UDC 575:630
DOI: 10.2298/GENSR1501033M
Original scientific paper

INVESTIGATION OF THE MORPHOMETRIC CHARACTERISTICS OF JUJUBE TYPES (*Zizyphus jujuba* Mill.) FRUITS IN REPUBLIC OF MACEDONIA

Aleksandar MARKOVSKI[1*] and Lence VELKOSKA-MARKOVSKA[2]

[1] Institute of Agriculture, "Ss. Cyril and Methodius" University in Skopje, Skopje, Macedonia
[2] Faculty of Agricultural Sciences and Food, "Ss. Cyril and Methodius" University in Skopje, Skopje,Macedonia

Markovski A. and L. Velkoska-Markovska (2015): *Investigation of the morphometric characteristics of jujube types (Zizyphus jujuba Mill.) fruits in Republic of Macedonia.*- Genetika, Vol 47, No. 1, 33 - 43.

In the period 2002-2004 have been studied 131 Jujube types in the experimental orchards of Agricultural Institute in Skopje. They are progeny derived from six varieties of Jujube: Zu tao czao, Da baj czao, Kitajski 2A, Wild midleasiatic jujube type, Ja czao, Vahshski 45-2. The seeds of these varieties were obtained by open pollination. Studies were done on the 7-9 aged plants in full fertility. Characteristics of fruits, fruit dimensions and mass of fruit were determined. It was established that the variety Kitajski 2A has the largest fruits (13.1 g). The progeny of the same variety (Kitajski 2A) is characterized with the largest fruits (8.9 g), and the progeny of the variety with the smallest fruits between varity-mothers - Da baj czao is characterized with the smallest fruits (6.3 g). The type 21/6 has an average the largest fruits (22.2 g), while the smallest are the fruits of the type 16/4 (1.8 g). The fruits from type 21/6 are bigger than fruits of the biggest Jujube variety introduced in R Macedonia -Ta jan czao.

Key words: jujube, fruit, morphometric characteristics, open pollination, variety, types

INTRODUCTION

According to the characteristics of the fruit, Jujube belongs to the stone fruit kinds. The form of the fruit varies from round, oval to elliptical, size varies from size of cherry to size of plum, and some varieties can reach size large than chicken egg (Taiwan jujube varieties). Fruit stalk is short to very short. Epidermis of the fruit is a thin, shiny, red-brown, chocolate, light

Corresponding author: Aleksandar Markovski**,** Institute of Agriculture, "Ss. Cyril and Methodius" University in Skopje, 16-th Macedonian brigade 3A, 1000 Skopje, Macedonia, Tel fax: +389 2 323 0910, email: maraleks@yahoo.com

brown to black (SOLIMAN H.I., HEGAZI G.A.E., 2013). The stone is small, with long, smooth surface and shallow furrow, which is divided into two halves, with a clearly expressed peak. The fruit flash is solid or with spongy consistency, pleasant taste and aroma (CHEN, SCHIRAREND, 2007). The Jujube is generally a self-incompatible, so for maximum fruit production is needed another genotype, similar to some other fruit kinds, likes sweet cherry (RADIČEVIĆ, *et al*., 2013). Their fruits are very healthy food. Despite presence of many bioactive compounds, jujube is diseases and pests tolerant, so its fruits are less chemical polluted, because less usage of pesticides in the cultivation, compared with some other fruit kinds (VELKOSKA-MARKOVSKA, PETANOVSKA-ILIEVSKA, 2013).

The Jujube fruits grow through three periods of the fruit growth, until fruit maturity (MARKOVSKI, VELKOSKA-MARKOVSKA, 2014). The maturity of the fruits can be judged by the fruits colour. When fruits are with 50% pigmentation of dark brown colour they have the best taste and succulence. At full maturity, i.e. when the fruits are fully coloured they have inferior organoleptic properties, but they are good for drying. Statistically differences in variation of jujubes at immature and mature stages were found in their chemical and biological properties by metabolic profiling and cellular assays (CHEN *et al.*, 2015). Good indicator of the fruits maturity is their specific weight, content of total dry matter, sugar-acidic index (total sugars / total acids) (SHENGRUI Y., 2013). Lots of studies suggest that similar fruit weight cause similar dimensions of the fruits, because between the traits is found positive correlation (JAĆIMOVIĆ, BOŽOVIĆ, 2014).

