

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/7>

SEED PRODUCTIVITY OF LEMON (CITRUS) VARIETIES

Khudayorova Sohiba Itolmasovna

Tashkent Pharmaceutical Institute, Tashkent City, Oybek Street, 45
sohibaxudoyorova81@gmail.com

Buriev Hasan Chutbaevich

Doctor of Biological Sciences, Professor, Tashkent State Agrarian University
Republic of Uzbekistan, 100140 Tashkent, Kibray District, st. University 2,
prof-buriev@mail.ru

Abstract

In this work, seed productivity indicators and their determinants in lemon cultivars were studied, including floral biology, pollination, fertilization efficiency, and internal fruit structure. The studies were conducted on the basis of phenological records, fruit and seed morphometry, seed quality indicators, and laboratory germination tests. The results obtained revealed differences in seed productivity and seed quality specific to cultivars. The results serve as a scientific basis for selecting propagation material.

Relevance: Investigations and information on seed productivity of lemon varieties and the morphophysiological factors that determine it are given.

The purpose of the study: This article analyzes the factors of pollination biology, fruit formation and embryo development that affect the seed productivity of lemon varieties and its formation.

Methods and methods: Researches were carried out in field and greenhouse conditions through phenological observation, morphometric measurements, seed quality and fertility tests. The results show that there are stable differences in the

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/7>

number of seeds, seed integrity and fertility among varieties. The work establishes practical criteria for managing seed productivity

Keywords: Lemon, variety, seed productivity, pollination, fruit set, seed quality, quality.

Introduction

Profitability: In lemon cultivation, productivity and fruit quality are often explained in relation to market demand, but seed productivity is a separate strategic indicator in the breeding system and selection work. Seed-propagated material, especially grafting, plays an important role in expanding the base of virus-free plants and maintaining genetic diversity. Nevertheless, seed productivity in lemon is multi-factorial and is determined by the genetic characteristics of the variety, flower biology, compatibility of pollination and seeding processes, fruit set, development of seed chambers in the fruit, as well as the effect of heat and moisture regime on phenophases..

In particular, there are different approaches in different schools about the fact that events such as parthenocarpy, multi-embryonicity, pollen grain viability and stigma-receptor mismatch lead to changes in the number and quality of seeds in citrus [1; 2]. In practical experience, even under the same agrotechnical conditions, there is a sharp difference in the number of seeds in the fruit among the varieties, in some varieties the completeness of the seeds is low or the instability of the fertility is observed. This problem leads to planning errors in seed preparation for grafting, insufficient seed fund formation in breeding populations, and inefficient use of resources. Although the formation of citrus seeds is mostly covered in the scientific literature within the framework of general physiological laws, studies on systematic assessment of seed productivity in certain lemon cultivars, especially in relation to local factors, have not been sufficiently generalized [3; 4]. Therefore, the research problem is to determine

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/7>

the variety-specific differences in seed productivity in lemon varieties and its morphophysiological determinants, as well as to establish practical criteria for managing seed quality indicators.

The task of the research: This goal is achieved through the following tasks: analysis of indicators of flower and fruit formation in lemon varieties in relation to seed productivity; comparing the number of seeds in the fruit, the morphometric characteristics of the seeds and the degree of completeness in the section of varieties; to evaluate the laboratory quality of the seed and initial growth energy; to create a scientific basis for practical recommendations to increase seed productivity based on the obtained results.

Researches were carried out in field and greenhouse conditions on the example of several types of lemons that have economic importance, in which the variety was widely spread in operation and the difference in the level of seediness of the fruit was taken into account. The methodological approach was based on the simultaneous combination of phenological observations, morphometric analysis and seed quality tests, because seed productivity is expressed not only by the number of seeds, but also by maturation, completeness and physiological vitality of the seed. Phenological observations were made by noting the beginning of flowering, the end of mass flowering and flowering, as well as the periods of fruit set and fruit ripening. In the assessment of flower biology, the morphological type of flowers, the development of anthers, the functional completeness of the bisexual structure of the flower, and the intensity of flower shedding were taken into account, because these indicators are considered to be directly related to pollination efficiency [5].

