

## Comparative investigation of black currant varieties – phenology, yield, fruit weight

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### SUMMARY

The investigation was carried out in the period 2014-2017 and included five Russian black currant varieties – Doch Pamyati, Seyanets Golubki, Studencheskaya, Chernaya grozd, Chernaya krupnoplodnaya and the standard Titania. In the conditions of Kostinbrod region the varieties Doch Pamyati, Seyanets Golubki and Studencheskaya reveal themselves as mid-blooming whilst Chernaya grozd and Chernaya krupnoplodnaya are late-blooming. The same sequence is observed with the ripening phase of the berries. In the period of investigation all varieties show poor fruitfulness. Very low yield have the varieties Chernaya krupnoplodnaya, Chernaya grozd and Seyanets Golubki. A little better yield but still below 1,00 kg/bush have the control variety Titania as well as Doch Pamyati and Studencheskaya. The fruitfulness of Studencheskaya and Doch Pamyati is greater than the one of Titania but the differences are insufficient and unproved,

0.68 g 0.79 g.  
(0,92 g).

which shows their similar qualities. The average berry weight varies from 0,68 g to 0,79 g. The varieties Doch Pamyati, Studencheskaya, Chernaya grozd, Chernaya krupnoplodnaya are medium-sized. None of the tested varieties surpasses the standard Titania which has the largest berries (0,92 g). A tendency of slight superiority of Studencheskaya and Doch Pamyati over the control variety Titania can be outlined as regards yield.

**Key words:** investigation, varieties, black currant, phonological, yield, average weight

## INTRODUCTION

Black currants contain many vitamins and are a good combination of sugars, organic acids, mineral salts, pectin, microelements and other bioactive compounds. This diverse biochemical composition of currants implies the therapeutic and prophylactic importance of black currant.

Black currant has specific characteristics and requirements which let it reveal to the greatest extent its valuable biological and economical qualities under certain environmental conditions. It blooms in early spring and April frosts can lead to blossom damages. Around 15-20 years ago the black currant blooming period under the conditions of the region of Kostinbrod used to start in the middle of April and lasted to the first week of May while now it takes place 6 to 9 days earlier. That makes the mid- and late blooming varieties preferable. To create new varieties having different ripening times has turned into an actual topic recently as this can prolong yielding periods. Planting more and more late-ripening varieties turns into a necessity.

Black currant variety lists continuously get richer owing to the fruitful work of foreign selectionists. Nowadays not all varieties are valuable for the black currant production sector. In the course of

(Shavyrkina and Knyazev, 2014; Stoyanova et al., 2015).

0,6-0,9 g.

g.

1,8-3,4

(Knyazev and Ogol'tsova, 2004).

time varieties recommended for creating plantations change as new ones appear. The choice of varieties is still dominated by high yield requirements. As regards yield increase an important factor is the selection of varieties which best adapt to the certain climatic conditions. Yield and fruitfulness vary depending on variety choice, climatic conditions and used agrotechnics. Some of the primary factors affecting yield are fruit/berry weight, number of clusters and shoots etc. (Shavyrkina and Knyazev, 2014; Stoyanova et al., 2015).

Black currant is a small fruit plant. Most old varieties have berries weighing between 0,6 g and 0,9 g. As a result of selection work there have been created varieties with berries weighing 1,8-3,4 g. Varieties having large berries often show poor fruitfulness. A negative correlation between berry weight and fruitfulness is found out, which predetermines the importance of the rest of the variety traits (Knyazev and Ogol'tsova, 2004).

The collection of black currant varieties that has been gathered and maintained in the course of time allowed us to carry out this investigation so that some phonological and fertility characteristics could be specified in order that we can nominate the most fruitful and varieties appropriate to grow under the certain climatic conditions in the region.

