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RESEARCHERS ON THE INFLUENCE OF THE SOWING TIME ON THE BIOLOGY AND CULTIVATION TECHNOLOGY OF THE *Dracocephalum moldavica* species, UNDER THE CONDITIONS OF INCDSCZ BRASOV

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Abstract

The main aim of this research was to improve the knowledge of cultivation of Dracocephalum moldavica L., by studying some aspects of biology and technology, adaptability to environmental conditions; the studies were carried out at NIRDPSB Brasov, within the Laboratory of Technology and Good Agricultural Practices, Department of Medicinal and Aromatic Plants. Originally cultivated in Central Asia and acclimatized in Central and Eastern Europe, Dracocephalum moldavica L. is traditionally used for medicinal and aromatic purposes and is also a valuable honey plant. In order to determine the optimal sowing time for Dracocephalum moldavica L., an experiment with 5 planting variants was set up in three replications, following the randomized block method, during 2015 - 2018. The area of a plot was 7.5 m^2, the experimental area including paths was 142.5 m^2; the number of plants per variant was 60 plants, and the total per experiment was 900 plants.

Key words*: Dracocephalum moldavica L., biology, conditions, planting, tehnology.*

INTRODUCTION

Romania, due to its geographical position and pedoclimatic conditions, presents a diversified flora, containing over 3600 species of superior plants, spontaneous and cultivated, of which 10-12% are used by traditional and scientific medicine.

Due to the high content of active principles, plant materials are requested by the pharmaceutical, cosmetic, dermatological industries and external manufacturing companies. The need for the cultivation of medicinal and aromatic plants is based on the hypothesis that the spontaneous flora cannot provide the necessary plant raw material for the phytotherapeutic industry, which is in full ascension.

The current guidelines in medicine are aimed at the large-scale use of phytotherapy, limiting the use of synthetic drugs to what is strictly necessary.

In this context, a paradoxical phenomenon is manifested: while the use of medicinal plants is in a vertiginous ascent (both as raw material in the drug industry and in simple forms, as natural remedies), fewer and fewer are those who use them I can also recognize the harvest. (Crăciun et al., 1988).

The introduction into culture also aims to solve some inconveniences such as: different species grow wildly, on large areas, often difficult to access, so that recognition, collection and transport are difficult. These problems postpone the optimal harvest time and lead to an increase in the cost price of the raw material. The impurity of the raw material and the harvesting of a product poor in active principles is determined by the lack of knowledge of the optimal harvesting moment, the use of casual or non-specialized personnel in this field. (Muntean, 1990; Păun et al., 1996). Romania, in the last five years, has experienced significant changes in the areas cultivated with medicinal plants: in 2016, the largest area cultivated with medicinal plants was approximately 4395 ha with a total production of 5627 t; these surfaces decreased by 27% in 2017 and drastically reduced by 61% between 2018 and 2020 (https://www.madr.ro).

Development of a cultivation technology for species *Dracocephalum moldavica* was determined by the need to introduce numerous species of medicinal plants into the therapeutic arsenal of homeopathic medicine (Alexandriu-Peiulescu, 1978; Muntean, 1990).

The research undertaken in the field of medicinal plant cultivation solves some issues related to: protecting natural pools with medicinal species from spontaneous flora, ensuring the maintenance of the natural gene pool and avoiding irrational harvesting; the maintenance of spontaneous flora of plants considered monuments of nature; the need to cultivate species whose vegetable raw material presents high toxicity, these being systematically eliminated from meadows; the cultivation of some species that are not found in the spontaneous flora, but which are requested by the pharmaceutical industry; carrying out the harvesting work, when the maximum content in active principles is registered; drying the product immediately after harvesting or processing the raw vegetable material in a fresh state, by means of special installations; providing the medicine industry with raw material, homogeneous in terms of chemical composition, eliminating the shortcomings due to the phytochemical variability of raw material harvested from spontaneous flora; the acclimatization of new species, which do not grow spontaneously in our country (Muntean, 1998).

Cultivation of improved populations and varieties, their placement in appropriate pedoclimatic conditions and the application of high-performance culture technologies, lead to higher yields, compared to spontaneous flora.

