Министерство сельского хозяйства Российской Федерации

Министерство сельского хозяйства и продовольствия Рязанской области

Министерство промышленности, инновационных и
информационных технологий Рязанской области

Федеральное государственное бюджетное образовательное учреждение
высшего образования
«Рязанский государственный агротехнологический университет
имени П.А. Костычева»

Некоммерческое партнерство
Рязанский аграрный университетский комплекс

НАУЧНО-ПРАКТИЧЕСКИЕ АСПЕКТЫ ТЕХНОЛОГИЙ ВОЗДЕЛЫВАНИЯ И ПЕРЕРАБОТКИ МАСЛИЧНЫХ И ЭФИРОМАСЛИЧНЫХ КУЛЬТУР

"Theoretical and Practical Aspects of oil and ether oil crops production and processing technologies"

Материалы
Международной научно-практической конференции,
3-4 марта 2016,
Рязань

International
Conference on the March, 3-4, 2016, Ryazan

Под общей редакцией
доктора биологических наук, профессора
Д.В. Виноградова

Рязань, 2016

УДК 633.853
ББК 42.14

Научно-практические аспекты технологий возделывания и переработки масличных и эфиромасличных культур: материалы Международной научно-практической конференции, РГАТУ, Рязань, 3-4 марта 2016. – Рязань: РГАТУ, 2016. – 327с.

ISBN 978-5-98660-259-2

В сборнике представлены тезисы докладов конференции по следующим направлениям: теоретические и практические аспекты интродукции и акклиматизации масличных и эфиромасличных растений; инновационные технологии возделывания масличных и эфиромасличных культур в сельскохозяйственном производстве; машины и приспособления для возделывания, уборки и послеуборочной обработки семян масличных культур; технологии хранения и переработки масличного сырья; экологическое состояние природной среды при использовании удобрений и средств химизации в технологиях возделывания масличных культур.

Материалы предназначены для научных сотрудников, преподавателей, студентов и аспирантов высших учебных заведений, работников информационно-консультационных служб, торговли и общественного питания, слушателей курсов повышения квалификации, специалистов и руководителей сельскохозяйственных и перерабатывающих предприятий АПК.

Материалы изданы в авторской редакции.

UDC

SEED YIELD AND SEED YIELD COMPONENTS IN MELON GENOTYPES WITH THE DIFFERENT SEX FORMS

Girek Z.[*], Prodanović S.[**], Vučković S.[**], Pavlović S.[*], Ugrinović M.[*], Adžić S.[*], Zečević B.[*]
[*]*Institute for Vegetable Crops, Smederevska Palanka, Serbia*
[**]*Faculty of Agriculture, University of Belgrade, Belgrade, Serbia*

Key words:
Cucumis melo L., monoecious, andromonoecious, number of seeds, seed weight, fruit number

Summary: Melon seeds are rich in oil contents while linoleic fatty acid is the most prevalent fatty acid in melon oil. In this work we have studied seed yield and seed yield components of 19 melon genotypes with the different sex forms. About two third of the commercial varieties of melon in the world are andromonoecious and one third is monoecious. In our experiments, we have crossed three monoecious (M) and four andromonoecious (A) melon varieties. Twelve MxA F_1 hybrids were produced, and then analyzed for four seed yield components: number of seeds per fruit, single seed weight, total seed weight per fruit and number of fruits per plant. Seed yield per hectare was calculated on the base of the seed yield per plant. The highest seed yield was recorded in F_1 monoecious genotype Pobeditel x A2-3lb (483.04 kg/ha).

Introduction. Melon (*Cucumis melo* L.) belongs to the family *Cucurbitaceae*, and with cucumber (*Cucumis sativus* L.) represents the most important species of the genus *Cucumis*. Melon has a specific biology of flowering, with several types of sexual expression: hermaphrodite, gynoecious, monoecious and andromonoecious. Sex expression in melon is under control of two major genes: *a* - controls presence of pistil in female flowers, and *g* - controls presence of two types of flowers on the same plant [1, 2]. Commercial melon varieties mainly belong to the andromonoecious type, with perfect and male flowers on the same plant. Wild melon species have mainly monoecious sex expression with male and female flowers on the same plant [3, 4].