## MATERIAL AND METHODS

The investigation was carried out at the Small Fruit Crops Department in Kostinbrod in the period 2014-2017 and includes five black currant varieties introduced from Russia – Doch Pamyati, Seyanets Golubki, Studencheskaya, Chernaya grozd, Chernaya krupnoplodnaya and the standard Titania. The soil type is chernozem with low acid reaction (pH 5.5-6.5) and the altitude is 560 m. The plants were established in rows 2.5 x 0.8 m and the distance between the varieties is 1 m. Twenty (20)

(2014-2017

.)

5.5-6.5)

(pH – 560 m.

2.50 m 0.80 m.  
20

).

(Nedev et al., 1979)

(Boicheva et al., 2003).

LSD-

plants of each variety were involved in the investigation (each repetition group included 5 plants). The experimental plantation was grown in accordance with an adopted technology but without irrigation. It was used Methods for studying of fruit crops (Nedev et al., 1979) and Methods for conducting variety comparisons of black currant for biological and economic characteristics (Boicheva et al., 2003). The period of investigation was not favourable since abrupt temperature fluctuations and high summer temperatures were registered.

The results were processed through statistical methods for variation (including LSD-criterion to prove statistical importance of the outlined differences between the standard and the variants).

## RESULTS AND DISCUSSION

Time and duration of flowering. Under the conditions of region of Kostinbrod black currant flowering is determined by the certain climatic conditions and genetic features of the varieties (Table 1).

( 1).

1. , 2014-2017 .  
**Table 1. Phenological observations of black currant varieties, 2014-2017**

Variety	/ Bloom			- ( /days) Duration	Ripening of fruit			- ( /days) Duration
	start	boom	end		start	boom	end	
Doch Pamyati	09.04.	13.04.	21.04.	12	20.06.	25.06.	06.07.	16
Seyanets Golubki	10.04.	13.04.	23.04.	13	22.06.	26.06.	07.07.	15
Studencheskaya	11.04.	17.04.	25.04.	14	25.06.	29.06.	10.07.	15
Chernaya grozd	16.04.	20.04.	01.05.	15	28.06.	03.07.	13.07.	15
Chernaya krupnoplodnaya	16.04.	19.04.	30.04.	14	28.06.	03.07.	13.07.	15
/Titania /standard	12.04	18.04	27.04	15	25.06	30.06.	10.07	15

(09 ),

- Doch Pamyati starts flowering earliest (09 April) closely followed by Seyanets Golubki and Studencheskaya

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 - ( 28 ).  
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 4-5 . 25  
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(10-11 April). Chernaya grozd and Chernaya krupnoplodnaya have late initial flowering (16 April). The mass flowering and its end follow the course of the initial one (19-20 April for the beginning of the mass flowering and 30 April – 1 May for its end). The variety differences regarding flowering are around 7-10 days.

Depending on the time when flowering starts Doch Pamyati, Seyanets Golubki, Studencheskaya and the standard Titania are mid-flowering whilst Chernaya grozd and Chernaya krupnoplodnaya are late-flowering. The flowering duration of the studied varieties is of medium length, around 12-15 days.

Time and duration of fruit ripening. The course of ripening of berries follows the one of the flowering. In region of Kostinbrod the berries of Doch Pamyati and Seyanets Golubki start ripening earliest (20 and 22 June) followed by Studencheskaya and the standard Titania (25 June) whilst Chernaya grozd and Chernaya krupnoplodnaya ripen latest (28 June). The variety differences as regards the beginning of fruit ripening are 7 days. Mass ripening starts 4-5 days after the initial one. It starts on 25 June for Doch Pamyati and lasts till 03 July for Chernaya grozd and Chernaya krupnoplodnaya. The standard reveals itself as a medium flowering variety. Later flowering is an advantage that is especially valuable as regards prolonging of the harvest period. The varieties do not show significant differences regarding the duration of fruit ripening.

Taking into account the time of fruit ripening Doch Pamyati, Seyanets Golubki, Studencheskaya and the standard Titania can be described as medium-early ripening whilst Chernaya grozd and Chernaya krupnoplodnaya as medium-late.

