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Front page photo: Cultivated common buckwheat with pink flowers in Sanjian area, see p. 68 in this issue.

FAGOPYRUM volume 41 (2), May 2024

CONTENTS

Fagopyrum 41 (2): 41-47 (2024)

Research Paper

Effect of Nitrogen Topdressing on Seed Yield and Flour Protein Content in Semidwarf Common Buckwheat

Shinya KASAJIMA[1*], Mirai YOSHIDA[1], Koji ISHIGURO[2], Takashi HARA[2], Shiori OTSUKA[2]

[1] *Faculty of Bioindustry, Tokyo University of Agriculture, Yasaka 196, Abashiri, Hokkaido 099-2493, Japan*

[2] *Hokkaido Agricultural Research Center, NARO, Shinsei, Memuro-cho, Kasai-gun, Hokkaido 082-0081, Japan*

[*] Corresponding author: *Shinya Kasajima, Faculty of Bioindustry, Tokyo University of Agriculture, Yasaka 196, Abashiri, Hokkaido 099-2493, Japan,* E-mail: s3kasaji@nodai.ac.jp

E-mail addresses of authors: s3kasaji@nodai.ac.jp (SK); 49520093@nodai.ac.jp (MY); kuro@affrc.go.jp (KI); harat302@affrc.go.jp (TH); otsukas517@affrc.go.jp (SO)

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Key words: buckwheat, flour protein content, nitrogen fertilization, nutritional quality, seed yield, semidwarf line

ABSTRACT

This study evaluated the effects of nitrogen topdressing on the semidwarf common buckwheat (line '18-601'), focusing on growth, seed yield, and flour protein content. We conducted a field experiment and applied four nitrogen topdressing treatments at different growth stages: basal fertilization alone (2-0-0), basal fertilization plus nitrogen at flower bud appearance (2-2-0), basal fertilization plus nitrogen at full flowering (2-0-2), and basal fertilization plus nitrogen at both stages (2-2-2), using a randomized complete block design, with each plot measuring 1.2 × 2.5 m. Basal dressing was applied at 2, 8, and 4.7 g m^{-2} N, P_2O_5, and K_2O, respectively. Nitrogen topdressing significantly increased chlorophyll content. The branch number, seed yield, number of seeds per square meter, and flour protein content tended to increase with nitrogen topdressing. The highest seed yield and protein content were observed in the 2-0-2 treatment, suggesting that nitrogen application at full flowering optimizes the yield and nutritional quality of semidwarf buckwheat. These findings highlight the importance of timing in nitrogen topdressing to enhance the agronomic and nutritional value of semidwarf common buckwheat.

INTRODUCTION

Common buckwheat (*Fagopyrum esculentum* Moench) is valued for its significant nutritional contributions, offering a rich source of protein, minerals, and the flavonoid rutin. Despite its benefits, this crop suffers from low and unstable seed yields, especially in Japan, where yields stagnate between 50 and 100 kg/10a (Tanaka, 2016). A major challenge in common buckwheat cultivation is lodging—a condition where stems bend, causing plants to lie horizontally, leading to pre-harvest sprouting and seed shattering, significantly impacting seed yield (Morishita et al., 2020). The development of semidwarf cultivars has emerged as a potential strategy to enhance lodging resistance and yield stability.

Although the identification of dwarf and semidwarf genetic variants within the species has been reported (Ohnishi and Nagakubo, 1982; Minami et al., 1999), the availability of practical semidwarf cultivars for common buckwheat remains limited. Recent progress in breeding programs has led to the development of new semidwarf variants (Morishita et al., 2015). These variants have seed yields that are either similar to or slightly lower than those of standard-height cultivars. It also shows enhanced seed production when influenced by nitrogen fertilizer (Kasajima et al., 2017). Additionally, the National Agriculture and Food Research Organization (NARO) of Japan has developed a semidwarf line resistant to seed shattering and pre-harvest sprouting (Suzuki et al., 2023). These developments highlight the need for optimized cultivation techniques for semidwarf common buckwheat lines.

In wheat cultivation, nitrogen fertilization, especially topdressing after the booting stage, significantly increases grain protein content, influencing yield and nutritional quality (Farrer et al., 2006; Shimazaki and Watanabe, 2010). Similarly, previous research on buckwheat has explored the effects of nitrogen fertilization on seed yield and protein properties (Fang et al., 2018; Wan et al., 2023). Nevertheless, the specific effects of nitrogen topdressing on the seed yield and flour protein content of semidwarf common buckwheat lines have yet to be fully explored. This study aims to examine the effects of nitrogen topdressing on the growth, yield, and flour protein content of a semidwarf breeding line of common buckwheat, and optimize the cultivation practices for this nutritionally valuable crop.

MATERIAL AND METHODS

The common buckwheat variant used in this study was the semidwarf line '18-601', developed by the NARO Hokkaido Agricultural Research Center. It is characterized by a shorter plant height than conventional varieties, attributed to a single recessive gene conferring lodging resistance. A field experiment was conducted in an unused field on a local farm in the Yobito district, Abashiri, Hokkaido, from June to August 2023. Soil samples were collected prior to the application of basal fertilizer and analyzed by a specialized agency, Miraizou Co., Ltd., located in Oita, Japan. The chemical parameters of the field soil are presented in Table 1. Seeding was conducted on June 8, 2023, using seeder tapes (Nippon Plant Seeder Co., Ltd.) with row spacing of 30 cm and a hill distance of 2 cm (one plant per hill) at a seeding rate of 167 seeds/m^2. Basal dressing by chemical fertilizer was applied at rates of 2, 8, and 4.7 g m^{-2} N, P_2O_5, and K_2O, respectively. Nitrogen topdressing treatments in the form of ammonium sulfate were established according to application timing in four treatment plots: 2-0-0 (basal fertilization of 2 g m^{-2} N only), 2-2-0 (basal fertilization plus an additional 2 g m^{-2} N at flower bud appearance stage), 2-0-2 (basal fertilization plus an additional 2 g m^{-2} N at full flowering stage), and 2-2-2 (basal fertilization plus 2 g m^{-2} N at both the flower bud appearance and full flowering stages). Fertilizer applications for basal dressing and during the flower bud appearance and full flowering stages were conducted on June 6, June 30, and July 14, respectively. The time of flower bud appearance was defined as the day on which flower buds were observed on 50% of all plants, and the time of full flowering was the

Table 1. *Chemical parameters of soil sampled in the field.*

pH (H_2O)	EC (mS/cm)	CEC (meq/100 g)	Nitrate nitrogen (mg/100 g)	Ammonium nitrogen (mg/100 g)	Available P_2O_5 (mg/100 g)	Exchangeable cation (mg/100 g)		
						K	Ca	Mg
6.3	0.04	16.0	0.5	0.7	32.8	24.2	251.2	26.0

day the apical inflorescence of the main stem bloomed on all plants. Each plot measured 1.2 × 2.5 m and was arranged in a randomized complete block design with three replications. To determine the chlorophyll content, we measured the SPAD value of five individual plants per plot, using one leaf from either the second or third leaf from the top. The measurements were taken on July 25 using a SPAD meter (SPAD-502, Konica Minolta). Before harvesting the plants, the main stem length and number of primary branches were recorded for ten individuals of average growth per plot. Then, we harvested plants on August 25 when 80% of the seeds changed color from green to black. Twenty individuals per plot were sampled, threshed by hand on site, and dried over two weeks. The seeds were then winnowed, and their dry weight was measured (seed yield). The number of seeds per 20 plants was counted using a multi-auto counter (Fujiwara Scientific Co., Ltd). The 1000-seed weight was calculated from this value, and the number of seeds per square meter was calculated from the seed yield and 1000-seed weight, corrected to a 15% moisture basis. These samples were used to determine the flour protein content. After removing the husks, the seeds were finely ground, and the total nitrogen content was measured using an NC analyzer (SUMIGRAPH NC-22F; Sumika Chemical Analysis Service Ltd., Tokyo, Japan). The protein content in flour was calculated by multiplying the nitrogen value by a nitrogen-to-protein conversion factor of 6.25. Statistical analysis (Dunnett's multiple comparison test) was performed using BellCurve for Excel provided by Social Survey Research Information Co., Ltd.

RESULTS AND DISCUSSION

In this study, lodging was not observed in any of the treatment plots. Remarkably, even after Typhoon No. 7 hit Hokkaido in 2023, lodging was absent across all plots, including those where only basal nitrogen was applied (2-0-0) and those with nitrogen topdressing (2-2-0, 2-0-2, and 2-2-2). This resistance to lodging in common buckwheat is believed to be related to stem strength, which is associated with lignin content (Wang et al., 2015). Thus, the significance of lignin synthesis in enhancing the lodging resistance of semidwarf lines warrants further exploration.

