QUANTITATIVE ASSESSMENT OF POSTGRADUATE THESES IN TÜRKİYE ABOUT YARN PRODUCTION TECHNOLOGY

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Abstract: Yarn and spinning technology is a complex process that is a combination of raw materials, machinery, and automation technology where continuous improvements, researches and innovations run progressively. For the evolution of spinning technology, academic publications, postgraduate theses, and technological contributions of related shareholders must be considered as adherent supplements. Aim of this study is to examine the accomplished 236 postgraduate theses related to conventional and novel textile fibre types, staple spun/filament yarn technology and machinery, yarn types with structural and functional varieties, and modified spinning technologies in Turkish Universities. Moreover, it is aimed to reveal any trend in theses on yarn technology and the regional textile clusters in Türkiye. The methodology of the pursuit is a quantitative assessment where postgraduate level, thesis subject, year of thesis defence, and raw materials used in the theses are concerned. The findings showed that researchers focussed on conventional spinning systems and yarns in parallel with the spinning capacity and import potential of the country. Other extractions of the study are; classical ring system is mostly studied by the researchers, modern spinning technologies are included in many theses, reflections of global circumstances are distinguished in theses with keywords of manmade/recycled fibres, and blended yarns.

Keywords: Raw Material**,** Yarn, Spinning Technologies, Graduate theses, Dissertations

İplik Teknolojileri ve Makinaları Konularında Türkiye'de Yazılmış Lisansüstü Tezlerin Nicel Olarak Değerlendirilmesi

Öz: İplik ve eğirme teknolojisi; hammadde, makine parkı ve otomasyon teknolojilerinin bir arada bulunduğu, sürekli iyileştirmelerin, araştırmaların ve yeniliklerin kesintisiz bir şekilde ilerlediği komplike bir süreçtir. Eğirme teknolojilerinin ve makinalarının gelişim sürecinde akademik yayınlar, lisansüstü tezler ve sektör paydaşlarının katkıları bir bütün olarak değerlendirilmelidir. Bu çalışmada, konvansiyonel ve yeni lif türleri, kesikli elyaftan eğrilmiş/filament iplik teknolojileri ve makinaları, yapısal farklılık ve fonksiyonel özelliği olan iplik türleri ve modifiye eğirme teknolojileri hakkında Türkiye Üniversitelerinde tamamlanmış 236 lisansüstü tez incelenmiştir. Ayrıca, iplik teknolojisi üzerine yazılmış tezler ve ülkenin bölgesel tekstil kümeleri arasındaki ilişkinin sorgulanması amaçlanmıştır. Araştırmanın metodolojisi, lisansüstü eğitim seviyesi, tez konusu, tez savunma yılı ve tezlerde kullanılan hammaddelerin dikkate alındığı nicel değerlendirmeye dayanmaktadır. İnceleme sonucunda tez içeriklerinin ülkemiz eğirme kapasitesi ve ithalat potansiyeline paralel olarak konvansiyonel eğirme sistemleri ve konvansiyonel iplikler üzerine yoğunlaştığı belirlenmiştir. Çalışma sonucunda ayrıca klasik ring sisteminin yanı sıra birçok tezde modern eğirme teknolojilerine yer verildiği, tekstil sektöründeki küresel değişimin yansıması olarak yapay lifler, geri dönüştürülmüş lifler, karışım iplikler gibi konuların önem kazandığı görülmüştür.

Keywords: Hammadde, İplik, Eğirme Teknolojileri, Yüksek lisans tezleri, Doktora tezleri

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1. INTRODUCTION

Yarn technology is one essential process in textile technologies both from the view of current applications and future perspective. Yarn spinning process is a historically well-known technology starting as a handicraft to the evolution of the process to mass production during the Industrial Revolution. This progressing technology retain its development through new alternative spinning principles and the adaptation of automation, informatics, and innovations parallel to the industry 4.0. State of the art about today's yarn technology continues its development related to fibre-based innovations, technological improvements on the spinning machinery lines, and the academic studies of scientific publications and postgraduate theses. Postgraduate theses are comprehensive studies consist of the "research question", "literature review", "material and method", "results and discussion", and "conclusion and future studies".

The aim of this study is to examine the postgraduate theses -graduate theses and dissertations- conducted under the discipline of "yarn technology and machinery" in Türkiye. Classification approaches of the study are based on the number of the theses between the years of January 2007 to August 2022, the universities-cities where the thesis is conducted, the thesis subject, and the raw material type that is used in the studies. The data in the study were obtained via the examination of 236 theses accessed through the YÖKTEZ, the national thesis database of Türkiye. Thus, it is aimed to question any potential relevance and imply a relationship between yarn technology in the postgraduate theses and the regional textile clusters of the country.

1.1. World and Türkiye Yarn Market

In the textile industry, which consists of sub-segments such as yarn, weaving, knitting, dyeing, finishing, ready-made garment/fashion, and technical textiles, the yarn segment is an essential segment being an intermediate product before fabric manufacturing. World textile consumption is constantly growing. The increment in consumption brings about the need for other textile-related processes including yarn manufacturing.

The total volume of yarns supplied to the world market is about 87 million tonnes for 2017 where annual growth of 6.1% in the filament yarn and 1.4% in the spun yarn business are reported (Engelhardt, 2019). The main yarn manufacturers in the world yarn market are China, India, Pakistan, USA, and Türkiye. It is worth of note that Vietnam, Indonesia, and Bangladesh have been rising recently. Among these yarn manufacturer countries, Türkiye is also a yarn importer country with its 4th rank in the world (ITC Trade Map, 2023). Türkiye is one of the important global players in the textile and apparel industry with its export-import volume, persistent investment, and well-trained human resource. Compared to its competitors, Türkiye has also other advantages such as knowledge in production, qualified and young workforce, ancient heritage in textile production, and geographical advantage to reach the major markets in Europe, Asia, and Africa as well as Russia and Middle East markets.

Besides its abovementioned strengths, prominent market data of Türkiye is the staple and filament yarn spinning capacity. Spinning machinery capacity of the country corresponds to 3% of the world's short-staple spinning capacity, 6.6% of the world's long-staple spinning capacity, and 8.8% of the world's open-end rotor capacity (Republic of Turkey Ministry of Industry and Technology, 2021a). The filament yarn manufacturing capacity of the country is estimated above 2% of the world's total filament manufacturing capacity (ITC Trade Map, 2023), (Republic of Turkey Ministry of Development, 2018), (Engelhardt, 2022).

