A pathway to break seed dormancy of endemic *Nigella turcica* Dönmez & Mutlu (*Ranunculaceae*): GA_3 and KNO_3

Endemik *Nigella turcica* Dönmez & Mutlu (*Ranunculaceae*) taksonunun tohum dormansisini kırmada izlenen yol: GA_3 and KNO_3

Research Article

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ABSTRACT

Nigella turcica Dönmez & Mutlu (*Ranunculaceae*) is a narrow endemic species and closest relative is *N. sativa* (black cumin) has an economic importance. In this study, optimum conditions of seed germination was searched for *N. turcica*. Germination did not occur during 45 days either 4 or 16°C. Potassium nitrate and giberellic asid (GA_3) with 10 and 25 ppm concentrations were ineffective in embro growth. Optimal conditions to seed germination of *N. turcica* have been determined as 100 ppm concentrations of giberellic asid at 16°C.

Key Words
Dormancy, Germination, *Nigella*, *Ranunculaceae*.

ÖZET

Nigella turcica Dönmez & Mutlu (*Ranunculaceae*) dar yayılışlı endemik bir türdür ve ekonomik öneme sahip N. *sativa* (çörek otu) türüne en yakın taksondur. Bu çalışmada bu türe ait tohum çimlenmesi için gerekli en uygun koşullar araştırılmıştır. Çimlenme 4 veya 16°C'de 45 gün süresince gerçekleşmemiştir. 10 ve 25 ppm potasyum nitrat ve giberellik asit (GA_3) uygulamaları da embriyo üzerinde etkili olmamıştır. Çimlenmenin sağlanabilmesi için en uygun koşullar 100 ppm giberellik asit derişiminde ve 16°C sıcaklıkta elde edilmiştir.

Anahtar Kelimeler
Çimlenme, Dormansi, *Nigella*, *Ranunculaceae*.

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INTRODUCTION

A completely nondormant seed has the capacity to germinate over the widest range of normal physical environmental factors possible for the genotype [1,2]. *Nigella turcica* is an endemic species in the genus *Nigella* L. [3] and germination of this taxon was not achieved in normal factors. Members of the *Ranunculaceae* exhibit basal rudimentary embryos [4-7]. Such immature embryos must complete development before germination can begin and the maturation period required varies from a few days to several months. There are different methods and techniques to overcome seed dormancy depending on these factors. These methods and techniques carried on different types and periods or if necessary carried out with combinations affiliated with dormancy types and degrees. Seed germination in the *Ranunculaceae* is commonly delayed since the mature, dry dispersal units contain immature embryos and require after ripening. Stratification, an alkaline soak, and gibberellic acid (GA_3) have been used to encourage embryo growth. 0.2% potassium nitrate (KNO_3) solution used to promote germination also enhanced basal rudimentary embryo development [4,8]. Also germination occurred after stratification at 0°C for 21 to 105 days [9].

Pre-sowing seed treatments with growth substances such as gibberellic acid have been found to improve the seedling growth of many species [10]. Seed germination and seedling growth are known to be regulated by exogenous hormones [11,12]. This analysis is considered necessary since the beneficial effect of presoaking treatment of seeds with growth regulator and other substances have been reported in the literature repeatedly [13].

The present study deals with the effects of GA_3 and KNO_3 seed treatments on the germination of *Nigella turcica* seed. Present study is the first research about seed germination of *Nigella* taxa.

MATERIALS AND METHODS

Seeds were collected from type locality, Tuzluca district of Iğdır in Turkey in 2009 and kept in refrigerator. 10, 25, 50 and 100 ppm of GA_3 and KNO_3 was applied to seeds both 4 degrees and 16 degrees in 2010. Seeds were kept in 4°C in refrigerator or in 16°C in growth room. 10 seeds was used for each treatment and controlled every day. Seeds surface were not sterilized with any chemicals. These experiments are separated into 2 groups (Table 1) and detailed below.

Table 1. Seed treatments of *N. turcica*.

	Temperature	
	4°C	16°C
Treatment	10 ppm GA_3	10 ppm GA_3
	25 ppm GA_3	25 ppm GA_3
	50 ppm GA_3	50 ppm GA_3
	100 ppm GA_3	100 ppm GA_3
	0.2% KNO_3	0.2% KNO_3
	10 ppm GA_3 and 0.2% KNO_3	10 ppm GA_3 and 0.2% KNO_3

1- GA_3 seed treatment: Seed were soaked for 24 hours in GA_3 soaks at 10, 25, 50 and 100 ppm. A control was treated only distilled water. After these periods were complete, seeds were placed on moistened filter paper in petri dishes and kept in a 4°C or 16°C in dark.

2- KNO_3 seed treatment: Seed were treated for 24 h in a 0.2% KNO_3 solution. Seeds were placed in petri dishes and stored at either 4°C or 16°C in dark.

3- KNO_3 and GA_3 treatment: Seed were soaked for 24 h in 10 ppm concentrations of GA_3 and 0.2% KNO_3 solution. Seeds were placed in petri dishes and stored at either 4°C or 16°C in dark.

RESULTS AND DISCUSSION

Growth regulators used in pre-sowing seed treatment play an important role in regulating germination and vigor. Treatment with concentrations of GA_3 is effective in overcoming dormancy and causing rapid germination of seed. Seeds in the GA_3 treatment of 50 and 100 ppm had germination at 16°C after 23 days. Seed are infected by fungal pathogens after 30 days. However only one seed germinated in 50 ppm of GA_3 (germination rate is 10%), 4 seeds

germinated in 100 ppm of GA_3 (germination rate is 40%) (Figure 1). The other treatments have not been resulted with seed germination of *Nigella turcica* (Table 2).

The results indicated that optimal germination of *Nigella turcica* seed is 100 ppm GA_3 at 16°C in dark. This result is interesting because immature embryos are common among members of the *Ranunculaceae* and GA_3 would not have a stimulating effect. This appears to be the case with *Helleborus* [9]. Unlike this, GA_3 is effective for germination of *Nigella* seeds.

Germination of KNO_3 treated seed was not significantly different from the control nor were there noticeable differences among the KNO_3 treatment in *Helleborus* [9]. These results contrast those obtained by Atwater (1980) [4] who stated that stratification or alkaline soak (KNO_3) was effective as well as the addition of GA_3 in hastening embryo growth in the *Ranunculaceae* [8]. In this study KNO_3 treatment and GA_3 + KNO_3 treatment are ineffective both 4 and 16°C in dark.

Figure 1. Root tip of *Nigella turcica* (*AAD* 15499) seed after 26 days (Scale bar =2mm).

Nikolaeva [14,15] devised a dormancy classification system that dormancy is determined by both morphological and physiological properties of the seed. Based on this scheme, Baskin and Baskin [1,2] have proposed a comprehensive classification system which includes five classes of seed dormancy. Physiological dormancy is the most abundant form and is found in seeds of gymnosperms and all major angiosperm clades in this system. GA treatment can break this dormancy and depending on species, dormancy can also be broken by cold or warm stratification [16]. It is clear that temperature and concentrations of GA_3 are important factors for germination of *Nigella turcica* seed. At least 50 ppm of GA_3 is enough to stimulate germination at 16°C. So result indicates that between 50-175 ppm GA_3 is enough to break seed dormancy. Possibly *Nigella turcica* seeds have physiological dormancy.

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Table 2. Seed germination of *Nigella turcica*.

	Treatment				
Temperature	10 ppm GA_3	25 ppm GA_3	50 ppm GA_3	100 ppm GA_3	10 ppm + 0.2% KNO_3
4°C	–	–	–	–	–
16°C	–	–	+	+	–

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