The main disadvantage of Jujube as perspective fruit kind is that there are very few varieties with large fruits and high randman (GRYGORIEVA *et al*., 2014). Initiated by this fact we achieved mass selection to study the progenies of the introduced Jujube varieties.

MATERIALS AND METHODS

The investigations were performed under conditions of selection orchard with planting distance of 4 x 2 m, planted in 1997 with two years old seedlings of Jujube varieties. During the investigations, plants were 7-9 years old, apropos that were in the beginning of full fruitfulness. The plants were grown without intervened pruning, left to develop naturally shaped crown, specific for each genotype (MARKOVSKI, PETKOVSKI, 2012). A total of 131 genotypes (62% surviving rate) in the progenies, which were obtained by open pollination between six Jujube introduced varieties, were examined. 35 seedlings of each variety-mother were planted in. As a control were used 3 trees of six varieties-mothers with grafted technique “whip grafting” in 1998. Classification, according to size of fruit, is performed in three groups: with large, with medium and with small fruits. In the group with large fruits belong varieties/types with a mass of fruit greater than 12 g. In the group of medium fruit size varieties were varieties/types with a mass of fruit from 7 to 10 g. Varieties/types with a mass of fruit below 7 g belong to the group of small fruit varieties.

The parameters used in the dimension analysis of the fruits include height, width, mass of fruits, and their volume. The examination of the dimensions of fruits was made using computer software “Image J” with the help of “The digital image processing method” that performs precise analysis of the dimensions of the fruits, which is impossible to perform with the usual manners in such large numbers of samples (MARKOVSKI, VELKOSKA-MARKOVSKA, 2012). The examined properties were variational statisticaly processed according to Mudra in two levels of probability (0.05 and 0.01).

RESULTS AND DISCUSSION

Progeny of the variety Zu tao czao stand out: The type 37/1 is with the highest width, volume and mass of fruit (Tab.1). 25-29 % of types have a greater height, volume and mass and 38 % of the types have more wide fruits than the variety-mother Zu tao czao. The types with smaller fruits have higher specific mass of fruit, with rare exceptions. The statistical analysis show no significant differences between variety-mother and average of the types. The type 37/1 deviates significantly with regard to all parameters. In this progeny, the types 22/1 and 34/1 statistically significant deviated with regard to the average of height of the fruits, while the type 20/1 and 37/1 are very statistically significant deviated from the average of height of the fruits (Tab.1).

The fruit weight, yield/plant and pulp/stone ratio in 20 jujube cultivars showed high genetic coefficients of variation (Islam M.N. et al., 2010). According to Godara (AZAM-ALI *et al*., 2006) is observed that the coefficient of variation was the highest for fruit set (16.9) followed by the number of leaves per shoot (14.2), yield (12.9), fruit drop percentage, shoot length and tree height in jujube varieties. In our case coeficient of variation is the highest for the fruits volume and mass of the types (Tab. 1,2,3). OBEED (2008) studied thirteen major quantitative characters of Chinese jujube. There was significant difference among characters in level of variation.

At the variety Da baj czao can be separated the type 14/2 with the greatest height, width and volume of the fruits (Tab.1). The largest specific mass of the fruits has a variety-mother Da baj czao. The highest mass of the fruits has the type 3/2. The types, statistically very significantly, deviate from the variety-mother in terms of height and mass (24 % of the types), volume (20 % of the types) and width of the fruits (4 % of the types) (Tab. 1).

