Hungary-Serbia
IPA Cross-border Co-operation Programme

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FARMADDINC

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as possible solutions for generating additional income and self-employment in the rural cross-border area

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Good neighbours creating common future

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Introduction

Institute of Field and Vegetable Crops was founded in 1938. by the Ministry of Agriculture of the Kingdom of Yugoslavia forming Agricultural and Monitoring stations in Novi Sad, which gave the Institute today. Successful work and excellent results implemented in agricultural practices give the Institute a major name in world science. Main activities of the Institute are researches with focus on the development of cultivars and hybrids of field crops, vegetables, abundance of forage, industrial, medicinal, spice plants and transfer of results into practice. The Institute has created over 1000 varieties and hybrids, of which nearly 500 registered and grown abroad. In an open competition on the world market, the Institute's cultivars and hybrids are present in 26 countries (EU countries, Russia, China, India etc). Institute has a powerful team of almost 100 researchers, of which there we 59 doctors of science which assists over 300 highly skilled workers of different profiles.

After 40 years of operation the College of Kecskemet became the centre for horticultural science in Hungary. The researchers of this institution established the methodological approach and educated the expert-basis of the South Great Plain (Dél-Alföld). The College started rural development courses - connected to the already existing-harmonized with the EU's Common Agricultural Policy and the local needs.

Both of the institutions have been researching the possibilities of enlarging capacities of small plots with intensive gardening (SPIN farming). These researches brought together the two institutions in 2009, at the Agricultural Fair in Novi Sad where a workshop was held in this topic.

The territory on both side of the border is characterized by a high percentage of the unemployed people (Vojvodina about 24%, Dél-Alföld about 10%) and those living on welfare, of which a significant number lives in rural areas. Poverty in rural areas is twice higher than in urban (Serbia: 9.8%: 4.3%). High unemployment in the region is caused by low educational category of the population, and elderly households which possess 500 to 1000 m^2 of land (in average) with excellent quality. This land is not cultivated or it is cultivated for their needs (about 75% of land). in addition to the social issues created by high unemployment rate and ageing population, these problems represent social, economic and environmental concerns for the overall community. Also negative trend of small farms disappear because they lease their land to the large commercial producers, coursing migrations and leaving rural areas deserted. As a result of this situation, there is a large amount of uncultivated, high quality land. Also, there is the problem of using these backyards at low efficiency so it is the one of the challenges to change their way of thinking (new trends).

One of the limiting factors of production is still unregulated market and the presence of a large number of dealers, who often "dictate" an extremely low price, so manufacturers often realize losses in production and are not economically motivated to extend the same. With this project we try to respond to a complex problem between society-economy-ecology and to offer a solution based on the EU rural development. Therefore, the aim is to define a model with a small investment and with existing resources and opportunities to give people the opportunity of sell-employment. Possible solutions are the most economical use of land and labor in the home vegetable production, in order to meet their own needs and market realization of surplus products, improving product quality and increasing households' income.

First and the most important target group of this project are unemployed people in rural areas and semi-rural areas on both sides of the borders who own land around houses (backyards) with 500 to 1000 m^2 (per household). Those people produce only for their own needs and do not have sufficient capacities and skills to be competitive at the market. Most of them are older with low educational structure. The target group is also consists of those people who produce vegetables within their gardens, but through this project (analysis of results obtained in the model farms) they will significantly change the mode of production, increasing efficiency in terms of improving the quality and quantity of products.

By using cost effective technology to make it available to everyone and less chemicals in production process, high quality food will be made, therefore it can be said that this project is also targeting the entire population of the programme area (population of about 2.000.000). The indirect beneficiaries of the project will be the research institutes and universities on the both side of the border. Connecting exact researches in horticulture with unemployment issues opens new topics and challenges for rural development. Moreover local decision-makers and development experts can be defined as target groups especially as these researches aim using already existing but not efficiently used internal sources in the region.

The overall objective of the project is to help the unemployed people living in houses with backyards in rural settlements in cross-border area to establish or upgrade their backyard farms to be more productive and cost-effective. The main instrument is going to be an efficient model farm defined by a horticultural research study, which will show the stakeholders the exact developing steps of their backyard. The short-term perspective of the project is to give a clearly defined easily learnable method to the people to raise their productivity and get a higher additional income or even get a possibility to self-employ them. The long term perspective of the project is to share and promote these results through best practices and through a website to connect these people with small markets, shops and malls, to co-operate in the region, reducing transportation cost and getting competitive with the prices.

The specific objectives of the project are: Specific objective 1 is to transfer valuable knowledge and expertise related to agriculture techniques as well as skills needed for fostering competitiveness of agriculture product, Specific objective 2 is to create knowledge base and promotional framework for supporting and placement of the agriculture products on the market and Specific objective 3 is to initiate research interaction through evaluation of the agro-economic aspects of the model farms established in both countries.

Project will promote new model farming business and will represent example of the best production technology that is optimal for the establishment and running of successful 'backyard' gardening businesses. It will provide farmers and decision makers with important information and statistical data. Farmers on both sides of the border, who will visit demonstration fields, will be encouraged to self-employment and furthermore become potential employers since the project offers them skills to be self-sufficient and improve their quality of life and standard of living. In the latter case, it would decrease the number of people living off social well are and increase the placement of their improved agricultural and horticultural goods on the national and international market. Small farming and gardening businesses could potentially form the basis of growth and development economically and within the local community. Also, very important benefit of this project will be knowledge and best practice transfer between experts, local people, local authorities, science research institutions and market through workshops, e-platform, conferences, model farms and promotional materials. Results obtained on the basis of the survey will be submitted to the local population.

Operations of model farms will focus on participatory approach through field visits, educations and practical work as proven methodologies that promote for active participation of target groups' representatives in agricultural sector. Project implementation will encourage networking of partners via promotional activities, conferences, training delivery and implementation of e-platform. Focus of project implementation is conduction of research and development of joint study that will be developed on the basis of data obtained from model farms and based on participatory approach between project partners and taking into account feedback collected from target groups. Research will be developed jointly between partners, data will be collected respecting principles of objectivity and statistical methods for data analysis will be used. Project will involve local unemployed people who have backyards (cultivated or none cultivated) and through the model farms and workshops explain to them that this model of production can bring them income. Project through the e-platform should provide communication between experts and local people, enabling them to define the best portfolio, processing data from model farms research, review best practices, establishing relationships with potential customers.

Project will contribute to raising the competitiveness of individual farmers in the border area; it will pursue this aim through employing new technologies and through establishing cooperation between the business sector and small 'backyard' farms on both sides of the border. The project will also support objective of encouraging the creation of cross-border networks and the development of cross-border actions with a view of revitalizing the economy. Two model farms will be created, one in each country, unique e-planer will be established on both sides of the border, advisory and support services will be provided to the farmers in the broader region. In addition, they will discuss and strategies the solutions for turning comparative advantages of the region into the competitive ones. Also, the data obtained from the survey to be carried out on both sides of the border should show the exact locations of activity. Through implementing the project the cooperation between the two institutions will become stronger. The researchers can compare the situations in the two countries. As Hungary is already member of the EU the Serbian researchers can learn the best practices in rural development from the agricultural point of view. While harmonizing the bases of the project, local decision-makers can be informed about the differences in managing local challenges. With the comparison of the soil and the geographical conditions the best species can be changed and refreshed what has a big cross-border impact. With disseminating the exchanged experience of the workshops, all the stakeholders can profit from the both side of the border.

Project contributes to program strategy in term of synergies and co-operation in the economy helping unemployed people living in houses with backyards in rural settlements in CB region to employ themselves and get an additional income. The e-platform provides continuous co-operation between the research institutions and people, enabling best practices exchange among stakeholders and improving their interaction. Considering it is about organic production, this project also contributes to programmed strategy in term of environmental sustainability. Project contributes to program horizontal objective creating joint structures by maximizing cross-border impact creating joint Study made by joint project team in order to transfer expertise and knowledge and to create cross-border networks. The main target group of the project is consist of unemployed people in rural area with uncultivated backyards, and a project in this way contributes to horizontal objective ensuring equal opportunities for the under privileged population. In long-term, the project contribute in creating sustainability as a horizontal objective, through improvement the quality of local farmers life and their families, food quality, through percentage of cultivated backyards, improvement of cooperation between research institutions and people in cross-border area.

The beneficiaries of the project will be firstly the unemployed people from the villages and small cities from the most underdeveloped regions. These people are mainly women with children who are keeping their household, long-term unemployed elder people and people belonging to ethnic minorities. Since the project focuses on these target groups, EU's horizontal policies on equal opportunities are ensured in general. The questionnaire will be mainly filled in by these above mentioned groups in villages and small towns. It means that the main study will be based on their exact problems and needs. Through the implementation of the project gender equality will be ensured as the project team consists of 3 women and 4 men. When choosing the answerers for the survey, all disadvantaged groups will be questioned. The two institutions will ensure the possibility for additional discussion about the topic presented on the workshops for unschooled people. Beside, basic information connected to farming will be also presented on the web paqe. With bilingualism the Hungarian minority in Vojvodina can be easily involved to the project. Moreover most of them live in houses in the under developed regions in northern Serbia. The gender equality will be secured directly in the project team: 3 of the 7 team members are women.

Project is consistent with EU horizontal policy on sustainable development through the main issue to create jobs with better use of existing local resources, to improve the quality of life achieving social inclusion of this vulnerable group. By creating jobs, the project contributes to social sustainability. Project should decrease the number of people living off social welfare and promote economic development in small rural communities. Considering the fact that project deals with the organic production of vegetables, it's consistent with environmental objectives' of EU policies. Project also contributes to the EU Danube Region Strategy and its Pillar 2, Agro environment, and Pillar 3 improvement of the quality of life and standard of living of the local community. Vegetable production on the experimental fields will be based on basis of ecological production, thus the project will effect on raising awareness of the local people.

The project aims to optimize the resources of the backyards by dividing the territory for more than one culture and accelerating the rotation of species. This ensures higher productivity on one hand and firstling vegetables on the other hand ergo higher income can be reached. The method is innovative in itself but the most important innovation of the project is the dissemination and the propagation of the findings. The results will be processed to an easily understandable curriculum for the target groups, they will be presented on workshops and paralel, every movement can be followed on the model farms in both of the countries. This eventuates that the people can reach and implement the new findings and can be competitive on the market immediately. By using some elemental filters and giving basic data on the e-platform, anyone will be able to reach the model that is the most efficient for him and approximate percent of the raise of the productivity and income will be also reachable. Connecting horticulture, agroeconomics and rural development and giving exact models to the target groups is an innovative but simple way to the raise the competitiveness of the local farmers and the cross-border region.

Experimental fields will be developed and managed within educational institutions that have capacities to operate and maintain them during and upon project closure. Field work, practical studies and training can be developed in later periods based on cooperation developed during project implementation. Idea of setting demonstrational fields instead of theoretical work is core of project sustainability because in long term it enables organization of practical work to target group representatives interested in obtaining knowledge about new farming models and improving their production. E-platform will be available to users after project closure and will continuously build and promote online collaboration of food producers and buyers. Long term system for data gathering, through online platform, will create analytical basis for data update and create new research opportunities. Information dissemination about the project outcomes will be organized through regular activities and operations of project partners. In the longer term project contributes to the improvement of environmental quality and better utilization of existing resources, meet the human need for better quality of food, and improve the quality of life for farmers and the entire society.

Research results in this project should enable the expansion of this vegetable production method to the other parts of Serbia and Hungary and in the long run could represent the best practice in the region. Also, such a wide range of data and examination results should form an important basis for numerous scientific research institutions on both sides of the border. The study should demonstrate that the achieved positive effects both in production and rural development can be replicated in the other regions, without great investments. The fact that there is no need for great investment and also the fact that there are significant unused local resources (local people with land) guarantee the development after the project closure. Multiplier effect should be given also through the e-platform that as a separate activity should be developed within the project. The data obtained by the research on the model farms will be presented on the platform as a filter for the best vegetables portfolio selection and best practice presentations. Good results in the form of income should be the motive for the inclusion of other local farmers from other regions.

Rural study of project

In rural development we can see the issue and organizing of self-sufficiency in two contexts. The first one, which we can call as “macro” level, concerns regional self-sufficiency. It means supplying a region, sub-region or village with products. Several programs have been launched in this direction in the European Union and Hungary. The success of these is highly variable and many questions arise about them, like the definition of local product, the size of the geographical area which is linked to the product. This issue also appears in the EU - 2014-2020 CAP reform, where member countries can manage this problem in the context of short supply chain thematic sub-program. This measure does not emphasize local food production as a priority but it tries to reduce the number of intermediaries between producer and consumer.

The issue of self-sufficiency also arouse son "micro-level" in rural development regarding the individual, family or your own supply, which essentially means the production in gardens around the house. Of course, this issue should not only be evaluated in the context of rural development (here we mean the living conditions, first of all), but is also closely related to social and economic prosperity. Since 2007 Euro stat SILC (Statistics on Income and Living Conditions) has paid special attention to the income derived from the price of goods and services produced for own consumption in its publications (Paats-Tiit, 2010).

According to Eurostat surveys, only food can be considered as a product or service for self-sufficiency. Based on the data, 4.9% of households produce for their own consumption, which accounts for 0.25% of their total income (Paats-Tiit, 2010). In compared to member countries we are among the laggards. In Estonia for example the first indicator reaches 52%. As for the second indicator Lithuania has the highest value, above 2%,

Our domestic trend is also confirmed by an international survey which indicates the decrease of the production around the houses and in the so-called hobby gardens since the beginning of 1990’s. Today we estimate about 200,000 hectares of gardens in the inner settlements of Hungary, which is regarded as the “national gold reserves of the agriculture" (www.kormány.hu).

The owners of inner settlement gardens are unaccustomed from cultivating their garden and keeping animals in the past 15-20 years. It is especially true in case of inner gardens in towns because, since the political system changed, big food trade chains and hypermarkets supply ample fruit, vegetable and meat. Most of the gardens are planted with perennial ornamental plants and annual flowers. During the process, knowledge to cultivate these gardens decreased and experienced older generation cannot pass the knowledge to younger generation who migrate to towns. Just recently, young garden owners, who live in little towns, realize the opportunities of the garden and they need to have knowledge and information to cultivate it. This change in attitudes is well demonstrated by the program which stimulates local production and sale in inner settlement gardens.

The main purpose of these gardens is to self-supply owners and, if the land is big enough, commercial production is possible. It is essential to have a crop structure that adapts to the size of the garden, crop rotation, proper selection of varieties and plant associations (Salamon et al, 2011). Small garden owners should have an adequate knowledge in order to use Smart Gardener Landscape architecture program which helps them to form small parcels even at the garden size of $40m^2$ (www. agrartermelo.hu). According to the already existing plans, a net of small garden horticulture advisors will be formed in 2014 to provide small garden owners with help (http://vmhaztaji.hu).

Material and methods

The research was carried out by cooperation between the Faculty of Horticulture of Kecskemet College and Institute of field and vegetable crops in Novi Sad, Serbia in the frame of a Mutual Hungary-Serbia Cross Border IPA competition. The main purpose of the competition is to work out a model for inner settlement garden production, which helps to optimize self-sufficiency and can provide a supplementary income for families. One of the elements of this research was a rural development survey with the intention to evaluate the role of the inner settlement gardens in self-sufficiency and commercial production with empirical means in the region observed.

The survey has been completed on both sides. 200-200 questionnaires were filled. 3-3 settlements were examined on the both sides of the border, which had a status of a city and two villages. Tiszakecske, Fulophaza and Borota were included in the sample on the Hungarian side. Sampling in Serbia, and Hungary was random and is not representative in any way. Therefore, only simple statistical analysis methods were used in the data processing and no significance tests were performed. Branislav Vlahović made a project analysis which provides some sources of information and some findings concerning Serbia (Vlahović, 2013).

Results

In our first question we wanted to know whether respondents (especially young people) consider the propagation and dissemination of this type of garden culture important. In both countries, responses indicate that there is a need for this activity. 99% of respondents in Hungary and 96% in Serbia think so. On the Serbian side older respondents had a negative opinion. They recommended that local producers should only be introduced with modern production methods, specifically the organic or ecological farming field (Vlahović, 2013). As a final conclusion, we believe that rural society find production around the house useful and important, in spite of the fact that today these gardens are not playing significant role. These gardens are not only important in self-sufficiency, but they are an integral part of the settlement picture too.

In the second group of questions we wanted to examine how widespread this production is today, how big these gardens and which are the main crop. We got a high proportion of the answers for the first question on both sides. As a result, 83,5% of the surveyed households have their own garden in Hungary while this ratio in Serbia is 100%. The higher rate in Serbian side is because multinational retail chains are not present there, so the traditional retail trade and the market have a greater role in agricultural trade. In addition, it is especially important that the unemployment rate is high in Hungary at the border, and in Serbian the unemployment rate is even double. For this reason, and because of the other types of ownership in agriculture and differences in the social systems, agricultural production has a more significant role in self-employment.

The average size of the gardens around the houses is bigger in Serbia than in Hungary 730 m^2 and 854 m^2 respectively. The size and distribution of gardens are shown in Table 1.

Table 1: The size of the gardens around the houses

size of garden (m^2)	Serbia (%)	Hungary (%)
-300	30	30
301-600	25.5	17
601-900	13	9.5
901-	31.5	26.5

Here it should be noted that a significant portion of fruit and vegetable demand of an average four-person family can be provided by a 200-400 m^2garden depending on the method of cultivation and skill. Basically, this means that both countries have substantial potential in direct home production. If we take the general social situation (contributions graders share, employment, unemployment) into account it can be said that rural development plans should definitely be addressed to this area. These producers and their products could be linked to a short supply chain to distribute fruits and vegetables to local public kitchens and restaurants. These products could also be used as raw material for special crafts which also could contribute to international agricultural trade. In this way globalism would work for local communities benefit and not against it.

As far as grown plants are concerned similar results were obtained in a survey on both sides. In most of the gardens either vegetables or fruits or only vegetables are grown. There was, however, great differences regarding ornamental plants. Based on the data they are not typical on the Serbian side. However, we believe that the difference is due to methodology and is not a real difference. In a national survey we found that plots under 300 m^2 are lawn, owners plant perennial ornamental plants, most often thuja. In the larger plots it is typical that there is a front garden with flowers and a “back” garden with fruit and vegetable. The structure of production is shown in the following table:

Table 2: The structure of production

plants	Serbia (%)	Hungary (%)
vegetable	140	149
fruit	20	112
mixed	80	103
ornamental plants	10	82

In the next group of questions we wanted to see how much of the crops that are produced in these gardens are used in the kitchen of the family, how much of it is sold on the market. We also wanted to know what percentage of the family income derives from these gardens and what channels are used in the distribution. On the Serbian side 18.5% of the respondents sell their fruit and vegetable on the local market. In Hungarian only 13% of the respondents sell the surplus in the market. In two cases fruit and vegetable were mostly produced for sale (90-95% of the product grown is not used for own purpose).

In questionnaires, which were filled in Bacs-Kiskun County, we also asked the respondents to estimate the percentage of monthly income that comes from the sale of these products. The data showed that this rate is about 10% on an average (those respondents who produce only for sale was also included). The way of how products come to market varied. In 15 cases products are sold in both market and at the house. In 6 cases products are sold only at the house while 3 respondents reported that purchasers take out the excess. Neighbours also buy and exchange fruit and vegetable.

Our next question is closely related to the previous one. We tried to find out how much of the fruit and vegetable that is grown in the garden is used for the family itself. According to the Serbian respondents it is 59.5%, while the Hungarians said it is 30.5%. The difference may be due to the size of the gardens (they are bigger in Serbia), and the production structure as well (more ornamental plants in Hungarian gardens). Of course, data from both regions shows that it is not possible to satisfy all kinds of needs. There are special needs, which could only be satisfied by a labour-intensive or costly way, thus it is not worth to deal with (Vlahović, 2013).

An important question of the questionnaire was related to the method of production. Only fertilizers and pesticides were taken into consideration in our analysis. We found that these chemicals are widespread in both Hungary and Serbia. In Serbian 66% of the respondents use them while in Hungary this ratio is 32%.

This shows that growers are aware of the fact that these chemicals are necessary if they want to have a good yield and effective pest management. The overall use of pesticides and fertilizers also means that these products cannot be considered as organic. They are excluded from bio-products. Thus, their use must be controlled and ,in favour of food safety,arandom sampling is needed.

When we examined the involvement of family members in gardening we found an imbalance in the two surveys. On the Serbian side 70% of the respondents take part in family gardening while in the Hungarian survey 58% of the 117 people responded positively (Figure 1).

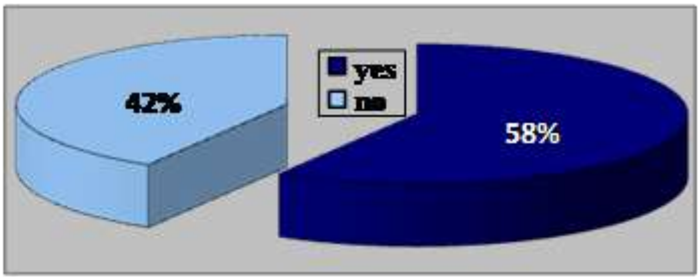

Figure 1: The contribution of family members in gardening
(yes is dark blue)

Related to the previous question we asked whether young family members are interested in horticulture management and animal husbandry. The Hungarian results are more encouraging. Although only 73 people responded 'yes' (37%), it is much higher than that in Serbia (11%).

While questionnaires were being filled we had conversations with respondents. Older people worried if the young generation will take over the knowledge from them. Farming, gardening is not attractive to young people. They do not want to make the living in agriculture.

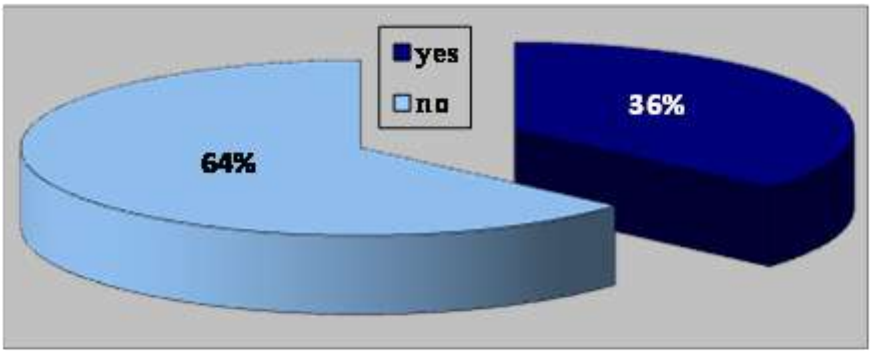

Figure 2: Does younger generation choose this lifestyle?

We asked people if they know about laboratory soil testing. The answers suggest whether the owners of gardens properly apply fertilizers. The Serbian respondents have almost three times as many soil testing as the Hungarians. In the Hungarian survey 7% of respondents take their soil samples to laboratory, that is14 person considers laboratory tests to be important.

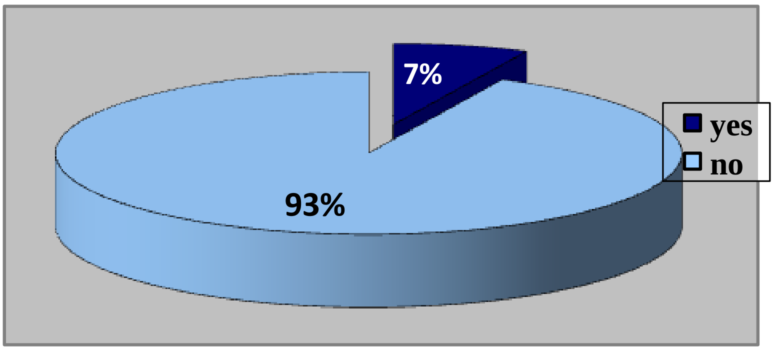

Figure 3: The demand of soil test advice of farmers

It is worth watching the shopping practices at the local market because we will know if the amount of product that is produced in the gardens sufficiently covers family needs. Figure 4 shows that 2% of the respondents doesn't purchase from primary producers, but 98% of them compensate the family vegetable and fruit needs from their garden rather than buying them in shops.

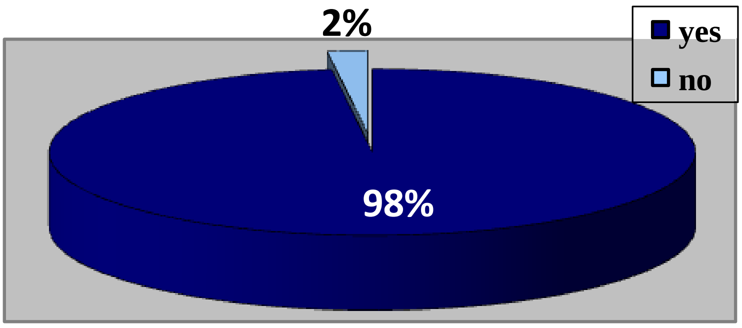

Figure 4: Do you buy in the local market?

In the next set of questions we examined the practice of animal keeping around the house. Slightly more than half of the respondents, that is110 people, are engaged in animal husbandry in Hungary (Fig. 5). In Serbia this ratio is greater, 61%. The reasons why they don't keep animals are: the lack of space, high feed prices and marketing difficulties of animals. These findings are also valid to the Hungarian situation.

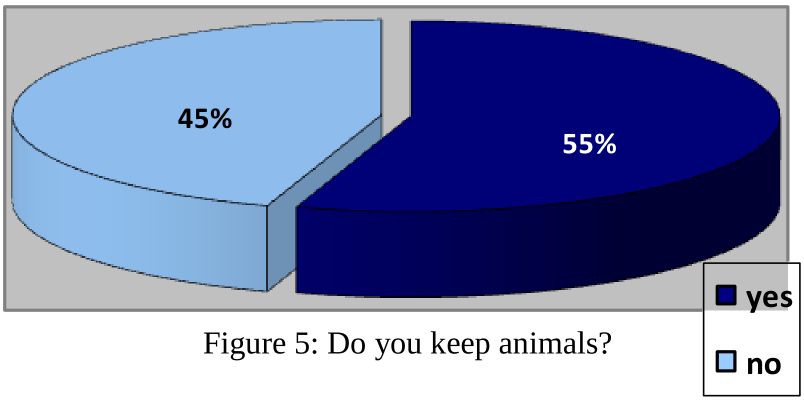

Figure 5: Do you keep animals?

We examined the size of the land to see how it is related to animal husbandry. Those farmers who have 800-1600 m^2 of land don't keep poultry only but pigs and cattle as well. The distribution of animal species is seen on Figure 6.

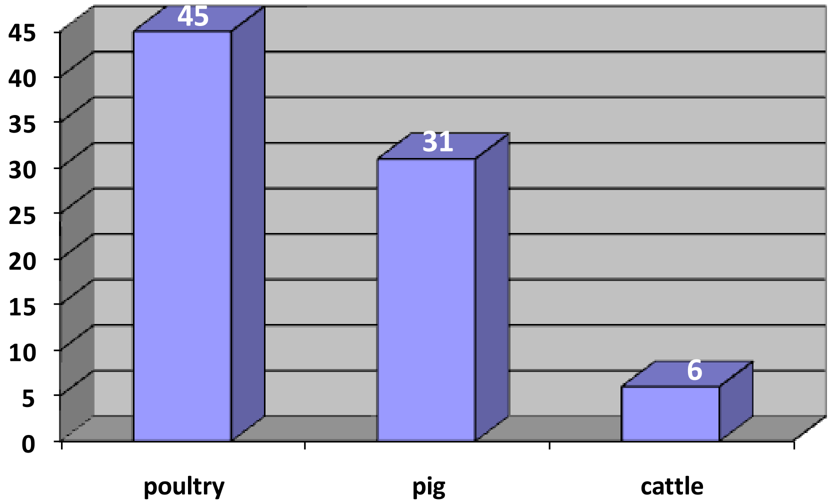

Figure 6: The distribution of animals in the gardens in Hungary

Figure 6 shows the distribution of the 3 most important animal species. Poultry represents the highest rate among animals. They are popular, because of producing meat and egg, they need a relatively small space and the investment cost is low. In larger size garden it is enough to isolate a small area and to provide the birds with indoor space for the night.

