Research Article

Germination Response of Jojoba Seeds under Different Temperature Conditions of the Cholistan Desert of Bahawalpur

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Abstract | Among arid zone plant species, Jojoba (*Simmondsia chinensis*), being an evergreen, perennial, multi-stemmed, and multipurpose plant has attracted wide attention due to its economic value, potential by-products and ability to withstand vagaries of the desert environment. By realizing the economic importance of this high-value desert plant, a pioneer study on seed germination response to various agro-climatic factors was conducted at the Arid Zone Research Institute Bahawalpur. Healthy jojoba seeds were sown at the fortnightly intervals by dividing the whole year into 16 treatments to identify the optimum sowing time for the Cholistan desert of Bahawalpur. The results revealed that maximum germination rate of 85.63%, 85.93%, and 82.83% were found in treatment 16th September during the whole study period (2011-14). The 16th of March, 16thSeptember, and 1st August were the other suitable sowing times for jojoba as these showed 82.37%, 75.47%, and 71.57% of germination respectively.

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Introduction

Jojoba is an economical desert plant, which can be grown successfully in arid and semi-arid deserts. It is a dioeciously, perennial, evergreen, woody shrub scientifically known as *Simmondsia chinensis*. Jojoba is considering very precious plant that can survive under drought, saline water, extreme hot climatic conditions and resists pest attack. An interesting fact about the jojoba plant is that nature has covered its leaves with a waxy coating/sheet, which helps to reduce the evapotranspiration from its leaves thus reducing the loss of moisture at a very minimum level. This probably is one of the most important reasons for its survival under desert conditions. Jojoba seed used in cosmetic industries because it contains 40 to 50% oil which 'is useful for lotions, massage oils, lipsticks, smoothing creams and nail polishes. It, s also has potential for lubricant, printing and pharmaceutical industries (Benzioni *et al.*, 1999). The oil extracted from Jojoba is usually called as "Liquid Gold". The chemical composition of jojoba oil resembles that of whale fish oil. As a strict ban is being observed on the hunting of whale fish at the international level,

increased attention is being paid since the 1970's to the alternate source of oil (i.e. jojoba oil) on a commercial scale. There is, however, a vital need to introduce this plant at a larger scale and make good use of its fruit/seed and the other by-products, which has largely been ignored in the past (Nechiporenko, 1989).

Some scientist also reported that Jojoba seed germination affected by various abiotic stresses (temperature, moisture, pH, soil type, different salinity levels and drought conditions). Thomson in 1982 examined seed germination rate with alkaline sandy media and temperature ranged at 80 to 100^0 F- and 100 to 110^{o}F. Jojoba germination rate (75 to 78%) recorded under the temperature of 21 to 35^{o}C (Kuepper, 1981). The Scientist also concluded that either October or February was suitable for sowing the seed and have high germination rate (Harsh *et al*., 1987).

As this plant is exotic thus, most of the farmers of the country are not familiar with its cultivation and production technology. There is a necessity of conducting various researches on different aspects to develop a sound technology package as a source of knowledge for farmers, investigator, and all stakeholders who are interested in this crop. By realizing the importance of this plant in desert areas a pioneer study was initiated with intention of observing the germination response of Jojoba seeds under various agro-climatic conditions in the Cholistan desert of Bahawalpur, Pakistan.

Materials and Methods

The study pertaining to the germination response of jojoba seed (*Simmondsia chinensis)* under various agro-climatic factors was conducted at the Arid Zone Research institute (AZRI), Bahawalpur. There were sixteen treatments in this study i.e. 1st July (T_1), 16th July (T2), 1st August (T3), 16th August (T4), 1st September (T5), 16thSeptember (T6),1st October (T7), 16th October (T8),1st November (T9), 16th November (T10), 1st February (T11), 16th February (T12), 1st March (T13), 16th March (T14), 1st April (T15) and 16th April (T16). All treatments were randomized in three replications. Ten bags were kept for every treatment in each replication. The trial was conducted according to completely randomized design. The sowing of jojoba seeds were done in polythene bags with depth 28cm and 12cm width. The polythene bags were punctured from different positions with the help of a needle to facilitate the aeration and seepage of excessive water. The soil media with the ratio of 1:1 was made of sand and silt and the polythene bags were filled with the soil media. Healthy, bold seeds of jojoba were sown in 1cm deep in a horizontal position and covered with the same soil media. After sowing, water was applied with hand sprinkler irrigation was made daily in summer and on alternate days during winter. The data of germination percentage were recorded, compiled, and subjected to statistical analysis. The data of agro-climatic conditions were obtained from the metrological station, in Bahawalpur.

Results and Discussion

The use of jojoba seeds is smooth and black in colour. Jojoba seeds have 8-17mm in length, 5-11mm in cross section and seed weight 61-157gm/100 seeds. Positive correlation recorded between seed size and oil content. Oil quality was exhibited variation regardless of geographic origin of seed (Yermanos, 1979; Ullah *et al*., 2020a). Pakistan have harsh temperature changes issues and jojoba have ability to perform better against wide temperature range from 18- 40^{o}C (NIPS, 2012-13, Al-Obaidi *et al*., 2017). In our study, there were 16 treatments with different temperatures and we measured the germination percentage. In previous, research scientists reported germination percentage of jojoba and other oil seeded crops readily growing fast in sandy, clay soil, and against different temperature ranges (Gentry, 1958; Domènech and Vilà, 2008; Ullah *et al*., 2019). The results given in Table 1 show that during 2012-2013, maximum germination rate of 85.63, 76.27, and 75.47% followed by relative maximum temperature 37.1, 38.1, and 38.9^{o}C. On the other relative minimum and maximum temperature affected the germination percentage. Relative high temperature, 38.1^{o}C, and 40.1^{o}C affected germination percentage and recorded 15.57 and 17.37%. Relative lower temperature 22.4^{o}C affected germination percentage and recorded 20.33 during February 2012-2013. Scientists working on the jojoba crop also reported the same results about temperature effects on germination percentage (Miwa, 1984). The relative humidity percentage data of these months are higher than other months and the maximum relative humidity 70%. While on the other rainfall average (mm) in September and October are 0.6 and 11.6mm respectively and during July annual

