“EVALUATION OF THE LABORATORY GERMINATION OF NIGELLA SATIVA L. SEEDS STORED UNDER GENE BANK CONDITIONS.”

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Seed germination is influenced by numerous factors, among which seed age and storage conditions are particularly important. Proper seed storage plays a crucial role in the conservation, protection, and enhancement of plant biodiversity. Furthermore, the successful cultivation of crops and the establishment of large-scale plantations require high-quality seed material with maintained seed viability, germination percentage, and germination vigor [1,2].

Seed viability and quality, including germination percentage and germination vigor, gradually decline during storage depending on the seed's tolerance to desiccation. This deterioration is primarily affected by three major factors: seed moisture content, the equilibrium moisture content determined by the surrounding relative humidity, and storage conditions, particularly temperature and the gaseous environment [3].

Studies on numerous orthodox seed species, whose seeds are tolerant to desiccation, have shown that reducing seed moisture content and storing seeds at low temperatures significantly prolong seed longevity and maintain viability during long-term storage [4]. In contrast, recalcitrant seeds, which are sensitive to desiccation, are suitable only for short-term storage and generally retain their viability for only a few weeks or months [5]. Such seeds require storage at relatively high moisture contents (approximately 20–70% on a fresh weight basis) and temperatures between 7 and 17 °C. For recalcitrant seeds of tropical and temperate species, recommended storage temperatures generally range from −3 °C to +5 °C [6].

There is currently insufficient scientific information regarding the maintenance of the germination capacity of *Nigella sativa* L. seeds produced under the environmental conditions of Nukus District, Republic of Karakalpakstan, during storage. Therefore, this study used *Nigella sativa* L. seeds harvested from the Samanbay experimental field of the Aral Sea International Innovation Center, State Unitary Enterprise, during 2022–2024 and subsequently stored in the Plant Genebank. To evaluate the effect of storage duration on seed germination, laboratory germination tests were conducted in May 2025 at the Plant Diversification Laboratory. The influence of storage duration on seed germination was assessed under controlled laboratory conditions.

The experiments were carried out using seeds stored for **9 months** (from August 2024 to April 2025), **21 months** (from August 2023 to April 2025), and **33 months** (from August 2022 to April 2025). Germination tests were conducted in a thermostatic chamber at temperatures of **10, 15, 20, and 25 °C** under a **12 h light/12 h dark photoperiod**. The experimental results are presented in **Table 1**.

Table 1. Effect of Storage Duration and Temperature on the Germination of *Nigella sativa* L. Seeds

№	Experimental treatments	Temperature (°C)	Time to germination onset	Germination percentage on day 22 (%)
1	Seeds stored for 9 months	10	8- Day	15.6±1.3
		15	4- Day	97.8±3.9

		20	7- Day	84.3±3.7
		25	12- Day	65.8±2.5
2	Seeds stored for 21 months	10	12- Day	-
		15	7- Day	65.7±2.4
		20	11- Day	45.4±2.5
		25	15- Day	33.8±3.1
3	Seeds stored for 33 months	10	14- Day	-
		15	9- Day	36.7±1.9
		20	14- Day	28.5±1.5
		25	22- Day	19.8±1.6

The results presented in Table 1 indicate that seed germination gradually decreased as the storage period increased. At the same time, the onset of germination was progressively delayed with longer storage duration. Both low and high temperatures had adverse effects on seed germination, whereas **15 °C** was identified as the optimum temperature for germination under the experimental conditions.

The findings demonstrate that the effective storage period of *Nigella sativa* L. (black cumin) seeds under genebank conditions is approximately **two years**. After two years of storage, the germination percentage declined to **65.7%**, while the onset of germination was delayed by **7 days**. In seeds stored for **three years**, the highest germination percentage recorded was **36.7%**, and germination commenced only after **9 days**.

In conclusion, the germination capacity of seeds exhibiting physiological dormancy is generally activated only within a specific temperature range characteristic of the species. In other words, such seeds are capable of overcoming physiological barriers to germination only under appropriate temperature conditions. This response is associated with the reactivation of internal metabolic processes and temperature-induced regulation of the phytohormonal balance, both of which are essential for successful seed germination.

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