Swine and cattle husbandry declined in small gardens in recent decades. Cattle are kept for milk (Figure 7), and not for meat production. Cattle herds, returning from the pasture in the evening, completely disappeared from the sight of the villages. The reasons include high feed prices, higher investment costs and the lack of necessary skills.

The results obtained on the Serbian side are similar. The proportion of cattle is higher (10%) and, probably due to the tradition, more people are engaged in goat and sheep farming then in Hungary. In Hungary we have no tradition of goat keeping. Some decades ago, poorer families kept goats, because it is an undemanding animal, but gives good quality milk and meat. In recent years, there is an increasing need for organic goat dairy products, but the customer layer is relatively narrow.

Beekeeping has a long tradition in Hungary. We are among the EU's largest honey producers, and small family farms play an important role in this. We also met beekeeper families in our Hungarian survey, although only one person in the 200 respondents is dealing with this activity.

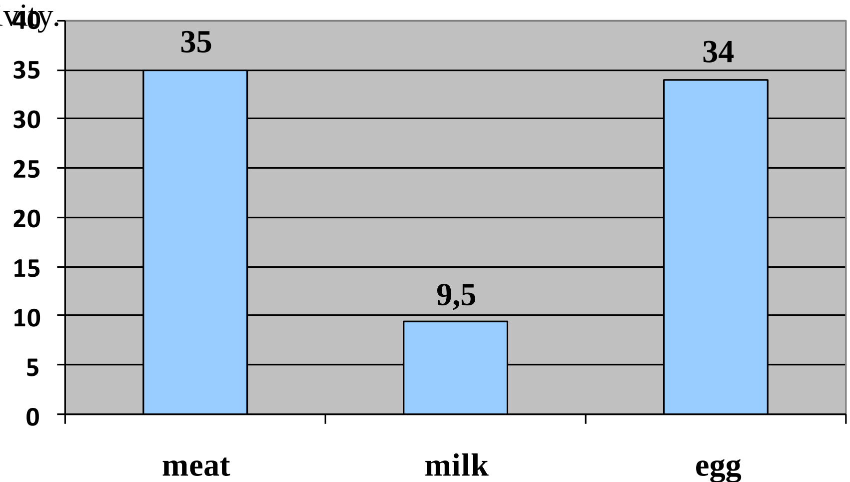

Figure 7. The purpose of animal keeping (meat, milk, egg)

If self-sufficiency is the purpose of animal keeping the key indicator is not profitability. To produce sound and good quality meat, milk and egg is the key issue.

However, if the owner does not have sufficient land to produce feed, he will quit animal husbandry due to high feed prices and will go to the supermarket to buy meat and dairy products for his family.

Conclusion

Inner settlement gardens are common in the examined regions, but over-generalizations have some drawbacks. We think that in both countries there are significant regional differences in this respect. According to the respondents, it would be important to transmit this knowledge to the younger generation. This is particularly true in practical organic farming. Study gardens of agricultural and horticultural education institutions in the region could be linked to the education system to be developed. This is particularly important because people (especially the younger generations) would become more health conscientious and could protect their health actively.

Our results show that the average size of the gardens allows production of fruit and vegetable for self-sufficiency. This production can provide goods for catering, hospitality and tourism, and based on local recipes, craft products could be made. In connection with these services and products short supply chains could be developed, which should be included in local development programs. Broad masses of the population could be involved. In this way they could substantially improve their living conditions and the economic situation. In addition, this would allow long-time unemployed people feel that they are useful for the community and they will have a better chance to get back to the labour market.

Food safety and testing are important issues because of the widespread use of fertilizers and pesticides. Regional laboratories could be set up to monitor these products continuously. Local production does not automatically mean high quality goods.

Therefore, according to the 6th priority of rural development in the new 2014-2020 period, a complex program of inner settlement gardens should be worked out to assist thematic sub-program of short supply chains and food safety in the favour of rural development as well as job creation. Although, this is a small-scale rural development it has a strong multiplier effect in respect of a settlement or region.

Recommendations

Based on our rural development research we believe that in the future we should extend this research to other closely related areas.

One of these, perhaps the most important, would be to test the range of homemade hand-craft products with high added value. Here the subjects of the research are: conditions of manufacture, food safety issues, market opportunities, and profitability issues on both sides of the border. In addition, it is important to examine some of these small business development milestones, as well as operations in order to gain an overall experience that leads to the production of handcrafted products in the context of rural development both in Hungary and Serbia.

Another recommendation of us would be to set up a program similar to the Dutch system called STIPO both in the Hungarian and Serbian border region. The central element of it would be a free business advisory network. Practically, this would mean that in every settlement, in a certain day of the week, a mentor would be available for growers and small business. Famers could review management and business plans together with the mentor. They could check the feasibility together and famers could count on the consultant in the future implementation as well.

GROWING TECHNOLOGIES

Technology of vegetable production in open field and in glasshouse in Serbian-Hungarian cross border area are similar. Because of weather conditions, consumer preferences and tradition, vegetable varieties, there are some differences. Some growing technology of vegetables is closer to Hungarian cross border region and their consumer preferences, while other is closer to Serbian cross border region and their consumer preferences. Producers from cross border region of project can choose between mentioned growing technologies, and to grow vegetables as it good for their conditions.

Growing vegetables on gardens plots

Being an intense, complex branch of plant production, vegetable production is characterized by multiple ways of growing a large number of biologically and genetically different species. In Serbia, vegetables are grown on about 250 000 hectares, with an annual variation of area of several thousand acres. Today, vegetable production takes place in the timed arable land production intended for different types of processing, then arable land production for fresh market, as well as intensive garden production for profit (trade) and nonprofit (for their own use) family production. Traditionally, garden cultivation accounts for about 20% of the total area under vegetables.

The importance of vegetables in nutrition is reflected in high biological and nutritional value. Vegetables, as an important food, provide vitamins, minerals, carbohydrates, dietary fiber, antioxidants, organic acids and various phytochemical compounds. Raw vegetables contain a lot of water and all the necessary enzymes. Due to large amount of water, the energy value of vegetables is low, from 9 calories (cucumber) to 133 calories (garlic). The dry matter content ranges from 4.8% (cucumber) to 38% (garlic). Most of the energy values of vegetables are carbohydrates, which are found in different shapes (simple, complex). Carbohydrates comprise 50 or more percents of dry matter, and are most common in melon, watermelon, tomatoes, peas, onion and garlic. Complex sugars (starch) are the most common in root and tuber vegetables (carrots, parsley, parsnip, radish, potatoes). Vegetable dietary fibers are an important component of vegetables and consist of cellulose, hemicelluloses, pectin, lignin and other polysaccharides. They play an important role in food digestion and the metabolism of sugar, triglycerides and cholesterol. Proteins are poorly represented in dry matter of vegetables, and most of them are in legumes (peas, green beans, broad beans and beans), spinach, cauliflower and leafy cabbage. Very important groups of compounds found in vegetables are vitamins (vitamin C, vitamin A and vitamin B group). Vitamin C is the most common in pepper and leafy vegetables. Vitamin A is found in vegetables in the form of beta-carotene, and most of it is present in carrots, spinach, parsley leaf and butternut squash. Vegetables are rich in minerals. When it comes to macro elements, vegetables contain calcium (spinach, green beans, and parsley), magnesium (green beans and peas), iron (spinach, brassicas), potassium (tomato, green beans, peas, bulbs). In addition, vegetables are rich in microelements. The taste of vegetables originates from organic acids, and the most frequent are malic, citric and tartaric acids. Specific odor derives from essential oils, which are most common in bulbs, parsley, parsnip, celery, dill, brassicas, radish, horseradish, etc.

Classification of Vegetables

The world knows about a thousand varieties of vegetables, 150 of which are cultivated and 30-50 species have worldwide use, as much as represented in nutrition in our area. Different organs of vegetables are used for nutrition: roots, underground and aerial part of plant, leaf, inflorescence, fruit and seed. Depending on the part of plant used for nutrition, vegetable species are classified into the following groups:

- root vegetables (carrots, parsley, parsnip, celery, red beet, small radish and radish)
- bulbs (onion, garlic, leek)
- tuber vegetables (potatoes, artichokes)
- leaf vegetables (cabbage, cauliflower, broccoli, kale, Brussels sprouts, kohlrabi, lettuce, spinach, chard)
- fruit-bearing vegetables (tomatoes, peppers, eggplant, cucumbers, green beans, peas, melon, watermelon, zucchini, pumpkins)
- legumes (green beans, peas, broad beans, okra)

Next classification is made by length of vegetable life cycle, where vegetable species can be classified into three groups:

- annual vegetables, which end their life cycle in one year (from germination to seed formation). This group is the most common in our climatic and soil conditions and consists of fruit-bearing and most of leaf vegetables
- biennial vegetable species, which in the first year form vegetative organs and are used in nutrition, and in the second year form generative organs. This group includes brassicas, bulbs, root and some of leaf vegetables
- perennial vegetables remain in one place for more than three years (horseradish, asparagus, artichokes, etc.)

Yet, when planning cultivation of vegetables in gardens and garden plots, the most important botanical classification is to genera and the families they belong to. Due to their relation and belonging to the same groups of plants, there are similarities or differences between the groups of vegetables. It is followed by the requirements of vegetable growing conditions (soil, heat, water, light), sensitivity to certain plant diseases, the need for certain nutrients (vegetables requiring potassium, legumes – vegetables nitrogen fixators), interaction between various types of vegetables (allelopathic relationships) and other important factors in the life of vegetables and gardening. The most common groups of vegetables in this classification are:

- bulb vegetables (*Alliaceae*; onion, garlic, leek, Welsh onion, chives),
- verdant (*Apiaceae;* carrot, parsley, parsnip, celery)
- brassicas (*Brassicaceae;* leaf - cabbage, cauliflower, broccoli, kale, Brussels sprouts, kohlrabi, arugula, mizuna, cress; and roots - radish and small radish, horseradish, daikon)
- lettuce (*Asteraceae:* lettuce, endive, wild chicory, chicory, artichoke, cardoon)
- goosefoots (*Chenopodiaceae:* spinach, chard, beet root)
- melons and squashes (*Cucurbitaceae*; watermelons, melons, cucumbers, squash, zucchini, Chayotte, bottle gourd)
- legumes (*Fabaceae*; peas, green beans, broad beans, vigna)
- berries and fruit-bearing vegetables (*Solanaceae;* tomatoes, peppers, eggplant, Golden berry and potatoes)

In addition to these groups, there are numerous vegetables, spices and herbs, all of which are grown in gardens. Mushrooms must be specially mentioned.

These classifications of plant species that are grown in gardens help to define the technology of growing vegetables, the economical use of all resources (requirements of plant species, varieties, available land and labor).

Growing Conditions

Successful cultivation of vegetables is conditioned by species biology, i.e. requirements for temperature, light and water. These requirements define the method of production (the time of sowing, tending measures during the growing season, harvest time), open field and/or the greenhouses. In relation to the temperature for growth and development (from emergence to maturity), vegetable species can be classified into groups that have high requirement in all stages of growth and development. This group includes tomatoes, peppers, eggplant, cucumbers, squash, green beans and beans. The best temperature for vegetative growth is around 25°C, but higher temperatures are also tolerated if vegetables are well provided with water. Adverse reaction occurs at lower temperatures (10°C) because they stop their growth. The second group consists of vegetable varieties that have moderate requirements for temperature, where the optimum is around 20°C, but they are more tolerant to lower temperatures of 10°C, while their growth is stopped at 5°C. This group includes root vegetables, cabbages, lettuce, spinach and peas. Onion, garlic, spinach and chard, where optimum temperature for growth of their vegetative organs is 15-18°C, have very modest requirements to heat.

Crop Rotation

Another important condition for the successful garden production is a crop rotation i.e. crop shifts in time and space, primarily because of the common diseases in groups of crop, nutrition requirements for the proper maintenance and increase of soil fertility. Vegetable crop rotation on garden plots is complex because it involves a change of crops throughout the year, as well as cultivation of mixed crops. This rotation is the most intense and provides a diverse vegetable production during the year, the maximum utilization of available resources (land and labor) and high profitability. Vegetable crop rotation is based on different plant requirements and especially the nutrients (manure) and biological traits of species. In relation to nutrition requirements, vegetables can be divided into three groups:

Group I consists of crop species that have high nutrient requirements and respond well to plenty of animal manure fertilization (gourd family, brassicas, tomatoes, peppers, eggplant, celery and leek) and thereby increase the yield while maintaining the quality.

Group II consists of crop species with lower nutrient and animal manure requirements and are often grown in the second year after the introduction of animal manure (parsley, carrot, parsnip, onion, lettuce, spinach, radish and small radish)

Group III consists of crops that enrich the soil with nitrogen – legumes (peas, green beans, beans and broad beans).

The most common is three-field vegetable crop rotation based on the previous partition and requirement of vegetable crops to nutrients.

Table 1. Three-field vegetable crop rotation (B. Lazić, 2002)

Field			
Year	I	II	III
First	Tomato, pepper, eggplant, cucumber, zucchini, squash, leek, brassicas	Carrot, parsley, parsnip, red beet, onion, garlic	Green beans, peas, beans, broad beans
Second	II	III	I
	Carrot, parsley, parsnip, red beet, onion, garlic	Green beans, peas, beans, broad beans	Tomato, pepper, eggplant, cucumber, zucchini, squash, leek, brassicas
Third	III	I	II
	Green beans, peas, beans, broad beans	Tomato, pepper, eggplant, cucumber, zucchini, squash, leek, brassicas	Carrot, parsley, parsnip, red beet, onion, garlic

Another important principle in formation of crop rotation is that species with deep root systems should be grown after those with shallow, in order to maintain good structure, transparency and porosity of the soil (root and legume; fruit-bearing and root). After that, a replacement of species that during the growing season produce different biomass (onion, garlic and gourd species) should be performed. The proper replacement of spring and winter vegetables should be performed in order to reduce weeds of garden plots, with minimal use of pesticides and rational use of land.

One of the most important requirements of proper use of crop rotation is that the groups of crops have a common diseases and pests. An introduction of crop rotation, one after another vegetable species belonging to the same family should be avoided, because they usually have the same enemies - insects and disease agents. This is especially important when it comes to tomato, eggplant, pepper, cucumber, then for root vegetables (carrot, parsley, celery and parsnip), as well as for bulbs (onion, garlic and leek).

The introduction of different varieties of the same species is performed according to duration of vegetation period, quality and diverse utilization. A crop pairing (mixed species) is characteristic for vegetable crop rotation. Species that have similar growing conditions requirements (temperature, light, water) and form different vegetative mass are being combined. Known types that are combined are carrot and onion, lettuce, onion and garlic, spinach and spring onions, brassicas and cucumber (especially by trellis breeding).

These species are known as "good neighbors" and are commonly grown row to row. There are also species that are not advisable to grow side by side, "bad neighbors", such as cucumbers with radish and small radish; leek with beans, red beets, peas and green beans; onion with green beans and beans; tomato with potato and peas, etc.

Vegetable Growing Technology on Open Field

Leaf Vegetables (Lettuce, Spinach, Chard)

LETTUCE

Lettuce can be grown throughout the year, due to its short vegetation, which is 30-90 days, depending on the variety and cultivation methods. It can be grown as a preceding crop, main crop (variety of neutral responses to day length) and succeeding crop.

Growing Conditions:

Temperature: It emerges at 2-3^{o}C, but the optimum daily temperature is 18-20^{o}C and night 8-12^{o}C. Optimum temperature for the growth of vegetative organs is 12-15^{o}C, and for head formation 18-20^{o}C. The minimum temperature for growth of lettuce is 5^{o}C and the maximum 20-25^{o}C. Young plant tolerates temperatures of 1-2^{o}C and short frost up to -8^{o}C.

Light: Lettuce is a long-day plant. To form a quality head, a day length of 10-12 hours is required, and summer and late varieties need 12-16 hours. Head lettuce varieties are tolerant to less light and have been successfully grown in the autumn-winter period.

Water: Lettuce has increased requirement for soil moisture and is particularly sensitive to the lack of moisture in the early stages of growth. Lack of soil moisture in the early stages of growth slows head formation.

Fertilization: Because of its short vegetation, lettuce comes second in crop rotation and is usually preceding, succeeding or inter crop. Short vegetation, intense growth and a large mass require many easily available nutrients. The highest requirements are during initial growth until rosette formation. Lettuce is fertilized with 6.0-10.0 g/m2 of nitrogen and phosphorus and 10.0-12.0 g/m2 of potassium. The entire amount of phosphorus and potassium are given before sowing, as well as half of the anticipated nitrogen and the remaining nitrogen are given in the first half of the growing season.

Growing Technology

Sowing: Lettuce sowing is performed during March (preceding crop) by direct sowing, with sowing density of 1-2 g/m^2 of seed, sowing depth of about 1 cm, or from seedlings produced in greenhouses and transplanted in late March and early April. Winter lettuce is sown in the August in the open seedbed, transplanted in early October (succeeding crop).

Direct sowing is performed in rows with 20-30 cm distance or in strips with 50-60 cm strip distance, and with 10-20 cm distance between the rows in strips. Winter lettuce is sown with 30-20x10-20 cm distance, with the same depth of planting as that on which the seedlings grew.

Crop cultivation: The compulsory measures of lettuce cultivation include thinning, irrigation, fertilization and weed control (hoeing). Lettuce thinning is performed 1-2 times, where first time is performed right after germination, and if needed, another time for final stand. Lettuce watering should be less frequent and abundant, especially by the time of head formation, after which the number of watering decreases. High humidity causes diseases or ruptures on heads. The optimal humidity for lettuce during sunny day is 70-80% and 60-70% during cloudy day. Irrigation of lettuce can be performed by drip system or sprinkling. Lettuce hoeing is performed two to three times during the growing season and as long as it is possible to enter the crop without damaging it. Winter lettuce is necessary to hoe right after winter, in order to establish a good air-water regime of the soil.

Harvest: Lettuce harvest is performed by hand when it matures technologically by cutting off the head and rosette, and with removal of dry leaves of the rosette. Lettuce harvest for closer market should be performed in morning hours, during the dew, and for other purposes when the dew evaporates. Lettuce yield ranges from 1.0 to 3.0 kg/m^2.

SPINACH

Spinach is grown for its green leaves that are used in the form of stews and salads. This vegetable has short vegetation and can be grown as preceding or succeeding crop and intercrop.

Growing Conditions

Temperature: Spinach has modest requirements for heat. The minimum temperature for germination and emergence is 4°C and the optimum 20^{o}C. The optimum temperature for development of vegetative organs is 13-16^{o}C and 30^{o}C maximum. Plants in the first stage of leaves withstand temperatures up to -8^{o}C. Well-developed plants in snow cover withstand -20°C, while temperatures above 25°C accelerate plants aging.

Light: Spinach is a long-day plant and has modest requirements for light. Therefore, it can be grown as an intercrop. Varieties resistant to low temperatures, but with long vernalization stage, can be grown during the winter.

Water: Because of the low developed root systems, short vegetation and large vegetative mass, spinach has increased requirements for water. In the absence of water it becomes slow growing, fast aging, and already after 3-4 leaves goes into the generative organs. Optimal soil moisture for the spinach should be about 70% of the FWC and 80% humidity.

Soil: Spinach requires structural, medium-heavy, fertile soils. It is an indicator of soil quality, because where spinach succeeds - all other types of vegetables succeed. In crop rotation, it comes second, after crops that are abundantly manure. In the intensive (garden) crop rotation, spinach is preceding or succeeding crop.

Fertilization: Spinach is fertilized with 10.0 g/m^2 of nitrogen, phosphorus and potassium nutrients. This quantity is given before sowing (during spring sowing), while in winter sowing half of the nutrients is given before sowing and the other in the spring, when it starts its intensive growth. It should be taken into account that the form of nitrogen nutrients is slowly decomposing, because of the harmful accumulation of nitrate in plants.

Growing Technology

Sowing: Spinach is produced by direct sowing of seeds. There are three modes of production: spring, autumn and winter. Spring sowing is performed at the end of February, beginning of March; autumn sowing in early August; and winter sowing is performed in early September. Spinach is sown manually in gardens, in rows with 20-25 cm distance, or strips with distance between the strips 40-50 cm, 10-12 cm in the row. For this kind of production 1.5-2.0 g/m^2 of seeds are needed. Sowing depth should be 3-4 cm.

Crop cultivation: It consists of fertilization, thinning, weed control (hoeing) and irrigation. Proper sowing, with appropriate seed quantity, excludes crop thinning. If sowing is too thick, thinning on 8-10 cm distance in the row is applied, under the appearance of the first two true leaves. It is necessary to hoe as soon as rows appear and by the end of growing season, and depending on the mode of production, it is usually twice. Watering is necessary after each harvest in spring and autumn production.

Harvest: Spinach from spring sowing is harvested in early May, from autumn sowing in early October and from winter sowing in early February. Harvest is performed when plants have 5-6 well-developed leaves. Harvest is manual and successive, where the biggest leaves are harvested by cutting or tearing off. Spinach cannot be kept for a long time. Under optimal conditions, length of storage is 5-6 days. The yield of spinach varies depending on the variety and growing methods, ranging 1.0-2.5 kg/m^2.

CHARD

Chard is grown for its leaves, which are used for soups or salads. It can be grown throughout the year and can substitute spinach.

Growing Conditions

Chard germinates at a temperature of 5°C, and the optimum is 16-24^{o}C. It grows slower at lower temperatures (5-10°C). Chard tolerates both lower temperatures (up to 7°C) and summer heats. It requires a deep fertile and structural soil. Under our climate conditions it can be grown for successful production without irrigation. Safe and stable yields of chard can be obtained only under conditions of intensive cultural practices. In this production organic nutrients (cured manure) and mineral fertilizers (40 g/m^2) 8:16:24, can be used.

Growing Technology

Sowing: It is sown from early spring to mid-June for a summer or autumn consumption, and in August and September for early spring consumption. It is grown by direct sowing at a depth of 2-3 cm, with 30-50cm row spacing and 10-15 cm distance in the row.

Crop cultivation: Crop cultivation measures include hoeing, thinning, fertilization and irrigation. Chard is thinned at the stage of 1-2 true leaves at the final distance of 15-20 cm. During the growing season it is necessary to hoe 2-4 times. Fertilization is performed 2-3 times with nitrogen fertilizers, after harvest, in order to foster the growth of leaves. Irrigation is essential for continued growth, particularly for the renewal of the leaf rosettes after harvest.

Harvest: Chard is harvested 60 days after sowing by severing external fully grown leaves. This allows further growth of plant and the formation of new leaves. Harvesting is performed repeatedly, usually 3-5 times. Number of harvests depends on the intensity of nutrition, irrigation, varieties and production conditions. During the last harvest the whole rosette is cut off. The yield ranges from 2.5 to 4.0 kg/m^2.

***Brassicas* (CABBAGE, KOHLRABI, KALE)**

Brassicas are species where, for nutrition, leaves, stalk, head and underdeveloped inflorescence are used. This group includes cabbage, kohlrabi, kale and cauliflower, which are usually grown in our region. In nutrition they can be used fresh, in the form of stews, marinades, frozen or pickled. Due to their requirement for heat, they can be grown as a spring, summer, autumn and winter crop, either as a main or stubble crop.

Growing Conditions

Temperature: Brassicas have modest requirement for heat. They germinate and emerge at 4-5^{o}C, but their optimal temperature for emergence is 18-20^{o}C. Optimal temperature for seedling production is 13-18^{o}C, and 15-18^{o}C for growth. Brassicas are the most tolerant to low temperatures at the stage of leaf rosette.

Light: Brassicas are plants of a long day and moderate requirements towards the light. The highest requirements occur at the stage of forming leaf rosette.

Water: This group of vegetables has increased requirements for water. This is caused by poorly developed root system and a large vegetative mass. Water requirements are the most intense at the stage of intensive rosette growth.

Soil: Brassicas are very well grown in different soil types. Kohlrabi has minimum requirements, and cabbage and kale have much higher requirements for the quality of soil.

Fertilization: In crop rotation brassicas come at the first place (field) or, they react very favorably to usage of organic fertilizers. For early and middle early production, manure is applied in the primary tillage, while for late production cured manure is applied during summer processing.

Growing Technology

Sowing: Production of early cabbage seedlings begins from mid to late February (in the warm seedbeds). Transplanting is performed in early April and the harvest, depending on the variety and the environment, is performed from June to July.

In the early production, seedlings for transplanting can be produced in boxes. For box size 50x35x8 cm sowing rate is 1.5-2 g of seeds per square meter, while for sowing in seedbeds there should be around 2-2.5 g/m^2 of seeds. Sowing depth should be up to 2 cm. One gram has 250-350 seeds. Seedbeds can cultivate up to 500 plants per square meter. In cotyledon stage and the appearance of the first true leaf, transplanting is applied into nutritional cubes or pots. The seedlings are transplanted at a spacing of 10x10 cm or 12x12 cm. Prior to transplant, both seedbeds are watered, so that from the first seedlings are easily removed, transplanted and adapted in another. Planting depth (for transplant) may be greater than it was in the germinating bed. It can be up to 1 cm below the cotyledons. Formation of quality seedlings requires certain heat conditions. Until emergence, the temperature is maintained at about 20°C, and after emergence it is decreased by 6-8°C, in order to prevent undesirable elongation of seedling stalks. The optimum daily temperature at this stage is 15-17^{o}C and 6-8^{o}C during night.

Planting out early cabbage is performed by the end of March and beginning of April, i.e. when danger of stronger frost passes. Only a strong, well developed and hardened off seedling, with 5-6 well-developed leaves is being planted out. To keep your plants better adapted to the conditions prevailing in the open field, they should be, whenever conditions allow, displayed and exposed to direct sunlight (hardening off seedlings). It is usually about ten days before the planting out (if the plants are well developed). The seedlings should be uncovered during the day and night, when there is no danger of frost.

Hardened seedlings become firm and tough. Otherwise, non-hardened seedlings are difficult to adapt, slow growing; petiole and stem often get sun scorches, and saprophytes attack scorched piece of tissue, causing seedlings to collapse and rot.

The early varieties are planted out at 40-50 cm spacing between rows and 30-40 cm in the row. When planting, care should be taken of plant density, as dense planting results in the formation of smaller heads.

First hoeing is performed 13-15 days after sowing, and the next one after every irrigation. The average irrigation norm ranges from 20 to 45 mm, and the number of watering for early production 3-5 times. When watering, it is essential that the soil moistens in the layer of 20-40 cm (zone of active root system). Irrigation is required cultural practice in our conditions. It is performed early in the morning or in the evening, not during the day in the sun. This prevents cold shock in plants, as well as damages that may result from contact of cold water and warm cabbage leaves.

LATE CABBAGE / KALE

Seedlings of late cabbage and kale are produced in open seedbeds from May 20 to June 10. For sowing, there should be 2.5-3 g/m^2 of seeds. Depth of sowing should be 1-2 cm. Deeper planting prolongs emergence, which reflects unfavorably to seedlings. The distance in row should be 1.5-2 and 25-30 cm between the rows. If the plant set is thick, there comes to shading and elongation of seedlings. After sowing, soil should be watered, but be careful not to create a crust, because then the seed emerges more difficulty and uneven. Production of seedlings takes about 40 days. The plants are planted out when they have five or six well-developed true leaves. It is transplanted at a distance of 50-60 cm in the row and 60-70 cm between the rows. Optimal time for planting late cabbage is from June 20 until July 20. Generally, the best time is during first or second ten-day period of July. Cabbage and kale are watered during the growing season 10-12 times, in the time interval of 8-15 days between watering, with 30-40 mm/m^2 of water.

Cabbage harvest is performed successively in full technological maturity. In late varieties of cabbage, last harvest must be arranged before the temperature drops below -5^{o}C. Kale can be harvested later, as it is more resistant to low temperatures.

KOHLRABI

The optimum temperature for growth of kohlrabi is 14-20^{o}C during the day and 8-20°C during the night. Kohlrabi production takes place mainly through the seedlings. Early spring production takes place in a greenhouse at temperatures above 14^{o}C. Planting density should provide a maximum of 550 plants per 1m^2, which requires about 2-3 grams of seed. Production of seedlings takes 4-5 weeks, until seedlings form 4-5 true leaves. If it is planned to produce kohlrabi in early spring with covering it with agro-textile or perforated polyethylene foil, it is preferable to produce seedlings for these growing conditions. This means the seedlings must be vigorous and stronger. If we want continual harvest, then the sowing and transplantation should be carried out every 15-20 days, so that during the whole season young kohlrabi can be harvested.