A significant fraction of edible oil production worldwide is made from sunflower, olive, sesame, peanut, soybean, coconut, palm, corn [5, 6]. However, there is a growing demand for edible oil from vegetable species. Within this group, melon oil has a special significance, taking into account its quality and composition.

Melon seeds oil was found to be a rich source of unsaturated fatty acids. Oil content in melon seeds varying from 35 to 49% and depends on varieties and different market types [7, 8]. Analysis of melon seed oil revealed the presence of 24 fatty acids and its concentrations varied from very small quantities to about 64% [9]. Linoleic acid is predominant fatty acid in *Cucumis melo* L. seeds, and its content depends on melon variety [10]. Concentrations of linoleic acid in melon seed oil ranged from 46.6 to 65.5%, followed by oleic 15.8 - 31.9%, myristic 34.0%, palmitic 9.5 - 27.4%, and stearic 4.9% [7, 11, 12]. Melon seed oil has refractive index 1.482, specific gravity 0.9, acid value 2.06, peroxide value 4.96, iodine value 112 and saponification value 210.62 [9].

In recent years, there are attempts with the conversion of melon seed oil into biodiesel [13].

Some recent programs of melon breeding are focused on the yield of melon oil. For such programs it is important to know the genetics of oil content, seed yield and seed yield components in melon.

Seed yield per plant is a product of the following melon characteristics (components): number of seeds per fruit x weight of single melon seed x number of fruits per plant [14]. Seed yield per hectare is a product of seed yield per plant and number of plant per hectare.

Melon varieties with more fruits form smaller fruit. Large number of smaller fruits will have greater yields together than only one large fruit [15].

The aim of this study was to investigate inheritance of seed yield components in melon genotypes with the different sex forms. We set additional aims in this work: 1) to determine whether hybrids differ significantly from their parents in seed yield, and 2) to select the melon genotypes with the highest seed yield, which could be used in the future programs of melon breeding for edible oils production.

Material and methods. Experiments were conducted during two growing seasons (2010 and 2011) at the Institute for Vegetable Crops in Smederevska Palanka, Serbia (latitude 44°21'22.46"N, longitude 20°57'08.97"E, elevation 101 m). The soil type on the experimental fields was vertisol.

In this study were used 7 parental melon genotypes: three monoecious (M) mothers (Sesame - M_1, Early dawn 4 - M_2, Pobeditel - M_3) and four andromonoecious (A) father (Chinese muskmelon - A_1, Anannas - A_2, Honey dew - A_3, A2-3lb - A_4). During 2010, we have performed MxA crosses, and subsequently we get seeds of 12 F_1 hybrids (Table 1). Parental and F_1 seeds were sown in clay pots (10 cm in diameter) in the greenhouse of the Institute, in the first decade of April 2011. 30 plants of each genotype were produced. Plants in the phase 7-9 leaves were transferred out of greenhouse and planted in soil.

The field experiments were set up in three replications using complete randomized block design of 19 (7 parents + 12 F_1 hybrids) plots in one block (150 cm distance between rows, and 100 cm distance between plants).

We have evaluated the following characteristics of melon genotypes: number of seeds per fruit, weight of single melon seed (g), seeds weight per fruit (g), number of fruit per plant, and seeds yield per plant (g). Weight of seed was measured after air drying, when seeds contain 10% of moisture. Seed yield per hectare was calculated as the product of the seed yield per plant (g) and number of plant per hectare (6667).

The results were biometrically analyzed, using ANOVA and the Fisher's Least Significant Difference (LSD) test [16].

Results and discussion. All obtained F_1 hybrids were monoecious. The average values of melon yield components (number of seeds per fruit, weight of single seed, seeds weight per fruit, number of fruits per plant) were given in table 1.