Nitrogen topdressing significantly influenced SPAD values (Fig. 1), indicating its impact on chlorophyll content. The SPAD values were highest in the 2-2-2 treatment, followed by the 2-0-2, 2-2-0, and 2-0-0 treatments. Despite increased nitrogen fertilization, the main stem length remained consistent across treatment plots (Fig. 2), suggesting that the semidwarf common buckwheat line is

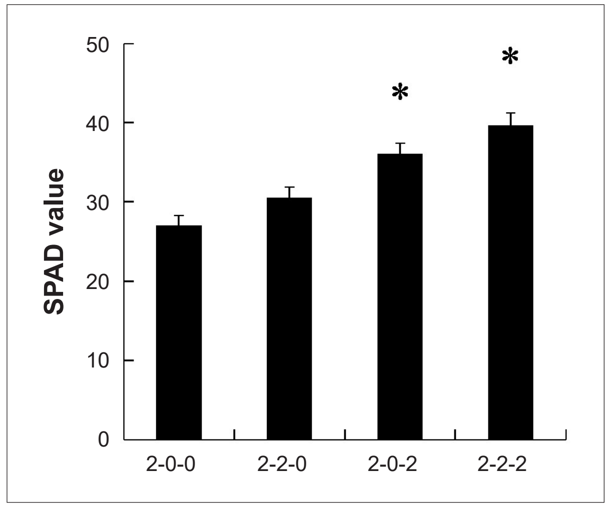

Fig. 1. *Chlorophyll content (SPAD value) in each treatment. Vertical bars represent standard errors based on three replicates. *Asterisks indicate significant differences from the 2-0-0 treatment by Dunnett's multiple comparison test (p < 0.05). Nitrogen topdressing treatments at different growth stages: basal fertilization alone (2-0-0), basal fertilization + nitrogen at flower bud appearance (2-2-0), basal fertilization + nitrogen at full flowering (2-0-2), and basal fertilization + nitrogen at both stages (2-2-2).*

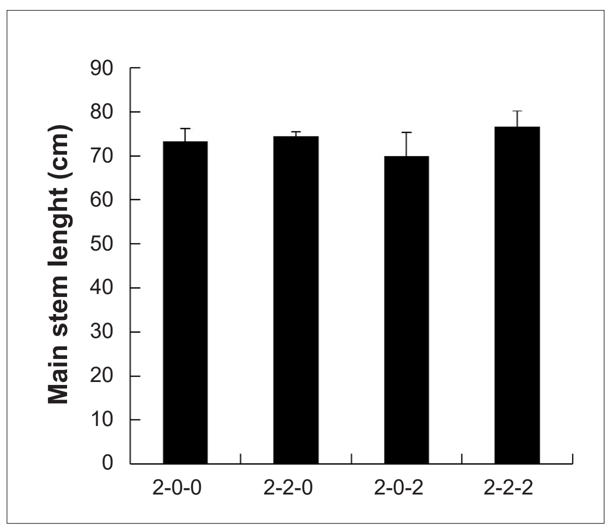

Fig. 2. *Main stem length in each treatment. Vertical bars represent standard errors based on three replicates.*

less susceptible to lodging and benefits from nitrogen topdressing in terms of yield enhancement. Furthermore, the number of branches was generally higher in plots receiving nitrogen topdressing (2-2-0, 2-0-2, and 2-2-2) compared to the plot without the topdressing (2-0-0) (Fig. 3). Given buckwheat's significant plasticity in branching in response to planting density and its reported increase in the number of flower clusters on branches (Kasajima et al., 2023), the nitrogen topdressing-induced increase in branch number may contribute to higher yields, highlighting the need for further research on the underlying mechanism of this process.

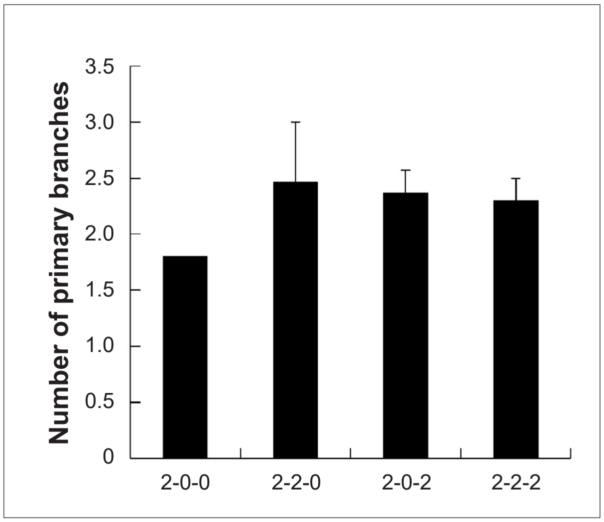

Fig. 3. *Number of primary branches in each treatment. Vertical bars represent standard errors based on three replicates.*

Seed yield was positively influenced by nitrogen topdressing, as shown in Fig. 4. The 2-0-2 treatment resulted in the highest seed yield, followed by the 2-2-0 treatment, with yields of 97.9 g and 89.5 g m^{-2}, respectively, representing increases of 1.34 and 1.23 times compared to 2-0-0. Similar studies in buckwheat have shown that yields are higher when nitrogen is primarily applied as basal fertilization rather than during the flowering stage as topdressing, even when the total amount of nitrogen used is the same. This suggests that nitrogen application timing critically impacts both yield and nitrogen-use efficiency (Sugimoto et al., 2004). This finding supports the notion that the semidwarf trait may enhance nitrogen-use efficiency, which warrants further investigation. Interestingly, no significant yield difference was observed between the 2-2-2 and 2-0-0 treatments. It has been reported that applying nitrogen up to 4 g m^{-2} can increase yields but applying between 4 and 10 g m^{-2} may reduce yields (Sugimoto et al., 2004; Fang et al., 2018). These studies also highlight that excessive nitrogen conditions can increase the vegetative growth of stems and leaves. This indicates that the triple nitrogen dosage in the 2-2-2 treatment might cause nitrogen metabolism imbalance within the plant, highlighting the importance of determining the optimal nitrogen application rate. Thousand-seed weight showed minimal variation across treatments (Fig. 5), and the number of seeds per square

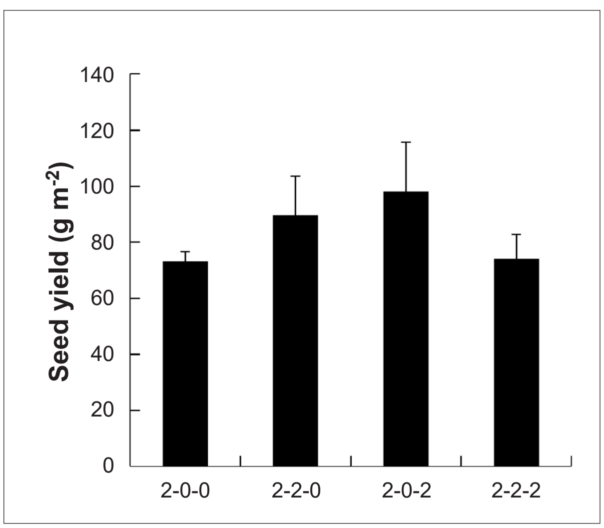

Fig. 4. *Seed yield in each treatment. Vertical bars represent standard errors based on three replicates.*

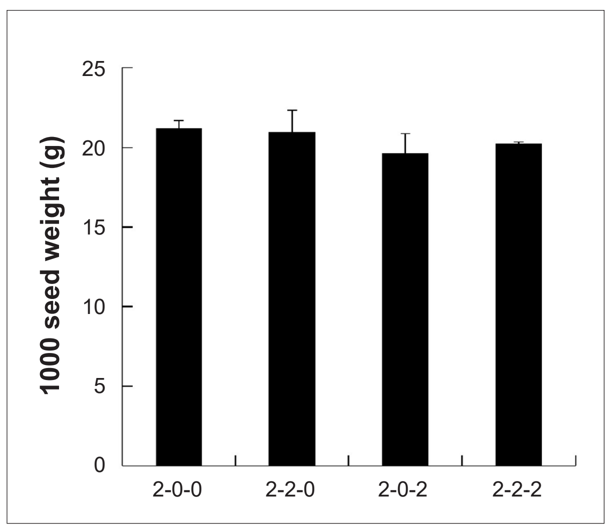

Fig. 5. *1000 seed weight in each treatment. Vertical bars represent standard errors based on three replicates.*

meter mirrored seed yield trends (Fig. 6). This finding suggests that the observed yield increase with nitrogen topdressing at the flowering and flower bud appearance stages is mainly due to an increase in the number of seeds per unit area. However, this study did not investigate yield-forming processes such as fertilization and seed set; thus, further physiological investigations are required.