By applying ecological technologies of differentiated culture, taking into account the biology and the relationship of plants with vegetation factors, large productions of raw material, with a high content of active principles, were obtained.

Thus, ecological agriculture is based on a series of objectives and principles, as well as common practices aimed at minimizing human impact on the environment, while ensuring that the agricultural system works as naturally as possible (Savescu et al., 2016).

Originally cultivated in Central Asia and acclimatized in Central and Eastern Europe, the species *Dracocephalum moldavica* L. is traditionally used for medicinal and aromatic purposes, being also a valuable honey plant.

Dracocephalum. moldavica L. (in popular language, mătăciune) is an herbaceous, annual plant, with a straight stem, 30-70 cm tall, four-sided, branched from the base, covered with absorbent bristles, often reddish; the leaves are opposite, oblong-lanceolate, divided into 3-7 narrow segments, short petioled, with crenellated edges and glandular points on the lower face; the flowers are blue-violet or white, grouped in 5-10 clusters; the fruits are ovoid, brown tetranucles. (https://www.remediilenaturii.ro).

Dracocephalum moldavica L. has been used for centuries in alternative medicine due to its sedative and analgesic, antirheumatic, antitumor and antioxidant properties; it is used in the form of infusions or teas to calm colic, nervous states, producing a peaceful sleep. The raw material used is represented by the aerial parts (grass), harvested during the flowering period.

The aerial part is rich in active principles: flavonosides, tannins, bitter substances, mineral salts, essential oil. The volatile oil content varies between 0.08-0.78% in fresh herb and between 0.23-2.80% in dry herb (Мустяце, 1988; Verzea, 1986; Котуков, 1964).

Principal compounds of volatile oil *Dracocephalum moldavica* are very similar to those of evening primrose oil (*Melissa oicinalis* L.); it is rich in citral (30-50%), geraniol (10-14%), nerol, limonene (Verzea, 1986). The composition of the volatile oil also includes: citronellol, thymol, linalool, linalyl acetate, geranyl acetate, niril acetate and some sesquiterpenes, lavonoid (moldavoside), caffeic and succinic acid (Bojor, 2003).

As a result of the pharmacodynamic actions (astringent, tonic-aperitif, antispasmodic, antiseptic, choleretic-collagogic, relaxing, carminative, anticolytic, antiemetic) determined by the active principles, the aerial part of the wormwood is used in the treatment of colic of various etiologies, insomnia, spasms abdominal pain, nausea and vomiting, eye diseases, neuroses). It is used in the cosmetic industry to manufacture perfumes, soaps and detergents, in the food industry to flavor soft drinks, syrups, compotes, jams, canned fish, and in the pharmaceutical industry to obtain vitamin A. Is

a honeydew species, with a high economic contribution - up to 200 kg/ha of honey. It can also be cultivated in dendrological parks.
The species *Dracocephalum moldavica* L. reacts well to the administration of nutrients, both to basic fertilization and in the case of the application of foliar fertilizers, an aspect highlighted by the increase in production, but also from a qualitative point of view, referring to the active principles found in the leaves of this species. The application of fertilizers - an important sequence of the cultivation technology influences the photosynthesis process, which generates the growth of the plant's organs, in different phenophases of vegetation. The percentage variation of oil production and of some compounds from the essential oil of *Dracocephalum moldavica* L., can be attributed to the composition of fertilizers, but also to pedoclimatic conditions, agricultural techniques or ecological factors; taking into account all these factors it can be said that evening primrose oil can change its composition, the main compounds identified being geranyl acetate, geranial, neral, followed by geraniol and neryl acetate. The difference in composition is revealed by other studies, which highlighted other main compounds such as citral, linaalol (Onofrei, 2017).

