Transforming textile expressions by using plants to integrate growth, wilderness and decay into textile structures for interior

Svenja Keune, ArcInTexETN, Swedish School of Textiles, University of Boras, Sweden

Abstract
The emergence of biodesign, as a new field in design, opens up the design process for new methods, techniques and materials, consequently these new possibilities offer special potential for the textile design practice i.e. integrating living systems into textile structures. The purpose of this work is to develop an understanding on dynamic and active expressions through using bio–based materials in textile design processes. Major placeholders are exploring new forms of plant organization, and challenging existing concepts of living with plants, focusing on surface aesthetics. By practice–based design research, the experimental design explorations will illustrate the expressiveness of growth, wilderness and decay, using moisture, light and heat as design materials. This pictorial shows seven sets of experiments that explore dynamic transformations of bio–based materials such as seeds and plants in interaction with textile materials and techniques like weaving, knitting and crochet. Consequently, the experiments illustrate potentialities in a design space where plants are placed as living materials for new processes and dynamic expressions. Subsequently, these materials open up the discussion on alternative aesthetics when designing interior textiles and designing spatial scenarios with them. The integration of living systems and dynamic expressions, especially towards growth, wilderness and decay, rises new issues i.e. their integration, maintenance, application and interaction.

Introduction
The transformative character of textiles by traditional techniques has been expanded through the development of smart materials (Worbin, 2010; Dumitrescu et al, 2014; Talman, 2015), therefore the functionality of textiles shift from static and passive towards dynamic and active expressions (Schülke, 2014). Thus, the materials potential for change becomes more essential than its visual appearance (Hibbert, 2001).
Biodesign as an emerging field has opened new materials and methods for designing textiles and envisioning contexts of applications. As Paola Antonelli states: “Biodesign harnesses living materials (...) and embodies the dream of organic design: watching objects grow and (...) letting nature, the best among all engineers and architects, run its course” (Myers, 2014). An example of living materials in textile structures is the project BioLogic, developed by the Tangible Media Group at MIT Media Lab. It presents a textile surface using living bacteria that react to body temperature and moisture with contraction and expansion (Yao et al., 2015). Exemplary for a collaborative design process is the “Bacterial Ink” research project by Chieza and Ward. They are developing a closed-loop manufacturing system for textile dyeing and printing by using bio-pigments, produced by living bacteria (Chieza and Ward, 2015). Their collaborative research project Faber Futures aims to establish a new craft discipline through the concourse of design practice and synthetic biology. They investigate processes of co-design with living technology by manipulating textiles through folding and creasing, and introducing bacteria to create deliberate patterns. An example of responsive architecture, based on material behavior, is the project Hygroscope – Meterosensitive
Morphology. The wooden materials silent changes of movement are a result of its hygrosopic behavior and anisotropic characteristics (Myers, 2014). Scherer is fascinated by dynamics of below-ground plant parts. She is studying and manipulating root systems and uses underground templates to shape the growth of roots into a textile-like structure (Scherer, 2015).

However, more research in the textile design field is needed to develop new methods to design dynamic and active expressions by transformation over time through using bio-based materials in textile design processes and on the scale of the interior.

This research started out with material experiments using seeds and plants to explore potentials of expressional changes in textile structures, thus the natural parameters of plant life, from growth to decay, were explored. These parameters are activated by levels of moisture, light and heat; their change lead to processes of germinating, rooting, swelling, drying, shrinking, color-changing.

The research explores different methods to integrate plants, the following method generated the first category of experiments. A textile hybrid material consists of a biological material, i.e. seeds, plants, soil and a textile material, i.e. cellulose based yarns. The seeds are inserted into the textile material, here a tubular knitted material, to produce a system that can contain and carry the seeds for later usage within textile production processes, thus, this textile–seed hybrid material can be used to produce a two–dimensional or three-dimensional hybrid textile by weaving, knitting and crochet. Color, material of the used textile material, diameter, construction, the inserted biological material (size, shape, color, surface) and its distance in between one another are important design variables. Smaller seeds such as grass seeds could be integrated on a material–level within the spinning process for example. For scaling up the experiments, bigger tubular knits (Set 7-8) and crochet–works (Set 5-6) have been filled with soil and seeds or plants.