In early production of kohlrabi, sowing is performed in early February in warm seedbeds or similar greenhouse with supplementary heating. It is planted out in late March and harvested in May.

In the summer production, sowing is performed in April in half-warm seedbeds and planted out in May. Harvest of summer kohlrabi is in July or August.

Seedlings for autumn production are grown in open seedbeds and planted when there are 4-5 formed leaves. For winter-spring production containerized seedlings are produced in warm buildings and planted out 35-40 days after emergence. Very good results are achieved by planting potted seedlings at the stage of thickened stalk.

In early production of kohlrabi sowing in warm seedbeds is performed in the period February 25 – March 10, with a sowing rate 2.5-4 g/m^2, transplanted at cotyledon stage and the appearance of the first true leaf. Planting out is performed in the period of April 01-10, in the open field. Because early kohlrabi tends to be less vigorous, i.e. sized, sufficient space planting is 25x25 cm or 30x25 cm and 13 to 16 plants per m^2. If dense planting is present, it comes to mutual shading and elongation of the leaves, as well as to changes of the stalk.

In late production of kohlrabi sowing is organized in cold seedbeds in the period May 25 – June 05, at sowing rate 2-3 g/m^2. Transplantation is performed in the period June 25 – July 15, at the distance of 50x30 cm. In autumn production, plant density should be between 8 and 12 plants per m^2, i.e. 40x30 or 30x30 cm.

Harvest is organized depending on the maturity, i.e. it can be single, twice or three times. Early kohlrabi yields range from 2.0 to 3.0 kg/m^2, and autumn and late kohlrabi up to 5.0 kg/m^2.

Fruit-bearing Vegetables (Tomatoes, Eggplant, Pepper)

This group includes the largest number of widely cultivated vegetable crops in our climate. Fruits in fresh, processed or preserved state are mainly used for nutrition.

TOMATO

Tomatoes are used in human nutrition as fresh or in the form of different products.

Growing Conditions

Temperature: Tomatoes are vegetable thermophilic species. Thanks to the production of seedlings, tomatoes can be grown in a wide range. Temperatures between 18 and 25°C are required for normal plant development. The minimum temperature for germination is 10°C. At moderate soil moisture, sowing at 2-3 cm depth and temperature of 25°C, the seed emerges in 5-6 days. Tomato stops flourishing at temperatures below 15°C and above 35°C. At a temperature of 9°C the plant growth stops.

Light: Tomato is a typical light plant. Light is essential in the production of seedlings, but also in fruit. The minimum day length for flowering and fruit set is 9-10 hours, which is achieved in our region by the end of April and lasts until the end of September. At high light intensity, flowering comes earlier.

Water: Tomato has a large leaf area and it needs optimum water quality from emergence to the end of the growing season. Tomato consumes 300-400 liters of water per kg of dry matter i.e. that is the transpiration rate. Soil moisture should be maintained by regular irrigation. Otherwise, if the dry and wet periods take turns, it results in fruit cracking. The best use of water irrigation is drip system. It is important to note that when it comes to tomatoes, it is better to water rarely, but abundantly, than often and not enough, thus only the surface layer is wetted and it leads to the formation of a shallow root system. For Vojvodina conditions, tomato requirements for water range from 450 to 520 mm, depending on the year, while the average daily consumption is from 3.6 to 4.5 mm. The maximum is 8 mm per day.

Fertilization: Tomato is a species that comes first in crop rotation, and it is fertilized with manure and mineral fertilizers. Manure is applied before the winter treatment (20-40 t/ha of cured manure). Depending on the type of planned yield and production type, over 14-16 g/m^2 of N, 18-22g/m^2 of P_2O_5 and 13-15g/m^2 of K_2O is applied to the soil. Producers should take these quantities only as approximate, since each plot is fertilized for itself. When calculating the amount of nutrients that are applied into soil, it is important to mention that tomatoes exploit nitrogen with 60%, phosphorus with 15% and potassium with 70%. Half to two-thirds of NPK nutrients is applied in autumn, under deep tillage, or in early spring before the closure of the winter furrow, and the rest is applied to top dressing, which takes place at the beginning of blooming. One-half of total nitrogen is applied before sowing and the other half is left for top dressing.

Growing Technology

Sowing: Depending on the time of maturity and type of varieties, tomatoes are produced from seedlings or by direct sowing. Production begins with sowing for seedling production. Seedlings are produced in greenhouses, warm or tepid seedbeds, depending on the type of production. Production time of seedlings is always dependent on climatic conditions, areas of cultivation and type of production. As a rule, if transplantation of seedlings is anticipated, sowing time should be set to approximately 5-6 weeks prior to the seedling planting out (whether in the open field or greenhouse). Sowing is performed in warm seedbed at the end of March, and for the late production, it is performed in April and May in the open seedbed. Tomatoes are sown thickly in a warm seedbed or box, and such seedbed is called germinating bed. That is a place where plants grow to the appearance of the first pair of true leaves, when they are transplanted to other hot seedbed, box, pot or some other place. In the production of transplanted seedlings row spacing (at sowing) is 3-4 cm, while distance in the row is 0.5 – 1.0 cm. Seedling is transplanted at the distance of 10x10 cm or 12x12 cm. Right after transplantation, plant is watered, in order to achieve a good contact between venation and soil particles. Another method is sowing in rows or freely. Free sowing is usually performed into warm seedbeds or greenhouses at the end of March, for full production season of tomato. When it comes to this method, 1.8-2.2 g of seeds per m^2 is needed, which gives circa 500-600 plants per m^2. These seedlings do not have to be transplanted. To keep your plants better adapted to the temperature conditions of an open field it is necessary to harden off the seedlings and it is usually about ten days before the planting out.

Planting out: Planting out is usually performed at the different distance between the rows and in the row. The most common combinations are 80x40, 80x50, 90x40 or in two strips 100+40x30 cm. Sowing density depends on variety, determinate (limited) or indeterminate (unlimited) growth, breeding systems and other circumstances. In an early production at the open field, when plants are grown with support and pruned to one stalk, they can have much bigger set. This contributes to higher yields, especially when it comes to early varieties. Irrigation must be a crucial element of sowing.

In addition, tomato can be grown by direct sowing which takes place from April 20 to May 05. Determinate varieties of different vegetation period are used for sowing.

Crop cultivation: After planting out, during first few weeks, it is necessary to provide careful crop cultivation, and primarily hoeing, irrigation and during last hoeing slight earthling up. When it comes to growing indeterminate varieties, one of inevitable measures of crop cultivation is tomato staking and directing to the support, with laterals tearing off. This measure regulates growth and plant fructification. Tomatoes can be attached to a wooden stalk, directed along the rope (if we have constructed structure) or grown in intertwined wire. There are two applied methods of forming the stalk in the practice. Pruning (laterals tearing off) to one stalk at high varieties and hybrids, and to one stalk with four flower branches. Two stalks are left at dense and late varieties. The other stalk is actually stipule below the first flower branch, which is not removed, but grown as well as the main stalk.

For the conditions of Vojvodina, tomato water requirements vary from 450 to 520 mm, depending on the year, while the average daily consumption is 3.6-4.5 mm and maximum 8 mm per day.

Harvest: Harvesting tomatoes is performed manually at full physiological maturity of fruit. Yield is 3-10 kg/m^2.

EGGPLANT

Numerous and very tasty dishes can be prepared from eggplant, and it is invaluable raw material in preparing vegetable spread, casseroles and other dishes.

Growing Conditions

Temperature: Eggplant requires long, warm vegetation season to achieve a successful production. Compared to other thermophilic species (pepper, tomato, potato, Golden berry), eggplant has highest requirements towards heat. The emergence starts at the soil temperature of 13^{o}C, but optimum temperature is 25^{o}C. Optimal temperature for growth of vegetative organs is 22-28^{o}C. Lower air and soil temperatures (around 15^{o}C) during seedlings production or immediately before flowering stop the growth, decrease number of formed flowers, decrease first harvest yields and total yields. Due to that fact, seedling production must be in accordance with optimal air and soil temperature, without significant temperature fluctuation during day and night. Sowing should be performed when soil temperature is 18-22^{o}C. Fruit formation requires optimal temperature of 24-26^{o}C.

Light: Eggplant is a plant of a short day (10-12 hours of light). In our climate conditions, during vegetation at an open field, light is not limiting factor for growth and development of eggplant. Eggplant has high requirements for intensive light. When light is too low, especially from the stage of seedling to the stage of flowering, plant has slow growth, branching and flowering. Lack of light is especially expressed during winter production in greenhouses.

Water: Eggplant has increased requirements for soil moisture. Optimal development of root and whole plant is present during soil moisture of 80% FWC (field water capacity).

Eggplant has highest requirement for water at the stage of fructification, where every reduction of available water in the soil leads to decline of flowers and young set fruits. Therefore, the eggplant should be grown under irrigation and at good air and water regime. The optimum relative humidity is 60-70%. At high humidity, the plants get elongated, etiolated and more affected by diseases. Low relative humidity (below 40%) leads to the decline of flowers and fruit.

Fertilization: Eggplant is a species that comes at the first place in crop rotation, as a main crop. It is fertilized with manure and mineral fertilizers. Cured manure application of 2-4 kg/m^2, depending on the origin, is included under the primary processing. Fertilization with mineral fertilizers is also necessary. They affect early maturity, fruit size and quality, and thus the total yield. The recommended doses in the production of eggplant are 15-20g/m^2 of nitrogen, 12-15g/m^2 of phosphorus and about 20g/m^2 of potassium. One-third of the total amount of NPK fertilizers is given during the primary tillage. The rest of the phosphorus and potassium and nitrogen-third are given before planting, one-third of the nitrogen in top dressing. At the stage of flowering and fruit formation the crop can be foliar fertilized by micronutrients.

Growing Technology

Sowing: Eggplant is produced from seedlings. Production of seedlings is performed in warm seedbeds or greenhouses. Sowing is performed on the first days of March, by direct seed sowing (without transplantation). For this harvest, we need about 2-2.5 g of seeds per seedbed square meter. For late production (harvest August-September) seedlings can be produced in greenhouses without heating. Sowing takes place around March 20. It is less frequently sown with a consumption of circa 2.5 g of seeds per m^2. Seedlings aged 55-60 days are being planted out. In continental parts of Serbia sowing can begin in the first week of May and can last (for late production) until June 10. The planting distance depends on the variety growth vigor and on existing machinery for inter-row cultivation. It is the most planted at row spacing of 70 cm and 40-50 cm in the row. Planting may be in two-row strips with distance of 70 cm + 45 +45 x40-50 cm.

Crop cultivation: After transplanting (planting out), provide a careful cropping, especially regular hoeing, watering, and after rooting with cultivating, you should mildly earth up the crop. With the beginning of plant growth first crop cultivation (plowing) is performed. Since eggplant is produced with irrigation, there should be 3-4 hoeing during growing season. During the growing season, watering is carried out every 6-8 days with 25-30 ml of water sediment. Together with hoeing crops, fertilizing with nitrogen fertilizers is also performed. If the crop is weak, we can fertilize with NPK fertilizers at a rate of 20 g/m^2 or apply supplemental nitrogen and potassium fertilizers.

Harvest: When it comes to early production, harvest starts in second half of July, and for late production, it is the end of July and beginning of August. Harvest should be performed with scissors or sharp knife, in order to prevent the damage of the plant (broken stem or plant). Eggplant yield ranges from 3.0 to 5.0 kg/m^2 of fruit. Fruit that shows characteristics of maturity for that variety, which is shape, size and shine of fruit, is harvested.

PEPPER

It is grown for nutritional and delicious fruit. It can be used in nutrition as fresh or processed in different ways. Every variety has its own biological and production traits, as well as usage purpose. Different pepper varieties are grown in our conditions: tomato peppers, bell pepper, bell sweet peppers, long fruit peppers, Hungarian wax peppers, chili peppers.

Growing Conditions

Temperature: Pepper is thermophilic species. Optimal temperature for growth and development is 25±5-7°C, and the highest requirements for heat appear at the stage of slow germination and emergence. The minimum temperature for germination is 10°C. At higher temperatures, germination is faster and smoother. When soil temperature is 22-25°C, germination begins for 6-7 days, and ends up practically for about 10 days. The optimum temperature for germination and emergence of pepper seed is 25-30°C. The largest amount of flowers and the best fertilization are achieved when pepper is grown at a temperature of 25°C during the day and 16-21°C during the night. Night air temperature should be decreased by 5-10°C from optimal daily temperature.

Light: Pepper is heliphilic plant. Pepper has the highest requirements towards light from emergence to full physiological maturity. Illumination intensity, which has a direct effect on the duration of the individual phases of pepper development, is very important. Requirements for light are particularly large in the seedling period. Shaded areas are not good for pepper production, which is the reason why it cannot be grown as intercrop. In the absence of sufficient light plants are elongated, flowers and set fruit are decreased and vegetative mass is increased.

Water: Due to the relatively underdeveloped root system and high production of organic matter, pepper has high requirements for water throughout the growing season, especially during the period of fructification. An average transpiration rate in pepper is 330. The amount of water pepper adopts depends on climatic conditions, the intensity of solar radiation, temperature, relative humidity and soil moisture. Pepper plant adopts the highest amount of water between 12-14 hours, and this is the period when the Sun's radiation is the strongest. In our climatic and soil conditions, pepper consumes the most water amounts in July and August, because it was found that one plant transpired 120-600 g of water per day. Naturally, that is the period when pepper vegetation reaches its maximum development, has the largest plant mass and continuous development of the fruit. The absence of easily accessible moisture during this period leads to physiological changes in fruit. They are manifested through scorches on top of fruit, firstly white-gray, then brown and finally black. This is a consequence of lack of moisture, and any disease, as it is often thought. The plant compensates the lack of moisture from the fruit, and therefore the “spots” appear.

Optimal soil moisture for growth of the above ground parts of the plant is 70-80% of field water capacity (FWC) and air humidity is 60-70%. Low humidity and high temperatures result in a decrease of flowers and set fruit. The best temperature for pepper irrigation should be 18-25°C. In our agro-climatic conditions, pepper should be irrigated every 7-10 days. Irrigation rates should be, in the initial stages, 15-20 l, and later 20-40 liters per square meter, depending on climatic conditions.

Fertilization: Pepper requires the presence of nutrients for growth and development. We need to apply manure and mineral macro elements (N, P, and K) for successful cultivation of pepper. Requirements towards nutrients change depending on the stage of development. In the initial stages of development, K plays the most important role, while N is the most important in the flowering stage and beginning of ripening. P and K play a significant role at a stage of full maturity, while at the end of ripening all three elements equally affect the formation of the total yield.

When it comes to organic fertilizers, fresh manure is applied in quantities of 30-50 t/ha under autumn deep tillage, and if cured manure is used, then the quantity is 20-30 t/ha, applied in spring. If we take into account the amount of nutrients applied with manure, then the yield of 30-40 t/ha needs the following nutrients: 12-16 g/m^2 of N, 6-10 g/m^2 of P_20_5 and 15-24 g/m^2 of K_20.

Use of mineral fertilizers depends on the assortment, the manner and purpose of production. When pepper is mainly produced from seedlings, the planting should include ½ of nitrogen and 2/3 of phosphorous and potassium fertilizers. The second half of the nitrogen fertilizer is given in two top dressings. The first one is given 3-4 weeks after planting, with inter-row cultivation, and the second at a stage of intense flowering and fruit setting, when the remaining portion (1/3) of phosphorus and potassium is given to ensure proper fruit shape.

Growing Technology

Sowing: In our conditions, pepper is produced from transplants, which allows an earlier harvest and higher overall yield. Medium early production in our country is the most widely used and carried out with planting in hot seedbeds, greenhouses with supplementary heating. Sowing of seedling production is carried out in March and transplanting in May, which products transplanted seedlings. Pricking is performed in nutritional box or containers. For the late production pepper seedlings are produced in greenhouses without heating (in cold seedbeds, low and high greenhouse tunnels and greenhouses). Sowing of seedling production is carried out in late March and early April, and planted out in late May and early June. When planting, with no pricking, proper arrangement of plants and required density is very important. The amount of good quality is 5-8 g/m^2 to provide 600-700 plants. Sowing depth is 1.5-2 cm.

Planting out is performed from the end of April until the first half of May for medium early production, while for late production, from half of May until the beginning of July. This planting is performed manually, by planting pricked seedlings and seedlings produced from containers and nutritional boxes. Manual planting is performed with non-pricked seedling, also. Pepper is usually planted at a distance of 50x20 cm, and for large-fruit bell pepper, the best distance is 60x20 cm. Planting can be performed in rows, two-row or multi-row measuring bands, but always with a plant in the box. Planting may be on a greater distance between rows, for example, up to 70 cm, depending on the variety and the way of row crop processing. Sowing depth should be 5-6 cm, i.e. it is planted up to cotyledons or one cm deep. Deeper planting is not recommended because more time is needed to warm up the soil on greater depth, as well as transplant adaptation lasts longer.

Crop cultivation: Seedling cultivation measures consist of regular watering with warm or stagnant water, ventilation, weed control, supplemental fertilization and seedling hardening off. Seedling hardening off begins seven days before planting out. The number of watering is reducing, but irrigation rates are increasing, for provoking the growth of root system. The greenhouse is intensively ventilated, preferably completely open.

After planting out, pepper should not be watered with large irrigation rates. If the soil is watered before planting, about 10 liters per m^2 are sufficient to combine soil moisture. During warm weather, the irrigation rate of 10-15 liters per m^2 should be repeated 2-3 times. After rooting, pepper should be watered with about 20-30 liters per m^2. If planting was good and proper, there is no need for correction of the stand. Otherwise, after 5-7 days the crops control and filling the empty places should be carried out, after which irrigation is of utmost importance.

Harvest: Pepper fruits mature from the base to the top of the plant, by levels. Bouquet pepper varieties have jointly maturing and can be harvested repeatedly. From fertilization to technological maturity, depending on the variety and growing conditions, about 30 days usually elapses. Pepper is harvested mostly in technological (usability) maturity, when the fruits have a yellow, white, light green or dark-green color and the shape and size characteristic for the variety. The yield of pepper ranges from 2.5 to 5.0 kg/m^2.

Runner (Creeper) Vegetables (Cucumber, Zucchini)

CUCUMBER

Cucumber fruits are used fresh and preserved. Cucumber is used in nutrition as a refreshing salad of low energy value.

Growing Conditions

Temperature: Cucumber is a typical thermophilic species. Cucumber seeds germinate quickly if temperature conditions are optimal (25-35^{o}C) and with enough moisture, germination can occur within 2-3 days. If the temperature is around the minimum (12-13^{o}C), germination is extended from 12 to 20 days and large losses within may occur. Normal field germination can be expected at temperatures below 17^{o}C.

Vegetative growth of cucumber requires temperatures over 15^{o}C, and the fastest growth is achieved at 25-27^{o}C, while at 40^{o}C plant growth stops. At a temperature of 0^{o}C cucumber plant dies very quickly, and even positive low temperatures of 3-10^{o}C, if continued for several days, can be fatal for cucumbers.

Water: Cucumber is a plant of wet areas and for optimum growth needs much soil moisture and air humidity. Therefore, soil moisture should be 70-100% of FWC with 70-90% of relative humidity. Growing cucumbers in the open field can only be achieved by irrigation, which can influence the air humidity partly. Water consumption is the most intensive since the beginning of flowering until the first harvest, after which consumption is constant.

Light: Cucumber is a short-day plant. At higher intensity, vegetative growth is faster, as well as development of flowers and fruits.

Soil: Growing cucumbers requires light, porous soil with a high content of organic matter and neutral valence. Compacted soil with high level of groundwater is not suitable for growing cucumbers, because it reduces the efficiency of nutrients utilization, root growth and reduction in yields.

Fertilization: Cucumbers come at the first place in crop rotation, mainly because of its high requirements for easily accessible nutrients. Cucumber is a species that requires plenty of fertilization, organic and mineral, especially due to short vegetation and root systems of weak intake power. Organic fertilizer, besides bringing nutrients that cucumber uses very well, significantly improves water and air regime of soil, which is very important for the formation of large number of fruits. In the early and mid-early production, manure is applied in the amount of 4-6 kg/m^2, and if cucumber is produced as a second crop, then, cured manure is applied in the amount of 2-3 kg/m^2 during the summer treatment. Cucumber root system is very sensitive to increased concentrations of nutrients and it is necessary that the time and input comply with manner of production and stages of plant growth. The required amount of nutrients for production in the open field is 8-10 g/m^2 of nitrogen, 8 g/m^2 of phosphorus and 10-12 g/m^2 of potassium. In this production, all amounts of phosphorus and potassium are applied before sowing, as well as half of nitrogen. In the production of cucumber (pickles), which is usually the second crop, the total quantity of nutrients is applied before sowing.

Growing Technology

Sowing: Field production occurs when the soil temperature conditions are favorable for planting; in our conditions, it is from mid-April until July. In the garden, sowing is performed in boxes and usually 3-4 seeds are sown, while thinning is performed later. Row spacing is 100-120x50-60 cm, to a depth of 2-3 cm.

Crop cultivation consists of thinning, inter-row cropping, fertilization, irrigation and the diseases and pests control. Crop thinning is performed at the stage of first and second leave. If manure is applied, then mineral fertilizers are applied only as top dressing during early and mid-early field production at the stage of vine, i.e. at the beginning of flowering. Top dressing is performed one or two times during vegetation period with mineral fertilizers. First one is performed before the beginning of vine formation, and the second one before the beginning of fructification. Top dressing is carried out with 2-3 g of nitrogen, 4-5 g phosphorus and 5-6 g of potassium per square meter. These quantities can be corrected depending on the state of crops and the amount of applied organic and mineral fertilizers.

Inter-row hoeing is an important measure to destroy weeds, while surface layer of soil is held in a loose condition, and it is conducted until the plants form rows. Irrigation of cucumbers is a measure that achieves safe and high yields, especially during the fructification and high temperatures. If the sowing layer is drained, then watering is needed after sowing, so that cucumber can quickly emerge. If a crust is created before emergence, it is necessary to maintain a sowing layer moist. Moderate watering is carried out until fruit setting, every 4-8 days, depending on temperature and soil moisture, so that vegetative mass cannot be too developed.

. Harvest: Cucumber is harvested in technological maturity, when fruit is firm, of regular shape and color appropriate for the variety. About 6-11 days are required from fertilization to technological maturity of pickles, and 12-21 for salad type varieties. Fructification may last up to 90 days. Harvesting is manual; salad cucumbers are harvested every 4-6 days, and pickle every second day. The yield of salad cucumber is 3.0-6.0 kg/m^2.

ZUCCHINI

Zucchini is mostly grown in the open field, but also as an early crop through seedlings in an open field or greenhouse.

Growing Conditions

Temperature: Zucchini as a plant species has a high requirement for heat. The optimum temperature for germination and plant growth is 25-30^{o}C, and plant growth ceases at temperatures below 10^{o}C. The minimum temperature for germination and emergence is 12-15°C, and the fruit growth is stopped if the temperatures are below 15^{o}C.

Water: For successful cultivation of zucchini, there should be evenly watering, especially at fructification stage, because this plant species forms large above-ground mass.

Light: Zucchini is a species that requires a lot of light (heliphilic plant), but it cannot handle shading when grown as inter-crop.

Soil: It requires structural fertile land and in crop rotation comes first. It responds very well to fertilization with manure.

Fertilization: Besides manure, in zucchini production it is necessary to apply 10-12 g/m^2 of nitrogen, 10-12 g/m^2 of phosphorus and 10-15 g/m^2 of potassium. Half of mineral fertilizers are applied under primary tillage and the remaining part as top dressing.

Growing Technology

Sowing: Zucchini is sown at an open field in late April or early May. Sowing is carried out by making a little elevated boxes or banks, which are much faster heated and 3-4 seeds are sown at 4-5 cm depth. Zucchini is usually in a form of shrub, so it is sown at the row spacing of 1-1.2 m with spacing between plants of 0.5-0.8 m.

For this sowing method, 3-5 g of seeds per hectare are needed. Zucchini can be successfully grown in the field as an early crop. For an early production it is necessary to produce seedlings in warm seedbeds or greenhouses. Sowing for seedlings is performed in early March, and the seedlings are produced in containers diameter of 10-12 cm. Transplanting (planting out) is carried out in early May on the field, and this crop matures 15-20 days earlier than the crop from direct sowing.

Crop cultivation: If zucchini is sown in boxes where 4-5 seeds are sown, it is necessary to perform post-emergence thinning. Crop thinning is carried out together with hoeing, in a stage of formed second leave, when only one well-developed plant is left. Earthing up is also carried out, which enhances the growth of adventitious roots. Inter-row cropping is performed as long as it does not damage the plant. Watering is performed if necessary, and it is especially needed at the time of fructification if there is lack of humidity with high temperatures. Fertilization at the stage of flowering gives good results, especially if organic fertilizers had not been applied.

Harvest: Harvest is performed in technological maturity, when fruit length is 12-20 cm. To form a large number of high-quality fruit, it is necessary to harvest every or every other day, with the removal of overripe fruit that stops the growth of newly formed fruits. One plant gives 15-20 fruits and good crop yields 2.5-4.0 kg/m^2.

Bulb vegetables (spring onion, garlic)

Onion and garlic are among most widespread vegetables species and can be grown in diverse agro-ecological conditions. During the whole year the bulb, young plants or leaves are used for consumption. Young plants and mature bulbs of onion and garlic are grown in gardens and house gardens as a preceding or succeeding crop.

ONION (Spring Onion)

Spring onion is produced from seedlings, large onion sets and small bulbs (diameter under 3 cm). Varieties with white skin (silver skin onion) are produced from seedlings, while large onion sets have bulbs of over 2.5 cm diameters).

Growing Conditions

Temperature: As onion grows and develops, it changes its temperature requirements, which are generally modest. Emergence begins at 2 to 3^{o}C while the optimal temperature is around 20^{o}C when emergence is very fast. Favorable conditions for above-ground mass formation, i.e. leaves imply 15-20^{o}C. Temperatures above 20^{o}C speed up the formation of leaf mass, thus producing shorter and smaller leaves in spring onion. Onion withstands low temperatures very well, but such winter-hardiness depends primarily on its developmental stage. Therefore, seedlings can withstand up to -3^{o}C, while at the 3-5 leaves stage the plant can withstand much lower temperatures (-15^{o}C). This allows sowing and planting in autumn because plants should enter winter at this stage.

Light: Onion is a long-day plant, but day length necessary for bulb formation varies and depends primarily on the variety origin. Our agro-ecological conditions allow growing varieties which need a long day to form bulbs. Day length conditions sowing and planting dates, because it these are missed the root and leaf formation stages are shortened, which in turn disturbs regular bulb formation.

Water: Onion has very low transpiration rate, primarily due to small leaf area and wax layer on the leaves. Regardless of the low transpiration rate, onion has high requirement for water because of the weakly developed root system (the largest part of the root is found in the top 20 cm layer). Onions largest requirements for water are at the emergence stage and leaf formation stage.

Fertilization: Onion has high nutrient requirements, but in crop rotation it comes second. Due to its shallow roots, onion requires easily-available forms of nutrients. Production of spring onions implies application of 30-40 g/m^2 of NPK fertilizers (15:15:15) prior to planting and additional 5 g/m^2 of N as supplemental fertilization.

Growing Technology

Sowing: Sowing dates include mid-October to mid-November, and planting depth is 5-6 cm. Spring onion production need growing area of only 100 cm, so that sowing is performed in bands (50-60 cm) with row spacing of 20 cm and inter-row distance of 5-10 cm. This sowing date provides 3-4 leaves and good root system before winter, which helps throughout wintertime.

Sowing for seedling production is carried out in the first ten-day period of August. Sowing density is 8-10 g/m^2 of seed in open seedbeds at the depth of 1-2 cm. Irrigation is necessary before and after sowing. Transplanting is carried out when onion reaches 3-4 leaves stage at the distance of 20-40x5-10 cm.

Crop cultivation: During the growing period spring onion is fertilized and hoed after winter. As soon as spring allows field work, 50 kg of N per hectare should be applied. If the vegetation lacks moisture during spring, it should be irrigated.

In seedling production moisture maintenance is necessary so that the plants can emerge uniformly, while irrigation is necessary after transplanting the plants. Supplemental fertilization is the same as with onion sets production.

