiation, resistance to ultraviolet radiation, biodegradability, high potential to retain water.Technical textiles and in particular agrotextilele, are instruments in order to transpose in practice the concepts and strategies for sustainable development by conciliation economic and social progress.*

Key words: *agrotextiles, sustainable development, eco-awareness*

1. INTRODUCTION

Technical textiles are high performance, special textile materials and they are becoming very popular all over the world due to several functional requirement, user friendliness; eco friendliness; health & safety; cost effectiveness; durability; high strength; light weight; versatility; customization; logistical convenience etc. Technical textile is also known as, functional textiles, performance textiles, engineering textiles, invisible textiles and high-tech textiles. Technical textiles are increasingly being used in various industries such as agro textile, clothing textile, construction textile, geo-textile, eco textile, home textile, industrial textile, medical textile, packaging textile, protective textile, sport textile and transport textile. Technical textiles sector is a pillar of textile export outside of EU -28 with a 38% share in 2016.[1] The top 5 exporters of technical textiles(Germany, Italy, France, United Kingdom and Belgium) represented almost 60% of total exports to the world from Member States. Moreover, the Member States for which technical textiles

represented the highest share of their textile exports (excluding clothing) were Croatia, Finland, Denmark, Sweden, Czech Republic and Hungary. EU countries are the main export destination markets for technical textiles, in particular for companies originating in Slovakia, the Czech Republic, Croatia, Bulgaria, Belgium, Hungary, Denmark, the Netherlands, Romania, Portugal and Poland (with Intra-EU shares above 71%).(figure 1)

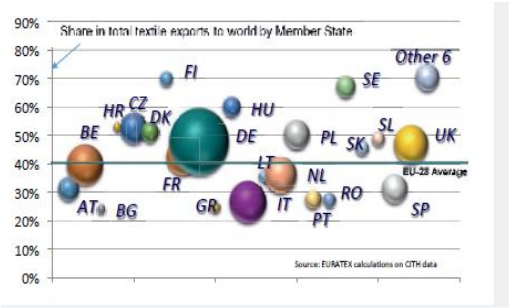


Fig.1: *Technical textile share of world exports Legend for Bubbles: size of TT exports to world - Member States size – clothing excluded [Sursa: Activity of year 2016, Annual Report, Euratex]*

2. CONSIDERATIONS ON THE AGROTEXTILES ROLE

Agrotech interdisciplinary field possess various desirable properties such as protection from pest, light or hail, lightweight, bio-degradability, resistance to microorganisms, and high potential to retain water. According to a new market report published by Credence Research, the global agro textile market is expected to reach over US$ 14,363.2 Mn by 2025, expanding at a CAGR of 5.5% from 2017 to 2025 [2] The demand for agrotextile products depends on the awareness and acceptance of these products by farming community and also on the technical and performance properties of these products. [3] Depending on the final application, the composition, production method and properties change.[4] As the world population continues to grow geometrically, great pressure is being placed on arable land, water, energy, and biological resources to provide an adequate supply of food while maintaining the integrity of our ecosystem.[5]

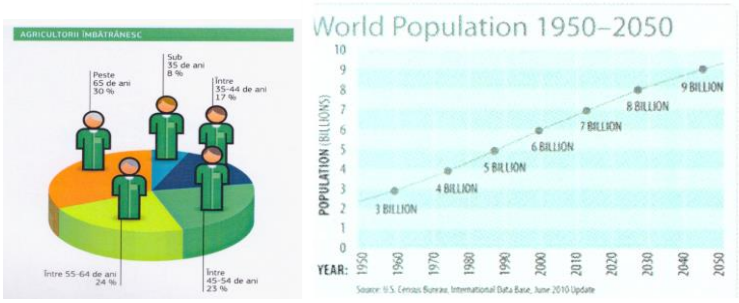


Fig.2: *World population generally and in agriculture*
Sursa:[EUROSTAT 2010; http://www.iijsr.org/data/frontImages/gallery/Vol._3_No._1/1._1-8.pdf]

Factors influencing agricultural activities are [6]: Sunshine – direct and indirect; Water; Climatic circumstances including wind, hail, humidity; External factors like birds, insects, wild plant; Post-harvest handling of produce – storage and packaging. Agrotech products are a partial solution to this problem as they increase yield and cater to major issues such as soil pollution, water

conservation, and climatic change. Grand View Research has segmented the global agro textiles market **(**volume, kg, tons; revenue, USD Million; 2014 – 2025) on the basis of product, application, and region (table 1):

Table 1: Segmented the global agro textiles market

Product Outlook	Application Outlook	Regional Outlook
Shade-nets Mulch-mats Anti-hail, anti- bird nets Fishing nets etc.	Agriculture Horticulture & Floriculture Aquaculture	North America: U.S., Canada, Mexico Europe: Germany, France, Spain, Italy Asia Pacific: China, Japan, India, Indonesia Central & South America: Middle East & Africa

3. TYPES OF AGROTEXTILES

There are many agrotextiles product used in various agricultural sectors. (table 2), (figure 3)

