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Cross-Border Alliance for Climate-Smart and Green Agriculture in the Black Sea Basin

Grant Contract BSB1135

AGREEN CROP MODELS:
Triticale and Okra

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30th of May 2022
Dobrich, Bulgaria

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Triticale model

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Triticale history

- First man-made crop – Wilson and Carman
- Rimpau natural amphidiploid
- First primary triticales
- Secondary triticales
- Modern triticale cultivars

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Triticale history

- First man-made crop – Wilson and Carman
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- …triticale has crossed the barrier as a plant for purely genetic research and is a regular production crop in many countries around the world…

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The beginning of x*Triticosecale*

- First crosses of common wheat and rye – 1870-1875 by Wilson.
- First attempts to obtain a stable form – Carman in 1884.
- First constant form triticale, found by Rimpau – 1891.
- First steps in creation of artificial constant forms –
  - Strampeli – 1904;
  - Tshermak – 1913;
  - Meister – 1930;
  - Lebedev – 1933;
  - Jezenko – 1941.

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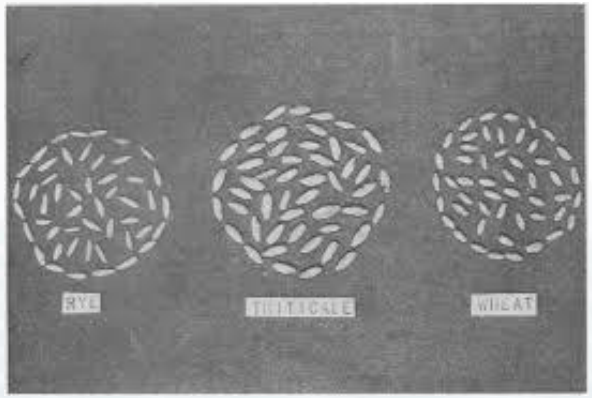
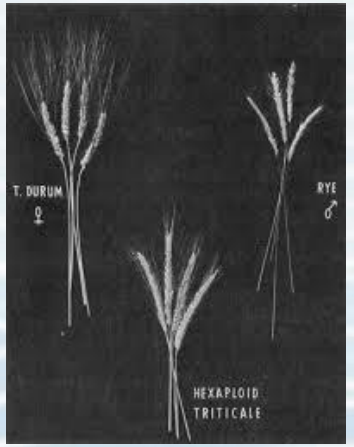
The beginning of x*Triticosecale*





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The beginning in Bulgaria
First period – 1963 - 1971

- Breeding work on triticale in the Institute of Wheat and Sunflower have started at 1963, by Stoyan Tsvetkov.
- Until 1971 – the main breeding task is focused generally to the creation of primary hexaploid forms triticale for genetic and breeding purposes.

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The beginning in Bulgaria
First period – 1963 - 1971

- In 1967 in Bulgaria is obtained the first Bulgarian hexaploid triticale – T-AD by Prof. Stoyan Tsvetkov by crossing winter durum wheat No13 and winter rye No59.

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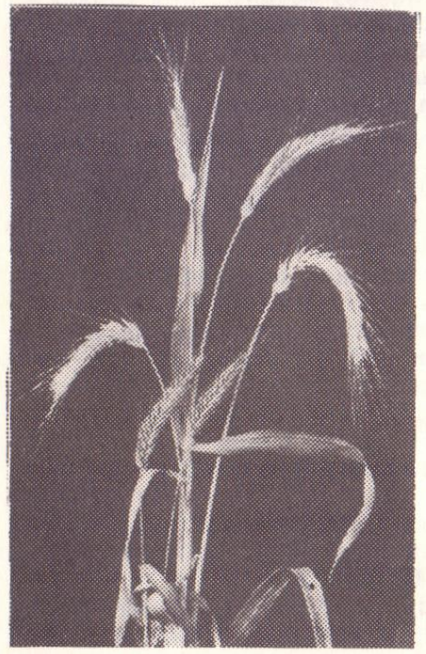
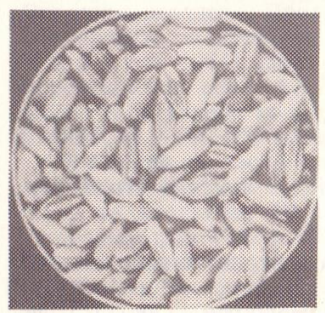
T-AD and Prof. Tsvetkov