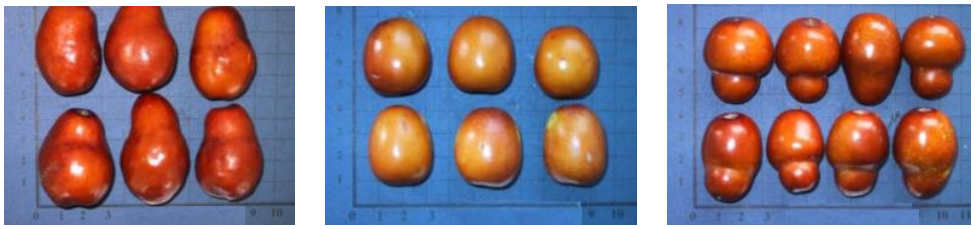
SARAN (2005) studied 10 quantitative characters for 35 genotypes. SARAN (2005) also observed that high estimates of genetic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance were recorded for stone size, pulp stone ratio, fruit weight and yield. It indicates the effectiveness of improvement through selection. He observed that fruit yield had positive and significant correlation with tree spread (0.319), fruit weight (0.515) and stone size (0.353). He also observed that fruit size (0.580) and flesh thickness (0.811) were indirectly contributing via fruit weight. Fruit weight (0.998) contributed to yield mainly through its direct effect followed by the indirect effect of stone size and number of flowers per cyme.

The fruit weight, yield/plant and pulp/stone ratio in 20 jujube cultivars showed high genetic coefficients of variation (ISLAM *et al*., 2010). According to Godara (AZAM-ALI *et al*., 2006) is observed that the coefficient of variation was the highest for fruit set (16.9) followed by the number of leaves per shoot (14.2), yield (12.9), fruit drop percentage, shoot length and tree height in jujube varieties. In our case coeficient of variation is the highest for the fruits volume and mass of the types (Tab. 1,2,3). OBEED (2008) studied thirteen major quantitative characters of Chinese jujube. There was significant difference among characters in level of variation.

At the variety Da baj czao can be separated the type 14/2 with the greatest height, width and volume of the fruits (Tab.1). The largest specific mass of the fruits has a variety-mother Da baj czao. The highest mass of the fruits has the type 3/2. The types, statistically very significantly, deviate from the variety-mother in terms of height and mass (24 % of the types), volume (20 % of the types) and width of the fruits (4 % of the types) (Tab. 1).

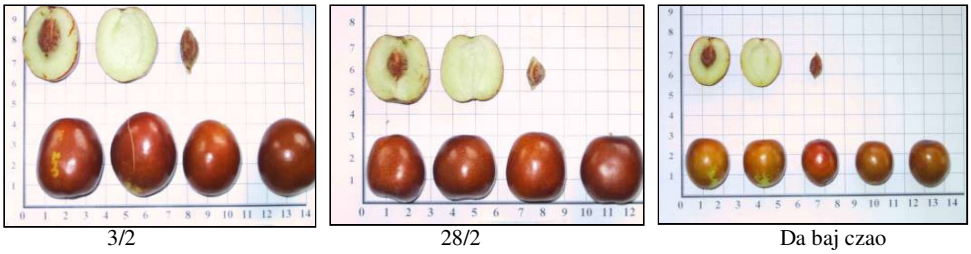
Table 1. Fruits size of Zu tao czao and Da baj czao varieties and their progenies