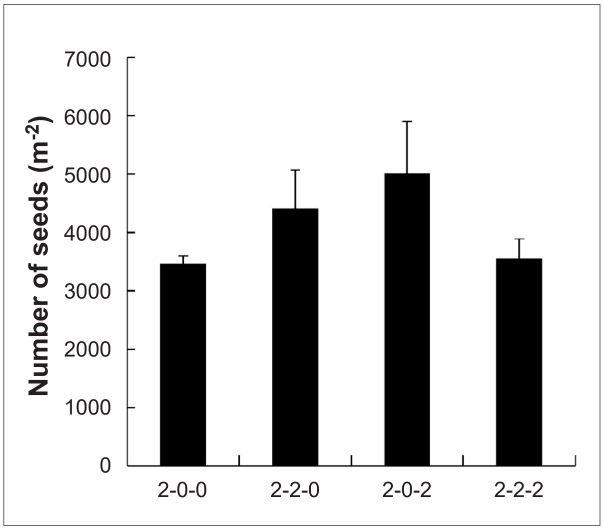

Fig. 6. *Number of seeds per square meter in each treatment. Vertical bars represent standard errors based on three replicates.*

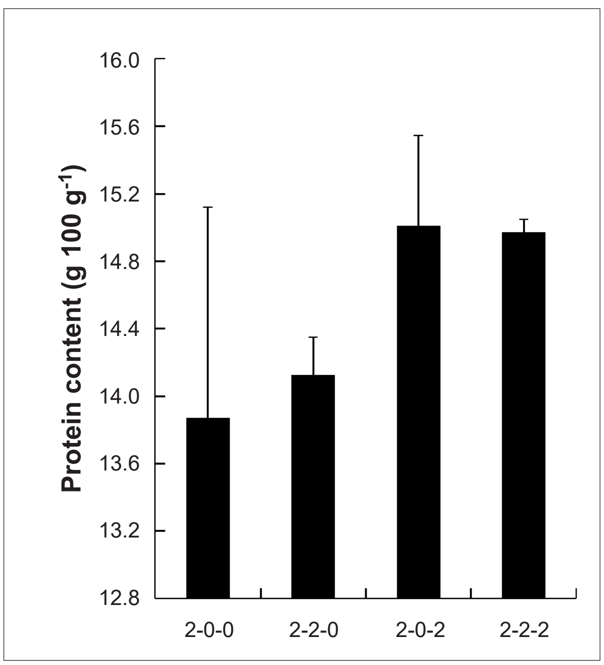

Fig. 7. *Flour protein content in each treatment. Vertical bars represent standard errors based on three replicates.*

The flour protein content exhibited an upward trend with nitrogen topdressing (Fig. 7), with the highest protein content observed in the 2-0-2 treatment, followed by the 2-2-2 treatment. Both treatments had a protein content of 15.0 g/100 g, representing a relative increase of 108% compared to the 2-0-0 treatment. Shimazaki and Watanabe (2010) indicated that applying nitrogen fertilizer after the booting stage of wheat, when the sink capacity is almost determined, is the main factor in increasing the grain protein concentration. A similar mechanism may be involved in buckwheat, necessitating further research into nitrogen allocation between vegetative and reproductive growth, given buckwheat's indeterminate growth habit (Funatsuki et al., 2000). Moreover, the protein content of buckwheat flour is crucial for its noodle-making quality (Matsuura et al., 2010), advocating for additional cultivation trials focused on processing suitability.

CONCLUSION

This study confirms that nitrogen topdressing can boost seed yield and protein content in semidwarf common buckwheat without increasing lodging risk. The observed lack of statistical significance in most parameters, except chlorophyll content (SPAD value), suggests variability in plant responses, highlighting the need for further research to optimize nitrogen application rates and avoid metabolic imbalances. Despite these complexities, our findings highlight a viable path to enhance the nutritional and agricultural value of buckwheat, a crucial crop for diversifying global food sources. Future efforts should focus on understanding the physiological mechanisms behind these benefits and assessing their impact on buckwheat's processing quality, ensuring the full potential of nitrogen topdressing is realized.

ACKNOWLEDGEMENTS

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IZVLEČEK

Vpliv dognojevanja z dušikom na pridelek semen in vsebnost beljakovin v moki polpritlikave navadne ajde

V raziskavi so ocenjeni učinki dognojevanja z dušikom na polpritlikavo navadno ajdo (linija ‚18-601'), pri čemer je raziskava osredotočena na rast, donos semen in vsebnost beljakovin v moki. Izvedli smo poljski poskus in uporabili štiri dognojevanja z dušikom v različnih fazah rasti: samo osnovno gnojenje (2-0-0), osnovno gnojenje z dušikom ob pojavu cvetnih popkov (2-2-0), osnovno gnojenje z dušikom ob polnem cvetenju (2-0-2) in osnovno gnojenje z dušikom na obeh stopnjah (2-2-2) z uporabo naključne zasnove blokov, pri čemer vsaka parcela meri 1,2 × 2,5 m. Osnovno gnojenje je bilo uporabljeno pri 2, 8 in 4,7 g m^{-2} N, P_2O_5 oziroma K_2O. Dodatek dušika je znatno povečal vsebnost klorofila. Število vej, pridelek semen, število semen na kvadratni meter in vsebnost beljakovin v moki so se povečali z dodatkom dušika. Najvišji pridelek semen in vsebnost beljakovin sta bili ugotovljeni pri obdelavi 2-0-2, kar kaže, da uporaba dušika pri polnem cvetenju optimizira pridelek in hranilno kakovost polpritlikave ajde. Te ugotovitve poudarjajo pomen časovnega usklajevanja pri dodajanju dušika za povečanje agronomske in hranilne vrednosti polpritlikve navadne ajde.

Fagopyrum 41 (2): 49-56 (2024)

Review Paper

Buckwheat at Slovenians in Hungary

Marija KOZAR – MUKIČ*

* *Marija Kozar – Mukič, Univ. Dipl. in Ethnology and Professor of Slovenian Language with Literature, Emeritus Senior Curator of the Museum of Savaria, corresponding member of the Slovenian Academy of Sciences and Arts*

E-mail address of author: mukic@t-online.hu

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ABSTRACT

Two types of buckwheat were grown in Porabje: grey buckwheat (törsko dino) for human consumption and feeding honey bees, and the green buckwheat, Tartary buckwheat (»wild buckwheat«) for animal feed. Buckwheat was sown at the beginning of July in a rye stubble and harvested at the end of September. History of growing buckwheat, nutritional habits and dishes of Slovenians in Porabje and other parts of Hungary are presented

The majority of Slovenians in Hungary live today – in an area of 94 square kilometers in the corner bordering Slovenia and Austria – in the town of Monošter/Szentgotthárd (with the suburb of Slovenska ves – Rábatótfalu) and in the following six villages: Gornji Senik (Felsőszölnök), Dolnji Senik (Alsószölnök), Sakalovci (Szakonyfalu), Števanovci (Apátistvánfalva), Verica-Ritkarovci (Kétvölgy) and Andovci (Orfalu). Slovenians and their descendants also live in the cities of Sombotel/Szombathely, Mosonmagyaróvár, Győr, Pécs and Budapest, and scattered throughout the Prekodonavje region (between the Danube and the Austrian, Slovenian and Croatian borders). On a demographic count in 2022, closely to 4000 Slovenian people were recorded in Hungary.

The ancestors of today's Slovenians appeared between the rivers Raba and Mura – together with the Avars – for the first time in the second half of the 6th century. Groups of Hungarians came to the Carpathian Basin during several decades between 860 and 896. Most of the Lower Pannonian Slavs were assimilated by the end of the Arpadovich era (1301). The rest were pushed into the area of the western border of defence belt. King Béla III of Hungary (1172–1196) founded a Cistercian abbey in Monošter in 1183 with the aim of cultivating and populating a sparsely populated area in this belt. The Cistercians needed manpower to cultivate their possessions. There were already settled, including newly immigrated Slovenians, Germans and Hungarians. Slovenians formed settlements on the auxiliary buildings of the Monošter monastery, which have been preserved at Slovenian Porabje to this day. For the inhabitants of Gornji and Dolnji Senik and Ritkarovci the landlords were members of the Batthyány family in Dobra (now Neuhaus in Austria).[1]

Buckwheat was cultivated in Hungary in some hilly areas adjacent to the areas inhabited with Slavic population. In the north of Hungary in the county of Nógrád, bordering Slovakia. To the west in Železna županija and Zala County, which border to Slovenia.[2] An archival source from the 17th century testifies to the fact that cereals, including buckwheat, were massively grown on the estates of the Batthyány family. The crop was harvested in Körmend (30 km from today's Porabje). In 1652, so much buckwheat was stored in the warehouses here that the grain was even spoiled.[3] In the scientific journal of geographers, back in 1918 ethnologist Zsigmond Bátky complained that less and less buckwheat was grown in this part of Hungary. In 1901, buckwheat was harvested in Železna županija (which includes Porabje) on 8,000 hectares.[4] »Most buckwheat in Železna županija was cultivated by Slovenians, Croats and Germans. Buckwheat fields with white flowers and red stems, ploughed to places (*slogi, ogoni*), attract the attention of anyone travelling from Szombathely in the direction to Graz in the valley of Raba.« [5]

First data on buckwheat at Slovenians in Hungary can be found in the Hungarian scripture of the Slovenian parish priest Jožef Košič (1788–1867) in Gornji Senik from the beginning of the 19th century, from which several chapters were translated into Slovenian.[6] When describing the diet, Košič mentions that "In winter, they eat a very popular buckwheat ... In the hills, they rarely bake pure rye bread, but mix oat, corn, buckwheat, barley flour, and during the years of distress also flax heads, corn cobs and often grape remains after pressing«[7]. For most peasant work, neighbours helped each other, and also offered each other food. Košič recorded that in the hills there should be no shortage of buckwheat štruklji (dumplings made from the stretched dough of buckwheat flour, filled with cottage cheese).[8] "They sow more buckwheat if the cereal crop sown in autumn does not thrive ... Buckwheat grows very well here and bears grain richly. I heard from

1 Kalász Elek, A szentgotthárdi apátság birtokviszonyai és a ciszterci gazdálkodás a középkorban, Budapest, 1932, str. 10.

