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Recent Trends of the Breeding Programs in Main Vegetables and Potatoes in Bulgaria

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Introduction

The Republic of Bulgaria is traditional producer and consumer of vegetables and potatoes - fresh and processed. The annual vegetable consumption per head is 200 – 215 kg including 56% in fresh condition. Bulgaria has ancient traditions in vegetable growing. It is well-known with great diversity of vegetable species and varieties. It is a secondary forming center for some of them. Many of local varieties have been distributed in the past by the Bulgarian gardeners in many European countries – Hungary, Austria, Romania, Serbia, Russia etc. The optimal climatic conditions in the country are prerequisite for cultivation of almost all vegetable species. This fact determines the prompt development of the scientific investigations in the field of vegetable production.

Today breeding programs already out of old frames when high yields were the main target of breeders. The attention of researchers has focused on new challenges. Greater attention is paid to the chemical and technological properties, biochemical characters and content of biologically active substances with antioxidant effect without the productivity of the new variety to be underestimated. The climatic changes, problem concerning the population feeding exert an influence on the trends of the experimental work. The food quality and safety, and the human health are a problem of the first importance on a world scale. They are both a leading motive in the scientific investigations in the vegetable production and a significant factor for research topics today. Priority research breeders are focused on:

Enhancement of vegetable quality by improving biological value (increasing the components with antioxidant effect), sensory characteristics, pest and disease resistance, high temperature and drought tolerance by the use of conventional and biotechnological breeding methods.

Evaluation and exploitation of various vegetable germplasm, comprising local and introduced accessions, breeding lines, and cultivars.

The basic trends of breeding programs are the following:

Tomato Program

The tomato breeding program is directed towards the creation of cultivars for early and mid-early production, for fresh consumption and for processing. Biological yield potential has certain limits and it is difficult to surpass. Efforts are focused on creating quality new germplasm - resistant to biotic and abiotic stress, with improved biochemical indices rich in substances with antioxidant - lycopene, beta-carotene, vitamin C and balanced content of sugars and acids. The aim is to revive the traditional Bulgarian taste for tomatoes, while it make look brand new - higher resistance, better keeping quality and transportability.

What are the main objectives of tomatoes? Higher yield; Resistance to biotic and abiotic stress; Excellent taste, set the content of sugars, acids and their relationship.
Biological value: Vitamin C content - over 40 mg%; Beta-carotene - more than 4 mg%;
Lycopene - 10 mg% over the type and high pigment than 6 mg% for other variety types. As a result of interspecific hybridization with cultivars of Lycopersicon esculentum Mill. and wild type Lycopersicon chilense Dun. in "Maritsa" Vegetable Crops Research Institute - Plovdiv created rich genetic material from three variety types tomatoes depending on the concentration of b-carotene in fruits:

- variety types I - yellow-orange fruits, 80-90% of beta-carotene from the general pigmentation;

- variety types II - orange fruit, 50-60% of beta-carotene from the general pigmentation;

- variety types III - red-orange fruits about 30% of beta-carotene of the total pigmentation [1].

The Institute has a large number of lines and varieties from determinate and indeterminate type tomatoes from variety types II and III, which include as a parental component in the creation of hybrid tomatoes with high biological value.

The creation of the initial forms with increased content of lycopene in fruits (high pigment) is an important part of the tomato breeding programs.

The most promising lines with high biological value are transformed with Tomato Mosaic Virus (ToMV) and Cucumber Mosaic Virus (CMV) resistance. A large part of the tomato breeding materials for fresh consumption and processing are assessed for their chemical, technological and sensory properties. The genetic diversity of the exploited materials of tomato is characterized and identified using molecular markers. Other directions are to incorporate a male-sterile gene in valuable breeding lines and cultivars as well as to investigate the expression of dominance and recessiveness responsible for fertility and sterility in hybrids and backcross progenies.

Pepper Program

In the course of over 70 years, a great diversity of genetic materials has been created and maintained, mainly based on unique local forms, typical for the region of Bulgaria. They were improved by the methods of conventional breeding.

At present involved with a valuable big collection from local and introduced accessions. Contemporary breeding program is focused on the creation of green and red fruited types as well as pepper for grinding [2]. The breeding program for "green pepper" and "red pepper" emphasizes the creation of lines and cultivars with high biological value (mainly on ascorbic acid content, over 150 mg per 100 g for green and over 200 mg for red) as well as on good sensory properties. Bulgarian cultivars and perspective lines are evaluated for dry matter content, ascorbic acid and total sugars in botanical maturity. The mutant genotypes and F1 hybrids with higher β-carotene amount and orange coloured fruit are created and evaluated.