MATERIALS AND METHODS

The studies were carried out at I.N.C.D.C.S.Z. Braşov, within the Laboratory of Technology and Good Agricultural Practices, Department of Medicinal and Aromatic Plants.
The experiments were located in the ecological system (45°42′ N and 25°45′ E, altitude 520 m); the soil texture in the upper horizons is sandy and loamy-sandy, and at depth it is sandy-loamy with a pH of 6.7. The soil of the experimental site contains 27% clay, 4.68% humus, total nitrogen 3.15%, P_2O_5 32.1 ppm (7.36 mg 100 g soil $^{-1}$) and K_2O 105.1 ppm (12.67 mg 100 g soil $^{-1}$) (Moldovan et al. 2021).
Dracocephalum moldavica L. prefers creeping as precursor plants. Being a species sensitive to weeding, it is sown after plants that leave the land clean of weeds. It is recommended to avoid placing crops after plants from the same botanical family (*Lamiaceae*).
Land preparation. A deep autumn plowing was carried out (25-30 cm); the furrows were left under the action of freezing and thawing, and in the spring, a few days before sowing, the seed bed was prepared with a disc harrow, followed by a harrow with adjustable tines.
Maintenance works. After the emergence of the plants, the weeds were weeded in rows and between the rows, and until the flowering stems appeared, 3 weedings were carried out with the motor cultivator.
In order to establish the optimal sowing season for the *Dracocephalum moldavica* L. species, between 2015 and 2018, monofactorial experiments were set up, with 5 sowing seasons (variants), in three repetitions, according to the randomized block method (Table 1).
The surface of a plot was 7.5 m^2, the experimental surface, including the paths, was 142.5 m^2; the number of plants per variant was 60 plants, and the total per experience 900 plants. The seed material (seed) was purchased from SCDA Secuieni.

Table 1. Sowing date to experience on determining the optimal time to sow to species *Dracocephalum moldavica* L. (Braşov 2015-2018)

Sowing variant	2015-2016	2016-2017	2017-2018
V1 - sown in October	20.10.2015	24.10.2016	21.10.2017
V2 - sown at the beginning of November	11.11.2015	07.11.2016	08.11.2017
V3 - sown in emergency I (beginning of April)	06.04.2016	10. 04.2017	04.04.2018
V4 - sown in emergency II (second decade of April)	18.04.2016	17.04.2017	19.04.2018
V5 - sown in the first decade of May	05.05.2016	08.05.2017	03.05.2018

RESULTS AND DISCUSSIONS

The studies and research carried out between 2015 and 2018 at the Braşov National Research and Development Institute for Potatoes and Sugar Beet, the Laboratory of Technology and Good Agricultural Practices, the Department of Medicinal and Aromatic Plants, regarding the optimal sowing period of the species *Dracocephalum moldavica* L., have shown that this species finds good climate and soil conditions for growth and development.
The phenological observations of the experience regarding the optimal sowing period reveal the fact that the physiological processes that take place in the plant are directly influenced by the

climate and environmental conditions, as well as the sowing period.

Table 2 and Figure 1, shows the results of the germination of the plants depending on the time of sowing: in the variants V1, V2 (V1 - sown in October, V2 - sown at the beginning of November), the plants did not germinate or those that germinated did not survive the winter, V3 - sown in emergency I (beginning of April) emerged, in 2016, 14 days after sowing, in 2017 at 15 days, and in 2018 at 14 days. In the case of the variants sown in emergency II (V4), the plants sprouted in 2016 after 11 days, in 2017 after 10 days, and in 2018 after 11 days after sowing. V5 - sown in the first decade of May, it sprouted in 11 days in 2016, in 2017 in 14 days, and in 2018 in 12 days.

Table 2. The date of emergence of the plants/variations to the experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Braşov 2015-2018)

Plant emergence date/variant	2015-2016	2016-2017	2017-2018
V1 - sown in October	-	-	-
V2 - own at the beginning of November	-	-	-
V3 - sown in emergency I (beginning of April)	20.04.2016	25.04.2017	20.04.2018
V4 - sown in emergency II (second decade of April)	29.04.2016	27.04.2017	30.04.2018
V5 - sown in the first decade of May	16.05.2016	22.05.2017	15.05.2018

From the date of sowing to the emission of flower stalks, the average of the three years was 88 days for V3, 85 days for V4 and 78 days for V5.