	Variety/ Type	Height (mm)	Width (mm)	Volume (cm^3)	Mass (g)		Variety/ Type	Height (mm)	Width (mm)	Volume (cm^3)	Mass (g)
	Zu tao czao $\bar{X}$	32.8	23.7	15.5	9.5		**Da baj czao $\bar{X}$**	22.1	18.4	5.9	4.8
P	**10/1**	34.8	24.6	17.5	9.4	**P**	**13/2**	27.8	17.5	7.7	4.9
	11/1	22.6	18.0	5.5	3.8		**14/2**	**38.6**	24.4	**20.3**	9.1
	13/1	28.3	17.3	7.6	4.1		**15/2**	20.1	17.2	4.7	3.1
R	**15/1**	19.8	19.5	5.3	4.1	**R**	**17/2**	30.4	19.3	9.8	5.9
	16/1	30.1	22.6	12.6	7.2		**18/2**	33.4	21.1	12.3	8.0
	17/1	30.9	26.1	16.0	10.7		**19/2**	32.4	20.2	11.7	7.1
O	**18/1**	27.0	22.0	10.3	6.4	**O**	**21/2**	29.3	21.6	11.2	7.1
	20/1	**43.9**	24.0	23.9	12.3		**22/2**	21.7	19.9	6.4	4.7
	21/1	29.8	25.1	14.3	8.9		**23/2**	28.5	21.0	10.2	6.0
G	**22/1**	39.6	24.0	21.7	11.7	**G**	**25/2**	32.6	21.3	12.7	7.6
	23/1	35.6	24.7	18.3	10.0		**26/2**	28.1	22.1	10.9	6.3
	25/1	32.0	23.0	14.5	9.0		**28/2**	29.6	23.7	13.6	8.2
E	**26/1**	32.9	24.0	15.5	8.9	**E**	**29/2**	28.0	18.8	8.5	4.7
	27/1	19.2	18.7	4.8	3.5		**3/2**	34.4	**27.0**	19.9	**10.9**
	28/1	36.9	24.3	18.7	10.2		**30/2**	26.6	18.5	7.6	5.0
N	**29/1**	27.9	18.4	8.3	4.7	**N**	**31/2**	30.3	22.0	12.2	6.7
	32/1	30.4	22.3	12.4	7.1		**32/2**	28.9	20.3	9.9	6.1
	33/1	34.9	22.7	15.5	8.4		**33/2**	27.1	18.1	7.8	4.6
Y	**34/1**	37.3	20.1	14.7	7.1	**Y**	**35/2**	29.8	23.9	16.1	8.2
	35/1	28.2	24.2	12.3	8.0		**36/2**	31.0	22.6	13.0	8.0
	37/1	41.4	**28.5**	**28.4**	**13.4**		**37/2**	22.7	20.0	7.2	4.8
	6/1	27.2	20.0	9.3	5.4		**6/2**	31.6	21.6	12.5	6.8
	7/1	25.9	20.4	8.5	5.4		**7/2**	27.6	19.6	9.1	5.4
	8/1	19.5	16.9	4.2	3.1		**8/2**	22.4	19.5	6.4	4.5
							9/2	21.7	16.1	4.6	3.1
	Type $\bar{X}$	**30.8**	**22.2**	**13.4**	**7.6**		**Type $\bar{X}$**	**28.4**	**20.6**	**10.5**	**6.3**
	CV% =	22	14	47	39			15	12	38	30
	Lsd $_{0.05}$=	4.4	3.1	5.5	2.9			6.7	4.5	5.3	2.3
	Lsd $_{0.01}$=	5.8	4.1	7.3	3.8			8.9	5.9	7.1	3.1



37/1 17/1 Zu tao czao

Fig. 1. The large fruit types of the variety Zu tao czao progeny



3/2 28/2 Da baj czao

Fig. 2. The large fruit types of the variety Da baj czao progeny

26/3 21/3 Ja czao

Fig. 3. The large fruit types of the variety Ja czao progeny

35/4 29/4 Wild Midleasiatic Jujube

Fig. 4. The large fruit types of the Wild form progeny

SARAN (2005) studied 10 quantitative characters for 35 genotypes. SARAN (2005) also observed that high estimates of genetic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance were recorded for stone size, pulp stone ratio, fruit weight and yield. It indicates the effectiveness of improvement through selection. He observed that fruit yield had positive and significant correlation with tree spread (0.319), fruit weight (0.515) and stone size (0.353). He also observed that fruit size (0.580) and flesh thickness (0.811) were indirectly contributing via fruit weight. Fruit weight (0.998) contributed to yield mainly through its direct effect followed by the indirect effect of stone size and number of flowers per cyme.

The type 26/3 of progeny of the variety Ja czao is characterized by the greatest height, volume and weight of the fruits. The lowest height of the fruits has the type 15/3, and the smallest width, volume and mass of the the fruits has the type 13/3. The greatest specific mass has the type 15/3, and the lowest specific mass has the type 38/3 (Tab.2). Very significantly deviation of the variety-mother have the types in terms of width (9 % of the types), mass (23 % of the types) and volume of the fruits (5% of the types) (Tab.2). No significant differences between the variety-mother and the average of progeny compared with height, width, volume and mass of fruits (Tab.2).

According to Godara (AZAM-ALI *et al*., 2006) correlation and path coefficients of 35 jujube genotypes indicated that the traits like fruit weight, fruit size and stone size should be given due consideration while performing selection for yield in segregating generations of jujube. So spread, fruit weight, stone size and fruit size were found to be effective selection indices.