Textile and apparel manufacturing plants are expanded all over Türkiye in a way of regional clustering. Yarn manufacturer clusters are intensively embodied in the provinces of Adana, Kahramanmaraş, Gaziantep, Denizli, Uşak, Bursa, İstanbul, and Tekirdağ. Apart from the yarn cluster, Denizli province comes to the fore with the production of cotton towels, bathrobes, and home textiles; Uşak province concentrates on recycled yarn, blanket, and mechanical textile

recycling; Tekirdağ province relies on wet processing; Adana province has become specific with filament yarn, weaving, and wet processing; Gaziantep province has been characterized by nonwoven surface, carpet yarn, and machine carpet manufacturing; Bursa and İstanbul provinces stand out with the filament yarn, weaving, apparel, and knitted fabric manufacturing. When only the circular knitted fabric production capacity is taken into account, İstanbul is followed by Tekirdağ, Kahramanmaraş, and Bursa, respectively. In addition to the mentioned provinces, other eastern provinces have emerged in apparel manufacturing intensively (Republic of Turkey Ministry of Industry and Technology, 2021b).

2.   RESEARCH METHOD

The data in this study were obtained by examining the graduate theses and dissertations accomplished in the Textile Engineering Departments in Türkiye between January 2007-August 2022, which were accessed through the Higher Education Council Thesis Centre (YÖK Thesis Centre-YÖKTEZ). Theses were accessed by using the filters of "University", "Institute", and "Department" respectively, in the detailed search section of YÖK Thesis Centre. The total number of all theses related to textile sciences and technologies accomplished in Textile Engineering Departments was accepted as the total number of theses accessed as a result of the abovementioned filtering method. The selection of theses that were conducted in the field of yarn technology and machinery[†] from this group of theses was carried out as a result of eliminating those that are not related to yarn technology and machinery. During the research of the study, 236 theses, whose content and material-method sections were examined were determined in relation to yarn technology and machinery. In the study, the below limitations were designated to accept a thesis as yarn-related thesis:

(1) If the research question of the thesis is directly related to yarn characteristics or yarn manufacturing process,

(2) If there are dependent/independent variable relations between yarn parameters and fabric parameters.

(3) If both the yarn properties and the fabric properties produced from these yarns are examined independently.

The theses to be discussed within the scope of the study are divided into 28 subgroups within abovementioned limitations. In line with this method, some theses were included in more than one subgroup. The subgroups can be stated as follows: Vortex spinning system, siro spun spinning system, Dref-2000 spinning system, core yarns, recycled yarns, blended yarns, slub yarns, conductive yarns, textured yarns, fancy yarns, elastic yarns, quality improvement, classical ring spinning system, compact spinning system, rotor spinning system,[‡] surgical suture, the cross section of fibre, energy consumption, carpet yarns, doped polymeric yarns, melt spinning principle, wet spinning principle, yarn tension, nanofiber spun yarn, yarn splicing, PVA utilized yarn, sewing thread, and system development.

[†] The term "yarn" will be used instead of "yarn technology and machinery" henceforth
[‡] The expression "rotor spinning system" stands for open-end rotor spinning system.

3. FINDINGS

3.1. Categorization of Theses by Field, Year, University and Postgraduate Level

A total of 1301 postgraduate theses were accomplished in the Textile Engineering Departments between 2007-2022 in Türkiye. 236 of these theses were accomplished in the field of yarn, and the rest were in other fields of textile technology and sciences including dyeing, printing, finishing, weaving, knitting, apparel, textile-reinforced composites, and technical textiles, etc. In Figure 1, the ratio of postgraduate theses accomplished in the field of yarn and other fields related to textile technology and sciences is given.
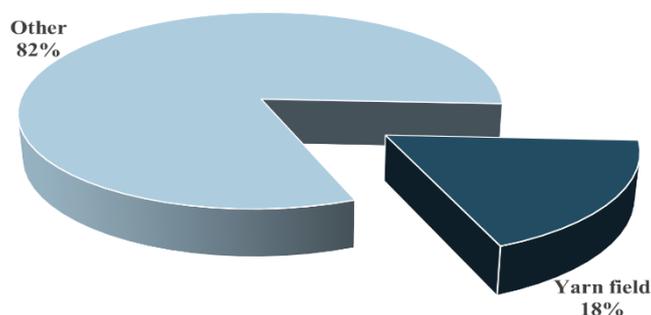

Figure 1:
Categorization of the postgraduate theses by field of study

Totally 13 Universities participated in yarn-involved graduate thesis writing, while 12 Universities participated in yarn-involved dissertation writing among total of 208 Turkish Universities (The council of higher education, 2023). When examined the yarn theses among these 13 universities, ratio of yarn theses in all textile-related theses are listed as follows: Çukurova (36%), Uşak (36%), Gaziantep (26%), Bursa Uludağ (23%), Kahramanmaraş Sütçü İmam (22%), Ege (18%), Marmara (17%), Süleyman Demirel (17%), Dokuz Eylül (16%), Tekirdağ Namık Kemal (16%), Erciyes (11%), Istanbul Technical (5%), and Pamukkale University (4%).

When the theses are examined according to postgraduate level, it has been found that there have been 174 graduate theses and 62 dissertations concerning yarn technologies as it is shown in Table 1. The highest number of graduate theses were conducted in Bursa Uludağ University (29), while the highest number of dissertations were conducted in Çukurova University (18).

Table 1. Number of the graduate theses and the dissertations in accordance with universities

	No. of graduate theses	No. of dissertations
Bursa Uludağ University	29	9
Çukurova University	25	18
Dokuz Eylül University	9	5
Ege University	21	8
Erciyes University	11	5
Gaziantep University	8	1
İstanbul Technical University	2	3
Kahramanmaraş Sütçü İmam University	17	2
Marmara University	14	4
Pamukkale University	3	-
Süleyman Demirel University	15	5
Tekirdağ Namık Kemal University	8	1
Uşak University	12	1
Total	174	62

