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Harvesting an experiment: observations of bushy landrace winter rye in a small scale experimental slash-and-burn field in Estonia

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INTRODUCTION

As a part of agricultural history and biodiversity protection, conservation of locally adapted crops is currently of great interest in the world. Landrace is a common term that denotes locally cultivated germplasm that has become adapted to a local environment. According to V. Negri (Negri *et al.* 2009), 'A landrace of a seed-propagated crop is a variable population, which is identifiable and usually has a local name. It lacks "formal" crop improvement, it is characterized by a specific adaptation to the environmental conditions of the area of cultivation (tolerant to the biotic and abiotic stresses of that area) and is closely associated with the uses, knowledge, habits, dialects, and celebrations of the people who developed and continue to grow it.' Landraces of cereals, and winter rye as one of them, have also attracted increasing attention.

In northeast Europe winter rye has been cultivated in manured permanent fields as well as shifting slash-and-burn fields. A number of experimental slash-and-burn archaeology projects have been carried out since the 1950s in Europe with the aim to broaden our knowledge on prehistoric agriculture (e.g. Iversen 1956; Reynolds 1977; Steensberg 1979; Engelmark 1995; Soto *et al.* 1995; Tvengsberg 1995; Meldgaard & Rasmussen 1996; Rösch *et al.* 2002; Eckmeier *et al.* 2007). In Estonia, the first experimental slash-and-burn field was made by Tanel Moora in 1969 (Moora 1971). In most cases barley and wheat have been used in these experiments because interest has focused on Neolithic land-use phases when barley and wheat were the main crops cultivated.

Being presumably one of the oldest land-use methods, slash-and-burn cultivation still played an important role in grain growing during Early Modern Age in Scandinavia (Ekengren 2013),

but also in northwest Russia (Vinokurova 2003; Klementjev 2003) and Estonia. Although not widespread, this land-use technology survived up to the early 20th century in east and south-east Estonia. Detailed research on the persistence and decline of slash-and-burn agriculture in Estonia is discussed in Jääts *et al*. 2010; 2011.

Mainly winter rye and barley were grown in the slash-and-burn fields of the region (EA 1: 551; EA 22: 144–155; EA 32). According to ethnographic sources there was a special landrace of winter rye grown on the slash-and-burn fields that differed from the one grown on the permanent fields (Manninen 1922; Vilkuna 1956, cited in Ligi 1963, 60). Together with the termination of slash-and-burn cultivation this landrace was probably lost in Estonia.

In 2006–2007 a small-scale experiment for investigating the landrace of burnt-land winter rye was carried out near Tartu in south Estonia. The experiment was inspired by a visit to Finland, where research and a number of educational programmes have focused on growing landrace winter rye during the last decade (e.g. at Mustiala, Häme University of Applied Sciences (HAMK) in 2005–2006 and 2006–2007 (A. Michelson 2015, pers. comm., 13.03.) and Koli National Park (Lovén & Äänismaa 2006)). The seeds used in the experiment were obtained from the Telkkämäki slash-and-burn heritage farm in Finland. In this paper we present the results of the experiment with the aim to widen the knowledge on the former land-use technique(s) and winter rye landrace(s).

HISTORICAL BACKGROUND OF WINTER RYE IN ESTONIA

According to pollen data of Estonia, rye is recorded in fossil sediments from 500 BC onwards, though it probably spread as a weed in other crops. The cultivation of rye may have started around AD 500–600 (Poska *et al*. 2004). Archaeobotanical analyses of burnt deposits dated to 11th century from Soontagana hill fort present charred rye grains and rye brome – weed in fields of winter sown cereals (Lepajõe 1982). By the early 13th century winter rye had become the most important cereal crop grown in the area.