Harvest: Spring onion matures for harvest successively from end March to end May, and reaches yields of 1.5-2.0 kg/m^2.

GARLIC

Garlic is used for fresh consumption and as a spice, food supplement, it is a good preservative, and can also be processed (dried with other herbs).

Growing Conditions

Temperature: Garlic has modest requirements for temperature, it is resistant to low temperatures and frost, especially in winter varieties. This resistance is due to high dry matter content (35-38%). Emergence starts at 3-5^{o}C, while optimal temperature for root growth is 10^{o}C, and for seedling growth 16-18^{o}C. Intensive cloves growth is best at 20^{o}C, and bulb maturation at 25^{o}C.

Light: Garlic has high requirements towards light, since it reacts to day length like onion. Bulb formation needs 14-hour day, so when northern varieties are planted in southern regions they do not form the bulb, but remain in the “grass” stage. In the other case, when southern varieties are planted in northern regions they have significantly longer growing period. Garlic does not favor shaded areas, or growing in orchard, because then it forms small bulb.

Water: Lack of water in critical developmental stages is very adverse for garlic production. Water deficit in the rooting stage is a disadvantage for early plant development, regardless of the fact that the germ uses reserve nutrients from the clove, because undeveloped root together with higher temperatures leads to plant death. Water requirements vary depending on the planting date (autumn or spring) because autumn garlic goes through critical stages in favorable moisture conditions yielding satisfactorily even without additional watering. However, spring garlic needs watering, as water deficit often occurs at the leaf formation stage which is when water requirements are the highest, and also at the bulb formation stage.

Fertilization: Garlic has higher requirements for soil fertility and ample fertilization with easily-accessible nutrients. Application of organic fertilizers in garlic production leads to large and juicy bulbs with decreased dry matter content, which are susceptible to disease attacks and root outgrowth, giving them shorter storage period. Nevertheless, application of cured manure during primary tillage in spring sowing gives favorable results in increased yield and quality of garlic. Mineral nutrition of garlic is based on its requirements for specific nutrients, soil fertility and available fertilization preparations. With primary tillage apply 1/3 of nitrogen, half of phosphorus and potassium (8:16:24). In spring apply the rest of phosphorus and potassium and half of nitrogen. In autumn sowing this should be applied as soon as garlic starts growing, and in spring sowing this should be applied at the very beginning (15:15:15), with the density of 40-50 g/m^2 if possible. The remaining quantity of nitrogen should be applied at the most intensive leaf formation stage, and if necessary apply twice.

Growing Technology

Sowing: Garlic can be sown in autumn and spring. Autumn varieties have larger bulbs and shorter storing period, while spring varieties have smaller bulbs and keep for longer. Optimum sowing date for autumn garlic is October, and for spring garlic as soon as weather conditions allow for garden cultivation. For spring garlic this is March 15 at the latest. Sowing depth determines the top layer depth which should be 2-3 cm above clove tip. Due to intensive root outgrowth under shallow sowing cloves very often rise to the surface and dry out because the root partially protrudes from the soil. Deeper sowing, on the other hand, causes slower emergence and later hampered growth. Sowing distance is conditioned by the variety and clove size, and it should provide optimum growing area for plant development. Autumn sowing requires row spacing of 40-50 cm and inter-row distance of 7-10 cm, because of larger cloves and robust plants, while spring sowing requires row spacing of 30-40 cm and inter-row distance of 6-8 cm. Sowing material quantity depends on the planned plant number and clove size, and it is 120-160 g/m^2 for autumn garlic, and 80-120 g/m^2 for spring garlic. Spring garlic production (young plants) needs much denser sowing and 1/3 more cloves for sowing.

Crop cultivation: Crop cultivation implies irrigation, supplemental fertilization and weed control. Inter-row tillage has very favorable outcome creating loose top soil and weed control during plant growth. It should be performed in early spring when autumn garlic starts growing to remove air pockets which were formed in winter, thus creating an adequate air regime for the plant. Loose soil also provides adequate bulb formation because compacted soils form smaller bulbs. Irrigation is applied when there is water deficit in the leaf development stage and start of bulb formation.

Harvest: Garlic is harvested when leaves are green and root is still alive, which is why it should be dug under when harvested, and not pulled, because the root dies out when leaves dry out. Garlic should be harvested when shoot is green and the plant begins lodging. If garlic is not harvested then and most plants are left to lodge completely and it rains, the garlic will continue growing, shoot will easily break from the bulb and cloves will break from the stem, which produces garlic that has no market value. Autumn garlic matures for harvest in the first ten-day period of July, and spring garlic by end July. After harvest garlic dries at the field, it is woven into wreaths and left at a drafty place. Autumn garlic can be used for 4-6 months, and spring garlic for up to 10 months. Autumn garlic yields from 1.0 to 1.8 kg/m^2.

Root Vegetables (Carrots, Parsley, Parsnip, Celery, Red Beet, Small Radish and Radish)

The root vegetables include a larger number of vegetable crops from several different families. Although they have different origin, they have similar requirements for growing conditions. Among all, a thickened root is used for nutrition, although there are varieties where leave is used for food (parsley and celery). The most widespread types of root vegetables in our vegetable production are carrots, parsley, parsnip, celery, i.e. verdant, red beet, radish and small radish.

CARROT

Carrot is used fresh, juiced, stewed and processed (spice component) in nutrition.

Growing Conditions

Temperature: Carrot is a plant of moderate requirements towards heat. Carrot seed slowly imbibes and germinates; the minimum temperature for germination is 3-4^{o}C. The optimum temperature for germination and emergence is 20°C. Temperatures over 30°C can cause secondary dormancy of seeds in the soil and postponement of germination. The optimum temperature for growth and development is in the range of 15-25^{o}C.

Light: Carrot is a species of a long day. Short day varieties in the north flourish in the first year of life. The best root yield is obtained by growing carrot when day length is 9-12 hours. In our climate carrot has good intensity and quality of exposure to the Sun.

Water: The requirements for water, compared to other vegetable species, are not as high. However, they are expressed in the period of germination, emergence and formation of 3-6 leaves, as well as in a stage of thickened roots formation. Water provides normal nutrition, makes soil structural and softer and contributes to the proper root formation. The optimum soil moisture is 70% of FWC. Excess moisture, in turn, causes root deformation (cracking and rotting) and a delay in root growth. At high groundwater level, the roots often deform in an early stage of growth.

Fertilization: Carrots must have sufficient available nutrients throughout the growing season for a high quality yield. Carrot is fertilized with mineral fertilizers, but on light or poor soils fertilization with cured manure is recommended, which gives positive results. In our conditions, the recommended amount of nutrients is 8-14 g/m^2 of nitrogen, 6-10g/m^2 of phosphorus and 8-16 g/m^2 of potassium. Time of nutrient intake is conditioned by environmental conditions and production methods. Therefore, potassium and phosphorus should be applied before autumn tillage in the amount of 1/2 to 2/3 of phosphorus and potassium. Another third to half of the phosphorus and potassium and half of the nitrogen should be applied in spring with pre-sowing preparation of soil on 8-10 cm. The second half of nitrogen is left for top dressing.

Growing Technology

Sowing: Time of carrot sowing is conditioned by the usage (fresh or storage). In our agro-climatic area there are three possible basic sowing dates: early, mid-early and autumn, which provide whole year use of carrot. Early sowing for fresh consumption is performed in March. Variety of short vegetation is used. A mid-early sowing, performed from mid-March until the end of April, and the third term of sowing, from mid-April to mid-May, produces carrots for winter consumption. Carrot is sown on a flat surface or containers. If sown on a flat surface, sowing is carried out in rows 20-40 cm row spacing with plant spacing of 3-5 cm. In addition, it can also be sown in strips with four to six rows, where row spacing is 20-30 cm. Sowing depth is 1.5-2.0 cm. Sowing on containers can be performed on containers width 50-100 cm. Strips are formed on containers and number of rows and inter-row distance depend on container width. It is good to flatten sown area after sowing, so carrot can emerge evenly.

Crop cultivation: In this production the following measures shall be applied: breaking the crust (if it appears), thinning, irrigation and diseases and pest control. Breaking the crust is an important measure until carrot emerges, especially during emergence from summer sowing, and this can be achieved by proper watering (keeping soil moist until the carrot emerges). Thinning is performed after the initial growth, at the stage of 2-3 true leaves. Top dressing, hoeing and irrigation are performed after thinning and stopped at the time of technological maturity.

Harvest: Carrot can be used in nutrition from the moment when it reaches the thickness of a pencil to the late autumn. Technological maturity of carrot occurs when the oldest leaves begin to die. With early varieties that moment starts when the smallest diameter of a root is 1 cm, and 8 g, and the largest 4 cm and 150 g. For summer and late varieties smallest diameter is 2 cm weighing 50 g, and the largest 4.5 cm weighing 200 g. For longer use, carrots from the garden can be stored in the basement, as well as other root vegetables. The yield of carrot root ranges from 2.0 to 3.5 kg/m^2

PARSLEY

Parsley is grown because of thickened root and aromatic leaves, which are used as a food supplement. It is mostly used in households. Usually, it is grown in households that produce carrots. Parsley root is inevitable supplement to soups and stews.

Growing Conditions

Temperature: Parsley has modest requirements for heat and optimal temperatures for the growth and development are 16±7°C. The seed emerges at a temperature of 2°C, but the optimum is around 20°C. Optimal temperature for growth of leaves and root is around 18°C. Parsley is more tolerant to low temperatures than carrot. Young plants can withstand frosts up to -10°C, and in stage of formed thickened root even -20°C.

Light: Parsley is a long-day plant with increased requirement for light. Due to lack of light, leaves can etiolate and the content of essential oil decreases.

Water: Parsley is more tolerant to lack of water than carrot, due to its stronger root system. Its requirements towards water are the strongest at the stage of emergence and intensive growth of leaf rosette. When it comes to leafy parsley, after every cutting (of leaves), it is necessary to water regularly.

Fertilization: Parsley is potassium-loving plant and approx. 8-12 g/m^2 of nitrogen, 8-10 g/m^2 of phosphorus and 10-14 g/m^2 of potassium are needed for 1 m^2. Leafy parsley requires more N, considering that it is cut 2-3 times. Fertilization is performed one time at a stage of 4-6 leaves, or simultaneously with second hoeing.

Growing Technology

Sowing: Parsley is sown in early spring, at the beginning of March, or in late autumn (November). Recommended vegetation space is 25-30x3-5 cm. Sowing depth is 1-1.5 cm. Sowing can be performed also in strips, with 50-60 cm distance between strips and 15-30 cm between rows (4-6 rows in one strip). In favorable conditions, the seed emerges for 16-25 days. Leafy parsley is sown same way as root parsley. Early sowing advantage in leafy parsley is longer utilization period.

Crop cultivation: Parsley production applies same crop cultivation as in carrot.

Harvest: Root parsley can be harvested as needed (more than one time). When intended for storage, parsley is harvested in technological maturity, which is usually during October. After harvesting, it is stored into appropriate storing facilities to be used during winter period. Yield of parsley root ranges from 2.0 to 4.5 kg/m^2.

PARSNIP

Parsnip root, which has high sucrose, protein and mineral content, is used in nutrition.

Growing Conditions

Temperature: Parsnip is a plant of moderate requirements. Vegetation period is 180-220 days long. Optimal temperatures for vegetative growth are 16-18°C, but it grows also at 4°C. High temperatures slow down the plant growth. It is very resistible to low temperatures and easily withstands winter in an open field. Temperatures around 10-15°C during 45 days are needed for transition to generative stage.

Light: This is a plant with high requirement towards light, but it is neutral compared to day length.

Water: Parsnip has a deep root system and can use the moisture from the deeper layers, and on alluvial soils along the river can be grown without irrigation. Of course, the equitable supply of water provides a good yield and good quality roots. It is best grown on structural, medium-heavy soils. Root is better developed in heavy and wet soils, than in sandy and light.

Fertilization: Parsnip is grown as a main crop due to its long vegetation. In crop rotation, it comes to the second place, after well-manure plants. Due to the high root yield and high leaf mass, enough nutrients for growth and development of parsnip should be provided. Therefore, it is needed to apply 4-8 g/m^2 of N, 1-4 g/m^2 of P_2O_5 and 6-10 g/m^2 of K_2O. In the primary tillage half of NPK is applied, in pre-sowing preparation ¼, and the rest in the form of supplemental fertilization, which is at the stage of leaf rosette development, before closing rows.

Growing Technology

Sowing: Due to its long vegetation, early sowing from March to mid-April has advantage. It is sown in rows, at rows distance of 40-50 cm, and distance in the row is 7-10 cm. Parsnip can be sown also in strips of 4-6-rows, with a distance between them of 50-60 cm. The distance between rows in one strip is 25-30 cm, and in a row 10-12 cm. Sowing depth is 1.5-2 cm. Total of 3-6 kg of seeds per hectare is needed.

Crop cultivation: Cultivation consists of cropping (until the rows are closed), thinning (if needed), irrigation and protection from plant diseases (if needed).

Harvest: Full technological maturity of parsnip occurs during late autumn, when assimilative accumulation in root stops. Percentage of dry matter reaches 18-22%. Parsnip can be harvested earlier, if needed, when it reaches the diameter of parsley. Root yields can achieve 5 kg/m^2. If parsnip is not harvested during autumn, it can stay in soil and be harvested during winter or early spring, before new leaves appear. Healthy, undamaged parsnip can be stored in clamps or basement, such as carrot. The optimum storage temperature is around 0°C with a relative humidity of 95%. Root yields of parsnip range from 2 to 5 kg/m^2.

CELERY

Celery is very reputable due to its exquisite aroma that originates from essential oils. It is used fresh, dried, as a spice and it is regular supplement to brines and pickles because of its strong antiseptic effect.

Growing Conditions

Temperature: Celery is a plant of moderate climate. Minimum temperature for germination is 3^{o}C, and optimal 18-20^{o}C. Young plants withstand temperatures up to -6^{o}C, while plants in technological maturity withstand frosts up to -9^{o}C. It is important to note that emergence stops at 24^{o}C. Seed emerges for 18-25 days. Therefore, celery seedlings are produced in half-warm seedbeds or greenhouses, because in cold weather conditions, young plants could be vernalized. That is one of many reasons why celery is produced from seedlings in greenhouses, where temperature is higher than 16^o.

Light: Celery requires much light and at shaded place, the root remains small, without intensive odor.

Water: During the whole vegetation period, celery has high requirements towards water. If watering is not equal, yields are small, drying occurs and celery forms a root of bad quality, which often lignifies.

Fertilization: Celery comes to first place in crop rotation, which means that it is fertilized with manure, and it is a good preceding crop, because it leaves structural soil. Manure is applied in quantity of 3-5 kg/m^2 before autumn tillage. In addition, mineral fertilizers are also applied, 10-12 g/m^2 of nitrogen, 9-10 g/m^2 of phosphorus and 12-16 g/m^2 of potassium. Half of phosphorus and potassium and quarter of nitrogen are applied during autumn. Quarter of NPK is applied before sowing and the remaining nitrogen part during top dressing.

Growing Technology

Sowing: Celery can be produced by direct sowing, but because have long vegetation, it is produced through seedlings. Seedlings are produced in half-warm seedbeds and greenhouses, in March and early April. For 1 m^2 0.5 g of seeds are used. Temperatures in greenhouses must not be lower than 12°C, and daily should not exceed 20°C. In such conditions, seedlings grow for transplantation for about 10-12 weeks (it has 4-5 permanent leaves). Planting out is performed from May until half of June, with necessarily irrigation right after sowing. It is planted out at the same depth as it was in a seedbed. It is planted on a distance of 50x20 to 50x40 cm, depending on variety and planned harvest time.

Crop cultivation: It consists of regular hoeing, fertilization and watering. Hoeing is performed after watering and fertilization. Fertilization is performed two times. First one is carried out when the crop is at the stage of 3-4 leaves, and the second one is at the stage of root formation. Watering is performed with 25-30 l/m^2 of water every 10-12 days.

Harvest: Root celery is harvested during autumn, in early October, when thickened root gained weight of 300-700 g. Celery yield ranges from 2.5 to 3.5 kg/m^2.

RED BEET

Red beet is grown because of its thickened root, which is used to make salads and stews. Red beet juice is healthy and refreshing beverage and is usually used as a cocktail with other juices.

Growing Conditions

Temperature: Red beet has moderate requirements towards temperature. Minimum temperature for germination and emergence is 5-8°C, optimal 18-20°C, and maximum 28°C. Optimal temperatures for vegetative red beet growth are 15-20°C, which causes intensive color of thickened root.

Light: Red beet is a long-day plant and seeks for intensive light, and therefore does not stand shading.

Water: Red beet has high requirements towards moisture at the first stages of growth, which decreases later. Red beet withstands lack of moisture better than other root vegetables. Good irrigation ensures equal growth and good root quality. It is necessary if red beet is grown as a stubble crop.

Fertilization: Red beet requires easily accessed nutrients during whole vegetation period in order to form quality root. Required nutrients quantity for production is ensured by mineral nutrition. Recommended dose of nutrients is 8-12 g/m^2 of nitrogen, 10 g/m^2 of phosphorus and 10-12 g/m^2 of potassium. Half of planned nutrients are applied under primary tillage, and the rest of it 1-2 times during top dressing.

Growing Technology

Sowing: Early production sowing can be carried out from the third ten-day period of March to the end of May. Sowing is performed in rows at a spacing of 40-50x8-10 cm. Sowing depth is 2-3 cm. Sowing on larger spacing provides bigger beets (suitable for the production of juice) and thicker sowing provides smaller beets. Stubble growing of beets for autumn and winter consumption is sown after removing the peas, lettuce, green onions, spinach and spring potatoes. Sowing is carried out in June and early July. Primary and pre-sowing preparation of the land is performed after the harvest. If the soil is dry, irrigation is performed before sowing so that the crop emerges more quickly and evenly.

Crop cultivation: Thinning is performed during vegetation period, when there are 2-3 permanent leaves formed. Other measures consist of keeping the land in loose condition and free of weeds, watering and fertilization. Watering is necessary in stubble cropping. Supplemental top dressing is carried out at the stage of 4-5 leaves and intense growth of the rosette.

Harvest: Red beet can be harvested during a long period (successively), depending on the thickened root size and the manner of production. The earliest one is when the root has diameter of 3 cm until the final size, characteristic for variety. Removal of the damaged leaves is performed on the harvested red beet, and it is brought to the market in a pack of 5-6 pieces. Yield ranges from 2 to 4 kg/m^2. Yield of early red beet ranges 1.5-2.0 kg/m^2, and the yield of stubble red beet ranges 2.0-2.5 kg/m^2.

SMALL RADISH

Small radish is used as a fresh product, for its mildly spicy, fresh flavor.

Growing conditions

Temperature: Small radish has moderate temperature requirements. The optimal temperature for growth is 13$\pm$7°C. Cotyledons can be grown at -3°C, and at -6°C during plant growth. The temperature of 12-13°C is required for root formation and then 15-20°C for intensive root growth. The optimal monthly temperature for growth and development is 15 to 18°C, up to the maximal 24°C, and minimal 4°C.

Light: Small radish requires a lot of light for growth. Being the long-day plant, it cannot be grown in shaded areas. If light periods last over 12-14 hours, the leaves lengthen and root growth decreases.

Water: Optimal soil moisture is required for successful development of small radish, ranging from 70-75% FWC, resulting in juicy and quality root. At the time of technological maturity, heavier rain and shorter drought periods cause excessive root damage.

Fertilization: High doses of nitrogen cause the accumulation of harmful nitrates in the root, which is important to consider in the process of fertilization. Therefore, after varieties which leave high doses of nitrogen in soil (peas, beans, green beans), additional nitrogen fertilization is often unnecessary. The accumulation of nitrates is more intensive under higher temperatures and less light. The usual amount of fertilizer is 6-8 g/m^2 of nitrogen and phosphorus and 8-10 g/m^2 of potassium. The required amount of potassium and phosphorus is applied during pre-sowing soil preparation, whereas nitrogen is applied during fertilization.

Growing Technology

Sowing: Sowing is conducted on flat surfaces or boxes. Precise sewing machines are used for row spacing of 15-20 cm, with approximately 300-350 seeds per m^2. Uniform sowing depth enables concurrent emergence. Under these sowing conditions, 200-250 small radishes per m^2 can be expected to grow. The amount of seed depends on 1000 seed weight (absolute seed weight), germination and planned number of plants, resulting in the approximate amount of 5-10 g/m^2. Sowing is performed under favorable weather conditions, starting from the end of February until the beginning of March for early production in our country. Sowing is performed for the purpose of summer production in April, and for autumn production in September. It is conducted in sequels, every ten days, thus prolonging the period of maturing.

Crop cultivation: Cultivation practices in small radishes production consist of thinning (if required), hoeing, watering and fertilization of crops. Timely watering is of utmost importance, for preserving soil moisture above 60% FWC. If daily temperatures are high, sprinkler irrigation is also required (artificial rain).

Harvest: Small radish is harvested gradually, after the full development of root. It is picked manually at the time when root diameter reaches 15 mm in most plants. Small radishes with the diameter of 20-30 mm are highly valued on our market. The amount of 0.8-1.2 kg is picked per m^2.

RADISH

Radish is used mainly in salads in our local cuisine, above all due to its spicy flavor deriving from essential oils.

Growing Conditions

Temperature: The minimal temperature for germination of radish is 1-2°C. Under 20°C it germinates very quickly (in 4 days). The optimal temperature for the development of vegetative organs is 15-20°C. Temperatures above 25°C influence the quality of root (the development of core tissue, lignifications of the root and enhancing the spicy flavor of the fruit). It withstands low temperatures up to -8°C. Vernilization occurs at 2-11°C over the period of 15 days, and the process is most intensive at temperatures ranging from 5-8°C, when 21 day old plants form flower stalks in 10 days. This is very important to consider during spring production of radish, in order to prevent premature emergence and yield loss.

Light: Radish is a long-day plant and it requires lots of light.

Water: During autumn production of radish, watering is essential for the crop to emerge evenly.

Fertilization: Radish requires high amounts of nitrogen, but under excess amounts it accumulates nitrates and nitrites. Therefore, nitrogen is applied in several stages, in order to avoid fast growth, which can cause the accumulation of harmful nitrates and core tissue development. Nitrates are most intensely absorbed during the fourth week after emergence, so the first fertilization is recommended in the third week. One half of fertilizer amount is given during the primary pre-sowing soil preparation and the rest in two fertilizing stages. If agrichemical analysis of soil is not performed, the recommended fertilization doses are between 8-10 g/m^2 of NPK.

Growing Technology

Sowing: Although it can be grown from seedlings, radish is mostly produced by direct sowing. In our country it is rarely produced as an early variety. Sowing is performed during March, and in July and August for autumn production. It is sown at row spacing of 30-35 cm x 8-10 cm, using 8-10 g/m^2 of seed. Sowing depth is 2-3 cm. For production of spring radish the recommended planting density is 25x20 cm, using 20 seeds per m^2. In late production, sowing is carried out at row spacing of 35-45 x 15 cm.

Crop cultivation: Cultivation practices are similar to those used for other brassicas. Total of 2-3 cultivations are performed during the vegetation period, as well as thinning at 2-3 leaves, if needed. Irrigation is a regular cultivation practice, especially in autumn production, used in order to ensure stable yield and high quality of fruit.

Harvest: Harvesting is performed when radish reaches technological maturity. Early radish is picked in June and July, by pulling out plants. Autumn radish is picked in October, before strong frosts. Leaves are removed and the root is packed in net bags or boxes. Root is kept in basements, clamps or storages. Autumn radish yield is approximately 2.0-2.5 kg/m^2. Radish kept in basements and storages can be used for 4-6 months.

Legumes (Peas, Green Beans, Broad Beans)

Legumes can be used in human nutrition as green and young, or as dry and mature seed. Young legumes are mostly used. What will be used as food depends on the variety. All parts of the plant can be used in only few varieties.

PEAS

Peas are commonly used as young grain, and less as young legume (sweet peas) or mature grain. It contains a large amount of sugar, proteins and vitamins.

Growing Conditions

Temperature: Peas are plants which grow in slightly humid, cold climate. Minimal temperature required for germination is 2-6°C. Optimal temperature for emergence is 20°C. Optimal temperature for blooming is 16-20°C, and for fruit formation at 16-22°C. Temperatures above 25°C stop the process of growing. Before blooming, young plants are able to withstand short-term frosts up to -6°C. This sum is on average 600-1000 heat units in our climate, depending on the variety.

Light: Peas have increased light requirements and therefore cannot be grown in shaded areas. Most pea varieties are long-day plants or do not react to day lengths (neutral). It requires intensive light during the stages of blooming and pollination.

Water: Requires a lot of moisture, being a plant grown in the continental humid climate and it is sensitive to moisture and humidity oscillations in soil and air. Critical periods with higher moisture requirements are from blooming to technological maturity. Optimal soil moisture should be 60-80% FWC. In case of high soil moisture, crops undergo rapid deterioration. Low relative air humidity (below 60%) and warm winds are very harmful for plants. For high yield achievement peas need 140 mm of precipitation.

Fertilization: In intercropping of vegetables, peas are a third crop in crop rotation, and most often it is a preceding crop in the same year. It has lower requirements for mineral fertilizers compared to other vegetables, given its capability of nitrogen fixation short period of vegetation. In our agro-ecological conditions, 2-3 g/m^2 of N, 6-8 g/m^2 of P_20_5 and 4-6 g/m^2 of K_20 should be applied. One half of phosphorus and potassium fertilizer compounds should be applied before primary tillage and the rest of the fertilizer with nitrogen during seedbed preparation.

Growing Technology

Sowing: Peas are rarely sown in spring. The optimal sowing period is 5–20 of March. However, peas can be sown in autumn, given that young plants of some pea varieties (Mali Provansalac) withstand frosts up to -15°C. If possible, sowing should be performed from February 25 to April 1, at latest. April sowing is not suitable for our conditions, given that sowing carried out after April 10 significantly decreases yield. Narrow-rowed sowing is performed, with 12-20 cm of inter-row spacing, 3-5 cm per row, to the 5 cm depth. Depending on the type of variety and verdure, 100-140 plants/m^2 should be provided.

Crop cultivation: Given the short vegetation, peas require minimal cultivation. The most important practice is weed control and 20-30 l/m^2 of watering during spring sowing.

Harvest: Since legumes mature slowly, for the purpose of fresh consumption peas are hoed at technological maturity. Usually 2-3 harvests are done. Harvested legumes are shelled and grains are frozen, because the process of maturing is continued and sugar quickly turns into starch, thus decreasing the quality of grain. Pea yields are approximately 0.5-1.0 kg/m^2.

GREEN BEANS

Young legume of green beans is used for nutrition. If the crop over matures, green, young grains can be used for nutrition. Green beans are used for cooking as fresh products, or processed in various ways and used later.

Growing Conditions

Temperature: Green beans have distinct temperature requirements during the whole vegetation period. The seed germinates and emerges slowly at 10-12°C. Optimal germination temperature is 20-25°C, and at this temperature emergence occurs 5-7 days after sowing. For the development of vegetative organs, optimal temperature is 18-20°C, and 22-25°C for the development of generative organs. Green beans do not withstand low temperatures and plants deteriorate at -0.5°C. At temperatures above 35°C and below 6°C they lose their flowers. Under the influence of high temperatures and less humidity mass abscission and weaker pollination occur. Long periods of cold and wet weather conditions can also disrupt plant development and create conditions for disease appearance. Depending on the variety, green beans vernalize quickly, with temperatures varying from 8-25°C.

Light: Green beans have distinct light requirements, especially in early stages of growth, because shading would initiate plant elongation, which would negatively affect growth and development. Intensive light and higher humidity during blooming positively affect pollination and formation of quality legumes. According to its origin, green beans are a short-day plant, but due to a wide area of dispersion, there are varieties grown in all regions regardless of day length. Varieties grown in our country are mostly short-day plants, grown in spring and as stubble crop in autumn.

Water: Green beans have distinct requirements for moisture and humidity. Water scarcity decreases yield and lowers the quality of legumes. High humidity is also damaging because it initiates blossom drop and weak pollination. Optimal soil moisture is 60-70% of FWC and 80-90% humidity. During stubble crop sowing of green beans (second crop) irrigation is necessary.

