STATE-OF-THE-ART, PROBLEMS AND PROSPECTS OF PEAR PRODUCTION IN BULGARIA


*Fruit Growing Institute, 4004 Plovdiv,
**University of Forestry in Sofia

PEZIOME
Статията прави обзор на състоянието и проблемите на крушовото производство в България и набелязва мерки, с оглед на неговото подобряване. България е малък производител на кури, но след 90-те години на миналия век родното производство се срива. От осемнадесето място в света през 1980 г. с 96 хил. тона, днес производството е 1 974 т. Изтъкват се основните причини за редуциране на площите, заети с тази овошна култура, които се отделя специално внимание на използваните технологии, сортове и сорто-подложкови комбинации, начини на формиране и резибари, съпътстващите фитосанитарни проблеми, както и методите, начините и средствата за тяхното ограничаване и контрол. Крайната цел е да се преодолеят предизвикателствата, като се предложат на производителите технологии, приложими за различните

SUMMARY
The paper reviews the state-of-the-art and the problems of pear production in Bulgaria and outlines measures for its improvement. Bulgaria is a comparatively small producer of pear fruit but after 90s of the last century domestic production collapsed.

From eighteenth place in the world by producing 96 thousand tons in 1980, the production has fallen down to 1974 tons at present.

The major reasons for the reduction of the areas occupied with that fruit crop were revealed, paying a special attention to the used technologies, cultivars and cultivar/rootstock combinations, the methods of training and pruning, the accompanying phytosanitary problems and the methods, ways and means for limiting and controlling them.

The final aim was to overcome the
challenges and to offer the producers technologies suitable for the different soil and climatic regions of the country: a technology for intensive growing; a technology for organic pear production in intensive orchards; a technology for growing of in vitro propagated pear cultivars requiring an interstock, grown on own roots without grafting on a rootstock. Finally, measures for the improvement of pear production in Bulgaria were proposed.

Key words: pear, technology, state-of-the-art, problems, prospects

INTRODUCTION

Pear fruit is traded both on the local and international markets. World production has been characterized by sustainable rates of growth.

Pear production has increased almost 3 times in the last thirty years and now stands at 23 897 556 tons (Figure 1).

China is the leader in pear production.

Chinese production is growing at a very fast pace – it has increased tenfold and today the country provides 67% of the world production. Italy is the second after China, but the difference between the two countries is huge.

Other major producers are the U.S., Argentina, Spain and Turkey (Figure 2). Among those countries, only Argentina has had a steady growth.

Bulgaria is a small producer, but after 90s, domestic production collapsed.

From eighteenth place in the world in 1980 by producing 96
света през 1980 г. с 96 хил. тона, през 2005 г. то стига най-ниското си равнище 750 т., а днес е 1 974 т.

thousand tons, in 2005 the country reached its lowest level of 750 tons and nowadays the production is 1 974 tons.

Източник: По данни на ФАО
Фиг. 1. Производство на круши
Fig. 1. Production of pears

Източник: Изобразяване по данни на ФАО
Source: Representation on database of FAO
Фиг. 2. Основни страни производители и България
Fig. 2. Top producers and Bulgaria
Currently, more than half of the pear orchards in the country are concentrated in the South Central and South West regions. Both regions provide the primary production (Figure 3).

The most common pear cultivars are ‘Cure’ (25.52%), ‘William’s’ (19.28%) and ‘Santa Maria Morettini’ (5.75%).

Фиг. 3. Териториално разположение на площите и производството, 2011 г.
Fig. 3. Location of the planted area and production, 2011

ПРОБЛЕМИ
Причините за редуцирането на кущовите площи са разнородни и се свеждат най-вече до използване на стари и неефективни технологии за

PROBLEMS
The reasons for the decrease of pear planted areas are diverse, the major ones being the use of old and inefficient technologies of growing the crop. There are quite a
отглеждане на тази култура. Не малки са проблемите, свързани с фитосанитарно състояние на градините и ефикасността на прилаганите стратегии за контрол. От болестите и неприятелите по крушата най-голямо икономическо значение имат: огненият пригор (Erwinia amilovora, Burrill), фитоплазмената болест загиване на крушата (Candidatus Phytoplasma pyri) и обикновената крушова листна бълха (Pear psylla) (Cacopsylla (Psylla) pyri L).

Огненият пригор (Fire blight) е икономически най-важната болест по крушата, която се причинява от бактерията Erwinia amyllovora (Burrill). Тя е сравнително нова болест за България и е открита у нас за първи път преди 15 години (Bobev et al., 1999). През периода 2003-2007 г. болестта получи силно разпространение и нанесе значителни щети на много крушови, дюлеви и ябълкови насаждения. Патогенът атакува листата, цветовете, плодовете и клоните на дърветата, а при по-силно намиране води до частично или пълно изсъхване на дървета, намаляване на добивите и снижаване на качеството на продукцията.