Winter rye was widely grown because it produced the most stable crop and endured the climatic conditions better than other cereals. In 1914, J. Hünerson states that rye accepts the harsh growing conditions of the northern climate (Hünerson 1914). Indeed, rye does not need much warmth: the seeds germinate at 1...2 °C, the optimal temperature being 6...12 °C and rye plants are able to survive temperature -25 °C or lower. Rye also has deep and extensive roots; therefore it is less demanding of water and nutrition than other cereals and can grow in poor and sandy soils. In addition to that, rye tolerates higher levels of soil pH (Tuppits 1981; Lepajõe 1982). Rye showed its reliability in the slash-and-burn fields as well – e.g. if the burning had been less successful it was recommended not to sow barley, but rye or buckwheat instead (Öpik 1992, 340; Ligi 1963, 117).

Historically rye cultivation was supported by economic factors, namely the growing grain trade during the 13th – 16th centuries between Eastern and Western Europe (Hybel 2002). Winter rye remained the main export article for the present Estonian territory from the early 13th up to the 18th centuries (Kivimäe 1992; Kahk 1958).

What is known about the grain landraces of northeast Europe, is rather limited and dates back to the 17th – early 18th centuries. Sources of this period make a distinction between the usual rye and a bushy type of rye which produced high yields (Öpik 1992, 336). According to Finnish ethnologists there was a special landrace of burnt-land rye characterized by exceptionally numerous stems – one plant could produce up to 30–40 of them (Manninen 1922).

K. Vilkuna (1956, cited in Ligi 1963, 60) states that in eastern Finland and Karelia a specific rye was sown in the slash-and-burn plots in old-growth forests, which had finer grain than the usual rye and which produced 40 or even up to 80–90 ears of one seed. I. Talve (1979) refers that in eastern Finland the productivity of rye grown in slash-and-burn fields in coniferous forests (*huuhta*) was 20-fold, even 30–40-fold and in deciduous secondary forests *ca*. 12–13-fold. Harvest was reportedly 20–40-fold in Novgorod oblast, while a well fertilised permanent field could produce 5–6-fold yield (Gromov 1958). As a comparison, at the time prior to agricultural modernisation in the mid-18th century the yields of a permanent manured field were 4-fold in Estonia (Ligi 1963, 59). The average productivity of the slash-and-burn fields was reportedly 10–20 seeds (Ligi 1963, 58). The yield was that high only during the first year of cultivation though. The crop from the second and the third year was much lower, closer to the productivity of the permanent arable fields.

In the 19th century the terms *suured rukkid* (Eng. the large/great rye), *rootsi rukkid* (Swedish rye), *võsu rukkid* (bush rye) were used in Estonian vernacular to distinguish the bushy rye from the usual one (Wiedemann 1923). This information is supported by ethnographic surveys from the early 20th century Estonia, '[On the burnt land] rye was sown thinly. You couldn't sow densely because it grows into a large bush. It grew big bushes, even 70–80 stems of one seed'. (EA 22, 367)[1]; 'In autumn it started to form a bush. You sow the slash-and-burn rye thinly, just throw a few seeds, because it grows so well and has so many stems that it will fill the space anyway.' (EA 22, 637). The general rule was to sow seeds in the burnt land up to twice as thinly as in the permanent fields (Ligi 1963, 59).

A grain growing handbook dating from 1926 (Liidemann & Rootsi 1926, 67) refers to the bushy winter rye varieties grown in northern Russia, Finland, Scandinavia and Estonia as the most primitive local landrace grain, distinctive for its abundant stems. Bushy rye is mentioned in connection to historical slash-and-burn fields, but also with newly ploughed fallow. The handbook describes bushy rye having numerous but quite weak stems, hardy, and with seeds ripening late and unevenly. It is also mentioned that the plants grow many stems only if the seed is sown early and thinly. The handbook emphasizes diversity of the local landrace rye, a consequence of adapting to particular growing conditions.

