

# The importance of local oat populations with a wide variety of phenotypic traits in relation to breeding process



Przydatność dla hodowli miejscowych populacji owsa siewnego o wysokim różnicowaniu cech fenotypowych

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Collecting missions are among the most important sources of collecting materials at the National Center for Plant Genetic Resources (KCRZG). The choice of Lithuania as a place to search for genetic resources was associated with historical relations with Poland. In the years 2011 – 2013 three collecting missions took place, collecting 32 accessions of *Avena sativa* L. with passport data. Collected samples were sown on 2.5 m<sup>2</sup> plots at Radzików IHAR in 2012, 2013, 2014. 600 seeds were manually sown on each plot. During observations, plant lodging and emerging diseases were noted, and thousand grain weight and yield was calculated. For most accessions, panicles appeared later than in reference varieties. Local objects in this category were higher than the reference objects and had a low lodging degree. Local oat can be a source of individual, unique traits for breeding.

**Słowa kluczowe:** owies, ekspedycje, zasoby genowe

Wyjazdy kolekcyjne są jednym z ważniejszych źródeł pozyskiwania materiałów w Krajowym Centrum Roślinnych Zasobów Genowych (KCRZG). Wybór Litwy jako obszaru poszukiwań zasobów genowych był związany z historycznymi relacjami z Polską. W latach 2011 – 2013 przeprowadzono trzy ekspedycje, podczas których zebrano 32 obiekty *Avena sativa* L. wraz z danymi paszportowymi. Zebrane próbki zostały wysiane na 2,5 m<sup>2</sup> poletkach Instytutu Hodowli i Aklimatyzacji Roślin (IHAR-PIB) w Radzikowie w latach 2012, 2013, 2014. Na każdym poletku, ręcznie wysiano 600 nasion. Odnotowywano stan wylegania roślin, pojawiające się choroby, wyliczono masę tysiąca ziaren oraz plon. U większości obiektów wiechowanie występowało później niż u odmian wzorcowych. Lokalne obiekty odmian owsa były wyższe od wzorcowych obiektów a mimo to odznaczały się niskim stopniem wylegania. Lokalne odmiany owsa mogą stanowić źródło pojedynczych, unikalnych cech poszukiwanych przy tworzeniu nowych odmian.

**Key words:** oat, collecting missions, gene resources

## Introduction

The collection of local and regional varieties of crop plants is an important aspect in the search for specific traits, including disease resistance and adaptation to local environmental conditions. These crop plants can be a source of useful traits in breeding new varieties. The genetic diversity of plants, ensured by the collection of accessions during collecting missions, is a key element of global food security. It is useful both in the breeding process and in maintaining plant biodiversity (Rocha et al. 2017). The area to search for genetic resources was chosen due to the historical relations between Lithuania and Poland. The decision to organize collecting missions to Lithuania was made because this region has been populated by many Poles for a long time. Similarities in the methods of crop cultivation are still observed there. In the past, there was an intensive

exchange of both seed material and information on farming practices. The aim of the collecting missions to Lithuania was to collect seeds of crop plants for further propagation and evaluation, as well as to deposit seeds in the long-term storage chambers of the National Centre for Plant Genetic Resources (KCRZG). The aim of this article is to present the preliminary evaluation of oat accessions collected during three collecting missions to Lithuania with the intention of selecting those most useful for further research.

## Methodology

Lithuania is located in the transitional climate zone. The mean temperature is +16.7°C in July and -4.1°C in January (<https://tradingeconomics.com/lithuania/temperature>). Agricultural land covers 47.98% of the country area (<https://tradingeconomics.com/lithuania/>

agricultural-land-percent-of-land-area-wb-data.html). In Poland the mean temperature is +16.8°C in July and -2.7°C in January (<https://tradingeconomics.com/poland/temperature>), and agricultural land covers 46.93% of the country area (<https://tradingeconomics.com/poland/agricultural-land-percent-of-land-area-wb-data.html>). In the years 2011–2013 three expeditions were organized, during which passport data, including utility traits of collected samples, and instructions from farmers on cultivation were recorded. Keeping records of detailed passport data is important when learning about traditional farming methods and changes introduced in them, which may result from progressive climate change (Bioversity International, 2015). After returning from the collecting missions, all information was entered into the database held by KCRZG IHAR-PIB in Radzików, and the oat samples were used for propagation on experimental plots of IHAR-PIB in Radzików. Collected samples were sown on 2.5 m<sup>2</sup> plots in 2012, 2013, and 2014. 600 seeds were manually sown on each plot. Plants were inspected for the degree of lodging (0–9 scale, where 9 is the absence of lodging) and emerging diseases (septoriosiis, powdery mildew and crown rust) on two dates during the growing season. Thousand grain weight (TGW) and yield in grams (converted to kg) were calculated. Two reference oat varieties were used in experiments: Polish variety Krezus (in 2012), and Celer (in 2013 and 2014).

