

**Резюмета на научни публикации, представени в конкурс за „Професор“  
в област на висше образование 4. Природни науки, математика и информатика,  
професионално направление 4.3. Биологически науки по Ботаника  
на доц. дн Нели Христова Грозева**

**Хабилитационен труд – научни публикации в издания, които са реферирани и индексирани в световноизвестни бази данни с научна информация (Web of Science и Scopus)**

**1. Grozeva, N.H.,** Gerdzhikova M.A., Pavlov, D.H, Panayotova, G.D, Todorova, M.H. (2016). Morphological variability of the Bulgarian endemic *Betonica bulgarica* Degen et Neič. (Lamiaceae) from Sinite Kamani Natural Park, Eastern Balkan Range. Acta Botanica Croatica, 75(1): 81-88.

**Abstract** – Four populations of *Betonica bulgarica* Degen et Neič. at Sinite Kamani Natural Park were morphologically tested. Intrapopulation and interpopulation variabilities were established. The relationship between morphological variability, number, area and ecological appurtenance of the studied populations were explored. The results demonstrated that the main source of phenotype variation is intrapopulation variability, mainly due to the age structure of populations. The most variable traits are height of stem and dimensions of leaves. The registered interpopulation variability was affected by the differences in altitude, soil type and differences in environmental conditions and soil properties. Indumentum and morphology of generative organs had taxonomic significance for distinguishing *B. bulgarica* from the other species in the genus, including the species that were morphologically most similar to it – *Betonica officinalis* L.

**2. Tzanova, M.T., Grozeva, N.H.,** Gerdzhikova, M.A., Argirova, M.D, Pavlov, .D.H., Terzieva, S.R. (2018). Flavonoid content and antioxidant activity of *Betonica bulgarica* Degen et Neič. Bulgarian Chemical Communication, 50 (C): 90-97.

**Abstract** – The Bulgarian endemic *Betonica bulgarica* Degen et Neič (syn. *Stachys bulgarica* Hayek) is a protected plant by the Biological Diversity Act and it is included in the Red Data Book of Bulgaria under the category “endangered“. The aim of this study was to determine the flavonoid content and antioxidant activity of different plant organs of this species (leaves, flowers, roots, stems and seeds), from four populations. Three flavonoids were found in significant amounts: rutin, quercetin and hispidulin. Rutin was in the largest quantity, followed by quercetin and hispidulin. The largest total flavonoid content was measured in leaves, followed

by roots and flowers. The antioxidant activity of methanol extracts was tested by DPPH-method. The total polyphenol was also assayed. The correlation between flavonoid content and antioxidant activity of the studied plant organs was established.

**3.** Dinev, T.G., Rusenova, N.V., Tzanova, M.T., **Grozeva, N.H.**, Gerdzhikova, M.A., Stoyanov, P.S., Mladenova, T.R., Beev, G.G. (2020). Antimicrobial potential of methanolic extracts from *Betonica bulgarica* Degen et Neič. (Lamiaceae). *Ecologia balcanica*, 12 (2): 165-174.

**Abstract** – *Betonica bulgarica* Degen et Neič. (syn. *Stachys bulgarica* Hayek) is a Bulgarian endemic plant included in Red Data Book of Bulgaria under the category “endangered“. The aim of the present study is to provide data about the antimicrobial activity of *B. bulgarica* leaf, flower, seed, stem and root methanolic extracts against *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, *Bacillus cereus*, *Aspergillus ochraceus* 2002 IM-BAS, *Fusarium moniliforme* 394 FN-9, *Fusarium graminearum* 2294 IMI 155426 and *Penicillium verrucosum* 2003 NRRL F-143. Antimicrobial activity of the extracts was evaluated by agar well diffusion method. Root extracts of *B. bulgarica* exhibited the highest antibacterial activity against *S. aureus* and *B. cereus* with large zones of inhibition. All extracts demonstrated either low and statistically insignificant activity against *E. coli* or a lack thereof. As a whole, extracts of Ablanovo area (in Sinite kamani National Park) exerted the highest activity against *S. aureus*, *B. cereus* and *E. coli*. Leaf, flower, stem and root extracts of *B. bulgarica* showed either a lack of antifungal activity or low and statistically insignificant one.

**4.** Gerdzhikova, M., Pavlov, D., **Grozeva, N.**, Mladenova, Tsv., Krastanov J., Angelova, T.(2020). Chemical composition, mineral content, in vitro gas production and relative feed value of *Betonica bulgarica* Degen et Neič. *Bulgarian Journal of Agricultural Science*, 26, pp. 48–57.

**Abstract** – Chemical composition and mineral content of biomass from four populations of *Betonica bulgarica* Degen et Neič. were determined. The average crude protein content in the biomass was 77.41 g.kg<sup>-1</sup> of dry matter (DM); crude fat – 7.77 g.kg<sup>-1</sup> DM; crude fibre – 260.16 g.kg<sup>-1</sup> DM; ash – 50.47 g.kg<sup>-1</sup> DM and nitrogen free extracts (NFE) – 604.19 g.kg<sup>-1</sup> DM. The content of nitrogen, calcium, phosphorus and magnesium in the biomass of *B. bulgarica* was close to the meadow grasses. The content of potassium is lower. The content of sodium, iron and manganese was significantly lower. Structural fibre components were an average for neutral

detergent fibre (NDF) 44.82 % and acid detergent fibre (ADF) 39.93 % close to that of alfalfa and legume grasses. “In vitro” gas production of *B. bulgarica* biomass at 24 hour was average 257.55 dm.ml<sup>-1</sup> and at the 48 hour – 270.35 dm.ml<sup>-1</sup> (CO<sub>2</sub> and CH<sub>4</sub>), which is close to the group of legume and cereal meadow grasses. The relative feed value (RFV) of *B. bulgarica* biomass is close to perennial legumes and exceeded alfalfa (*Medicago sativa* L.) with 6 to 33 %. Regression equations were developed for advanced determining the quantity of gas production at 24 and 48 hours through the metabolizable energy (ME), MJ.kg<sup>-1</sup> DM and the Relative feed value through the neutral detergent fibre.

**5. Grozeva, N,** Pavlov, D, Petkova, N, Ivanov, I, Denev, P, Pavlov, A, Gerdzhikova, M,

Dimanova-Rudolf, M. (2015). Characterisation of extracts from *Stevia rebaudiana* Bertoni leaves. International Journal of Pharmacognosy and Phytochemical Research; 7(6); 1236-1243.