Table 1: *Effect of temperature on seeds germination of Jojoba.*

	2012-13					2013-14					2014-15				
Treatments	Average seed germination percentage	Average temperature °C		Relative humidity percentage	Average rainfall (mm)	Average seed germination percentage	Average temperature °C		Relative humidity percentage	Average rainfall (mm)	Average seed germination percentage	Average temperature °C		Relative humidity percentage	Average rainfall (mm)
		Max.	Min.				Max.	Min.				Max.	Min.		
T1=1st July	15.57 H	40.1	25.8	71.4	51.3	15.87 H	42.4	26.4	66.7	---	18.27 H	40.2	28.4	73.2	56.0
T2=16th July	17.37 H	38.1	24.6	74.6	---	17.73 GH	39.6	24.8	69.3	59.0	22.43 H	36.2	24.8	76.6	---
T3=1st August	51.73 E	38.6	24.9	74.7	---	58.70 D	40.1	25.9	70.5	---	52.27 F	38.5	26.1	76.6	---
T4=16th August	71.57 BC	37.8	24.1	75.3	42.1	69.80 BC	38.3	24.7	72.9	---	69.90 BC	36.5	25.7	79.0	22.0
T5=1st September	75.47 B	38.9	21.5	73.1	---	75.20 B	38.3	24.2	67.5	---	75.60 B	36.6	24.6	81.5	---
T6=16th September	85.63 A	37.1	20.3	71.5	11.6	85.93 A	38.0	21.0	67.7	39.0	82.83 A	36.2	22.0	86.1	---
T7=1st October	76.27 B	38.1	17.3	70.3	0.6	72.03 B	37.7	17.4	73.5	---	66.80 CD	36.4	20.5	81.5	---
T8=16th October	67.77 CD	36.9	14.1	72.9	---	55.93 D	36.2	15.0	76.1	---	59.10 E	36.4	18.7	81.5	---
T9= 1st November	50.97 E	32.4	8.6	73.6	---	45.57 E	31.2	9.8	71.0	---	51.87 F	28.9	8.9	80.0	---
T10=16th November	38.53 F	27.6	6.4	74.0	4.2	36.17 F	29.2	7.8	71.0	---	37.23 G	26.9	6.3	78.2	---
T11=1st February	20.33 H	22.4	8.1	71.1	---	24.67 GH	21.5	3.5	77.2	---	33.57 G	19.0	5.7	80.8	---
T12=16th February	65.70 D	24.6	12.2	69.5	11.1	62.50 CD	26.3	5.3	75.4	---	66.70 CD	23.8	7.3	80.0	---
T13=1st March	67.93 CD	25.9	17.9	68.6	9.2	56.13 D	26.9	6.8	70.0	---	74.03 B	27.1	7.5	74.7	---
T14=16th March	73.53 B	26.3	18.7	68.0	---	77.73 A	29.7	8.6	67.6	---	82.37 A	28.5	8.7	70.8	---
T15=1st April	66.80 CD	30.4	17.2	67.9	7.1	57.77 D	37.5	16.5	60.5	---	62.50 DE	33.4	16.9	68.9	14.0
T16=16th April	29.67 G	36.4	19.4	66.7	---	25.87 G	38.7	19.5	58.1	---	34.60 G	35.7	18.8	65.7	---

rainfall was recorded higher (51.3) than other months. Which showed that, relative humidity percentage and annual rainfall affects jojoba germination percentage (Shadrack, 2016; Yermanos and Duncan, 1976; Ullah *et al*., 2020b). During 2013-14, the germination percentage of jojoba was higher (85.93 and 72.03%) during September and October. Relative humidity percentages have similar effects like 2012-2013, while the annual rain was 39%, which is higher than the previous year. During 2014-15, the germination percentage was higher (82.83 and 75.60) during September 1st and September 16th. The maximum temperatures averages of these months were 36.2 and 36.2°C. While during the most important part of this year, the relative humidity percentage was higher than in previous years, especially the humidity percentage was higher (81.5 and 86.1) than other months. Annual rainfall during 1st July 2014-15 was 56mm, which increased the germination percentage of this year as compared with others. Data regarding to this month showed that relative humidity percentage also affect the germination percentage of jojoba (Edlabadkar *et al*., 2004; Bala *et al*., 2017).

Based on of three years data, recorded we conclude that, higher temperature effects jojoba germination percentage. Higher average percentage of temperature increased germination rate while lower temperatures decreased the germination. In Pakistan, during the month of September and October temperatures are suitable for germination of jojoba seed. We also concluded that, temperatures with higher annual rainfall and a relative humidity is favourable for germination of jojoba.

Novelty Statement

To the best of our knowledge this is the first study conducted on germination response of jojoba under arid conditions of Cholistan Desert.

Author's Contribution

Malik Muhammad Yousaf: Conceived the idea and provided technical input at every stage.
Muhammad Mohsin Raza, Jahangir Shah and Rao Wali Muhammad: Wrote the manuscript.
Mumtaz Hussain: Presented methodology.
Sami Ullah: Did SPSS analysis.
Hera Gul: Provided technical input at every stage.
Ijaz Ahmad: Overall management of the article.
Muhammad Zeshan: Managed references.

Conflict of interest

The authors have declared no conflict of interest.

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