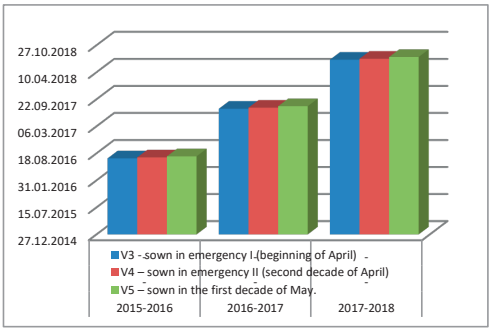

Figure 1. The date of emergence of the plants/variations to the experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Braşov 2015-2018)

The obtained results point out that the date of sowing does not greatly influence the physiological processes of plant development, the emission of flowering stems occurring approximately in the same period, being directly determined by climatic factors (Table 3 and Figure 2).

Table 3. The date of issuing the flower stalks/variant to the experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Braşov 2015-2018)

Date of issue of flower stalks/variant	2015-2016	2016-2017	2017-2018
V1 - sown in October	-	-	-
V2 - sown at the beginning of November	-	-	-
V3 - sown in emergency I (beg. of April)	04.07.2016	06.07.2017	02.07.2018
V4 - sown in emerg. II (second decade of April)	11.07.2016	14.07.2017	10.07.2018
V5 - sown in the first decade of May	20.07.2016	25.07.2017	23.07.2018

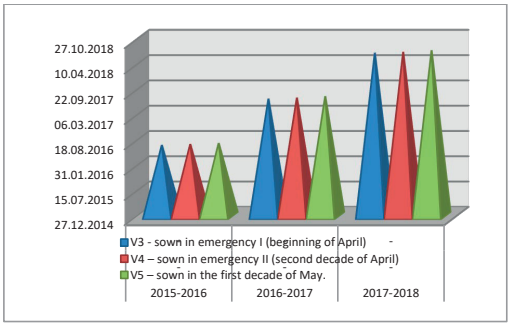

Figure 2. The date of issuing the flower stalks/variant to the experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Braşov 2015-2018)

From the date of emergence to full flowering, V3 - sown in emergency I (beginning of April) recorded, in 2016, 83 days, in the second year 80 days, and in the third year 83 days. In the case of the variants sown in emergency II (V4), the plants bloomed in 2016 at 81 days, in 2017 at 86 days, and in 2018 at 80 days after emergence. V5 - sown in the first decade of May bloomed in 72 days in 2016 and 2017, and in 2018 in 78 days (Table 4 and Figure 3).

Table 4. Flowering date/variant to experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Brașov 2015-2018)

Flowering date/variant	2015-2016	2016-2017	2017-2018
V1 - sown in October	-	-	-
V2 - sown at the beginning of November	-	-	-
V3 - sown in emergency I (beginning of April)	12.07.2016	14.07.2017	12.07.2018
V4 - sown in emergency II (second decade of April)	19.07.2016	22.07.2017	19.07.2018
V5 - sown in the first decade of May	27.07.2016	02.08.2017	01.08.2018

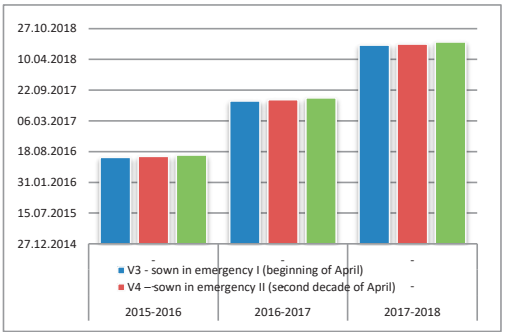

Figure 3. Flowering date/variant to experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Brașov 2015-2018)

For the duration of the vegetation period in the species *Dracocephalum moldavica* L., from emergence to the beginning of fruiting, the average of the three years was 89 days for V3 and V4, and for V5, 80 days (Table 5 and Figure 4).

