Courgette seed characteristics: planting method and timing effects

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Abstract. The article provides information on the results of a study on the volume of physical parameters of seeds obtained from seed fruits when growing squash varieties Orbita and Viridi from seedlings and non-seedlings, their germination energy and germination. The aim of the research is to establish the influence of seedling and seedless methods of cultivation of squash in different terms on the qualitative characteristics of seeds. According to the results of measurements of seeds of courgette varieties Orbita and Viridi in longitudinal and cross sections, it was found that when grown by seedling method seeds are longer (Orbita – 19.05 mm, Viridi – 14.04 mm), wider (Orbita – 9.33 mm, Viridi – 8.30 mm) and thicker (Orbita – 2.98 mm, Viridi – 2.40 mm). It was found that the highest germination energy (81%) and high seed germination (98%) were possessed by seeds of the variety Orbita grown on 1 April, and those of the variety Viridi grown by the seedling method on 1 April and 10 April (energy-79% and germination 97%). Seeds obtained from the seedlingless method also had relatively high germination energy 78-79% and germination 97%.

1 Introduction

Vegetable varieties of common pumpkin (*Cucurbita pepo* L.), despite their botanical proximity, morphologically differ from each other in shape, size and color of fruits [1-6]. Low caloric content and rich mineral composition of fruits make them valuable for dietary nutrition [3]. Squash (2x=2n=40) is native to North America and has been observed wild in the southern United States and northeastern Mexico. Squash is important food crops in temperate, subtropical, and tropical climate regions [2].

Cucurbita pepo L. - Annual plant with stalked, sharply faceted furrowed twigs; leaves 5-lobed, with deep notches between lobes, with acuminate and, in turn, lobed lobes, with spiky coarse pubescence. Flowers are monoecious; calyx barrel-shaped, yellowish; sepals spiky, thickened at the base; corolla petals acuminate, straight (not bent); anther columns conical, shorter than filaments; stigma orange. Stalk with 5-8 scars, with deep grooves.

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Fruit obovate, usually highly variable in size, shape, color and flesh fibrous, bark woody. Seeds are medium-sized to small, smooth, with a clear rim [6].

Squash is one of the most widely grown gourds in the world, although it is difficult to estimate how much is actually produced because agricultural statistics usually combine the total production of squash and pumpkin [5].

Production of pumpkin and squash in the world, according to FAOSTAT, is 35,4 million tons. The leaders in pumpkin and squash production are such countries as China (7,48 million tons), India (5,11 million tons), Ukraine (1,27 million tons), Russia (1,14 million tons) and USA (1,05 million tons) (www.fao.org.). The average yield of the crops mentioned above in the countries of the world is about 20,7 t/ha; in Bahrain – 74,0 t/ha, Indonesia – 68,0 t/ha, Spain, China, and Poland it ranges from 41,6 to 49,8 t/ha. The total area under pumpkin and squash crops in the Republic of Uzbekistan is 9571 hectares, with a gross yield - 180.0 thousand tons and an average yield of 18,8 t/ha. Due to the increasing demand of domestic and foreign markets for squash products rich in nutrients and vitamins, the introduction of high-yielding varieties and the organization of seed production have important scientific and practical importance. Also, indicators of the physical values of seeds, determination of germination energy, and germination of squash seeds are necessary for the organization of seed production.

2 Research methodology

Seed yield depending on sowing and planting date was determined according to the methodology of V.F. Belik "Methodology of experimental work in vegetable and melon growing" [1]. Fruits were harvested to determine seed yield in the phase of biological ripeness, when they had rough hard bark. Determination of seed yield from fruits and seed yield was carried out in each variant in 4-fold repetition, where 20 fruits were taken, fruit weight was determined, from which seeds were extracted and after drying the number and weight of seeds were determined. Then the weight of fruit and seeds was used to determine the seed yield and the weight of 1000 seeds. According to seed yield and yield of seed fruits (70% of marketable fruits), seed yield per plant and per unit area was determined.

Seed sowing qualities, such as germination energy, germination performance, coarseness (weight of 100 seeds) characterize the suitability for sowing and storage.

The study on determination of germination energy and germination of seeds was carried out according to O'zDSt 2823:2014 (Seeds of agricultural crops. Varietal and sowing qualities. Technical conditions) [4]. Squash seeds were taken 4 samples (100 pieces in each sample) for germination.

