

The Food Value Chain of Triticale in Switzerland

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1. THE FOOD VALUE CHAIN OF TRITICALE IN SWITZERLAND

1.1 Triticale in Switzerland

Triticale (x*Triticosecale*) is a bred between a female wheat parent (*Triticum* spp.) and a male rye parent (*Secale* spp.). At the origins, triticale was created for bread production and would profit from bread-making qualities from wheat and field robustness from the rye. In Switzerland, research about triticale begun in the 1950s and fertility enhancement was the main focus (Fossati et al., 1996). Triticale breeding started in the middle of the 1970s at the National research institute of agriculture (ex-Agroscope) (Schori et al., 2007). First statistical registration of the surface cultivated for triticale appears in 1984 with 70 hectares (SBV, 1985). The surface increased quickly, with 5'350 hectares cultivated in 1995 (SBV, 1995). For now, triticale is mainly used as feed in Switzerland. Cultivated surface and yields evolution can be seen in Table 1.

Table 1. Area cultivated and yield of triticale in Switzerland

Year	2000	2010	2018	2019	2020	2021
Cultivated area (ha)	10'306	10'274	7'960	7'683	7'457	7'447 ^a
Average yields (usable production divided by cultivated area) (kg/a)	62.2	56.8	59.4	60.2	60.2	- ^b

According to Agristat (2021a). ^a number for 2021 is an estimation (Agristat, 2021b). ^b not available at the time of writing the report.

We will cover in this report a food value chain. When the National research institute of agriculture (Agroscope) gave up its triticale breeding program at the beginning of the 2010s, the genetic material was sold to a biodynamic-organic breeding institute in Switzerland (Spuhler, 2014). The biodynamic-organic breeding institute continued breeding feed varieties, and started breeding a high-protein variety usable for feed and food, especially for bread-making. The idea behind breeding triticale for bread production is to replace bread wheat with bread triticale, especially in marginal zones, where triticale can have advantages over wheat due to its robustness.

The biodynamic-organic breeding institute mentioned above started to establish a value chain for triticale bread, i.e. for human nutrition by searching value chains actors like producers, mills and bakeries. Triticale is a feed crop already known to some extent in Swiss agriculture. The unique variety used in this value chain, "Tripanem", is mainly used to produce triticale bread and not used for feeding animals. If triticale is already well known in the upstream sector, the food downstream sector is not familiar with triticale. We consider the value chain of triticale bread thus interesting for the CROPDIVA project, because the upstream sector is already familiar with triticale, while the downstream food sector not.

1.2 Overview of the interviews completed

Interviewees were found through the help of a former triticale breeder, which was contacted through their¹ former biodynamic-organic breeding institute. Some contacts were found online as well as through articles or websites. In addition, some interviews were “crossed” with other CROPDIVA crops. Table 1 displays the interviews we did. We interviewed two triticale breeders (one former) and one responsible for seed production and seed trading. In addition, we interviewed one producer. Some other producers (cross-interviews) gave us information about producing triticale. One producer did not answer to our interview request.

Table 1. Overview of the number of interviews performed for each VC actor.²

VC actor	Numbers of interview
Organisation (extension, research, etc.)	1
Breeders	2
Seed production	1
Organisation linking breeding and seed production	1
Seed trader	2
Producer	1
Collector	2
Mill	2
Bakery	2

Regarding the downstream part of the value chain, we interviewed two collection centres through cross-interviews. We could interviewed one mill that once made triticale flour, thanks to a cross-interview. One value chain involved collection centre-mill contacted did not answer to our interviews request, as well as two mills that had triticale flour in their assortment. At last, we interviewed two bakeries. One of them is sometimes milling its own triticale flour. One bakery is selling bread to specialized shops (like organic small shops); however, we did not interview one of those shops.

1.3 Results

1.3.1 Description of the triticale food value chain

The idea to develop a triticale variety and a value chain for triticale bread came from a person active in a biodynamic-organic breeding institute. This biodynamic-organic breeding institute could recover some genetic material of the former triticale breeding programs of the national research institute for agriculture (ex-Agroscope), as mentioned in the part 1.1 (Triticale in Switzerland). The biodynamic-organic breeding institute started then to breed triticale for both feed and food purposes. The triticale variety Tripanem was breed to ideally replace wheat in marginal locations and is high in protein. The food variety was developed after 9-12 years of breeding. In parallel, contact was taken with other value chain actors like producers, collection centres, mills and bakeries, in order to build a value chain.