Table 2: *Classification of agro-textiles product with the fabric type (Agrawal, July, 2013) (Dr V Subramaniam, April 2009) (Gopalakrishnan)*

	Crop production and packing	***Horticulture & Floriculture***	***Forestry***	***Animal Husbandry***	***Fishing & Aquaculture***
Woven	Sunscreen, Packing sack, Insect meshes, Cold/frost control, Ground cover.	Sunscreen, Root ball net	Soil protection	Tape net, Mats for animals	Anti fouling nets
Non woven	Mulch mat	Mulch mat, mixed bed for mushroom	Weed control fabric	Reducing mud, Filter for milking	Anti fouling nets
Knitted	Plant net, Bird protection, Shade cloth,Wind shield, Anti hailstone nets, Support nets, Monofil nets.	For plant, Bird, insects, light shade, Windshield, Anti hailstone, Harves-tings,		Udder protection , mosquito protection, tape nets	Fishing nets, Aquaculture nets, Anti fouling nets
Plastic Sheets	Ground cover, Cherry cover	Ground, Green-house covers, Rain protection			UVradiation
Braided & Twisted				Baler twine, belt	Fishing line

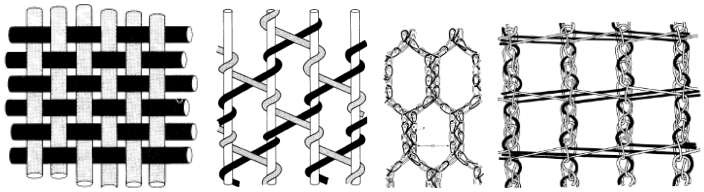
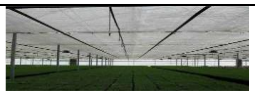


Fig. 3: *Images with textile fabrics meant for agrotextiles*

4. AGROTEXTILES - PRODUCT DIVERSITY

Application of textile materials in agriculture is growing fast. In table 3 there are presented types of agrotextiles with different functions/ requirements.

Table 3:Function of different agro-textile product [7,8]:

Product	Scope	Product Picture
Protective screen against solar radiation	Controls the distribution of solar radiation. The degree of shading between (35-95)%	
Mulch mat	Enhances the intensive character through early production, high quality.	
Harvesting nets	Facilitates harvesting in hygienic and more sustainable conditions.	
Udder protection nets and support nets	These protect against udder damage in the pasture and in crowded barns. It is also ideal to protect the udder against steps injuries.	 
Porous tube for localized irrigation	Connects the entire surface cultivated by irrigation pipes, controls the watering process of the target surface uniformly	
Insect meshes	Keeps pollinating insects inside the mesh. Protect to harmful insects.	
Nets for root protection	Biodegradable material that protects the roots of crops from possible damage caused during transport and storage.	
Antifouling nets	Physical barrier for bacteria, diatoms and microalgae that could be planted on fishing nets;	
Bird protection net	It protects seeds, crops and fruit from birds but allow movement of bees.	
Aquaculture net	To cultivate different types of fish in the same pond. Cltivation of predatory fish with normal fish, cultivation of different fish size in one pond or lake.	

5. AGROTEXTILES – TEXTILE POTENTIAL

In figure 4 it is shown the basic characteristics of agrotextiles correlated to their destination as well as the functional and design parameters.

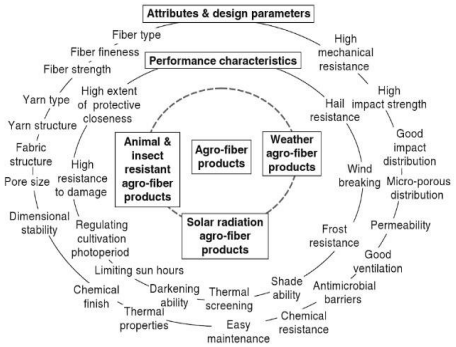


Fig. 4: *The basic characteristics of agrotextiles and their functional&design parameters; Sursa: Mogahzy Y, Engineering Textiles: Integrating the Design and Manufacture of Textile Products, Elsevier, 2008.*

Agrotextile systems are generally architectural elements that can be placed at negative and positive level share, in relation to the soil (zero rate). Both absolute and real values are direct expressions regarding the type, complexity, and the requirements of an agrotextile system. At present, by developing technical textiles, it is possible to use all textile structures (woven fabrics, warp knitted fabrics, knits, nonwovens). It is observed that the textile structure, woven type, component part of an agrotextile system, is recommended for those architectural elements that have explicit mechanical durability requirements. At the level of the textile structure, this requirement affords an optimal response, adequate to mechanical deformation demands, in dynamic conditions. For commonly used agrotextile systems, textile structures made from warp knits are the most recommended and found on profile market. Warp knitted fabrics are very linked to woven fabrics. The differences are related to the the possibility to obtain elasticity, in longitudinal direction, having in view that in a woven structure, the elasticity is esspecialy on transversal direction (weft direction). Both have dimensional stability, of different amplitudes, but superior to other textile structures.