In order to obtain high yields, it is important to use seeds with high varietal and sowing qualities. Varietal qualities characterize the belonging of seeds to a certain variety. Sowing qualities of squash seeds were determined in accordance with the requirements of O'zDSt 2823:2014 "Seeds of agricultural crops. Varietal and sowing qualities. Technical conditions.".

By sowing quality, melon seeds are divided into first and second classes. Original and elite seeds sown in seed farms for multiplication should be not lower than the first variety category in terms of varietal qualities, and in terms of sowing qualities not lower than the norms of the first class (not less than 95%).

3 Research Results

Laboratory experiments were laid in the laboratory of seed production of Research Institute of Vegetable, melon crops and potato. Experiments were conducted with promising lines of

squash varieties Orbita and Viridi. Seeds were germinated on sand. The experiment had the following variants:

1. Seeds received by seedling method from planting on April 1, April 10, April 20, and April 30.
2. Seeds from the non-seedling method of cultivation on April 1, April 10, April 20, and April 30.

Seed germination was carried out on sand in 4-fold repetition in a 210x120x30 mm grow bed in thermostat at 22 - 250C. Observations were carried out daily and the number of germinated seeds was determined. By comparing the number of germinated seeds with the total number of seeds on the 3rd day, the germination energy was determined, and on the 10th day, the laboratory germination of seeds was determined.

The tested lines had measurements (length, width, thickness) of seeds before sowing. When measuring (in longitudinal and cross section) seeds of the variety Orbita it was found that at seedling method the lines had an insignificant difference of up to 1,3 mm in seed length within the terms of cultivation. In terms of thickness, seeds from all terms of cultivation had an insignificant difference, ranging from 0,15 to 0,34 mm.

Measurement of seeds grown by seedless method showed that at all studied dates the length of seeds ranged from 17,23 to 18,26 mm. The longest seeds were at sowing date 1.04 – 18,26 mm, followed by sowing dates 10.04 and 20.04 respectively 18,04 and 17,91 mm, and relatively short at sowing date 30.04 – 17,23 mm. Seeds had insignificant difference in thickness, which ranged from 2,79 to 2,83 mm (Table 1).

Table 1. Indicators of physical values of seeds grown by seedling and non-seedling methods at different dates methods at different dates

Cultivation method	Timing of planting and sowing	Seed length, mm				Seed width, mm				Seed thickness, mm			
		X_{min}	X_{max}	x=	V%	X_{min}	X_{max}	x=	V%	X_{min}	X_{max}	x=	V%
variety Orbita													
seedling	1.04	17,07	18,99	18,20±0,60	3,28	8,48	9,68	9,22±0,27	2,88	2,22	3,16	2,77±0,29	10,59
	10.04	16,22	20,10	19,04±1,07	5,62	7,70	9,76	8,71±0,51	5,85	2,28	3,28	2,83±0,26	9,36
	20.04	16,80	19,06	18,25±0,57	3,14	8,88	10,26	9,33±0,46	4,90	2,03	3,31	2,64±0,36	13,66
	30.04.	17,20	21,21	19,05±1,07	5,63	8,05	9,60	8,93±0,49	5,50	2,54	3,28	2,98±0,22	7,54
non-seedling	1.04	15,97	19,78	18,26±1,12	6,16	8,07	9,47	8,87±0,43	4,89	2,12	3,16	2,81±0,25	9,07

	10.04	17,39	19,48	18,04±0,52	2,89	7,44	9,89	8,55±0,68	7,98	2,28	3,18	2,79±0,23	8,33
	20.04 (control)	16,21	19,64	17,91±1,01	5,64	8,11	10,04	9,20±0,57	6,16	2,24	3,46	2,81±0,45	15,88
	30.04	16,62	18,53	17,23±0,51	2,94	7,30	8,27	7,78±0,26	3,31	2,10	3,35	2,83±0,36	12,58
variety Viridi													
seedling	1.04	12,95	14,62	13,83±0,50	3,65	7,5	8,42	8,06±0,23	2,85	2,14	2,50	2,35±0,13	5,34
	10.04	12,61	14,90	13,87±0,74	5,35	7,13	8,59	7,95±0,40	5,04	2,17	2,57	2,40±0,12	5,07
	20.04	12,72	14,61	14,03±0,26	1,84	8,12	8,39	8,30±0,23	2,77	2,01	2,49	2,29±0,18	7,89
	30.04.	10,98	14,0	12,49±0,79	6,35	6,65	8,6	7,57±0,46	6,12	2,08	2,48	2,37±0,11	4,65
non-seedling	1.04	12,97	14,61	13,83±0,55	3,97	7,56	8,69	8,07±0,28	3,48	2,02	2,57	2,35±0,21	8,77
	10.04	13,07	14,54	13,93±0,47	3,35	7,68	8,56	8,25±0,26	3,15	2,09	2,64	2,38±0,17	6,96
	20.04 (control)	11,97	14,29	13,15±0,68	5,19	7,16	8,28	7,91±0,33	4,48	2,04	2,62	2,34±0,18	7,58

