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Article

Biobased Approaches to Textile Surface Creation: Example of Grass Root

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Abstract:

In today's world, the use of natural materials and the concept of sustainability have gained importance in all fields, including textile and fashion design. Designers have started to develop innovative approaches towards the use of bio-based materials. Developing innovative approaches in textile surface formation, the use of natural materials, and sustainable design conceivable as a significant step. The use of natural materials such as grass roots provides an organic and natural feel in design, while making an important contribution to sustainable textile and fashion design. In this study, the use of bio-based materials in textile surface formation will be exemplified with contemporary artists and designers. Bio-based materials will be examined under the headings of bacteria and yeasts, fungi, algae, and PLA. In this context, the "Grassroot" used in textile surface formation will be described. "Grassroot" is an expression used to create a surface by directing plant roots and seeds through molds. "Grassroot", being a natural material, stand out as an alternative option with infinite sustainability in textile surface formation. Artists such as Diana Scherer and Zena Holloway have done important work in creating textile surfaces using grass root, creating a unique bridge between nature and human creativity. These artists will be emphasized, and their works will be explained with examples. The study was restricted based on the characteristics of the sample and was constrained by the instances that were chosen.

Key words: Textile; Design; Biobased; Sustainability; Grassroot; Biomaterial.

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Introduction

There is always a cycle of production and consumption in the world, in order for human generation and life to continue. Today, with the impact of industrialization and popular culture, this cycle has turned into a process that operates not on the basis of compulsory needs but on the basis of arbitrariness [1, p. 3]. When population growth is added to this new consumption habit, the damage done to nature increases. It is clearly seen in the sources that the greatest damage to nature is caused by industrial branches [2].

The textile and fashion industry is one of the oldest industries in the world. The textile industry is one of the sectors that cause the most damage to the environment, with its structure based on raw fibers produced with chemicals that pollute energy and water and air, and the use of excess water in the production process [3, p. 147]. As the industry grows, so does the damage to the environment. The process of textile formation, both in terms of the fibers used and the dyestuffs used, has harmful consequences for nature and human health. Even after the manufacturing process, approximately 700,000 individual microplastics are released into the water each time a synthetic garment is washed [4]. All these reasons make sustainable approaches and research in textiles valuable. At the international level, our responsibilities towards the future and the environment must be clearly stated and it has become imperative to act with this awareness [5, p. 4].

It is not a coincidence that artists and designers have chosen nature as inspiration for centuries. It is thought that this preference should not be limited to art and artists, but there should be eco-friendly and nature-inspired approaches in every field. It is seen that this approach is realized with biomimicry approaches and biomaterials that researchers and artists have been working on for a long time.

Biomimetic is a field where biology is started to be used together with technological developments. In this field, the philosophy of learning from nature is adopted. The process of combining the principles and ideas in nature with engineering disciplines is also referred to as biomimicry and the world of living things is tried to be imitated with technology [6, p. 675].

The biomimetic approach is thought to contribute fully to sustainability when it not only technically mimics nature, but also uses materials that are compatible with nature. The term biomaterials are used to describe building materials derived from living organisms, including plants, animals and fungi. Plant-based materials are in an important for users due to their environmental performance. This is because they offer animal and environmentally friendly production, are generally biodegradable and can store CO_2 over their lifetime [4]. In this approach, the use of biomaterials reduces the environmental impact of the products and designs they create [7].

In this research, the use of bio-based materials, which emerges as a sustainable proposal for textile surface formation, is examined through examples. The applications on obtaining textile surface with grass root, which is one of the most current examples of these approaches, are discussed through the artists who pioneered this field. The research method uses qualitative data analysis techniques for descriptive analysis. Literature review was utilized in the data collection process of the research. The artists preferred in this study were selected in line with the purpose of the research. The artists selected as examples in this study were chosen as an easy sample because of the faster access to information and more up-to-date information. These artists, chosen as the sample, determined the limit and scope of the study. This study investigates the use of bio-based materials in the creation of textile surfaces, exploring the relationship between art, design, and nature. Various examples have been examined, aiming to highlight contemporary artists' return to nature through sustainable design approaches in textile surface creation. Additionally, the goal of this research is to contribute to the literature by adding current developments in this field. The grass root samples examined in this study are still being studied on an experimental basis, and it is considered valuable to examine them in order to enable future studies for textile art and textile industry.