Since 2007, the theses on yarn field have been constantly accomplished every year. The annual number of the graduate theses and dissertations in the yarn field is shown in Figure 2. It is seen that the highest number of graduate theses (25) was accomplished in 2019 and the highest number of dissertations (6) was accomplished in 2009 and 2012. As it is seen in Figure 2, there was not any constant trend in the number of accomplished theses at both levels.
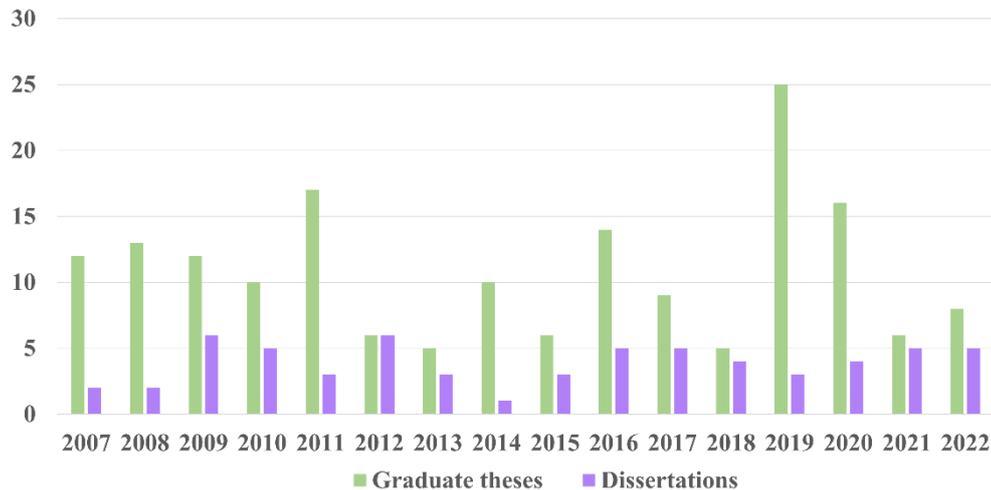

Figure 2:
Categorization of the graduate theses and dissertations between 2007-2022

Theses in the yarn field expand to quite wide range covering conventional-modern spinning systems, fibre type, yarn quality parameters, energy consumption, and modified spinning system. Table 2 shows the list of 28 subgroups of yarn-related subjects and the number of accomplished theses on these subgroups. According to Table 2, the top three subgroups studied

in the total postgraduate theses are "blended yarns (27)", "melt spinning principle (22)", and "core yarns (21)". When the postgraduate level is analyzed, the top three subgroups studied in the total graduate theses are "blended yarns (20)", "recycled yarns (15)", "melt spinning principle (15)", and "core yarns (14)". In the case of dissertations "quality improvement (8)", "core yarns (7)", blended yarns (7)", "melt spinning principle (7)", and "textured yarns (5)" are stated as the most interested yarn subjects.

Table 2. The number of theses by subgroup subject

	No. of graduate theses	No. of dissertations	Total
Vortex spinning system	5	4	9
Siro spun spinning system	5	1	6
Dref-2000 spinning system	2	-	2
Core yarns	14	7	21
Recycled yarns	15	3	18
Blended yarns	20	7	27
Slub yarns	4	1	5
Conductive yarns	9	2	11
Textured yarns	12	5	17
Fancy yarns	8	4	12
Elastic yarns	6	2	8
Quality improvement	10	8	18
Classical ring spinning system	13	4	17
Compact spinning system	4	3	7
Rotor spinning system	13	3	16
Surgical suture	2	1	3
Cross section of fibre	9	-	9
Energy consumption	1	1	2
Carpet yarns	4	3	7
Doped polymeric yarns	7	4	11
Melt spinning principle	15	7	22
Wet spinning principle	3	3	6
Yarn tension	3	1	4
Nanofiber spun yarn	3	1	4
Yarn splicing	2	-	2
PVA utilized yarn	4	1	5
Sewing thread	2	-	2
System development	4	4	8

3.2. Categorization of Thesis Subjects by Years and Universities

3.2.1. Staple Yarn Spinning Methods

Conventional and modern yarn spinning technologies are widely studied in the universities. Figure 3 shows the categorization and the annual number of accomplished postgraduate theses based on the spinning systems. Notwithstanding the graduate theses on spinning systems were conducted in almost all years, it was focused between 2007-2014. It is seen that the graduate theses about spinning systems were majorly about classical ring (13) and rotor (13) spinning systems. These systems were followed by the vortex (5), siro spun (5), compact (4), and Dref-2000 (2) spinning systems in the theses between 2007-2022. At the graduate level, between 2007-2013 researchers focused on the classical ring spinning system, while between 2013-2022 researchers focused on the rotor spinning system.
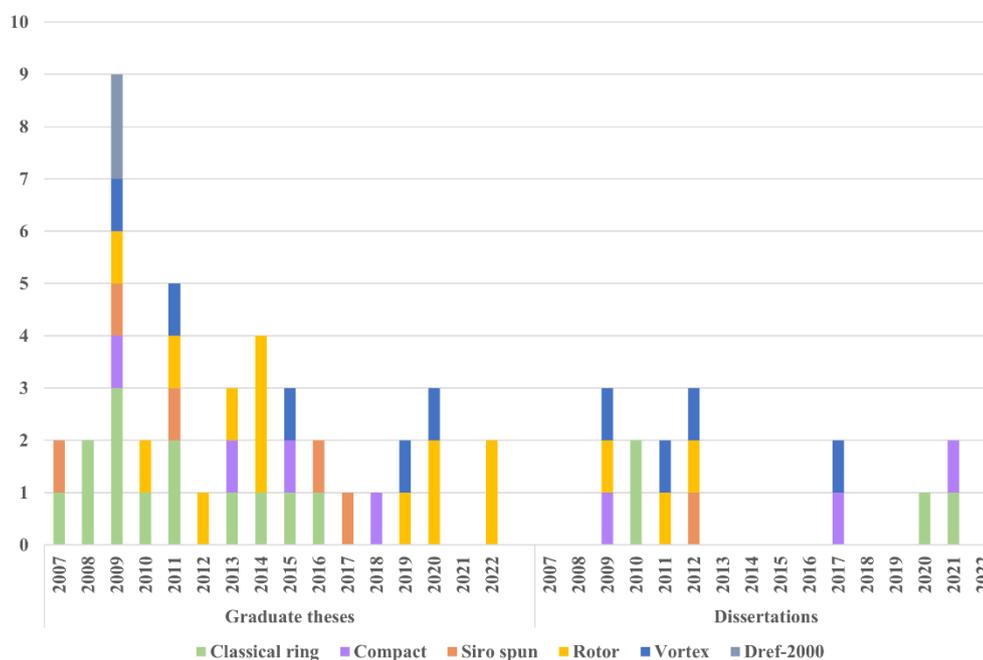

Figure 3:
Categorization of the annual number of the postgraduate theses on spinning systems.

Figure 3 also reveals that the number of dissertations from the highest to the lowest number is about classical ring (4), vortex (4), compact (3), rotor (3), and siro spun (1) spinning systems. At the doctoral level, while there was more often focus on the spinning systems between 2009-2012, the subject was ceased to be a trend after 2012.

It is worth to mention that the total number of spinning system-related postgraduate theses is not considerable high while the number of theses that rely on these spinning systems or the yarns is remarkably high. Table 3 exhibits the detail of postgraduate theses relying on spinning systems/yarn. The number of theses involving with classical ring system/yarn is 100; rotor system/yarn is 33; compact system/yarn is 20; siro spun system/yarn is 17; Vortex system/yarn is 14 and Dref-2000 system/yarn is 2.

