Journal of Applied Research on Medicinal and Aromatic Plants 2 (2015) 168–173

Contents lists available at ScienceDirect

Journal of Applied Research on Medicinal and Aromatic Plants

journal homepage: www.elsevier.com/locate/jarmap

Effects of moist stratification, GA_3 and seed age on seed germination of *Rheum khorasanicum* B. Baradaran & A. Jafari

Reza Darrudi, Mohammad Reza Hassandokht*, Vahideh Nazeri

Department of Horticultural Science, University College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran

ARTICLE INFO

Article history:
Received 9 March 2015
Received in revised form 3 July 2015
Accepted 4 July 2015
Available online 5 August 2015

Keywords:
Rheum khorasanicum
Seed germination
GA_3
Stratification
Seed age
Dormancy

ABSTRACT

The aim of this study was to investigate the effects of some breaking dormancy treatments on *R. khorasanicum* seeds. Treatments were arranged in three experiments: (1) Stratification temperature (2 and 5 °C in moist perlite), length of stratification period (0, 15, 20, 25 and 30 d) and germination temperature (2, 5 and 13 °C); (2) Combinational treatment of stratification period (0, 15, 20, 25 and 30 days) and gibberellic acid of 500 ppm (0, 24 and 48 h); (3) Combinational treatment of (2 and 10 months after harvesting) and stratification period (0, 15, 20, 25 and 30 d). The results showed that the best temperature for stratification and germination was 2 and 5 °C, respectively, with a stratification period of 30 d. The highest seed germination percentage (81%) was obtained by soaking in 500 ppm GA_3 for 48 h followed by stratification at 2 °C for 30 days. A negative correlation between germination traits and seed age was observed. The highest germination percentage was achieved in 2-month-old seeds.

1. Introduction

The Polygonaceae family contains approximately 800 species, which are grouped into 30 genera and widely distributed all over the world (Stastn et al., 2010; Naqishbandi et al., 2009). The genus *Rheum* comprises about 103 species and is distributed in the temperate and sub-tropical regions (Rechinger and Schiman Czeika, 1968). This genus is documented in Iranian flora by four species including *R. ribes*, *R. turkestanicum*, *R. persicum* and *R. khorasanicum,* the last two of which are endemic in Iran (Jafari et al., 2012; Mozaffarian, 2007). Its Persian name is "Rivas" (Zargari, 1997). *Rheum* species are medicinally important plants due to the presence of anthraquinone derivatives occurring in the subterranean parts of the plant (Kashiwada et al., 1988). The roots of rhubarb are used to treat diabetes, hypertension, obesity, diarrhea, ulcer, hemorrhoids and as antihelmintic and expectorant (Abu-Irmaileh and Afifi, 2003; Nabati et al., 2012; Sindhu et al., 2010; Tabata et al., 1994). Rhubarb roots are used as laxative medicine and an antipsoriatic drug in Iran (Shokravi and Agha Nasiri, 1997). Several reports on this plant have revealed that it exhibites various pharmacological properties such as antioxidant); (Krishnaiah et al., 2011; Oktay et al., 2007), antibacterial (Alaadin et al., 2007; FazlyBazzaz et al., 2005), antifungal (Sardari et al., 2009) and antiviral (Hudson et al., 2000) effects. Its young shoots and petioles are used against diarrhea as well as stomachic and antiemetic, while juice of some parts of the plant is used against hemorrhoids, measles, smallpox and cholagogue (Baytop, 1999). *R. khorasanicum* is a hardy perennial that was first reported by Jafari et al. (2012) and accepted as a new species. Morphologically, it is very close to *R. ribes* but differs in some characters such as the presence of bracts, inflorescence surface, the pedicle joint position and the epidermal cell shape. Stem 50 cm long, erect and branched, with leaves. Leaves are shorter than petioles, upper surface of leaves verrucose, lower surface glabrous. Lamina dimensions 25 × 35 cm, suborbicular, weakly lobed, with three prominent veins. Base of leaves reniform, margins undulate. Inflorescence is pyramidal, erect or recurved and glabrous. Bracts are cordate—ovoid. Pedicle 5–9 (13) mm long, jointed near apex or at middle. Fruits are cordate—ovoid, acuminate 15* 5–9 (11) mm (Fig. 1) (Jafari et al., 2012).

Fresh stems and petioles are consumed as vegetable as well as digestive and appetizer (Abu-Irmaileh and Afifi, 2003). In Iran, its blanched young stems and petioles are consumed in midspring. In order to produce blanched plants, stones were arranged around plants with closed swollen buds and the plants were covered with soil in late March and early April. 30–35 days after this process the plants produce blanched stems and petioles because of the lack of light. After this period of time the plants would be harvested and sold in local market (Fig. 2).