2. Relationship between Art Design and Nature

Nature has always been the most important source of inspiration and the most creative reference point for artists. Approaches that place people at the center of the interaction between art and nature and view people as superior to nature lose ground in today’s art to ones that attempt to equalize people and nature. For a long time, there have been heated debates to find the differences between art and nature [8, p. 247]. Naturalists believe that the beauty of nature should be a model and example for art. Philosophers, on the other hand, have compared the beauty of art with the beauty of nature. According to idealist aesthetics, art makes beauty superior to natural beauty and glorifies it when it deals with nature. According to naturalist and materialist aesthetics, beauty is first and foremost in organic life and in nature [9, p. 407]. In this context, the concepts of togetherness of art and nature, respect for nature, preference for sustainable and organic have become popular today. The terms organic and sustainable are now used everywhere, day by day, as a marketing term to attract more and more customers. The interest in nature and natural things in food and clothing is easily recognizable [10, p. 68]. From this perspective, it can be said that natural objects strengthen art and design. Today, some designers, who adopt the idea that nature is unique, and art is only human creation, are trying to make their works a part of nature [11, p. 25].

Designer Pontus Willfors, for example, reflects the rebellious side of nature by using materials in a controlled and functional way in his designs, while encouraging a rethinking of "known" resources by keeping the design connected to its natural source [12] (Fig. 1).

Academic artist Öznur Enes produces works of art with dried calf intestine, an organic material in the context of fiber art (Fig. 2). She states that fibers contribute to the perception and cycle of life. Summarizing her working subjects as "about life", the artist states that she takes a stance against human relations whose natural structure has deteriorated in the face of social and economic changes and the man-made materials used in art [13, p. 62].



Fig. 1. Pontus Willfors, Chair, 2014 (wood) https://www.pontuswillfors.com/



Fig. 2. Öznur Enes, Dikkat Sinek Konabilir! Exhibiton, 2012 (calf intestine) http://turkishpaintings.com/index.php?p=34&l=1&modPainters_artistDetailID=3522

In this work created by academic artist Yüksel Şahin by machine embroidering with polyester thread on the inner tissue of a cactus plant after it dries, the plant's own formal structure determines the form of the work [14]. In today's world, where artists and designers are rediscovering nature in the face of the damage caused by consumption habits to the environment and nature, there may be numerous factors for the orientation towards the use of bio-based materials [14]. One of these reasons may be the concern for nature. The art, which appeared with the admiration for nature and the reflection of the beauty seen in it before 1960, has realized itself after 1960 by aiming to draw attention to nature, which is helpless in the face of environmental problems, and to create social sensitivity. Environmentalist art rose between 1960 and 1980 [9, p. 408]. Today, this rise continues with the use of different materials such as organic, soluble, sustainable and bio-based materials in interdisciplinary studies.

3. Surface Formation with Bio-Based Material

In this part of the study, textile surface examples obtained using biomaterials with the philosophy of sustainability are examined.

Bacteria and yeasts

While the use of animal skins for the human need to cover and dress dates back to ancient times, artificial leather is widely used as a textile surface today [15]. Artificial leather and fur, the source of which is petrol, cannot be evaluated within ethical fashion because they threaten the ecosystem. In this case, the most important responsibility is to work on recyclable materials that can be used instead of leather within ethical elements [16].

For example, Suzanne Lee, a London-based fashion designer who conducts research on sustainable textiles with the slogan 'I will never get bored thinking about how to design a better future', is working on a leather-like material created with bacterial cultures instead of animal hides. To develop her research, she founded BioCouture company to carry out textile surface research with live microorganisms. The designer has created an ecological and sustainable leather material by creating bacterial cellulose from several bacteria and yeasts that multiply by feeding on sugar and tea [17].

Cellulose is one of the most abundant natural polymers on Earth. Although plants are the largest source of cellulose, several species of bacteria are able to produce cellulose as an alternative source [18, p.1451].

The bio textile, which the artist works on, is developed from the cultivation of microorganisms in an aqueous environment and forms a gelatinous paste with the interlacing of microfibrils. The resulting paste is thinned and turned into a textile surface [19]. As shown in Figure 3, traditional methods have gained a garment appearance with appropriate cutting and sewing processes.