Table 5. The date of the beginning of fruiting/the variant to the experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Brașov 2015-2018)

The date of the beginning of fruiting/the variant	2015-2016	2016-2017	2017-2018
V1 - sown in October	-	-	-
V2 - sown at the beginning of November	-	-	-
V3 - sown in emergency I (beginning of April)	19.07.2016	20.07.2017	20.07.2018
V4 - sown in emergency II (second decade of April)	26.07.2016	28.07.2017	27.07.2018
V5 - sown in the first decade of May	02.08.2016	09.08.2017	07.08.2018

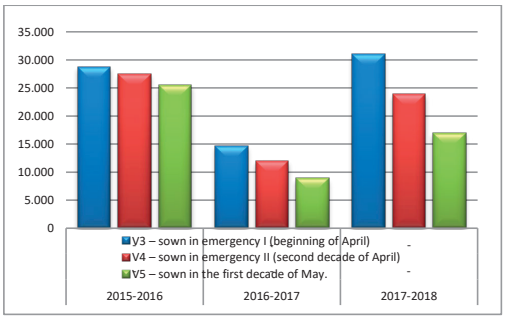

Figure 4. The date of the beginning of fruiting / the variant to the experience regarding the establishment of the optimal time to sow at species *Dracocephalum moldavica* L. (Brașov 2015-2018)

Table 6 shows the average productions of fresh grass per ha/variety, during the experimental years. V3 - sown in emergency I (beginning of April) recorded an average production of 24,763 kg/ha, V4 - sown in emergency II (second decade of April) 21,129 kg/ha, and V5 - sown in the first decade of May 17,111 kg/ha (Figure 5).

Table 6. The production of fresh grass (kg/ha/variant) to the experience regarding the establishment of the optimal season for sowing at species *Dracocephalum moldavica* (Brașov 2015-2018)

Production of fresh grass (kg/ha/variety)	2015-2016	2016-2017	2017-2018	Average (kg/ha)
V1 - sown in October	-	-	-	-
V2 - sown at the beginning of November	-	-	-	-
V3 - sown in emergency I (beginning of April)	28,716	14,613	30,960	24,763
V4 - sown in emergency II (second decade of April)	27,493	12,053	23,840	21,129
V5 - sown in the first decade of May	25,493	8,880	16,960	17,111

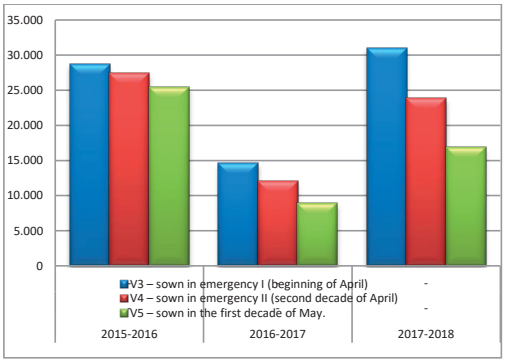

Figure 5. The production of fresh grass (kg/ha/variant) to the experience regarding the establishment of the optimal season for sowing at species *Dracocephalum moldavica* L. (Brașov 2015 - 2018)

CONCLUSIONS

The general objective of this study was the introduction into culture of some species of medicinal and aromatic plants of phytotherapeutic interest and the maintenance of biodiversity in these species. This objective resulted from the increased concerns of growers, processors, consumers of medicinal and aromatic plants, aiming to return to nature in terms of human nutrition and health preservation with products of an ecological nature and the increased responsibility for protecting the environment and natural habitats of these plants. The research on the influence of the sowing time on the biology and cultivation technology of the species *Dracocephalum moldavica* L., in the conditions of the National Research and Development Institute for Potato and Sugar Beet Braşov, the Laboratory of Technology and Good Agricultural Practices, the Department of Medicinal Plants and Aromatic, they showed that this species finds good climate and soil conditions for growth and development.

Studies have shown that the species *Dracocephalum moldavica* L. needs a higher temperature for germination, being sensitive to late frosts; it is recommended to sow in spring, in emergency I. Some authors recommend as sowing times, both the one in spring and the one on the threshold of winter (https://www.agrimedia.ro), sowing in the "threshold of winter" being advantageous from an organizational point of view as well, having place in the period when less agricultural work is carried out, compared to the spring season. This era also presents disadvantages due to the alternation of favorable periods for germination and emergence, with frosty periods, when the young seedlings are destroyed (Constantinescu, 2009).