## Results and Discussion

During three collecting missions organized in 2011–2013, seeds from 124 accessions representing 6 species of cereal plants were collected, including 32 accessions of oat *Avena sativa* L. (Tab. 1). A large proportion of oat accessions were plants grown for fodder, and some came from mixed crops. In 2011 we collected 9 samples of *Avena sativa* L.: four (138, 139, 144, 168) from crops grown for food, and the rest from crops grown for fodder. In 2012 we collected 19 samples: 6 from fields where oat was grown with barley (006, 383, 389, 390, 289, 309); 2 samples of oat grown for sprouts (338 and 360), and the other 11 grown for fodder. In 2013, in the Šalčininkai region, only 5 samples were collected, and they came from mixed crops, most often with barley, as well as with rye, peas and field pea, grown only for fodder.

Observations conducted in 2012 revealed that plants representing the LITLIT11 139 object of *Avena sativa* L. produced panicles on the earliest date and were among the earliest maturing ones. Plants on this object were the shortest in 2012, free

**Table 1**  
**Tabela 1**  
**Samples collected during three collecting missions in Lithuania in 2011 - 2013**

**Obiekty zebrane podczas trzech wyjazdów kolekcyjnych na terenie Litwy w latach 2011 – 2013**

Cereals Zboża	Number of samples Liczba obiektów
<i>Hordeum vulgare</i> L.	31
<i>Triticum aestivum</i> L.	31
<i>Triticum spelta</i> L.W	1
× <i>Triticosecale</i> Wittm. ex A.Camus	14
<i>Avena sativa</i> L.	33
<i>Secale cereale</i> L.	15
<b>Łącznie / Total</b>	<b>125</b>

from lodging and diseases. The object was characterized by the highest thousand grains weight (TGW 38.6 g), the highest weight of grains after threshing, and one of the highest yields (1.24 kg/2.5 m<sup>2</sup>, 70% of the value for the reference variety). The lowest yield (0.52kg/2.5m<sup>2</sup>), despite the absence of lodging and high resistance to diseases, was found for object LITLIT11 119, which produced only 30% of the reference yield (Fig.2 A).

In breeding experiments conducted in 2013 the highest yield (1.58kg/2.5m<sup>2</sup>, 87% of the reference yield) and TGW (31 g) (Fig.2 B) were recorded for object LITZAP12 360, which was also highly resistant to powdery mildew and crown rust. Panicles were produced by plants from this accession in late June. This oat is husked and grown for grain for sprouting. The poorest performance was recorded for the LITZAP12 390 object: it produced the lowest yield (43% of the reference yield), low TGW (21.7 g) and had the highest rate of infestation with crown rust (Fig. 2). (Fig.1 B). The rate of infestation with powdery mildew was 4 to 6 for reference oat varieties, 7 to 9 for local varieties, and 8 out of 19 objects were resistant to powdery mildew (Fig.1 B).

In 2014 most objects were free from infestation with powdery mildew (Fig.1 C) and lodging, despite the fact that plants were taller compared to reference oat plants. On the object LITCEN13 399 producing the highest yield (980 g) (Fig.2 C) panicles were formed not later than the end of June. This oat came from a mixed crop (faba bean, field pea, oats) grown for fodder.

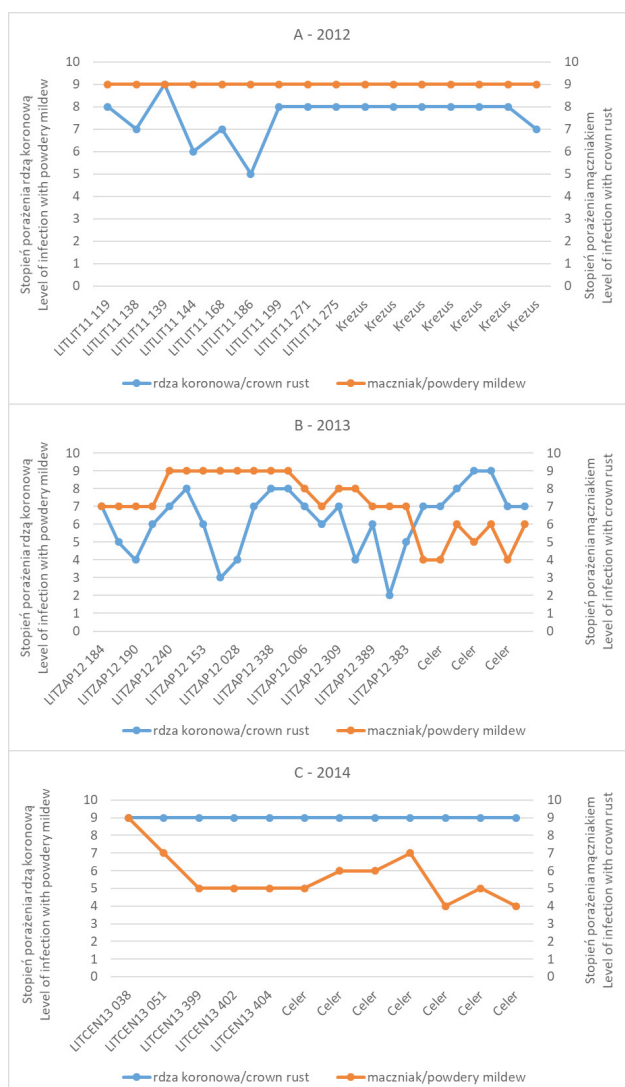
A large diversity of phenotypic traits was observed between the analysed local oat populations. This allows for the selection of beneficial