2 Bátky Zsigmond, Kivesző gabonaféléink, Földrajzi Közlemények, 1918, str. 31.

3 Iványi Béla, Képek Körmend múltjából, Körmendi füzetek 4., Körmend 1943, pp. 82-83.

4 Bátky Zsigmond, Kivesző gabonaféléink, Földrajzi Közlemények, zv. 46/1, Budapest,1918, p. 32.

5 Bátky Zsigmond, Kivesző gabonaféléink, Földrajzi Közlemények, zv. 46/1, Budapest,1918, p. 33.

6 [Jožef Košič] Csaplovics János, A magyarországi vendus-tótokról, Tudományos gyűjtemény, Pest, 1828, zv. 5., p. 3-50. Some chapters have been translated into Slovenian: Marija Bajzek (ur.), O Slovencih na Ogrskem, v: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, pp. 17-50.

7 Marija Bajzek (ur.), O Slovencih na Ogrskem, v: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, str. 28.

8 Marija Bajzek (ed.), O Slovencih na Ogrskem, in: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, p. 29.

a plane-land farmer that 4 kebli[9] of seeds produced 180 kebli of buckwheat grain. However, this rarely happens. They sow large areas with buckwheat, because buckwheat fields are very attractive for bees, which are highly valued by local people. Buckwheat cake (pogača) and žganci are favourite food of Slovenians.[10] Arable land was also obtained by arsonism (burning bushes). "Rye is first sown in the soil prepared in this way, then buckwheat, and next spring - oats," writes Košič.[11]

Buckwheat was cultivated in Porabje and in the Hungarian provinces of Őrség, Göcsej and Hetés until the 70s of the 20th century. In Porabje in the villages of Ritkarovci, Sakalovci, Štanovci and Gornji and Dolnji Senik. During the Second World War, buckwheat groats (kaša) was still sold at the market in the county centre of the province, Körmend in Hungary and Gornji Petrovci in Prekmurje, Slovenia.[12] Cultivation was abandoned due to a change in weather conditions, since buckwheat is a delicate plant. In the 70s of the 20th century, "beautiful, sunny autumn days were replaced by humid, foggy days. A lot of damage is also done to buckwheat by wild game living in impenetrable forests all over the land.«[13]

Two types of buckwheat were grown in Porabje: grey buckwheat (törsko dino) for human consumption and flowers for feeding honey bees, and the green buckwheat, Tartary buckwheat (»*divdjo dino*« - »wild buckwheat«) for animal feed. Buckwheat was sown at the beginning of July in a rye stubble and harvested at the end of September.[14] They ploughed the soil only 10-15 cm deep, buckwheat seeds were sown by hand. Buckwheat grew up to 30-40 cm high. Originally, buckwheat was harvested with a sickle, and later already with a scythe. Harvested buckwheat was tied up in small bundles, which were placed individually on the field. In a good weather, the bundles dried up within a week. They were threshed with threshing sticks (grain flails), hand or animal driven, or electric driven threshing machines. The grain was dried on tarpaulins, after which it was stored in wooden boxes or barrels. It was husked into groats

Fig. 1. *– Seller of buckwheat groats (kaša) in Gornji Petrovci in 1943. (Photo: József Csaba, kept by Savaria Museum, Inv. SNF 517)*
Slika 1. *– Prodajalec ajdove kaše v Gornjih Petrovcih 1943. (Foto: József Csaba, hrani Muzej Savaria, inv. št. SNF 517)*

9 kebel – škaf, mernik, bushel, wooden container of cca. 30 liters, measure of volume for cereals.

10 Marija Bajzek (ur.), O Slovencih na Ogrskem, in: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, p. 40.

11 Marija Bajzek (ur.), O Slovencih na Ogrskem, in: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, p. 40.

12 Madáchy Károly, Pridelovanje in uporaba ajde pri Slovencih v Železni županiji, in: Etnografija južnih Slovanov na Madžarskem 2., Budimpešta, 1977, p. 143. in: Csaba József, A hajdina termesztése és felhasználása Vas megyében, in: Savaria, A Vas megyei múzeumok értesítője, zv. 7-8., Szombathely 1973-1974, 2012.

13 Madáchy Károly, Pridelovanje in uporaba ajde pri Slovencih v Železni županiji, in: Etnografija južnih Slovanov na Madžarskem 2., Budimpešta, 1977, p. 147.

14 Marija Kozar, Etnološki slovar Slovencev na Madžarskem. = A magyarországi szlovének néprajzi szótára, Monošter – Szombathely, 1996, p. 14.

(kaša) in a wooden hand stope (mortar with a pestle) or with a wooden hand mill with two wooden disks (*mlin za dino*). Buckwheat grains were ground into flour in a mill in Gornji and Dolnji Senik. In 1970, another 50 hundredweights of buckwheat flour was ground in Dolnji Senik.[15]

Buckwheat groats (kaša) was cooked on milk, served with cabbage and beans (*rič*). They baked it in the furnace or stuffed in black pudding sausages. They ate it in the evening, For breakfast or lunch. Buckwheat flour was used to bake buckwheat cakes (*zlevanke*), prepared with yeast (*raji dinski šterc, kaup*) or without yeast (*žeti dinski šterc, kaup*). For lunch or dinner, žganci (*žgonke, žgounitje*) were also prepared from buckwheat flour and eaten with fresh or sour milk. Women thought it was easier to give birth to a baby than to mix buckwheat žganci (*Baukše eno dejte roditi, kak žgonke z dine graužati.*)[16]

Figure 2. *– Bundles of buckwheat. Gornji Senik 1966. (Photo: János Bárdosi, kept by Savaria Museum, Szombathely, Inv. SNF No. 13522)*
Slika 2. *– Snopi ajde. Gornji Senik 1966. (Foto: János Bárdosi, hrani Muzej Savaria, Szombathely, inv. št. SNF 13522)*

Nowadays, consumers from Porabje purchase buckwheat groats and flour from neighbouring Slovenia. Groats can be prepared as a side dish, instead of rice.[17] Buckwheat flour is used to bake buckwheat zlivanka (*žeti dinski šterc*), which is served warm, to taste also with cracklings on the top.[18] For dessert, buckwheat cake (*dinska torta*) is baked.[19]

The flowering fields of buckwheat with grey seeds (*törske dine*) once served for feeding bees with the nectar in Porabje. Bees were maintained in straw baskets, knitted from rye straw and willow viters (basket, koš)[20]. When the fields of green buckwheat (Tartary buckwheat), »wild buckwheat« (*divdje dine*) for animal feed prevailed, this type of beekeeping ceased in Porabje, because this type of buckwheat does not give nectar for honey-bees. However, a stinger has been preserved, saying that »in Sakalovci they harvest everything when it is green, only buckwheat when it is white. When buckwheat bloomed, white dust flew around and they began to ring the bell, saying buckwheat was burning. That the field burns. The firefighters came to extinguish the fire, but there was no fire. Only buckwheat bloomed, and that was smoking«[21]

15 Madáchy Károly, Pridelovanje in uporaba ajde pri Slovencih v Železni županiji, v: Etnografija južnih Slovanov na Madžarskem 2., Budimpešta, 1977, p. 144.

16 Madáchy Károly, Pridelovanje in uporaba ajde pri Slovencih v Železni županiji, v: Etnografija južnih Slovanov na Madžarskem 2., Budimpešta, 1977, p. 145.

17 Put a tablespoon of lard in a saucepan, when it is hot, add a cup of washed buckwheat groats (kaša). Fry a little. Pour 2 cups of water, salt, then let it boil. Stir a couple of times in between. Add onions and, if necessary, a little more water. Cover and place in the oven to simmer until soft. Source: Hilda Čabai, Slovenska kuhinja ob Rabi = Szlovén konyha a Rába mentén, Monošter / Szentgotthárd, 2000, p. 53.

18 In sour milk mix buckwheat flour, lard and salt. The mass should be denser than for pancakes. Grease the baking pan well with fat and pour a mass into it, about 1 cm thin, and bake. In: Hilda Čabai, Slovenska kuhinja ob Rabi = Szlovén konyha a Rába mentén, Monošter / Szentgotthárd, 2000, p. 84.

19 The yolks from six eggs are mixed with sugar until foamy. Add hard egg white snow and 10 dkg buckwheat flour with half of the small bag of baking powder. Bake the cake. Cut it into slices, pouring them with cooked wine. Serve it hot or cold. Source: Hilda Čabai, Slovenska kuhinja ob Rabi = Szlovén konyha a Rába mentén, Monošter / Szentgotthárd, 2000, p. 102.

20 Marija Kozar, Etnološki slovar Slovencev na Madžarskem. = A magyarországi szlovének néprajzi szótára. Monošter – Szombathely, 1996, str. 29.

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POVZETEK

Ajda pri Slovencih na Madžarskem

Marija Kozar - Mukič*

* *Marija Kozar – Mukič, dipl. etnologinja in prof. slovenskega jezika s književnostjo, višja kustosinja Muzeja Savaria v pokoju, dopisna članica SAZU, mukic@t-online.hu*

Večina Slovencev na Madžarskem živi danes – na območju 94 kvadratnih kilometrov v kotu, ki meji na Slovenijo in Avstrijo – v mestu Monošter/Szentgotthárd (s predmestjem Slovenska ves – Rábatótfalu) ter v okoliških šestih vaseh: Gornji Senik (Felsőszölnök), Dolnji Senik (Alsószölnök), Sakalovci (Szakonyfalu), Števanovci (Apátistvánfalva), Verica-Ritkarovci (Kétvölgy) in Andovci (Orfalu). Slovenci in njihovi potomci živijo še v mestih Sombotel/Szombathely, Mosonmagyaróvár, Győr, Pécs in Budimpešta ter raztreseno po Prekodonavju (med Donavo in avstrijsko, slovensko ter hrvaško mejo). Na ljudskem štetju leta 2022 so jih popisali blizu 4000.