Figure 1 shows the value chain mapping of the triticale food value chain. After breeding, an organisation coordinates the seed production and the seed trading. Producers cultivate only the triticale variety

¹ In this text, “their” is used as a singular gender-neutral third-person pronoun.

² Please note that we counted the number of interviews for each role taken by one interviewee. For example, if one producer was processing and selling its lupin directly to consumers, one interview with this producer would count as three interviews: one producer interview, one processor interview and one seller interview.

Tripanem and deliver it to collection centres and mills (about three integrated collection centre-mills were identified). Tripanem flour is sold to bakeries, which are producing the triticale bread. Some bakers are using 100% triticale, while others mix it with other flours. One of the interviewed bakeries is selling bread mainly to specialized shops (like organic small shops or food health shops) and on a local market stand. The other bakery is selling bread directly to the bakery's clients.

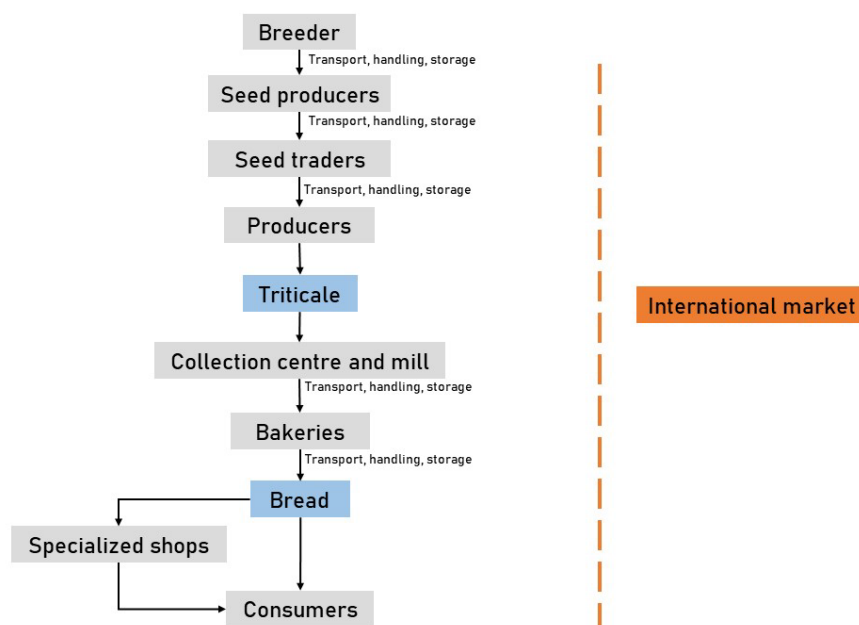


Figure 1. Triticale food value chain mapping.

In Switzerland, a large number of agricultural products including oats are subject to customs duties when imported at the border. This allows domestic producers to sell their products more expensively than in a market regime without tariffs. This agricultural protection benefits not only producers, but also those upstream and downstream of farmers (Christoffel & Leuenberger, 2016). For triticale, tariff protection is relevant for seed imports, food and feed imports. Please consult Annex A, BAZG (2022) and Ramseyer et al. (2021) for more information about tariff protection on triticale.

1.3.2 Input suppliers (Breeders, researchers, seed producers, seed traders)

The national research institute of agriculture (now Agroscope) was responsible for triticale breeding until the 2010s. However, the public breeding program stopped in the course of cost-cutting measures (BLW, 2016). A private biodynamic-organic breeder institution bought the genetic materials for a symbolic price. After this, the biodynamic-organic breeder institution pursued triticale breeding by using Swiss, Polish and German genetic resources. After about 9-12 years of breeding, they put a new variety on the market. This variety is destined for human consumption (mainly bread baking) and exhibits a lower yield level but higher protein content than Swiss triticale varieties used for feed production. In parallel, the triticale breeder was also involved in finding producers, collection centres, mills and bakeries through their network. Breeder's' motivation was mainly to give organic farms a robust alternative to wheat in marginal land and enhance biodiversity.

When the Tripanem variety was marketable, a biodynamic-organic seed producing and trading organisation, which works closely with the biodynamic-organic breeding institution, agreed to produce and sell triticale seeds. One seed producer produces each 3 years at once enough seeds for 3-4 years. The triticale is mostly sold as "food triticale", but it has been used for feed in mixture with e.g. peas, because of its good support function (as stake).