The above-mentioned handbook, but also another one from 1928 (Rootsi 1928) refers to yet another variety of bushy winter rye – *jaanirukis* [St John's Day rye or midsummer rye]. According to K. Liidemann & N. Rootsi (1926, 68), it is one of the bushy rye varieties grown in Estonia to some extent, N. Rootsi (1928, 32–33) seems to imply that midsummer rye was the only bushy rye grown at that time, 'A distinction is made between bushy rye and the usual rye. Of the bushy varieties midsummer rye is cultivated here. Sown around St John's Day it produces abundant fodder in the autumn and an average grain crop next year. If sown thinly around St John's Day it grows many stems, a single plant may grow up to 40 stems. If sown later it resembles more the usual rye plant'. The latest information on midsummer rye dates from the late 1930s and 1940s when it was mentioned as potential fodder crop (Järva Teataja 1938; 1939; 1940; Virumaa Teataja 1944).

From the early 19th century, the manors in Estonia started to cultivate foreign landraces introduced from aboard and since mid-19th century imported formally bred rye varieties while the farms still continued to cultivate local landraces (Ratt 1985, 205–206). However, those landraces could only survive in remote areas because rye is a wind-pollinator, i.e.

[1] Translations of the archive material into English by the authors.

pollen exchange between different varieties happens easily. In the 1920s, a local variety called 'Sangaste' started to spread and in the late 1950s and early 1960s it covered 97–98% of the winter rye cultivation terrain (Tuppits 1981).

The situation was different in Finland, where according to Paatela (1953, cited in Ahokas 2009) and Valle (1958, cited in Ahokas 2009) landrace rye made up 26.5% of all rye cultivated in 1950 and 18% in 1955. Nowadays the conservation of locally adapted crops is of great national interest in Finland, therefore landraces of cereals are still cultivated to some extent. The statistics from 2006 shows that there were 13 farmers cultivating landraces of winter rye and two farmers growing old cultivars of it in their farms (State ... 2008). One example of such conservation work is Telkkämäki Nature Reserve, a heritage farm in North Savo Kaavi municipality, Finland (http://www.luontoon.fi/telkkamaki). Slash-and-burn agriculture played an important part in why this region has been permanently settled from the beginning of the 15th century. The last time slash-and-burn technique was used at Telkkämäki in the course of traditional farming practices was in the 1930s, but the Finnish state-run enterprise Metsähallitus (Eng. Administration of Forests) has practiced traditional slash-and-burn agriculture there again from 1993. The rye cultivated in Telkkämäki originates in North Savo area and it is preserved in the Nordic Genetic Resource Center (http://www.nordgen.org/index.php/en/content/view/full/2).

THE EXPERIMENT

A small-scale experiment with the landrace winter rye, obtained from the above-mentioned Telkkämäki heritage farm was conducted in 2006 near Tartu in south Estonia. The experimental plot was prepared in the area of clayey soil, which had been in fallow with perennial grasses for at least 8 years. The burnt timber used in the experiment was brought to the site from elsewhere and belonged to deciduous trees, mainly aspen.

The seeds were planted one by one straight into ashes on 25 August 2006, to the depth of *ca*. 1 cm, and about 30 cm apart. Afterwards the burnt-land bed of 1.5 × 3 m was raked slightly. There was rain immediately after sowing. The seeds germinated in a week's time and before the frosts the bushes were formed (Fig. 1).

Fig. 1. *Bushes of burnt-land winter rye in March 2007, after snow had melted.*
Jn 1. *Alerukki puhmad pärast lume sulamist 2007. aasta märtsis.*
Photo / Foto: Kersti Kihno

The crop was harvested on 5 July 2007. The experiment produced 28 plants with stems (including ears) of 130–150 cm height. The ears were 14–17 cm long. All the plants were uprooted and stems higher than 30 cm were counted. 1134 stems had ripe ears, 71 had unripe ears and 40 stems had broken stems with no ears. On the average there were 43 stems with ears per plant, 40.5 of them ripe (Fig. 2).