**Abstract** – *Stevia rebaudiana* Bertoni is widely used as a source of natural sweetening agent in human nutrition. The aim of present study was to characterise the leaves extracts as evaluate the polyphenol and carbohydrate contents. The effect of different particle size and various solvents on the antioxidant activity of leaves extract were also studied. The content of fructans, polyphenols, radical scavenge activity (DPPH), metal reducing activity (FRAP) in the extracts were established. It was found that the fructans amount did not depend significantly from the size of grinding (2.8 % DW). The type of the solvent had a highest effect only to the yields of the extract (from 254 mg/g DW to 377 mg/g DW). Additionally, the total polyphenols content (from 12.7 mg GAE/g DW to 15.6 mg GAE /g DW), radical scavenge activity - DPPH (from 135.8 mM TE/g DW to 221.4 mM TE/g DW) and metal reducing activity-FRAP DPPH (from 117.7 mM TE/g DW to 149.5 mM TE/g DW) were influenced mainly from the particle size and degree of grinding. The highest values of the presented parameters concerning to antioxidant activity were obtained when the dried leaves of stevia were finely ground and water were used as extracting solvent. Radical scavenge activity and metal–reducing activity correlated very well with total polyphenol content.

**6. Gerdzhikova, M.,** Pavlov, D., **Grozeva, N.,** Tzanova, M., Dimanov, D., Terzieva, S., Krastanov, J. (2018). Chemical composition, mineral content, “in vitro” gas production and relative feed value of *Stevia rebaudiana* Bertoni. Bulgarian Journal of Agricultural science, 24: 40-46.

**Abstract** – The aim of present study was to determine the chemical composition, digestibility, gas production, energy nutrition, relative feed value, and the use of *Stevia rebaudiana* Bertoni as a forage crop. The chemical composition and mineral content of biomass from *S. rebaudiana* were determined. The average crude protein content in the biomass was 86.33 g/kg of dry matter (DM); crude fat – 11.79 g/kg DM; crude fibre – 284.68 g/kg DM; ash – 96.56 g/kg DM and nitrogen free extracts (NFE) – 520.64 g/kg DM. The mineral content in the biomass of *S. rebaudiana* was similar to that of meadow grasses. Structural fibre components were on average for neutral detergent fibre (NDF) 35.52% and acid detergent fibre (ADF) 31.18% which are close to that of alfalfa and legume grasses. New data were obtained concerning in vitro gas production of *S. rebaudiana* biomass at 24 hour period – it was 225.83 dm/ml average, and at 48 hour period – 246.70 dm/ml (CO<sub>2</sub> and CH<sub>4</sub>), which is close to the group of legume and cereal meadow grasses. The relative feed value (RFV) of *S. rebaudiana* biomass is close to that of perennial legumes. Regression equations were developed for advanced determination of: the quantity of metabolizable energy (ME), through the gas production at 24 hour period; and the relative feed value (RFV) and acid detergent fibre through the neutral detergent fibre.

7. Dinev, T., Tzanova M., Rusenova N., **Grozeva N.**, Gerdzhikova M., Beev G.(2021). Antimicrobial and antioxidant potential of methanolic extracts from different parts of *Stevia rebaudiana* Bertoni cultivated in Bulgaria. Sains Malaysiana, 50(9)(2021): 2641-2651.

**Abstract** – *Stevia rebaudiana* Bertoni is a plant species, which is frequently used not only as a sweetener, but also for its antibacterial and antioxidant properties. Nowadays, there are a large number of studies on the antimicrobial and antioxidant activity of *S. rebaudiana* leaves, but there are almost no data about the antimicrobial and antioxidant potential of extracts from the other parts of *S. rebaudiana*. The aim of the present study is to provide data of the antibacterial and antioxidant potential of methanolic extracts from different parts of *S. rebaudiana* (flowers, leaves, stems, rhizomes, and tubers) cultivated in Bulgaria. Antibacterial activity of the extracts against *Staphylococcus aureus*, *Bacillus cereus* and *Escherichia coli* was evaluated by agar well diffusion method, rutin content - by HPLC method, total phenolic content and radical scavenging potential - by UV-Vis analysis. *S. rebaudiana* extracts demonstrated antibacterial activity mainly against *S. aureus* - flower extracts expressed the highest activity, followed by the leaf and stem extracts. Only flower and leaf extracts demonstrated very low antibacterial activity against *B. cereus*. *S. rebaudiana* extracts did not show any antibacterial activity against *E. coli*. Methanolic

extracts of this plant are rich in antioxidants. The highest concentrations of rutin and total phenols were found in the rhizomes of the plants, followed by the leaves, tubers, flowers, and stems, which corresponded to the radical scavenging potential of the same plant part. Comparisons between Trolox equivalents and gallic acid equivalents in different parts of *S. rebaudiana* on one hand, and Trolox equivalents and rutin concentration on the other hand showed a positive dependence and high values of the Pearson correlation - 0.9612 and 0.9707, respectively. The most important part of *S. rebaudiana* with medicinal significance (the leaves) has both comparatively good antibacterial activity and high antioxidant content, although the flowers and rhizomes expressed higher antibacterial and antioxidant activity, respectively. The experimental results imply that the cultivation area and climatic conditions of Bulgaria are very suitable for cultivation of *S. rebaudiana* plants with high content of antioxidants.

**8. Grozeva, NH.,** Gerzhikova, MA., M. T. Tzanova. (2020). Chemical composition, antioxidant activity and total phenol content of six vascular medicinal plants. Bulgarian Chemical Communications, 52, 161-167.

**Abstract** – The Bulgarian flora is rich in medicinal plants, the annually collected and exported herbs are used on the Bulgarian and international markets as a raw material for a number of medicinal, cosmetic and other objectives. Despite the exceptional biodiversity and significant resources, the antioxidant potential of Bulgarian medicinal plants is still insufficiently explored. Data on the chemical composition of a number of medicinal wild plants are not complete. The aim of this study was to determine the chemical composition, antioxidant activity and total phenol content of the aerial parts of *Artemisia annua* L. (sweet wormwood), *Artemisia vulgaris* L. (common mugwort), *Prunus laurocerasus* L. (cherry laurel), *Tanacetum vulgare* L. (common tansy), *Urtica dioica* L. (common nettle) and *Verbascum densiflorum* Bertol. (denseflower mullein) from their populations in the Thracian Lowland. The Weende method was used to determine crude protein, crude fat, crude fiber, ash, and nitrogen free extracts (NFE). The antioxidant activity was tested by determining the radical scavenging capacity of the selected species by the DPPH method and the total phenol content - by using Folin-Ciocalteu reagent and gallic acid as a standard.

9. Tzanova M.T., Gerdzhikova M.A., **Grozeva N.H.**, Terzieva S.R.(2019). Antioxidant activity and total phenolic content of five *Salvia* species from Bulgaria. Bulgarian Chemical Communication, 51 (A), 90 – 94.