VC capacities and organization

Vertical linkage

There is a well established cooperation between the biodynamic-organic breeder institution and the biodynamic-organic seed company. Both actors were pioneers in the organic breeding and organic seed production.

Knowledge and technology of actors

The triticale variety results from crossing hard wheat with rye. Hard wheat does not contain the same gluten proteins than soft wheat used for bread baking. The missing gluten content for bread baking of the Swiss bread triticale variety is challenging bakeries (see part 1.3.6, Bakeries on baking challenges). One interviewee of the breeder institute mentions that they now want to focus more on finding about the importance of parameters like protein content, sedimentation value³ and falling number (also: Hagberg number), in order to meliorate baking properties.

Entry/exit barriers

One interviewee reported that handling more species translate into higher costs. As they have many niche crops, they need to raise the prices on all crops. However, selling niche crops is reportedly advantageous for them, since they can obtain new clients interested in niche crops. Necessary high seed prices might be an entry barrier for other seed traders, as they could lose clients who are not interested in organic niche crops but rather in buying cheap seeds.

One interviewee mentioned the need to test seed germination each year (out of the three-year seed stock for Tripanem). If germination is bad, they have to sell the seeds in lower quality (bread quality instead of seed), and as a result, they can make economic losses.

Resource and infrastructure

Inputs availability

Breeding material was acquired from the triticale breeding program of the Swiss national research institute for agriculture (ex-Agroscope). In addition, genetic resources from Poland and Germany are used. An interviewee reported that in Poland triticale bread was already consumed to some extent. Regarding seed production and trading, triticale seed availability is not problematic. One producer produces seeds for three years, which covers the demand for triticale.

Market conditions

Market size

The market size for bread triticale is small. This is linked to a low demand for triticale bread. In addition, the triticale bread variety is not on the Swiss variety list⁴, but registered as a niche variety, thus, its utilisation is restricted (see below “Regulatory and institutional environment”).

Framework conditions

Regulatory & institutional environment

Seed traders try to minimise the costs of seed certification, which is implemented per parcel and year. This is why a single producer produces triticale seeds on a single plot for three years. Certification costs are lower than if different producers produce triticale seeds each year on different parcels.

³ The sedimentation value according to Zeleny (Zeleny value) is a measure of the baking quality of a flour, based on the sedimentation degree of flour suspended in a lactic acid solution. Gluten quantity and quality are linked to slower sedimentation and higher Zeleny test values (Hruskova and Famera, 2003). One interviewee reported that wheat flour has a test value of at least 30 ml, whilst triticale flour test values range between 8 and 15 ml (for this triticale variety).

⁴ Swiss variety list exists for different crops (Agroscope 2022, Swissgratum 2022).

An important process for seed breeders is the registration of a variety. Variety registration is done in Switzerland but also in other countries in order to guarantee that good quality varieties are available. Having a variety registered on the variety list is ensuring its commercialisation for a seed breeder, because it serves as quality guarantee for producers, food industry and foreign seed importers as well, and hence the variety is demanded for cultivation.

Two tests are required for a variety to be registered on the variety list. The bread triticale variety could pass the DHS test⁵. However, the VAT-test⁶ was not successfully passed for the bread triticale. The most important characteristic for the triticale VAT-test is essentially the delivery of a very high yield. As bread triticale delivers low yields (but high protein content), the variety did not pass the triticale VAT-test. Thus, this means that the variety could not be on the triticale variety list and had to be registered as a "niche variety".

The consequences of this "niche variety" regulation are that the bread triticale variety cannot be exported and can be subject to a limit of hectare and quantity of seed used per year (WBF, 1998). This limit is calculated by taking the 0.1% of the total area cultivated with triticale registered varieties (BLW, 2010). Thus, in 2020, the area cultivated for the Tripanem variety should not have exceeded 10 hectares. If the niche registration can be seen as negatively, there is a justification for having the VAT test and the variety list. The justification is mainly guarantying high quality of the commercialised varieties, as mentioned previously. Hence, the interviewees generally perceive the registration as a niche variety as a positive thing for niche crops, as this classification still allows the use of alternative varieties. In fact, some interviewees mentioned that in other countries (at least in previous years) the regulation only allows the use of varieties listed on the national list, and that niche crops are not authorised for production.

However, interviewees felt that this regulation was a hindrance to the development of the triticale value chain for human consumption. The triticale variety is disadvantaged for VAT testing, by being an organic variety for human consumption. The VAT tests have been reported as using conventional farming standards to evaluate varieties, although this appears to be changing. In addition, the VAT test is done for triticale varieties used for animal feed; however, the bread triticale is destined to human consumption.