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The beginning in Bulgaria
First period – 1963 - 1971

- 1970 - Specialization of Stoyan Tzvetkov in Hungary, where under the direction of Dr. Arpad Kish detailed research has been conducted on T-JC cytology.
- In the autumn of the same year, the hybrid materials created during specialization were sown in the breeding garden of the Institute of Wheat and Sunflower.
- The gene pool of various triticale forms is enriched from Mexico, Canada, USA, USSR, Hungary.
- The Institute becomes a co-operator of CIMMYT and EUCARPIA.

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Early years
Second period – 1971-1992

- By 1978, many triticale forms and lines were created in Bulgaria through different hybridization methods.
- The best materials are tested in different variety trials.
- Early research at the selection trials showed that the triticale lines exceeded yields of wheat, rye and barley.
- The breeding work in the Institute of Wheat and Sunflower is significantly expanding, and the interest in triticale in the country is increasing.

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Early years
Second period – 1971-1992

- In 1982, Valentin Baychev was appointed a researcher, whose primary task was the creation of triticale primary forms. For a relatively short period, an extremely large variety of primary triticale has been created.
- In 1990, as a result of the active work, Valentin Baychev defended a dissertation on the topic: "Creation and research of primary and secondary triticale"

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Early years
Second period – 1971-1992

- During the period the main directions of breeding were differentiated:
  - Winter hexaploid triticale for grain
  - Winter hexaploid triticale for biomass/silage

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First cultivars - Vihren

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First cultivars
- Persenk

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First cultivars
- Belitsa 1

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First cultivars
- Rakita

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The New Generation
Third period – 1992-2017

- High-yielding cultivars have been created that possess sufficient and good cold tolerance and resistance to economically important diseases.
- The main work is aimed at creating cultivars that are focused to practical agricultural production.
- The adopted hybridization method is basically 2n = 42 x 2n = 42

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New cultivars - Kolorit

Very good seedset

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New cultivars - Atila

High grain and biomass yield potential

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New cultivars - Akord

Balance of yield components

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New cultivars - Respekt

Very good cold tolerance

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New cultivars – Bumerang

Good balance of productivity and stress tolerance

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New cultivars - Irnik

Good seedset and drought tolerance

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New cultivars - Dobrudzhanets

High productivity and drought tolerance

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New cultivars - Lovchanets

Unique productive tillering

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New cultivars – Doni 52

The best combination of high productivity, stability and stress tolerance

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New cultivars - Blagovest

High productivity in optimal growing conditions

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New cultivars - Borislav

Unique productivity

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Why triticale and No till

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Why triticale

- High production efficiency
  - The modern hexaploid triticale cultivars are characterized by exceptionally high productivity of grain, which can reach over 1200 kg/da.
  - Such yields are significantly higher than the yield from common winter and come close to the yields obtained from maize.
  - Triticale is of limited production in modern agriculture.
  - This crop is not traditional neither for Bulgaria nor for Dobrudzha region in spite of its good food and forage properties.
  - Triticale remains a neglected crop for the farmers and the processors of raw materials.

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Why triticale

- Source for various foods
  - A significant trait of triticale is its high applicability for diversification of the traditional production of cereals.
  - Various pastry products can be made from triticale, including high-quality bread.
  - Triticale has considerably higher amounts of fibers, protein, and easily digestible carbohydrates and arabinoxylans, which make it a better dietetic food than wheat, maize or oat.
  - Triticale products are suitable food for children and teenagers.
  - High-quality beer can also be made from triticale.
  - Since this grain is also rich in carbohydrates, it is suitable for the production of different types of beverages.