In the depressed area of Brasov, where the experiments took place, autumn sowing is not recommended; the seeds do not have favorable temperatures for germination and, where they manage to sprout, they perish in the winter due to the very low temperatures. In the depressed area of Brasov, where the experiments were located, autumn sowing is not recommended; the seeds do not have favorable temperatures for germination and, where they manage to sprout, they perish in the winter due to the very low temperatures.

The best herb production of the species *Dracocephalum moldavica* L. at I.N.C.D.C.S.Z. Braşov was obtained during spring sowing, in emergency I, at the beginning of April, when the highest values of the plant mass were determined, with an average production of the 3 experimental years of 24,763 kg/ha .The contribution with new information on the crop technology of *Dracocephalum moldavica* L. species leads at the enrichment of knowledge in this field, as the information in the literature is more geared towards studying the species in terms of active principles in the plant, rather than crop technology (Nitu et al., 2017). The results obtained can also be used by agronomists, pharmacists and biologists, who, directly or indirectly, contribute to the cultivation and use of medicinal and aromatic plants.

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REFERENCES

Alexandriu-Peiulescu, M., Popescu, H. (1978). *Plante medicinale în terapeutica modernă*. Ed. Ceres, Bucureşti.

Bojor, O. (2003). *Ghidul plantelor medicinale şi aromatice de la A la Z.* Ed. Fiat Lux.

Constantinescu, E. (2009). *Cultura plantelor medicinale şi aromatice.* Ed. Universitaria Craiova, ISBN 978-606-510-486-0.

Crăciun, F. (1988). *Ghidul plantelor medicinale uzuale.* Ed. Recoop, Bucureşti.

Котуков, Г.Н. (1964). Лекарственные и эфиромасличные культуры: Справочник. – Киев: Наукова думка, 194 с.

Мустяцэ, Г.И. (1988). Возделывание ароматических растений. К.: Штиинца, 198 с.

Muntean, L.S. (1990). *Plante medicinale şi aromatice cultivate în România*. Ed. Dacia, Cluj-Napoca.

Muntean, L., Muntean L.S. (1998). Variétés des plantes médicinales et aromatiques crées en

Roumanie. *Notulae Botanicae Horti Agrobotanici, XXVIII*. 37–43.

Moldovan, C., Nițu, S., Hermeziu, M., Vidican, R., Sandor, M., Gâdea, Ș., David, A., Stoian, V.A., Vâtcă, S.D., Stoian, V. (2022). Growth Characteristics of *Dracocephalum moldavica* L. in Relation to Density for Sustainable Cropping Technology Development. *Agricultura, 12*(6), 789. https://doi.org/10.3390/agriculture12060789

Niţu, S., Ștefan, F.M., Chelmea, C., Hermeziu, M., Bădărău, C.L. (2017). Preliminary aspects concerning the introduction into crop of the *Dracocephalum moldavica* L. (Moldavian dragonhead) species under the environmental conditions of NIRDPSB Brasov.

Onofrei, V. (2017). Cercetări privind influența unor fertilizanți foliari ecologici asupra producţiei și calităţii acesteia la unele specii medicinale și aromatice -Teza de doctorat USAMV Iasi.

Păun, E., et al. (1996). Breeding research on medicinal and aromatic plants - a survery of Romanian experiences. *International Sympozium Breedingresearch on Medicinal and Aromatic plants, Quedlinburg, Germany*, p. 136–142.

Savescu, P., Poenaru, M.M., Iacobescu, F. (2016). Study regarding the development of organic farming systems in Romania as the basis for obtaining of innocuity agricultural raw materials–used in functional food. *Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series, 46*(1), 281–285.

Verzea, M. (1986). *Dracocephalum moldavica* L. - mătăciunea - *Tratat de plante medicinale și aromatice cultivate*. București: Ed. Ac. R.S. Rom., Vol. I. - P. 254-260.

https://www.remediilenaturii.ro/remediu_fitoterapie.php?n=M%C4%83t%C4%83ciune&ID=124https://www.agrimedia.ro/articole/tehnologia-de-cultivare-pentru-mataciune-dracocephalum-moldavica-10.03.2023

https://www.madr.ro/culturi-de-camp/plante-medicinale-si-aromatice.html (accesat pe 26 februarie 2023).