1.3.3 Producers

Whether triticale is used as for human consumption or as animal feed, has no influence on the cultivation of the crop. Hence, through cross-interviews, we could gather information about triticale cultivation. One bread triticale producer we interviewed cultivates this plant for its robustness, its benefits to the soil and crop rotation, and its lower fertilizer requirement than wheat. The producer supports diversity and has the interest to work with the breeding institute. In addition, the awns of the variety would protect against wild pigs and birds.

VC capacities and organization

Knowledge and technology of actors

One producer of triticale for food has knowledge from growing triticale for feed. In general, all interviewees reported that triticale is a very easy to grow, low-input crop. Hence, no special lack of knowledge or technical difficulties were reported regarding its cultivation.

⁵ The DHS test is the official examination of distinctness, homogeneity and stability (DHS) of a variety (BLW, 2017). Those three criteria must be met for a variety, in order to be officially accepted as new one.

⁶ The VAT test is the official test of suitability for cultivation and use and lasts two years (BLW, 2017). VAT stands (in French) for «Valeur Agronomique et Technique » (Agronomic and technical value).

However, two interviewees mentioned a potential problem with the ergot disease caused by the fungus *Claviceps purpurea*. This fungus is historically known to grow on rye and related cereals and cause health problem (ergotism) to humans when infected grains are eaten. Ergot disease would be no problem, if collection centres clean the harvested goods and handle it properly, according to one interviewee. However, this person did not recommend on-farm direct selling for producers, due to the health risks linked to the ergot disease and the potential insufficient handling. Another interviewee mentioned that the European Union amending regulation changed as of the beginning of 2022 with regard to maximum levels of ergot sclerotia and ergot alkaloids (European Commission, 2021).

Maximum levels were decreased, and will even further decrease as of 01.01.2024. New is the introduction of the maximum levels for ergot alkaloids. As noted in the amending regulation: *“this relationship [between the presence of ergot sclerotia and of ergot alkaloids] could not always be demonstrated at lower levels which indicates that the absence of sclerotia does not exclude the presence of ergot alkaloids. A reason is that the handling of cereals breaks the sclerotia, resulting in ergot dust, which is then adsorbed to the cereal grains”*. One conclusion of this statement is that *“It is therefore appropriate to lower the maximum level for ergot sclerotia and establish maximum levels for ergot alkaloids [..]”* (European Commission, 2021).

Interestingly, the annex of the amending regulation does not refer to triticale under the milling products (only rye, barely, wheat, spelt and oat). It can be expected that this regulation will be adopted in Switzerland.⁷ The regulation change might be problematic for use of triticale for human consumption, according to one interviewee.

Market conditions

Distribution channels

Interviewees mentioned the importance of having a contract with a bakery or a mill before seeding triticale. Purchase guarantee must be ensured, unless triticale would be sold as feed. One producer reported that the bread triticale could be delivered to a collection centre, which especially accepts low tonnages, in contrast with other bigger collection centres. This interviewee perceived that bigger collection centres would consider taking smaller quantities of niche crops as well. We are unsure about actual development and motivation of some collection centres to adapt and collect smaller quantities.

The producer mentioned that parameters like protein or hectoliterweight, which are very important for wheat in bread quality, were not as important as for triticale for bread baking. However, this producer reported a lower profitability due to lower price when compared to wheat or spelt.

1.3.4 Collection centre

Information was obtained from other actors in the value chain, as well as from other cross-interviewed collection centres. Triticale is delivered to a collection centre and is dried (if needed) and cleaned. Some collection centres and mills are vertically integrated; however, we treat them separately in this report.

VC capacities and organization

Entry barriers

There is actually no entry barrier for collection centres. The barrier to entry is the establishment of a logistics chain. Establishing the collection infrastructure for a new crop involves entry costs.

Besides higher costs linked to more species being taken (see also Volume and capacity of facilities below), another entry barrier could be the ergot disease. New European Union regulations on ergot alkaloids levels (see above: 1.3.3, Producers) would probably be adopted in Switzerland. Hence,

⁷ At the time of writing this report, Swiss ergot maximal levels corresponds to the future EU ergot sclerotia thresholds. Swiss regulation does currently not distinguish between ergot sclerotia maximal levels and ergot alkaloid levels, according to the Ordinance of the Federal Department of Home Affairs on maximum levels for contaminants (EDI, 2016).

collection centre might fear ergot alkaloids contamination in their collection centre or would need to handle it properly.