**Abstract** – A lot of species of the genus *Salvia* L. are used as herbal tea. They are also applied by the food flavouring, as well as in the cosmetic, perfumery and pharmaceutical industries. The most used as a medicinal plant and the best studied species of the genus is *Salvia officinalis* L. (garden sage). The aim of the present study was to determine the antioxidant activity and total phenol content of *Salvia amplexicaulis* Lam.; *Salvia pratensis* L.; *Salvia sclarea* L.; *Salvia verticillata* L. and *Salvia aethiopsis* L., collected from their natural populations in the Thracian Lowland, Bulgaria. The methanolic extracts from the dried leaves and flowers of each species were tested for their radical scavenging capacity by DPPH method and the total phenol content by using of Folin-Ciocalteu reagent and gallic acid as a standard. The observed Pearson correlation between the measured quantities demonstrated a coefficient of 0.9565 at significance level  $p \leq 0.01$ . The tested species showed large total phenolic contents: from  $906 \pm 90$  to  $1795 \pm 153$  mmol GAE/kg DM and from  $1746 \pm 151$  to  $4555 \pm 410$  mmol GAE/kg DM of the methanolic extracts of leaves and flowers, respectively. The tested antioxidant capacities were found to be in the range from  $21.8 \pm 1.8$  to  $59.9 \pm 5.0$  mmol TE/kg DM and from  $49.3 \pm 4.5$  to  $89.0 \pm 7.8$  mmol TE/kg DM of the methanolic extracts of leaves and flowers, respectively. The results of the investigations showed that *Salvia verticillata* is the favorite *Salvia* species with the highest total phenol content and antioxidant activity.

10. Gerdzhikova, M.A., **Grozeva, N.H.**, Tzanova, M.T., Terzieva, S.R.(2020). Determination of total phenol content and antioxidant activity of five medicinal plants growing in Bulgaria. Bulgarian Chemical Communications, 52, 155-160.

**Abstract** – Interest in natural compounds with antioxidant activity as alternatives to commercial antioxidants has increased in recent years. Herbal extracts are well recognized sources of antioxidants. The phenols contained therein, including flavonoids, have been increasingly identified by many researchers as important dietary antioxidant factors. Studies have shown that there are differences in the content of bioactive substances in plants collected from different geographical regions. About 750 species in the Bulgarian flora are medicinal and have not yet been sufficiently studied. Because of this, in the present paper the total polyphenol content and antioxidant activity of some populations of *Equisetum arvense* L., *Equisetum telmateia* Ehrh.,

*Juniperus communis* L., *Lavandula angustifolia* Mill. and *Rosmarinus officinalis* L. were evaluated. In *Juniperus communis* the highest total phenol content of 946 mg GAE.kg-1 DM and antioxidant activity of 58.5 mmol TE.kg-1 DM were measured.

#### **Участие в научни форуми, индексирани в Web of Science и Scopus**

**11.** Panayotova G., **Grozeva, N.**, Todorova, M., Gerdzhikova, M. (2015). Seed germination of *Betonica bulgarica* Deg. et Neic under the influence of different treatments and seed quality. Scientific Papers. Series A. Agronomy, Vol. LVIII, 2015: 284-290.

**Abstract** – *Betonica bulgarica* Degen & Nejeff is a Bulgarian endemic species protected under the Biological Diversity Act and included in the Red Data Book of the Republic of Bulgaria, vol.1. Plants and fungi in the category “endangered“. The aim of this research was to study seeds germination of endemic species *Betonica bulgarica* Deg. et Neic, as well as 1000 seeds weight of four natural habitats from the Nature Park Sinite Kamani, Bulgaria. Harvested seeds from plants in the Sinite Kamani Nature Park were collected by means of insulators to assist the natural reproduction of the populations. The seed germination was studied in petri dishes after different temperature treatments - in a laboratory at 15°C, in a thermostat at 20°C and 25°C, at a temperature of 5°C, treated with water at 35°C, and direct sowing in the soil without any treatment. It was found that *B. bulgarica* is characterized by a prolonged period of germination and emergence. The best results were achieved after direct sowing in soil - 35.0%, followed by seeds placed for germination in laboratory conditions at 15°C - 25.0 %. Treatments of stratification and hot water at 35°C did not give good results for seed germination. The 1000-seed weight of four populations was an average of 0.971 g, from 0.840 to 1.055 g.

**12.** **Grozeva, N.**, Panayotova, G., Gerdzhikova, M., Todorova, M. (2020). Possibilities for ex situ conservation of bulgarian endemic *Betonica Bulgarica* Degen. & Neič. Scientific Papers. Series B, Horticulture. Vol. LXIV, No. 1, 2020 Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653, 578-584.

**Abstract** – The Bulgarian endemic *Betonica bulgarica* Degen. & Neič. is a protected species included in the Red Data Book of the Republik of Bulgaria vol.1. Plants and fungi. On the territory of “Sinite Kamani” Natural Park it forms populations in Ablanovo area, Slancheva polyana area, Upper lift station area and Karandila area. Main threats to the populations in the

Park are the anthropogenic impact, difficult seed reproduction, soil erosion processes and the spread of eagle fern (*Pteridium aquilinum*) in the border areas of the population in Slancheva polyana area. According to evaluations, both in-situ, and ex situ conservation measures should be included for the protection and stabilization of populations of *Betonica bulgarica*. The aim of this study was to develop a technology for growing species from mature seeds in laboratory conditions. In order to realize the objective, a vast amount of literature was studied and biennial field research of the populations in the “Sinite Kamani” Natural Park was conducted. The developed technology is successful and fully complies with the environmental conditions of the natural habitat of the species in the Park. Using it, the species has been successfully propagated in the scientific laboratories of the Faculty of Agriculture at Trakia University from mature seeds to 6-8 leaves (phenophase) for replenishment of the populations. The technology can be used to replenish other natural populations of *Betonica bulgarica* in Bulgaria. In order to determine the effectiveness of the application of this measure for ex-situ conservation is necessary to continue observations after introduction of the plants grown in laboratory conditions, to follow their adaptation and further development, and if necessary to protect them and stabilize their condition.

**Научни публикации в издания, които са реферирани и индексирани в световноизвестни бази данни с научна информация (Web of Science и Scopus), извън хабилитационния труд**

**13.** Tzanova, M., Grozeva, N., Gerdzhikova, M., Atanasov, V., Terzieva, S., Prodanova, R. (2018). Biochemical composition of essential oil of Corsican *Helichrysum italicum* (Roth) G. Don, introduced and cultivated in South Bulgaria. Bulgarian Journal of Agricultural Science, 24 (6). 1071-1077.