The desired characteristics for fresh consumption are crispness, succulence, freshness and non-pungency and for processing (for baked, canned, and for juices) are easy peeling, fleshy pericarp and intensive red color [3]. Attention is paid also to variable nuances of green (light yellow to dark green) and red (light orange to dark red) colors and to various shapes: oblate, edged, bell, blocky, conical, kapia, and slender type. The objectives of the paprika breeding program are: higher yield; resistance to economically important diseases; excellent taste determined by the content of dry matter, sugars, acids, etc.; save dyes stored in the ground pepper; pendant fruits; earliness and uniformity in ripeness as well as enhancement of quality and quantity of total pigments and their long storage. Red pepper lines with over 300 ASTA units are now established. One of the breeding directions is to search or create forms with stable pigment content after frost.

Biological value:

- Vitamin C technical maturity - over 150 mg%;

- Vitamin C botanical maturity - over 200 mg%

Cucumber Program

On the cucumber breeding program a great number of F1 hybrids of high yields have been created already with gynoecious flowering type, parthenocarpic fruits with dark green to green color, smooth to slightly rubbed surface, tolerant to Sphaerotheca fuliginea [4]. Several F1 hybrids combine CMV tolerance and gynoecious flowering type combined with the excellent taste [5].

Interspecific hybrids were created in vivo between Cucumis sativus and Cucumis melo var. agrestis subsp. sikimensis to increase genetic diversity. The intensive breeding program matches up with continuous new demands in term of disease resistances. A new trend of the current plan is to combine the CMV tolerance with resistance to Sphaerotheca fuliginea and Pseudoperonospora cubensis. The aim of the breeding program in cucumbers is higher yields, complex resistance to economically important diseases; excellent taste.

Cabbage Program

Bulgaria appears to be a second center of origin for Brassica oleraceae var. capitata. Bulgarian cultivars possess unique taste characteristics, appropriate for fresh consumption and processing.

The objectives of the breeding program are to release a new white head cabbage lines and cultivars and broccoli genotypes with improved productivity and quality characters [6,7]. From Plant Tissue Culture optimize in vitro propagation and obtaining haploids in anther culture [8]. In breeding on cabbage to increase the genetic diversity using mutagenesis together with modern methods for evaluation. Current investigations are dealing with complex resistance towards three pathogens: Peronospora parasitica, Alternaria brassicicola and Xanthomonas campestris pv. campestris Search for resistance to Brevicoryne brassicae, Mamestra brassicae, Pieris brassicae and Pieris rapae is an aim of the breeding program. Identify Bulgarian varieties suitable for organic production.

Potato Program

Bulgaria is at the border area of optimal conditions for potato growing. The aims of the breeding program are follow – dry matter over 21.0%, reduced sugar no more than 0.5% and resistance against cystnematodes (Globodera rostochiensis) [9]. The most important limiting factor for potato production are aphids as virus vectors causing degeneration of seed potatoes. In this respect the Maritsa Vegetable Crops Research Institute is a pioneer in elaborating a strategic breeding program in the 1960s for the creation of virus-resistant cultivars and technology for virus-free seed production.

Genes for virus resistance were transferred from different wild species such as Solanum acaule, S. demissum, S. sisimbrifolium, S. chacoense, S. stoloniferum to S. tuberosum materials. Valuable breeding lines and cultivars (Perun, Rojen and Orfey) were created with high productivity, earliness, resistance to nematodes and good organoleptic properties. A network for virus-free seed production was elaborated.

The current potato program places special emphasis upon introducing resistance to cystnematodes (Globodera rostochiensis) in valuable and widely used cultivars. Serious damage to potato production due to climate changes impose a new trend in the breeding program: development of breeding lines and cultivars tolerant to high temperature and drought [10]. The currently aim of the potato program is to develop of specialized cultivars for boiled potatoes and puree, French fries and chips, in order to respond to the new requirements of the processing industry in Bulgaria.

The breeding programs in "Maritsa" VCRI aimed to enrich the Bulgarian catalog with new high-yielding varieties of vegetables and potatoes, resistant to biotic and abiotic stress, with high biological value, suitable for fresh consumption and processing in functional foods.

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