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Why triticale

- Biomass usage
  - The biomass obtained from triticale is characterized by high content of lignin and cellulose and therefore it can be efficiently used for production of biogas and lignocellulosic bio alcohol.
  - High-quality silage and haylage is obtained, which possess high nutrition value for different types of animals.
  - High fodder value of grain, make triticale an indispensable part of the forage crop rotations, especially in the cattle farms.
  - Triticale is digested by the animals much better than rye, although the crop concedes to oat in this respect.

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Why triticale

- Tolerant and Resistant
  - One of the most important practical aspects of the crop is that it can be grown under variable environments.
  - Triticale is characterized by resistance to unfavorable conditions of the environment, which is considerably higher than that of the wheat types and barley, and the crop can be efficiently cultivated on almost all soil types.
  - The contemporary cultivars possess high cold resistance, some of them are more cold-resistant even than rye.
  - Triticale is more adaptable to dry conditions in comparison to wheat, rye and barley.
  - Triticale tolerates also high levels of soil acidity, which is toxic to the other cereal plants.
  - **In practice, this crop can be grown on almost all soil types, with the exception of the high salinity ones.**

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Why triticale

- Diseases, Pests and Weeds
  - Triticale is a crop, which needs less resources in the form of fertilizers and plant protection preparations.
  - Due to its well-developed roots, it can assimilate nutrients more efficiently.
  - On the other hand, triticale suffers from a comparatively low number of pathogens and pests and competes to a lesser degree with the weeds.
  - Among the pathogens, most important are yellow rust and the different types of Fusarium bligths; most important among the pests are the cereal ground beetle and the cereal leaf beetle but only under certain conditions.
  - The adequate plant protection management allows considerably less treatments with plant protection chemicals.

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Why No till

- No till advantages and disadvantages
  - One of the methods allowing the fast restoration in soil of the organic matter from the grown triticale is No-till.
  - This is a method of not using tillage for soil cultivation. Such a technology allows maintaining a comparatively good level of productivity, strongly reducing almost all types of input – fuel, fertilizers, plant protection preparations, deprecation of equipment and labor.
  - However, the method has certain disadvantages:
    - significant decrease of the phytosanitary status of the crop in the field, which requires very good plant protection management,
    - over-compaction of the soil and disturbance of its water-air regime,
    - impossibility to provide optimal nutrition regime for the plants.
  - Such disadvantages are an obstacle to the wide usage of this method for growing of agricultural plants.

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Why No till Triticale

- In triticale, a scientifically based technology for growing the crop by the No-till method, which would take into account the soil and climatic peculiarities of Bulgaria, and Dobrudzha region in particular, has not been developed yet.
- This poses a great number of questions
  - as to whether the combination of triticale with No-till is suitable, what would be the input of resources,
  - whether this type of production is sufficient enough in comparison to the conventional growing,
  - whether the structure of the soil and its physical and chemical properties will be preserved, and
  - whether triticale will respond adequately to such conditions.
- Finding answers to all these questions justifies the testing of the crop with the aim to determine if the combination of these two resource-saving practices can be applied simultaneously under the soil and climate of Dobrudzha region.

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Main objectives of the model

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Main purpose

- The main purpose of the experiment is to provide high-quality plant raw material with high dietetic and nutrition properties at high level of productivity. At the same time, it is necessary to determine whether triticale can be efficiently grown under conditions of No-till. The main target of such an experiment is diversification of the production of the grain raw materials at high level of efficiency.

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Main objectives

- The following tasks derive from the above objective:
  - To determine whether No-till can be successfully used in growing of triticale under the conditions of Dobrudzha;
  - To investigate if No-till is more efficient in comparison to the conventional growing of the crop;
  - To find out if the soil maintains most of its physical and chemical properties, which are in accordance with the priorities of regenerative and conservation agriculture.
  - To investigate whether triticale maintains its productivity potential under the No-till method;
  - To determine if it is cost-effective to grow triticale by the No-till method in comparison to the conventional growing of the crop.