Predniki današnjih Slovencev so se med rekama Rabo in Muro – skupaj z Avari – pojavili prvič v drugi polovici 6. stoletja. Skupine Madžarov so prihajale v Karpatski bazen v več desetletjih med letoma 860 in 896. Večina spodnjepanonskih Slovanov se je do konca dobe Arpadovičev (1301) asimilirala. Ostali so bili potisnjeni na območje zahodnega obmejnega obrambnega pasu. Madžarski kralj Béla III. (1172–1196) je leta 1183 v Monoštru ustanovil cistercijansko opatijo z namenom, da bi se obdelovalo in obljudilo redko naseljeno območje v tem pasu. Cistercijanci so za obdelovanje svoje posesti potrebovali delovno silo. To so bili že naseljeni in na novo priseljeni Slovenci, Nemci in Madžari. Slovenci so na pristavah monoštrskega samostana izoblikovali naselja, ki so se v Slovenskem Porabju ohranila do danes. Prebivalcem Gornjega in Dolnjega Senika ter Ritkakovcev so bili zemljiški gospodje člani družine Batthyány v Dobri (danes Neuhaus v Avstriji).[22]

Na Madžarskem so gojili ajdo v nekaterih hribovitih predelih, ki so mejili na sosednje s slovanskim prebivalstvom naseljene pokrajine, države.[23] Na severu Madžar-

[22] Kalász Elek, A szentgotthárdi apátság birtokviszonyai és a ciszterci gazdálkodás a középkorban, Budapest, 1932, str. 10.

[23] Bátky Zsigmond, Kivesző gabonaféléink, Földrajzi Közlemények, 1918, str. 31.

ske v županiji Nógrád, ki meji na Slovaško. Na zahodu v Železni županiji in županiji Zala, ki mejita na Slovenijo. Arhivski vir iz 17. stoletja priča o tem, da so množično gojili žita oz. poljščine, med njimi ajdo, na posestvih družine Batthyány. Pridelek so zbirali v kraju Körmend (30 km od današnjega Porabja). Leta 1652 se je toliko ajde nabralo v tukajšnjih skladiščih, da se je pridelek celo pokvaril.[24] V znanstveni reviji geografov pa se je etnolog Zsigmond Bátky že leta 1918 pritoževal, da na tem območju Ogrske gojijo vedno manj ajde. Leta 1901 so v Železni županiji (kamor spada tudi Porabje) poželi ajdo še na 8000 hektarjih.[25] »Največ je ajde v Železni županiji med Slovenci, Hrvati in Nemci. Ajdova polja z belimi cvetovi in rdečimi stebli na kraje (*sloge, ogone*) oranih njivah pritegnejo pozornost vsakega, ki potuje iz Szombathelya proti Gradcu v dolini Rabe.«[26]

Prve podatke o ajdi pri Slovencih na Madžarskem najdemo v madžarskem spisu gornjeseniškega slovenskega župnika Jožefa Košiča (1788–1867) z začetka 19. stoletja, iz katerega je nekaj poglavij prevedenih v slovenščino.[27] Pri opisu prehrane omenja Košič, da »Pozimi se hranijo … z zelo priljubljeno *ajdo* … V hribih le redko kje pečejo čisto ržen kruh, temveč zmešajo ovseno, koruzno, *ajdovo*, ječmenovo moko, v letih stiske pa tudi lanene glavine, koruzne storže, velikokrat pa tudi grozdne tropine.«[28] Pri večjem kmečkem delu so si sosedje pomagali, ki so jim ponudili tudi hrano. Košič je zabeležil, da v hribih ne sme manjkati *hajdinjače* (štrukljev iz ajdove moke, napravljenih iz vlečenega testa, napolnjenih s skuto)[29]. »Več ajde sejejo takrat, če jeseni posejano žito ne uspeva … Ajda tukaj zelo lepo uspeva in bogato rodi. Od ravninskega kmeta sem slišal, da s 4 kebli[30] semena pridela 180 keblov ajde. Vendar se to le redko zgodi. Z ajdo posejejo velike površine, ker ajdova polja zelo rade obiskujejo *čebele*, ki pa jih tukajšnji ljudje visoko cenijo. Ajdova pogača in žganci so priljubljena hrana Slovencev.«[31] Orno zemljo so pridobivali tudi s požigalništvom. »V tako pripravljeno zemljo najprej posejejo rž, potem *ajdo*, naslednjo pomlad pa oves,« piše Košič.[32]

Ajdo so v Porabju ter v madžarskih pokrajinah Őrség, Göcsej in Hetés gojili do 70. let 20. stoletja. V Porabju v vaseh Ritkarovci, Sakalovci, Števanovci ter Gornji in Dolnji Senik. Med drugo svetovno vojno so ajdovo kašo še prodajali na tržnici v okrajnem središču pokrajine, Körmendu na Madžarskem ter v Gornjih Petrovcih v Prekmurju.[33] Gojenje so opustili zaradi spremembe vremenskih razmer, saj je ajda občutljiva rastlina. V 70. letih 20. stoletja so zamenjali »lepe, sončne jesenske dneve vlažni, megleni dnevi. Mnogo škode pa napravi v ajdi tudi razpasla divjad v nepreglednih gozdovih širom pokrajine.«[34]

V Porabju so pridelovali dve vrsti ajde: sivo ajdo (*törsko dino*) za prehrano ljudi in pašo čebel ter zeleno ajdo (*divdjo dino*) za živinsko krmo. Sejali so jo na začetku julija v rženo strnišče, poželi pa konec septembra.[35] Zemljo so

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24 Iványi Béla, Képek Körmend múltjából, Körmendi füzetek 4., Körmend 1943, str. 82-83.

25 Bátky Zsigmond, Kivesző gabonaféléink, Földrajzi Közlemények, zv. 46/1, Budapest,1918, str. 32.

26 Bátky Zsigmond, Kivesző gabonaféléink, Földrajzi Közlemények, zv. 46/1, Budapest,1918, str. 33.

27 [Jožef Košič] Csaplovics János, A magyarországi vendus-tótokról, Tudományos gyűjtemény, Pest, 1828, zv. 5., str. 3-50. Nekaj poglavij je prevedenih v slovenščino: Marija Bajzek (ur.), O Slovencih na Ogrskem, v: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, str. 17-50.

28 Marija Bajzek (ur.), O Slovencih na Ogrskem, v: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, str. 28.

29 Marija Bajzek (ur.), O Slovencih na Ogrskem, v: Jožef Košič, Življenje Slovencev med Muro in Rab,. Izbor del, Budimpešta, 1992, str. 29.

30 kebel – škaf, mernik, lesena posoda prb. 30 litrov, prostorninska mera za žitarice

31 Marija Bajzek (ur.), O Slovencih na Ogrskem, v: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, str. 40.

32 Marija Bajzek (ur.), O Slovencih na Ogrskem, v: Jožef Košič, Življenje Slovencev med Muro in Rabo, Izbor del, Budimpešta, 1992, str. 40.

33 Madáchy Károly, Pridelovanje in uporaba ajde pri Slovencih v Železni županiji, v: Etnografija južnih Slovanov na Madžarskem 2., Budimpešta, 1977, str. 143. in Csaba József, A hajdina termesztése és felhasználása Vas megyében, v: Savaria, A Vas megyei múzeumok értesítője, zv. 7-8., Szombathely 1973-1974, 2012.

34 Madáchy Károly, Pridelovanje in uporaba ajde pri Slovencih v Železni županiji, v: Etnografija južnih Slovanov na Madžarskem 2., Budimpešta, 1977, str. 147.