The climate in the years of the investigation was milder than in the preceding time periods. The time of

6-9

flowering and fruit ripening was around 6-9 days earlier compared with preceding years.

Yield is one of the most important biological indicators. Under the conditions of Kostinbrod region the introduced varieties not always demonstrate to the desired degree their genetically predetermined traits (Table 2).

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2.

(g) (kg/ .)

**Table 2. Comparative analysis of traits average weight of berries (g) and average yield (kg/bush)**

Trait \ Variety	Doch Pamyati	Seyanets Golubki	Studencheskaya	Chernaya grozd	Chernaya krupnoplodnaya	Titania standard	LSD		
							0.05	0.01	0.001
<b>2014</b>									
average mass (g)	0.76ns	0.75ns	0.73ns	0.55ns	0.75ns	0.9	6.885	9.787	0.1417
yield per bush (kg/ .)	0.76ns	0.45++	0.53+	0.54+	0.42++	0.85	0.2766	0.3933	0.5695
<b>2015</b>									
average mass (g)	0.82ns	0.61ns	0.62ns	0.75ns	0.77ns	0.94	7.961	0.1131	0.1638
yield per bush (kg/ .)	1.05ns	0.54+	1.15ns	0.8ns	0.46++	0.899	0.2894	0.4115	0.5958
<b>2016</b>									
average mass (g)	0.85+	0.77++	0.83+	1.05ns	0.85+	1	0.1333	0.1895	0.2745
yield per bush (kg/ .)	1.05ns	0.53+++	0.97ns	0.34+++	0.43+++	1.07	0.2205	0.3135	0.4539
<b>2017</b>									
average mass (g)	0.72ns	0.57ns	0.77ns	0.61ns	0.75ns	0.85	7.235	0.1028	0.1489
yield per bush (kg/ .)	0.58ns	0.43++	0.83++	0.25+++	0.2+++	0.6	0.1189	0.169	0.2447
<b>2014-2017</b>									
average mass (g)	0.787ns	0.677ns	0.74ns	0.74ns	0.783ns	0.923	4.558	6.479	0.0938
yield per bush (kg/ .)	0.859ns	0.489+++	0.870ns	0.482+++	0.378+++	0.854	0.1083	0.154	0.223

ns – ; + (P<0.05); ++ (P<0.01); +++ (P<0.001)

0,200 kg/ ( )  
 1,150 kg/ ( ).  
 (0,866 kg/ ),  
 -  
 (0,378 kg/ ).

During the investigation period the actual yield varies over the years from 0,200 kg/bush (Chernaya grozd) to 1,150 kg/bush (Studencheskaya). The greatest average yield has Studencheskaya (0,866 kg/bush) followed by Doch Pamyati and the standard Titania whilst Chernaya krupnoplodnaya has the lowest one (0,378 kg/bush).The differences

2017 .

0,500 g/ .  
 (0,378 kg/ .),  
 (0,482 kg/ .)  
 (0,488 kg/ .),  
 (0,859 kg/ )  
 (0,866 g/ .).

1,8-3 g. -  
 1,2-1,5 g ( 2).

0.55-1.05 g.  
 0.68 g 0.79 g.

between the studied varieties are not great, which shows their similar abilities. In 2017 the varieties demonstrated the lowest fruitfulness compared by the one they had in the previous years of the investigation.

All of the studied varieties show poor fruitfulness. Very low yield below 0,500 kg/bush have Chernaya krupnoplodnaya (0,378 kg/bush), Chernaya grozd (0,482 kg/bush) and Seyanets Golubki (0,488 kg/bush). A little greater yield have Doch Pamyati (0,859 kg/bush) and Studencheskaya (0,866 kg/bush). Under the climatic conditions of our region the studied varieties cannot demonstrate their fruitfulness to the desired degree.