Rutherford and Ali (1977) reported that cold storage is able to break dormancy in *Rheum palmatum* seeds. Farzami Sepehr

* Corresponding author.
E-mail address: mrhassan@ut.ac.ir (M.R. Hassandokht).

http://dx.doi.org/10.1016/j.jarmap.2015.07.001
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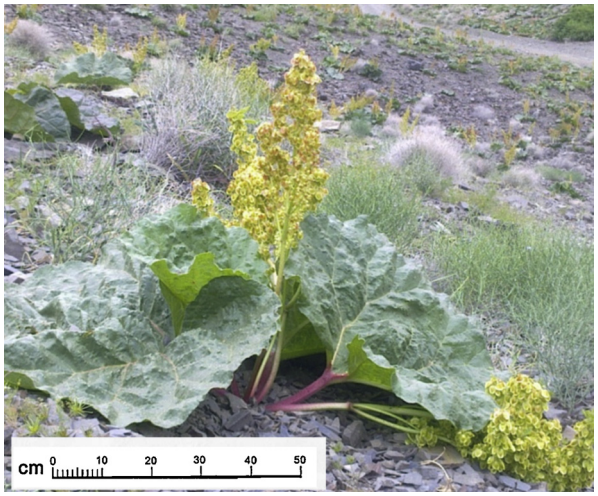

Fig. 1. *R. khorasanicum* in natural habitat from Neyshabour mountains (36 °10 N, 59 °08 E, 2050 m a.s.l.) in Khorasan Razavi Province, Iran (April, 2012).

and Ghorbanli (2010) demonstrated that dormancy in R. ribes is imposed by the embryo and some inhibitors in embryo which may be responsible for the dormancy. GA3 is widely used to break seed dormancy of various plant species. Dormant seeds, which require chilling, dry storage after ripening or light as a germination stimulator, are often treated with GA_3 to overcome their dormancy (Gupta, 2003). Nabaei et al. (2011) reported that the highest germination percentage (96%) in *Rheum ribes* was obtained by using combined treatment of GA_3 (500 ppm) and pre-chilling (for 25 days) at 2 °C. Negative relationship between germination percentage, germination rate and seed age in *Rumex scutatus* has been reported by Demirezen Yilmaz and Aksoy (2007). Furthermore, they showed that the highest and lowest germination percentage occurred 0 and 36 month after seed harvesting. Because of over harvesting due to the increasing market request and the very limited distribution, wild resources of *R. khorasanicum* is decreasing rapidly and no attempt has been performed for its domestication. After investigations on seed treatment with KNO_3 and $CaCl_2$ combined with stratification (Darrudi et al., 2014), the aim of this work was to evaluate the effects of germination and stratification temperatures, length of stratification period, GA_3 and seed age on seed germination of *R. khorasanicum*.

2. Materials and methods

2.1. Seeds

The seeds were collected from a natural habitat from Neyshabour mountains (36 °10 N, 59 °08 E, 2050 m a.s.l.) in Khorasan Razavi Province, Iran (July, 2012).

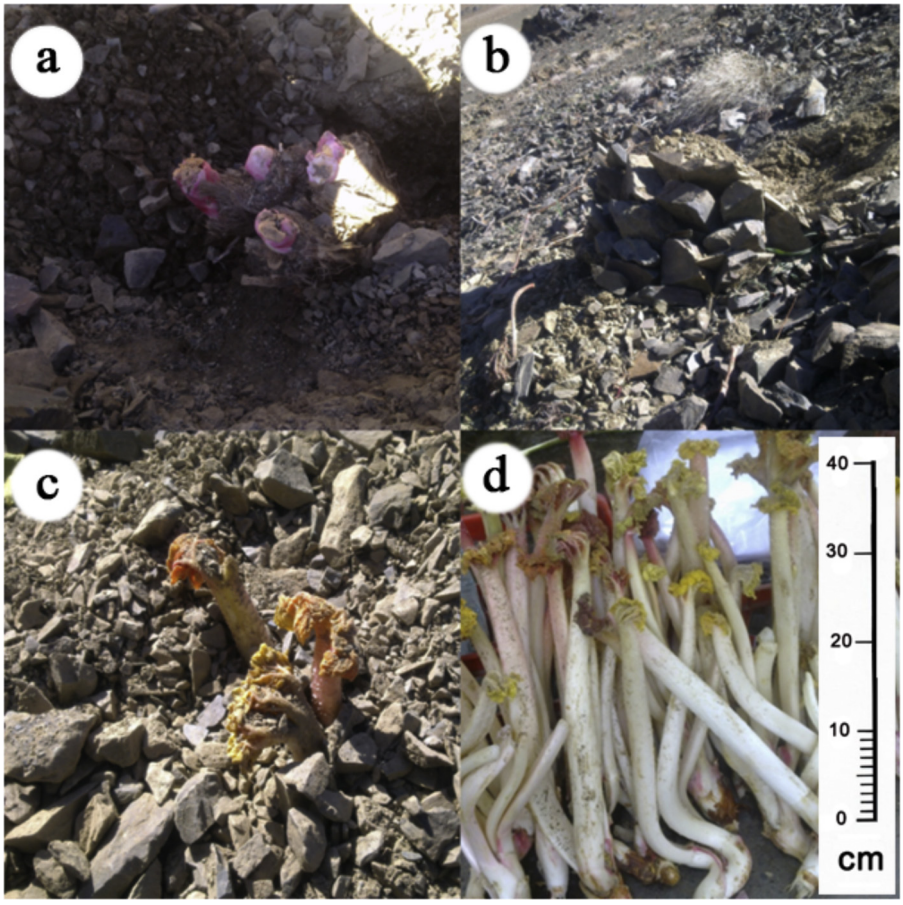

Fig. 2. Different stages of blanched petioles and stems of *R. khorasanicum* production.
(a) Plants with closed swollen buds in late March and early April.
(b) Stones were arranged around plants and were covered with soil.
(c) Plants producing blanched stems and petioles after 30–35 days because of the lack of light.
(d) Harvested plants in local market.