**Abstract** – This study provided GC-FID and GC-MS analysis of the volatile constituents of *Helichrysum italicum* (Roth) G. Don, introduced from Corsica (France), cultivated in South Bulgaria, harvested in different phenological stages – floral budding period and flowering period, and compared its quality to the quality of the species of native origin. Similarities in qualitative, but with differences in quantitative composition of their essential oils were indicated, because of the different environmental conditions. 41 components were identified, representing 89.25-95.63% of the total essential oil composition. In the essential oil of H. italicum, harvested in the



floral budding period, the content of sesquiterpenes and oxygenated monoterpenes were higher. The essential oil had a good, balanced content of monoterpenes, sesquiterpenes and their oxidized derivatives, like  $\alpha$ - and  $\gamma$ -curcumene, neryl acetate,  $\alpha$ -pinene,  $\alpha$ -copaene, limonene, cis- and trans- $\alpha$ -bergamotene,  $\beta$ -caryophyllene, eudesm-5-en-11-ol and selina-4,11-diene. Cultivating ability of these plant species opens up new opportunities for the food, pharmaceutical and cosmetic industries.

**14. Grozeva, N., Todorova, M., Pavlov, D. (2019).** Karyological and morphological variation within *Petrosimonia brachiata* Bunge in Bulgaria. *Botanica serbica*, 43 (1): 13-21,

**Abstract** – We studied karyological and morphological variability of the only representative of the genus *Petrosimonia* (Amaranthaceae) in Bulgaria and evaluated the current state of its populations in the country. The results indicated that Bulgarian populations of *Petrosimonia brachiata* have a diploid chromosome number of  $2n = 16$ . In the population from the Pomorie Lake, the karyotype consists of six pairs of metacentric and two pairs of sub-metacentric chromosomes. In the population from the Atanasovsko Lake, satellites were observed on one pair of submetacentric chromosomes. Statistical analysis demonstrated that the main source of phenotype variation in the species is within the populations. Vegetative traits are more variable than generative ones. No significant variability was found in the studied quantitative characteristics or pollen morphology. Given the biological type of the species (annual) and its limited distribution in Bulgaria, the status of the two populations of *P. brachiata* cannot be regarded as stable, and the danger of a potential threat to them in the future is a possibility not to be excluded.

**15. Georgieva, S., Gencheva, D., Popov, B., Grozeva, N., Zhelyazkova, M. (2019).** Radioprotective action of resurrection plant *Haberlea rhodopensis* Friv. (Gesneriaceae) and role of flavonoids and phenolic acids. *Bulgarian Journal of Agricultural Sciences*, 25(6): 158-168.

**Abstract** – *Haberlea rhodopensis* Friv. (Gesneriaceae) is a Balkan endemic and resurrection glacial relict plant which is distributed in Bulgaria (Rhodope Mountains, Sredna Gora Mt. and Central Balkan). Currently, there is a huge interest in *Haberlea rhodopensis*, and several scientific studies aimed at the isolation and identification of its active components as well as the investigation of the pharmacological effects and possibilities of the use of *Haberlea rhodopensis* as a medical plant have been conducted. The main effects of *Haberlea rhodopensis* include

radioprotective, anti-mutagenic, antioxidant and anti-ageing properties. This review emphasises the radioprotective potential of *Haberlea rhodopensis* and focuses on the biological properties of its ingredients like flavonoid aglycones and glycosides as well as phenolic acids in relation to their capacity to capture free radicals and reduce oxidative stress. More research on animals and humans are needed for clarification of the mechanisms of action and the eventual side effects of *Haberlea thodopensis* and its compounds as radioprotective agents.

**16.** Petkova, N., Bileva, T., Valcheva, E., Dobrevska, G., **Grozeva, N.**, Todorova, M., Popov, V. (2019). Bioactive compounds and antioxidant activity in apple fruits cultivar Florina, Bulgarian Journal of Agricultural Sciences. 25(6): 13-18.

**Abstract** – The consumption of different apple cultivars contributes to improved human health by reducing the risk of cardiovascular disease and cancer. Apple fruit is a major source of phenolic compounds, dietary fibers (pectin and cellulose) and antioxidants. The current review demonstrates the nutritional potential of apple cultivar Florina and focused on the chemical composition and antioxidant potential of its fruits. Physicochemical characteristics such as moisture and ash content, phytochemical composition including sugar content, organic acids, phenolic acids (hydroxycinnamic acid), flavonols, dihydrochalcones, anthocyanins, mineral composition in apple cultivar Florina were summarized. Moreover, the present study evaluated the antioxidant potential of Florina apple fruits for healthy nutrition.

**17.** Zhelyazkova, M., Georgieva, S., **Grozeva, N.** (2019). Study of population variability of the endemic species *Moehringia grisebachii* Janka (Caryophyllaceae) in Bulgaria. Bulgarian Journal of Agricultural Sciences, 25(6): 169-177,

**Abstract** – *Moehringia grisebachii* Janka is a Balkan endemic species spread on the territory of Bulgaria, Romania and Turkey. In the present study were included 17 populations of *M. grisebachii* from Bulgaria. Morphometric measurements of 24 quantitative traits were performed in all populations. On the base of the data obtained, within population and between population variability was examined. A comparative analysis has been made and similarities and differences have been identified. Dominant in total variability was within populations variability (63.87%). The impact of environmental conditions on measured quantitative traits was reported and as the more important factors the longitude and elevation were pointed out. The results obtained are of

importance in the development and updating of the conservation programs for keeping and trust of the genetic diversity and the protected species included in the Red Data Book of Bulgaria.

**18. Grozeva, N.,** Atanassova, S. (2019). Karyology of *Chenopodiastrum* S. Fuentes et al. (Amaranthaceae) from Bulgaria. Bulgarian Journal of Agricultural Sciences, 25(6): 131-135,

**Abstract** – The karyotypes of *Chenopodiastrum murale* and *Chenopodiastrum hybridum* were examined for the first time in their Bulgarian populations. Diploid chromosome number  $2n = 18$  was found. The karyotype of 8 pairs of metacentric and 1 pair of submetacentric chromosomes was established for the *C. murale* populations. The total length of the chromosomes varied from 1.4 to 2.55  $\mu\text{m}$ . For the populations of *C. hybridum* the submetacentric pairs of chromosomes were a total of 3 pairs and the metacentric, respectively, were 6 pairs. The total length of the chromosomes varied from 1.42 to 5.7  $\mu\text{m}$ . Clustering of the species based on karyotype features grouped them into separate clusters. Higher values for mean centromeric asymmetry (Mca) is registered for *C. hybridum*. Idiograms of the studied populations were presented.