Studencheskaya and Doch Pamyati are a bit more fruitful than the standard Titania but the differences are not great and not proven. The fruitfulness of Titania is greater than those of Seyanets Golubki, Chernaya grozd and Chernaya krupnoplodnaya.

The unsatisfactory yield is probably due to the unfavourable climatic conditions in the period and the genetic specifics of the varieties.

Average weight is one of the factors contributing to the yield rate. Average weight is genetically predetermined but directly dependent on climatic conditions. In the recent years Russian selectionists have achieved very good results creating varieties with fruit weight over 1,8-3 g. Big-fruit varieties having berry weight over 1,2-1,5 g are the most desired (Table 2).

The studied varieties are of Russian origin and when grown without irrigation show certain variation regarding fruit weight (0,55-1,05 g).

The average fruit weight varies between 0,68 g and 0,79 g. Seyanets Golubki has small berries which are close to the medium-weight ones. The rest of the varieties have medium-weight berries.

None of the studied varieties surpasses

1,05 g,  
(0,92 g).

1,05 g,  
(0,55 g),

2016

(1,05 g)

- the standard Titania which has the greatest berries (0,92 g). In one of the years of the period the berries of Chernaya grozd reach 1,05 g and in another year they are small – only 0,55 g, which shows the great variation of the average weight and reveals instability of this trait and of the individual abilities of the variety.

- None of the studied varieties is a big-fruit. In 2016 the varieties have the largest berries but this is combined with poor fruitfulness. Chernaya grozd, the variety that have the greatest average fruit weight of 1,05 g during one of the years is not of interest as despite its big berries its fruitfulness is very low.

- The studied varieties have unproved differences compared to the standard Titania.

Under the conditions of Kostinbrod the studied varieties do not produce large berries to the desired degree.

- The trait fruit weight is mostly connected to growing conditions especially in time when berries grow and get large and in this relation wetter years contribute to the best performance of this trait.

- Under the certain climatic conditions the studied varieties cannot demonstrate entirely their inherent genetic abilities and do not perform well. The performance of the varieties is unsatisfactory mainly as regards Chernaya grozd, Chernaya krupnoplodnaya and Seyanets Golubki and these varieties cannot be recommended for commercial growing.

## CONCLUSIONS

- According to the start of flowering the varieties Doch Pamyati, Seyanets Golubki, Studencheskaya and the standard Titania are mid-flowering whilst Chernaya grozd and Chernaya krupnoplodnaya are late-flowering.



		0,500 g/
(0,378 kg/ .),	(0,482	
kg/ .)	(0,488 kg/ .),	
(0,859 kg/ .)	(0,866	
g/ .).		
0.68 g	0.79 g.	
	(0,92 g).	

As regards ripening time the berries of Doch Pamyati, Seyanets Golubki, Studencheskaya and the standard Titania turn out to be mid-early ripening whilst the ones of Chernaya grozd and Chernaya krupnoplodnaya are mid-late ripening.

In the period of the investigation all the varieties have poor fruitfulness. Very low yield below 0,500 kg/bush have Chernaya krupnoplodnaya (0,378 kg/bush), Chernaya grozd (0,482 kg/bush) and Seyanets Golubki (0,488 kg/bush). A little greater yield have the standard Titania and the varieties Doch Pamyati (0,859 kg/bush) and Studencheskaya (0,866 kg/bush). There is a tendency of slight domination of Doch Pamyati and Studencheskaya over the standard Titania.

The average weight of a berry varies between 0,68 g and 0,79 g. Seyanets Golubki has small berries. The rest of the varieties can be classified as having medium-sized berries. None of the varieties surpasses the standard Titania which gives the largest berries (0,92 g).