Resource and infrastructure

Volume & capacity of facilities

It was reported that collection centres have in general no interest in small tonnages, as it represents higher costs per unit. Depending on the collection centre, minimum quantities of 3-8 t are required to fill drying machines. With small batches, there is also a higher risk of mixing with other products during collection, storage and processing. This is not dramatic when working with large quantities, but when a small batch of bread triticale is mixed with larger batches of other crops, the triticale might be too “diluted” with the other crops. In addition, taking bread triticale would require separating it from feed triticale, raising transport, handling and storage costs. One interviewee mentioned perceiving a trend of big collection centres to accommodate smaller batches, which we could at the time of writing this report neither validate nor explain.

1.3.5 Mills

Information was provided by one mill and one bakery. The bakery is using a small milling machine for itself. Triticale after being cleaned is milled to flour. Stored at the mill, triticale flour can be delivered by the mill or be collected by bakeries.

VC capacities and organization

Vertical linkage

Some mills were functioning as collection centres and hence both stages of the value are vertically integrated.

Knowledge and technology of actors

The baker milling their own flour reported that their flour has a much finer texture. Finer texture means for them that more water can bind to the flour, enhancing bread quality and conservation (shelf-life).

Entry barriers

As for collection centres and producers, ergot disease (both sclerotia and alkaloids) could be challenging and represent an entry barrier for mills. It is possible to recognize and clean grains from ergot sclerotia, however, we remain unsure about ergot alkaloids testing. In addition, similar than for collection centres, more species taken increase handling and storage costs.

1.3.6 Bakeries

Bakeries are food processors and sellers. They sell bread to either end-consumers or clients like organic small shops and health food shops. The two interviewed bakeries had very different recipes. One was using a mixture of sourdough, red wheat and triticale flour. This bakery was not totally organic, hence did not market the bread under the organic label. The other bakery is certified organic and produces 100% triticale bread, using yeast and a scalded dough⁸. However, last year the triticale bread needed to be stretched with 20-33% of wheat, because of insufficient dough properties.

⁸ Scalding is procedure whereby flour is mixed with hot water and incorporated to the dough after a rest period. Different scalding techniques can be used depending on flour-water ratio, temperature, resting time, etc. (Ask et al. 1991).

VC capacities and organization

Vertical linkage

Both bakeries knew the producers and the mill delivering them the triticale flour. Communication between the mill and the producers was important as well for both.

Knowledge and technology

The bakers reported that triticale flour was very challenging to work with. However, both interviewees mentioned being pleased to work with a different flour and appreciate the personal challenge of bread recipe creation with triticale flour. One interviewee reported not knowing about the parameters such as protein content or falling number of the dough. The baker who needed to stretch triticale bread with wheat, had no explanation for the different flour quality of last year. The two bakers believed that no industrial bakery could handle triticale flour and dough. The reason for that is the stickiness of the dough, and its lack of wheat-like properties.

Entry barrier

The challenge linked to triticale flour handling and baking can be considered as an entry barrier. However, this entry barrier can serve as a protection from large competitors, allowing the possibility to successfully keep the niche.

Market conditions

Distribution channels

Clients such as organic small shops and health food shops were source of reliability for one bakery. Both bakers also sold directly to end consumers, through the bakery shop or through a local market stand. Proximity with clients was very important for promoting their innovative creations, and in particular explaining clients about triticale. One baker organises sourdough and bread baking workshops. These workshops were very helpful to inform consumers about sourdough and different flour types.

Products

As mentioned at the beginning of this part, bakers have different bread recipes to use the triticale flour. Triticale flour seems to work with both sourdough and yeast, and with scalded dough. It is possible to do 100% triticale bread, however, flour quality might have an influence on stretching necessity.

Demand

One baker had sales statistics of triticale bread and shared it with us. The baker mentioned that triticale bread quantities were sold in “waves” (in cycles), and rather increasing over time. However, the baker is of the opinion that the sales potential will soon be reached, since all their clients might now know about this bread. Only new clients would further increase sold quantities.