In the empirical part, fruit samples of each variety were collected based on the principle of random selection, and the morphometric indicators of the fruit, especially fruit weight and the number of segments, were separated into seeds. Seed productivity was characterized by the number of seeds in the fruit, the

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/7>

average seed mass, the visual completeness of the seed and the percentage of unbroken seeds. In the assessment of seed completeness, the percentage of broken seeds, shell deformation, and external indicators reflecting signs of embryonic development were taken into account, because a certain relationship between the appearance of the seed and its physiological quality was noted in citrus [2; 6]. In laboratory tests, the seeds were checked for germination under standard conditions, in which the beginning of germination, the final percentage of germination and the initial growth energy were evaluated. These indicators of fertility tests provide an opportunity to predict the practical value of seed material, especially in transplanting for grafting [7]. The comparative analysis method served to consistently compare the differences between species, and the analytical approach served to explain the chain of factors determining seed productivity from the phenomenological level to the level of cause-and-effect relationships. In the interpretation of the results, conceptual harmony with international and regional scientific views on reproductive biology and agroecology of citrus was preserved [1; 4; 8].

Results of the study: The obtained results showed that the seed productivity of lemon varieties is stable even in the same agrotechnical background, and it was observed that this difference is primarily related to the phenological rhythm of flowering and the mechanisms of fruit formation.

In the observations, the period of mass flowering in some varieties was relatively extended, which, while expanding the convenient field for pollination, did not always lead to an increase in the number of seeds; on the contrary, due to the increase in flowering and the selectivity of fruit formation, the average number of seeds in the fruit was restored, but the maximum values were less frequent. In other varieties, the flowering was frequent in a relatively short period of time, and the number of seeds in the fruit tended to be relatively high, while fruit set was higher. This result provided an empirical basis for the conclusion that seed

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/7>

productivity is determined not only by the percentage of fruit set, but also by the internal efficiency of fertilization and embryo survival.

In the morphometric analysis, there was no unidirectional relationship between the increase in fruit weight and the number of seeds in all varieties. In some varieties, large fruits have more seeds, while in other varieties, the seediness of large fruits remained at an average level, and the difference was mainly due to the weight and completeness of the seeds. Therefore, fruit size cannot be a universal indicator for directly predicting seed productivity, it becomes significant only when interpreted together with the reproductive strategy specific to the variety. Significant differences between the varieties were found in the evaluation of the completeness of the seeds: in some varieties, the percentage of broken seeds was relatively high, and this condition was accompanied by the lightness and unevenness of the shell in appearance and the low mass of the seeds. In other varieties, the main part of the seeds is full and even, and the output of the seed material after sorting was observed to be higher. This result also revealed the economic importance of variety selection in the process of seed fund preparation, because varieties with a high proportion of unripe seeds require more fruit pulp to obtain the same amount of unripe seeds.

Differences in the speed of germination and the final yield indicators were noted in the laboratory yield tests. It was determined that varieties with a fast onset of germination usually have a higher initial growth energy, which provides an opportunity for germination at one stage and optimization of subsequent cultivation. On the contrary, in some varieties, the onset of germination was prolonged and the final germination was relatively low, and this situation occurred mostly with samples with a high percentage of broken seeds. Also, in a number of samples, it was observed that the fertility of fully visible seeds was lower than expected, which strengthened the conclusion that seed quality is determined not only by external morphological features, but also by physiological maturity of the embryo and stress factors in field storage conditions. Overall, the

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/7>

results showed that seed productivity is a combined expression of three components: number of seeds per fruit, seed integrity, and fertility; It was arranged that which of these components can be the limiter depending on the variety.

The results show that the variety specificity of seed productivity in lemon cultivars is explained by several mechanisms within reproductive biology. In international literature, it is emphasized that post-pollination selection in citrus fruits, that is, pollen tube growth, fertilization success, and early embryo abortion, can severely limit the number of seeds [1]. In our observations, the constant increase in the number of seeds even in cases of high fruit set is interpreted as a practical manifestation of this mechanism: in conditions where the plant sets a lot of fruit, the distribution of resources increases, as a result, the probability that a part of the embryos will not develop in the stages after seeding increases. This approach shows that increasing pollination is not enough to increase seed productivity, but also management related to the plant's physiological state, nutrition, and stress tolerance is necessary.