The results show a significant variation of the studied traits (Table 1). Number of seeds per fruit varies in monoecious parents from 439 (Early down 4) to 733 (Sesame), while in andromonoecious parents from 275 (A2-3lb) to 368 (Chinese muskmelon). Number of seeds per fruit in F_1 hybrids varies from 506 (Early down 4 x Chinese muskmelon) to 801 (Pobeditel x A2-3lb).

Weight of single seed varies in monoecious parents from 0.030 (Early down 4) to 0.038 (Pobeditel), while in andromonoecious parents from 0.021 (Annanas) to 0.035 (Chinese muskmelon). Weight of single seed in F_1 hybrids varies from 0.026 (Early down 4 x A2-3lb) to 0.042 (Pobeditel x Chinese muskmelon).

Weight and size of seeds effects the germination of melon seeds. Extremely small melon seeds germinate slower and poorer than larger seeds [15].

The highest weight of seeds per fruit was recorded within the monoecious parents (M) for Sessame (25.48 g), within the andromonoecious parents (A) for Chinese muskmelon (13.06 g), and within the F_1 hybrids for Pobeditel x A2-3lb (29.09 g). The lowest weight of seeds per fruit was observed in andromonoecious genotype A2-3lb (6.18 g).

Number of fruits per plant ranged from 1-3. Three fruits per plant were observed only in parent A2-3lb and its hybrid Pobeditel x A2-3lb.

Table 1. Average values of seed yield components in melon genotypes

Genotype	Number of seeds per fruit	Weight of single seed (g)	Seed weight per fruit (g)	Number of fruits per plant
Sesame (*M_1*)	733	0.035	25.48	2
Early down-4 (*M_2*)	439	0.030	12.99	2
Pobeditel (*M_3*)	591	0.038	22.36	2
Chinese muskmelon (*A_1*)	368	0.035	13.06	2
Anannas (*A_2*)	302	0.021	6.25	1
Honey dew (*A_3*)	333	0.032	10.63	1
A2-3lb (*A_4*)	275	0.022	6.18	3
M_1 x A_1	629	0.041	25.58	2
M_1 x A_2	612	0.036	22.16	2
M_1 x A_3	632	0.034	21.50	2
M_1 x A_4	644	0.034	21.84	2
M_2 x A_1	506	0.037	18.72	2
M_2 x A_2	605	0.033	19.90	2
M_2 x A_3	538	0.030	16.09	2
M_2 x A_4	536	0.026	13.69	1
M_3 x A_1	674	0.042	28.59	1
M_3 x A_2	614	0.036	22.39	2
M_3 x A_3	617	0.036	22.39	2
M_3 x A_4	801	0.036	29.09	3
F value	435.51^{**}	0.0023	228.41^{**}	759.45^{**}
$lsd_{0.05}$	36.0	0.0031	1.299	0.08
$lsd_{0.01}$	48,2	326.63^{**}	1.742	0.11

On the figure 1 are showed average values of seed yields of 19 melon genotypes. Average values of seed yields ranged from 139.97 kg/ha (Early down 4) to 247.70 kg/ha (Sessame) for monoecious genotypes, from 41.67 kg/ha (Annanas) to 174.07 kg/ha (Chinese muskmelon) for andromonoecious genotypes and from 91.24 kg/ha (Early down 4 x A2-3lb) to 483.04 kg/ha (Pobeditel x A2-3lb) for F_1 hybrids.

Lowest values for almost all observed characteristics were recorded for andromonoecious genotypes, while for monoecious genotypes these values were higher but more variable. Significant differences in seed yield of different cucurbits genotypes were observed in the other experiments [17].