In the progeny of the type-mother Wild Midleasiatic Jujube the type 27/4 has the highest height and volume, and the type 35/4 has the highest width and mass (Tab.2). The type 16/4 has the lowest height, volume, width and mass of the fruits. 38 % of the types exceed the height, and 81 % exceed the width of the fruits of the variety-mother Wild Midleasiatic Jujube. There is no statistically significant difference between the types in terms of height and width. 9 % of the types statistically significantly exceed the width, while 23 % of the types very significantly exceed the mass of the fruits. 9.5 % of the types very significantly exceed the fruits of the variety - mother in terms of cross-sectional surface. Fruit weight, fruit size and stone size were the main contributors towards yield which contribute via fruit weight (SARAN, 2005).

Within the progeny of the variety-mother Vahshskij 45/2 stands the type 17/5 (in terms of height and volume of the fruits), the type 25/5 (in terms of mass of the fruits), while the lowest area, perimeter and height of the fruits has the type 33/5 (Tab. 3). The greatest width of the fruits is characterized variety-mother, Vahshski 45/2. The smallest width has the type 16/5, and the smallest mass has the type 27/5.

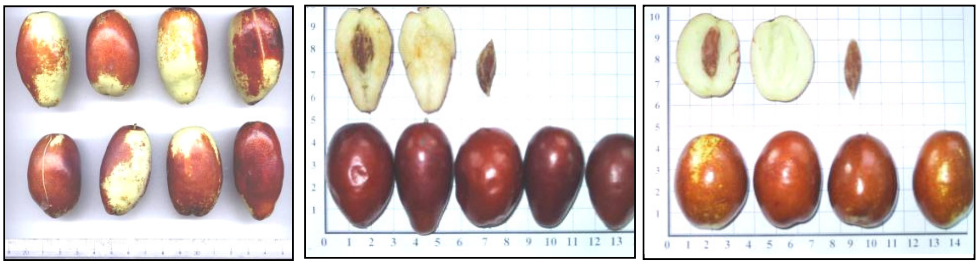
There is statistical significant difference in 5.5 % of types compared with variety-mother according to the parameters: mass and volume of the fruits. In terms of height and width of the fruits no statistically significant difference between the variety-mother and the types exist (Tab. 3). Twelve cultivars evaluated for ten economic characters showed high heritability with high genetic advance for fruit weight and leaf length (GUPTA and MEHTA, 2000).

Table. 2. Fruits size of Ja czao and Wild M. Jujube varieties and their progenies

	Variety/ Type	Height (mm)	Width (mm)	Volume (cm^3)	Mass (g)		Variety/ Type	Height (mm)	Width (mm)	Volume (cm^3)	Mass (g)
	Ja czao X	**34.8**	**18.8**	**11.8**	**6.0**		**Wild M. Jujube X**	**23.2**	**20.2**	**4.7**	**5.2**
P	**12/3**	29.2	21.1	10.7	7.9	**P**	**10/4**	28.9	15.2	5.6	4.6
	13/3	22.1	16.1	4.7	4.5		**13/4**	26.3	20.3	9.0	5.5
	14/3	34.7	23.1	16.1	10.0		**14/4**	20.3	18.6	5.5	5.0
R	**15/3**	21.4	16.5	4.7	4.7	**R**	**16/4**	16.4	13.8	2.6	1.8
	16/3	31.3	20.1	11.6	6.4		**17/4**	31.6	24.9	14.8	9.4
	17/3	38.2	20.0	14.8	7.4		**18/4**	28.3	20.2	9.8	5.6
O	**19/3**	25.8	18.1	6.6	4.5	**O**	**19/4**	29.9	20.5	10.7	6.0
	20/3	39.2	24.0	20.2	10.7		**21/4**	33.0	26.7	18.4	11.1
	21/3	39.4	24.7	21.6	11.5		**22/4**	30.1	21.3	11.7	6.5
G	**22/3**	28.7	24.4	13.2	8.2	**G**	**23/4**	33.4	22.0	14.4	8.0
	23/3	29.0	21.2	10.9	6.2		**24/4**	37.9	22.5	17.4	8.3
	24/3	36.9	26.0	21.0	11.4		**25/4**	25.7	21.5	9.0	6.0
E	**25/3**	33.7	18.0	10.7	5.4	**E**	**26/4**	36.5	21.4	15.3	7.7
	26/3	**43.6**	24.5	**24.5**	**12.9**		**27/4**	**47.7**	22.2	**24.2**	9.6
	28/3	31.9	22.7	13.9	7.1		**28/4**	39.2	20.7	16.3	7.9
N	**30/3**	35.6	**26.1**	19.7	11.4	**N**	**29/4**	44.1	23.4	23.2	11.8
	31/3	31.8	22.5	17.5	7.5		**30/4**	31.5	17.5	9.1	4.6
	32/3	41.6	22.4	19.9	9.7		**31/4**	36.0	18.7	12.2	6.0
Y	**33/3**	28.5	20.1	9.7	5.7	**Y**	**32/4**	34.1	19.3	12.9	5.9
	37/3	27.6	21.9	10.4	7.0		**34/4**	42.6	21.7	19.8	8.8
	38/3	41.9	24.8	23.5	10.4		**35/4**	36.2	**28.0**	22.5	**13.3**
	Types X	**33.0**	**21.6**	**14.4**	**8.1**		**37/4**	39.4	23.9	20.3	9.1
							Types X	**32.7**	**21.1**	**13.5**	**7.4**
CV % =		19	14	41	32			22	16	43	36
$Lsd_{0.05}$ =		8.9	6.2	9.6	3.5			7.8	4.7	5.1	2.3
$Lsd_{0.01}$ =		11.9	8.3	12.7	4.6			10.4	6.3	6.8	3.0