Marketing communication

Almost each value chain interviewee reported that the name “triticale” was very unfavourable regarding marketing potential. There are two reasons for this; people not familiar with agriculture would not know about triticale and people familiar with agriculture would associate it negatively with animal feed. The exception was one baker, who mentioned not experiencing negativity towards triticale, only ignorance. One interviewee thinks that the current trend regarding health perception of food is strongly linked to ancient diets. What is old, like ancient grains, would be healthier. However, triticale is not an old cereal but a new breed.

One baker wants to enhance transparency and market regionalism by showing clients the value chain behind the triticale bread. The idea is to add a QR-Code on the bread packaging. Clients could scan

the QR-code and see the people involved in producing, milling and baking the bread. Other aspects could be taken into account for the marketing, for example, agrobiodiversity benefits, the robustness of the triticale, reducing plant protection product and fertilization needs.

Two other important aspects regarding the marketing of the triticale bread is its special taste and long shelf life. Triticale bread has a reported “nutty, triticale taste”, that is not just equal to a mix of rye and wheat flour. In addition, triticale bread would have a long shelf life.

Framework conditions

Certification

One baker was certified organic, which is a big advantage according to them. Because of this certification, they can market their bread through organic small shop and healthy food shops. The clients of these shops are both more sceptical about standard products and more open to new products, and they show a higher willingness to pay. This would be a chance for special products like the triticale bread.

1.4 Discussion

The cultivation of triticale for baking bread is still very restricted to few actors. However, the entire value chain stage seems to be resilient, as the bakeries seem to show stable interest for triticale. The quantity produced is very low; this could mainly be attributed to the low demand of consumers and the low interest of other bakeries. In the next sections, we will discuss past and current challenges/opportunities linked to the bread triticale value chain. A summary table of challenges and opportunities can be found in table 2.

1.4.1 Past challenges & successes of the value chains

Breeding variety

The breeding of a bread triticale, usable for baking bread, is of course the mandatory success for the value chain creation. In addition, the breed is usable for the feed sector and reported as good in mixture with peas, making it a polyvalent variety. The triticale breeder achieved their goal of establishing a variety for bread baking in the market. Even though the market penetration is still limited, this can be considered a success. Although the variety did not pass the VAT-test, it was able to pass the DHS-test and is now registered as a niche variety, which allows its marketing with certain restrictions.

Finding actors

Creating a breed designed for new utilisation is unfruitful without finding value chain actors interested in testing and producing the need crop. This was, in our opinion, successfully done by the former triticale breeder, which could find different partners from different stages of the value chain interested in bread triticale. Strong connections are important to create a certain value chain resilience; however, it seems that low demand is threatening the potential of the bread triticale. We had the impression that motivation of food value chain actors (mostly breeders and producers) was not at its highest level, whilst bakers were very pleased to work with triticale. However, as one interviewee of the breeding institute mentioned, any piece of biodiversity is important to conserve. In the next section, we will discuss the current and future identified challenges and opportunities.

Table 2. Summary of the challenges, strategies and potential benefits for each value chain actor.

VC actor	Main challenges/ opportunities (order: most important first)	Strategies undertaken/ to be undertaken	Potential & benefits for the actor in the VC chain
Input suppliers (Breeders, researchers, seed producers, seed traders)	<ul style="list-style-type: none"> Improve quality traits of variety with regard to baking properties Bring variety on the triticale list (no niche variety anymore) 	<ul style="list-style-type: none"> Continue breeding and test properties Take (politic) action 	<ul style="list-style-type: none"> More interesting breed for industrial or “less artisanal” bakeries Higher visibility of the breed (if on variety list) No export or surface restriction anymore
Producers	<ul style="list-style-type: none"> Prices could be increased (comparable to wheat and spelt) Ergot disease Low input, robust crop 	<ul style="list-style-type: none"> Try negotiations with value chain actors Increase proper on-farm practices to decrease ergot disease Lobby for triticale (e.g. producer group, syndicate) 	<ul style="list-style-type: none"> Higher profitability No deductions due to ergot disease Yield stability
Collection centres and mills	<ul style="list-style-type: none"> Small quantities Ergot alkaloids handling and measuring (New EU-regulation) 	<ul style="list-style-type: none"> Work horizontally or vertically to obtain higher tonnages Invest in small batches-adapted machines and infrastructures Establish procedures to test for and separate ergot <u>alkaloids</u> 	<ul style="list-style-type: none"> Niche culture to attract new clients
Bakeries	<ul style="list-style-type: none"> Triticale marketing Dough complexity 	<ul style="list-style-type: none"> Inform clients about triticale Baking and experimenting with triticale Information exchange (networking) 	<ul style="list-style-type: none"> Attract clients by offering a wide range of breads Image: triticale as sustainable crop Pioneer reconnaissance

1.4.2 Current and foreseen challenges and chances of the value chains

Collection centres: infrastructure

As for niche crops in general, collection centre are reluctant to enlarge the spectrum of species they collect. Reasons are obvious: more species are linked to higher transaction required more separated storage facilities. In addition, niche species usually come in smaller batches, which sometimes machine cannot handle, like the drying machines, which require higher volumes. In turn, this results in increased storage and transaction costs per unit.