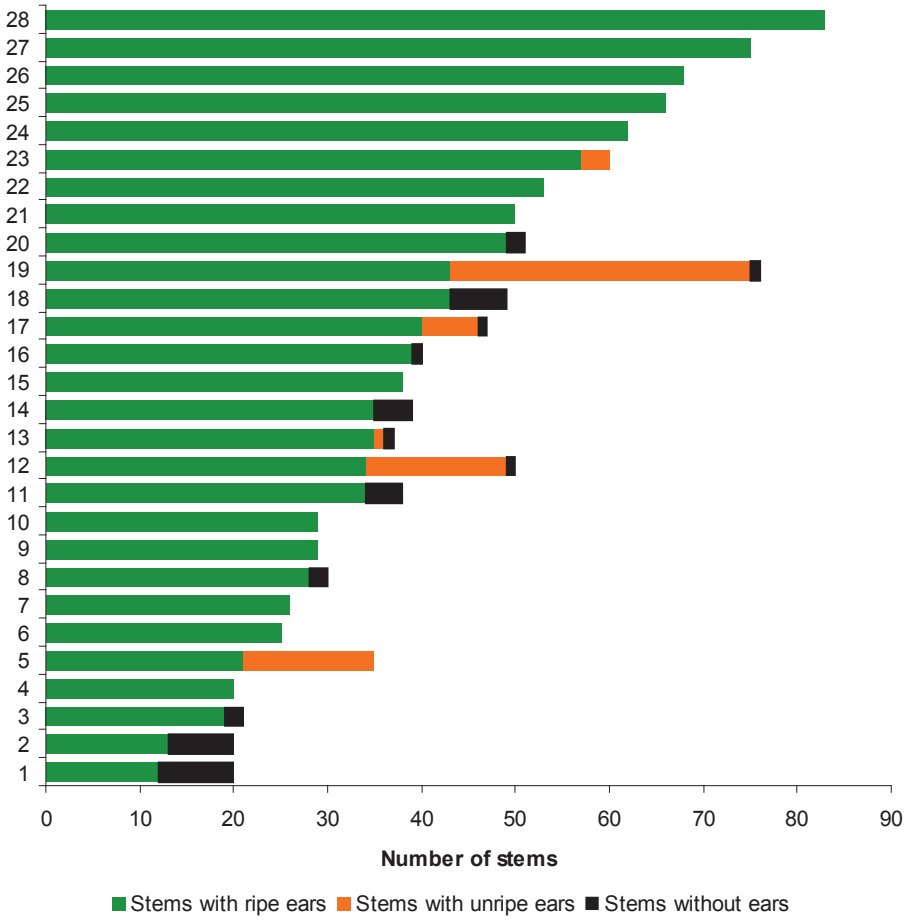

Fig. 2. *Plants of winter rye in the slash-and-burn experiment.*
Jn 2. *Eksperimentaalpõllul kasvanud talirukki taimed.*
Drawing / Joonis: Vivika Väli

The crop was threshed on 15 October 2007, excluding 2 plants (with 120 ears in total) for a forthcoming exhibition (Fig. 3). The total weight of the harvest was 1294.5 g. The weight of 1000 kernels (TKW) was 32.5 g. Computationally the crop per 26 plants was 1294.5 × 1000 : 32.5 = 39831 kernels. The calculated result of kernels per one ear was 39.3. On the average one plant had 40.5 ripe ears, and the average number of kernels per ear was 39.3, thus summing up to 1592 kernels per plant.

Fig. 3. *The uprooted specimens in October 2007.*
Jn 3. *Ülesjuuritud taimed 2007. aasta oktoobris.*
Photo / Foto: Mati Laane

DISCUSSION

The productivity of our small-scale slash-and-burn field cannot probably be directly extrapolated to the conditions of larger-scale fields, although the results of the experiment are supported by other similar investigations. For example, trial growing of at least 130 years old rye kernels discovered in an old threshing barn in Norway in 1973, produced 7 plants, the biggest with 162 ears, each containing on average 75 grains (Tvengsberg 1995). These 7 plants gave rise to Norway's first officially approved (in 2012) conservation variety 'Svedjerug Tvengsberg' (Valand 2014).