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## State-of-the-art of actinidia (kiwi) production and perspectives for development in Bulgaria

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### SUMMARY

Kiwi is one of the most interesting fruits in the world. The search of the higher-quality fruit has been growing, despite of the price and the changing market tendency. Fruit get realization in inner and international market. It brings about a mass production of planting material and creates new seeding. The growing interest is primarily due to the biochemical composition of fruit meat, which includes an extremely rich content of Vitamin C (twice higher than the lemon one). The review shows that during the past 35 years the kiwi production has been a precedent in the world fruit-growing practice for a dynamical development of a new fruit-bearing culture concerning production of fruits, areas and average yields. The world kiwi market will continue to grow fast in response to the factors in and out of industry. These changes will acquire a new way of thinking and a new operational approach by manufacturers, packers, marketing and scientists- researchers. Bulgaria is one of the countries with a certain potential in

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increasing the yields. However, the quality  
 rise could be realized by only intensifying  
 the production which requires high  
 technological decisions in all parts of the  
 production process and implementing  
 high yield new cultivars with a higher  
 water resistance, also appropriate in the  
 northern parts of the country.

**Key words:** kiwi, production,  
 intensification

Actinidia, also known as Kiwi fruit,  
 or Chinese grapes, fruiting vine native in  
 southwestern China. As a single family  
 Actinidia as a member of Dilleniaceae,  
 contains more than 50 sorts, grouped in 4  
 sections. The most popular sorts to have  
 business significance are Actinidia  
 chinensis Planch Actinidia deliciosa  
 Chev from which many of the growing  
 ones have derived so far.

As an orchard culture Actinidia has  
 been growing since the middle of 19<sup>th</sup>  
 century but the biggest merit for its  
 examination and distribution is due to  
 New Zealand fruit-growers. It is namely  
 the place where the plant found its second  
 motherland and got its name Kiwifruit or  
 Kiwi, dedicated to the bird – a symbol of  
 the country. Hayward Right made the  
 selection activity and in 1928 they got  
 varieties of big fruits.

Nowadays 90% of the created and grown  
 throughout the world Actinidia plantations  
 are the same varieties (Zahov, 2005).  
 Despite the changing market tendencies,  
 the demand of more quality fruit has been  
 growing apart from the price (Carlos,  
 2014). Produced fruits find realization in  
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 brings about a mass production of  
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 seeding.

In Europe the creation of small industrial  
 plantations started in the mid 1970s but  
 the fastest development of this culture is

increasing the yields. However, the quality  
 rise could be realized by only intensifying  
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seen in Italy, followed by France and Greece. The unique Kiwi characteristics are due to the to the biochemical composition of fruit meat, which includes an extremely rich content of Vitamin C (twice as big as the lemon), high content of Vitamin C, Calcium, Iron, Phosphorus, Proteins and a lot of other useful qualities. Kiwi contains the Actin enzyme which contributes for the whole absorption of the fruit meat by the human being.

Actinidia is called “Healthy fruit” by the East Peoples because of the high content of vitamins, especially Vit C. It is highly recommended to consume in conditions of exhaustion and weakness, after severe infectious diseases, after physical or mental stress, remiss digestion or Lazy bowel syndromes (Kornova and Djeneva 2010; Göksel and Atak, 2015).

The precious fruit qualities and their storable ability that give the opportunity for longer market supply and the recent higher demand in the pastry industry assign Kiwi growing into two guidelines – as well as providing quality fruit and a possibility for running a good business.

In Bulgaria the first Actinidia 8 da planting was made with French planting material near Varna in 1976. Then other plantations have been made in Byala, Pomorie, Tsarevo and Petrich.

Kiwi fruit production tendencies for Bulgaria, the first 4 countries producers in the world, according to FAOSTAT data during the period 1980-2016 are presented on Figure 1. During the period the production on a world scale recorded remarkable growth. The data show 160 times increase – from 27000 t in 1980 to 4275000 t in 2016. During the 1980s Italy occupies the position of the biggest kiwi producer in the world after using the existing technology and infrastructure for

- grapes growing. Combining its closeness to European market, the low transport expenses and the EU subsidies, Italian producers managed to lower the price and to replace competitors from New Zealand. Since 2000 in China a serious subsidizing of this culture began, the infrastructure and its conditions for growing improved and as a result of this China became the biggest producer in the world nowadays.