Fertilization: As well as other legumes, it is the third crop in crop rotation. Mineral fertilizer requirements are 6-8 g/m^2 of NPK. Fertilization should be applied during pre-sowing, using nitrogen fertilization at the stage of 3-4 leaves. Green beans positively react to bacterial fertilizers, by the inoculation of seed during the first sowing.

Growing Technology

Sowing: Green beans are produced through direct sowing as regular (spring) sowing and summer (stubble crop sowing). Spring sowing is performed from the second half of April until mid May. Sowing is being performed when soil temperature reaches 10-12^{o}C. Summer sowing starts on June 25 lasting until July 15, with 7 day breaks, due to fast germination in this period. They are sown using 50x4-5 cm spacing, giving the density of 40-50 plants /m^2; 70-150 g/m^2 of seed is required to achieve this density, depending on the variety, seed size and emergence. Sowing depth is 4-6 cm in light soils and 3-4 cm in heavy soils.

Tall and indeterminate green beans are sown using support. Tall varieties are suitable for this type of growing due to long periods of blooming, formation of beautiful, gentle pods and small space requirements. Sowing is performed 3-5 times successively for the purpose of timely harvesting, for home preparation or sale. It is sown in boxes, using row spacing of 80-100 cm, and 40-60 cm between boxes in the row. Total of 5-6 seeds are sown in each box, and 3-4 plants are left after emergence. Poles are placed before sowing.

Crop cultivation: It consists of inter-row cultivation, irrigation, disease, pests and weeds control, and fertilization. Inter-row cultivation is performed 2-3 times during the vegetation period. First one is performed several days after germination, the second one after 2-3 weeks, and the third one before blooming or when plant starts to close the rows. Hoeing needs to be shallow not to damage the root system. Irrigation is a necessary cultivation practice in our agro-ecological conditions, especially if repeated harvests are planned. The crop must have enough moisture in the stage of blooming and legume formation. Spring crops should be watered three times. Irrigation during summer sowing is mandatory. Without irrigation, sowing during summer is risky due to high temperatures in July and August and low humidity, resulting in plant losing flowers. For this type of production approximately 4-5 irrigations, with irrigation rate of 30 l/m2, are needed depending on precipitation and temperatures.

Harvest: Green beans reach technological maturity fast, due to short vegetation period of 55-75 days. Early varieties are harvested 30-40 days after emergence. Legumes can be used 10-15 days after blooming. Young legume is mature when it reaches the size characteristic for the variety, but while still brittle and juicy, with the seed ¼ of its total size. When grown in gardens, beans are harvested several times. One harvest can give 0.3 to 1.0 kg/m^2, and up to 6 harvests are performed.

In tall varieties, legumes mature gradually and harvest lasts for over three months. Yields of tall green beans vary between 3-6 kg/m^2 of young legumes, and in fruitful years they can be even higher.

BROAD BEANS

Broad beans are grown for their grain of different size and shape. Broad bean grain is used at technological maturity as young, and at physiological maturity as dry, for the preparation of side dishes, salads and purees. In many varieties, young legumes can be used in nutrition. In early spring, broad bean leaves are excellent in salads and as side dish.

Growing Conditions

Temperature: Broad bean has modest temperature requirements, and it is resilient to low temperatures. It germinates at 4-6^{o}C, and the optimal temperature is 22^{o}C.

Light: Broad bean is a long-day plant.

Water: For successful growing it needs irrigation (humid climate plant)

Fertilization: Broad bean positively reacts to fertilization with cured manure with added 5 g/m^2 of nitrogen, 10-15 g/m^2 of phosphorus and 10 g/m^2 of potassium.

Growing Technology

Sowing: Autumn sowing is performed in October and November, and spring sowing since mid February until mid March. It is sown in rows or boxes. Inter-row spacing is 45-80 cm, plant or box spacing is 20 cm, and sowing depth is 4-6 cm.

Crop cultivation: Cultivation practices include weed control, watering, fertilization during repeated harvests and protection. In several varieties stalk top tearing off is performed.

Harvest: Harvest is performed every ten days in May, or in July in time of full maturity.

Technology of Growing Vegetables in Greenhouses

Production in greenhouses is the most frequent type of vegetable growing with high economic and biological significance. Production in greenhouses ensures continuity in supply of fresh vegetables in autumn, winter and spring. Greenhouses are also used for the production of seedlings for closed spaces and open field. When planning the time frame of production inside closed spaces, heat, water, light and nutrition requirements must be considered, as well as proper inter-cropping.

LETTUCE

During production in protected spaces lettuce is the preceding or succeeding crop to cucumber, tomato and pepper. Butterhead lettuce is mostly produced in greenhouses. The selection is made according to their ability to develop quality head under the conditions of weak light and lower temperatures.

Growing Conditions

Temperature: Lettuce emerges quickly, in 3-6 days at optimal temperature, and in 4-5 days during winter. It forms well developed cotyledons and a pair of true leaves. Optimal temperature for emergence is 12-15°C (emergence occurs at 2-3°C). Daily temperature is kept at 8-12°C after emergence, and night temperature at 6-10°C. After planting seedlings, the required temperature in the greenhouse should be 12-15°C for the first two weeks. It helps the formation of firm heads.

Water: Preserving the favorable soil moisture is required. If not so, scorches at leaves appear fast, so watering is required depending on soil moisture every 7-10 days using 15-20 l/m2.

Fertilization: Approximately 80 g of N, 50 g of P_2O_5 and 120-150 g/m^2 of K_2O are applied prior to sowing, including additional fertilization with manure (2-3 kg/m^2). Fertilizers should be easily absorbed, as lettuce is highly sensitive to increased concentration of salt in soil.

Growing Technology

Sowing: In greenhouses, lettuce can be grown from seedlings or by direct sowing, depending on the period of growing. Lettuce seedlings are grown in containers (capacity 10-30cm^3), cubes and pots. For early production seedlings are grown from the end of February to the end of March, and the succeeding crop in August and September. Seedlings are planted in April and May, and in November for winter production. Planting out is performed when plants are 15-45 days old. For spring sowing spacing is at 20x17-25 cm (8-16 plants /m^2), while for autumn sowing it is 20-25x20 cm, or 20 plants per 1m^2. Planting out is performed at the depth of seedling growth.

Crop cultivation: During vegetation period timely watering, fertilization and weed control are required. After sowing, watering is performed (about 20 mm of water) to provide better root formation, and afterwards watering is more intense (30 mm), but less frequent. High relative humidity provokes fungal diseases. The first fertilization is applied at the stage of 6-7 leaves, using 30-40g/m^2. After root formation, it is important to perform hoeing and then one more fertilization (until plants close the rows).

Harvest: Lettuce is picked at technological maturity of heads (200-400 grams).Heads is chopped off, along with the removal of dry and damaged lower leaves. Yield depends on the number of plant per surface unit, variety and time of harvest and ranges from 2-4 kg/m^2.

SPINACH

It is grown above all in the cold period of the year, with the selection of varieties for winter and autumn production, as a preceding or succeeding crop, and as an intercrop. Growing spinach as an intercrop provides maximum use of the greenhouse production capacities.

Growing Conditions

Temperature: Optimal temperature for growth is 14-18^{o}C, while the temperatures above 20^{o}C unfavorably affect plant growth. Low temperatures are the best at the stage of germination (seedlings) and poorly developed leaf rosette.

Water: Highest water requirements are in the stage of germination, emergence and formation of rosette.

Fertilization: It comes second in crop rotation, with high nutrient requirements. However, for the collection of nitrates, spinach is fertilized with 80-100 g/m^2 of nitrogen, phosphorus and potassium nutrients, which are slowly degradable.

Growing Technology

Sowing: Spinach forms rosette after 28-40 days, which needs to be considered when planning sowing. Winter sowing is performed in October, and spring in February and March. Sowing is performed at 10x10 cm spacing in narrow rows, with 20-25 g /m^2 of seed.

Crop cultivation: Maintaining temperature at 10-15^{o}C during the day and 5-8^{o}C at night is very important during vegetation period. Higher daily temperatures can be regulated by ventilation. Spinach requires regular watering, with lower irrigation rates at the beginning of vegetation, and later each 7-10 days using 10-15 mm of water. A fertilization using complex fertilizers is needed if the crop is poorly developed.

Harvest: Harvest begins after the development of rosette with 5-6 leaves, and lasts until blooming. Spinach is harvested gradually, by picking individual leaves of specific size and leaving the vegetative top where leaves continue to grow. Yield varies from 2 to 4 kg per square meter.

PEPPER

Varieties with sweet, large or small fruits and spicy fruits of the chili type are used for production in greenhouses.

Growing Conditions

Temperature: Greenhouse production of pepper must meet the optimal temperature requirements of air and soil. The optimum temperature during sunny days is 22-28°C, until the stage of fructification, while at night it is 16-18°C. In this stage, under lower insolation (cloudy weather) optimal temperatures are lower, 18-20°C during the day and 14-16°C at night. Plant growth and the stage of fructification increase temperature requirements by 2-3 degrees.

Water: Water requirements are high because of poorly developed root system. Optimal moisture should be 80% FWC. The optimal water supply is achieved by gradual watering (drip system) and by spraying. Water temperature has an important role and the best is at 20-25°C. Maintaining favorable moisture is achieved by watering during the initial stages of growth using 15-20 l/m^2, every 4-6 days, and later this irrigation rate rises to 20-30 l/m^2, in time of blooming and fructification.

Fertilization: Pepper is fertilized with organic and mineral fertilizers. Total of 5-10 kg/m^2 of manure or compost, or 80-100 g/ m^2 of NPK mineral fertilizer are applied at the ratio of 1:0,8:1. Mineral fertilizers are applied during primary tillage and fertilization. Before planting out, 1/3 of nitrogen and 2/3 of phosphorus and potassium should be applied to provide an ample amount of accessible nutrients. The rest of planned nutrients are applied during vegetation as part of fertilization. Highly concentrated, easily soluble fertilizers containing macro and microelements should be applied.

Growing Technology

Sowing: Production of pepper in greenhouses is done by planting seedlings. Seedlings can also be grown in greenhouses and sowing begins on 15-20 of March. If transplanted seedling is produced, transplantation boxes should be prepared. Before transplantation, seedlings are thoroughly watered. Transplantation is performed at the stage of first leaf. Plants are taken one by one along with as much soil as possible, in order to prevent root damage. After transplantation, maintaining high humidity and lowering the temperature by 3-4°C compared to the optimal is required. Cultivation of seedlings consists of timely watering with lukewarm or stale water, ventilation, weed control, fertilization and seedlings hardening off. Favorable temperature requirements should be provided at this period, with oscillations not higher than 10°C, with enough light, moisture and nutrients. Seedlings mature for planting out 50-80 days after sowing. Plants should have 8-10 leaves, and a well developed root system. Seedling hardening off is performed 10 days before planting out, by ventilation, or gradual lowering of air and soil temperature, in order to let the plants adapt to the new conditions. Planting out is performed when temperature reaches 20°C. Peppers with large fruits are sown at 80x30-40 row spacing or in two-row bands 100+60+60x30-40 cm, and small fruit peppers and chili peppers at 40-50x25-30 row spacing and two-row bands 60-70+40-45x25-30cm.

Crop cultivation: Cultivation in greenhouses consists of ventilation, watering, hoeing, fertilization and regular harvesting. After sowing and rooting (7-10 days) crops should be fertilized using 30-40 g/m^2 of NPK fertilizer and first hoeing should be performed. Fertilization is performed every 15-20 days with the same amount of fertilizer. Since pepper reacts to hoeing very well (improving water and air regime in soil) it should be carried out 3-4 times during vegetation, i.e. until plants close the rows. Pepper needs to be grown using support for its verdure. They can be in the form of the pole gauntlet and rope or to associate supporting branches with permanent and temporary support structure. In order to direct or regulate growth, weak, fruitless and excess branches are torn off, as well as verdure branches where fruits poorly develop. Only the main branch is left, that wraps around the rope, forming large fruits up to 1.5 m high.

Harvest: Fruiting occurs 20-30 days after blooming, at the end of May and the beginning of June. Fruits are ready for harvest and use at the time of full maturity and firmness, regardless of the color. Harvest is performed at technological maturity, and larger number of harvests contributes to higher yields. Harvesting chili peppers starts 40-50 days after planting out, or 60-70 days for varieties with larger fruits. Chili peppers are harvested every 3-4 days or 5-6 days if they have large fruits. Fruits with stems should be carefully harvested (to avoid damaging the branches). Average yield in small fruit varieties range from 4 to 6 kg/m^2 and 6-8 kg/m^2 in varieties with large fruits.

TOMATO

Tomato production in greenhouses can be completed in two terms, as spring and early autumn production. Preceding crop in spring production is usually lettuce, spinach, radish and other vegetable varieties grown in autumn and winter.

Growing Conditions

Temperature: Heat requirements are different during vegetation period of tomato. Optimal daily temperatures until fructification should be 22-28^{o}C during the day and 16-18^{o}C at night. Optimal temperature average rises by 2-3^{o}C during the period of fructification. During periods of cloudy weather temperature falls by 3-4^{o}C, at days and nights.

Water: Critical period when water requirements of tomato are increased is during blooming, when the lack of water can cause losing flowers. Before this stage, moisture should be at 70% of FWC and 80% of FWC during the fructification period. Optimal humidity is 45-60%. At initial stages of growth irrigation rate is 15-20 l/m^2, rising to 30-40 l/m^2 at the time of fructification, repeating the process every 7-10 days.

Fertilization: Tomato has high nutrient requirements. Organic fertilizers have special significance in tomato nutrition. Cured manure is used at the quantity of 60-10 kg/ m^2, even 20 kg/ m^2 in newly built objects. Mineral fertilizers are also used at the quantity of 80-100 g/ m^2 of NPK. One half of the planned quantity is applied during primary tillage and the rest during 2-3 fertilizations. Mineral fertilizers with microelements such as magnesium, calcium, iron, manganese and zinc should be used.

Growing Technology

Sowing: Growing quality seedlings enables successful production of tomato in greenhouses. For early production of tomato, sowing is performed at the beginning of March, and planting out at the end of April, or sowing in May and planting out in June and July for autumn production. Transplanted seedling is used for this type of production. Sowing is inside boxes, in narrow rows using 8-10 g/ m^2 of seed. Transplantation is performed after the development of cotyledons into cubes, plastic bags, size 8x8 or 10x10 cm in a high quality substrate. The usual cultivation practices are applied in the production of tomato seedlings. Seedlings are planted out when they are 40-80 days old, at the stage of 6-8 leaves, after the formation of the first flowers. Tall varieties are planted out at 80x30-40 cm of spacing or in two-row strips with inter row spacing of 50 cm or 35-40 cm in a row, with 70-80 cm between the strips. If pot seedling is used, then deeper sowing is applied in order to support the growth of root, enabling better supplementary nutrition. Watering is carried out after sowing.

Crop cultivation: During the vegetation period, the necessary cultivation practices are watering, hoeing, fertilization, laterals tearing off and providing support. Watering starts after planting out (20-25°C). The first fertilization is applied 7-10 days after planting out (20-30 g/m² of NPK fertilizer) and the mandatory hoeing. The second fertilization is applied after the formation of fruits, and then after each harvesting. Hoeing is a favorable cultivation practice in tomato production, and it is performed 3-4 times during vegetation. Along with hoeing, mulching is also performed (1-2 times). In cultivation of tall varieties, the mandatory practice is binding. The plant is connected to the rope so that the rope is bound to the bottom of the stalk and the top is bound for the building structure. During the growing period, the plant wraps around the rope below the inflorescence. A lateral tearing off is usually performed so that one stalk is left. If plant with two stalks left is grown, then the first lateral below flower branch (inflorescence) is left.

Harvest: Depending on the length of vegetation period, harvesting starts 60-80 days after sowing. At the beginning, harvesting is performed every 7-8 days and later on every 3-4 days. Fruits are harvested when mature, or at half-maturity in late harvests, leaving them to ripen afterwards. After the harvest is completed, green fruits still remain on the plants. They can be used for pickling or they are left to ripen. Yields are different, varying from 6 to 16 kg/m².

CUCUMBER

Cucumbers are grown in greenhouses and pickles are produced for pickling and grown due to short vegetation period during the autumn production.

Growing Conditions

Temperature: To achieve regular fruit formation, proper temperature regulation is required. Any deviation from the optimal temperature negatively affects the crop. High temperatures result in plant elongation, while low temperatures provoke deflowering and stop growth.

Water: Cucumber is a runner species that prefers high levels of soil moisture and humidity. Water requirements are high, especially at the beginning of vegetation and during formation of fruits. Harmony between temperature and irrigation is important in cucumber production. Shallow root system and large vegetative mass require frequent watering. Watering should be adjusted to temperature and light. Less watering is required during cloudy weather, and then only around the root, while at higher temperatures watering of the surface is necessary to cool the plants and provide appropriate moisture. Humidity should be 70-80%, as lower humidity causes wilting and fruit deformities.

Fertilization: The soil should have proper physiochemical traits and be supplied with accessible nutrients. It is the first plant in crop rotation, so fertilization of 8-10 kg/m² using 50 g (8:16.24) and 30-40 g/m² of KAN as basic fertilizer. Fertilization is applied with NPK mineral fertilizer in the amount of 20-25 g/m². Application of foliar fertilizer is helpful in greenhouse cucumber production.

Growing Technology

Sowing: Cucumber is grown from seedlings. Seedlings are grown in containers 10x10 cm in diameter, cubes or plastic seedling bags around 1 liter in volume. Plants are planted out when they form 4 leaves. Soil should be heated to 16°C and well prepared. Sowing is performed in rows of 100-120x40-50 cm or double rows 100+50x35-40 cm, and 2.7-3.8 plants are sown per square meter. Sowing for production of seedlings is done at the beginning of March and planting at the beginning of April. For autumn production, sowing is done in early August.

Crop cultivation: Maintaining temperature and water regime is essential in cucumber production, above all due to plant sensitivity to variations of these conditions. Hoeing, fertilizing and binding are performed during the vegetation period. Hoeing and earthling up should be carried out regularly because cucumber does not grow on compacted soil (frequent watering). Fertilization is performed 3-4 times with 20-25 g/m^2 of NPK fertilizer, as well as foliar fertilization. Ropes and setting up the gauntlet are used for binding plants.

Harvest: Cucumbers are ready for harvest in 60 days, and pickles in 35-50. Harvesting is performed every 5-6 days at the beginning and later every 2-3 days. Pickles harvests are more frequent, in order to get more fruits of 3-5 cm in size (first class). Fruits are cut using knives at the half of the stem, to avoid damaging the vine. Cucumber yields (early production) ranges 10-12 kg/m^2, and pickles autumn production up to 6 kg/m^2.

ZUCCHINI

Zucchini is produced in greenhouses and grown as second plant, after lettuce and spring onion.

Growing Conditions

Temperature: Zucchini has high temperature requirements which influences the period of sowing. Temperature variations result in deflowering and wilting, which affects the sowing period.

Water: Zucchini form a large vegetative mass in a short period, and has high moisture requirements especially during blooming and fruit formation. Water requirements depend on the stage of plant development. More watering is required at germination and emergence stages, which decreases at time of intensive rooting and vegetative mass production.

Fertilization: Zucchini has high nutrient requirements and come first in crop rotation, showing a favorable reaction to compost (5-8 kg/m^2). The rest of nutrients should be applied during blooming and fruit formation. Recommended amounts are 30g/m^2 of nitrogen, 15g/m^2 of phosphorus and 70 g/m^2 of potassium.

Growing Technology

Sowing: Zucchini is produced from seedlings. Seedlings are grown in pots (10x10 cm), cubes or plastic bags 1 liter in volume, and at 2-4 leaves it is ready to be planted out. Sowing is performed at the end of April and beginning of May, at 100x50 cm spacing. Intensive ventilation is necessary when temperatures rise (in April and May) during vegetation period.

Crop cultivation: Watering is essential after planting out. Inter-row hoeing is carried out until plant damage is prevented. Watering is performed if needed at the time of fruit formation if lack of moisture occurs due to high temperatures. Fertilizing plants at the beginning of growth is favorable, especially if there is lack of organic fertilizer.

Harvest: Zucchini harvest is performed in May and June every 2-3 days. Yields range 4-5 kg/ m^2.

ONION (*Production of Spring Onion*)

Depending on the purpose of production, spring onion is grown from seedlings and onion sets (of different size). Production of different varieties from sets is frequent in our region.

Growing Conditions

Temperature: Onion has modest temperature requirements, which makes it suitable to be grown as a succeeding crop and intercrop in a greenhouse. Although the optimum for germination and emergence is 20^{o}C, it germinates at 5^{o}C, forms root at 10^{o}C, and leaves at 18^{o}C.

Water: Regular watering is required until planting out.

Fertilization: Along with seedbed preparation, fertilization with 80 g of N, 40 g of P_20_5 and 120 g of K_20 on 10 m^2 is performed. Foliar fertilization is performed if necessary (with the addition of adhesives).

Growing Technology

Sowing: Spring onion is sown every 15-20 days in order to provide longer harvest. Spring onion matures in 30-40 days (depending on the variety and greenhouse conditions). Sowing is carried out in bands (four or five-rowed), with row spacing of 20 cm and 40-50 cm between bands.

Crop cultivation: Temperature should be kept at 15-18^{o}C (during sunny days), but the highest quality is achieved above 10^{o}C. Hoeing and fertilization is necessary during vegetation.

Harvest: Spring onion of the highest quality has 6-9 leaves, long white stalks and matures in 20-45 days after sowing, depending on the variety. Suitable varieties for spring onion production are silver skin onions (May and June varieties). Yields vary from 1.5 to 2.5 kg/m^2.

RADISH

Radish is grown in greenhouses in spring and autumn, and in combination with open field growing, the production is ensured over the whole year. Short vegetation varieties are used for this type of production (35-45 days).

Growing Conditions

Temperature: Temperature of 18-20^{o}C is required during emergence, afterwards falling by 5-6^{o}C, and results in the optimal temperature of 12-14^{o}C during root formation. Temperature minimum is -3^{o}C and maximum 35^{o}C.

Water: Maintaining soil moisture at 70% FWC is essential during growth. Watering with 10-20 l/m^2 is required 2-3 times in autumn, and every 5-7 days in spring using the same irrigation rate.

Fertilization: 50 g of nitrogen, 100 g of phosphorus and 120 g of potassium is applied. One fertilizing is also required at the stage of first 3 leaves with 50 g of nitrogen per square meter.

Growing Technology

Sowing: Spring sowing of radish is performed in February and March, and autumn in October and at the beginning of November. It is sown in bands of 10-15 rows, with 40-50 cm spacing. Row spacing in band is 10-15 cm, inside a row 3-5 cm, sown to the depth of 2 cm. Under these sowing instructions, plant density is 150-300 plants per square meter, with the expense of 3-4 grams of seed.

Crop cultivation: Fertilizing and watering is needed during vegetation. The crop should be watered regularly with lower irrigation rate of 10–20 liters of water/m^2, depending on the stage of plant growth, temperature and light. Apart from soil moisture, radish requires humidity, which should not be excessive because the plant develops the rosette rather than the root, and it also provokes the development of plant diseases.

Harvest: Radish is harvested every 2 days by screening, in order to last 7-14 days. Radish with the diameter of 20-30 mm has the highest value on our market. Harvesting depends on the sowing period, and yields vary from 2.5 to 4 kg/m^2.

Horticulture growing technologies closer to Hungary cross border region

Vegetable Growing Technology on Open Field

Brassica crops (KOHLRABI, SAVOY CABBAGE)

Timing: We start early field planting at the end of March or early April, depending on vegetable species.

Variety selection: The goal of early field growing is to produce vegetable for fresh consumption at the earliest time possible. Because of this you should choose one of the shortest growing period varieties. As for Savoy cabbage 50-60 day varieties can only be suggested. As for kohlrabi 40-50 day short period variety has to be chosen. Tuber can be white or purple. The white grows slightly faster, so it is advisable to choose this type.

Fertilization:

Savoy cabbage requires the following nutrients per hectare on medium fertile soil:

nitrogen	135 kg/ha
phosphorus (P_2O_5)	162 kg
potassium	310 kg
magnesium	12 kg.

The total amount of phosphorus and 40-50% of potassium are added as basic fertilizer. Nitrogen is added as a starter fertilizer and top dressing. The rest of potassium is added as top dressing in 2-3 portions.

Kohlrabi needs the following amount of nutrients per hectare:

nitrogen	140 kg/ha
phosphorus (P_2O_5)	135 kg
potassium	240 kg
magnesium	15 kg.

In kohlrabi cultivation the total amount of phosphorus and 40-50% of potassium is added as basic fertilizer. Both brassica need a lot of potassium.

Propagation, plant density: In field cultivation bare rooted or tray seedlings can be used. The spacing is:

Savoy cabbage:	30-40×30-35 cm
kohlrabi:	30×30 cm is suggested.

Cultivation:

Water: After planting we should irrigate immediately. The quantity of water is 5-10 mm. At the beginning of the growing period regular irrigation is essential. 5-10 mm wateris added. Later, we add 25-30 mm of water. Irrigation should be connected to top dressing. Kohlrabi particularly demands an even supply of water, otherwise tuber can burst. Keep the area weed-free. Approximately 1-2 hoeing can assure that.

Plant protection: Plant protection is essential. We start protection against cabbage peronospora (Peronospora brassicae) as early s in seedling production. We should always protect kohlrabi against spring cabbage fly (Phorbia brassicae), cabbage aphids (Brevicorine brassicae).

In Savoy cabbage and kohlrabi production the main two factors are irrigation and plant protection. We must do them very carefully.

Picking: We start picking kohlrabi when the diameters of tubers reach 7 cm. We leave 3-4 leaves on the tuber. Up of 85-90% of the transplanted plants are harvested. We start harvesting Savoy cabbage when 10% of the total plants are big enough. We start picking cabbage when 10% of them are large enough. Picking should be done in a hurry because the early varieties crack easily. The average weight of the heads is 0.4-0.6 kg.

Second crop brassicas
(CABBAGE, SAVOY CABBAGE, CAULIFLOWER)

Timing: Second crop brassica vegetables can be planted when the fore crop has already been harvested. In our cultivation system they are grown after pea and green bean. The latest possible time of planting is the middle of July.

Variety selection: In all the three species medium-long term varieties are needed. The growing season of cabbage is 90-110 day, in Savoy cabbage it is 90-100 days, and in cauliflower 70-90 days.

Fertilizing: Fertilizing technology described here is common in early field vegetables. In this technology starter fertilizer and top dressing are added. Basic fertilizer (phosphorus and part of potassium) should be applied before fore crop.

Propagation, plant density: In second crop production bare rooted or tray seedlings can be used. These crops can be grown in field conditions. Seedlings are produced in 4-5 weeks. The density of cabbage is 2.4 to 3.3 plants/m^2, which means 60-70 × 50-60 spacing. In Savoy cabbage 50-60 × 40-50 cm row planting distances is used which corresponds to 5.0 to 3.3 plants/m^2 plant density. In cauliflower, spacing is 60-70 × 50-60 cm which corresponds to 3.3 to 2.2 pieces/m^2 plant density.

Cultivation:

Water: Soil is filled with 30-50 mm of water before planting. After planting we water seedlings. Then we irrigate regularly, initially 10-15 mm, and after 20-30 mm are supplied. The total amount of water is 150-2010 mm depending on the rain. The irrigation is connected with N, K. top-dressing. The best is when we add them in nutrient solution.

Weed control: We hope the field 1-2 times after planting, because foliage is closed afterward and weeding is minimal. Then we remove weeds by hands.

Plant protection:
Cutworm (*Mamestra brassicae*), cabbage aphid (*Brevicorinae brassicae*) and cabbage butterfly (*Pieris brassicae*) are the most threating pests to cabbage. Flea (*Phyllotreta* spp.) can be dangerous after planting. We start plant protection against these pests when their swarming begins. If they infect overcasted leaves we can not kill them. We must take precautionary measures against cabbage peronospora and Alternaria diseases. Do not forget to use adhesive with pesticides as cabbage has waxy leaves.

Harvest: Scheduling cauliflower harvest is a critical issue and we should pay a close attention to it. Expected yield is 1.5-2.5 kg/m^2. Harvesting should be done 2 times. Cauliflower can be stored for up to 1-2 months.

Cabbage: The heads will be of 2-3 kg average weight. We can predict a yield of 4-5 kg/m^2. We pick only ripe and hard heads.