The graph shown in the beginning of this pictorial illustrates the order of the examples, from hybrid material to hybrid structure, from Set 1 - Set 7 and concludes in forms of human management.
Set 4 shows a wool–corn material crochet into an organic form. The woolen tubular knit was chosen due to its material qualities and the fine construction that highlights the corn. Activated by regular watering, the outgrowth of roots positioned, stabilized and enlarged the object towards the ground and sides. The up-reaching sprouts transformed its soft expression, form, color, size and materiality.

Set 5 shows a textile container crochet from wool and a cotton–corn material, forming a ring around the soil containing object. Regular watering into the object started the growing. White and red roots grew underneath and inwards. Stopping the watering initiated the drying process which transformed the material again, changed color, pliability and direction of the leaves, their sound and the objects weight.

Set 6 shows a tubular knit from Polyester, filled with soil and grass seeds. The textile materials was chosen due to its color, the grass due to its potential to cover an entire surface. The outgrowing grass covers the up-facing parts of the structure like a fur. Its density increased, the expression transformed from subtile to more expressive, from glossy, bright green and straight to fuzzy, dark green and distorted due to the initiated drying process.
Set 1 shows corn, introduced into a tubular knitted material made from cotton and polyester. The cotton–corn material has been heated in a microwave, popped and expanded the tube. The corn-polyester material has been sprayed with water, roots were developing after two days. The experiment was directed to explore the transformation of a material that unactivated can be used in textile constructions. The corn was chosen due to its potential of reacting to heat and moisture.

Set 2 shows a prev. described cotton–corn material used in hand weaving. It has been activated by a heatgun (4mins), a microwave (2x2mins) and a water spray bottle (2x/day). The experiment explores 3 forms of activating a cotton–corn–cloth and its transformation/disruption over time. The popcorn–cloth turns brownish, expands broadly, has a sweet smell, the sprouting cloth has an earthy smell, and sharp, green sprouts.

Set 3 shows a cotton–barleygrass material crochet onto a weave. The barley grass was chosen due to its fast growing process and its nutritional value. The textile has been activated by regular watering with a spray–can. Due to the green colored cotton–barleygrass material and its sprouts, the first changes and the contrast between the plant–parts and the textile design are subtle, thus they are aesthetically interwoven and blend into one another.
Set 7 shows a tubular knit from Polyester, filled with soil and planted with lettuce. As in Set 6, the tube was expanded and shaped by the contained soil and manipulation. Through a hole in the structure the lettuce could be planted and the structure watered. The neon–yellow color of the knit was dampened by the soil that penetrated the construction. The vertical, threedimensional structure can be altered, reshaped, expanded, and repositioned easily, due to the flexible construction of the knit. The structure’s main transformation is expressed by the withering lettuce–leaves, hanging down, nestling to the structures form and downwards. The leaves first strong and upwards but pliable, turned weak and adapted a textile–like character, by its folding, wrinkling, hanging leaves. Their color, bleached by the drying process, matched up with the color of the structure.
Both, the biological material and the textile material, transform over time, due to their distinct material qualities. The biological material, seeds for example, will express different states of plant-life, in this context described as growth, wilderness and decay. These transformations open up for people–plant–interaction which is summarized as human management and includes activities such as observing, manipulating, harvesting, draping, touching, cutting, braiding. The transformation itself and the human management lead to expressional changes on the different levels/scales that can be perceived as adaptive and responsive and expressed by changes in size, form, color, texture, pliability, weight and odor, to name a few.
Discussion
The use of knitting, weaving and crochet, as illustrated in this pictorial, offer different qualities to embedding seeds and plants and to provide a growing matrix or to disrupt the expressions of the constructions. Knitting was used to explore flexible, more spacial and threedimensional constructions. The density and the position of the knit influence the outgrowth of the germinating seeds. The material effects the water distribution and the reaction to moisture, heat and light. Crochet was used to explore free–formed threedimensional shapes that resemble with common plant containers but differ by using the textile–seed material to form the soil–containing structure. Hand–weaving was used to explore the transformation of twodimensional constructions. When using corn, the form of the activation makes a significant difference, as well as the position of the cloth.