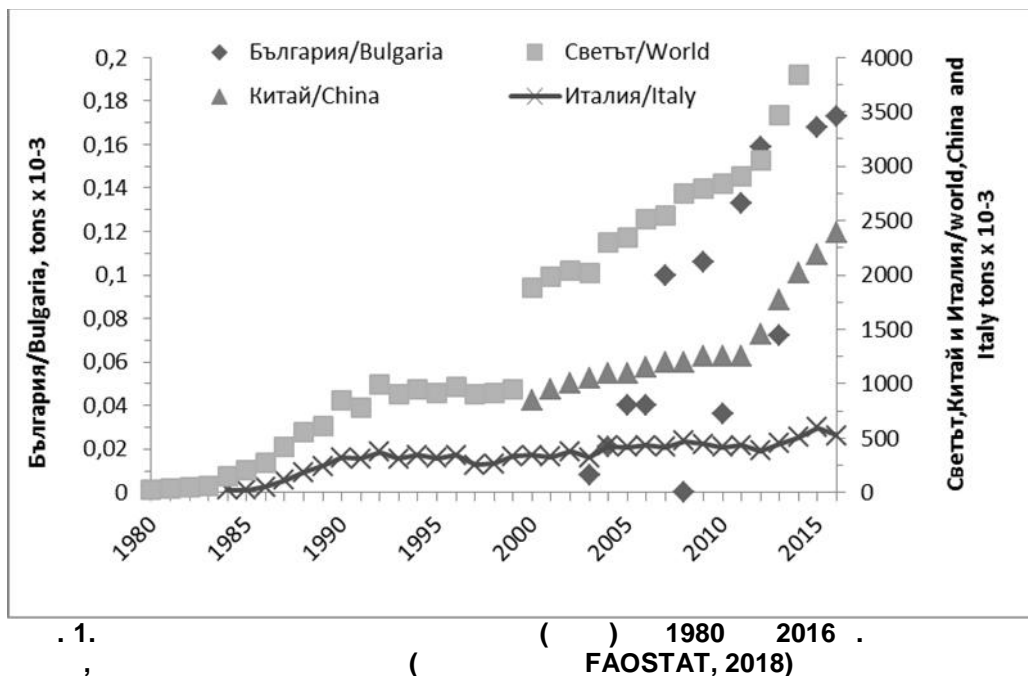


Fig. 1. Production of kiwi fruit (metric tons) from 1980 till 2016 in Bulgaria, China, Italy and total in the world (data from FAOSTAT, 2018)

The world trade production of Kiwi at the moment exceeds 4000 million tons per year. China produces about a half of the whole production. Italy, New Zealand and Chile are the other countries which provide about 80% of the production outside China (Ferguson, 2015). In 2016 the world Kiwi fruit production is 4274870 t. The biggest producer is China with 2390287 t a year, followed by Italy - 523595 t, New Zealand - 434048 t and Chile – with 225797 t, as the four countries provide approximately 84% of

225797 t,  
84%  
22-  
173 t.  
2.  
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6890 ha 277527  
ha.,

the world production. Bulgaria stands far from the world producers and holds the 22<sup>nd</sup> position with annual production of 173 t.

35-year old data for occupied kiwi plantation areas are presented in Figure 2. On a world scale it hasn't been observed so far such fast areas increase for such a period with another fruit-bearing culture, having in mind numerous unknown connected with the biology of Kiwi and the influence of ecological factors. During this period the areas have risen 40 times from 6890 ha to 277527 ha. As since the beginning of the new century China has dominated.