**19. Grozeva, N.,** Atanassova, S., Terzieva, S. (2019). Karyological study of genus *Oxybasis* Kar. & Kir. in Bulgaria. Bulgarian Journal of Agricultural Sciences, 25(6): 124-130,

**Abstract** – A karyological study of *Oxybasis chenopodioides*, *O. glauca*, *O. rubra* and *O. urbica* was conducted and the karyotype morphology from their Bulgarian populations was reported for the first time. The studied species showed  $2n = 2x = 18$  and differed significantly in total size of chromosomes, the size of the long and the short arms. The karyotype consists of metacentric and submetacentric chromosomes and their size varied from 0.8 to 3.12  $\mu\text{m}$ . Clustering of the species based on karyotype features grouped them in 2 clusters: *O. chenopodioides* with *O. glauca* and *O. rubra* with *O. urbica* with greater karyotype similarity found between *O. rubra* and *O. urbica*. The idiograms of all studied populations have been illustrated.

**20. Terzieva, S.,** Velichkova, K., **Grozeva, N.,** Valcheva, N., Dinev, T. (2019). Antimicrobial activity of *Amaranthus* spp. extracts against some mycotoxigenic fungi. Bulgarian Journal of Agricultural Sciences, 25(6): 120-123,

**Abstract** – Plants, their parts and products have been used to treat diseases and pathogens. The aim of the present study was to test different extracts from three species of genus *Amaranthus* L.- *A. deflexus* L., *A. retroflexus* L. and *A. hybridus* L. for antifungal activities. The plant extracts

(methanol and ethanol) from ground and underground plant parts were tested for antimicrobial activity by agar well diffusion method. Five fungal strains (*Penicillium verrucosum* var. *verrucosum* NBIMCC 2003 NRRL F-143, *Penicillium expansum*, *Fusarium graminearum* NBIMCC 2294 IMI 155426, *Aspergillus ochraceus* NBIMCC 2002 IM-BAS, *Aspergillus niger*) were used. Antimicrobial activity was evaluated by measuring zones of inhibition of microbial growth surrounding plant extracts in the wells. The most effective extracts, which showed activity against all tested strains of microorganisms, were *A. deflexus* and *A. hybridus* ethanol flower extract, *A. retroflexus* ethanol root extract and *A. retroflexus* methanol leaves and stem extract.

**21.** Terzieva, S.R., Grozeva, N.H., Velichkova, K. N. (2019). Morphological studies on three *Amaranthus* species. Bulgarian Journal of Agricultural Sciences, 25(6): 136-140,

**Abstract** – The study examined indumentum, stomata and pollen morphology of *Amaranthus deflexus* L., *A. hybridus* L. and *A. retroflexus* L. from their Bulgarian populations. Mature pollen and herbarized plant parts have been observed and photographed with a scanning electron microscope (SEM). The indumentum of the three species is of multicellular, unbranched, uniseriate, glandular trichomes. Three types of stomata have been registered-anomocytic, paracytic and anisocytic with the latter type being the dominant one. Paracytic type were observed only in *A. deflexus*. Pollen grains were spheroidal, pantoporate, scabrate, with diameter from 15.4 to 24.2  $\mu\text{m}$ . Among the studied three species differences in pollen morphology have been found in *A. deflexus*.

**22.** Zhelyazkova, M., Georgieva, S., Kostova, M., Gencheva, D., Grozeva, N. (2019). Preliminary study on genetic diversity in *Moehringia jankae* Griseb. ex Janka based on inter-simple sequence repeat (ISSR) markers. Bulgarian Journal of Agricultural Sciences, 25(6): 148-157,

**Abstract** – Genetic diversity among eleven natural populations of the *Moehringia jankae* species, Caryophyllaceae family, spread in the Sinite Kamani Natural Park in Bulgaria was assessed by inter-simple sequence repeats (ISSR) markers. A total of 68 loci were identified by using 5 selected ISSR primers, of which 59 are polymorphic and 9-monomorphic. Presences of 3 specific ISSR bands were reported in the Mj1, Mj5 and Mj9 population. For the primers used, mean values of the polymorphic information content (0.64), effective multiplex ratio (4.53),

resolving power (27.66) and marker index (2.84) have been calculated. Shannon's information index ( $I = 0.226$ ), expected ( $H_e = 0.149$ ) and unbiased expected ( $uH = 0.165$ ) heterozygosity, estimated based on molecular characteristics demonstrate a significant level of intra-species genetic diversity of *M. jankae*. Cluster analysis, Principal component analysis (PCA) and Principal coordinate analysis (PCoA) divide the studied plant populations into 2 main clusters- first (A) comprises Mj7, Mj8 and Mj10, and Mj1, Mj11, Mj9, second one (B) consists of 2 subclusters, too with Mj5 and Mj6 being in the first one, and Mj2, Mj4 and Mj3 in the second one. The current data complement the studies in the area of genetic resources, therefore they could be included in conservation programs for protection of rare and endangered plant species.

**23.** Tzanova, M., Atanasov, V., Ivanov, M., Iliev, A., Atanassova, S., Peeva, P., **Grozeva, N.**, Gerdzhikova, M., Dinev, T. (2019). Antioxidant constituents and antioxidant activity of some red wine and red table grape varieties, cultivated in different regions of Bulgaria. *Bulgarian Journal of Agricultural Sciences*, 25(6): 3-12,

**Abstract** – Foods that have a positive effect on human health are becoming more and more popular nowadays. Such foods are the grapes-rich in phenolic compounds, which are known as very potent bio-antioxidants. This paper presented a research made for the first time-twelve red wine varieties (Rubin, Kaylashki Rubin, Storgozia, Mavrud, Nikopolski Mavrud, Melnik 55, Bouquet, Cabernet Sauvignon, Merlot, Syrah, Mourvedre and Malbec) and eight red table varieties (Velika, Dunav, Siyana, Hybrid V5-1, Muskat Hamburg, Moldova, Palieri and Black Pearl), cultivated in different regions of Bulgaria were tested for their antioxidant activity (AA) and contents of total phenols (TPC), trans-resveratrol (t-RVT) and quercetin (QU). In the grape skins the parameters ranged: t-RVT-from  $2.05 \pm 0.21$  to  $14.34 \pm 1.35$  and from  $1.44 \pm 0.17$  to  $23.71 \pm 2.53$  mg/kg FW; QU-from  $0.27 \pm 0.03$  to  $1.98 \pm 0.18$  and from  $0.63 \pm 0.07$  to  $2.12 \pm 0.20$  mg/kg FW; TPC-from  $17 \pm 2$  to  $371 \pm 33$  and from  $21 \pm 2$  to  $444 \pm 43$  mmol GAE/kg dm and AA-from  $23.2 \pm 1.9$  to  $59.9 \pm 5.5$  and from  $32.4 \pm 2.8$  to  $66.4 \pm 6.3$  mmol TE/kg dm for wine and table grapes, respectively. The table grape varieties had higher mean values of the parameters examined than the wine grape varieties. South Bulgaria have grape varieties with higher values of the antioxidant parameters with comparison to North Bulgaria. But, Danubian region, North Bulgaria, have wine and table grape varieties with very good antioxidant parameters and can't be ignored. The reason for this is the agrometeorological conditions. The correlations between the determined values were positive with very high correlation coefficients.