Fungi

Another biomaterial used for vegan leather works is fungus derivatives. In addition to plants such as pineapple, cactus, flowers, apple, coconut, palm leaves, as well as the fungus type known as mycelium, vegan leather production studies are carried out with the equivalent of real leather [15].

Mycelium is the root part of the fungus called hyphae, which grows in the soil. Mycelium, which can be fed with low-grade agricultural waste, becomes capable of sequestering carbon stored in biomass as it grows. MycoTEX, developed by the NEFFA company established in cooperation with designer Aniela Hoitink, has obtained from entirely biodegradable material based on mycelium. The material was first used in the production of hard objects, then developed and developed a flexible textile product that can be used in clothing. This material can be produced in different sizes, shapes and textures. It is possible to change the fiber density by controlling the growing conditions such as temperature, humidity and CO_2. Since the material can be grown to the desired size, it does not give much waste. Compared to animal leather production, lab-grown mushroom leather uses time, resources and chemicals sparingly and is a completely biodegradable material [20]. MycoTEX was founded with the philosophy of replacing the short life of the material with the speed of biodegradability when it becomes waste, in response to the fast fashion understanding and works in this direction [21].

The mycelium textile surface bypasses the steps in the production process of spinning yarn and weaving or knitting it into a fabric, resulting in less industrial processing and reduced waste. This surface is being developed as entirely degradable and land fillable product after use.

The "Living Skin" (living vegan leather) wearable prototype obtained from mycelium mushroom is shown in Figure 4. Vegan leathers have started to take place in the collections of famous brands today.



Fig. 3. Garment application with vegan leather made from bacterial cellulose made by Suzanne Lee http://www.designboom.com/design/suzanne-lee-biocouture-growing-textiles/



Fig. 4. MycoTEX prototype, created by Aniela Hoitink in collaboration with fashion designer Karin Vlug. https://www.thelovepost.global/biotech-change/articles/

Algae

Algae is a designation for a group of photosynthetic organisms that live mainly in water. This includes algae, which are the most important source of oxygen in water and are responsible for storing and sequestering more carbon than land plants [22, p. 1057]. Many studies are being carried out today to create textile surfaces with algae. In New York, a group making interesting experiments on algae-derived works has created the brand 'AlgiKnit'. AlgiKnit creates a moulded bio yarn derived from alginate (seaweed). This yarn can then be naturally dyed and used as a textile yarn in a looping or weaving process [23].

AlgiKnit's alginate is a biopolymer structure derived from kelp, one of the fastest growing organisms on Earth. The process starts by adding water to the biopolymer to make a paste and increase its strength. The paste is then physically transformed into filaments. The resulting filaments have the flexibility and durability to allow hand or machine knitting. Figure 5 shows the transformation process of alginate.

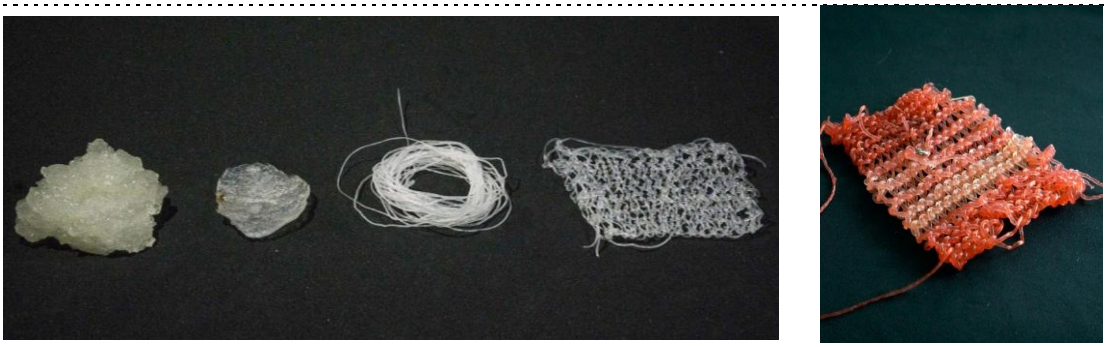

Fig. 5-6. Conversion stages of alginate-based putty to knitted surface and coloring.
https://www.materialdriven.com/blog/2017/6/16/the-promise-of-bioyarn-from-algiknit

The bio textile surfaces and fibers obtained by Algiknit can be colored with natural dyes (Fig. 6). In 2017, the group started with the name AlgiKnit and established a new brand called Keel Labs in 2022. Keel Labs produces a seaweed-based yarn used in the textile industry with a significantly lower carbon footprint.