Table 3. Number of the postgraduate theses utilized spinning systems

	Classical ring system/yarn	Rotor system/yarn	Compact system/yarn	Siro spun system/yarn	Vortex system/yarn	Dref-2000 system/yarn
Graduate theses	74	24	14	13	9	2
Dissertations	26	9	6	4	5	-

Another approach to construct the research question of the theses is the comparison of yarn quality parameters that are spun through conventional and modern spinning systems. In the theses, classical ring spun yarns are commonly compared to rotor (14), compact (10), vortex (10), and siro spun yarns (7). Additionally, there are theses about RoCos compact (3) yarn and compact siro spun yarns (1) compared to classical ring spun yarns. Rotor spun yarns are another prominent yarn types compared to other spun yarn systems of vortex spun yarns (6), compact spun yarn (5), and compact siro spun yarns (1). There are other theses focused mostly on the comparison of modern yarn spinning technologies such as classical compact versus RoCos compact; classical compact versus vortex; classical compact versus siro spun; classical compact versus compact siro spun; compact siro spun versus siro spun; vortex versus siro spun.

Distribution of spinning systems/yarn that are involved in the theses is found in line with the age of spinning technologies. Classical ring system, the oldest and most commonly implemented technology, is studied intensively in the theses while vortex system, the youngest and new flourishing technology, is not commonly favoured due to the rare number of installed machinery.

Figure 4 shows the categorization of accomplished postgraduate theses on spinning systems in accordance with universities. The university in which the highest number of graduate theses were conducted was Ege University with a total of eight theses, three of which were classical ring, three of which were siro spun, and two of which were rotor. Then, Ege University was followed by Marmara University, with a total of seven theses, three of which were classical ring, one of which was compact, one of which was rotor, one of which was vortex and one of which was Dref-2000.
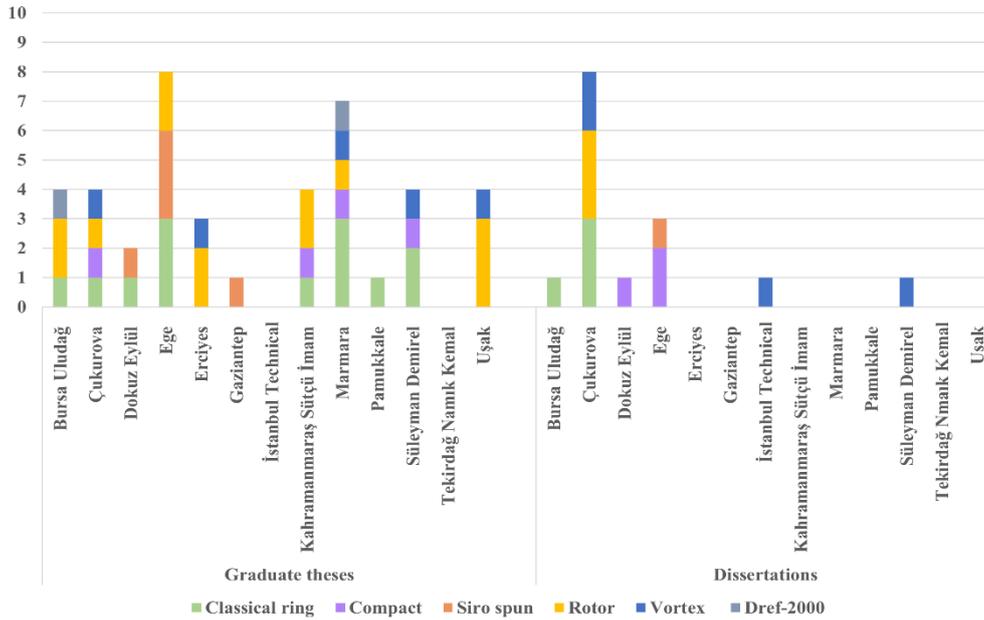
Figure 4:

Categorization of the postgraduate theses on spinning systems in accordance with universities

The universities with the highest number of dissertations are Çukurova University with a total of eight theses, three of which were classical ring, three of which were rotor and two of which were vortex and Ege University with a total of three theses, two of which were compact and one of which was siro spun.

3.2.2. Filament Yarn Production Methods

Filament production methods have recently attracted interest of researchers parallelly to the increasing volume of synthetic fibre consumption in the world. From the frame of Turkish universities, the number of theses related to filament yarn is still less than that of theses on conventional spun yarn. Figure 5 shows the categorization and the annual number of accomplished postgraduate theses based on filament production methods. At the graduate level, when the production methods are compared among themselves, it is seen that the number of the studies on melt spinning principle (15) is higher than that on wet spinning principle (3).
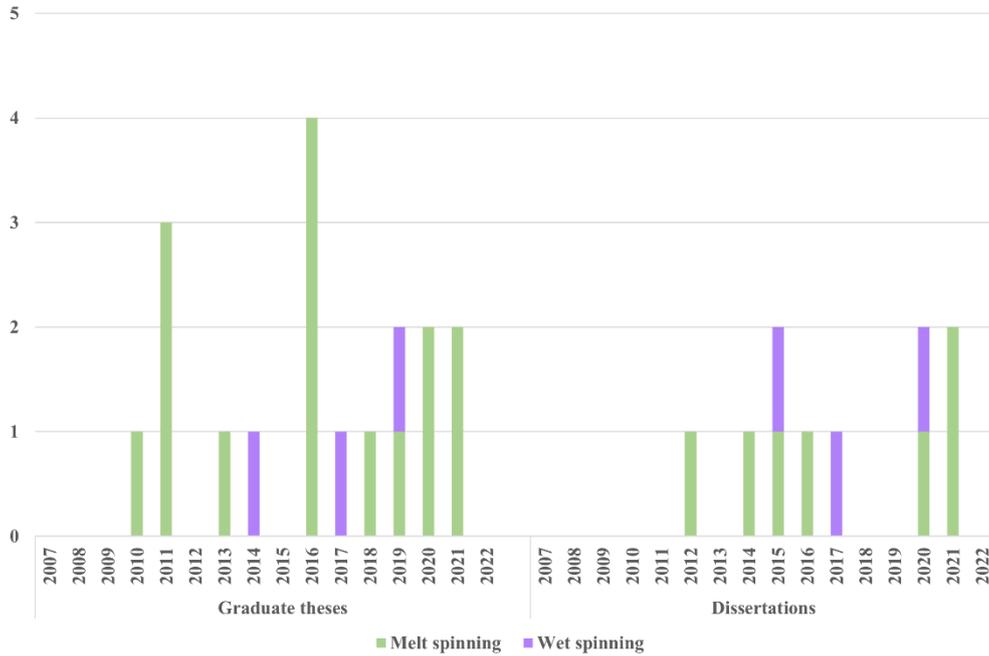
Figure 5:
Categorization of the annual number of the postgraduate theses on filament production

At the doctoral level, when the production methods are compared among themselves, it is seen that the number of theses accomplished on the melt spinning principle (7) is higher than that on wet spinning principle (3) similar to the graduate level. It is also seen that both graduate and doctoral level theses on the subject have been slightly increasing by the year of 2013.