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Methods

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Methods

- C1. Technology for growing of triticale
- I. Growing by the No-till method
- 1. Preparation of the terrain for sowing
- *1.1. Plant residues*
- *1.2.1. Plant residues from technical crops*
- *1.2.2. Plant residues from cereals*
- *1.2.3. Plant residues from legumes*
- *1.2. Compaction of soil*
- *1.3. Flora and fauna in soil*
- 2. Primary fertilization
- 3. Sowing
- *3.1. Ways of sowing*
- *3.2. Sowing dates*
- *3.2.1. Early dates*
- *3.2.2. Optimal dates*
- *3.2.3. Late dates*
- *3.2.4. Exceptional dates;*
- *3.2.5. Spring sowing dates*
- *3.3. Depth of sowing*
- *3.4. Resources for sowing*
- *3.5. Compaction*
- 4. Cares during the vegetative growth of plants
- 5. Harvesting

- C1. Technology for growing of triticale
- II. Conventional growing (referential experiment)
- 1. Soil preparation prior to sowing
- *1.1. Types of soil tillage applicable to conventional growing of triticale*
- *1.2. Plant residues from the previous crop*
- *1.3. Dates of pre-sowing tillage*
- *1.4. Resources needed for pre-sowing tillage of soil*
- *1.5. Tillage dates*
- 2. Primary fertilization
- *2.1. Types of fertilizers introduced with the primary tillage and fertilizer norms*
- *2.2. Dates of fertilization*
- *2.3. Ways of applying the fertilizer*
- *3.1. Ways of sowing*
- *3.2. Sowing dates*
- *3.3. Depth of sowing*
- *3.4. Resources for sowing*
- *3.5. Compaction*
- 4. Cares during the vegetative growth of the plants
- *4.1. Spring fertilization*
- *4.2. Plant protection*
- 5. Harvesting

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Materials

- Two triticale cultivars were chosen, which were developed at Dobrudzha Agricultural Institute – General Toshevo: Respekt and Dobrudzhanets.
  - Respekt
  - Dobrudzhanets

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Respekt

Very good cold tolerance

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Dobrudzhanets

High productivity and drought tolerance

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Methods

- **Parameters of soil**
  - **Determining of soil moisture**
  - **Determining soil PH**

- Parameters of the plants
  - *Physiological parameters*
    - - Chlorophyll content
    - - Leaf area and leaf area index
    - - Temperature of the leaf area
  - *Morpho physiological parameters*
    - - Plant height
    - - Days to heading
    - - Number of productive tillers
    - - Length of spike
    - - Number of spikelets in spike
    - - Number of grains in spike
    - - Weight of grains in spike
    - - 1000 kernel weight
    - - Spike density
    - - Fertility

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Okra model

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Okra history

- Allopolyploid of uncertain parentage. Truly wild (as opposed to naturalised) populations are not knownThe geographical origin of okra is disputed, with supporters of Southeast Asian, South Asian, Ethiopian and West African origins.The Egyptians and Moors of the 12th and 13th centuries used the Arabic word for the plant, bamya, suggesting it had come into Egypt from Arabia. The plant may have entered southwest Asia across the Red Sea, rather than north across the Sahara, or from India. One of the earliest European accounts is by a Spanish Moor who visited Egypt in 1216 and described the plant under cultivation by the locals who ate the tender, young pods with meal. From Arabia, the plant spread around the shores of the Mediterranean Sea and eastward. (https://en.wikipedia.org/wiki/Okra#Origin_and_distribution)

- Presumably, the crop has been introduced in Bulgaria from Asia Minor, and its production is nowadays traditional for the country, though it is limited exclusively and only to private gardens. The large-scale production of okra for the market is rather limited and is concentrated only in the southern regions. On the territory of Dobrudzha, the growing of okra as an industrial crop has no traditions.