PLA

PLA, known as Polylactic Acid, is a type of plastic produced from fermented plant starch such as corn starch, sugar cane, sugar beet pulp. It is an organic material since natural ingredients such as starch and sugar cane are used in its production. This filament has no negative impact on human health and the environment [24, p.124].

PLA is obtained from recyclable sources due to the biological structure of its content. In addition, filament is a very widely used 3D printer material. In addition to being a sustainable material, it can be purchased with a more affordable budget in terms of cost. Regarding the material's disintegration time in the human body, which ranges from 6 months to 2 years, it is also used in the healthcare industry [25, p. 35]. Polylactic acid is the most common bioplastic (PLA), which is forged at high temperatures to achieve the desired form. In this way, it can also be used in 3D printers (Fig. 7).

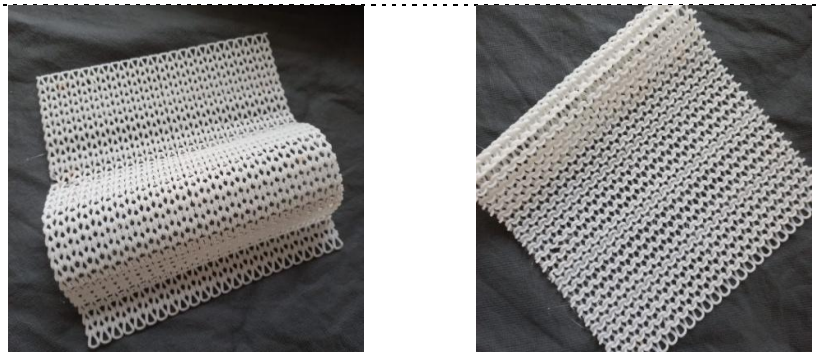

Fig. 7. Knitted face and reverse image produced in 3D printer with PLA filament.
Öğülmüş Özkum E., 2022, proficiency in arts thesis, p. 86

As a production method, 3D printer offers both rapid prototyping and a waste-free production process. When the process is analyzed, the model to be produced is modelled in its finished and ready-to-use state and printed directly from the printer. Designs and products are made in many branches of the industry with 3D printers. These areas include creating textile surfaces and creating wearable products. In Figure 7, a knitted surface was obtained using PLA bioplastic. The knitted surface with a movable loop structure of 20X20 cm was created in one go from a 3D printer without using support material and with PLA material, which is a completely natural plastic.

4. Creating a Surface with Grass Root

Today, there are many artists and designers who stand out with the use of natural materials. This trend has brought along many innovative ideas in order to convey the beauties of nature, to provide an organic touch, and to draw attention to environmental damage. In this context, Zena Holloway and Diana Scherer's work on creating a textile surface with grass roots is remarkable.

Zena Holloway

Born in 1973 in Bahrain, Zena Holloway is a British underwater photographer specializing in creating moving and still images. Using the desolate and open space of the ocean environment, she takes the underwater aesthetic and creates her own magical environment. Holloway's work has been exhibited worldwide and she is the recipient of numerous international photography and film awards [26].

Zena Holloway's background as an underwater photographer made her realize the true depth of the plastic crisis. Pollution was so visible, so destructive and so guilt-inducing that it sparked an interest in sustainability and biodesign. She grew mycelium in her basement for a year before encountering the tangled root system of a willow tree in a river, which gave her the idea of "What if we could grow our clothes from seed?" [27]. vIn 2022, Holloway pioneered a new technique for growing wheatgrass using templates carved from wax (Fig. 8). In his system, the shoots are nurtured for 12 days and grow up to 20 cm, while the root part forms a naturally woven structure. By using the roots like a 3D printer, Holloway allows nature to weave its own path, noting that each growth cycle yields a different result. Therefore, no two parts ever grow in the same way. The challenge is to plant, cut, join, pluck, adjust and finish until the root finds the optimal form [28].

Stem is an exciting and versatile material that works with the natural flow of the fiber to produce the most honest results. It can be grown into large structures or adjusted and molded to create containers. The materials at the center of the process are organic and locally sourced. Irrigation water is reused in the process and any waste, shoots or seeds are reused as animal feed. This technique can be described as infinitely sustainable.