Figure 6 shows the categorization of accomplished postgraduate theses on filament production methods in accordance with universities. The highest number of graduate theses on the subject was conducted at Bursa Uludağ (3), Gaziantep (3), and Süleyman Demirel (3) Universities. It is also seen that all theses accomplished in these universities are on melt spinning principle.
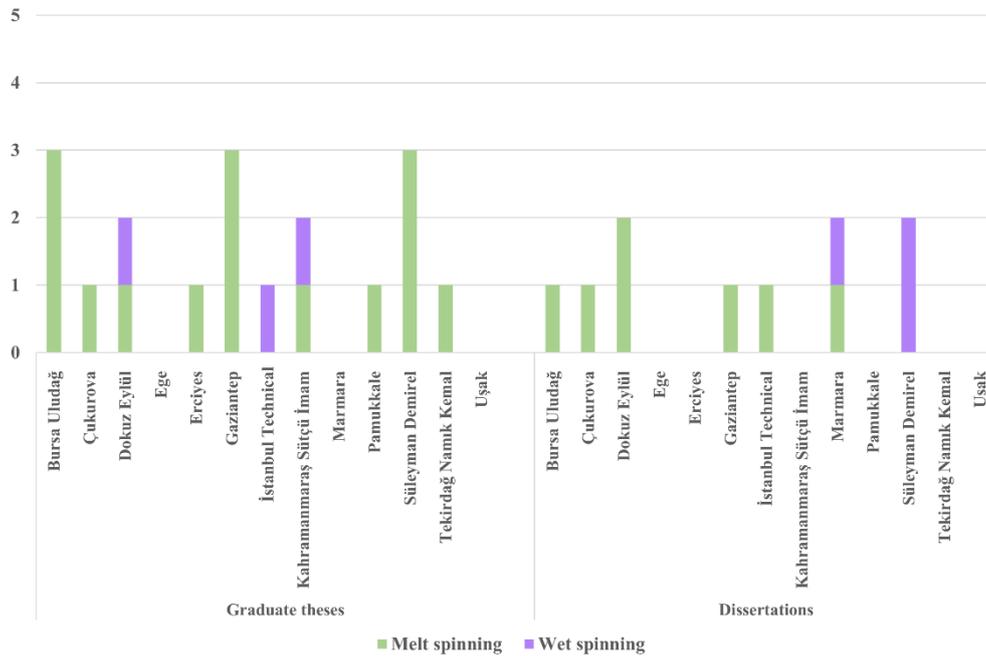
Figure 6:
Categorization of the postgraduate theses on filament production in accordance with universities

Figure 6 also shows that the universities with the highest number of dissertations on the subject are Dokuz Eylül (2), Marmara (2), and Süleyman Demirel (2) Universities. When filament production methods are compared among themselves, the number of theses focusing on melt spinning principle is higher than that on wet spinning principle.

3.2.3.   Yarn Types with Structural and Functional Varieties

Transition in textile and apparel sector, developments in the yarn manufacturing technologies, and innovations in fibre varieties, which are triggered by economic and environmental circumstances, brings about the yarn diversity both on yarn market and also on scientific works. Figure 7 exhibits that the mentioned yarn diversification reflected on the subjects of postgraduate theses. In Figure 7, categorization and the annual number of accomplished postgraduate theses on yarn types are shown. In the graduate theses, between 2007-2022, the most focused yarn types were blended yarns (20), recycled yarns (15), and core yarns (14). From Figure 7, it is seen that the interest in recycled yarns has increased, while the interest in fancy yarns has decreased in recent years. On the other hand, blended yarns have been the focus of the authors for all years.
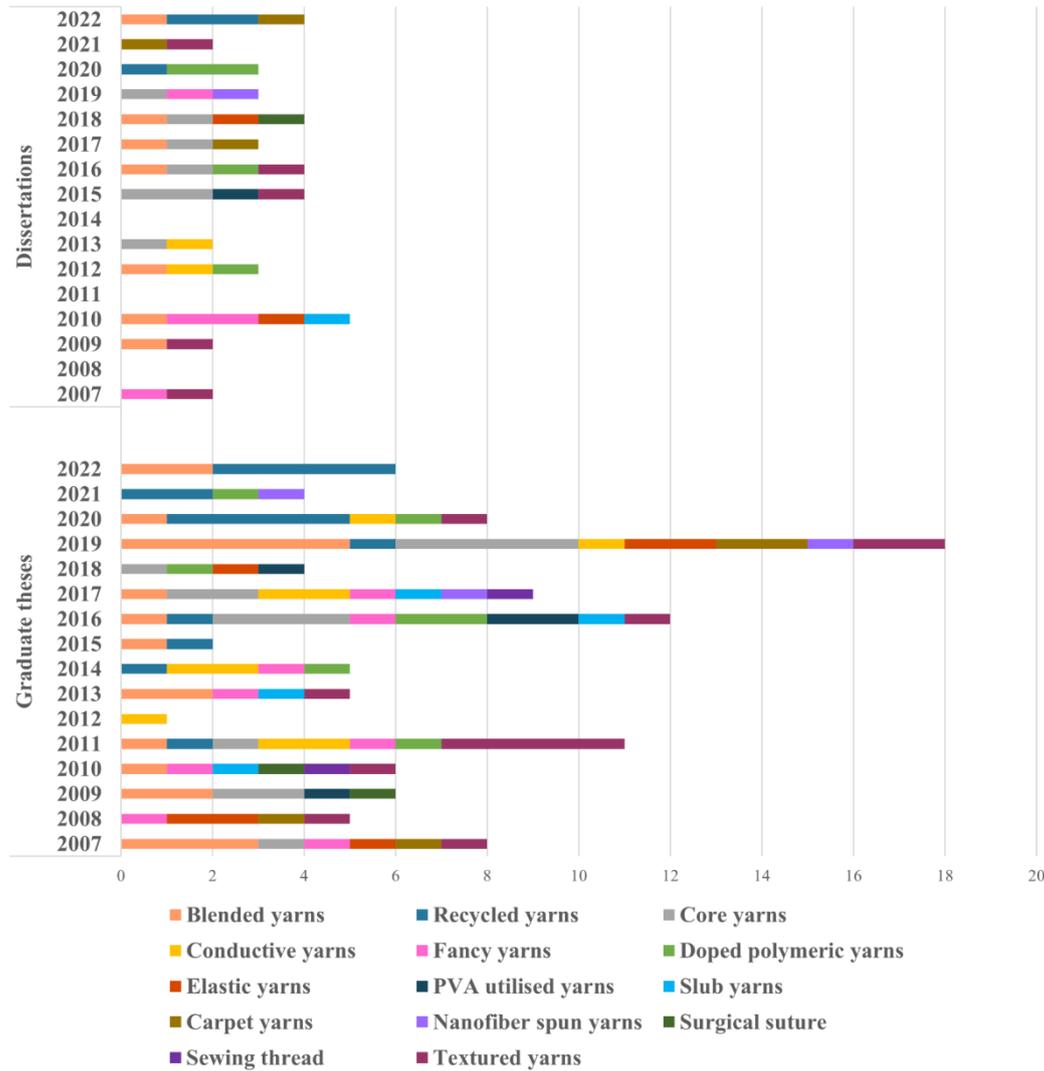
Figure 7:

Categorization of the annual number of the postgraduate theses on yarn types

In the dissertations, the most focused yarn types were blended yarns (7), core yarns (7), doped polymeric yarns (4), fancy yarns (4), recycled yarns (3), and carpet yarns (3) between 2007-2022. Figure 7 shows that the interest in recycled yarns and carpet yarns recently increased in the doctoral level research for the last few years.

Figure 8 shows the categorization of accomplished postgraduate theses on yarn types in accordance with universities. It could be seen from Figure 8 that the universities in which yarn types were mostly studied at the graduate level can be stated as followed; Blended yarns were studied in Bursa Uludağ (4) and Ege (4) Universities; recycled yarns were studied in Uşak (4) University; core yarns were studied in Çukurova (2), Ege (2), Kahramanmaraş Sütçü İmam (2), Marmara (2), Süleyman Demirel (2), and Tekirdağ Namık Kemal (2) Universities; conductive yarns were studied in Süleyman Demirel University (3); fancy yarns were studied in Bursa Uludağ (2) and Ege (2) Universities; doped polymeric yarns were studied in Bursa Uludağ (2) and Kahramanmaraş Sütçü İmam (2) Universities; elastic yarns were studied in Kahramanmaraş Sütçü İmam University (2); PVA utilized yarns were studied in Tekirdağ Namık Kemal

University (2); carpet yarns were studied in Gaziantep University (3), and nanofiber spun yarns were studied in Tekirdağ Namık Kemal (2) University. On the other hand, one thesis on slub yarns was accomplished at Bursa Uludağ, Ege, Erciyes, and Kahramanmaraş Sütçü İmam Universities; one thesis on surgical suture was accomplished at Bursa Uludağ and Kahramanmaraş Sütçü İmam Universities, and one thesis on sewing thread was accomplished at Dokuz Eylül and Uşak Universities.
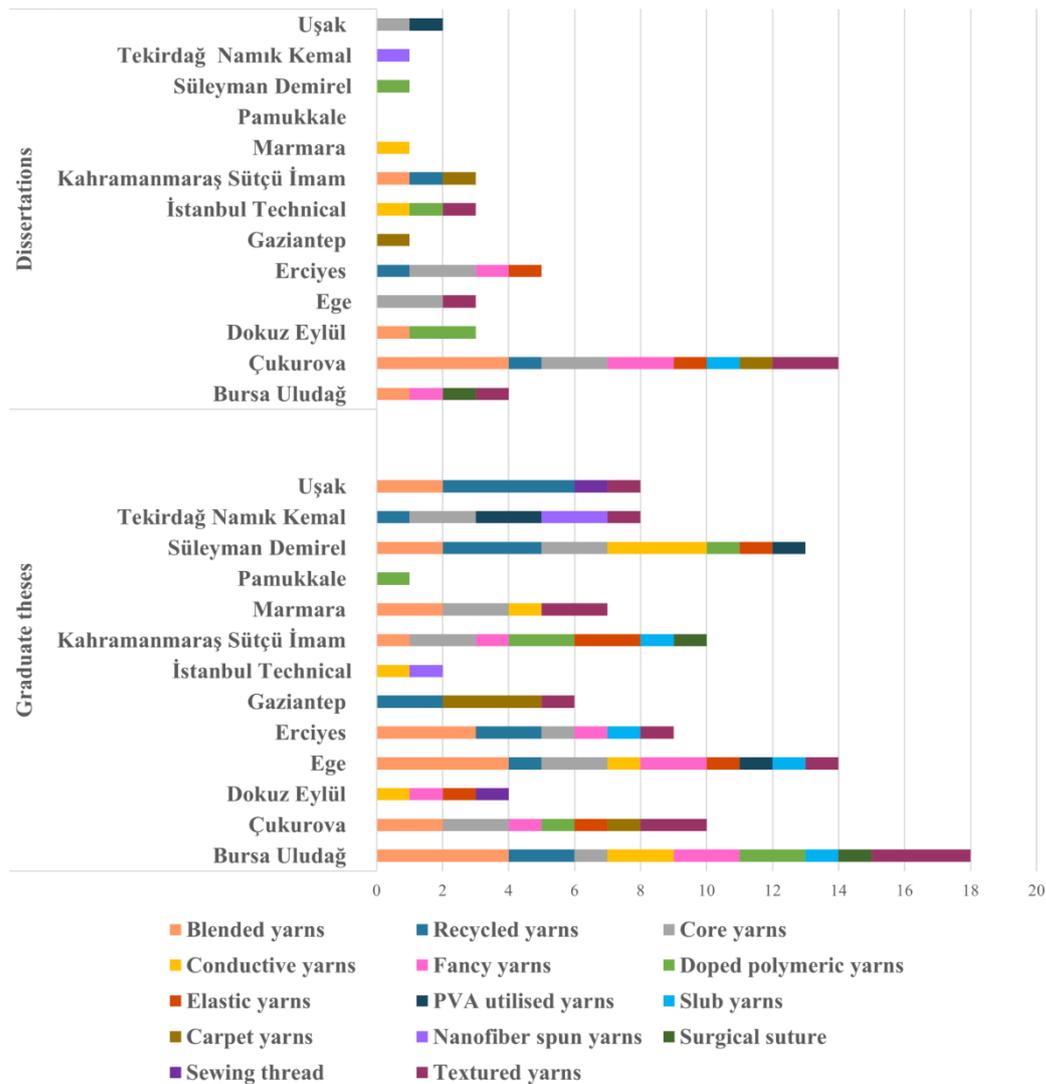

Figure 8:
Categorization of the postgraduate theses on yarn types in accordance with universities