35 Marija Kozar, Etnološki slovar Slovencev na Madžarskem. = A magyarországi szlovének néprajzi szótára, Monošter – Szombathely, 1996, str. 14.

preorali le 10-15 cm globoko, ajdovo seme so sejali na roko. Zrasla je do 30-40 cm visoko. Prvotno so tudi ajdo želi s srpom, pozneje že s koso. Požeto ajdo so zvezali v manjše snope, ki so jih postavljali posamično. V lepem vremenu so se snopi v tednu dni posušili. Mlatili so jih s cepmi, gepljem ali mlatilnico. Zrnje so sušili na ponjavah, potem pa ga pospravili v lesene zaboje ali sode. V kašo so ga ophali v leseni ročni stopi (*možar s tokačom*) ali lesenem ročnem mlinu z dvema lesenima kolutoma (*mlin za dino*). V moko so ajdovo zrnje mleli v mlinu na Gornjem in Dolnjem Seniku. Leta 1970 so na Dolnjem Seniku zmleli še 50 stotov ajdove moke.[36]

Ajdovo kašo so kuhali na mleku, z zeljem in fižolom (*rič*). Pekli so jo v peči in nadevali v krvavice. Jedli so jo zvečer. Za zajtrk ali kosilo so iz ajdove moke spekli ajdove zlivanke s kvasom (*raji dinski šterc, kaup*) ali brez (*žeti dinski šterc, kaup*). Za kosilo ali večerjo so pripravili iz ajdove moke tudi žgance (*žgonke, žgounitje*), jedli so jih s sladkim ali kislim mlekom. Ženske so bile mnenja, da je lažje otroka roditi, kot pa ajdove žgance mešati (*Baukše eno dejte roditi, kak žgonke z dine graužati.*)[37]

Porabci ajdovo kašo in moko danes nabavljajo v sosednji Sloveniji. Kaša se lahko pripravi kot priloga, namesto riža.[38] Iz ajdove moke se peče ajdova zlivanka (*žeti dinski šterc*), ki se servira toplo, po okusu tudi z ocvirki.[39] Za sladico pa se peče ajdova torta (*dinska torta*).[40]

Cvetoča polja sive ajde (*törske dine*) so nekoč tudi v Porabju služila za pašo čebel. Čebele so gojili v slamnatih koših, pletenih iz ržene slame in vrbovih viter (*koš*).[41] Ko so prevladala polja zelene ajde (*divdje dine*) za živinsko krmo, so v Porabju prenehali s tovrstnim čebelarstvom, ker ta vrsta ajde ne medi. Ohranila pa se je zbadljivka, ki pravi, da »v Sakalovcih pospravljajo vse, ko je zeleno, le ajdo, ko je bela. Ko je cvetela ajda, je letel naokoli bel prah in so začeli zvoniti, češ da ajda gori. Da njiva gori. Gasilci so prišli gasit, a ni bilo nobenega ognja. Ajda je cvetela in tisto se je kadilo.«[42]

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38 V kozico damo žlico masti, ko je vroča, dodamo skodelico oprane ajdove kaše. Malo prepražimo. Prelijemo z 2 skodelicama vode, solimo, potem naj vre. Vmes nekajkrat premešamo. Dodamo čebulo in po potrebi še malo vode. Pokrijemo in postavimo v pečico, da se duši do mehkega. Vir: Hilda Čabai, Slovenska kuhinja ob Rabi = Szlovén konyha a Rába mentén, Monošter / Szentgotthárd, 2000, str. 53.

39 V kislo mleko zamešamo ajdovo moko, mast in sol. Masa mora biti gostejša kot za palačinke. Pekač dobro namažemo z mastjo in vlijemo vanj maso, približno 1 cm tanko, ter specemo. Vir: Hilda Čabai, Slovenska kuhinja ob Rabi = Szlovén konyha a Rába mentén, Monošter / Szentgotthárd, 2000, str. 84.

40 Rumenjake iz šestih jajc umešamo s sladkorjem do penastega. Dodamo trd sneg iz beljakov in 10 dkg ajdove moke s pol pecilnega praška. Specemo torto. Narežemo jo na rezine, ki jih prelijemo s kuhanim vinom. Ponujamo jo toplo ali hladno. Vir: Hilda Čabai, Slovenska kuhinja ob Rabi = Szlovén konyha a Rába mentén, Monošter / Szentgotthárd, 2000, str. 102.

41 Marija Kozar, Etnološki slovar Slovencev na Madžarskem. = A magyarországi szlovének néprajzi szótára. Monošter – Szombathely, 1996, str. 29.

42 Pripovedno izročilo Slovencev v Porabju: pravljice in povedke z zvočnih posnetkov Milka Matičetovega. Uredili: Marija Kozar Mukič, Dušan Mukič, Monika Kropej Telban. Ljubljana, Založba ZRC, ZRC SAZU, 2017. 392 p. (Zbirka Slovenski pravljičarji 2.), str. 340.

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Fagopyrum 41 (2): 57-63 (2024)

Review Paper

The Origin of Cultivated Buckwheat in Mankang District of the Sanjiang Area of Eastern Tibet and its Diffusion to India and the Himalayan Hills

Ohmi OHNISHI

Kyoto University, Kyoto, Japan

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To the memory of Ohmi Ohnishi, Professor Emeritus of Kyoto University and Editor Emeritus of FAGOPYRUM journal is reprinted the paper, originally published in FOLIA BIOLOGICA ET GEOLOGICA 61/1 (2020), 7-15.

Key words: buckwheat, wild ancestor, origin, diffusion, India, Himalaya, short day plant

ABSTRACT

Natural populations of the wild ancestor of cultivated common buckwheat were searched and collected, starting from its discovery in1990 and finishing the collections in 2005. Among the collections, the samples Zhuka, Xihe from Mankang district of Tibet are most closely related to cultivated common buckwheat. On the other hand, cultivated populations of common buckwheat in Zhouba, Zhubalong both from Mankang district are most closely related with the wild ancestor of common buckwheat. This leads to the hypothesis on the origin of cultivated buckwheat in Mankang district in the Sanjiang area. The diffusion rout from the original birthplace to India and the Himalayan hills is proposed. Several characteristics of Indian and Himalayan common buckwheat are discussed. A main conclusion of the discussion is that the European buckwheat is not of Indian origin nor of the Himalayan origin. It probably came from the northern China through the Silk Road

1. INTRODUCTION

Since the time of de Candolle (1883), (a) what is the wild ancestor of cultivated common buckwheat and (b) where is the original birthplace of cultivated buckwheat, these two problems have been the main issues to be solved by buckwheat scientists.

The wild ancestor of cultivated buckwheat was clarified as *F. esculentum* ssp. *ancestrale* Ohnishi, which was first discovered in 1990 in the Wulang river valley in Yongsheng district of Yunnan province, in China by Ohnishi (1991). As for the birthplace of buckwheat, Ohnishi (2004, 2007, 2010, 2016, and 2018) has repeatedly claimed that the Sanjiang area of Yunnan, Sichuang provinces and east Tibet in China is the original birthplace of cultivated buckwheat.

In the Himalayan countries, India, Nepal, Bhutan, and Pakistan, buckwheat is cultivated extensively and buckwheat is consumed well. Buckwheat in India and the Himalayan hills has some characteristics which are not seen in other regions such as China, Japan and European countries.

Today, I discuss the original birthplace of buckwheat in more details, and I consider the diffusion rout from the place of origin to India and to the Himalayan hills. Finally I discuss the characteristics of Indian and the Himalayan buckwheat. As a conclusion, I suggest that the cultivated buckwheat in European countries has never come from India nor from the Himalaya, it probably came from northern China through the Silk Road.

2. THE EXACT ORIGINAL BIRTHPLACE OF COMMON BUCKWHEAT

The wild ancestor of cultivated common buckwheat was first discovered in Yongsheng district in Yunnan province of China in 1990 (Ohnishi, 1991). Ten-years searches for the wild ancestor in Yunnan and Sichuan provinces, and the searches in Mankang district of eastern Tibet in 2002 and 2004, and finally the searches in the Tongyi river valley and the Nyiru river valley in 2004 and 2005 clarified the distribution areas of the wild ancestor of common buckwheat (Ohnishi, 2007, see also Ohnishi and Tomoyoshi, 2005).

The wild ancestor is distributed in

1. The Sanjiang area of Yunnan province and eastern Tibet,
2. Sporadic distribution in northwestern Yunnan province and southwest corner of Sichuan province, and
3. The Tongyi river valley in Muli district of Sichuan province and the Nyiru river valley in Shangrila district of Yunnan province. Both the Tongyi river and the Nyiru river are small tributary of the Shuiluo river, a tributary of the Jinshajiang river.

Among the collected wild ancestor populations, the wild ancestors from the Sanjiang area were revealed to be the most closely related with cultivated common buckwheat in AFLP variation (Konishi et al., 2005) and allozyme variability (see Figure 1, see Ohnishi and Nishi-

Photo 1: *Cultivated common buckwheat in Sanjian area (Weixi district, Yunnan provice). Flower color in this area near the original birthplace is beautiful pink.*

Photo 2: *The wild ancestors growing in the Xihe river valley of Mankang district in eastern Tibet. The wild ancestors in this valley are genetically most closely related with cultivated buckwheat. Hence, the Xihe river valley along with the towns in northern Mankang district are considered as the original birthplace of common buckwheat.*

Photo 3: *The cultivation of common buckwheat in Yanjing town of southern Mankang district. The brown part of the cultivated field is common buckwheat just before harvest. Yanjing town has a good weather condition for buckwheat cultivation and the wild ancestors of commom buckwheat are also growing at the margine of buckwheat fields, although those wild ancestors are not so closely related with cultivated buckwheat.*

Photo 4: *The landscape of northern Mankang district. Although this area is believed to be the original birthplace of common buckwheat, barley is mainly cultivated in cultivation fields.*

moto, 1988 for the procedures of the electrophoresis and the names of enzymes analyzed). A part of the data on the frequencies of allozymes can be found in Ohnishi (2007). The N-J tree of Figure 1 was written following by Saitou and Nei (1987) using PAUP* version 4.0 (Swofford, 1990, 2002).

The wild ancestors in the Tongyi river valley and the Nyiru river valley are highly variable in AFLP and allozymes, however, the populations from those valleys are most distantly related with cultivated populations of common buckwheat (Fig. 1). The sporadically distributed ancestral populations in Yunnan and Sichuan provinces showed intermediate closeness to cultivated buckwheat (see Fig. 1).

This may leads to the conclusion that the Sanjiang area is the original birthplace of common buckwheat. Konishi and Ohnishi (2007) showed that close genetic relation between the wild ancestor in the Sanjiang area and cultivated populations is not due to recent hybridization between them.