Savoy cabbage: Because of the vesicular leaves their head-weight is much smaller than that of cabbage (1-1.5 kg / head).
Predictable yield is: 3-4 kg/m^2. Heads tolerate -3 - 5 ° C of cold very well without damage.

LETTUCE field cultivation

Timing: We can plant lettuce in field in the middle or at the end of March.

Variety selection: We should choose a variety that we can be plant in the spring time, forms a large, firmly closed and thick head (minimum 300 g), resistant to diseases and has thick leaves. Besides butter type, iceberg lettuce can also be considered to grow. We just have to clarify the market opportunities.

Fertilization: The following amount of nutriments is suggested to add on medium fertile soil for lettuce:

nitrogen 75 kg/ha
phosphorus 30 kg/ha
potassium 125 kg/ha.

Lettuce has low nutrient requirements in compared to other vegetable species, but the plant has to take up nutriments in a short time (up to 6 weeks). The transplanted lettuce has shallow roots (in the upper 20 cm layer), and it is sensitive to salt. These should be taken into account at fertilization. The total amount of phosphorus may be dispersed as basic fertilizer, but it has to be worked in the soil in max. 20 cm depth. Half of the potassium can be applied at the same time. The total amount of nitrogen and the rest of potassium should be dispatched as nutrition solution in 2-3 portions.

Propagation, plant density: Today we grow mostly transplanted lettuce, though it is often sown to their permanent place in open fields as well. We do not recommend sowing in this system because it has a long growing season and the second crop can be very late.

When we plant transplant seedlings we should be careful not to plant it deep in the soil because of plant protection problems. We can avoid deep planting by using seedlings in tray so that we put maximum half of the soil-ball into the soil. The applied row and plant spacing is 30 × 25-35 cm depending on the head size of the variety. The bigger the head mass is (300-400-500 g), the larger planting distances must be applied. This corresponds to 10-13 db/m^2 plant numbers.

Cultivation: After planting the each plant are watered. If the soil is very dry we should water the soil first and then we can start planting. Weed control is performed manually in 1-2 times as long as the leaves are not covering the soil.

Irrigation: Very dependent on weather conditions, the water capacity of the soil should not drop below 65% in the springtime. We have to add 10-15 mm of irrigation water until heads are formed. At the beginning of heading a thorough 15-20 mm water is added, that is followed by humidifier irrigation at the dose of only 1-2 mm in each case. Micro-sprinkler irrigation is very good for this purpose. Top dressing should be applied until head-forming.

Plant protection: We should protect lettuce regularly against lettuce peronospora (Bremia lactucae), seedling fall (Rhizoctonia solani) and lettuce Botrytis.

The most important pests are: slug, real aphids (Aphididae) and lettuce bollworm.

Picking: As soon as the weight of the heads has reached the minimum of 300 g we can start harvesting. After cutting off the heads we clean them by removing the brown leaves. Then we wash it.

The expected yield: 85-90% of the plants are expected to be harvested.

RADISH field cultivation

Timing: We can start sowing radish from the beginning of March.

Variety selection: Domestic consumers are fond of round red radish and are less interested in the two-colour elongated radishes. We should choose a variety which has at least 40 mm tuber diameter. The variety should not have a 30-50 day longer growing season.

Fertilization: We add the following nutrients into a medium fertile soil:

nitrogen 35 kg/ha
phosphorus 15 kg/ha
potassium 35 kg/ha active ingredient.

Phosphorus and potassium fertilizers are added as basic fertilizers, nitrogen as starter fertilizer and top dressing. Since radish is not rooted deep the basic fertilization should be in 15-20 cm. As radish is chlorine-sensitive we should not use chlorine-containing fertilizers.

Propagation, plant density: We sow the seeds on permanent place. We should sow the seeds 2-3 cm deep. We suggest handheld precision seeding drill to use. We choose a row planting distance which makes weeding possible. Thus, row spacing is 20-30 cm and the recommended distance between plants is 5-8 cm.

Cultivation: At the beginning it is important to keep the area weed free. Then we start irrigation with the most even water supply possible. Therefore, we irrigate with small water quantities and frequently. If water supply is uneven radish will crack. We should add 5-8 mm water at a time. Nitrogen and potassium are added together with the irrigation in nutrient solution.

Plant protection: Preventive protection against radish peronospora (Peronospora brassicae), root fly (Phorbia radicum), flee of cruciferous plants (Phyllotreta spp.) is essential.
Harvest: We start picking when the diameter of the tuber reaches 30 mm. We do it by hand and in 2-3 times. We bunch 5 pieces of radish and we wash it.

Expected yield of radish: 15-25 bunches/m^2.

PEPPER field cultivation

Timing: Pepper and tomato are planted after lettuce, kohlrabi and radish. The ideal planting time is the 2nd decade of May (from 10 to 20 May). By this time, the previous crops will be harvested.

Variety selection: White pepper (for stuffing), kapia, tomato-pepper and apple-pepper can be grown in field conditions. Farmers grow these types of pepper in the largest volume. We recommend white pepper and apple-pepper for field cultivation. For both types, if possible, we should choose resistant varieties. Continuous growth and good regeneration ability are required.

Fertilization: We suggest the following amount of nutrients on medium fertile soil to reach 25 t/ha yield:

nitrogen	100 kg/ha
phosphorus	120 kg/ha
potassium	200 kg/ha active ingredient.

The total amount of phosphorus and 40% of potassium are added as base fertilizers. Nitrogen and the rest of potassium are added as starter fertilizer and in top-dressing. Since pepper is sensitive to chlorine, only potassium sulphate and potassium-nitrate can be used.
If the daily temperature exceeds 26-27 °C we have to start adding calcium nitrate. This reduces the number of calcium deficient berries. We add magnesium fertilizer in sandy soils.

Propagation, plant density: We recommend propagating pepper by seedlings. It is worth planting transplants and seedlings in trays. The most common spacing is double row 80+50×25 or 80+50×30 cm. At planting time we add starter fertilizing in nutrient solution irrigation.

Cultivation: Regular irrigation is a key to a successful production. This culture requires 300-350 mm of water in the growing season.

On an average 6 °C heat sum is equivalent with 1 mm evapo-transpiration.

The frequency of irrigation above 27°C is weekly and less than 25 °C is 10-14 days. We start irrigation when the daily average temperature reached 20 °C-. We do top-dressing together with the irrigation in 4-6 times. We start it when the first berries reach 2 cm. Drip irrigation is very effective in field cultivation. It is also suitable to for adding nutrient solution. The concentration of nutrient solution should not be more than 0,1-0,2 %.

Weed control: Hand hoeing is necessary in 1-2 times.

Plant protection: The major risks of production: cutworms, leafhoppers (viral vectors), aphids, cotton bollworm.

Protection is based on observing swarming. Continuous plant protection is essential after the 2-3 days of swarming.

Harvest: White pepper (for stuffing) and apple-pepper are picked in the state of economic maturity. The frequency of picking is 10-14 days. Berries are ready for picking when they have reached the size which is characteristic for the variety, the skin is smooth, the surface is shiny and its touch is hard. The predictable yield is 20-30 t/ha.

TOMATO field cultivation

Timing: The ideal time for planting is the beginning and middle of May, like in pepper.

Variety selection: We recommend choosing a high yield variety, which has a berry size in the range between 80-100 g, can be picked by hand and suitable for both fresh consumption and for home canning. It should be disease resistant and has a semi-determinate growth. It can be a constant, open-pollinated or hydride variety.

Fertilization: In a medium fertile soil we suggest to add the following nutrients in the following amount if we want to reach 60-80 t/ha yield:

nitrogen	220 kg/ha
phosphorus	180 kg/ha
potassium	380 kg/ha active ingredient.

Base fertilization: 25-40 % of the base fertilizers can be added in animal manure.
85% of phosphorus and 40% of potassium should be added as base fertilizers.
15% of phosphorus and 10-15% of nitrogen are added as starter fertilizers, the rest is added as top dressing:

after roots are taken	N:K	3:4
from the beginning of blooming	N:K	1:1
during berry growth	N:K	1:1,2
from big green berry size	N:K	2:4

Nutrition solution is the best way of adding nutrients. It can easily be done by drip irrigation. The concentration of the nutrition solution can be 0,2%.

Propagation, plant density: It is possible to sow seeds on permanent place, but tomato is usually propagated by tray seedling transplants. In general, double line layout is used by 140 +30 × 35-40 cm row and plant space. This corresponds to 3.8 to 3.1 db/m^2-plant density.
Cultivation: Weed-free plantation can be ensured by hand hoeing in 2 to 3 times. In order to have a high yield we should irrigate tomato regularly. We irrigate in 10-14 days frequency depending on the weather. As the roots of tomato penetrate deep in the soil we can irrigate in larger dose (25-35 mm/irrigation). It is worth linking irrigation with supplying nutrition solution.

Plant protection: The main diseases: tomato Xanthomonas, tomato Phytophtora, Septoria, Alternaria. We should use preventive plant protection.

Regular protection is essential against the following pests: nematodes, bollworm, aphids, Colorado potato beetle.

Picking: We start picking tomato in the biological state of maturity and do it continuously once a week. The berries should be taken without peduncle for both fresh consumption and processing. Ideally, the predictable amount of yield is 60-80 t/ha.

GREEN BEAN

Timing: The main season of bean sowing is from the middle of April to the end of May. It is possible to cultivate bean as a second crop as well. We can also sow bean after early crops (lettuce, kohlrabi, early cabbage) from June to July middle.

Variety selection: Some farmers grow both bush bean and pole bean in a small scale. If we grow pole bean, a trellis must be built.

A range of yellow- and green pod varieties are suitable for production, but domestic consumers prefer the yellow-pod varieties. It is expected that the species should have a high yield; round or oval pod cross-section, resistance and fibre-free pods.

We can also grow "pencil pod beans", which has less than 10 cm long pod and of 7-8 mm diameter. It is suitable for canned green bean. In addition, we can also cultivate a "flageolet" type of bean as shelled bean.

Fertilization: Green bean is quite sensitive to the nutrients. Because of the short growing season its nutrient uptake is intensive. It needs 1.26 kg of nitrogen, phosphorus, 0.27 kg and 1.16 kg of active ingredient potassium for 1 ton of crop yield.

Although nitrogen-fixing bacteria live on the roots nitrogen fertilizing is still necessary. We add nitrogen in the spring time before sowing. Phosphorus fertilizer is added in the autumn of the previous year with potassium fertilizer. Bean requires manure, but we sow it in the second year after manure was added.

Propagation: We sow green bean on permanent place. As it requires 10 ^{o}C for germination we start sowing in the middle of April. The main sowing season lasts until the middle of May. It is possible to grow green bean as a second crop. In this case the time of sowing is in the middle of June and July.

We can sow bush bean in nests at 50 x 50 cm spacing and we sow 6-8 seeds per nest. If we sow in row, the row distance is 30 cm and the seeds are in 7-8 cm apart from each other. In both ways of sowing the seed depth is 4 cm. If we grow pole bean, we make a frame out of 3-4 sticks and we sow 3-4 seeds per stick. In cordon cultivation the row spacing is 120-150 cm and plant spacing can vary from 7-10 cm.

Cultivation: Weed control is made by hand hoeing. We should hoe close to soil surface and do it carefully, because the roots of the plants are shallow and we can hurt them. In flowering we must not hoe because we strike the flowers down.

Today, irrigation is essential in green bean growing. It demands water mostly in the germination and flowering time. In an average year we irrigate green bean 3-4 times until pods are developed.

Defence against pests and diseases should be based on prevention. If we improve plant condition we can increase plant tolerance. The optimum number of plants can positively influence the defence against Botrytis and Sclerotinia diseases. Crop rotation is the most effective way of protecting bean against rust.

We can prevent viral diseases if we destruct viral vectors. We can prevent Colletotrichum, Pseudomonas and bean mosaic virus diseases by growing resistant varieties. In recent years, the larvae of cotton bollworm have become a dangerous pest of bean. We have to apply chemical plant protection against it.

Picking: We can start harvesting pods 8-10 weeks after sowing. Pods are harvested as soon as possible because delayed harvest result lower yield. The yield of bush bean is 1.5-2.5 kg /m^2, and the yield of the pod bean is 2.5-4.0 kg /m^2.

PEA

Variety selection: Among variety types both shelling pea and sugar snap pea are suitable for small farms. Shelling pea is more tolerant to cold so we can sow it earlier and we will have an early fresh crop. Sugar snap pea is more demanding, but it is tender for a longer time.

It is required that varieties should develop big pods, there should be many peas in the pod and easy to shell. In addition, the breeding season of the variety is an important factor because simultaneous sowing of different varieties ensures that we can pick pea continuously. It is also important that a variety should be resistant, because it facilitates the pest control work.

Fertilization: We can not use animal manure right before pea cultivation. We should choose a place where animal manure has not been used for at least 3-4 years.

for 100 kg seed crop	2,3 kg N	
	1,9 kg P	
	2,4 kg K	fertilizers are needed

In early sowing fertilizer that contain macro-elements, should be added in the autumn. In case of a late sowing date half of the nitrogen is added in springtime in an easy available form. Most of the nitrogen that is needed for pea is captured from the air by nitrogen-fixing bacteria. Excessive nitrogen fertilization reduces the bacterial activity which moves the plant into vegetative direction. Because of this we will have fewer pods.

Propagation: We sow pea in permanent place. The main season of sowing is from the end of February to the middle of April. Sugar snap pea is less cold tolerant so we do not sow before the middle of March. We can pick continuously if we sow the same variety in different time (in 2 weeks delay) or if we sow different varieties with different growing season at a time.

It is recommended to sow seed in beds. In beds the row space is 30 cm. The distance between seeds is 3 cm, the depth of sowing is 5-6 cm. The depth of seeds is also important because of birds. Crows, pigeons eat seeds if they are near the soil surface. Raschel net cover can solve this problem.

Cultivation: The germinating seeds should be hoed as soon as possible to get a loose, air permeable soil that keeps water well. If necessary, we repeat hoeing once and pull the big weeds out by hand before they maturate core. In dry years multiple irrigations may be required, especially during flowering and pod development.

Plant protection: The most important diseases are downy mildew, powdery mildew, rust and. As for pests aphids, pea moth, locust borer are the most dangerous.

Picking: We can start picking the earliest pea varieties 11-12 weeks after sowing. We start harvesting pods when seeds have reached their typical size but they are still tender, easy to cook and have good flavour. Shelling pea can easily be “floury” while sugar snaps pea remains tender for a longer time. We can expect 1-2 kg of pods per square meter. The weight of pea seeds is about 30% of the total weight.

CARROT

Timing: We can sow varieties with short growing season and for early fresh consumption from the middle of March until the second half of June. We sow long-term varieties for winter storage in the 2nd half April.

Variety selection: The production method and the intended use determine the selection of the right variety. Growing season length is an important aspect. We grow short-season varieties for fresh consumption, medium long-season varieties for fresh consumption and storage and we grow long-season varieties exclusively for storage.

Carrot varieties for fresh consumption have shorter roots, develop stronger foliage (we bunch them), and have intense orange-red colour and sweet taste. Varieties for storage have longer roots they have high dry matter which improves their shelf life. Each variety should be resistant diseases.

Fertilization: Carrot does not like if we added organic manure to the soil. In such places carrot can be grown only in the second year. Carrot has a medium nutrient need. It utilizes the nutrients which we added well. We add 16-18 g nitrogen, 12-16 g potassium and 15-25 g phosphorus for 1 m^2. We work 50% of potassium in the soil in autumn. We add the rest of phosphorus, 25% of potassium and 10-20% of nitrogen at sowing. We add the rest of nitrogen and potassium in the growing season in several portions.

Propagation: We seed carrot in permanent place. The date of sowing is determined by the intended use of the crop and the cultivation method the length of growing season. The training method can be plain cultivation and ridge cultivation. In plain cultivation we apply 30-50 cm plant spacing. In the ridge cultivation and distance between the ridges is 70-75 cm and the height of the ridge is 20-25 cm or sometimes 10-15 cm. Usually, we grow plants in twin-rows on the ridges. The distance between rows is 7-10 cm. The advantage of this method of cultivation is that it provides optimal environment for plant development. The seed requirement of early varieties is 4 g/m^2. In medium long growing period varieties we sow 3 g/m^2, and 1 g/m^2 of the late varieties.

Cultivation: Carrot develops slowly in the beginning, therefore it is important to keep the field weed-free in this season. We ensure weed control by mechanical soil loosing. We set plant density at the age of 2-4 leaf. Plant spacing depends on variety.

Water demand is less in early growing and it is more when we grow carrot for storage. We supply the extra water demand by irrigation. Carrot needs most of the water when it develops roots, which starts at the second half of the growing season. It is important to provide carrot with even amount of water. In this way we can avoid root cracking. We stop irrigation 3-4 weeks before picking because we cannot store it for a long time.

We top-dress short-period varieties once, medium-, and long period varieties 2-3 times with nitrogen and potassium fertilizers.

Picking: We can start picking carrot from the 2nd half of June. If we market carrot with foliage we do the picking by hand. We start picking carrot for storage in the middle of October. The expected yield is 30-60 kg/m^2.

PARSLEY

Timing: We can grow parsley for several purposes. If we produce parsley for bunching, we start sowing in the spring or autumn. If we produce it for storage or canning we start propagation in March-April.

Variety selection: The selection of variety is determined by the method of cultivation and the purpose us use. In early production we choose those varieties that have short-season, short or half long roots. The strength of foliage (at bunching), colour and smoothness of roots are also important factors. Varieties should have high dry matter, adequate fibre content which is essential in canning and storage.

Fertilization: Parsley does not like soil which was fertilized by organic manure. Therefore we cultivate it in a year after manure was spread. Parsley demands a lot of potassium and a medium amount of nitrogen and phosphorus. Potassium and phosphorus nutrients are worked in the soil in the autumn. We add nitrogen as top-dressing 2-3 times in the growing season.

Propagation: We sow parsley on permanent place. We can sow it in plain field or in ridges. The row space in plain growing method is 24-36 cm, and 70-75 cm in ridge method. The distance between the twin rows is 7-10 cm.

We grow 100-120 plant/m^2 in parsley for bunching and 70-80 plant/m^2 for root production. We need 0,2-0,4 g amount of seed in 1m^2.

Cultivation: Parsley has a long growing season so it needs an extra care.
We thin parsley only in small gardens. We thin parsley at a 2-4 leaf age. The distance between plants depends on the shoulder diameter and sowing method. It is about 1-5 cm. In small gardens we do mechanic weed control. Since parsley demands loose, airy soil, we have to loos soil if necessary. We hand hoe 2-4 times and we solve the problem in this way.

We protect parsley against earth pests and diseases like Septoria and powdery mildew.
We top-dress 2-3 times with nitrogen nutrient mainly in root development period.

Picking: The picking of early parsley, which was sown in the autumn, is scheduled for the end of May. If we sow in the springtime we will get parsley for bunches in the 2nd half of June. We pick parsley with foliage by hand. The expected yield is 10-12 bunches/m^2.

Parsley that is grown for storage or canning is harvested from the end of September till frosts. We can expect a 20-30 kg/m^2 yield.

CELERIAC

Timing: We grow celery as a main vegetable because it has a long growing season. Sometimes radish can be a forecrop because of its short growing season.

Variety selection: We grow mostly celeriac (big tuber) in Hungary. Celery (thick stalks) and leaf celery are less popular among consumers.

We should choose a celeriac variety that has round tuber with smooth surface, and is not prone to cavitations and sponginess. The tuber must be uniformly white inside.

Fertilization: We recommend the following nutrients in celeriac growing on medium fertile soil:

nitrogen (N) active ingredient	150-180 kg
phosphorus (P_2O_5) active ingredient	60-80 kg
potassium (K_2O) active ingredient	250-300 kg/ha.

We add the total amount of phosphorus in the autumn, one third of potassium in the autumn as base fertilizer and the rest of potassium is added as top dressing in July-August. The whole amount of nitrogen is added as top dressing in 3-4 portions.

Propagation, plant density: Celeriac has a tiny seed so it is recommended to use transplants. The seedlings that is ready for planting has 4-5 leaves and is 12-15 cm tall. Seedling in trays are worth planting because they take better effect.

We plant after spring frosts in May, but planting has to be finished before the end of May.

We recommend planting in double rows at the spacing of 40+30×25-30 cm. It means approx. 8-10 plants/m^2.

Cultivation: The field must be weed-free. It is especially important in 4-6 weeks after planting. When we hoe the field we air the soil at the same time, because celeriac demands airy soil.After planting we water the plant thoroughly then we supply water regularly. It means that we add 25-35 mm of water in 5-7 times. Top dressing is linked with irrigation.

Plant protection: The following diseases are the important: celery tubes scab (Phoma apiicola), celery leaf blotch (Septoria apii), celery rot (Botrytis). We must protect against these diseases regularly.

The most important pests: root-gall nematodes (Meloidogyne hapla), cutworm (Scotia segetum) an common mite (Tetranychus urticae). We must protect against these pests regularly.

Picking: We harvest tubers in the autumn from September to October. We cut the leaves first and we either dry it or freeze it as herbs.

We can store tubers in simple storage.

The expected yield is 25-35 t/ha (2,5-3,5 kg/m^2) depending on the tuber size.

Technology of Growing Vegetables in Greenhouses

LETTUCE

Forcing timing: If we use a single-layer unheated plastic houses we usually start planting in the first decade of March. If agro-veiling coverage is used, planting begins from the end of February to March.

Variety Selection:Those varieties can be considered, which are good for cold forcing. The head size of the varieties must be at least 300 grams, because the market requires at least as much head size. Besides butter-head type of lettuce, iceberg lettuce and coloured leaf lettuces are also worth growing.

Fertilization: Lettuce is not sensitive to soil structure, but it is sensitive to salt and chemical residues. Nitrogen need is increasing until heading parallel with the growth of foliage, but if nitrogen and water are in excess heading slows down. When soil has a medium nutrient content we propose the following nutriment dosage:

nitrogen (N)	active ingredient 15 g/m^2
phosphorus (P_2O_5)	active ingredient 8-10 g/m^2
potassium (K_2O)	active ingredient 20 g/m^2

Propagation, planting: In all cases, seedling transplants should be used. It can be small, 4.4 x 4.4 or maximum 5 × 5 cm soil block, but it is better to use seedling tray because it is a less expensive solution.

Lettuce should be planted in beds. The width of the bed should be around 2-3 m. Of course, it is important to utilize the plastic house in the maximum width possible.

The recommended spacing is 30 cm x 25-30 cm, depending on the average head weight. If the head average weight is greater than 400 g a larger plant-to-plant distance should be chosen.

When we are planting we either put the transplant in the ground surface or half-lower it into the ground. In case of deeper planting serious pest problems can occur. The nitrogen should be added in three portions: 1/3 prior planting and the rest in two portions until heading in 5-5 g/m^2 dosage. We can add the entire amount of phosphorus and potassium before planting.

If lettuce is well supplied with potassium it tolerates cold more and is more tolerant to diseases. Varieties that tolerate cold more are usually more resistant to diseases. On sandy soil, magnesium deficiency can occur and Mg-containing complex fertilizer should be used once as top dressing.

Cultivation

Climate regulation

Heat: When leaves develop at least 4-5 ° C is needed. Roots start to grow at 6-7 ° C soil temperature. Lettuce survives a temporary lower temperature if it has taken roots. When heads are about to form more intense ventilation is necessary to get a better quality of head.

Water: few days before planting soil should be charged with water fully. This means 30-50 mm of water, which should be dispatched in several portions. Immediately after planting each plant should be watered. If sprinkler irrigation is used, 4-5 mm of water is sufficient.

Depending on temperature conditions we irrigate 1-3 times with 20-25 mm amount of water which ensures optimal water supply from planting to heading. At the beginning of heading a full irrigation of 20-40 mm of water is recommended. With this amount of water lettuce survives until harvest. Lettuce shrivels If temperature is 20 ° C or above during heading time. We can avoid these phenomena by 1-2 mm water irrigation.

We draw the attention to the following: after several days of long cloudy skies a sudden sunny warm weather can cause the browning of outer leaf edge due to excessive water loss. Therefore, the relative humidity of the air should not be below 70%. In this case misting irrigation is necessary in every 1-2 hours during the day. This can cool the leaves of the lettuce down and increase the relative humidity of the air.

Other cultivation works: In 1-2 weeks after planting the soil must be kept weed free.

Plant protection: We must start protecting lettuce against downy mildew disease by using contact pesticides since we started seedling production.
Ventilation is the best way to prevent Botrytis. Humidity should not be over 80 %.

Picking: We should start picking when the head size reached 300 grams. If the plants are even most of the heads can be harvested in 1-2 times. We harvest lettuce by hand. We lift one half of the lettuce head then we cut it at the ground surface. We turn the head upside-down and clean dead leaves. Then it is recommended to wash the head with water keeping it stalk-down.

Expected quantity: 80-90 % of the planted lettuce can be harvested.

KOHLRABI

Forcing timing: It is the same as in lettuce. If we plant kohlrabi seed-stalk can develop early after 6-8 days of cold period. Thus, we start planting lettuce first and kohlrabi later from 5-10 of March.

Variety selection: Those varieties are suitable which have short growing period. The shape of the tuber should be slightly flattened, globe-shaped, because they reach the minimum 7 cm diameter earlier. The variety should not be prone to develop seed-stalk or be „woody", if possible. The colour can be white or purple, but white varieties have a few days shorter growing season.

Fertilizing: Kohlrabi likes loose sandy and loamy soil. The soil should have 2-3% of lime.

The following nutrients are added in a medium fertile soil:

nitrogen (N) active ingredient	8-10 g/m^2
phosphorus (P_2O_5) active ingredient	5 g/m^2
potassium (K_2O) active ingredient	20 g/m^2

We add nitrogen as a starter fertilizer or may be 1-2 times as top-dressing. We add nitrogen until tuber reaches walnut size. If we add nitrogen later nitrate can accumulate in the plant.

Propagation, planting: We use only earth-ball seedlings which can be small size soil block or seedling in tray. Depending on the tuber diameter row and plant space can be about 25-30×25-30 cm. We should avoid planting kohlrabi seedling deep. Tubers can not touch the ground.

Cultivation.

Heat: If temperature is below 8 °C plant development can be abnormal, seed-stalk develops and tuber tends to be „wody".

Water: Kohlrabi needs a lot of water. The plant has shallow roots, so we irrigate with small amount of water but more frequently. We fill up the soil with water 3-4 days before planting. We add 30-40 mm of water in 1-2 times.

This amount of water is enough until the tuber reaches 2 cm. Then we irrigate frequently with small amount of water to ensure 70-90 % water capacity. We add maximum

10-15 mm of water at a time. Uneven water supply can cause tuber cracking and „woody” tubers.

Other cultivations: Soil must be kept weed-free.

Plant protection

Kohlrabi peronospora (*Peronaspora brassicae*) is one of the most important diseases in kohlrabi cultivation. We have to start plant protection against this disease from seedling production.

Spring cabbage fly (*Phorbia brassicae*) can infect forced kohlrabi. Plants can fall out, so it is essential to spray against them with piretroid chemical agent.

Picking: We start picking when tubers have reached 7 cm diameter. Usually 80-90% of the tubers can be harvested in 2-3 times. It is important to have a smooth surface on the tuber after we cut it from the stalk by pruning shears. Most of the foliage should stay on the tuber.

RADISH

Forcing timing: In plastic house we can start forcing radish first, because it has the lowest heat demand (13 ^{o}C). We can start sowing when the soil is not frozen. This is usually in February.

Variety selction: Mostly red, round radish is in demand in Hungary. Consumers like big-tuber, so called butter type of radish so we should choose such a variety. More recently bi-colour radish is getting popular. Their shape is long and oval. In general, these elongated shape varieties are firmer and less prone to cavitations, cracking.

Fertilization: Radish is fond of quickly warming soil which is rich in organic matters. Therefore organic manure should be added in the soil in the autumn of the previous year and must be worked in the soil. We use mature manure in the amounts of up to 10 kg/m^2. A continuous supply of nitrogen is the main condition of a rapid and steady tuber growth.

Suggested amount of nutrient on medium fertile soil:

nitrogen:starter	5 g/m^2 active ingredient
top-dressing	5 g/m^2 active ingredient
phosphorus:starter	6-8 g/m^2 active ingredient
potassium:indító trágyaként	10 g/m^2 active ingredient
fejtrágyaként	10 g/m^2 active ingredient

We can add top-dressing together with complex fertilizers.