25/5 17/5 Vahshskij 45/2

Fig. 5. The large fruit types of the variety Vahshskij 45/2 progeny



21/6 22/6 Kitajskij 2A

Fig. 6. The large fruit types of the variety Kitajski 2A progeny

Table. 3. Fruits size of varieties Vahshskij 45/2 and Kitajski 2A and their progenies

	Variety/ Type	Height (mm)	Width (mm)	Volume (cm^3)	Mass (g)		Variety/ Type	Height (mm)	Width (mm)	Volume (cm^3)	Mass (g)
	Vahshskij 45/2 X	38.4	25.8	21.9	11.7		**Kitajski 2A X**	38.6	26.4	20.1	13.1
P	**11/5**	31.0	22.4	12.8	7.1	**P**	**13/6**	22.4	17.6	5.5	3.4
	15/5	25.9	20.4	8.7	5.9		**14/6**	32.3	21.9	13.3	7.1
	16/5	25.8	18.6	7.3	4.9		**21/6**	**51.3**	**31.2**	**44.8**	**22.2**
R	**17/5**	**47.4**	24.0	26.8	12.7	**R**	**22/6**	44.5	28.7	32.0	16.0
	18/5	30.5	23.0	13.0	8.0		**24/6**	40.6	24.8	24.4	10.5
	19/5	35.3	21.4	14.6	7.7		**31/6**	31.6	19.7	10.8	5.8
O	**23/5**	28.1	24.5	12.7	8.0	**O**	**33/6**	22.3	20.1	6.6	4.6
	24/5	33.9	23.0	15.1	8.8		**37/6**	21.1	18.5	5.0	3.9
	25/5	43.9	**28.6**	**31.0**	**15.7**		**40/6**	33.0	23.7	15.3	8.6
G	**26/5**	43.1	20.4	20.8	9.4	**G**	**41/6**	39.1	24.5	20.9	10.3
	27/5	26.8	18.2	7.5	4.5		**9/6**	25.6	22.4	9.8	5.8
	31/5	35.1	20.1	13.3	6.2		**Types X**	**33.5**	**23.3**	**17.4**	**8.9**
E	**32/5**	37.1	24.7	20.2	10.2	**E**					
	33/5	22.7	19.0	6.4	4.7						
	35/5	31.7	23.4	14.2	8.2						
N	**38/5**	29.4	19.4	10.0	6.1	**N**					
	6/5	43.0	20.4	18.6	9.2						
	7/5	44.4	20.8	19.7	9.3						
Y	**Types X**	**34.3**	**22.0**	**15.5**	**8.1**	**Y**					
CV % =		22	12	44	35			30	18	73	64
Lsd $_{0.05}$ =		13.3	7.7	6.0	3.8			3.9	3.2	9.7	2.9
Lsd $_{0.01}$ =		17.7	10.3	8.0	5.1			5.2	4.2	13.0	3,9