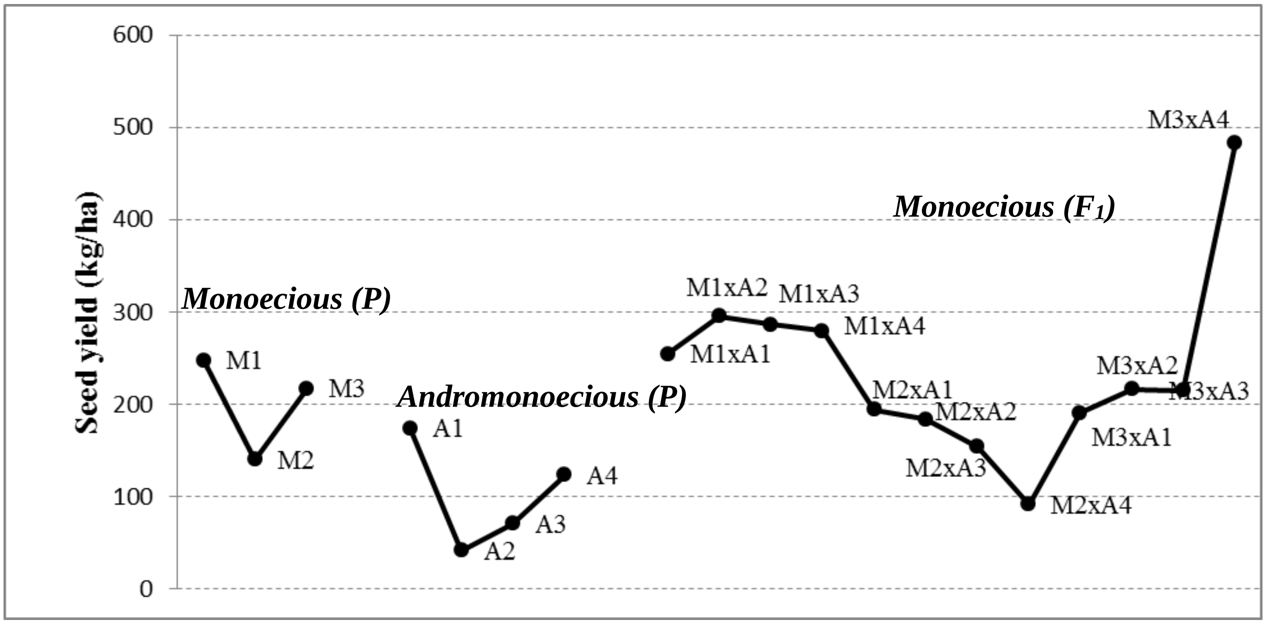

Figure 1. Average seed yield of 19 melon genotypes

After the best yielding hybrid Pobeditel x A2-3lb, next in the rank are three hybrids obtained from parental monoecious genotype Sessame (M1): M1 x A2, M1 x A3, and M1 x A4, with seed yields 279.30 kg/ha, 286.67 kg/ha, and 295.47 kg/ha, respectively. It can be concluded that melon genotype Sessame (M1) has good combining ability.

Based on results of these experiments we can recommend genotype Sessame, but also Pobeditel as monoecious parents for the obtaining of high seed yielding melon hybrids. The best yielding hybrids (Pobeditel x A2-3lb and three hybrids with melon genotype Sessame) could be use, after improvements for the oil content in seed, for commercial production of melon oil.

Conclusions. Melon seed has high oil content and in the future we can expect increasing use and demand for edible and industrial oils of this species. Results of this experiment showed that melon seed yield is higher in monoecious genotypes, especially in monoecious hybrids. The highest yields were recorded in the hybrid Pobeditel x A2-3lb and in hybrids with cultivar Sessame. These hybrids could be used in the future programs of melon breeding for edible oils production.

Acknowledgment. This study was supported by the Project TR31059: “New approaches of breeding vegetables designed for use in sustainable growing systems based on biotechnological methods” of Ministry of Education, Science and Technological Development (Government of the Republic of Serbia).