By embedding the potential of growth into textile structures, the interaction of cloth and plants evokes. The illustrated examples indicate various transformations, expanding and altering textile expressions by adding organic disturbances to former complete forms, structures or textures. Set 1, 2 and 6 illustrate disruptions of the construction of the cloth whereas Set 5 - 7 provide a living matrix for growing plants, by using soil as a substrate. Set 4 exemplifies a threedimensional transformation of a textile object and Set 5 displays a complete biological lifecycle from growth to decay. Consequently the transformations can vary in their diffusion and density and are mostly unique and irreversible. In contrast to the project Hygroscope, the proposed hybrid textile material system is aligned, based on textile techniques, constructions and applications.

The difference to the project Bacterial Ink is the production that doesn’t require special environments such as a laboratory and sterile conditions. Another difference are the two general states: passive and active. Whereas the wooden materials hygroscopic behaviour and anisotropic characteristics initiate the silent changes of movement, which is more a static and dynamic expression, the activation of the hybrid textile material system starts a process, comparable to a chain reaction that is not reversible and increasingly erratic as the complexity of the material system expands and the scale increases.

Consequently the presented examples provide perspectives on textile structures for interior that can be edible - degradable, passive - active, promote a symbiotic relationship between human and plant through the textile and a biological lifecycle. Especially the integration of seeds open up potentials for using unactivated structures on the scale of the body or in interior settings. Thus, not only the stable and passive structures challenge new forms of interaction, the activation becomes an open field for exploring interactions as well, using moisture, light and heat as design materials. The parameters of life, from growth to decay, open up for interactions regarding maintenance, i.e. watering, cutting, harvesting.
and regarding i.e. eating, manipulating, arranging.

This research illustrates potentialities in a design space where the living material is placed as dynamic material for new processes and expressions; a potential design space where the dynamic and transformative materiality give textile design a bio–based dimension in the design process. Thus, biological materials such as plants and seeds in particular, are used as natural smart materials used to develop new textile materials and expressions. Subsequently, these materials open up the discussion on alternative aesthetics in interior spaces when designing textiles and spatial scenarios. Expressions of wilderness and decay challenge the limits of conventional textile and interior design and promote a discussion about future forms of living with plants that ranges from textile design to indoor gardening.

The further practical work will consist of experiments and scenarios that concentrate on the interaction of plant and textile construction, suggest different forms of human management and promote an extended lifecycle that results into a biocycle by focusing on pure cellulose-based fibers. The potentials of industrial weaving for plant–containing structures will be explored by using pocket–weave constructions Therefore sprouts will be used, as they grow fast, demand little, come in different shapes and colors and can be trimmed, harvested and eaten.

Conclusion
As pictured, textile materials, techniques and constructions will be of foundational use to interweave interior living and plant organization in a hybrid environment that is managed by humans. To create alternative expressions of static and dynamic qualities, „Farming Textiles“ proposes biological materials such as plants and seeds in particular, as natural smart material for using in textile design processes to develop new textile materials. These materials open up for a new range of interactions, since human management is part of their maintenance and transformation. These forms of interactions and conditions redefine what is understood as behaviour and prevailing states indoors, the present definition of interior is challenged and open for discussion. „Farming Textiles“, as an artistic research program, is not directed to develop functional solutions, it aims to propose future perspectives in forms of living with a hybrid of interior textiles and a diversity of local plants. Seasons and lifecycles are usually not expressed in interiors, especially Subnatures and processes of degradation are not considered as experiences of beauty and enjoyment, they are expressions of evanescence and imperfectionism. They are often seen as threatening, uncomfortable and a disturbance of a pleasant atmosphere. As a side–effect of „Farming Textiles“ materials and processes, interactions and transformations, a range of Subnatures such as mud, dust, puddles and
insects can occur and challenge the understanding of a comfortable space. Thus, they force a confrontation with the prevailing relationships to the environment.

References
Schülke, B. (2014). New materialism - The transformation of intelligent textiles towards an interactive user generated interface, ESJ September 2014 /Special/ Edition VOL.3: European Scientific Institute, ESI.