In the frame of the progeny of the variety Kitajski 2A the highest width, height, volume and mass of the fruits has the type 21/6, the lowest height and volume of the fruits has the type 37/6, while the lowest mass and width of the fruits has the type 13/6 (Tab. 3). The type 21/6 has the largest fruits from the types in all researched progenies, as well as varieties-mothers of those progenies. The fruits of this type are larger than the fruits of one of the greatest introduced jujube variety in Macedonia, Ta jan czao variety. This our finding is more important according to Godara (AZAM-ALI *et al*., 2006), that the fruit length, fruit breadth and weight per fruit had low heritability along with low genetic advance, indicating that dominance of epistatic effect is of considerable value for these characters and hence little improvement in these characters is possible through selection.

The lowest height and volume of the fruits has the type 37/6. The greatest specific mass has the type 37/6, and the lowest specific mass has type 21/6, which is caracterized with the largest fruits. The statistics shows very significant differences in 19 % of the types in terms of variety, according to the height of the fruits and about 9 % in terms of width, volume and mass of the fruits (Tab. 3).

Fig. 7. The type 21/6 (upper row) of the progeny of the variety-mother Kitajski 2A with larger fruits than the variety Ta jan czao, which has the largest fruits between introduced jujube varieties

From our investigations, we can conclude that the largest fruit types are obtained in the progenies of the varieties Kitajski 2A and Vahshki 45/2 which are characterised with large fruits. We found certain influence of dominant maternal effect in the inheritance of the fruit mass and dimension in progeny. For example, the variety Kitajski 2A with the biggest fruits, in progeny, has the types with the biggest fruits, whiles the variety Da baj czao with the smallest fruits, has progeny with the smallest fruits. From all jujube progenies are selected eight types with larger fruit mass than 12 g, which, according to the classification, belong to the group of Jujube types with large size of the fruits. Is obtained jujube type (21/6) with almost double size of fruits than its largest fruit variety-mother Kitajski 2A. It can be recommended using of jujube varieties and forms with large fruits in jujube breeding, hybridization and selection programs for greater opportunity to select of more large fruit jujube types and hybrids from the progenies.
Fig. 7

Received April 15th, 2014
Accepted October 05th, 2014

REFERENCES

AZAM-ALI S, E. BONKOUNGOU, C. BOWE, C. DEKOCK, A. GODARA, J.T. WILLIAMS (2006): Fruits for the future (Revised edition). Ber and other jujubes - monograph. International Centre for Underutilised Crops, Southampton, UK.

CHEN J., P.H. CHAN, C.T.W. LAM, Z. LI, K.Y.C. LAM, P. YAO, T.T.X. DONG, H. LIN, H. LAM, K.W.K. TSIM (2015): Fruit of Ziziphus jujuba (Jujube) at Two Stages of Maturity: Distinction by Metabolic Profiling and Biological Assessment. J. Agric. Food Chem., 2015, *63* (2), pp 739–744.

CHEN Y., C. SCHIRAREND (2007): Rhamnaceae. Flora of China, vol. 12, p.120, Science Press. Beijing, China.

GRYGORIEVA O., V. ABRAHAMOVÁ, M. KARNATOVSKÁ, R. BLEHA, J. BRINDZA (2014): Morphological characteristics of fruits, drupes and seeds in genotypes of Ziziphus jujuba MILL. Potravinarstvo, vol. *8*, 2014, no. 1, p. 306-314.

GUPTA N.K., A.K. MEHTA (2000): Genetic variability and association of component characters for fruit yield in ber (Ziziphus mauritiana Lamk.). Advances in Plant Sciences, *13*, 75-78.

ISLAM M.N., M.M. HOSSAIN, M.M. RAHMAN, M.S. UDDIN, M.M. ROHMAN (2010): Heritability, Correlation and Path Coefficient Analysis in Twenty Ber Genotypes. Academic Journal of Plant Sciences *3* (2): 92-98.