Propagation, sowing: We sow radish on permanent place. If we want event plants we need to sow calibrated seeds. This ensures that we harvest all the plants in one time.
The row space is 10-20 cm, the plant distance is 5-8 cm. We calculate 2 g/m^2-seeds in one row.

We can sow both by hand and by hand sewing machine. Many people prepare handheld machine which corresponds to plant space and makes an approx. 1-1.5 cm deep wholes. Seeds are put in one by one by hand. This is labour-consuming, but the population is very even which ensures a more effective harvest.

Cultivation

Heat: Radish seed germinates in 2-3 °C-on. It can survive -3- -6 °C for a short time without any damage.

Water: A careful attention should be paid to ensure steady water supply. Radish is a shallow rooting plant so it must be irrigated often with small portions of water. In February we irrigate 6-10 mm of water weekly. In March we irrigate in 2-3 times.

Other cultivation works: We remove weeds by hand.

Plant protection: We start protecting radish against peronospora (Peronospora brassicae) right after it germinated and has 2 cotyledons. We can use both systematic and contact pesticides (folpet, metiram, copper-sulphate, copper-hydroxide, etc. chemical agent).

Picking: We start picking radish when the tuber size has reached minimum 25 mm, or the minimum of 35 mm in big tuber-size varieties.

After picking we bunch 5 pieces of radish together. Then we wash them.
The expected yield: 100-200 db/m^2 that is 20-40 bunches/m^2.

PEPPER

Forcing timing: After forecrop is harvested we start planting pepper. It's late April, but rather occurs in early May.

Variety selection: The type of variety must be adapted to the needs of the market. In Hungary, white pepper for stuffing is the most popular. Kapia type of pepper is getting popular just like tomato-shaped pepper. Virtually any type of the above three types can be forced and can be planted in May. However, the chosen variety should have a continuous growth.

Fertilization: Pepper is very demanding to the soil structure. Therefore, you should mix mature organic fertilizer into the soil in 10-15 kg/m^2 quantity. If nutrient content is moderate in the soil the following amount of fertilizer can be added.

before planting:

nitrogen (N) active ingredient	8 g/m^2
phosphorus (P_2O_5) active ingredient	5-8 g/m^2
potassium (K_2O) active ingredient	20 g/m^2

top dressing:

nitrogen (N) active ingredient	15-20 g/m^2
potassium (K_2O) active ingredient	10 g/m^2

Propagation, planting: Transplant seedlings should be used in all cases. This can be either in soil ball or in tray seedlings.

Plant density depends on whether trellis or cordon cultivation is employed. We would recommend the trellis method, though it requires more manual work. However, the yield is higher and the quality is better. In trellis cultivation 6-plant/m^2 density may be considered if we leave one stem. 80 × 20 cm spacing ensures this density. For an easier cultivation double row arrangement is recommended, for example: 100 + 60 x 20 cm.

Cultivation

Temperature: We recommend painting the plastic foil to protect pepper against excessive heat. We apply raschel net shading, but any colour (yellow, red, white, silver, etc) except green.

Water: Before planting we should water the soil thoroughly. Right after planting abundant watering (soaking) should be applied approx. 2-4 dl/plant. Phosphorus nutrient solution facilitates faster rooting.

Irrigation should be connected with nutrient solution top dressing. Its concentration should not be more than 0.1-0.2%. N: K ratio should be changed according to the phenologic phases.

2 weeks after planting:	N: K = 1:1.8
after flowering:	N: K = 1:1.3
from the beginning of berry set:	N: K = 1:1.7

Every second week we should add $Ca(NO_3)_2$ which decreases the number of calcium deficient berries.

If we train pepper with 1 stem the plant should be pruned to maintain generative-vegetative balance.

If we have a manual conducto-meter we can check the conductivity of the nutrient solution. The conductivity of nutrient solution should be between 2-2,5 mS/cm.

Pepper needs 20-30 mm of water twice a week. The relative humidity should be between 65-80%.

Plant protection: If we force pepper it is essential to chose virus-resistant varieties (TMC, CMV and TSWV viruses are the most common).

Botrytis and pepper powdery mildew are the most dangerous diseases.

As for pests, root-knot nematodes, aphids, western flower thrips, cotton bollworm, greenhouse whitefly, broad mite are the biggest challenge.

Biologic control is a good solution. Chemical control is difficult because of pesticide residues.

The beginning of the first picking is at 35-days after the first flowers appeared.

In white pepper we can count for 6-8 kg/m^2, in kapia 4-6 kg/m^2 and in tomato-pepper 3-4 kg/m^2 yield.

Tomato forcing

Forcing timing: Planting should be, right after forecrop is harvested. This is the end of April, beginning of May.

Variety selection: Since the period of the forcing is approx. 5 months, only a continuous growth type of variety can be grown. If possible, varieties are required to have short-internodes and no greenback on the berry. The average berry weight is about 100 grams, or slightly higher as buyers like it in the summer. The variety should be LSC resistant and tolerant to diseases. On soil cultivation nematodes are the most dangerous pests, so nematode resistance is an important concern. If we have no resistant variety we can use grafted tomato. The selected variety can be picked in cluster or in berry.

Nutrition: If the soil has medium nutrient content we can consider the following amount of active ingredients:

nitrogen (N) active ingredient	60 g/m^2
phosphorus (P_2O_5) active ingredient	15 g/m^2
potassium (K_2O) active ingredient	100 g/m^2

These quantities are sufficient to reach approx 15 kg/m^2 yield. We should add the total amount of phosphorus as a base fertilizer prior to planting. 50% of the potash fertilizer should be dispensed as base fertilizer, the rest in the growing season as continuous top dressing. 10-20% of the nitrogen is added as a starter fertilizer before planting, the rest as top dressing in the growing period. Top dressing should be initiated as soon as the first clusters have been set and the berry size reached 1 cm. From then fertilizer should be given continuously. After the second cluster is set calcium and magnesium should be supplied on sandy soils.

Propagation, planting: If we plant tomato, only transplant (soil-ball) seedlings can be used. We plant 3-3,5 plants/m^2 in trellis cultivation. In economic point of view double-rows are better 90+60×45-50 cm.

If we train 1 stem tomato seedlings should be supported with a string. An upper wire is needed to fix the string there. The other end of the string is pulled under the earth-ball.
The plant can be several meters long at the end of the growing season. When the main shoot reached the top of the trellis, we remove shoot tips (topping). This accelerates maturation. Sometimes we let the top of the shoots grow continuously we fix them with a string and pull it down.

Cultivation works

Side shoot removal: Side shoots, that come from the main stem or from the base of the leaves, should be removed weekly.

Leaf removal: We remove old and sick leaves as high as the first ripen cluster is.

Twisting: We drive a string around the stem of the tomato to keep the stem in vertical position. When the plant reaches the top of the plastic, the plant should be pulled down so that stems are bent horizontally on the support wire. The ripe berries hang but they should not touch the ground.

For a better pollination it is advisable to apply bees into the plastic house. In this way we will have a better fertilization and bigger average berry weight.

Non-stop watering and nutrition supply (top dressing) 0,1% concentration of nutrition solution provides plants with water and nutrients at the same time. The amount of the dispensed water is 5-6 l/m^2 in June and in July, 4-5 l/m^2 in August and 3 l/m^2 in September per day.

Nitrogen and potassium are the main components of nutrient solution. Their ratio is an important matter. From the planting until the third cluster's berry set N: K = 1:3 is optimal. From the set of the third cluster to the fifth cluster N: K = 1:2, then later a N: K= 1:1 is ratio optimal.

Once air temperature reached 28 °C, calcium nitrate should be added to the nutrient solution in order to prevent berry patchiness. We should apply drip irrigation, if possible, in both tomato and pepper. We can calculate approx. 500-600 l/m^2 nutrient solution throughout the growing period. In the summer we remove only sick leaves so that remaining leaves could cool the plant by their transpiration. Plastic foil must be shaded as it was described in pepper.

Plan protection:

The most important diseases are: Botrytis, Phytophtora and tomato powdery mildew and Septoria leaf spotting from the middle of August.

The common pests are: root-knot nematodes, aphids, glasshouse whitefly, leaf miners, tomato, cotton bollworm.

Biological control is the most efficient against these pests as tomato is picked 3 times in a week in a hot weather.

Picking: We can pick berries with pedicle or in clusters (depending on variety). Picking begins 35-40 days after flowering. The expected yield can be up to 10-14 kg/m^2.

Carrot and parsley forcing technology

Forcing timing: In unheated plastic house we recommend sowing seeds until February.

Variety selection: The most important aspect of the species is their cold tolerance and disease resistance to downy mildew and powdery mildew diseases. Their growth should be fast, the growing season should be short, colouring should be quick (carrot) and their foliage should be strong. Carrot should look like cylindrical, should have smooth surface and good taste.

Fertilization: We add the following amount of nutrients in medium fertile soil:

for basic fertilizing:

N	5 g/m^2
P_2O_5	8 g/m^2
K_2O	12 g/m^2

for top-dressing 2-3 times

1.	time	N	3 $/m^2$
		P_2O_5	3 $/m^2$
		K_2O	6 $/m^2$

2.	time	N	3 /m^2
		P_2O_5	7 g/m^2
		K_2O	12 g/m^2
3.	time	N	3 g/m^2
		P_2O_5	5 g/m^2
		K_2O	8,5 g/m^2

Fertilizing can be done either by nutrient solution or by dispersing the nutrients on the soil before irrigation, and then wash them in the soil with water.

Propagation: We sow carrot seeds in permanent place. Cultivation can be done in ridges or in flat ground. In ridge cultivation the ridge distance is 70-75 cm and the height is 20 cm. We sow carrots and parsley seeds in double rows in ridges. The twin-row spacing is 10 cm and approx. 0.5 mg seed/meter/ is used.

Cultivation: The top of the ridge should always be wet until the emergence. 5-8 mm water is sufficient after emergence. From March 15-20 mm of water is required per week. If we have a good emergence, we thin the seedlings at 3-4 leaf stage. Plants should not be closer than 3 cm.

Weed Control: We must remove weeds manually on ridges.

Plant protection: against:

Carrot: *Stemphyllium*, Alternaria leaf spot, carrot powdery mildew.

Parsley: Septoria disease, parsley powdery mildew.

Harvest: We start picking carrot when the diameter of the root shoulder has reached 10 mm and the root has orange colour.

As for parsley, the diameter of the root shoulder is 10 mm too. Five-five roots can be bunched together but 3 carrots and 2 parsleys can also be bunched together. The expected yield on the ridge is 50-60 pieces/metre.

Possible model of Vegetables production in Serbian project area

Production plan for **Open field production** (8 x 30 m)

A = 1,6 x 27 m	**8 x 3 m Production of seedlings area**
B = 1,6 x 27 m	
C = 1,6 x 27 m	
D = 1,6 x 27 m	
E = 1,6 x 27 m	

preceding crop		the main crops		subsequent crop	
1. Pea	A	1. Cabbage	A	1. Onion	A
2. Radish	B	2. Pepper	B	2. Garlic	B
3. Kohlrabi	C	3. Tomato	C	3. Lettuce	C
4. Spinach	D	4. Red beet	D	4. Spinach	D
5. Lettuce	E	5. Kale	E		

T1a- brief description of **preceding crops** production in **open field**

preceding crop	variety	sowing date	harvest date	growing area	row/plant distance (cm)	rows x seeds
1. Pea	Tamiš	till 31.III.	till 10.VI	1,6 x 27m=43,2m^2	20 x 5	7 x 540
2. Radish	Verica	till 31.III.	till 31.V	1,6 x 27m=43,2m^2	20 x 5	7 x 540
3. Kohlrabi	Bečka bela	till 31.III.	till 31.V	1,6 x 27m=43,2m^2	30 x 20	5 x 135
4. Spinach	Matador	till 31.III.	till 31.V	1,6 x 27m=43,2m^2	30 x 10	5 x 270
5. Lettuce	Vuka	till 31.III.	till 31.V	1,6 x 27m=43,2m^2	30 x 20	5 x 135

T1b- brief description of **preceding crops** production in **open field**

preceding crop	number of plants/m^2	AV (g)	grams of seeds for sowing	small packs of seeds	retail price of 1 pack (din)	total price for packs (din)
1. Pea	3780 /43,2m^2	300	1134	3x0,5kg	135,0	405,0
2. Radish	3780 /43,2m^2	3,5	13,23	5 x 3g	30,0	150,0
3. Kohlrabi	675 /43,2m^2	2,5	1,69	1 x 3g	30,0	30,0
4. Spinach	1350 /43,2m^2	7,5	10,13	3 x 4g	30,0	90,0
5. Lettuce	675 /43,2m^2	1,1	0,74	1 x 3g	30,0	30,0

T1c- brief description of **preceding crops** production in **open field**

preceding crop	Growing area	Yield in kg/1m^2 or grams of 1 piece	Total yield
1. Pea	1,6 x 27m=43,2m^2	1kg/m^2	0,6 kg (1m^2)
2. Radish	1,6 x 27m=43,2m^2	45g/piece	3,94 kg (1m^2)
3. Kohlrabi	1,6 x 27m=43,2m^2	180g/piece	2,9 kg (1m^2)
4. Spinach	1,6 x 27m=43,2m^2	2 kg/ m^2	2 kg(1m^2)
5. Lettuce	1,6 x 27m=43,2m^2	250g/piece	4 kg(1m^2)

T2a- brief description of **the main crops** production in **open field**

the main crops	variety	sowing date	harvest date	growing area (m^2)	row/plant distance (cm)	rows x seeds
1.cabbage	Orion	till 10.VII	from 15.X	1,6 x 27m=43,2	50 x 40	3 x 70
2.pepper	Anita	till 31.V.	from 15.IX	1,6 x 27m=43,2	50 x 20	3 x 135
3.tomato	NS Jabučar	till 31.V.	from 15.IX	1,6 x 27m=43,2	50 x 40	3 x 70
4.red beet	Bikor	till 01.VII	from 20.X	1,6 x 27m=43,2	35 x 10	4 x 270
5.kale	Gvozdena glava	till 15.VII	from 15.XI	1,6 x 27m=43,2	50 x 40	3 x 70

T2b- brief description of **the main crops** production in **open field**

the main crops	number of plants/m^2	AV (g)	grams of seeds for sowing	small packs of seeds	retail price of 1 pack (din)	total price for packs (din)
1.cabbage	210 /43,2m^2	3,5	0,74	1 x 3g	30,0	30,0
2.pepper	405 /43,2m^2	6,5	2,63	2 x 2g	30,0	60,0
3.tomato	210 /43,2m^2	2,5	0,53	1 x 3g	30,0	30,0
4.red beet	1080 /43,2m^2	13,5	14,58	4 x 4g	30,0	120,0
5.kale	210 /43,2m^2	3	0,63	1 x 3g	30,0	30,0

T2c- brief description of **the main crops** production in **open field**

the main crops	growing area	yield in kg/1m^2 or grams of 1 piece	total yield
1.cabbage	1,6 x 27m=43,2m^2	2,5 kg/piece	12,5 kg (1m^2)
2.pepper	1,6 x 27m=43,2m^2	150g/ piece	5 kg (1m^2)
3.tomato	1,6 x 27m=43,2m^2	120g/ piece	4 kg (1m^2)
4.red beet	1,6 x 27m=43,2m^2	130g/ piece	3,25 kg (1m^2)
5.kale	1,6 x 27m=43,2m^2	1,5 kg/ piece	7,5 kg (1m^2)

T3a- brief description of **subsequent crops** production in **open field**

subsequent crop	variety	sowing date	harvest date	growing area	row/plant distance (cm)	rows x seeds
1. Onion	Majski	till 15.X	till 15.V	2,0 x 27m=54m^2	30 x 5	6 x 540
2. Garlic	Bosut	till 15.X	till 15.VI	2,0 x 27m=54m^2	20 x 10	10 x 270
3. Lettuce	Nansen	till 20.X	till 15.V	2,0 x 27m=54m^2	30 x 20	6 x 135
4. Spinach	Matador	till 15.IX	till 15.V	2,0 x 27m=54m^2	30 x 10	6 x 270

T3b- brief description of **subsequent crops** production in **open field**

subsequent crop	number of plants/m^2	AV (g)	grams of seeds for sowing	small packs of seeds	retail price of 1 pack (din)	total price for packs (din)
1. Onion	3240 /54m^2	4	13,00	5 x 3g	30,0	150,0
2. Garlic	2700 /54m^2	5 kg	13,5 kg	3x5 kg	540	1620,0
3. Lettuce	810 /54m^2	1,1	0,89	1 x 3g	30,0	30,0
4. Spinach	1620 /54m^2	7,5	12,15	3 x 4g	30,0	90,0

T3c- brief description of **subsequent crops** production in **open field**

subsequent crop	growing area	yield in kg/1m^2 or grams of 1 piece	total yield
1. Onion	2,0 x 27m=54m^2	120g/piece	7,2 kg (1m^2)
2. Garlic	2,0 x 27m=54m^2	60g/piece	3 kg (1m^2)
3. Lettuce	2,0 x 27m=54m^2	2 kg/ m^2	2 kg (1m^2)
4. Spinach	2,0 x 27m=54m^2	250g/piece	4 kg(1m^2)

Production plan for **Greenhouse production** (8 x 30 m)

A = 1,6 x 27 m	**8 x 3 m Production of seedlings area**
B = 1,6 x 27 m	
C = 1,6 x 27 m	
D = 1,6 x 27 m	
E = 1,6 x 27 m	

preceding crop		the main crops		subsequent crop	
1. Sypinach	A	1. Tomato	A	1. Lettuce	A
2. Pea	B	2. Pepper	B	2. Onion	B
3. Radish	C	3. Cucumber	C	3. Spinach	C
4. Lettuce	D			4. Red beet	D
5. Kohlrabi	E			5. Spinach beet	E

T4a- brief description of **preceding crops** production in **greenhouse**

preceding crop	variety	sowing date	harvest date	growing area	row/plant distance (cm)	rows x seeds
1. Spinach	Matador	till 01.III.	till 01.V	1,6 x 27m=43,2m^2	30 x 10	5 x 270
2. Pea	Tamiš	till 01.II.	till 10.VI	1,6 x 27m=43,2m^2	20 x 5	7 x 540
3. Radish	Verica	till 01.III.	till 01.V	1,6 x 27m=43,2m^2	20 x 5	7 x 540
4. Lettuce	Vuka	till 01.III.	till 01.V	1,6 x 27m=43,2m^2	30 x 20	5 x 135
5. Kohlrabi	B.Bela	till 01.III.	till 01.V	1,6 x 27m=43,2m^2	30 x 20	5 x 135

T4b- brief description of **preceding crops** production in **greenhouse**

preceding crop	number of plants/m^2	AV (g)	grams of seeds for sowing	small packs of seeds	retail price of 1 pack (din)	total price for packs (din)
1. Spinach	1350 /43,2m^2	7,5	10,13	3 x 4g	30,0	90,0
2. Pea	3780 /43,2m^2	300	1134	3x0,5kg	135,0	405,0
3. Radish	3780 /43,2m^2	3,5	13,23	5 x 3g	30,0	150,0
4. Lettuce	675 /43,2m^2	1,1	0,74	1 x 3g	30,0	30,0
5. Kohlrabi	675 /43,2m^2	2,5	1,69	1 x 3g	30,0	30,0

T4c- brief description of **preceding crops** production in **greenhouse**

preceding crop	growing area	yield in kg/1m^2 or grams of 1 piece	total yield
1. Spinach	1,6 x 27m=43,2m^2	250g/piece	4 kg(1m^2)
2. Pea	1,6 x 27m=43,2m^2	1kg/m^2	0,6 kg (1m^2)
3. Radish	1,6 x 27m=43,2m^2	45g/piece	3,94 kg (1m^2)
4. Lettuce	1,6 x 27m=43,2m^2	2 kg/ m^2	2 kg (1m^2)
5. Kohlrabi	1,6 x 27m=43,2m^2	180g/piece	2,9 kg (1m^2)

T5a- brief description of **the main crops** production in **greenhouse**

the main crops	variety	sowing date	harvest date	growing area	row/plant distance (cm)	rows x seeds
1. Tomato	NS.Jabučar	till 15.V	from 15.IX	3,0 x 27m=81 m^2	50 x 40	3 x 70
2. Pepper	Vranjska	till 15.V	from 15.IX	3,0 x 27m=81 m^2	50 x 20	3 x 135
3. Cucumber	Tajfun	till 15.V	from 15.VIII	2,0 x 27 m=54 m^2	60 x 30	3 x 90

T5b- brief description of **the main crops** production in **greenhouse**

the main crops	number of plants/m^2	AV (g)	grams of seeds for sowing	small packs of seeds	retail price of 1 pack (din)	total price for packs (din)
1. Tomato	210 /81 m^2	2,5	0,53	1 x 3g	30,0	30,0
2. Pepper	405 /81 m^2	6,5	2,63	2 x 2g	30,0	60,0
3. Cucumber	270/54 m^2	25	6,75	3 x 3g	30,0	90,0

T5c- brief description of **the main crops** production in **greenhouse**

the main crops	growing area	yield in kg/1m^2 or grams of 1 piece	total yield
1. Tomato	3,0 x 27m=81 m^2	120 g/piece	4 kg (1m^2)
2. Pepper	3,0 x 27m=81 m^2	150 g/piece	5 kg (1m^2)
3. Cucumber	2,0 x 27 m=54 m^2	100 g/piece	15 kg (1m^2)

T6a- brief description of **subsequent crops** production in **greenhouse**

subsequent crop	variety	sowing date	harvest date	growing area	row/plant distance (cm)	rows x seeds
1. Lettuce	Nansen	till 20.X	till 01.V	1,6 x 27m=43,2m^2	30 x 20	5 x 135
2. Onion	Majski	till 20.X	till 10.V	1,6 x 27m=43,2m^2	20 x 5	7 x 540
3. Spinach	Matador	till 20.X	till 01.V	1,6 x 27m=43,2m^2	30 x 10	5 x 270
4. Red beet	Bikor	till 20.X	till 01.V	1,6 x 27m=43,2m^2	35 x 10	4 x 270
5. Spinach beet	Srebrnolisna	till 20.X	till 01.V	1,6 x 27m=43,2m^2	30 x 20	5 x 135

T6b- brief description of **subsequent crops** production in **greenhouse**

subsequent crop	number of plants/m^2	AV (g)	grams of seeds for sowing	small packs of seeds	retail price of 1 pack (din)	total price for packs (din)
1. Lettuce	675 /43,2m^2	1,1	0,74	1 x 3g	30,0	30,0
2. Onion	3780 /43,2m^2	4	15,1	4 x 4g	30,0	120,0
3. Spinach	1350 /43,2m^2	7,5	10,13	3 x 4g	30,0	90,0
4. Red beet	1080 /43,2m^2	13,5	14,58	4 x 4g	30,0	120,0
5. Spinach beet	675 /43,2m^2	15	10,13	3 x 4g	30,0	90,0

T6c- brief description of **subsequent crops** production in **greenhouse**

subsequent crop	growing area	yield in kg/1m^2 or grams of 1 piece	total yield
1. Lettuce	1,6 x 27m=43,2m^2	2 kg/ m^2	2 kg (1m^2)
2. Onion	1,6 x 27m=43,2m^2	2,5 kg/ m^2	2,5 kg (1m^2)
3. Spinach	1,6 x 27m=43,2m^2	250 g/piece	4 kg (1m^2)
4. Red beet	1,6 x 27m=43,2m^2	130 g/piece	3,25 kg (1m^2)
5. Spinach beet	1,6 x 27m=43,2m^2	300 g/piece	5 kg (1m^2)

Possible model of Vegetables production in Hungary project area

Production plan **for Open field production** (300 m^2)

1.session	**2.session**
Pea	Lettuce
String bean	Savoy cabbage
	Cauliflower
Cabbage lettuce	Tomato
Kohlrabi	Pepper
Savory cabbage	
Radish	
Celery	
Carrots	
Parsley	

1.session: data of cultural in open field

Plant	Area	Planting space	Sowing or set quality	Time of propagation	Time of harvest	Average of yield
Pea	78 m^2	30x3 cm	20 g/m^2	III.11	V.27	2-3 kg/m^2
String bean	58 m^2	30x7 cm	14 g/m^2	IV.18	VI.17	1,5-2,5 kg/m^2
Lettuce	58 m^2	30x30 cm	11 piece /m^2	IV.08	V.20	9 piece /m^2
Kohlrabi	39 m^2	30x30 cm	11 piece /m^2	IV.08	V.20	9 piece /m^2
Savoy cabbage	19 m^2	30x30 cm	11 piece /m^2	IV.08	V.20	2-3 kg/m^2
Radish	19 m^2	30x5 cm	3 g/m^2	III.25	IV.30	15-20piec./m^2
Celery	10 m^2	30x40 cm	8 piece /m^2	V.05	IX.20	3-4 kg/m^2
Carrots	10 m^2	25x3 cm	0,2 g/m^2	IV.10	VIII.20	30-40 kg/m^2
Parsley	10 m^2	25x3 cm	0,4 g/m^2	IV.10	VIII.20	10-20 kg/m^2

2.session data of cultural in open field

Plant	Area	Planting space	Sowing or set quality	Time of propagation	Time of harvest	Average of yield
Lettuce	78 m^2	40x40cm	6 piece /m^2	VIII.05	X.20	4-5 kg/m^2
Savoy cabbage	39 m^2	40x40 cm	6 piece /m^2	VIII.05	X.01	3-4 kg/m^2
Cauliflower	19 m^2	40x40cm	6 piece /m^2	VIII.05	X.01	1,5-2 kg/m^2
Tomato	58 m^2	60x30 cm	5 piece /m^2	VI.05	VII.25	5-6 kg/m^2
Pepper	77 m^2	60x30 cm	5 piece /m^2	VI.05	VII.25	2-3 kg/m^2

Production plan **for Greenhouse production** (200 m^2)

1. session	2.session
Carrots	
Parsley	
Lettuce	Pepper
Kohlrabi	
Radish	Tomato

<u>1.session</u> data of cultural in <u>greenhouse</u>

Plant	Area	Planting space	Sowing or set quality	Time of propagation	Time of harvest	Average of yield
Carrot	21 m^2	30x3 cm	0,2 g/m^2	III.04	VI.25	20 bunch /m^2
Parsley	21 m^2	30x3 cm	0,4 g/m^2	III.04	vi.25	15 bunch /m^2
Lettuce	60 m^2	30x30 cm	11 piece /m^2	II.28	IV.30	8 piece /m^2
Kohlrabi	52 m^2	30x30 cm	11 piece /m^2	II.28	IV.30	8 piece /m^2
Radish	45 m^2	30x5 cm	3 g/m^2	II.28	IV.30	20 bunch/m^2

<u>2. session</u> data of cultural in <u>greenhouse</u>

Plant	Area	Planting space	Sowing or set quality	Time of propagation	Time of harvest	Average of yield
Pepper	110 m^2	80+50x30 cm	5 piece/m^2	V.23	VII.15-from	6-8 kg/m^2
Tomato	48 m^2	80+50x40 cm	4 piece/m^2	V.23	VII.25-from	10-12 kg/m^2

Agroeconomical study of project

The volume and value of labour in the evaluation of the production play an important role in the *productivity* ratio calculation. In the operating calculation the time requirement of operations have been defined by standards. We adapted the operational standards from production and from our experiences. If the operation was not available (eg. pulling up plastic foil), working day survey-method was used. If we divide quantitative values of the operation with the standard we will get time requirement. The cost of labour was calculated based on the minimum wage per hour. Of course, fertilization and operation with chemicals were associated with higher hourly wages.

For accurate calculations we had to determine the area and number of plants both in case the seeds were sown in the field or were in seedling transplants. Time requirements of treated areas and also material used associated with the different modes of propagation varied. There are significant differences between the field and forcing technologies as for construction-related costs. The establishment of forcing equipment is an important part of the model, as it has significant labour needs and high costs. This expenditure cannot be accounted in one year, so this cost is built in yearly costs of production. Therefore, the cost of the plastic foil is accounted in two years and the frame cost and the construction wages are accounted in 10 years.

The cost of materials always includes VAT, as the farmers will not be in the VAT taxing system. In the calculation a number of material factors have been taken into account, which can be part of the cultivation (eg. tools, wheelbarrows, etc), but they are used every day by private individuals. In this calculation the cost of seedling cultivation is built in at the price level farmers purchase seedlings. Thus this cost does not distort the calculation.