	30.04	12,88	13,87	13,19±0,49	3,73	7,07	8,12	7,63±0,35	4,57	2,06	2,54	2,38±0,17	7,16

According to the results of measurements of seeds in longitudinal and cross sections it was found that both at seedling and non-seedling methods of cultivation variants differed from each other insignificantly, at that, grown by seedling method, more fulfilled.

When measuring the seeds of the variety Viridi, it was found that at the seedling method on the length of seeds within the growing terms had an insignificant difference, which was 0,16-1,54 mm. In terms of width, the largest were the seeds grown at the term of 20.04 by seedling method – 8,3 mm, and the smallest - at the term of 30.04 – 7,57 mm. At planting dates of 1.04 and 10.04, seed width ranged from 7,95 to 8,06 mm. In terms of thickness, seeds from all growing dates had a thickness of 2,29-2,40 mm.

In seedless method of cultivation of variety Viridi, it was found that seeds obtained from sowing dates of 1.04 and 10.04, respectively, were 13,83 and 13,93 mm, and with pushing back the sowing dates, seeds formed shorter than 13,15 and 13,19 mm.

In terms of seed width in cross section, the widest seeds were those grown at 10.04 seedless method – 8,25 mm, slightly less - at 30.04 – 7,63 mm. At sowing dates of 1.04 and 20.04 it was equal to 8,07 and 7,91 mm. In terms of thickness, seeds of all growing dates had insignificant difference from 1,19 to 2,08 mm (Table 1).

The laboratory experiments on determination of sowing qualities of seeds allowed to establish that at line variety Orbita seeds received from seedling method of cultivation on April 1 had maximum germination energy - 81% and seed germination - 98%.

When determining the germination energy and germinability of squash seeds, it was found that the germination energy and germinability of seeds decreases with moving away the planting and sowing dates. Seeds of squash variety Orbita, grown by seedling method on April 1 has the highest percentage of germination energy (81%), with a decrease in the terms of April 10 and 20 - 80%, and April 30 - 79%.

In terms of germination, seeds grown by seedling cultivation method from different dates did not have a big difference among themselves, i.e. seeds from the first 2 dates had a germination of 98%, and from planting dates of April 20 and 30 - 97%. The highest percentage of germination energy of seeds from the seedless method of cultivation was found at sowing on April 1 and 10 (80%), and seed germination at all dates was 97%.

The seeds of variety Viridi grown by seedling method on April 1 and 10 (79%) had the highest germination energy, seeds grown by seedling method on April 20 and 30 (78%) were distinguished with decreasing value of germination energy. In terms of germination, seeds obtained from the seedling method of cultivation had not a big difference at the studied planting dates and was in the range of 97-98%. Seeds grown by non-seedling method had germination energy of 78-79% and germination of seeds from all terms was 97% (Table 2).

Table 2. Determination of germination energy and laboratory germination of seeds of promising squash lines grown at different planting and sowing dates (two-year average)

Planting date	Germination energy, %	Laboratory germination, %	Planting date	Germination energy, %	Laboratory germination, %
	seedling method			non-seedling method	
variety Orbita					
1.04	81	98	1.04	80	97

10.04	80	98	10.04	80	97
20.04	80	97	20.04 (control)	79	97
30.04	79	97	30.04	79	97
variety Viridi					
1.04	79	98	1.04	79	97
10.04	79	97	10.04	78	97
20.04	78	97	20.04 (control)	78	97
30.04	78	97	30.04	78	97

When determining the laboratory germination of squash seeds, it was found that at planting and sowing dates, the average germination value was 97-98% and the seeds of the studied squash lines grown at different planting and sowing dates are in the I-class category.

References

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