JAĆIMOVIĆ V., D. BOŽOVIĆ (2014): Biological traits of cornelian cherry genotypes (Cornus mas L.) from teritory of Montenegro. Genetika, Vol. *46*, No. 2, 427-436.

MARKOVSKI A, D. PETKOVSKI (2012): The vegetative characteristics of jujube (Ziziphus jujuba Mill.) types. Soil and Plant, Vol.*61*, No.2, 85-98.

MARKOVSKI A., L VELKOSKA-MARKOVSKA (2012): The Leaf characteristics of jujube (Ziziphus jujuba Mill.) types. Soil and Plant, Vol.*61*, No.3, 165-178.

MARKOVSKI A., L. VELKOSKA-MARKOVSKA (2014): Dynamics of Jujube fruit growth. Scientific Conference with International participation "Challenges in modern agricultural production", Skopje, p.37.

OBEED R.S., M.M. HARHACH, A.L. ABDEL-MAWGOOD (2008): Fruit properties and Genetic Diversity of Five Ber (Ziziphus mauritiana Lamk.) Cultivars. Pakistan journal of Biological Sciences, *11*(6): 888-893.

RADIČEVIĆ S., S. MARIĆ, R. CEROVIĆ, M. ĐORĐEVIĆ (2013): Assessment of self-(in)compatibility in some sweet cherry (Prunus avium L.) genotypes. Genetika, Vol. *45*(3):939-952.

SHENGRUI Y. (2013): Past, present, and future of Jujubes-Chinese Dates in the United States. HortScience, *48*(6):672–680.

SARAN P.L. (2005), Studies on genetic divergence in ber (*Ziziphus mauritiana Lamk.*) germplasm. PhD. thesis, CCS Haryana Agricultural University, Hisar, India.

SOLIMAN H.I., G.A.E. HEGAZI (2013): In Vitro Clonal Propagation and Molecular Characterization of Jujube (Ziziphus Jujuba Mill.). Life Science Journal, *10*(2), 573-582.

VELKOSKA-MARKOVSKA L., B. PETANOVSKA-ILIEVSKA (2013): Optimization and development of a spe-hplc-dad method for the determination of atrazine, malathion, fenitrothion, and parathion pesticide residues in apple juice. MJCCE, Vol. *32*, No. 2, 299–308.

ISPITIVANJE MORFOMETRISKIH KARAKTERISTIKA PLODOVA TIPOVA KINESKE URME (*Zizyphus jujuba MILL.*) U R. MAKEDONIJI

Aleksandar MARKOVSKI[1] i Lenče VELKOSKA-MARKOVSKA[2]

[1] Poljoprivredni institut, Univerzitet "Sv. Kiril i Metodij", Skopje, Makedonija
[2] Fakultet poljoprivrednih nauka i hrane, Univerzitet "Sv. Kiril i Metodij", Skopje, Makedonija

Izvod

U periodu 2002-2004, u oglednim zasadima Poljoprivrednog Instituta u Skoplju proučavan je 131 tip kineske urme kao potomstvo dobijeno od šest sorti kineske urme: Žu tao czao, Da baj czao, Kitajski 2A, Divlja Srednjoaziska forma, Ja czao i Vahshski 45-2. Seme sorata je dobijeno od stabala u početku pune rodnosti, starih 7-9 godina. Ispitivane su dimenzije i masa plodova. Utvrđeno je da sorta Kitajski 2A ima najveće plodove (13.1 g), a isto tako i njeno potomstvo u proseku ima najveće plodove (8,9 g), dok potomstvo sorte sa najmanjim plodovima među sortama - Da baj czao se karakteriše najsitnijim plodovima (6.3 g). To ukazuje na mogućnost postojanja materinskog efekta u nasleđivanju krupnoće plodova kod kineske urme. Tip 21/6 ima prosečno najveće plodove (22.2 g), dok za vrstu sa sitnim plodovima se karakterizuje tip 16/4 (1.8 g). Plodovi tipa 21/6 su veći nego plodovi najkrupnije sorte kineske urme introdukovane u R Makedoniji -Ta jan czao.

Primljeno 15. IV 2014.
Odobreno 05. X. 2014.