One producer reported a general trend towards niche crops and adaptation to small batches by some collection centres; however, this trend remains unclear to us. Since our case study approach did not allow getting an overview of Swiss collection centres⁹, we could not verify this trend and understand the motivations behind it.

Seed regulation

One important challenge regarding the potential upscaling of this value chain is the restriction linked to the variety being registered as a niche variety and not as a “regular variety”. As we reported in the results, this is the consequence of the VAT-test, which favours high-yield triticale breeds. Conventional standards, in addition, would be used to determine agronomic and technical value of the tested variety. However, interviewees reported that variety testing is becoming more “organic-inclusive” and that criteria for judging varieties are adapting towards organic and/or extensive levels.

⁹ One interviewee estimated the number of collection centers in Switzerland at around 210.

Still, if the most important parameter for triticale remains the yield, yield standards of the bread triticale variety will perhaps not be decisive for the bread triticale to pass the VAT, even with organic standards as criteria. In line with some interviewees, the creation of a new “type” of triticale, like food triticale or bread triticale, with different important parameters for the VAT-test, could be a solution for its registration as a listed variety. Protein or bread triticale will probably not be in competition with feed triticale varieties, rather with wheat cultivated on marginal surfaces. Hence, the first objective of this bread triticale, which is to replace wheat on marginal surfaces, in order to have higher quality and yields of bread triticale than wheat of a lower quality, could be achieved. Wheat varieties would not be threatened, as they would still be cultivated on adapted surfaces (not marginal).

Ergot disease and new European Union regulation

The changing in the regulation of the ergot sclerotia will not affect Switzerland. However, the new EU-requirement to test for ergot alkaloids and respect a maximal level could become challenging for triticale food production and processing (European Commission, 2021). According to European Commission, there is the need to test for ergot alkaloids, as ergot sclerotia levels do not correlate with ergot alkaloids levels at low sclerotia levels.

We make here the probable assumption that Switzerland will adopt this new regulation. We are unsure about testing possibilities and consequences for Switzerland in general. The article of Lattanzio et al. (2021) reports about this new regulatory challenge for monitoring ergot alkaloids in Italian food commodities. Authors state for example that “*due to analytical challenges in the EAs [ergot alkaloids] determination, the occurrence of data available in the literature are scarce and provide a limited picture of EAs distribution worldwide.*” Whether there might be new analytical challenges in Switzerland is still unclear to us; however, we expect that this might represent an entry barrier for collection centres and food processors.

Baking challenges

Bakers and other value chain actors reported difficulties regarding the production of triticale bread. The reason for this is mainly the lack of certain gluten proteins linked to good baking quality and the “stickiness” of the dough. However, triticale bread is not comparable to a bread based on a mix of rye and wheat flour; a bread from triticale rather has a unique triticale-typical and nutty taste, not just a mix of rye and wheat. The bakers mentioned that a lot of knowledge and experience is required, and that industrial baking would be impossible with triticale flour. The complexity linked to triticale bread production is thus another barrier for upscaling the production. However, breeders are aware of this challenge and reflecting about the breeding direction.

There is the need to think about the goals that should be achieved for the bread triticale, for example if industrial use should be targeted. The possibility of using triticale in industrial baking, together with a higher demand for triticale bread thanks to a higher-scale marketing, would help for enhancing agrobiodiversity, as triticale would be cultivated on more surfaces and be more consumed. However, first, the variety should be on the variety list of triticale and not be registered as niche variety (See above “Seed regulation”). Then, “artisanal” bakeries might have the interest to sell a special niche product with bread triticale. If industrial bakeries start to sell triticale bread in large supermarkets, clients of artisanal bakeries might not find any interest in special triticale bread. Currently, the demand for triticale bread is still low, so it remains unclear how the triticale bread value chain will evolve.