Literature

1. Pitrat, M. Melon // Handbook of Plant Breeding: Vegetable, Vol. I. - New York: Springer Science, 2008. - P. 283-316.
2. Martin, A. A transposon-induced epigenetic change leads to sex determination in melon / A. Martin, Ch. Troadec, A. Boualem, M. Rajab, R. Fernandez, H. Morin, M. Pitrat, C. Dogimont, A. Bendahmane // Nature - 2009. - № 461. - P. 1135-1139.
3. Wang, Y. H. Cucurbits / Y. H. Wang, T. Joobeur, R. A. Dean, J. E. Staub // Genome Mapping and Molecular Breeding in Plants, Vol. 5 – Vegetables - Berlin-Heidelberg: Springer-Verlag, 2007. - P. 315-329.

4. Abdelmohsin, M. E. Pleiotropic effect of sex expression on fruit shape in melon / M. E. Abdelmohsin, M. Pitrat // Proceedings of the IXth EUCARPIA meeting on genetics and breeding of Cucurbitaceae - Avignon (France) - 2008. - P. 551-555.
5. Govindaraj G. Present status of edible oil consumption and household demand projection for Tamil Nadu (India) / G. Govindaraj, S. Suryaprakash, N. Sivaramane // Journal of Agricultural Sciences - 2012. - V. 57, № 1. - P. 41-56.
6. Xiu-Qin, L. Analysis of synthetic antioxidants and preservatives in edible vegetable oil by HPLC/TOF-MS / L. Xiu-Qin, J. Chao, S. Yan-Yan, Y. Min-Li, C. Xiao-Gang // Food Chemistry - 2009. - V. 113, № 2. - P. 692-700.
7. Hemavatahy, J. Lipid composition of melon (*Cucumis melo*) kernel // Journal of Food Composition and Analysis - 1992. - V. 5 - P. 90-95.
8. Mian-hao, H. Characteristics of some nutritional composition of melon (*Cucumis melo* hybrid ‘ChunLi’) seeds / H. Mian-hao, A. Yansong // International Journal of Food Science and Technology - 2007. - V. 42, № 12. - P. 1397-1401.
9. de Melo, M. L. S. Characterisation of some nutritional constituents of melon (*Cucumis melo* hybrid AF-522) seeds / M. L. S. deMelo, N. Narain, P. S. Bora // Food Chemistry - 2000. - V. 68, № 4. - P. 411-414.
10. Yanty, N. A. M. Physicochemical properties of *Cucumis melo* var. *inodorus* (honeydew melon) seed and seed oil / N. A. M. Yanty, O. M. Lai, A. Osman, K. Long, H. M. Ghazali // Journal of Food Lipids - 2008. - V. 15, № 1. - P. 42-55.
11. Lazos, E. S. Nutritional, fatty acid, and oil characteristics of pumpkin and melon seeds // Journal of Food Science - 1986. - V. 51, № 5. - 1382–1383.
12. El-Magoli, S. B. Evaluation of some Egyptian sweet melon seed oils // Fette, Seifen, Anstrichmittel - 1979. - V. 81, № 5. - P. 201–203.
13. Rashid, U. Muskmelon (*Cucumis melo*) seed oil: a potential non-food oil source for biodiesel production / U. Rashid, H. A. Rehman, I. Hussain, M. Ibrahim, M. S. Haider // Energy - 2011. - V. 36, № 9. - P. 5632-5639
14. Nerson, H. Seed production and germinability of cucurbit crops // Seed Science and Biotechnology - 2007. -V. 1, № 1. - P. 1-10.
15. Nerson, H. Relationship between plant density and fruit and seed production in muskmelon // Journal of the American Society for Horticultural Science - 2002.a - V. 127 - P. 855-859.
16. Fisher, R. A. The design of experiments // London: Oliver and Boyd, 1935. - 251 p.
17. Nerson, H. Relationship between fruit shape and seed yield in *Cucurbita pepo* / H. Nerson, H.S. Paris // Cucurbit Genetic Cooperative - 2002.b - V. 24 - P. 82-86.