**24. Grozeva, N.,** Zhelyazkova, M., Gerdzhikova, M., Tzanova, M., Pavlov, D., Georgieva, S., Georgiev, D. (2020). Morphological and karyological variability of the Balkan endemics *Moehringia jankae* Griseb. ex Janka and *Moehringia grisebachii* Janka (Caryophyllaceae) from Eastern Balkan Range (Bulgaria). Bulgarian journal of agricultural science, 26:30-47.

**Abstract** – Seven populations of *Moehringia jankae* and eleven populations of *M. grisebachii* at Eastern Balkan Range-Sinite Kamani Natural Park were morphologically and karyologically tested. The chromosome numbers, the karyotype characteristics and the stomata type of *M. grisebachii* and *M. jankae* were described. Intrapopulation, interpopulation and interspecies variabilities were established. The chromosome number  $2n = 2x = 24$  have been found in all studied populations. The karyotypes of *M. jankae* and *M. grisebachii* consist of metacentric and submetacentric chromosomes, differences in morphology and size of chromosomes have been identified and in the studied populations of *M. grisebachii* were established one pair of chromosomes with satellites. The main source of phenotype variation was intrapopulation variability mainly due to characteristics of habitats of both species and their biological type. More variable in all populations of *M. jankae* and *M. grisebachii* were vegetative traits and the most variable was height of stem. The registered interpopulation variability was affected by the differences in the karyotype, the altitude, the exposure and the type of rock, number and area of population. Indumentum, dimensions of leaves and flowers and morphological features of pollen and seeds had taxonomic significance for distinguishing *M. jankae* from *M. grisebachii*.

**25. Tzanova, M.,** Atanassova, S., Atanasov, V., **Grozeva, N.** (2020). Content of polyphenolic compounds and antioxidant potential of some bulgarian red grape varieties and red wines, determined by HPLC, UV, and NIR spectroscopy. Agriculture (Switzerland), 10(6), pp. 1-14,

**Abstract** – Today, good food criteria also include healthy capacity. So, the wine on our table should not only have good organoleptic qualities, but should be characterized by a high healthy potential. For the first time, extensive research was conducted on commercial red wine grape varieties cultivated in different Bulgarian regions in two consecutive years. Antioxidants, including trans-resveratrol, quercetin, and total phenolic content and antioxidant potential in wine grapes and wines were determined by HPLC, UV, and NIR methods. The results obtained showed similar concentration levels compared to the same varieties, produced in other countries. Trans-resveratrol showed the greatest contribution to the radical scavenging capacity. The factor with largest impact on the content of the tested substances was definitely the variety. Among

agro-meteorological condition, temperature amplitude, rain fall, and UV irradiation before ripening had strong influences. Maintaining the balance between the level of synthesized and degraded and captured antioxidants during the wine making process was crucial to preserving the antioxidant properties of the final wine product. NIR spectroscopy showed very good accuracy of determination of trans-resveratrol, quercetin, total phenolic content, and the antioxidant activity of tested grape varieties and red wines. It could be a promising technique in the quantification of their antioxidant parameters.

**26.** Zhelyazkova, M., **Grozeva, N.**, Georgieva, S. (2020). Karyotype studies of endemic species *Moehringia grisebachii* (Caryophyllaceae) from Sredna gora mts, Bulgaria. Bulgarian Journal of Agricultural Science, 26(1): 202-206.

**Abstract** – The chromosome number and karyotype of the Balkan endemic species *Moehringia grisebachii* are described for the first time. Plant material was collected from 10 populations spread in Sredna Gora Mts., Bulgaria. Basic chromosome number  $x = 12$  and diploid chromosome number  $2n = 24$  have been established. Metacentric and submetacentric chromosomes have been registered with the metacentric ones being dominant. Differences have been found among the studied populations in the chromosome size and morphology. Microphotographs of somatic metaphase plates and idiograms of all studied populations are presented.

**27.** Zhelyazkova, M., **Grozeva, N.**, Georgieva, S. (2020). Karyological study of Balkan endemics *Moehringia jankae* Griseb, and *Moehringia grisebachii* Janka (Caryophyllaceae) in Bulgaria. Bulgarian Journal of Agricultural Science, 26: 58-71.

**Abstract** – The study presents the somatic chromosome number of *Moehringia jankae*  $2n = 24$ , and confirms the one for *Moehringia grisebachii*  $2n = 24$ . The karyotype morphology of ten populations of the two species were described in detail. Karyotype variability was registered for *M. jankae* (Hcl = 17.99-37.58) and *M. grisebachii* (Hcl = 15.30-36.63), while the chromosome analysis showed mainly metacentric and submetacentric chromosomes for both species. Five different karyotypes were registered for all studied populations. Based on the calculated values of Mca (0.46-1.34 and 0.55-1.21), A1 (0.117-0.141 and 0.117-0.217), TF% (41.97-47.26 and 42.76-46.73) and Ask% (52.74-58.03 and 53.27-57.24), it was determined that the karyotype of

*M. jankae* and *M. grisebachii* is symmetric. The chromosome number of *M. jankae* is announced for the first time.

**28.** Gerdzhikova, M., Todorova, M., **Grozeva, N.**, Dobreva, A., Petkova, N. (2022). Chemical composition, *in vitro* gas production and relative feed value of rose flower wastes (*Rosa damascena* Mill.) from conventional and organic production. Bulgarian Journal of Agricultural Science, 28 (No 2) 2022, 291-298.

**Abstract** – The oil-bearing rose is one of the main essential oil crops grown in Bulgaria. During the processing of rose flowers rose oil, rose concrete, rose absolute, and rose water are obtained. Waste rose flowers after the distillation of the essential oil still have a limited usage. The objective of the present study is to determine the chemical composition, *in vitro* gas production, digestibility and relative feed value of waste flowers of *Rosa damascena* Mill. and their suitability for use as forage. The rose flowers were collected from six fields located in the Kazanlak valley, Southern Bulgaria: three of them are with organic rose production and three are conventional. After their distillation the chemical composition of rose wastes was determined: crude protein, crude fat, crude fibre, ash and nitrogen-free extracts (NFE). Comparative analysis of the chemical composition, structural fibre components: neutral detergent fibre (NDF) and acid detergent fibre (ADF), *in vitro* gas production and relative feed value (RFV) of rose wastes was made under the conditions of the two production systems.

**29.** **Grozeva, N.**, Atanassova, S. (2022). Karyological and morphological variability of *Suaeda salsa* (L.) Pall. in Bulgaria. Bulgarian Journal of Agricultural science, 28(2), 305-313.

**Abstract** – The karyological and morphological intrapopulation and interpopulation variability of *Suaeda salsa* populations in Bulgaria have been studied in quest of reliable characteristics to distinguish the species from the remaining members of the genus. In all studied populations a tetraploid chromosome number  $2n = 36$  and a karyotype of metacentric and submetacentric chromosomes have been registered with the metacentric ones being dominant. Vegetative traits are more variable than generative ones. More pronounced is the interpopulation morphological variability, which is probably due to the different environmental conditions, and in some of the populations it also correlates with the recorded karyotype differences. Two types of stomata have been registered: anomocytic and paracytic. Data about the pollen have been presented:



pantoporate, spherical, with diameter from 21.1 to 25.81  $\mu\text{m}$  and pore diameter from 1.91 to 2.46  $\mu\text{m}$ . The karyotype has been described for the first time and data have been published about the type of stomata and pollen morphology of *S. salsa* from Bulgarian populations.

**30.** Todorova, M., Dobрева, A., Petkova, N., **Grozeva, N.**, Gerdzhikova, M., Veleva, P. (2022). Organic vs conventional farming of oil-bearing rose: Effect on essential oil and antioxidant activity. In: Chankova S, Peneva V, Metcheva R, Beltcheva M, Vassilev K, Radeva G, Danova K (Eds) Current trends of ecology. BioRisk 17: 271-285.

**Abstract** – The aim of this study was to establish whether the type of the agricultural system has any influence on the essential oil production and antioxidant activity of industrial cultivated *Rosa damascena* Mill. in the Rose valley, Bulgaria. Six private farms from Kazanlak (Rose) Valley, Southern Bulgaria were included in the study conducted in the period 2019–2020. The first three selected farms are designated within the conventional farming and the other three are certificated as organic farms. GC/FID and GC/MS analyses were performed; the contents of total polyphenols and flavonoids in the methanol extracts from rose petals were determined. Additionally, the antioxidant activity of rose extracts was evaluated by four reliable methods: 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2'-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid (ABTS), ferric reducing antioxidant power (FRAP), and cupric reducing antioxidant capacity (CUPRAC) assays. The impact of the agricultural system on the essential oil composition and antioxidant activity was evaluated by ANOVA statistical analysis. The results obtained showed that organic farming produced essential oil with a higher linalool and geraniol content and lower  $\beta$ -citronellol + nerol concentrations than conventional farming. It was found that organic farming production demonstrated a better antioxidant activity evaluated by the three DPPH, ABTS, and CUPRAC methods according to the averaged data for two years, 806.82, 797.66 and 1534.40 mM TE/g dw versus 510.34, 521.94 and 917.48 mM TE/g dw for CF, respectively, with high statistical significance for the DPPH and ABTS analyses. Consequentially, the rose extracts from the organic farming accumulated more phenolic compounds that corresponded to the higher antioxidant potential of the organic roses.

## Участие в научни форуми, индексирани в Web of Science и Scopus

**31.** Zhelyazkova, M., Georgieva, S., **Grozeva, N.** (2021). Genetic diversity of the balkan endemics *Moehringia janka* Griseb. ex Janka and *Moehringia grisebachii* Janka (Caryophyllaceae) from Bulgaria using ISSR markers. *Ecologia balcanica*, Special Edition 4: 191-206.

**Abstract** – Eleven populations of the endangered plant *Moehringia janka* and twenty-eight of the rare plant *Moehringia grisebachii* were collected across its natural range from Bulgaria. Their genetic diversity was investigated through fifteen selected Inter Simple Sequence Repeats (ISSR) primers. The ISSR primers produced a total of 285 bands, of which 275 were polymorphic and 10 – monomorphic. Capability of the primers was assessed through the high mean values for the polymorphic information content (0.78), effective multiplex ratio (14.73), resolving power (27.90) and marker index (11.36). Based on the obtained mean values of the molecular data the species *M. grisebachii* (effective number of alleles = 1.39, Shannon's information index = 0.38, expected heterozygosity = 0.24, Nei's genetic diversity = 0.25, gene flow = 0.65) demonstrated higher genetic diversity than the species *M. janka* (effective number of alleles = 1.28, Shannon's information index = 0.26, expected heterozygosity = 0.17, Nei's genetic diversity = 0.23, gene flow = 0.52). These results were supported by Analysis of molecular variance (AMOVA), showing higher variability within populations of *M. janka* (90%) and *M. grisebachii* (62%), than among populations - 10% and 38%, respectively, and 25% among both species. Neighbor joining and principal coordinate analysis (PCoA) grouped the thirty-nine studied populations by species and region of spread. The data are applicable in conservation programs for protecting and keeping of both species. The registered genetic similarity between the populations of the two species (from Eastern Balkan Range) does not exclude the possibility of hybridization between their natural populations.

**32.** Petkova, N. Tr., Kuzmanova, S., Bileva, T, Valcheva, Ek., Dobrevska, G., **Grozeva, N.,** Popov, V. (2021). Influence of conventional and organic agriculture practices on the total phenols and antioxidant potential of Florina apple fruits. *IOP Conf. Series: Materials Science and Engineering* 1031 012088 IOP Publishing doi:10.1088/1757-899X/1031/1/012088.

**Abstract** – The aim of the current study was to evaluate the influence of conventional and organic growing conditions on the total phenolic content, the total flavonoids content, the total

monomeric anthocyanins content and the antioxidant potential in the apple fruits of Florina variety. The samples were grown and collected from the experimental fields, around Plovdiv and the village of Brestnik. The total phenolic content, the total flavonoids, the total monomeric anthocyanins content were determined. The antioxidant potential was evaluated by four different assays. The apple fruits grown under organic conditions contained higher total phenolics and they showed stronger antioxidant activity than fruits from the conventional conditions. The total phenolic content was from 3 to 5 mg gallic acid equivalent/g dry weight. The total flavonoids were below 1 mg quercetin equivalents/g dw. In the organically grown fruits, the average values for antioxidant activity varied from 30 to 100 mM Trolox® equivalent/g dw. The total monomeric anthocyanins in the organically grown apples their levels were the highest (67 mg cyn-3-glc/100 g dw). There was a positive, high correlation between antioxidant methods and the total phenolic content and total monomeric anthocyanins. These results indicated that organically grown apples accumulated higher levels of antioxidants and bioactive compounds, in comparison to conventionally grown apples.

**33.** Todorova, M., Petkova, N., **Grozeva, N.**, Gerdzhikova, M., Lazarova, S. (2020). NDVI, chlorophyll and carotenoids content of leaves of *Rosa damascena* Mill under organic and conventional farming. IOP Conference Series: Materials Science and Engineering, 2021, 1031(1), 012013.

**Abstract** – The aim of our study was to compare NDVI index, total nitrogen, chlorophyll and carotenoids content of leaves of oil-bearing roses cultivated under organic and conventional agricultural systems in order to find impact of farm management on the physiology status of *Rosa damascena* Mill. leaves. The experiment was conducted on six private arable areas with *Rosa damascena* in Rose valley, Southern Bulgaria. The selected study area size was 5000 m<sup>2</sup> from each private territory. Three of the oil-bearing rose plantations are certified as organic farming and have been applied an organic agriculture system and the rest of them are characterized as conventional farming. NDVI index of the leaves of *Rosa damascena* was measured with Plant Pen 310 device in the field. The same leaves were picked up for future laboratory analysis. The total chlorophyll and carotenoids, µg/g dw content of leaves in the 80 % acetone were determined, total nitrogen by Kjeldahl method as well. Linear discriminant analysis (LDA) was performed to classify *Rosa damascena* leaves on the base of NDVI and photosynthetic pigment content according to relevant farm management. The results from

conventional rose bushes leaves contained statistically proven higher total chlorophyll and lower total carotenoids than leaves belonging to organic oil-bearing roses cultivation. It is worthwhile to continue investigations with NDVI leaves measurements as a promising tool for recognition organic or conventional farm production.

**34.** Todorova, M., **Grozeva, N.**, Gerdzhikova, M., Dobрева, A., Terzieva, S. (2020). Productivity of oil-bearing roses under organic and conventional systems. Scientific Papers. Series A. Agronomy, Vol. LXIII, No. 1, 2020, ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785, 580-585.

**Abstract** – Organic production and markets are expanding rapidly. A field study was carried to compare effects of different agriculture soil system on productivity of *Rosa damascena* Mill. and *Rosa damascena* x *Rosa gallica*. The experiment was conducted on six private arable areas with oil bearing rose in Rose valley, Southern Bulgaria. The selected study area size was 5000 m<sup>2</sup> from each private territory. The flowers of *R. damascena* were picked up in the morning (6:00-8:00 a.m.), in 3, 4 and 5 phases. The productivity was determined as essential oil content in the blossoms. Soil samples were also collected from every study area from surface horizon 0-30 cm. The samples were analyzed for several soil parameters as, organic matter content, pH values, available nitrogen, phosphorus and potassium content. Statistical analysis was done with Unscrambler (Camo, Norway) software packages. The agricultural system of the oil bearing rose (*Rosa damascena* Mill.) grown has an effect on the essential oil content. The mean value of essential in organic production = 0.026% is statistically proven lower than conventional production = 0.038%.

**35.** Petkova, N., Todorova, M., **Grozeva, N.**, Gerdzhikova, M. (2020). Phenolic content and antioxidant activity of water extracts from *Rosa damascena* petals grown in Kazanlak Valley, Bulgaria. Scientific Papers. Series B, Horticulture. Vol. LXIV, No. 1, 2020 Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653.

**Abstract** – The current study aimed to evaluate the phenolic content, total flavonoid content, as well as the antioxidant activity in water extracts obtained from *Rosa damascena* petals grown in Kazanlak valley, Stara Zagora region, Bulgaria. The rose samples were collected during May 2019 from the plantations in Skobelevo, Asen, Iasenovo, and Koprinka villages grown under different conditions. The contents of total polyphenols and flavonoids in the water extracts from

rose petals were determined. Additionally, the antioxidant activity of rose water extracts was evaluated by four reliable methods: 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2'-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid (ABTS), ferric reducing antioxidant power (FRAP) and cupric reducing antioxidant capacity (CUPRAC) assays. The highest values of total phenols and flavonoids were found in the rosewater extract from organically grown plantation:  $47.09 \pm 2.89$  mg GAE/g dry weight and  $6.87 \pm 3.00$  mg QE/g dry weight, respectively. The highest radical scavenging activity demonstrated the extracts from organic plantations, while the metal-reducing assays showed higher antioxidant potentials in the extracts from conventionally grown roses. The results demonstrated the potential application of these edible flowers rose extracts as ingredients or additives for food and cosmetic purposes with the potential antioxidative properties.

**36.** Petkova N., M. Ognyanov, S. Kuzmanova, T. Bileva, E. Valcheva, G. Dobrevska, N. **Grozeva**, 2020. Carbohydrate content of “Florina” apples grown under organic and conventional farming systems, Proceedings of the 16th International Conference on Polysaccharides-Glycoscience Prague 4th - 6th November 2020, ISBN 978-80-88307-05-1 ISSN 2336-6796, 98-101.

**Abstract** – The aim of the current study was to evaluate the carbohydrate content of apple fruit cultivar “Florina” grown under organic and conventional farming systems. The total carbohydrate content was in the range from 67.8 to 63.6 g/100 g dry weight. Sucrose, fructose, glucose, and sorbitol were detected in all apple samples, as their content was the highest in the organically grown fruits. In general, organically grown apples contained the highest level of polysaccharides as pectin (4.6% g/100 g dry weight) and cellulose (4.6% g/100 g dry weight). In conclusion, the organically grown apples were evaluated as the sweetest ones with sweetness index (SI) 69 and with the highest fiber content, due to the high cellulose and pectin content, respectively.

**37.** Todorova, M., **Grozeva, N.**, Takuchev, N.P., Velichkova, R., Boneva, V. (2021). Vegetation in Bulgaria according to data from satellite observations and NASA models. IOP Conference Series: Materials Science and Engineering , 2021, 1031(1), 012083.

**Abstract** – Introduction. The condition of the vegetation cover can be traced from Space. Aim of the research. To assess the condition of the vegetation cover in Bulgaria during the last twenty years – its distribution over the country, its change in connection with the typical climatic

changes, its seasonal change. Material and methods. The vegetation index NDVI according to NASA data was used to analyze the condition of the vegetation cover in Bulgaria for the years 2000 - 2020. The methods used were: seasonal data decomposition, t-test, GIS methods for spatial representation of data, Fourier analysis. Conclusions. 1. During the summer months the vegetation in the eastern parts of the territory of Bulgaria is noticeably weaker than in the western parts. The influencing factors - drought and frequent fires are probably related to global warming. 2. For the territory of Bulgaria there is a seasonal rotation of the horizontal gradient of the vegetation index in a counterclockwise direction - from east to west in summer, from northeast to southwest in autumn and from north to south in winter. 3. There is a winter increase in vegetation for Northern Bulgaria and to the greatest extent for Northeastern Bulgaria, as well as for Southwestern Bulgaria. Together with the decreasing snow cover, the winter vegetation contributes to the drought in the eastern parts of the country.