In the case of slash-and-burn cultivation, an even quality of burning process is required all over the field area because only a certain amount of burned material and intensity of fire can guarantee sufficient available nutrients for excellent growth of plants. In our experiment the amount of available nutrients was probably several times higher than in historical slash-and-burn fields due to abundant ash, thus the results illustrate more the possibilities of growing the burnt-land rye in horticulture. The experiments in Umeå, Sweden have demonstrated that there were no differences in results depending on land preparation methods (from raking to ploughing), but the variations in burning conditions in larger-scale fields were big enough to reduce the gross harvest of grain (Engelmark 1995). In the case of ideal burning, the yields can be higher than the average. Nevertheless, historically the fluctuations in productivity have been very big both in permanent and slash-and-burn fields, although slightly bigger in the latter. Ethnographic data from south Estonia (Helme parish) illustrates this as follows, 'A good harvest from a slash-and-burn field could produce 15 seeds, a low harvest 2–3 seeds and sometimes it happened that you got nothing' (EA 22, 141–155). Reportedly, during the 18th century there were more years with less-than-average harvest than those above average (Manninen 1922). In addition to most common factors that could damage the growing crop both on slash-and-burn as well as manured fields, slash-and-burn fields had a specific problem – if the summer was rainy, the field could not be burnt and consequently the grain could not be sown in the first place (Manninen 1922). However, an official of the Livonian government Bruiningk claimed in the 1840s (cited in Kahk 1992, 366) that the slash-and-burn fields produce an important part of the peasants' food supplies, which support the whole economy during the years of famine.

Based on historical and ethnographic data we know that bushy landrace of winter rye was grown in Estonian slash-and-burn fields from the 17th century onwards. The results of the experiment confirm the description of the landrace in historical sources: numerous stems and high productivity under favourable conditions. Although the results of this small-scale experiment cannot be taken as a full model for proper slash-and-burn fields it gives us more empirical evidence on a historical winter rye which has received undeservedly little attention in Estonian context.

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PUHMASRUKIS JA SELLE SAAGIKUS VÄIKESEMÕÕTMELISE ALEPÕLLU EKSPERIMENDI NÄITEL

Kersti Kihno, Liisi Jääts ja Mati Laane

Kohalike maasortide uurimine on elurikkuse säilitamise ja agraarajaloo kontekstis praegu maailmas populaarne teema. V. Negri määratluse järgi on seemnetega paljuneva põllukultuuri maasort varieeruv populatsioon, st maasordi üksikud taimed erinevad üksteisest rohkem kui tänapäevaste aretussortide puhul harjunud oleme, samas võimaldab hulk ühisjooni seda piiritleda ühtse sordina. Maasorti ei ole tänapäevases mõistes sihipäraselt aretatud, vaid see on kohastunud piirkondlike keskkonnatingimustega. Maasordi puhul peetakse oluliseks, mil viisil on taime traditsiooniliselt kasvatatud, millised on kohalike elanike teadmised ja tavad selle taimega seoses, milline on tema kohalik nimetus jms. Käesolev artikkel annab ülevaate, mida on teada talirukki puhmasjatest maasortidest ning käsitleb täpsemalt eksperimenti, kus puhmasrukist kasvatati väiksemõõtmelisel alepõllul.

Soo- ja järvesetete õietolmuanalüüsi alusel võib väita, et kuigi rukki õietolmu leidub juba 500 aastat eKr ladestunud setetes, sai rukkikasvatus Eestis alguse siiski tuhatkond aastat hiljem. Arheoloogilised andmed talirukki kasvatamisest pärinevad 11. sajandist Soontagana maalinnast leitud söestunud rukkiterade kihist, mis sisaldas mh rukkiluste seemneid. Talirukis kujunes 13. saj alguseks Eesti ala tähtsaimaks toiduteraviljaks ning oli 13.–18. sajandini ka peamine ekspordiartikkel.