traits for breeding (Łapiński et al. 2013; Kordula-sińska and Bulińska-Radomska 2014; Pszczółkowski and Sawicka, 2016). Nita (2003) reported that varieties characterised by the best morphological or agricultural traits should be used in the breeding process to create genotypes with the desired properties (Nita, 2003). Iannucci et al. (2011) additionally emphasized that the absence of strong links between the studied traits allows for the creation of „useful combinations” for breeding experiments.

**Summary**

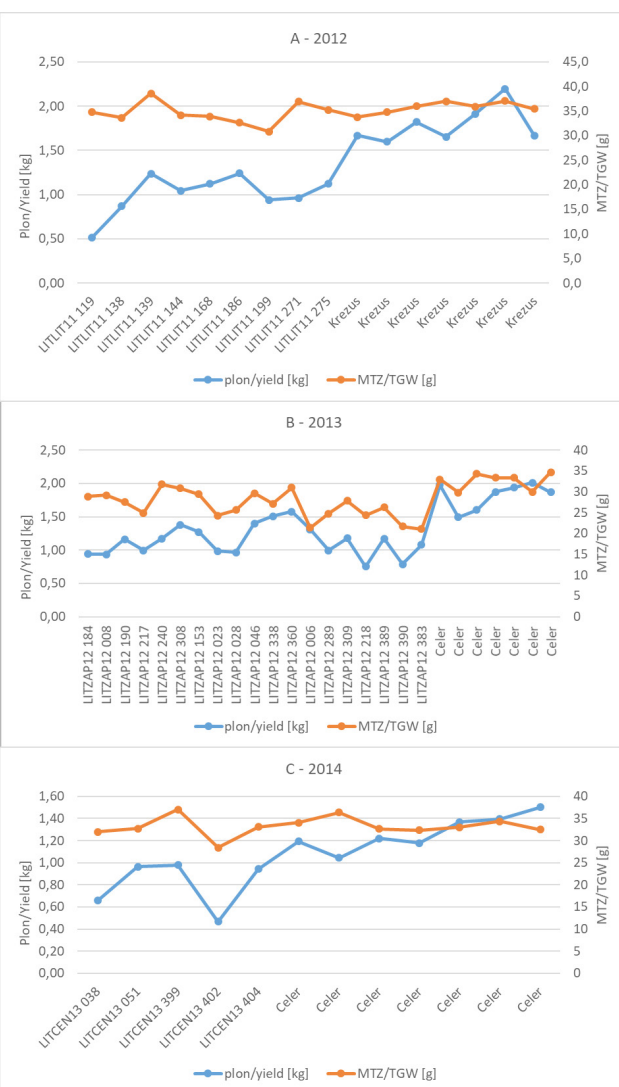
Local varieties of *Avena sativa* L. collected during the expeditions to Lithuania were characterized by a large diversity of traits. On most objects,

panicles were formed later than in reference varieties. Local objects of oat varieties were taller than reference varieties, but despite that were characterised by a low degree of lodging. Less pronounced differences were found for thousand grains weight (TGW) compared to reference varieties, despite the fact that local varieties generally produced lower yields. Accessions collected in 2012 were characterised by a higher resistance to powdery mildew than reference varieties. Local varieties collected in 2013 in the Šalčininkai region, where there is no tradition of oat growing, were used only for fodder, and therefore they were characterized by low yield parameters. Local oat varieties can be a source of individual, unique traits for breeding studies.



**Fig. 1. Susceptibility of *Avena sativa* L. for powdery mildew and crown rust (2012-2014).**

**Rys. 1. Stopień porażenia mączniakiem prawdziwym oraz rdzą koronową obiektów *Avena sativa* L. (2012–2014)**



**Fig. 2. Yield level and thousand grain weight for *Avena sativa* L. (2012-2014).**

**Rys. 2. Wysokość plonu oraz masa tysiąca ziaren obiektów *Avena sativa* L. (2012–2014).**

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## Sponsorzy Dni Młodego Naukowca:

