

PRACTICE OF GREEN COVER CROPS, WITH BENEFITS FOR INCREASE OF SOIL PROPERTIES AND THE VALUE OF BEE PRODUCTION

Mirela DRĂGAN¹, Silvana Mihaela DĂNĂILĂ-GUIDEA¹, Adrian Gheorghe BĂȘA¹, Ștefana JURCOANE¹, Constantin DOBRESCU²

e-mail: mirela.dragan78@yahoo.it

Abstract

Numerous studies have demonstrated the importance of proper cover crop management for optimized benefits to soil physical, chemical and biological properties. Cover crops can increase soil carbon and nitrogen as well as other nutrients and improve their cycling within cropping systems. Cover crops have the potential to provide many benefits to soil health in various cropping systems and climates and to obtain various organic agricultural products demanded in the market at low cost. The potential of cover crops to maintain and build soil fertility can allow a reduced dependence on synthetic fertilizer inputs. The research undertaken aims to identify, study and put into practice alternative sources of food (nectar and pollen) for bees and other pollinating insects by introducing new crops into the agricultural circuit, which meet the agro-environmental conditions, in the situation of limiting food sources for these, due to the expansion of monocultures and crops with diminished honeydew qualities and with a shorter flowering period.

Key words: cover crops, soil improvement, bee production

Soil is an important and often neglected element of the climate system. It is the second largest carbon store or "carbon dioxide sink" after the oceans. Restoring essential terrestrial ecosystems and sustainable land use in urban and rural areas can help us mitigate and adapt to climate change. (<https://www.eea.europa.eu/ro/pressroom/infografica/solul-si-schimbarile-climatice/view>).

The vulnerability of agricultural lands to current and future climate changes will depend on the degree of manifestation of the changes and the concrete properties of the soil units (Corman I. *et al*, 2015). The increase or decrease of the water deficit (drought) in the soil depends on the duration of the drought in the atmosphere and on the specific properties of the soil: texture; structure; compaction (porosity; organic matter content, etc.).

Through various agrotechnical, agrochemical and phytotechnical actions, it is possible to make the plants use the available water reserves from the soil as efficiently as possible, first of all, the easily accessible ones and thus increase the volume of agricultural production. Cover crop management between established crops is one of the oldest agricultural practices and is currently gaining attention worldwide

(Romdhane S. *et al*, 2019). Cover crops can include any plant species grown for purposes other than primary grain or forage production and are generally classified as legumes, nonlegumes, or grasses.

Cover crops have been well known for decades, defining benefits for the environment and the agricultural community. These crops are cultivated precisely to protect the soil from erosion and to prevent the loss of nutrients in the deep layers through leaching and surface runoff. Cover crops can also be established between main crops to improve agricultural production and productivity. Basically, leguminous species are used for cover crops because, in addition to the role of surface cover, they also help to improve the physical, chemical and biological properties of the soil.

According to FAO reports (2010), about 117 million hectares (about 8 percent of global arable land) in such systems are cultivated worldwide, increasing by about 6 million hectares per year (<https://www.fao.org/3/i1881e/i1881e00.pdf>).

As defined by the Soil Science Society of America (SSSA), "cover crops" are those used to protect and improve the soil between periods of regular annual crop production or between trees in

¹ Iasi University of Life Sciences, Romania

² Federation of the Romanian Beekeepers Associations, Bucharest, Romania

orchards and vines in vineyards (Fageria N. K. *et al*, 2005).

Increasing attention has been given to cover crops by researchers, consultants and producers in practicing organic farming (Vollmer E.R. *et al*, 2010; Parr M. *et al*, 2011), as well as organic ones (Saracin V.C., Vasile A., 2015). Currently, several studies have demonstrated the usefulness of cover crops in agricultural production, and most of them have focused on the physical, chemical or biological properties of the soil (Adetunji A.T. *et al*, 2020)

In this sense, the obtained results demonstrated that the management of green cover crops can provide a wide range of benefits to the physical, chemical and biological properties of the soil. In addition, cover crops can enhance beneficial soil microbial activity (Patkowska E. *et al*, 2020), while suppressing some important soil plant pests. (Saleem Saleem M. *et al*, 2020).

The soil degradation process, in many areas of the world, is a main problem in agriculture (Cerbari V., Leah C., 2016). According to Irmak S. *et al*, (2018), cover crops help to reduce soil water evaporation, thereby conserving soil moisture for the next crop. Although this has been observed in some environments (Basche *et al*, 2018), under water-limited conditions without irrigation, cover crops have frequently been found to limit soil moisture for subsequent crops (Nielsen S.M. *et al*, 2016).

In further research reported by Saleem M. *et al*, (2020), it was found that additional root growth resulting from cover crops can provide benefits to the soil, including increasing soil organic carbon content, available nutrients, and soil aggregation. In addition, cover crops have been found to improve nutrient cycling, soil physicochemical and biological properties, as well as soil pest management and weed suppression. In addition, long-term accumulation of soil carbon through cover crops can reduce compaction while increasing soil aggregation and water infiltration.

In autumn, the areas sown with cover plants have the role of taking over excess nitrogen and reducing soil erosion. The fact that we sow cover crops is also an effective means to reduce the loss of nitrogen and phosphorus. Many studies have assessed the impact of cover crops and tillage practices on soil quality using soil quality indices. Jokela W. *et al*, (2009) found that soil quality index (SQI) ranged from 80 to 87% and 73–83% at 0–5 cm and 5–15 cm depth, respectively, in a cover crop effect study and liquid manure on SQI in corn production system.

Later, Islam R. and Sherman B. (2021) showed that management practices that integrate

soil conservation works with cover crops could help recover, preserve and build soil quality (SQ) to address food security issues. Also, Farmaha B.S. *et al*, (2021), after analyzed soil nutrients in 196 field trials in the southeastern United States, reported improved soil health in cover cropping systems compared to conventional tillage.

However, the potential of cover crops is not yet fully understood in all crop systems and climatic zones, a fact that requires the continuation of research in the context of current climate changes, which also have an impact on agricultural crops in Romania. responds to food security issues.

MATERIAL AND METHOD

Several studies have determined the influence of cover crops on soil properties in a wide range of soil types and climates (Koudahe K. *et al*, 2022). One of the ways in which this process can be prevented, even ameliorated and improved, is represented by "cover" (or "greening") crops, which are established immediately after the harvesting of meadows and other autumn crops. Grass cover crops have also been confirmed to increase soil water content by reducing evaporation and therefore conserving moisture for subsequent crops (Blanco-Canqui H., Ruis S.J., 2020; Burke J.A. *et al*, 2021).

In recent years, soil erosion has become an increasingly acute problem in Romania as well. If 10-15 years ago it seemed more like a theoretical matter, now it has been practically felt in important agricultural areas in Oltenia, in the south of Bărăganu, as well as in Moldova (Lup A. *et al*, 2017; Niacsu L. *et al*, 2021).

Romania also has a long tradition in the field of raising bees and making bee products, beekeeping establishing itself as an independent occupation since ancient times, initially for the products obtained (honey, pollen, royal jelly, apiarnil, propolis, wax, bee venom, hive air), and later, including now, for the contribution that these insects have to the increase of fruit, vegetable and seed harvests, through pollination, according to the 2022 report on the Situation of the Beekeeping Sector in Romania, published on the Romanian National Beekeeping Program website (<https://www.madr.ro/fond-funciar-si-imbunatatiri-funciare/163-studiul-transmis-comisiei.html>).

Currently, in the context of globalization, beekeeping acquires new values, its practice aiming not only at its economic importance, but also at the scientific, ecological, social importance, the biodiversity of the environment, etc. In Romania, the activity of raising bees developed in particularly favorable natural conditions, which contributed to the continuous development of this activity and, implicitly, to

obtaining significant bee production in the Eastern region of Europe (Zugravu A., 2020).

In order to solve some of the previously mentioned problems, starting from the spring of 2021, the Federation of Beekeeping Associations in Romania (ROMAPIS), one of the most well-known professional associations of beekeepers in Romania, is conducting research on plots of agricultural land located near the municipality Bucharest (in the S-E area of Romania), together with the partners UASVM from Bucharest, Didactical Farm Station Belciugatele (Găneasa city, Ilfov County) and the Alliance of the Romanian Seed Industry (ASRI), in order to achieve the objectives of the project with the title - "Project for increasing the value of beekeeping production through the use of agricultural crops beneficial to bees and pollinators in accordance with the agro-environmental conditions", (with the acronym AGROAPIS).

RESULTS AND DISCUSSIONS

Greening crops have been included in Romania, including in the eco-schemes of the National Rural Development Program - NRDP (PNDR) and, under certain conditions, they are subsidized. That is, in order to obtain the approximately 58 euros/ha, which is the amount granted for their establishment, the respective crop must ensure the coverage of the land for a period of at least eight weeks from sunrise, must be sown between July 1 and October 1 and to be destroyed by mechanical embedding in the ground (Grigoriev A., 2021).

Regarding the composition of cover crops, there are several mixtures, information about which can be obtained from the website of the Agency for Payments and Intervention for Agriculture (PIAA/APIA) and through the publications written for the benefit of farmers in Romania. In accordance with art. 45, para. 9 of Regulation (EU) no. 639/2014 and with the Order of the Ministry of Agriculture and Rural Development (MARD) no. 45/2021 the areas with a vegetal layer represent areas of ecological interest. They are selected so that, regardless of the characteristics of the area in which they are found and the soil they have, farmers can always have at hand something that lends itself to being taken over in cultivation.

In the PIAA (APIA) 5th Edition publication (2021), entitled "Informative guide regarding the application of agricultural practices beneficial for the climate and environment", it is specified that "Areas with a vegetal layer are the arable surfaces cultivated with the mixtures of crop species included in annex no. 12 to MADR Order No. 45/2021, which does not participate in the

calculation of crop diversification and which ensures soil coverage for a period of at least 8 weeks from the date of emergence. The establishment of the vegetation layer as an area of ecological interest is done after harvesting the declared main crop in the year of application" (https://apia.org.ro/wp-content/uploads/2021/11/Ghid-EFA_2021.pdf).

In the article popularizing useful information for farmers from FERMA magazine published by Grigoriev A. (August 17, 2021), the 3 reasons for establishing cover crops with honeydew potential are specified, such as: they protect the soil from erosion, are subsidized by APIA and can ensure a source to feed the bees during the critical period of the end of flowering periods in the basic crops.



Figure 1. **Bee hives located next to the buckwheat and mustard plant lots, used as cover crops (Belciugatele Educational Center, Romania, October 24, 2021)**

Also, the Payments and Intervention Agency for Agriculture (PIAA/APIA) from Romania, makes available every calendar year the list of crop species mixtures for the vegetation layer and the related codes, valid for surface subsidies (AgroInfo, 2020). These areas are taken into account by PIAA PIAA (APIA) when paying for agricultural practices beneficial to the climate and the environment, in short, the "greening payment". For example, the amount for the greening payment from the level of the 2019 application year was 59.3201 Euro/ha.

Intensive agricultural practices, can pose various threats to bee populations. To mitigate these effects, research within the AGROAPIS project, ongoing for the period 2021-2023, will focus on the inclusion of greening crops with melliferous potential in agricultural landscapes through natural areas on the farm or flowering crops. The idea of these researches started from the finding that although cover crops provide

numerous services to agroecosystems, there is little information about their role in providing nutritional resources for pollinators.

The value of cover crops for providing additional summer floral resources for both managed and wild bees differs depending on the characteristics of the respective plants (nectariferous and polliniferous potential, flower morphology in terms of insect accessibility, etc.) and pollinator type.

For the implementation of the pursued objectives, during the first year (2021), of the implementation of the AGROAPIS project,

experimental crops were established with areas of 0.5 ha, with each of the crops with melliferous potential: mustard, phacelia, peas, buckwheat and camelina. Several beehives were placed near the lots in order to monitor the behavior, but also the yield of the bees (*figure 1*), in the use of nectar taken from the staggered blooming flowers during 2-3 weeks.

Table 1 shows small descriptions of the plant species that were selected in the year 2021 for the implementation of the AGROAPIS project, for cultivation after meadows and due to their honeydew importance.

Table 1
Characteristics of cover crops and of beekeeping importance, selected for testing in the second crop after sedges in the AGROAPIS project / The Species Selected In 2021, For Cover Crops (AGROAPIS Project)

Plant crops of beekeeping importance	Melifer potential	Agronomic and beekeeping characteristics of the species used
Phacelia (Phacelia tanacetifolia)	300- 1000 kg/ha	Depending on the time of sowing, phacelia culture can be practiced starting from early spring and lasting until late autumn. Studies have shown that phacelia inflorescences provide bees with nectar with a high percentage of sugar, which can then be used in a good honey production calculated per hectare. The vegetation period of the phacelia crop is ~80 days, of which the flowering period represents ~35 days. (Tiței V. <i>et al</i> , 2009) In Romania, it was established that the amount of nectar secreted by a flower varies between 1 and 4.5 mg with a sugar concentration of 28%, the assessed potential of nectar 10-34 kg/day/ha, of honey production 600-1000 kg/ha under favorable culture conditions.
White mustard (<i>Sinapis alba</i>)	40-50 kg/ha	Annual species, reaching full maturity in about 10 weeks. Honey production can increase in the case of mustard, if sowing is staggered. It blooms in the same period as spring rape, i.e. about 40 days after sowing. The duration of creeping is 20-30 days, in the months of May-June. (Seed and Oilseed Crops as Bee Plants, 2016)
Buckwheat (<i>Fagopyrum esculentum</i>)	50-60, up to ~100 kg/ha	Buckwheat is a very fast growing plant (8-10 weeks) up to 60cm, which makes it a good short-term weed suppressor. Buckwheat is an important honey plant. The buckwheat flowering period is long, from June to September. (Cawoy V. <i>et al</i> , 2009; Crop Pollination, Issue 7, 2012)
Common vetch (<i>Vicia sativa</i>)	30-50, up to ~100 kg/ha	Common vetch, represents a honey-bearing opportunity in May-June. The specialized literature shows that the nectar secretion of pea flowers is 0.2-1.5 mg/flower and its fields have a honey production of 30-100 kg/ha (Bareke K.T. <i>et al</i> , 2014).
Camelina (<i>Camelina sativa</i>)	Within the limits recorded by white mustard	As an annual - summer or winter plant, camelina (<i>Camelina sativa</i> (L.) Crantz) grows to heights of 30-120 cm, with branching stems that become woody at maturity. It is often combined with other crops, such as lentils, wheat and peas, because it covers the land intensively and prevents the growth of weeds. (Dobre P. <i>et al</i> , 2014 a, b)

In the next two years (2022 and 2023), of the period of the project, on the plots of the vegetable farm, it is planned to sow in successive rotations the agricultural crops of wheat, triticale, peas, sunflower, corn, rape, purchased from most of the companies producing seeds on the market, precisely to follow their evolution in the S-E area of the Romanian Plain. And as regards greening crops with melliferous potential, the melliferous potential of plants from the greening crops category, such as white mustard, buckwheat and peas, will be further tested in independent batches but also by testing combinations of seeds from two pollinating crops (eg camelina + peas or peas + alfalfa).

CONCLUSIONS

Because the effects of cover crops are generally not realized in the short term, further experiments will be needed to determine the long-term effects of cover crops and their potential benefits on sustainability, under various cropping systems and climatic conditions. Most of the research papers used in the review attributed the positive changes in improving soil health and properties to the practice of cover crops.

Correlated with the objectives proposed within the project with the acronym AGROAPIS, which is ongoing by the partners involved, by

establishing crops with high honey production potential, it is desired to identify species and agricultural practices that will benefit both beekeepers and farmers. For the pollinating insects, it would also ensure a continuous flow of nectar and pollen for most of the beekeeping season, ensuring at the same time conditions for the good health of the bees and sufficient food reserves for the winter.

Such a practice would bring a sum of benefits not only to the parties involved in the project - beekeepers and farmers - but also to the whole society in general. The continuation of the research will contribute to the understanding of the effects of the cover crops practiced on the soil properties, and on the other hand, to the evaluation of the melliferous capacities of the different types of vegetable crops that will be able to take place after the harvest period of the main crops.

Thanks to the actions of guiding farmers in the use of vegetable crops, by ensuring the existence of specialized technologies and suppliers of inputs for these crops, there will be increases in economic efficiency, as well as the fulfillment of the agro-environmental conditions necessary to obtain subsidies conditioned by them.

ACKNOWLEDGMENTS

This publication was made with the support of the Doctoral School - Plant and Animal Resource Engineering and Management, Biotechnology field, from the Biotechnology Faculty of the University of Agronomic Sciences and Veterinary Medicine Bucharest.

At the same time, the work was developed within: Project financed by the Agency for the Financing of Rural Investments - Romania, and the Regional Center for Financing Rural Investments 8 Bucharest-Ilfov, Project code: CRFIR-BUCURESTI-ILFOV, no: 1610000011884200019, with the title "Project for raising the value of beekeeping production by using agricultural crops beneficial to bees and pollinators in compliance with agro-environmental conditions"(acronym AGROAPIS)"

REFERENCES

- Adetunji A.T., Ncube B., Mulidzi R., Lewu F.B., 2020** - Management impact and benefit of cover crops on soil quality: A review. *Soil and Tillage Research*, 204, 104717.
- Bareke K.T., Kibebew Wakjira H., Admassu A.M., 2014** - Screening of Potential Herbaceous Honey Plants for Beekeeping Development. *Agriculture, Forestry and Fisheries*. Vol. 3, No. 5, pp.386-391.
- Blanco-Canqui H., Ruis S.J., 2020** - Cover crop impacts on soil physical properties: A review. *Soil Science Society of America Journal*, 84:1527-1576, 10.1002/saj2.20129
- Blanco-Canqui H., Shaver T.M., Lindquist J.L., Shapiro C.A., Elmore R.W., Francis C.A., Hergert G.W., 2015** - Cover crops and ecosystem services: Insights from studies in temperate soils. *Agronomy Journal*, 107:2449-2474, 10.2134/agronj15.0086.
- Burke J.A., Lewis K.L., Ritchie G.L., DeLaune P.B., Keeling J.W., Acosta-Martinez V., Moore J.M., McLendon T., 2021** - Net positive soil water content following cover crops with no tillage in irrigated semi-arid cotton production. *Soil and Tillage Research*, 208, pp. 1-8.
- Cardei P., Sfiru R., Muraru V., 2020** - Intensity of soil erosion in Romania, predictions in time and space, *European and indigenous perspectives*. E3S Web of Conferences 180(6): 03001, TE-RE-RD.
- Cawoy V., Ledent J.-F., Kinet J.-M., Jacquemart A.-L., 2009** - Floral Biology of Common Buckwheat (*Fagopyrum esculentum* Moench). *The European Journal of Plant Science and Biotechnology*, Vol. 3, no. 1, p. 1-9.
- Cerbari V., Leah C., 2016** - Green manure - only possibility to save Moldova's arable soils from degradation. *Lucrări Științifice. Seria Agronomie*, 59(2): 155-158.
- Corman I., Kuharuk E., Popov L., Cojocaru O., 2015** - Ghidului privind conservarea și utilizarea rațională a umidității din sol. [et.al.]; Parteneriatul Global al Apei pentru Europa Centrală și de Est (GWP CEE), Inst. de Pedologie, Agrochimie și Protecția Solului "Nicolae Dimo" Univ. Agrară de Stat din Moldova[et.al.], Chisinau, (Tipogr. „Print-Caro”). -48p, ISBN 978-9975-56-237-9, available on-line at: https://www.gwp.org/globalassets/global/gwp-cee_files/regional/idmp-guide-moldova-ro.pdf.
- Dobre P., Jurcoane S., Matei F., Cristea S., Farcas N., Moraru A.C., 2014a** - *Camelina sativa* as a double crop using the minimal tillage system. *Romanian Biotechnol. Letters*, Vol. 19, No.2, p.9190-9195.
- Dobre P., Farcas N., Udrioiu N.A., Gidea M., Moraru A.C., 2014b** - Research on *Camelina sativa* wintering, by genotype and fertilizer doses used, in the pedo-climatical conditions from the south of Romania. *Rom. Biotech. Letters*, 19 (6), p.9964-9973.
- Fageria N. K., Baligar V. C., Bailey B. A., 2005** - Role of Cover Crops in Improving Soil and Row Crop Productivity. *Communications in Soil Science and Plant Analysis*, 36(19-20): 2733-2757.
- Farmaha B.S., Sekaran U., Franzluebbers A.J., 2022** - Cover cropping and conservation tillage improve soil health in the southeastern United States. *Agronomy Journal*, 114(1): 296-316.
- Grigoriev A., 2021**- Cum să iei 58 euro în plus la hectar? *Culturile 2 în 1: înverzire și plante melifere*. *Revista Ferma, Tehnologii Agricole*, available on-line at: <https://www.revista-ferma.ro/articole/tehnologii-agricole/cum-sa-iei-58-euro-in-plus-la-hectar-culturile-2-in-1-inverzire-si-plante-melifere>.
- Irmak S., Sharma V., Mohammed A.T., Djaman K., 2018** - Impacts of cover crops on soil physical properties: Field capacity, permanent wilting point, soil-water holding capacity, bulk density, hydraulic conductivity, and infiltration. *Transactions of the ASABE*, 61(4): 1307-1321, available on-line at: <https://doi.org/10.13031/trans.1270>.
- Islam R. și Sherman B. (2021)** Cover Crops and Sustainable Agriculture (1st ed.). CRC Press,

- available on-line at: <https://doi.org/10.1201/9781003187301>.
- Jokela W., Grabber J., Karlen D., Balsler T., Palmquist D., 2009** - *Cover Crop and Liquid Manure Effects on Soil Quality Indicators in a Corn Silage System*. *Agronomy journal*. 101. 10.2134/agronj2008.0191.
- Koudahe K., Allen S.C., Djaman K., 2022** - *Critical review of the impact of cover crops on soil properties*, *International Soil and Water Conservation Research*, 10(3): 343-354,
- Lup A., Miron L., Alim I., 2017** - Soil erosion in romanian agriculture. *Lucrări Științifice. Seria Agronomie*, 60(2): 237-240.
- Niacsu L., Ionita I., Samoila C., Grigoras G., Blebea-Apostu A.M., 2021** - *Land Degradation and Soil Conservation Measures in the Moldavian Plateau, Eastern Romania: A Case Study from the Racova Catchment*. *Water*. 13(20):2877, available on-line at: <https://doi.org/10.3390/w13202877>.
- Nielsen D.C., Lyon D.J., Higgins R.K., Hergert G.W., Holman J.D., Vigil M.F., 2016** - *Cover crop effect on subsequent wheat yield in the Central Great Plains*. *Agronomy Journal* 108:243–256.
- Parr M., Grossman J. M., Reberg-Horton S. C., Brinton C., Crozier C., 2011** - Nitrogen delivery from legume cover crops in no-till organic corn production. *Agronomy Journal*, 103(6), 1578-1590, available on-line at: <https://doi.org/10.2134/agronj2011.0007>.
- Patkowska E., Mielniczuk E., Jamiolkowska A., 2020** - *The influence of cover crops and antagonistic fungi on the healthiness of carrot (Daucus carota L.)*. *Scientific Papers. Series B, Horticulture*, Vol. LXIV, Issue 2, Print ISSN 2285-5653, 223-226.
- Romdhane S., Spor A., Busset H., Falchetto L., Martin J., Bizouard F., Bru D., Breuil M.C., Philippot L., Cordeau S., 2019** - *Cover crop management practices rather than composition of cover crop mixtures affect bacterial communities in no-till agroecosystems*. *Front Microbiol.*, 10:1618.
- Saleem M., Pervaiz Z. H., Contreras J., Lindenberger J. H., Hupp B. M., Chen D., Zhang Q., Wang C., Iqbal J., Twigg, P., 2020** - *Cover crop diversity improves multiple soil properties via altering root architectural traits*. *Rhizosphere*, 16, 100248.
- Saracin V.C., Vasile A., 2015** - *An exploratory research regarding romanian organic farming sector*. *AgroLife Scientific Journal*, 4(2): 119-123.
- Țiței V., Mazăre V., Teleuță A., 2017**- *Calitatea biomasei de facelie și posibilități de utilizare*. Conferința "Genetica, fiziologia și ameliorarea plantelor", Ediția a VI-a, 23-24 octombrie 2017, Chișinău, Moldova, Editura: Tipogr. "PrintCaro", ISBN: 978-9975-56-463-2, p. 407, available on-line at: https://ibn.idsi.md/vizualizare_articol/91146
- Vollmer E.R., Creamer N., Reberg-Horton C., Hoyt G., 2010**- *Evaluating Cover Crop Mulches for No-till Organic Production of Onions*. *HortScience*, 45(1): 61-70.
- Zugravu A.** (coordinator), **2020**- *Guide to apicultural potential, climate conditions, air and soil quality in the Black Sea Basin*, available on-line at: https://blacksea-cbc.net/wp-content/uploads/2020/12/BSB136_ITM-BEE-BSB_Guide-to-apicultural-potential-climate-conditions-air-and-soil-quality-in-the-Black-Sea-Basin_EN.pdf
- ***APIA, 2021** - Ghidul informativ privind aplicarea practicilor agricole benefice pentru climă și mediu", Ediția a V-a, available on-line at: https://apia.org.ro/wp-content/uploads/2021/11/Ghid-EFA_2021.pdf.
- ***AgroInfo, 2020** - *Lista APIA 2020 amestecuri de culturi pentru strat vegetal!* , available on-line at: <https://www.agroinfo.ro/economic/lista-apia-2020-amestecuri-de-culturi-pentru-strat-vegetal>.
- ***Crop Pollination, Issue 7, 2012**, available on-line at: https://www.far.org.nz/assets/files/uploads/25801_FAR_focus_7_crop_pollination.pdf
- ***FAO, 2010** - *Climate-smart agriculture—Policies, practices and financing for food security. Adaptation and Mitigation*. Rome: FAO, available on-line at: <https://www.fao.org/3/i1881e/i1881e00.pdf>.
- ***Programul Național Apicol Din România Situația Sectorului Apicol Din România, 2022**, available on-line at: <https://www.madr.ro/fond-funciar-si-imbunatatiri-funciare/163-studiul-transmis-comisiei.html>.
- ***Seed and Oilseed Crops As Bee Plants** , 2016, available on-line at: <https://www.beeculture.com/seed-oilseed-crops-bee-plants/>
- ***Solul și schimbările climatice, 2019**, available on-line at: <https://www.eea.europa.eu/ro/pressroom/infografica/solul-si-schimbările-climatice/view>.