Конвенционалната селекция при крушата за устойчивост на болести е трудна поради високата large number of problems related to the phytosanitary condition of the orchards and the efficacy of the applied strategies of plant protection control.

Economically most important diseases and pests in the pear crop are: fire blight (Erwinia amylovora, Burrill), pear decline (Candidatus Phytoplasma pyri) and pear psylla (Cacopsylla pyri L).

Fire blight is the economically most important disease in pear, caused by Erwinia amylovora (Burrill). It is a comparatively new disease in Bulgaria and it was first found in our country 15 years ago (Bobev et al., 1999).

In the period 2003-2007 the disease was widely spread and it caused severe damages in many pear, quince and apple plantations. The pathogen attacks the leaves, flowers, fruits and tree branches and its accelerated growth causes partial or total tree failure, decrease of the yield and low fruit quality.

Conventional breeding for disease resistance is difficult due to the fact that pear is a highly heterozygotic fruit species and cross breeding progenies express a lot of characteristics different from those of the parents. Seedlings have a long juvenile period before the fruiting stage
Plant biotechnology can offer the pear breeders new tools to increase the efficiency of hybridization and breeding (Chevreau and Skirvin, 1992). New approaches are offered by molecular biology, somaclonal variation and genetic transformation.

A number of studies with pears have been carried out at the Fruit-Growing Institute – Plovdiv for increasing the resistance of pear genetic types to fire blight. The perspective rootstocks OHF 333 (‘Old Home x Farmingdale’) and ‘Pyrodwarf’ and the cultivars ‘Karamanets’, ‘Latifah’ and ‘Victoria’ were included in the studies.

Those rootstocks and cultivars were micropropagated and artificially inoculated with local strain of Erwinia amylovora for testing their resistance. It was found out that some of them demonstrated a low susceptibility/tolerance to fire blight.

In order to obtain resistant/tolerant to Erwinia amylovora genotypes, an efficient system for shoot regeneration from in vitro leaf explants of the rootstock OHF 333 was developed (Nacheva et al., 2009).

All the obtained regenerants were cloned, propagated, rooted and acclimatized to greenhouse
conditions. Somaclones were tested for resistance to fire blight (Erwinia amylovora). It was found out that ten of the studied clones demonstrated low susceptibility/tolerance to fire blight. The field trials on the selected genotypes are in progress.

Pear decline (Candidatus Phytoplasma pyri) is a phytoplasma disease causing severe damages to pear trees. The disease is manifested in two forms. In one of the forms it develops rapidly and the trees die in several days. In the other form the progress of the disease is slow.

The infected trees develop poorly, their growth is suppressed and they usually do not bear fruit (Verderevskaya, and Marinescu, 1985).

The causative agent of the disease is Candidatus Phytoplasma pyri, which is usually spread by pear psylla (Cacopsylla pyri L.).

In our country the disease was found by Topchiiska et al. (2000) and proved in ‘William’s’, ‘Cure’, ‘Trapezitsa’ and in some local pear forms (Milusheva S., unpublished data).

In Bulgaria two psyllid
species have been identified as pests in the pear crop: Cacopsylla (Psylla) pyri L. and Cacopsylla (Psylla) pyrisuga Foster., the first one being more widely spread and of greater economic importance not only in our country (Harizanov, 1982) but also in many countries in Central and Western Europe (Kocourek and Stará, 2006).

Until 60s of the last century, due to the low density in the plantations, less attention had been paid to C. pyri. The higher pest multiplication throughout the years is related to the favourable climatic conditions and the lack of systematic chemical control (Atger and Bassino, 1984; Harizanov, 1966; Staubli, 1984).

The process of intensification and chemization in pear production in the 70s and 80s enabled the increase of its density to such levels, making it a serious problem to the producers of pear fruit.

Frequent and repeated applications of broad-spectrum insecticides led to the mortality of the natural enemies of P. pyri, to the development of pesticide resistance of its populations enabling the severe outbreaks of the pest (Arzone, 1979; Harizanov, 1982; Staubli and Antonin, 1984).

In observations carried out under field conditions, Arnaudov and Kutinkova (2001) found out
that the 15 tested chemical products showed different levels of efficiency to *C. pyri* populations.

The highest efficiency was established for the insecticides and acaricides Amitraz and Pyridaben (91-92%), followed by the pyrethroid insecticides: High Cis Cypermethrin, Bifentrine and Lambda cyhalothrin (83-88%) and some insecticides of the group of the chitin synthesis inhibitors, such as Teflubensuron (80%) and Flufenoxuron (70%).

However, two other products of the same group – Diflubenzuron (57%) and Triflumuron (43%), showed less efficiency.