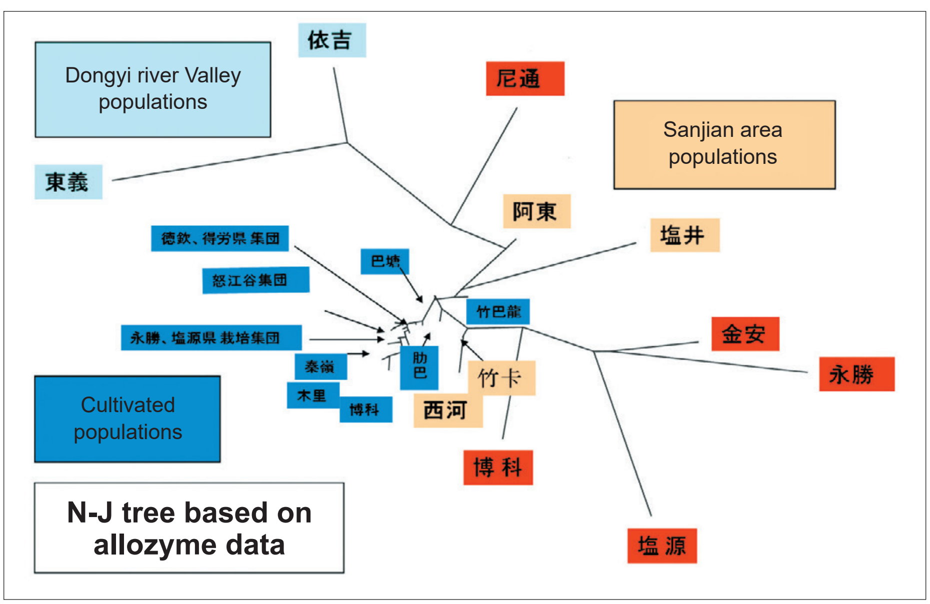

Figure 1. *The N-J tree among the populations of wild ancestor and cultivated populations of buckwheat based on allozyme data.*
The name of locations written in Chinese letters in the figure should be expressed in pinyin as is shown in blackets. Only the loctions appeared in text are listed bellow.
西河 *(Xihe)* 竹卡 *(Zheke)*
阿東 *(Adong)* 塩井 (Yanjing)
博科 *(Boke)* 塩源 *(Yanyuang)*
金安 *(Jinan)* 永勝 *(Yongsheng)*
尼通 *(Nidong)* 東義 *(Tongyi)*
依吉 *(Yiqi)* 竹巴龍 *(Zhebalong)*
巴塘 *(Batang)* 肋巴 *(Zhouba)*

Now, by observing Fig. 1 more carefully, you may find that the Zhuka population and the Xihe population from Mankang district are most closely related with cultivated populations. The Adong population (in Yunnan province) and the Yanjing population (close to the border between Yunnan and Tibet, see Fig. 2) are both from the Sanjiang area, but they are slightly far away from the cultivated populations as compared with the Zhuka and the Xihe popultions (Fig. 1).

Furthermore, by observing Fig. 1 from the cultivated population side, you may find that the cultivated populations of Zhubalong and Zhouba (both come from northern Mankang district) are closely related with the wild ancestor of cultivated buckwheat (see Figs. 1 and 2).

Now, as a conclusion, we can say that the Yunnan part of the Sanjiang area is not involved in the origin of buckwheat cultivation, rather, Mankang district of the Sanjiang area, particularly, north part of Mankang district is the original birthplace of cultivated

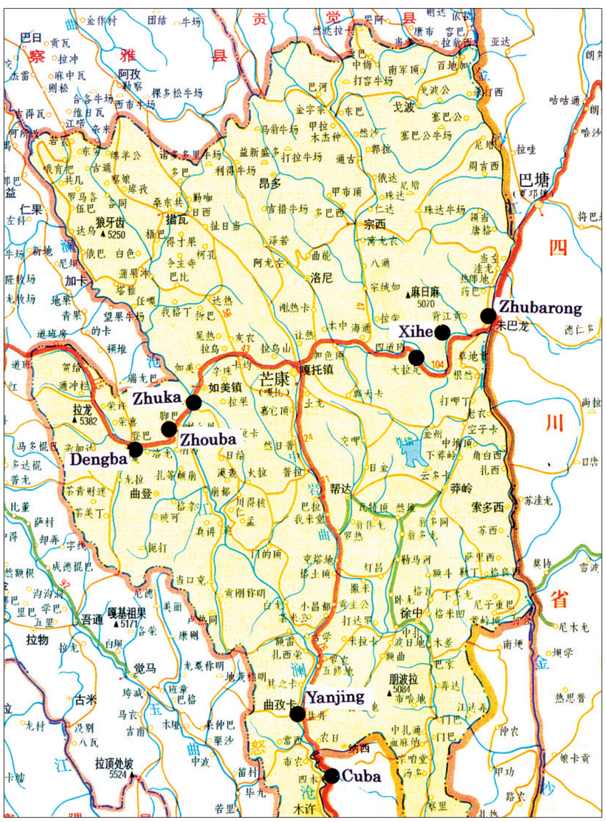

Figure 2. *Distribution of the wild ancestor of cultivated common buckwheat in Mankang district of the Sanjiang area. ●: village or town where the wild ancestor was found. Northern population such as Zhouba, Zhuka and Xihe are close to cultivated populations (see Fig. 1)*

buckwheat. So, it is reasonable that Wang (1986) reported archaeological remains (buckwheat seed grains) in the archaeological site of Karuo village near Chamdu of east Tibet. This site is close to the original birthplace Mankang district of eastern Tibet (see Fig. 3).

3. DIFFUSION OF CULTIVATED BUCKWHEAT TO INDIA AND THE HIMALAYAN HILLS

Cultivated common buckwheat migrated from its original birthplace, the Sanjiang area of southwestern China to northern China first, then to the Korean peninsula and Japanese islands (Murai and Ohnishi, 1996). From northern China, cultivated buckwheat migrated west, to the central Asian countries, then to European countries through the Silk Road as I discussed in the previous 13th ISB (Ohnishi, 2016).

From the original birthplace of common buckwheat, Mankang district, cultivated buckwheat first went west (Murai and Ohnishi, 1996), overcoming high mountains, the Hengdan mountains, in the three- river region (the Sanjiang area), and entered to the Yaruzanpu river basin, then finally arrived at Bhutan, Sikkim, Nepal and India. There exists only one rout connecting Mankang district in the Sanjian area and the Yaruzampu basin in Tibet as seen in Fig. 3. After arriving to these countries, it is easy for buckwheat to travel further west along the Himalayan hills, because the Himalayan hills may provide a comfortable cultivated conditions for cultivated buckwheat.

Only a few crops diffused through the same rout as buckwheat. Tea plant, *Camelia chinensis*, originated in Yunnan province in China, diffused through the same rout as common buckwheat and became an important cultivated plant in India and the Himalayan hills. Only the crop diffused opposite direction from the Himalayan hills to the Sanjiang area is the finger millet (*Eleusine coracana*), originated in Africa. It arrived at the Indian subcontinent, India and Pakistan. Then it diffused to southern China, through the same rout as of buckwheat, but in the opposite direction (Hoshikawa, 1992).

As shown in Fig. 3, the Karuo archaeological site, from where the oldest buckwheat seed grains were reported, is located not so far away from the original birthplace of cultivated buckwheat. Along the diffusion rout, wild perennial buckwheat, *F. cymosum* ssp. *pillus* (syn. *Fagopyrum*

Figure 3. *Diffusion rout of cultivated buckwheat from Mankang district in the Sanjiang area to India and the Himalayan hills.*

pillus Chen, see Chen, 1999) and a weed species *F. gracilipes* are found, near to Dongmai village, Bomi district of Tibet, and Paro of Bhutan, respectively (see Fig. 3).

It is well-known that *F. cymosum* growing in the west of the Yaruzampu grand canyon is all tetraploid, and is often called *F. dibotris* in Nepal and India (see Hara, 1972).

4. CHARACTERISTICS OF BUCKWHEAT IN INDIA AND IN THE HIMALAYAN HILLS

Here, I mention several characteristics of buckwheat and buckwheat cultivation in India and the Himalayan hills.

4-1. buckwheat cultivation as a fresh vegetable in India

Both common buckwheat and Tartary buckwheat are cultivated as a fresh vegetable in India, rather than as a grain crop. As a result of long history of cultivation as a fresh vegetable, local varieties for such purpose have become the varieties with very small grains. I observed such a small grain variety in Bageshwar town, the state of Uttar Pradesh, west India. This custom of buckwheat use as a fresh vegetable is found both in eastern India and western India.

4-2. Common buckwheat in India and in the Himalayan hills is a short day-length plant

Common buckwheat in India and in the Himalayan hills is usually cultivated in fall to early winter, from September to December. As a result of cultivation under the condition of mild temperature and of short day-length, buckwheat in India and the Himalayan hills have become short day-length plant, with characteristics of tall vigorous vegetable parts with relatively longer cultivation period as compared with buckwheat from northern China and Japan.