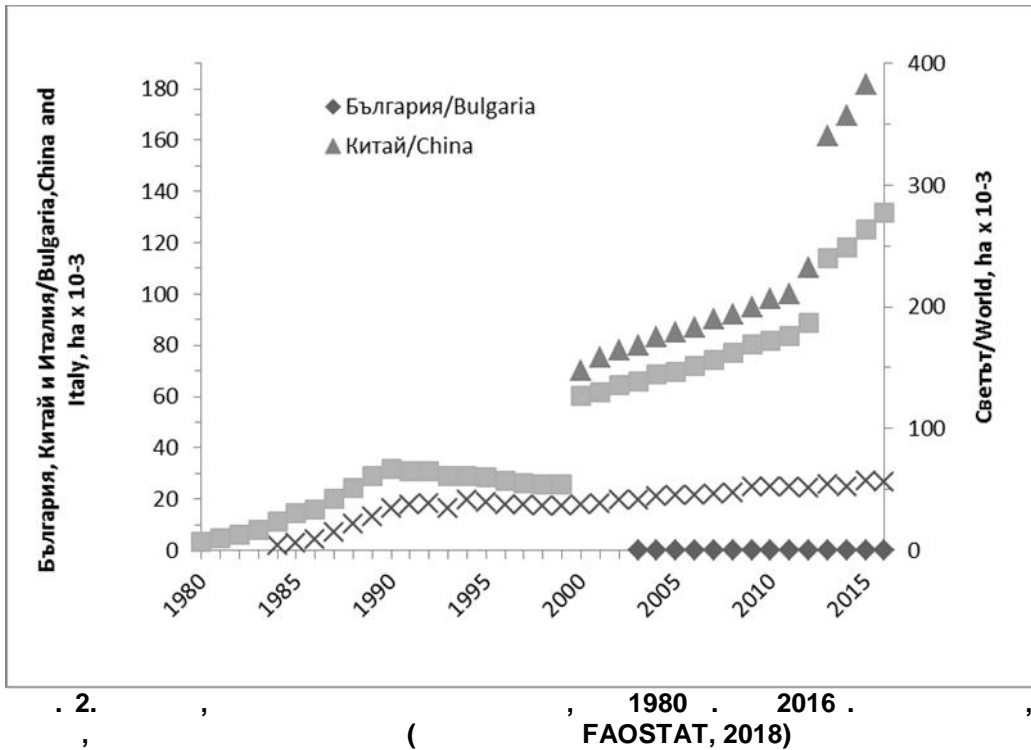


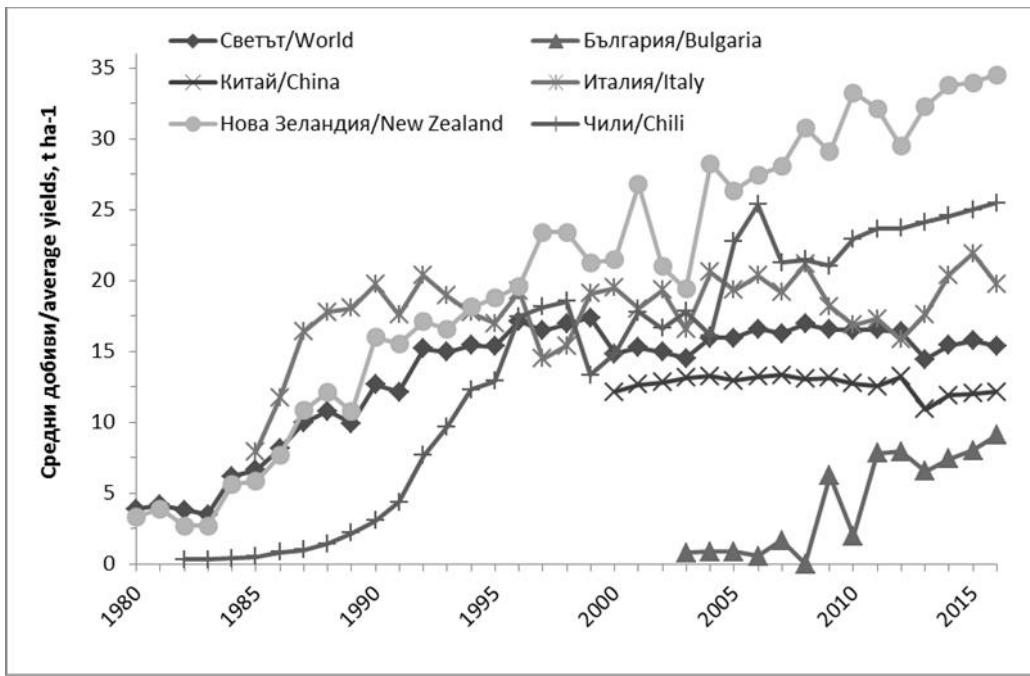
Fig. 2. Area occupied by kiwi plantations from 1980 till 2016 in Bulgaria, China, Italy and total in the world (data from FAOSTAT, 2018)