Low efficiency (44-57%) was also reported when applying some of the organophosphorus insecticides, such as Chlorpyrifos-Methyl, Pirimiphos-Methyl, Quinalphos + Thiometon, in contrast to some others like fenitrothion (76%) and dimethoate (88%).

The results of those and some other studies carried out in a previous period, confirmed the opinion of a number of authors that pear psylla is able to rapidly and easily develop populations resistant to plant protection products that are often used in practice, especially to those belonging to the group of organophosphorus insecticides.
особено такива от групата на органо-фосфорните инсектициди (Harizanov, 1982; Berrada et al., 1995; Bues, Boudinhon, 2002; Bues et al., 2003). Факт, с който производителите на круши би следвало да се съобразяват в следващите години.

През последните години в различни страни на Европа се появиха съобщения и за наблюдавана кръстосана резистентност в популяциите на C. pyri към органофосфати, пиретроиди и амитраз (Bués et al., 1999). В Чехия Kocourek and Stará (2006) докладват за прояви на резистентност в популяциите на C. pyri в крушови градини, интензивно третирани с тетлубензурон.

Голям брой овошари в България споделят, че повечето от препоръчваните инсектициди не контролират в достатъчна степен популяцията на C. pyri, с изключение на инсектоакарицида амитраз. Инсектицид, който до скоро беше единственото възможно средство, което гарантираше адекватна защита срещу ларвите на този неприятел. След отглеждането му от пазара през 2005г., възникна остра необходимост от търсене на нови алтернативни средства за борба с този вредител.

Биологичният контрол, чрез наличната ентомо- и акарофауна в градините, предлага само частично решаване на (Harizanov, 1982; Berrada et al., 1995; Bues, Boudinhon, 2002; Bues et al., 2003). That is a fact, which should be taken into account by pear producers in future.

In the last years, in different European countries, it was announced that cross-resistance was observed in the populations of C. pyri to organophosphates, pyrethroids and amitraz (Bués et al., 1999).

In Czech Republic, Kocourek and Stará (2006) published information about the resistance of the populations of C. pyri in pear orchards that had been treated intensively with Teflubenzuron.

Many fruit-growers in Bulgaria announced that most of the recommended insecticides failed to adequately control the populations of C. pyri, with an exception of the insecticide and acaricide Amitraz, an insecticide, which until recently, was the only possible product guaranteeing an adequate control against the larvae of the pest.

After it was taken off the market in 2005, there is an urgent need of finding new alternative means of controlling the pest.

Biological control based on the available in the orchards
problems, but the use of non-selective pesticides against that one and some other pests decreased the efficiency of the predators and parasites (Burts & Beers, 1994). Including specific and selective pesticides in the strategies for plant protection contributed to improving the role of biological control (Burts, 1983).

At present Abamectin (a mixture of 80% avermectin B-1a and 20% avermectin B-1b) is one of the few products providing efficient control of P. pyri and to a great degree protecting the beneficial arthropods, which are important factors for biological control of the pest (Nguyen & Berrada, 1994; Miletić and Tamaš, 2006; Arnaudov and Kutinkova, 2009).

Problems of pear production in Bulgaria are not limited only to developing suitable methods and means of control of the economically important diseases and pests in that crop.

Other important reasons for the drastic reduction of the areas occupied with pear orchards refer to difficulties in the production of planting material of cultivars requiring an interstock. Most summer cultivars like ‘Ranna Bolyarka’, ‘Trapezitsa’, ‘Beurre
Giffard’, as well as some of the major cultivars like ‘Williams’, ‘Beurre Bosc’, ‘Starkrimson’, ‘Abbe Fetel’, etc. do not have good compatibility with the quince rootstock.

That necessitates twice grafting and extending the production cycle for one more vegetation season in comparison with the conventional technology.

A solution of the problem could be found by applying in vitro techniques for propagation of fruit species, including pear (Bomminemi et al., 2001; Damiano et al., 2000; Grigoriadou et al., 2000).

Those techniques eliminate the necessity of grafting – an agricultural practice needing highly qualified manual labour, and, for cultivars requiring an interstock – the need of grafting the tree twice.

On the other hand, the production of micropropagated own-rooted pear planting material removes the necessity of establishing mother plantations for producing cuttings and rootstocks and the necessity of a nursery for the second and the third year for the cultivars requiring an interstock.

A number of technological elements in micropropagation of
pear cultivars at the stages of multiplication, rooting and adaptation to \textit{ex vitro} conditions have been developed in our country (Kornova, Popov, 2005; Kornova, Popov, 2009, 2013).