European common buckwheat has the characteristics of long-day to neutral day-length plant as the descendants of diffused buckwheat through the Silk Road (Ohnishi, 1993, 2016). The characteristics of buckwheat in the Himalayan hills, short-day plant, is opposite to the characteristics of European buckwheat, day-neutral to long day-length plant. This leads to the conclusion that European buckwheat does not have the origin in India nor in the Himalayan hills.

4-3. Making buckwheat noodle by hands in Ladakh of India

Buckwheat noodle was not developed well in Nepal, India, and Pakistan.

Two methods of making buckwheat noodle (Ohnishi, 2016), one using a noodle making wooden equipment, I call this as a Chinese method, one using special cooking knife to cut and make fine noodle of buckwheat dough. I call this as a Japanese method.

Neither methods diffused to Nepal and India. In Bhutan a buckwheat noodle making equipment, called Putta in Bhutan, is used, hence buckwheat noodle is served as a dairy food. If peoples know neither methods, what happens for them? In a section of this symposium, Mr. Inazawa and his group will report the method for making buckwheat noodle by hands in Ladakh of India, where peoples make buckwheat noodle by their own hands only without using any special equipments, such as putta in Bhutan or special kitchen knife as in Japan.

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IZVLEČEK

Izvor gojene ajde na območju distrikta Mankang območja Sanjiang Vzhodnega Tibeta in razširitev v Indijo ter na območje Himalaje

Iskali in zbirali so naravne populacije divjega prednika gojene navadne ajde, začeli so leta 1990 in zaključili 2005. Med zbranimi vzorci je bil vzorec Zhuka, Xihe iz Mankanga, Tibet, najbolj soroden gojeni navadni ajdi. Po drugi strani, vzorca gojenih ajd iz Zhouba in Zhubalonga, oboje iz Mankanga, sta najbolj sorodna divjemu predniku navadne ajde. Na osnovi tega lahko oblikujemo hipotezo o izvoru gojene ajde v Mankangu na območju Sanjianga. Pot širjenja od prvotnega izvora v Indijo in na območja gorovja Himalaje je predlagana v tej razpravi. Avtor opisuje lastnosti navadne ajde v Indiji in na območju Himalaje. Glavni zaključek je, da ajda v Evropi ne izvira iz Indije ali z območja Himalaje. Verjetno je v Evropo prišla iz Severne Kitajske po Svilni poti.

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Obituary

Ohmi Ohnishi

By Yasuo YASUI, Kyoto University, Kyoto, Japan

(yasui.yasuo.2a@kyoto-u.ac.jp)

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Dr. Ohmi Ohnishi, Emeritus Professor at Kyoto University and a pioneering figure in the field of buckwheat genetics, passed away on November 5th, 2023, at the age of 80. His death is a significant loss to the global buckwheat research community. In 1980, Professor Ohnishi became one of the founding members of the International Buckwheat Research Association (IBRA), significantly contributing to establishing and operating this vital group. Throughout his career, he was a driving force behind the publication of the IBRA's journal, Fagopyrum, which has been crucial in fostering collaboration among buckwheat researchers worldwide.

Moreover, Professor Ohnishi devoted himself to advancing the genetics of common buckwheat and clarifying the origin of cultivated common buckwheat. I (author of this contribution, Yasuo Yasui) was fortunate to spend twenty years, from 1988 onwards, working alongside Professor Ohnishi at Kyoto University on the genetic research of buckwheat. I would like to share some anecdotes from that time, recalling our moments together.

Figures 1 and 2. *Professor Ohmi Ohnishi at his home in Kyoto. In Figure 2 are in the background some plants of Fagopyrum esculentum ssp. ancestrale.*

In 1988, when I met Professor Ohnishi as a master's student, he was working on developing chromosomal linkage maps for common buckwheat. The markers he used were isozymes and phenotypic mutations that he had discovered through sib-matings of common buckwheat. At that time, many researchers collaborated on developing linkage maps for crops such as corn and rice. Remarkably, Professor Ohnishi was working on the common buckwheat linkage map by himself. He carried out electrophoresis from 8:00 am to 4:00 pm, and then stained allozyme markers for 100 to 200 individuals to determine their genotypes until 7:00 pm. During breaks in the electrophoresis process, he conducted sib-mating experiments to detect mutations and the establishment of mapping populations. He maintained this routine daily, and I remember he often looked a bit tired during seminars and would frequently doze off. Although I do not handle as much work as Professor Ohnishi did, I seem to have taken after him in dozing off during seminars and meetings.

After preparing the morphology and isozyme markers for common buckwheat himself, Professor Ohnishi surveyed the diversity of common buckwheat worldwide.

Figure 3: *Cover page of journal Fagopyrum, 11 (1991) with the photo of in that time newly discovered Fagopyrum esculentum ssp. ancestrale*

His results showed that, with some exceptions in Europe and Nepal, the degree of population differentiation in common buckwheat is very low; there is vigorous gene flow as if all the populations around the world were one single genetic group. Furthermore, his most remarkable achievement was clarifying the origin of common buckwheat. In the 1980s, it was commonly believed that buckwheat originated in Siberia, while some researchers suggested that Yunnan Province in China, where wild plants of the *Fagopyrum* genus thrive, could be the potential origin. Therefore, Professor Ohnishi explored the regions around Yunnan Province by himself and discovered the wild ancestral species of common buckwheat, *F. esculentum* ssp. *ancestrale*, which had not been found by botanists or crop scientists worldwide before. His energetic investigations continued until around 2010 after his retirement, revealing that ancestrale also grows naturally in Sichuan Province and eastern Tibet. Using isozyme markers to study the diversity of ancestrale, he demonstrated that cultivated common buckwheat originated in the east Tibet. Moreover, Professor Ohnishi discovered a self-fertile wild species, *F. homotropicum*, closely related to cultivated buckwheat, enabling the development of self-pollinating cultivated buckwheat. The self-fertility gene from *F. homotropicum* is actually utilized in countries like Canada and Japan.

In this way, Professor Ohnishi, throughout his life, developed genetic markers for common buckwheat and further clarified the origin of cultivated buckwheat by elucidating the genetic diversity within/among cultivated and wild buckwheat. Many researchers in the International Buckwheat Research Association (IBRA) refer to Professor Ohnishi's papers and conduct research using the materials he discovered. Incredibly, Professor Ohnishi carried out this significant achievement almost entirely on his own. Undoubtedly, Professor Ohnishi is a giant in buckwheat research, and we must strive to surpass his achievements to advance the field of buckwheat research further. Lastly, there is a phrase that Professor Ohnishi has always said since I met him: "What is your question? Solving your question is what research is all about. The significance of your question drives your research." Let us keep his words close to our hearts, surpass his achievements, and diligently advance buckwheat research! That would be our finest way to honor Professor Ohnishi's legacy.

4th European Buckwheat Symposium

1st circular

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University of Debrecen, IAREF Research Institute of Nyíregyháza and
International Buckwheat Research Association (IBRA) are pleased to inform you that
4th European Buckwheat Symposium will be held on July 2025 in Hungary.

EuroIBRA provides opportunity for dialogue and exchange of ideas between European buckwheat experts, so we welcome all interested parties both inside and outside Europe to the event.

Conference participants will have the opportunity to present their professional work, scientific results and practical experiences.

Planned topics of the conference:

- Genetic resources, germplasm collection
- Genetic and breeding
- Biotechnology, OMICS technology
- Physiology, responses to environmental conditions
- Flowering, pollination, fertilization
- Cultivation technology and its development
- Plant protection
- Utilization of buckwheat
- Nutritional values of buckwheat
- Food production and other processing technology

The official website and more details about the symposium will be announced shortly.
Further information is intended to be published as well in FAGOPYRUM journal 42 (1) early in spring 2025.

The conference will be held in traditional, in-person format, but there will be possibility for online participation, as well.
Official language of the Symposium will be English.

Nóra Mendler-Drienyovszki
mendlernedn@gmail.com

INSTRUCTIONS AND INVITATION TO SUBMIT THE MANUSCRIPTS TO FAGOPYRUM JOURNAL

Mostly cited international journal specialized to buckwheat research, published since 1981. All published papers are published electronically **as open access, no publication fees** are charged to authors or their institutions. Papers are registered and included in prominent international databases like OJS (Open Journal Systems), DOI, Food Science and Technology Abstracts (FSTA), CABI (Former: Commonwealth Agricultural Bureaux), ResearchGate, Academy, and other.

INSTRUCTIONS FOR AUTHORS

Manuscript should be written in standard English and submitted to the Editorial office as a word (.doc) document. Figures (photographs) should be IN SEPARATE FILE each in jpg or other original file, not imbedded in word .doc document or in PDF. Submission shall be sent to the email: ivan.kreft@guest.arnes.si. After reviewing by two reviewers and accepting the paper, the editorial office will ask the authors to provide the original figures if the first submission will not be adequate. Your manuscript should be sent to the Editor-in-Chief (Prof. Ivan Kreft). E-mail: ivan.kreft@guest.arnes.si

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Additional abstract in Slovenian will be for foreign authors made by the editors.

The literature references should be arranged alphabetically, in the text referred to as: author and year of publication, e.g., Budagovskaya (1998), (Inoue et al., 1998). If relevant, DOI number should be added at the end of the literature citation, in the suggested form: for example like https:/doi.org/10.1515/biorc-2015-0006
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The deadline to submit the manuscripts for Issue 42(1) is **December 20, 2024**. The issue is expected to be published on-line in March 2025.