( 3)

Data on average yields (Figure 3) shows that yields on a unit area have been continuously increasing on a global scale. That confirms the fact that highly

12-20 t/ha  
 35 t/ha,  
 t/ha.  
 8-9 t/ha

- productive cultivars have been used and modern cultivation technologies are applied. That's why an average yield of 12-20t/ha is absolutely normal for the modern crop.
- Yields in the leading countries –producers New Zealand and Chile are between 25 and 35t/ha and in China they are about and above 12t/ha.
- In comparison yields in Bulgaria have revealed an unfulfilled productive potential in the sector for the last years.



3. ( FAOSTAT, 2018)  
**Fig. 3. Average yields of kiwi fruit from 1980 till 2016 in Bulgaria, other countries and average for the world (data from FAOSTAT, 2018)**

- Although Actinidia is a thermophilic culture in Bulgaria there are regions with appropriate conditions for its growing.
- In many countries a selection activity for creating cultivars with high stool resistance, self-pollination and better taste qualities has started. That helps for expanding of production not only in the southern regions near the Black Sea coast but in other parts of the country

(Dyankov and Djeneva 2004).  
FAOSTAT

10 ha	2003	70 ha	2006
18-25 ha.			
8 t/ha	2003	173 t/ha	2016

2011).

(Costa, 1999; Pancino et al., 2011).

(O'Rourke,

with a colder climate.

The first Actinidia plantations in our country were made in the late 1970s. A factor for the slow spreading of the culture in Bulgaria is the occurred economical reform as a result and also the lack of enough literary sources and knowledge about the possibilities for growing it here in our country (Dyankov and Djeneva, 2004). According to FAOSTAT data for the last 13 years in our country the areas increased from 10 ha in 2003 reaching its peak -70 ha in 2006. During the past 10 years they decrease and fluctuate around 18-25 ha. However, fruit production considerably increased from 8 t/ha in 2003 to 173 t/ha in 2016 which is over 20 times more.

The review shows that for the past 35 years Kiwi fruit production has been a precedent in the world fruit-growing practice for a dynamic development of a new orchard culture including fruit production, areas and average yields. Fruit production has increased as a result of increasing Kiwi planted areas –a fact that can be considered as a testimony for the extensive nature of the production.

The world Kiwi market is going to change fast in response to factors in and out of industry. These changes are going to acquire a new way of thinking and new operational approaches by the producers, manufacturers, packers, marketing and scientists- researchers. It is necessary to diminish the expenses, to rise up the efficiency of production and to implement new cultivars (O'Rourke, 2011). An economical evaluation of the systems for growing is needed – organic, integrated and the conventional by using the yields case study, the size of the fruit, quality characteristics gained and prices, got from the three different systems (Costa, 1999; Pancino et al., 2011). It is obvious that the arrangements for solving that difficult task need to be multi-directional.



- Bulgaria is one of the countries with a certain potential in increasing the yields. However, the quality rise could be realized by only intensifying of production which requires high technological decisions in all parts of the production process and implementing high yield new cultivars with a higher water resistance, which are also appropriate for the northern parts of the country.

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