Further to that, studies were carried out with a number of \textit{in vitro} propagated fruit species, including pear, on their growth and reproductive behavior in the nursery and in the orchard (Popov, Kornova, 1995; Popov, Prodanova, 2003; Popov, Kornova, 2009), as well as on their health status related to the economically important pests and the application of different agrotechnical, biotechnical and chemical methods of control.

Problems of pear production in Bulgaria are also greatly related to the choice of an appropriate technology and proper conducting of all pruning activities with the aim of obtaining well-trained and regularly fruiting pear trees.

When carrying out pruning for tree training and regular fruiting, it is very important to pay enough attention not only to biological characteristics of the species and the cultivar, but also to the growth vigour of the rootstocks. Conducted studies (Domozetov, 1982) showed that pear pruning during the period of fruit-bearing
and growth stimulated the development of the fruit trees grafted on both seedling and quince rootstocks. In that relation, the effect of the detailed pruning is more obviously expressed, because along with contour partitioning and pruning to allow more light, a part of the fruiting wood is also removed.

In later studies Gandev (1999), following out the vegetative habits of pear cultivars of different growth vigour, used various training systems – pruning, thinning and bending. The author found out that pruning practices did not show the same effect on the studied cultivars.

In another investigation Arnaudov and Gandev (2004) established a positive correlation between pear shoot growth vigour and the attacks of pear psylla (C. pyri L.).

They proved that pruning practices inducing more vigorous and continuous shoot growth, stimulated more severe and more continuous attacks by the pest.

Studies of some authors (Petrov et al., 1979; Domozetov, 1982; Gandev, 1999) allow concluding that two types of pear orchards should be grown in Bulgaria – intensive and extensive. Intensive plantations are more suitable to be grown on rich soils
екстензивните - за по-бедни почви в полупланинските райони, където би могло да се търсят предимствата на биологичното земеделие. На този етап проучванията в страната и при двата типа насаждения не дават ясно становище относно системите на формиране и избора на сорто-подложкови комбинации. Предстоящите изследвания в тази насока трябва да бъдат насочени към проучване на сорто-подложкови комбинации, устойчиви и толерантни към огнен пригор (E. amilovora) и обикновена крушова листвна бълха (C. pyri L.), и подходящи за формиране на дърветата в двата типа насаждения.

ПЕРСПЕКТИВИ

Перспективите за отглеждане на крушата в България в предстоящите 8-10 години не са добри, въпреки подходящите в страната почво-климатични условия. Доказателство за това твърдение е факът, че площите с тази култура намаляват драстично и в съществуващите градини добивите са ниски и с незадоволително качество. Освен това, на този етап овошарската научната общност не е предоставила на производителите съвременна технология за отглеждането на тази овочна култура. Своевременните мерки, които трябва да се предприемат в тази

and under irrigation; while the extensive ones – on poorer soils in semi-mountainous regions, where the advantages of organic farming could be sought.

At the present stage of the research studies in the country, both types of plantations do not obviously express the advantages of the training systems and the choice of the cultivar/rootstock combinations. Future investigations in that direction should be targeted at, with the aim of finding the cultivar/rootstock combinations that are resistant or tolerant to fire blight (E. amilovora) and pear psylla (C. pyri L.), and the trees are suitable to be trained for both types of orchards.

PERSPECTIVES

Perspectives of pear growing in Bulgaria are not good for the next 8-10 years, despite the suitable soil and climatic conditions in the country.

That statement is proved by the fact that the areas planted with the crop have been dramatically decreasing, the yields obtained from the existing pear orchards are low and fruit quality is unsatisfactory.

Besides, the fruit-growing scientific community has not offered the producers a modern technology of growing the pear crop. Timely measures should be adopted in that direction, as
follows:
- Making a research team comprising of different specialists, who should implement a modern project on pear production problems;
- Improving the technology of producing grafted planting material of pear cultivars requiring the use of interstocks;
- Introducing modern cultivars and rootstocks, resistant or tolerant to the bacterial disease fire blight (E. amylovora) and pear psylla (C. pyri L.).
- Producing virus-free grafted and micropropagated pear planting material;
- Carrying out research trials with traditional and newly introduced cultivars, rootstocks and cultivar/rootstock combinations in the area of in vitro propagation and production of planting material, pruning, plant protection, fertilization and irrigation.

The final aim of the research studies is to develop technologies, which could be applied in the different soil and climatic regions of the country: a technology of intensive growing; a technology of organic pear production in extensive orchards; a technology of growing in vitro propagated pear cultivars requiring an interstock and own-rooted without grafting on a rootstock.

Eliminating the need of the
Quince rootstock could eventually prove the resistance of pear cultivars to a number of diseases and pests and the positive information about the behavior of the cultivars grown on own roots, could provide an alternative opportunity for establishing orchards with that type of planting material.

At present fruit-growing research community faces a real challenge, the solving of which should stimulate pear production in Bulgaria.

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