It could be seen from Figure 8 that the universities in which yarn types were mostly studied at the doctoral level are as follows: Blended yarns were studied in Çukurova University (4), core yarns were studied in Çukurova (2), Ege (2), and Erciyes (2) Universities; fancy yarns were studied in Çukurova University (2), and doped polymeric yarns were studied in Dokuz Eylul University (2). On the other hand, one thesis on recycled yarns was conducted in Çukurova, Erciyes, and Kahramanmaraş Sütçü İmam Universities; one thesis on conductive yarns was conducted in Istanbul Technical and Marmara Universities; one thesis on elastic yarns was

conducted at Çukurova and Erciyes Universities; one thesis on PVA utilized yarns was conducted in Uşak University; one thesis on slub yarns was conducted in Çukurova University; one thesis on carpet yarns was conducted in Çukurova, Gaziantep, and Kahramanmaraş Sütçü İmam Universities; one thesis on nanofiber spun yarns was conducted in Tekirdağ Namık Kemal University and one thesis on surgical suture was conducted at Bursa Uludağ University.

It is possible to mention that regional clusters. For example, focused on recycled yarn and doped polymeric yarn manufacturing may be affiliated with the number of postgraduate theses focused on recycled yarn and doped polymeric yarn.

3.3. Categorization of Raw Materials Used in Theses by Years

Similar to requirements for yarn type diversification, there is also a constraint on the raw material supply and utilization in yarn sector. Increased textile consumption, raising environmental issues, agricultural and climate limitations, and technological improvements in manmade fibre technologies can be encountered as influential factors in global fibre market that changes constantly in the favour of manmade fibres. In the theses, the use of synthetic fibres was predominantly preferred by the researchers. Then, synthetic fibres were followed by natural and regenerated fibres, respectively. It must be highlighted to the fact that materials of all theses investigated in the scope of the study include synthetic fibres, where natural fibres were totally included in the materials of 168 theses, and regenerated fibres were only included in the materials of 101 theses.

Figure 9 shows the categorization and the annual number of the natural-based, synthetic-based, and regenerated-based raw materials that are used in all accomplished theses in the yarn field. As can be seen from Figure 9, natural fibres were preferred more in the materials of the researches between 2007-2011. Since 2012, synthetic fibres rather than natural fibres have been included in the materials of more researches.
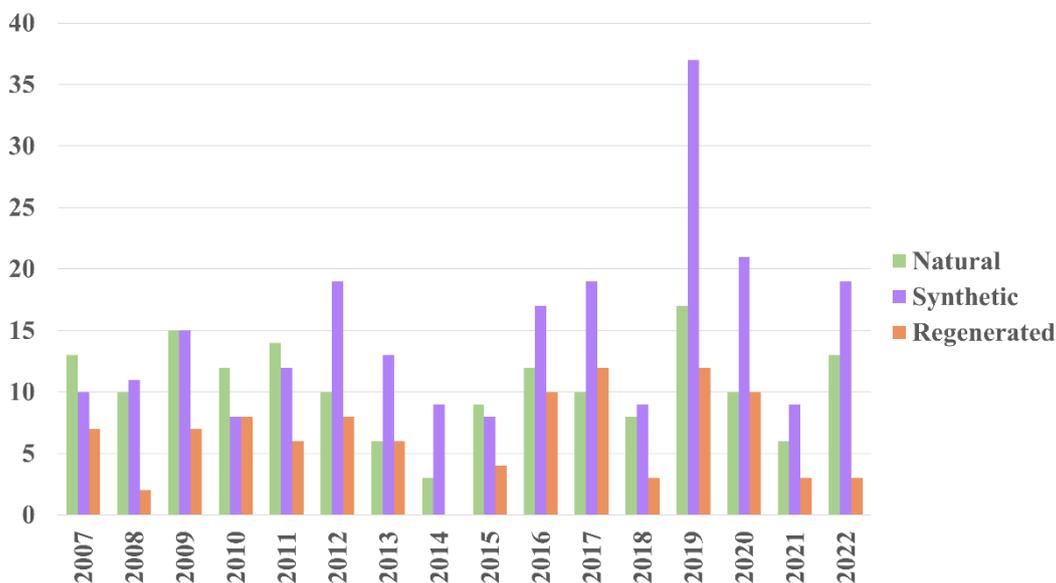

Figure 9:
Categorization of raw material types used in the postgraduate theses by years

Figure 10 exhibits the specific categorization of raw material type, where cotton (135) is the most commonly used natural fibre by researchers in all years, followed by wool (13), bamboo (12), silk (5), flax (2), and hemp fibre (1). In case of regenerated fibre, viscose (52) is the most