Fig. 8. Zena Holloway, grass and roots
https://zenaholloway.com/root

Collaborating with nature and transforming plant roots into wearable art, Holloway received the 2022 Green Concept Fashion award and made a name for itself with its sustainable designs made of grass roots (Fig. 9-10).


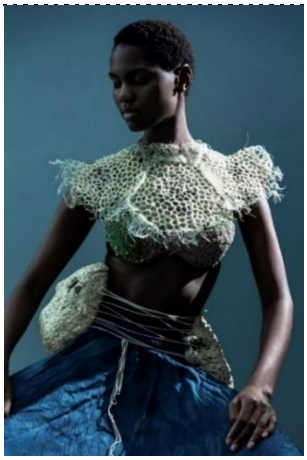

Fig. 9-10. Zena Holloway, rootfull designs. https://zenaholloway.com/root

Describing her clothing designs as "100% organic, 100% compostable and 100% edible", Holloway states that she grows roots inspired by marine life and corals [29]. Disturbed by the fast fashion cycle, artist-designer Holloway imagines a future where fashion is sustainable and compostable [30].

Diana Scherer

Diana Scherer is one of the pioneers of biotechnological art in plant root samples. Born in Germany, she studied botany and photography in Amsterdam and started to work in this field. Initially, the artist took photographs of plants with her botanical installations and her interest in root systems, which neuro-biologists call "the brain of plants" [32, p. 67]. During the process of photography, she moved the plants to her studio to examine their growth processes more closely. Scherer, who grew up in farm life, started this project with grains such as oats and corn. Inspired by the nature/culture dichotomy and his desire to control nature began working with plant parts growing above the ground and gradually moved downwards to focus on the root system of plants [33, p.25]. This journey initiated the artist's relationship with roots and led to the Inter Woven technique (Fig. 11) [31].



Fig. 11. Image of free movement of grass roots and arrangement with stencil
https://www.priscillawoolworth.com/diana-scherer/

Scherer, describing her adventure with plants, says that the image of a root, a plant that grew in a pot in her studio, stayed in her mind for a long time. Scherer, set in motion he growth of plant roots according to predefined patterns by placing barriers in the growth paths of the roots. The interaction between plants, roots, and their environment in search of food and water has been labeled "plant intelligence" [32, p. 2]. When she continued this rooting process by breaking and deforming the vases, she witnessed the paths the roots drew for themselves and the way they interlocked with each other like textile threads. The artist, who has been interested in textiles and fabrics since childhood, has created a relationship between roots and textiles.

Scherer, who defines InterWoven as the merging of plants with human traces as they grow their roots, describes the craft here as both the manipulation of natural processes and the common path of two living species. The artist, who creates paths and maps with the molds she created on the plant roots, was surprised by the result each time. The intuitive journey of the plant roots with the guidance of the artist has created unique surfaces [33].

The artist wants to produce a piece that resembles geometric patterns found in nature, like honeycombs or microscopic cell formations, by using stencils to direct the growth of plant roots (Fig. 12). Scherer's work describes roots as not only a productive material but also an intelligent material that actively and dynamically responds to and adapts to external reactions. By watering and feeding the plants in the template, the artist removes the roots from the soil after 3-4 weeks and cuts off unwanted branches. The roots reveal an intersecting and interlocking pattern on the surface of the volume [34, p. 179]. The artist describes her journey with plants as a learning process. She expressed the process in question as follows "*'While I think I create surfaces with my stencils by weaving them like textile threads, the roots create their weaves on their journey in search of food and water. It's really a collaboration with nature and learning that nature is always stronger than us. Despite all the interventions I make with the roots, the result surprises me every time by being different"* [31].