6. AGROTEXTILES - PERFORMANCE & SUSTAINABILITY

Depending on requirements, raw materials for agrotextile are textile fibers, natural-artificially - synthetic types or hightenacity- high density – high elasticity types or virgin / first processing – recycled- waste recovered – (bio) degradable types. The textile fibers meant for agrotextile structures are: polyester, polyamde, polyethylene with high/ low density, polypropylene, linen, flax, different compostion of fiber type in waste recoverd textile structures. Agrotextiles as support should be mainly high tenacity (performant fibers). Agrotextiles as fitering net for different lights should have specific colours. Agtotextiles for filtering different hazardous agents should have mecnaical potential in time. Agrotextiles from crop to crop should be durable and/ or sustainable.

In Romania, research in the field of technical textiles is a standard for INCDTP. The experience of over 20 years in this field, including agrotexillor, is a certainty. The presence of agrotextile products is at first on the road in Romania, with the observation that most of the products come from outside. During the beginning of technical textiles 1990-2005, the research and the results of the specialists from INCDTP were promoted and implemented at various R&D Resorts in agriculture, and the raw materials and processing technologies were 100% Romanian. Nowadays, through research projects, a reconsideration of technical textiles in agriculture, in line with policies, strategies, research directions at international level, to which INCDTP is aligned, is desirable. Current multidisciplinary research allows for a complex, convergent, viable research with real personalization attributes and / or real-time response. All these are the elements that will allow for a real, useful technological transfer, assumed by multidisciplinary, by thinking of agrotextile systems. The transition from technical textile entities to technical textile systems in agriculture is the solution that INCDTP specialists, along with a multidisciplinary consortium, are currently implementing in a complex research project.

7. CONCLUSIONS

Textiles as elements and structures used in agriculture have some advantages, namely: increase crop production, avoid the soil from drying out, decrease the requirement of fertilizers, pesticides and water, they make product quality better, increase the early maturing of crops and non-seasonal plants, protects from climatic changes and its effect. Climate alteration, ecological degradation, increasing competition for land and water, high energy charge, and uncertainties about future acceptance rates for new technologies all present enormous challenges and danger that make predictions complicated. Today, agriculture has realized the need of tomorrow and opting for various

technologies to get higher overall yield, quality and tasty agro-products. Textiles, in different forms are exclusively used for many agricultural end uses and the most important requirements of textiles for agricultural applications are weather resistance, resistance to microorganism, stable construction and lightweight. In Romania, research in the field of technical textiles is a standard of INCDTP. The experience of over 20 years in this field, including agrotexillor, is a certainty. The weak point is represented by a mix of mistakes such as lack of education for technical textiles in non-textile fields including agriculture, destruction of textile industry after 2000 and policy and strategy support among textile patronages and clusters of lohn, to the detriment of the redevelopment of a real textile industry, including the accreditation of false ideas that the textile industry means clothing.

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REFERENCES

[1].Eu technical textiles &menswear exports up in 2016, Posted by Editorial Team ,Jul 31 ,2017,Global [Online].Available:http://www.apparelviews.com/eu-technical-textiles-menswear-exports-2016/

[2]. Agro Textile Market By Product Type (Shade Net, Mulch Mat, Ground Cover, Crop Cover, Insect Net, Pond Liners), By Application (Crop Production, Animal Husbandry, Horticulture & Floriculture) - Growth, Future Prospects And Competitive Analysis, 2017 - 2025[Online]. Available: https://www.credenceresearch.com/report/agro-textile-market

[3]. Agro Textiles Market Analysis, 2018 – 2025, [Online]. Available:https://www.grandviewresearch.com/industry-analysis/agro-textiles-market

[4]. M. Ferrándiz, L. Capablanca, D. García, Ma. Á. Bonet, Application of Antimicrobial Microcapsules on Agrotextiles, Journal of Agricultural Chemistry and Environment, 2017, 6, 62-82.

[5]. David, Pimentel, X. Huang, A. Cordova, and M. Pimentel (1996). Impact of Population Growth on Food Supplies and Environment, Presented at AAAS Annual Meeting, Baltimore, MD, 9 February 1996, [Online]. Available: http://dieoff.org/page57.htm

[6]. K., Bhavani, N. Mallikarjun, N.M. Sunilkumar, Agro textiles - Their applications in agriculture and scope for utilizing natural fibers in agro tech sector, International Journal of Applied Home Science, Volume 4 (7&8), July & August (2017) : 653-662

[7]. Md. J. Chowdhury, S. Nasrin, Significance of Agrotextiles and Future Prospects in Bangladesh, European Scientific journal, july 2017 edition Vol.13.No.21 ISSN: 1857-7881, [Online].Available:https://www.researchgate.net/publication/319059456_Significance_of_Agro-Textiles_and_Future_Prospects_in_Bangladesh

[8]. E Dirgar, O ORAL, M.C.Erdogan, Properties of agrotextiles and their use, Textile Science and Economy VI, Proceedings, 2014, [Online]. Available:http://www.tfzr.uns.ac.rs/tnp2015/files/Zbornik%202014.pdf