Info Eestis ajalooliselt kasvatatud rukkisortidest pärineb 17.–18. sajandist. Teada on, et rukist kasvatati nii põlispõllul kui ka alemaal. Alepõllul kasvatatud puhmasrukis andis suuri saake, kuid oli nõudlik maa viljakuse suhtes. Soome etnoloogide andmetel andis üks alerukki taim 30–40, isegi 80–90 kõrt. Ida-Soomes võis suurale (sm k *huuhta*) puhul saagikus olla väidetavalt 20–40 seemet; võsaale puhul 12–13 seemet. Eestis oli alepõllu keskmine saagikus Niedenburgi Hermanni järgi 10–20, Hupeli järgi 9–12 seemet, põlispõllult saadi 19. saj keskpaigani vaid 4 seemet. Kõrgeid saake saadi alepõllult vaid esimesel aastal, teise ja kolmanda aasta saak oli märgatavalt madalam.

Puhmasrukki maasordid ei ole Eestis teadaolevalt tänapäevani säilinud. Puhmasrukkile viitavad 19. sajandil käibel olnud nimetused: *suured rukkid*, *rootsi rukkid*, *võsu rukkid*, samuti 20. saj alguses kogutud pärimus.

Viimased hajusad andmed puhmasrukki kasvatamisest Eestis pärinevad 1940. aastatest. 1920. aastatel hakkas levima kohalik aretussort "Sangaste", mis 1950. aastate lõpus ja 1960. aastate alguses hõivas 97–98% talirukki kasvualast. 2006. aastal Tartumaal Nõo vallas läbi viidud aleeksperimendiks saime puhmasrukki seemne Soomes Põhja-Savos asuvast Telkkämäki talumuuseumist. 1,5 × 3 m suurune aleplats valmistati ette vähemalt 8 aastat söötis seisnud heinamaal, põletades seal mujalt toodud haavapuitu. 25. augustil 2006. a umbes 30 cm-ste vahedega 1 cm sügavusele külvatud rukkiteradest tärkasid taimed nädala pärast. Enne külmade tulekut olid moodustunud korralikud puhmad, mis talvitusid hästi (jn 1). Järgmisel suvel, 5. juulil 2007. a juuriti 28 rukkipuhmast üles ja loeti üle kõik vähemalt 30 cm kõrguseks kasvanud kõrred. Keskmiselt saadi taime kohta 43 kõrt, neist 40,5 küpsete viljapeadega (jn 2). Vili peksti 25. oktoobril 2007, jättes alles 2 näidiseksemplari kokku 120 viljapeaga (jn 3). Kogusaak oli 1294,5 g; 1000 tera mass 32,5 g. Arvutuslikult saadi 26 taime kohta kokku 39831 viljatera, ühe taime kohta keskmiselt 1592 tera.

Selle väikese katselapi produktiivsus oli rohke põletusmaterjali tõttu ilmselt oluliselt suurem kui minevikus tavaline. Alepõllu saagikuse kõikuvus oli suur, 20. saj alguse andmetel 2–3 kuni 15 seemet, vahel võis saak täiesti nurjuda. Üks ale spetsiifilisi probleeme oli vihmane ilm, mille tõttu ei saanud aleladet põletada ja vili jäi maha külvamata.

Tuginedes ajaloo ja etnograafia andmetele teame, et puhmasrukist on Eesti alal kasvatatud vähemalt 17. sajandist peale. Eksperimendi tulemused kinnitasid ajalooallikates olevaid kirjeldusi – soodsates tingimustes kasvatab puhmasrukis arvukalt kõrsi ja on väga saagikas. Kuigi selle väiksemõõtmelise eksperimendi tulemusi ei saa päriselt käsitleda kui suure alepõllu täpset mudelit, annab see siiski empiirilist materjali talirukki maasordi kohta, mis on saanud teenimatult vähe tähelepanu.