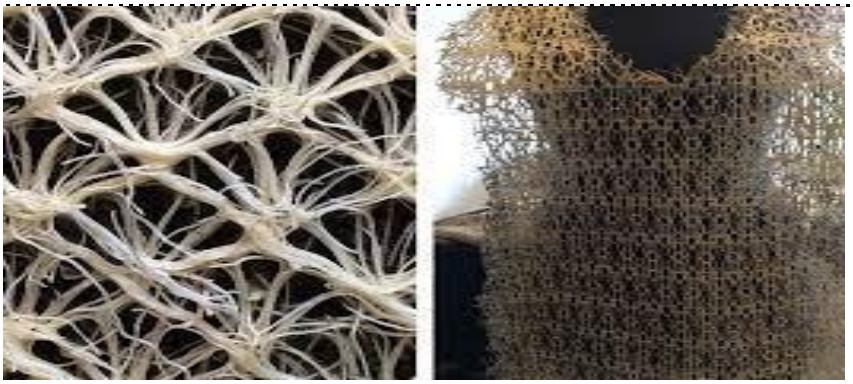

Fig. 12. Diana Scherer, Grown dress from plant roots, seeds, soil.
https://dianascherer.nl/category/commissions/

The artist considers her approach to plant roots with a pattern aid, mapping, and the acquisition of this result valuable as a guide for bio-design communities interested in further research with other living organisms [31, p. 120].

Conclusion

Researchers, scientists, academics, artists and designers are focusing more on environmental protection by developing sustainable bio-based materials to protect the earth.

It is seen that the designs created with bio-based materials are not only produced as environmentally friendly products that do not harm nature, but also have aesthetic qualities and can maintain interesting product features with an artistic perspective.

The resulting materials and designs can have more qualified features in a functional and useful way rather than the surfaces created in the usual way. In this context, sustainable, bio-based design surfaces should be designed to reduce the consumption of natural resources and minimize the damage to the environment in the production and consumption process.

In this study, when examining the artists and designers in the examples, it was concluded that contemporary art pursuits are inspired by nature, have a desire to return to nature, and place importance on the concept of sustainability. However, the examples in the study are not yet suitable for mass production and are more experimental, serving the concept of wearable art.

It has been observed that some of the samples examined within the scope of the study started in the experimental process in the field of textiles and later gave sensitivity to industrial use and fashion brands. This result raises the possibility that even individual studies in the field of sustainability can create great effects with the right steps.

With this study, which emphasizes the return of today's designers to nature, it is possible to say that problems such as environmental problems, environmental pollution, pandemic, escape from humanity, introversion, and individualization have triggered the search for imitation of nature, inspiration from nature and bio-based materials. In order to consciously design and protect the future, it is extremely important that one of the indispensable features of design is sustainability. These biobased design examples reveal the process of designing and producing by considering nature, allowing nature to regenerate without harming nature. Sustainability and environmental issues, which have become an integral part of life, are observed to play a role in the emergence of creative skills in art and design, as well as in design practices. It contributes to academic fields with a current perspective by examining the base sample, which is still a new field of study.

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Biobased Approaches to Textile Surface Creation: Example of Grass Root [Биологические подходы к созданию текстильных поверхностей: пример массового производства]

Аннотация:

В современном мире использование натуральных материалов и концепция устойчивого развития приобрели важное значение во всех областях, включая текстиль и дизайн одежды. Дизайнеры начали разрабатывать инновационные подходы к использованию материалов на биологической основе. Разработка инновационных подходов к формированию текстильной поверхности, использованию натуральных материалов и устойчивому дизайну может рассматриваться как важный шаг. Использование натуральных материалов, таких как корни травы, обеспечивает ощущение органичности и естественности в дизайне, внося важный вклад в экологичный текстиль и модный дизайн. В этом исследовании использование материалов на биологической основе для формирования текстильной поверхности будет продемонстрировано современными художниками и дизайнерами. Материалы на биологической основе будут изучаться под рубриками бактерий и дрожжей, грибков, водорослей и PLA. В этом контексте будет описан «Grassroot», используемый при формировании текстильной поверхности. «Grassroot»

— это выражение, используемое для создания поверхности путем направления корней и семян растений через формы. «Grassroot», будучи натуральным материалом, выделяется как альтернативный вариант бесконечной устойчивостью при формировании текстильной поверхности. Такие художники, как Дайана Шерер и Зена Холлоуэй, проделали важную работу по созданию текстильных поверхностей с использованием корня травы, создав уникальный мост между природой и человеческим творчеством. Эти художники будут подчеркнуты, и их работы будут объяснены с примерами. Исследование было ограничено характеристиками выборки и ограничено выбранными случаями.

Ключевые слова: текстиль; дизайн; биооснова; устойчивое развитие; массовый рост; биоматериал.

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