In the Russian school of citrus science, seediness in citrus varieties is often explained in connection with genetic factors and the parthenocarpic tendency of certain varieties [2; 6]. In our results, the non-universality of the relationship between fruit mass and seed number partially supports this position: in varieties with parthenocarpy or low fertilization efficiency, fruit enlargement may be caused by other physiological ways than by seed multiplication. At the same time, low seed integrity in some varieties is not explained only by parthenocarpy, because the low fertility of even fully visible seeds puts the issue of embryo physiological maturity on the agenda. This situation shows the multi-stage formation of the seed quality, that is, the morphological and physiological changes of the seed are not always synchronized; It is noted in the literature that ripening dynamics and storage conditions in citrus seeds have a significant effect on fertility [8].

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/7>

In local sources, it is emphasized the need to evaluate the completeness and fertility of the seed at the initial stage during seed selection and grafting in the operation of citrus breeding [3; 7]. Our analysis expands this idea: variety selection itself is the main determinant for the stability of the seed fund, because selection and breeding processes are unstable in varieties with a high percentage of broken seeds. Also, the result that elongation of flowering does not automatically increase the number of seeds gave an opportunity to scientifically explain the situation that often occurs in practice, but is rarely analyzed. The important thing here is that while the width of the flowering area increases the possibility of pollination, sensitive factors such as the matching of heat and moisture to the phenophases, the vitality of the pollen grains and the receptivity of the stigma may prevail [5]. Therefore, measures such as optimizing the microclimate, reducing stress factors during flowering and maintaining the general nutritional status of the plant are biologically justified in managing seed production.

At the same time, the research has certain limitations. Seed productivity can have multi-year variability, because in citrus, the change of harvest years, the balance of vegetative and generative growth, and the level of growth strongly affect reproductive indicators [1; 4]. Therefore, although the obtained results reliably show the direction of inter-species differentiation, it is desirable to enrich the results with multi-year observations and deeper experimental investigations of pollination biology in order to accurately forecast seed productivity.

Conclusion:

The study proved that seed productivity in lemon cultivars is a stable characteristic characteristic of the cultivar and that it is visible as a joint expression of three main components such as the number of seeds in the fruit, completeness of the seed and fertility. Although the phenological characteristics of goulash and fruit ripening affect the number of seeds, it was shown that the

Eureka Journal of Agricultural Science & Bio-Innovation (EJASB)

ISSN 2760-4969 (Online) Volume 2, Issue 2, February 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/7>

preservation of the embryo and the physiological maturity of the seed in the stages after sowing can often be a limiting factor. From a practical point of view, it is recommended to select a variety when forming the seed fund for grafting and seedling production, to recalculate the rate of fruit yield in varieties with a high percentage of seeds, as well as mandatory assessment of seed quality through laboratory quality tests. In the future, researches should be directed to determine the compatibility mechanisms of pollination, the causes of embryo abortion, and the influence of microclimate factors on the dynamics of seed quality on the basis of multi-year experiments.

References

1. Spiegel-Roy P., Goldschmidt E. E. Biology of Citrus. Cambridge: Cambridge University Press, 1996. 230 p.
2. Sinko L. T. Citrus crops: biology, plant breeding, reproduction. Sochi: VNIITsiSK, 2012. 256 p.
3. Zhuraev A. Citrus crops and the basics of their reproduction. Tashkent: Teacher, 2016. 184 p.
4. Ladania M. S. Citrus Fruit: Biology, Technology and Evaluation. San Diego: Academic Press, 2008. 560 p.
5. Karpun N. N., Mikhailova E. V. Biology of flowering and pollination of citrus crops. Krasnodar: KubGAU, 2015. 148 p.
6. Ryndin A. V., Belousov A. A. Subtropical fruit crops of Russia. Sochi: VNIITsiSK, 2010. 304 p.
7. Abdukodirov S. A. Seed and seedling cultivation in fruit and vegetable crops. Samarkand: SamDU publishing house, 2018. 212 p.
8. Davies F. S., Albrigo L. G. Citrus. 2nd ed. Wallingford: CABI Publishing, 2009. 336 p.