Sales opportunities, promotion and marketing

Consumer demand for triticale bread was reported low in the bakeries interviewed, and one bakery reported a potential saturation of triticale bread sales. Reasons for the low demand are numerous. The first reason is that the visibility is very low, because triticale is not a very much known grain. In addition, the trend regarding cereals and bread would be the return to “ancient grains”. Triticale, as a “recently”

bred crop in the human history, does not fall into the “ancient grain” category. For people with a background in agriculture, triticale would be directly (and negatively) associated with feed, decreasing the interest for this bread. People unfamiliar with agriculture might just not know about triticale. The resulting low demand could explain the reported lower profitability of triticale when compared to spelt and wheat.

However, marketing opportunities are great. The bakeries could use ecological benefits of triticale compared to wheat for promoting triticale to their clients. Environmentally aware clients could find personal satisfaction in knowing that triticale is robust crop, which allows farmers reducing plant protection products and fertilizers and whose cultivation copes well with climatic changes. In addition, taste was reported as nutty and triticale-typical, and not as a simple mix between rye and wheat. The long shelf-life could be another marketing argument for consumers, since bread is very often thrown away because it too dry or too moist.

We recommend choosing the name of the bread made with triticale carefully, in order to address negative views regarding feed usage, and address lack of knowledge of clients. In addition, if the bread can be guaranteed as being organically made, the certification should be promoted as well.

1.4.3 Limitations

Through the interviews realised we believe that we could obtain a quite good picture of the opportunities and challenges linked to the triticale bread value chain. However, breeders were still uncertain about the direction to give for the bread triticale breeding and the value chain development. Consequently, it is difficult to assess its future development. In addition, we did not interview a collection centre and a mill that were especially taking triticale for this value chain, but did cross-interviews. We did not always get an answer for our interviewee requests regarding these value chain stages.

The statement of one interviewee that collection centres are starting to consider collecting niche crops (and becoming specialised in handling smaller batches) could not have been validated. Hence, we suggest further research about the structural change of collection centres, in order to capture this trend (or not). Besides this, we suggest to do more research about whether the new EU regulation on ergot disease might bring new analytical challenges in Switzerland. In addition, if it is indeed an analytical challenge, to what extent it could represent an entry barrier for producers, collection centres and/or food processors.

1.5 Synthesis

Triticale is a robust crop that provides benefits to the producers for its low-input and carefree cultivation. Triticale bread is a unique bread that provides a triticale-like, nutty taste and a long shelf life to clients and is not just a mix of rye and wheat. For this value chain, we consider as past successes the creation of a bread triticale adapted for (still challenging) bread baking as well as the creation of a network and value chain through the former breeder of the biodynamic-organic breeding institute.

Regarding the current situation, we consider the niche variety registration, new regulations regarding ergot alkaloids, the low volumes (small batches) for collection centres and mills, the complex baking process and the marketing issues regarding the name “triticale” as major challenges of the value chain. Upscaling this value chain, if targeted, will perhaps require the breeding of triticale even more adapted for bread baking for non-artisanal bakeries, the acceptance of the bread triticale on the variety list (political actions might be required), the handling of ergot alkaloids, and a consistent marketing towards triticale benefits and triticale bread characteristics like taste and shelf-life. Enhancing consumer demand might require very well targeted marketing plans. Enhancing offer might as well prove challenging, if other bakeries do not show any interest in triticale flour. Convincing producers would not be the most difficult

part, as triticale cultivation is not new to the upstream sector. Higher profitability is mandatory to be attractive to them and should be comparable to wheat or spelt.

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Annexe

Annex A. Overview of some normal tariff protections (duty rates) on tritcale (Number 1008.60XX) and for different usages. Retrieved 17.06.2022

Usage	Tariff protection in CHF per 100 kg
Seed	57.00 ^a
For the manufacture brewers' malt or beer	28.35 ^b
Other, for human consumption within the tariff quota (N°27)	1.60 ^{a c}
Other, for human consumption, other	40.00 ^a
Triticale flour, for human consumption	27.50
Other, for animal feeding, containing other cereals of chapter 10	Import benchmark ^{a d}
Other, for animal feed, other	Import benchmark ^{a d}

From BAZG (2022), retrieved on 17.06.2022. ^a Tariff of 0.00 for "Least developed countries" and Lesotho. ^b Tariff of 0.00 for "Least developed countries", China and Lesotho. ^c depends on the quota. ^d The import benchmark is 38 CHF per 100 kg since 2009 to 2021 (Swissgranum, 2021).