The cost per square meter is markedly different in technological variations even though the investment was divided over several years. However, the forcing technology drives higher revenues due to the earliness which compensates for the additional costs. At the end of the production technology sales revenue can be determined from the operational costs (material, labour, etc).

The expense and cost calculations were based on the operation. The calculation includes the operating natural inputs (labour, material used), and are expressed in monetary value: the cost (wages, cost of materials). Costing does not count with common charge, since the production process is not yet completed. In this calculation, the cost of labour is recognized because it arouses to the applicant (the Kecskemét College). In the model, the farmer's wages occur after the sale as gross income.

Working Methods and Data Sources

Operation calculations

This is the base element of the specific crop cultivation technology. The work operation is an independent part of the workflow, which the workforce performs in the same workplace with the same job working tool. The norm of operation is required for the calculation. More precisely it shows how an average capability labour force can perform his job over a period of time without health-damage. Based on it time requirement of labour can be calculated. It is based on a full-time operation needs to calculate: quantity of work, and the norm of the quotient to be performed. The norm can be calculated by empirical data in the absence of this working day procedure can be formed.

When machine operation is performed, we can also calculate the standard time of work. The operation usually includes the use of materials as well. That is, this is the working time requirement that is necessary for the accomplishment of the particular work. This time does not only contain the appropriate amount of working time, but it raises the quality of the work requirement. The calculation of this time is essential in the study, as it shows how much time entrepreneur spends in order to achieve his tasks.

Labour, machine work and material are naturalistic uses, which values' are expressed in operational costs. In the technology, what we use, labour and machine labour costs are calculated. The calculations of the individual transactions are put in chronological order allowing receiving production technology and production costs of the associated plant.

Cost calculations

The labour cost of operation is determined as follows: the amount of labour per unit and the value of wage give the unit cost of machine work and the per unit cost. The material cost can be calculated by the multiplication of material and their price. Some costs are calculated combined in 300 m^2field and under 200 m^2greenhouse: soil fumigation, fertilization and tillage. Most of the costs are calculated based on the work operations of vegetables: eg. sowing, planting, picking.

The model was tested in two ways. In one case, a minimum wage salary was calculated, in the other case, this cost was omitted. The farmer does not pay a salary for himself, but the so-called total income includes this.

The costs of the high value equipments are taken into account calculated proportionally.

The calculation of income

Income is the multiplication of quantity and per unit price. Revenue should not only be considered only by plants, but also by variety and quality classification. In the model only the income of the particular crop is summarized at the time of sale. In the Kecskemét model the market prices were followed up nationwide inthe ripening period by which a typical average price was formed. This was multiplied by the quantity sold at that time. By this we got approximately punctual revenue in the vegetable culture examined.

The calculation of revenue

Revenue is the difference between income and costs. We can count net and total income. In net income labour cost can be calculated as a cost. Total (brutto) revenue does not include labor cost as a small holder does not calculate his labor costs therefore it is closer to life situation. So labor cost is included in the revenue.

The model raises the question of cost efficiency. Possibly, higher income is realized under covered crop but with higher costs.

Efficacy indexes

1. Thrift.

It indicates whether the production of a good is cheap or expensive. It indicates whether how much is the yield that can be produced by a production cost unit (e.g. 100 HUF or Euro).

Calculation:

$$\textbf{Thrift} = \frac{\text{quantity of the product}}{\text{total production cost}} \text{ Ft (Euro)}$$

In the next calculation we will get the first cost (overhead).

$$\textbf{Thrift} = \frac{\text{total production cost}}{\text{quantity of the product}} \text{ Ft, Euro / 1 kg, 1 db, 1 unit}$$

This index shows the production cost of a product unit.

2. Productivity

This index concerns only living labour. It shows that what quantity or value of product is produced in a unit of time (e.g. man-hour).

Calculation:

$$\textbf{Productivity} = \frac{\text{quantity or value of total product}}{\text{workday or man} - \text{hour or wage}}$$

This index can be used reversely! In this case we express work-time or value of living labour per product unit of product.

Calculation:

$$\textbf{Productivity} = \frac{\text{workday, working hour, wage}}{\text{total amount of product or value of product}}$$

3. Efficacy

This index concerns the efficacy of materials. It shows that what amount of product is produced by a unit of material. This can be expressed in quantity or value.

Calculation:

$$\textbf{Efficacy} = \frac{\text{quantity or value of product}}{\text{quantity or value of means used}}$$

$$\textbf{Efficacy} = \frac{\text{quantity or value of means used}}{\text{quantity or value of product}}$$

4. Profitability

We compare the total revenue to total cost by this index.

Net revenue = income–total cost

In a classic case it expresses how much of cost is the cost is used for obtain a unit of revenue.

Calculation:

$$\textbf{Profitability} = \frac{\text{revenue}}{\text{total cost}}$$

$$\textbf{Profitability} = \frac{\text{revenue}}{\text{total cost}} \text{ x } 100$$

We get the most practical economical index when the revenue is divided between the unit of area and product:

$$\textbf{Profitability} = \frac{\text{revenue}}{\text{area}} \text{ Ft, Euro / 1 m2, 1 hectare}$$

$$\textbf{Profitability} = \frac{\text{revenue}}{\text{area}} \text{ Ft, Euro / 1 kg}$$

From the above two data we can see how big area and product quantity is needed to get a profitable enterprise.

Revenue per working time shows how much revenue can be achieved in a unit of working time.

Summary of Overall Results

Summary of Overall Results in Serbian project area

Table 1. Summary of Results by Particular Crops

Crop	Total costs (€)	Profit (€)	Profit/m² (€/m2)	Cost price (€/kg)	Profit/kg (€/kg)
Open field					
preceding crop, peas	82,09	-3,20	-0,07	3,17	-0,12
preceding crop, small radish	79,87	31,13	0,72	0,47	0,18
preceding crop, kohlrabi	78,83	139,05	3,22	0,63	1,11
preceding crop, spinach	79,35	-4,22	-0,10	0,92	-0,05
preceding crop, lettuce	78,83	221,69	5,13	0,46	1,28
main crop, cabbage	78,83	5,69	0,13	0,15	0,01
main crop, pepper	79,09	43,00	1,00	0,37	0,20
main crop, tomato	78,83	18,84	0,44	0,46	0,11
main crop, red beet	79,61	-42,99	-1,00	0,57	-0,31
main crop, kale	78,83	62,04	1,44	0,24	0,19
succeeding crop, silver skin onion	99,52	52,62	0,97	0,26	0,14
succeeding crop, garlic	112,30	239,88	4,44	0,69	1,48
succeeding crop, lettuce	98,47	-23,34	-0,43	0,91	-0,22
succeeding crop, spinach	98,99	126,40	2,34	0,46	0,59
Greenhouse					
preceding crop, spinach	110,75	69,56	1,61	0,64	0,40
preceding crop, peas	113,49	-34,60	-0,80	4,38	-1,33
preceding crop, small radish	111,27	66,34	1,54	0,65	0,39
preceding crop, lettuce	110.23	40.03	0.93	1.28	0.46
preceding crop, kohlrabi	110.23	129.44	3.00	0.88	1.03
main crop, tomato	206.45	18.94	0.23	0.64	0.06
main crop, pepper	206.71	75.03	0.93	0.51	0.19
main crop, cucumber	138.24	495.67	9.18	0.17	0.61
succeeding crop, lettuce	110.23	70.08	1.62	1.28	0.81
succeeding crop, silver skin onion	111.01	11.08	0.26	1.03	0.10
succeeding crop, spinach	110.75	39.51	0.91	0.64	0.23
succeeding crop, red beet	111.01	23.28	0.54	0.79	0.17
succeeding crop, chard	110.75	77.08	1.78	0.51	0.36
TOTAL	2,864.57	1,948.02			

Table 2. Income Statement - Open Field

№	Description	Value (€)
1	**Production value**	2,070.03
2	**Costs**	
3	Seed material	24.91
4	Depreciation	88.00
5	Fertilization costs	28.30
6	Energy costs	16.09
7	Wages	1,127.01
8	Water	100.17
9	Total	1,384.49
10	**Profit**	685.54
11	**Income**	1,812.55

Table 3. Income Statement - Greenhouse

№	Description	Value (€)
1	**Production value**	2,742.56
2	**Costs**	
3	Seed material	11.61
4	Depreciation	628.00
5	Fertilization costs	28.30
6	Energy costs	16.09
7	Wages	1,127.01
8	Water	66.78
9	Total	1,877.79
10	**Profit**	864.77
11	**Income**	1,991.78

Table 4. Income Statement - Total Production

№	Description	Value (€)
1	**Production value**	4,812.59
2	**Costs**	
3	Seed material	36.52
4	Depreciation	716.00
5	Fertilization costs	56.61
6	Energy costs	32.17
7	Wages	2,254.02
8	Water	166.96
9	Total	3,262.28
10	**Profit**	1,550.31
11	**Income**	3,804.33

Summary of Overall Results in Hungary project area

Table 1. Revenues of field vegetable growing (in €)

Fiels lettuce	m2			Crop quantity	Final quantity	Unit	Average price	Unit	Revenues
	58,5	11	piece/m2	643,5	515	piece	0,50	€/piece	**257,40**

Kohlrabi									
	39	11	piece/m2	429	343	piece	0,43	€/piece	**146,43**

Radish:									
	19,52	4	bunch/m2	78,08	70	bunch	3,00	€/bunch	**210,82**

Green pea:									
22. week				39	35,1	kg	1,60	€/kg	56,16
24. week				39	35,1	kg	1,40	€/kg	49,14
26. week				39	35,1	kg	1,47	€/kg	51,48
28. week				39	35,1	kg	1,60	€/kg	56,16
30. week				39	35,1	kg	2,00	€/kg	70,20
Total:	78	2,5	kg/m2	195	175,5	kg			**283,14**

Green bean:									
25. week				19,5	17,55	kg	2,40	€/kg	42,12
27. week				19,5	17,55	kg	1,30	€/kg	22,82
29. week				19,5	17,55	kg	1,33	€/kg	23,40
31. week				19,5	17,55	kg	1,50	€/kg	26,33
33. week				19,5	17,55	kg	1,53	€/kg	26,91
35.week				19,5	17,55	kg	1,30	€/kg	22,82
Total:	58,5	2	kg/m2	117	105,3	kg			**164,39**

Carrot									
30. week		5		48,75	44	kg	0,57	€/kg	24,86
31. week		5		48,75	44	kg	0,52	€/kg	22,67
35. week		5		48,75	44	kg	0,43	€/kg	19,01
39. week		15		146,25	132	kg	0,37	€/kg	48,26
Total:	9,75	30	kg/m2	292,5	263,25	kg			**114,81**

Parsley									
30. week		2		19,5	18	kg	1,73	€/kg	30,42
31. week		2		19,5	18	kg	1,60	€/kg	28,08
35. week		2		19,5	18	kg	1,50	€/kg	26,33
39. week		10		97,5	88	kg	1,40	€/kg	122,85
Total:	9,75	16	kg/m2	156	140,4	kg			**207,68**

Tomato after cole and kohlrabi									
30. week		1		58	52	kg	1,00	€/kg	52,20
31. week		1		58	52	kg	0,97	€/kg	50,46
32. week		3		174	157	kg	0,93	€/kg	146,16
33. week		1,5		87	78	kg	0,88	€/kg	69,17
Total:	58	6,5	kg/m2	377	339,3	kg			**317,99**

Pepper									
32. week		1		78	70	kg	1,00	€/kg	70,20
33. week		1,5		117	105	kg	0,97	€/kg	101,79
34. week		1,5		117	105	kg	0,93	€/kg	98,28
36. week		0,5		39	35	kg	0,88	€/kg	31,01
Total:	78	3	kg/m2	234	210,6	kg			**301,28**

Early cole									
24. week		1,5	kg/m2	29,25	29	kg	0,93	€/kg	27,30
		2	kg/m2	39	39	kg	0,83	€/kg	32,50
Total:	19,5	3,5		68,25	61	kg			**59,80**

Celery (40. week)	19,5	6,2	kg/m2	120,9	109	kg	0,93	€/kg	**101,56**

Cabbage after green pea									
(second)									
40. week		2,5	kg/m2	195	176	kg	0,63	€/kg	111,15
41. week		2,5	kg/m2	195	176	kg	0,58	€/kg	102,38
Total:	78	5	kg/m2	390	351	kg			**213,53**

Cole after green bean									
(second)									
39. week		2	kg/m2	78	70	kg	1,18	€/kg	83,07
40. week		2	kg/m2	78	70	kg	1,07	€/kg	74,88
Total:	39	4	kg/m2	156	140	kg			**157,95**

Cauliflower after grean bean									
(second)									
38. week		1	kg/m2	19	17	kg	1,07	€/kg	18,24
39. week		1	kg/m2	19	17	kg	1,00	€/kg	17,10
Total:	19	2	kg/m2	38	34	kg			**35,34**

Fiels vegetable Total	**2572,09**
	8,57

REVENUES OF FORCED VEGETABLES

Forced lettuce:				Crop quantity	Final quantity	Unit	Average price	Unit	Revenue
18. week	60,6	11	piece/m2	666,6	533	piece	0,50	Ft/piece	**266,64**

Kohlraby:									
18, week	51,7	11	piece/m2	568,7	455	piece	0,41	Ft/piece	**185,02**

Radish:									
18. week	45,2	4	bunch/m2	181	163	bunch	0,33	Ft/bunch	**54,24**

Carrot:									
21. week	21,4	20	bunch/m2	428	385	bunch	0,77	Ft/bunch	**295,32**

Parsley:	21,4	20	bunch/m2	428	385	bunch	0,88	Ft/kg	**340,26**
21. week									

Tomato:									
29. week		1	kg/m2	58	52	kg	1,20	€/kg	62,64
30. week		1,5	kg/m2	87	78	kg	0,92	€/kg	71,78
31. week		2	kg/m2	116	104	kg	0,70	€/kg	73,08
32. week		1,5	kg/m2	87	78	kg	0,73	€/kg	56,90
33. week		3	kg/m2	174	157	kg	0,76	€/kg	118,49
34. week		1,5	kg/m2	87	78	kg	0,84	€/kg	66,03
36. week		1	kg/m2	58	52	kg	0,77	€/kg	40,19
Total:	58	11,5	kg/m2	667	600,3	kg			**489,11**

White pepper:									
28. week		1	kg/m2	29	26	kg	1,40	€/kg	36,54
29. week		1	kg/m2	29	26	kg	1,37	€/kg	35,67
30. week		1,5	kg/m2	43,5	39	kg	1,33	€/kg	52,20
31. week		1,5	kg/m2	43,5	39	kg	1,17	€/kg	45,68
32. week		1	kg/m2	29	26	kg	1,00	€/kg	26,10
33. week		1,5	kg/m2	43,5	39	kg	0,97	€/kg	37,85
34. week		0,5	kg/m2	14,5	13	kg	0,93	€/kg	12,18
35. week		0,5	kg/m2	14,5	13	kg	0,88	€/kg	11,53
Total:	29	8,5	kg/m2	663	596,7	kg			**257,74**

Kapia pepper									
31. week		1,5	kg/m2	43,5	39	kg	1,59	€/kg	62,38
32. week		1,8	kg/m2	52,2	47	kg	1,51	€/kg	70,94
33. week		2	kg/m2	58	52	kg	1,12	€/kg	58,46
34. week		1	kg/m2	29	26	kg	1,14	€/kg	29,75
35. week		0,5	kg/m2	14,5	13	kg	1,07	€/kg	14,01
Total:	29	6,8	kg/m2	530,4	477,36	kg			**235,54**

Pritamin pepper									
32. week		1	kg/m2	29	26	kg	1,64	€/kg	42,72
33. week		1,5	kg/m2	43,5	39	kg	1,58	€/kg	61,99
34. week		2	kg/m2	58	52	kg	1,35	€/kg	70,47
35. week		1	kg/m2	29	26	kg	1,25	€/kg	32,63
Total:	29	5,5	kg/m2	429	386,1	kg			**207,80**

Forced vegetable Total:	**2331,67**
	11,66

Usability of the results

If calculations are put in Excel or other spreadsheet program we can optimize production. In the program we can change basic data (e.g. composition of species) by leaving area unchanged and we will have cost composition, income at once.

Entrepreneur will know how big area is needed for him to make his family living. This calculation also shows the cost of product that he consumes, so the calculation also shows self-sufficiency.

The model doesn't examine several problems but this not the goal. It doesn't examine liquidity that is how monthly revenue affects the company's liquidity.

Calculations can be made easily in the model but we need many data to see clearly. Entrepreneur does not possess many data e.g. norm, exact use of material. If this model provides cross-technologies for the entrepreneur and he is willing to fill the given cell he will get such information about his enterprise which makes him able to plan his long-run business.

Conclusion of agroeconomical study

The calculation of the financial results of vegetable production based on a common established methodology was carried out in the border areas of the Republic of Serbia, as well as in the case studies presented in the border areas of the Republic of Hungary. The calculation in the case of production in the border areas of the Republic of Hungary was based on the production on small land areas where cultivation of vegetable crops in open fields used area of 300 m^2, and greenhouse production 200m^2.

During cultivation in the open field, according to the study performed in border areas of the Republic of Hungary, the total production value was € 2,353.23, while total costs were € 1,802.50; if we compare values per one m^2 approximate values are obtained. The total value of production amounted to € 7.84/m^2 in the case of calculation completed during studies in the cross-border territory of the Republic of Hungary, or € 8.63/m^2 in the case of calculation completed during studies in the cross-border territory of the Republic of Serbia. On the other hand, cost calculation shows slightly larger deviations, so that total costs in the case of calculations completed during studies on cross-border territory of the Republic of Hungary were € 6.01/m^2, or € 7.76/m^2 in the case of calculations completed during studies on cross-border areas of the Republic of Serbia. Calculations completed on cross-border areas of the Republic of Hungary showed actual profit of € 1.84/m^2, or € 2.85/m^2 in the calculations completed on the cross-border areas of the Republic of Serbia. These deviations originate from differences in crop structure and market prices, and cannot be interpreted as significant.

According to the tests performed in cross-border areas of the Republic of Hungary, the overall production value of cultivation in greenhouse was € 2,300.99, while total costs were € 1,658.06; comparing values per one m^2 approximate values are obtained. The total production value amounts to € 11.50/m^2 in the case of calculation completed in the cross-border areas of the Republic of Hungary, i.e. € 11.43/m^2 in the case of calculation completed on the cross-border areas of the Republic of Serbia. On the other hand, cost calculation also shows a larger variance, so that total cost in the case of calculation completed on the cross-border areas of the Republic of Hungary was € 8.40/m^2, or € 7.82/m^2 in the case of calculation completed on cross-border areas of the Republic of Serbia.

Actual profit amounted to € 5.53/m^{2}for the cross-border areas of the Republic of Hungary, or € 3.60/m^{2}for the cross-border areas of the Republic of Serbia. These deviations also originate from differences in crop structure and market prices, and cannot be interpreted as significant.

Analysis of financial indicators confirms previously established good economic results. During this, it should be noted that, regardless of higher investments, better performance was achieved under greenhouse production. On the other hand, the total observed surface or approximately 500 m^2 for production in the greenhouse and open field is able to provide part-time employment, according to average wages in the Republic of Serbia economy and/or minimum wages for the territory of Hungary, which represents almost identical size.

Summary

Nowadays changes in the social system and the ownership structure of the economy make unemployment outstanding problem of our society. Since it is obvious that the answer to the problem of unemployment is among the rural regions, it is necessary to find the specific form of rural development. The inclusion of the widest possible range of activities in development plan preparations in rural areas is of particular importance to the new concept of rural development in the region. Although rural areas do not represent a driving economic force, they are of great importance due to the following: 1) they represent the existential basis for a significant part of population, especially for the part of population that does not have the conditions to be included in the formal economy, 2) rural areas are the basis of population nutrition, 3) they are basis for a wide range of environmental resources such as water, air, biodiversity, bioenergy and tourist attractions, and 4) they are of particular importance for the utilization of bioenergy resources. Although rural resources do not constitute a safety factor in terms of meeting the basic needs on a sustainable basis, they are a very important part of rural diversified household budget. This is particularly important if we know that an unemployment rate in rural areas is high (amounts to 21%) and clearly indicates the lack of employment opportunities. It is important to note the fact that youth have especially poor position in the labor market in rural areas, since unemployment rate of youth (up to 25 years old) is three times higher than the average. This situation can be changed only by intense investments in development of rural regions. Investments in rural regions should not be considered only in their literal form, i.e. production facilities investments. In fact, these particular investment activities are typically preceded by investing in the development of technologies that are suitable for use in small capacity facilities, which are typically built within the rural regions. This kind of consideration should be placed opposite the global trends related to steady growth of production, consumption and markets. Accordingly, it is necessary to find new ways to increase sustainably production and employment. The development of other technologies, where technology involved in getting healthy food and renewable energy has a dominant share, is of great importance.

The minimum wage in Serbia at this time is very low; specifically, according to Law, employee in Serbia must be paid at least 176 Euros per month. On the other hand, the minimum monthly wage in Hungary is €355, which is twofold. Cost calculation of labor in vegetable production is carried out in accordance with a given minimum wage, and labor cost for simple jobs is €1.92 per hour, or €2.4 per hour of labor for jobs that require qualification. The wages of unskilled persons are in line with this. Since the minimum wage in Serbia is very low and, essentially, it represents an obligation for companies, it is not possible to use it in calculation within the project, so an average net wage in the economy was used, which amounts to €2.61/h.

Regardless of that, when it comes to labor market, it should be noted that this is very specific market, which modifies the actions of trade laws. That is because each person is the "owner" of its workforce and the price of labor is determined by the minimum living costs of workers and often their families. All this causes small price elasticity and low labor mobility. If we look at jobs within agriculture, it is possible to estimate the effect of the traits as intense. On the other hand, there is a strong interest of the state and its interventionism. Difficulties in cost estimation of wages in agriculture, i.e. labor costs, are resulting from large variations in required expertise, professional profile. The labor market is divided into primary and secondary. Additionally, secondary level market is a market of unskilled labor. The final amount of the wages or the cost of labor expressed in money largely defines the relationship between supply and demand of labor. Such market determination of the labor price was corrected by determining the lowest amount that can be paid by the employer.

If we analyze the differences in prices of finished products in monitored regions, it is not possible to establish the regularity since the prices of vegetables have a very strong seasonality and largely fluctuate annually.

If we look at consumption in both countries, it is possible to conclude a relatively low consumption of vegetables per capita, which is particularly evident in the region of Vojvodina. Consumption of vegetables annually in Serbia is 124 kilograms, which lags behind European countries, while Hungary has a higher consumption of about 180 kg. Average for the world is 160.3 kg, the European Union 158.4 kg and for the whole Europe 172.3 kg. The highest consumption recorded was in the states of Eastern Europe, with 200.55 kg per capita annually. Nutrition habits in both studied areas are similar, since it is a region with relatively similar structure of population.

The project was implemented in the border area between Serbia and Hungary, which belongs to the Pannonian plain. Most of the edaphic and climatic factors are therefore the same.

Observing the necessary soil (edaphic) conditions, i.e. 1) the slope (inclination) of the field, 2) exposure of the field, 3) the level of underground waters, 4) soil weediness and 5) soil type, or physical, chemical and biological soil properties, and mechanical composition of soil, soil structure and soil reaction, they can be assessed as favorable. On the other hand, climatic conditions largely depend on the requirements of vegetables towards heat. Accordingly, vegetable crops are classified as 1) thermophilic, 2) moderate requirements towards temperature, and 3) poor requirements towards temperature. The combination of open field and greenhouse production can utilize favorable climatic conditions and minimize negative effects on the best possible way.

According to its properties, soil of cross border areas of Serbia and observed region is among the best land in Europe and the world. It is black soil or chernozem. This zonal soil type is developed on loess substrate. It occurs under the influence of continental and steppe climate. During the fall and harsh winters, decomposition of organic matter is reduced to a minimum, which leads to the accumulation of humus. For this reason, the black soil is very fertile ground. During humid spring, grassy vegetation thrives on chernozem. Chernozem is prevalent in much of continental Europe - Croatia, Hungary, Serbia, Russia, Ukraine and others. In Serbia, chernozem covers large areas in Vojvodina (Srem, Banat and Backa). There is also in Mačva and Stig, partly. It should be noted that degraded chernozem occurs at the edges of these areas and it is less fertile. Chernozem depth is 50-60 centimeters, rarely three meters. The color is dark black, which is why it got that name. The structure is crumby-nutty. Chernozem is one of the typical developed land and life inside it is very intense - earthworms, microorganisms, shrews and others. Black soil is suitable for growing all kinds of plants.

Climate of cross border area of Serbia and Hungary is temperate continental with some specifics. A wide range of extreme temperatures, mean maximum temperature in July (mean monthly temperature is 21.4°C), mean minimum temperature in January (mean monthly temperature -1.3°C) are typical and the mean annual air temperature is 11°C, which corresponds to spring. Precipitation regime carries part of the Central European feature, i.e. Danube regime distribution of rainfall with very large uneven distribution by month. The average annual precipitation ranges from 550 to 600 mm/m², where very rainy periods in early summer (June) and periods with no or little rainfall (October and March) can be distinguished. The winds that blow are kosava, north and south wind.

Differences in microclimate and edaphic conditions in the border area between Serbia and Hungary influenced type and mode of production selection in the open field and greenhouses in the year of project implementation, and had an effect on proposed models for vegetable production.

The average vegetable consumption in Serbia is just over 124 kilograms with a tendency to decrease. The level of vegetable consumption is lower compared to other European countries, and since the optimum vegetable quantity in human nutrition is 146 kilograms (excluding potatoes), according to the report of the World Health Organization (WHO), it should be increased. The marked differences in prices across various regions are caused by the supply, level of retail prices, consumption habits and so forth. Given the nutritive value of vegetables and their importance as part of a healthy nutrition, the production and consumption of vegetables in Serbia should be increased. Therefore, the completion of observed project is highly significant to the economic and other development factors.

In order to finance the implementation of rights and performance of duties of the Republic of Serbia, towns and municipalities (hereinafter referred to as the state administration) to apply the regulations, it exercises the right to the following taxes: personal income tax, corporate tax, property tax, inheritance and gift taxes, transfer tax, value added tax - VAT, excise tax, tax on possession and carrying of certain goods. Furthermore, the state administration collects customs and other import duties and fees (administrative, court, communal, registration and sojourn taxes and fees). In some cases, the government may charge fees or tolls for the use of common interest resources (water, forests, roads, soil, natural resources, and mineral wealth). In addition, the obligation of employers and employees includes payment of social contributions (social insurance, health insurance, unemployment insurance). Local administration charges local income tax (local self-contributions, communal tax, provincial and municipal administrative taxes, public land use and development fee, tax for environmental enhancement and protection). Other public revenues (fines, confiscated assets, income derived from activities directly conducted by the state, revenues from leasing of movable and immovable state property, concession income, capital gains, income from funding) have no direct effect on observed production.

Tax policy of Serbia and Hungary are fundamentally similar, charging taxes following to the same mechanisms. In the previous period, the tax system in Serbia consisted of the lowest tax rates in Europe. Income tax rate was 10%, while VAT calculation was based on the general rate of 18% and special rate of 8%. Special rate was applied to food, raw materials that are used in agriculture, medicine and medical supplies, computers and their components and so on. Present changes in the fiscal system in Serbia are headed to the increase of income tax rate to 15%, and VAT rate to 20%. In addition, in 2014 special VAT rate will increase to 10%. On the other hand, low tax rates are not a characteristic of the tax system in Hungary. In 2010, income tax rate decreased to 10%, and further simplification of the tax system is planned in the near future. Therefore, income tax is among the lowest in Europe. VAT in Hungary is calculated by three rates. The standard VAT rate is 27%. It is increased to 25% during January of 2012. Lower tax rate of 18% is used for food and services of the hospitality industry. The 5% rate is used for books, pharmaceutical and medical products. Hungary is a politically stable and fast developing European economy. Regardless of that, the tax system of Hungary is complex, so the calculation of financial results has to consider the two-tier personal income tax and a number of other smaller taxes and fees.

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Pictures:

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P20. Greenhouse in Institut of field and vegetable crops, purchased from project funds.

P21. Equipment in Institut of field and vegetable crops, purchased from project funds.

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