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Why okra and Organic farming

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Why okra

- Lack of industrial production
  - The large-scale production of okra for the market is rather limited
  - On the territory of Dobrudzha, the growing of okra as an industrial crop has no traditions.
  - Lack of irrigation systems and the comparatively dry climate
  - The conditions of North Bulgaria are characterized by lower temperatures till considerably later in spring (the beginning of May),
  - Okra is widespread in backyards and gardens all over the country, including Dobrudzha region
  - A tendency is observed of using okra of non-local origin to prepare home-made preserves and for food in restaurants and catering establishments.
  - An opportunity to develop a local market for this crop, provided that it can be successfully grown in industrial fields on the territory of Dobrudzha.

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Why Organic

- Source for various foods
  - A conventional greenhouse production can hardly be considered regenerative and crop-friendly agriculture.
  - Such production requires considerable resources for fertilizers, chemical preparations and fuel.
  - An agricultural system is needed, which will significantly reduce the use of more chemical products for plant protection and fertilization, and be at the same time soil and environment friendly.
  - Organic system of agriculture in the greenhouse production of okra can be an efficient and environmentally friendly process,
  - This could contribute to the necessary diversification of the vegetable products in the region of Dobrudzha at optimal utilization of the resources for production.

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Main objectives of the model

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Main purpose

- The main purpose of the experiment is to provide high-quality plant raw material produced through an organic method, that will meet the demands of the local markets and ensure short chains at high level of productivity. At the same time, it is necessary to determine if okra as a crop can be grown effectively under conditions of greenhouse organic production. The primary target of such a research is diversification of the vegetable production at high efficiency.

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Main objectives

- The following tasks derive from the above objective:
  - To find out if the organic greenhouse production can be efficiently applied to the growing of okra under the conditions of Dobrudzha;
  - To investigate if the greenhouse production can ensure earlier and longer period of produce in comparison to the conventional growing of the crop;
  - To determine if the soil largely maintains its physical and chemical properties in accordance with the priorities of regenerative and conservation agriculture;
  - To study if okra maintains its productivity potential under organic greenhouse production;
  - To find out if it is cost-effective to grow okra by the organic method in a greenhouse in comparison to the conventional cultivation of the crop in a greenhouse and in field.

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Methods

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Methods

- C1. Technology for growing of okra
- I. Greenhouse growing
- 1. Pre-sowing preparation of soil
- *1.1. Stages of soil tillage*
- *1.2. Resources for pre-sowing soil tillage*
- *1.3. Dates of primary soil tillage*
- *1.4. Dates for pre-sowing soil tillage*
- *1.5. Resources necessary for primary soil tillage*
- 2. Primary fertilization
- *2.1. Within an organic agriculture system*
- *2.2. Under conventional growing*

- 3. Sowing
- *3.1. Ways of sowing*
- *3.2. Sowing dates*
- *3.3. Sowing depth*
- *3.4. Resources necessary for sowing*
- *3.5. Compaction*
- 4. Cares during the vegetative growth
- *4.1. Under organic agriculture system*
- *4.1.1. Nutrition*
- *4.1.2. Plant protection*
- *4.1.3. Irrigation*
- *4.2. Under conventional growing*
- *4.2.1. Nutrition*
- *4.2.2. Plant protection*
- *4.2.3. Irrigation*
- 5. Picking

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Methods

- C1. Technology for growing of okra
- II. Growing under field conditions
- 1. Pre-sowing soil preparation
- *1.1. Stages of soil preparation*
- *1.2. Resources for pre-sowing soil tillage*
- *1.3. Dates for primary soil tillage*
- *1.4. Dates for pre-sowing soil tillage*
- *1.5. Resources for pre-sowing soil tillage*
- 2. Primary fertilization
- *2.1. Within the system of organic agriculture*
- *2.2. Under conventional growing*

- 3. Sowing
- *3.1. Ways of sowing*
- *3.2. Sowing dates*
- *3.3. Depth of sowing*
- *3.4. Resources necessary for sowing*
- *3.5. Compaction*
- 4. Cares during the vegetative growth of plants
- *4.1. Within organic agriculture system*
- *4.1.1. Nutrition*
- *4.1.2. Plant protection*
- *4.1.3. Irrigation*
- *4.2. By the conventional method*
- *4.2.1. Nutrition*
- *4.2.2. Plant protection*
- *4.2.3. Irrigation*
- 5. Harvesting

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Materials

- The old landrace Lyaskovska bamya was chosen for this experiment. It is characterized by very good productivity under local (predominantly garden) conditions and very good quality of the plant production. This cultivar has not been tested under greenhouse conditions, nor within organic production system on the territory of Dobrudzha region.