frequently used fibre followed by modal (24) and lyocell fibre (20) respectively.§ In case of synthetic fibre, polyester (PES) (126) is the most frequently used fibre followed by acrylic (24), elastane (19), polyamide (18), polyolefin (14), aramid (10), and carbon fibres (6) respectively.**
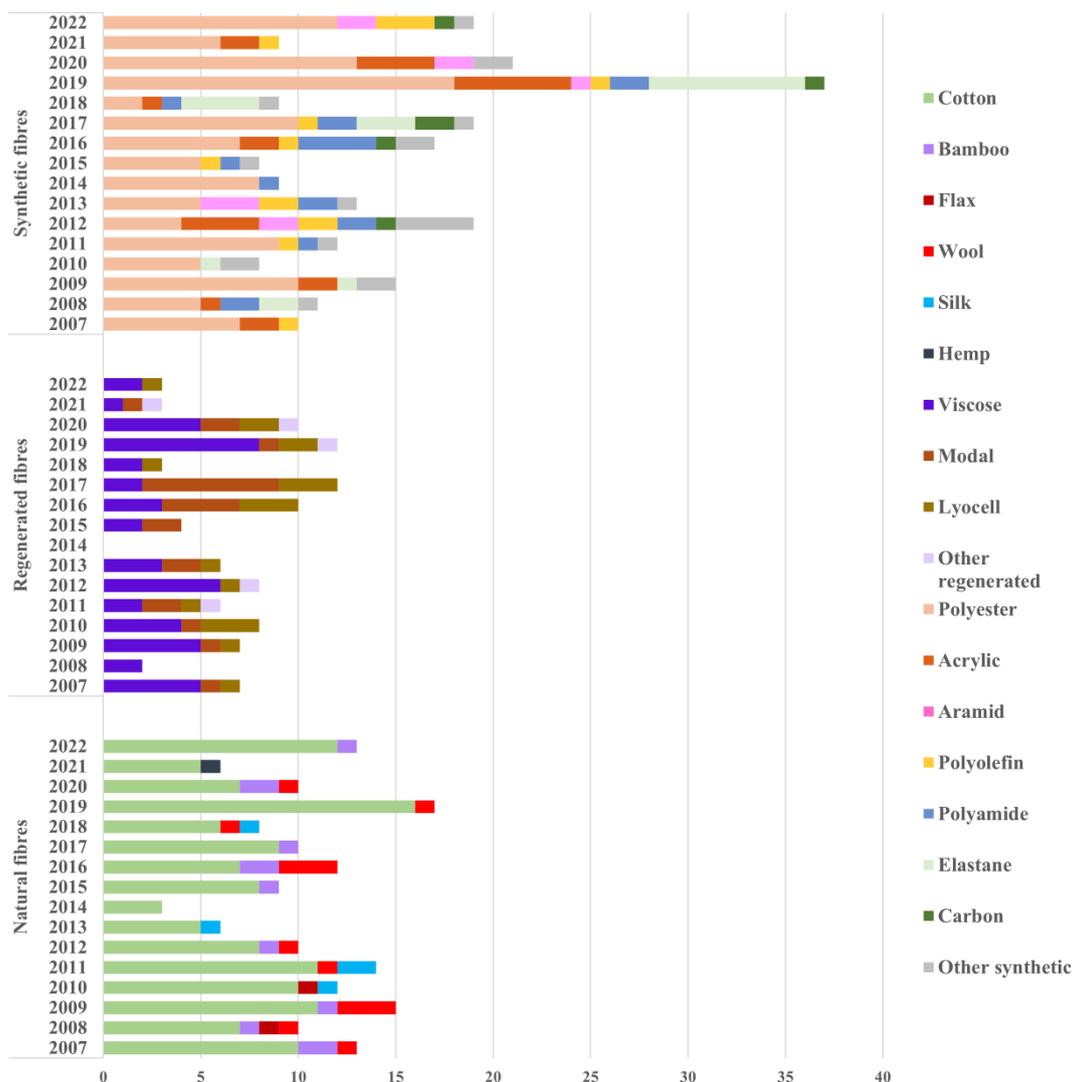

Figure 10:
Specific categorization and the annual number of raw material type

§ Figure 10 shows the top three regenerated fibres used in the postgraduate theses. Fibres specified in the "Other" classification include Umorfil®, soy, lignin, and polyhydroxyalkanoate fibres.
** Figure 10 shows the top seven synthetic fibres used in the postgraduate theses. Fibres specified in the "Other" classification include polylactic acid, shape memory polyurethane, polycaprolactane, polyvinyl alcohol, polyglycolide, polycarbonate, polytetrafluoroethylene, hexafluoropropylene vinylidinfluoride polymers, glass, silver, and metal yarns.

4. CONCLUSION

In this study, a research based on quantitative assessment of postgraduate theses in Türkiye about yarn technology and machinery is conducted. The yarn process is an essential intermediate process in textile manufacturing and also an attractive research issue by textile scientists in Türkiye. The academic works of scientists and the technological works of yarn manufacturers positively influence each other. The postgraduate theses that are investigated in this study are classified to extract the current trends in the yarn field and also question existence of any regional clustering in the yarn field in terms of scientific research. The findings imply that the theses subjects are focussed on conventional yarn spinning systems and conventional yarns in parallel with the spinning capacity and import potential of the country. Also, it was detected that there is a relation between the dissemination of spinning technology involved in the theses and the age of spinning technologies. In this context, classical ring system, the time-tested and commonly used, is mostly relied on by the researchers. However, modern yarn spinning technologies are also included in many theses. As well as this, the revival of interest in synthetic filament production in the theses is incontrovertible, could be ascribed to the global consumption of synthetic fibres increment. On the other hand, the reflection of some global conceptional approaches -sustainability, fibre recycling, doped polymers, and nanofibers-prompted by economic and environmental circumstances in the theses could also be recognized. Recycled yarns were attracted by researchers due to increased global awareness of the sustainability concept during the last ten years. Also, there are theses about doped polymeric yarns and nanofiber spun yarns in recent years, which must be ascribed to the increased importance of technical textiles in Turkish textile sector as is the case all over the world. Within the frame of raw material type, fibre technologies confronted such influential factors as concerning of environmental issues, agricultural and climatic limitations, technological advancements, and diversifying manmade fibre technologies. The widespread utilization of synthetic fibres in theses displays the impression of formerly mentioned factors in involved 236 theses. In the theses, polyester was the most commonly used synthetic fibre among time-tested synthetic fibres, where cotton and viscose were the most commonly used natural and regenerated fibres respectively. However, recycled and sustainable fibres such as r-cotton, r-polyester, r-acrylic and Ecovero™, and new type regenerated fibres such as PHA's and Umorfil® fibres have been started to use in recent years. Also, it is noteworthy to mention that the technology which regional industry relies on is reflected parallelly in the subject of theses carried out in the related region. For example, Uşak University focuses on rotor spinning system and recycled yarn while Gaziantep University concentrates on melt spinning and carpet yarns. Bursa Uludağ University is interested in melt spinning while Çukurova University pays attention to conventional spinning systems.

For the possible future perspectives, it is forecasted that pursuing raw materials having efficient and productive manufacturing lines to be substituted for natural fibres will bring about the increment of the studies on filament production methods such as melt and wet spinning systems. As well as this, interest in technical textiles of the sector gives rise to the manufacture of technical yarns and thus related manufacturing lines. Also, the studies on the yarns from new types of recycled raw materials and/or novel regenerated raw materials are estimated to be in the ascendant. Addition to technological and environmental concerns on yarn field, economical and fashion-oriented concerns will also reform the yarn market and the rest of textile sector. In order to meet the emerging needs of yarn market, beside of conventional yarn spinning systems related theses and searches, relatively young yarn spinning technologies of compact and air-jet spinning systems are expected to be involved more frequently in the theses aiming to serve to the fine counted-blended yarn market.

It is also worth to mention about possibility of some limitations and complications to accomplish a postgraduate thesis. Current technological facilities, global trade regulations, and environmental awareness are the challenging factors that influence author's idealistic

perspective during research period. Both global and local factors such as Covid-19 pandemic, transportation cost, and natural disasters are the other important factors influencing contents of the theses in Türkiye.

CONFLICT OF INTEREST

Authors confirm that there is no known conflict of interest or common interest with any institution/organization or person.

AUTHOR CONTRIBUTION

Cansu Var and Sema Palamutcu are responsible for determining the conceptual and design processes of the study and data analysis and interpretation. Cansu Var is responsible for conduct of conceptual and design processes of the research and data acquisition. Cansu Var and Sema Palamutcu are responsible for construction of article draft and critical review of intellectual content and also final approval and full responsibility.

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