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Lyaskovska

Traditional and higly-productive

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Methods

- **Parameters of soil**
  - **Determining of soil moisture**
  - **Determining soil PH**

- **Parameters of the plants**
  - ***Physiological parameters***
    - **- Chlorophyll content**
    - **- Leaf area and leaf area index**
    - **- Temperature of the leaf area**
  - ***Morpho physiological parameters***
    - **- Plant height**
    - **- Days to flowering and fruiting**
    - **- Number of pods per plant**
    - **- Numbers of flowers**
    - **- Weight of pod**
    - **- Yield**

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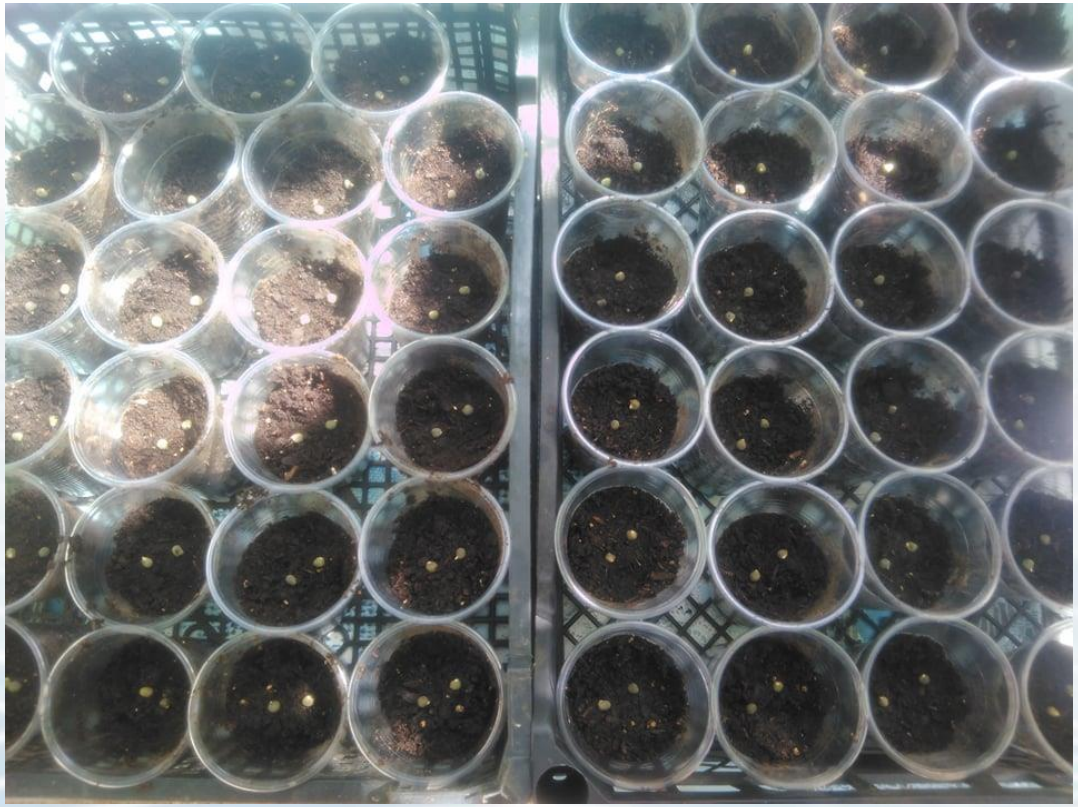

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Thank you for your attention!

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