

Height and diameter affect survival rate of jujube suckers transplanted in a semi-arid farmland of New Mexico

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Abstract

Jujube belongs to family Rhamnaceae and its fruit is rich in nutrients. Jujube tree is drought- and frost-tolerant and can be widely planted across the state of New Mexico. Recently, interest in jujube from consumers and growers is surging. The major challenge is a very limited availability of jujube saplings. The experiment was conducted in Portales, NM from 2017 to 2018 to study the effects of sucker height and diameter on jujube survival. Jujube suckers of four different sizes (height and diameter) were transplanted in the experimental field and replicated three times. Result showed that the most suitable size of jujube sucker for transplantation is 50-100 cm height with 0.36-0.75 cm diameter. This result could be useful for growers who plan to plant jujubes trees in the semi-arid regions like New Mexico. It is expected that jujubes could become a valuable alternative fruit crop in the United States.

Key words: *Ziziphus jujuba*, propagation, medicinal importance

Introduction

Jujube (*Ziziphus jujuba*, family Rhamnaceae) fruit is rich in nutrients, and famous for the sweet, apple-like taste (Li *et al.*, 2005). It is native to China and distributed in over 47 countries around the world (Li *et al.*, 2005; Liu *et al.*, 2014). Jujube seedlings were first introduced in the United States in 1837 (Wang *et al.*, 2008; Yao, 2013). A total of 60 to 70 jujube cultivars are available in the United States (Yao, 2013). Different parts of jujube such as root, bark, leaf, fruit, and seed have been commonly used as sources of crude drugs from ancient time (Li *et al.*, 2005). In addition, *Z. jujuba* has multiple human health benefits, such as anticancer, antioxidant, anti-inflammatory, anti-obesity, and gastrointestinal protection attributes because of the presence of bioactive compounds in the fruits (Tahergorabi *et al.*, 2015; Abedini *et al.*, 2016). Jujube is very tolerant to drought and well adapted to diverse climatic conditions (Outlaw *et al.*, 2002; Yao and Zhao, 2014; Xinguang *et al.*, 2017). Jujube can survive in minimum temperature of -10 to -20 °C, maximum temperature of 36 °C and an annual rainfall of 20 to 45 cm (Azam Ali *et al.*, 2006).

Vegetative propagation can preserve desirable characteristics such as growth rate, fruit yield, and flavor and is thus commonly used in jujube industry (Sharif *et al.*, 2015). Sucker is a plant part (shoot) growing from stem-originated root at the base of the tree, usually used for propagation. Jujube contains high number of offshoots or suckers on lateral roots. Use of suckers is one of the most common techniques of jujube propagation (Johnstone, 2016). Factors that restrict the adoption of jujube as a viable commercial crop in the United States are difficulties in tree propagation, limited cultivars, and poor marketing (Yao, 2013). O'Brien *et al.* (1995) reported that plant height and bole diameter are two important parameters that determine tree survivability. However, we still lack information on jujube height and diameter related to survival

rate. Thus, the main objective of this project was to study the effects of sucker size (height and diameter) on survival of jujube transplanted in a semi-arid farmland in Portales, New Mexico.

Materials and methods

Study site: The experiment was performed on a farm close to the city of Portales, New Mexico from 2017 to 2018. The study area was situated at latitude 34°10.277' N, longitude 103°16.695' W and at an elevation of 1213 meters. The mean annual temperature and precipitation of the study area was 15 °C and 43.33 cm respectively. Soil analysis was done at Agricultural Science Center at Clovis, New Mexico. The soil pH and electrical conductivity of the study area were 6.95 and 0.61 dSm⁻¹, respectively.

Land preparation, collection and transplantation of jujube suckers: Pits of size 40 × 40 × 40 cm³ were dug one week before sucker transplantation by keeping both plant to plant, and row to row distance of 5 m. A total of 72 suckers (having average number of roots 3 and average root length 5 cm) were collected from a 15 years old jujube tree (*Z. jujuba* – Lang cultivar) from experimental field in October 2017. Collected suckers were kept in water before transplantation. Water was added weekly within the first month after the transplantation and once every two weeks one month after transplantation. Water was applied manually to the level of field saturation around the suckers using water hose. Hand pulling was performed to remove all the weeds from the field without using any chemicals.

Field layout: The experiment consists of four treatments and was performed in a complete randomized block design (Table 1). The treatments were based on both sucker height and diameter which were measured using ruler and digital Vernier caliper respectively. Sucker diameter was measured at 15 cm from the

base. Each treatment consists of 6 suckers and was replicated three times. Stem height and diameter are interdependent to each other. Certain stem height categories can have a particular range of diameter.

Table 1. Experimental details

Treatments	Sucker Height (cm)	Sucker Diameter (cm)
T1	< 50	0.15-0.35
T2	50-100	0.36-0.75
T3	100-150	0.76-1.25
T4	> 150	1.26-2.45

Data collection and analysis: Response variables such as number of leaves produced, and sucker survival rate were recorded one year after transplantation. One-way analysis of variance was performed using R studio software and statistical mean comparisons were calculated according to least significant difference test.

Results and discussion

Number of leaves: Fifty to hundred cm tall suckers with diameter 0.36-0.75 cm had the highest number of leaves with a mean value of 134 as shown in Table 2. Kenzo *et al.* (2015) also found that leaf-based photosynthetic features of dipterocarp trees were dependent on plant height in Malaysia.

Survival rate: The suckers height of 50-100 cm with diameter 0.36-0.75 cm had the highest survival rate (84 %) as shown in Table 2. Suckers with appropriate height and diameter may be physiologically active, produce roots and shoots easily and thus survive better. Proper root formation helps in transportation of water and nutrients from the soil to different plant parts thus helps in better sucker survival. Dwarf suckers (<50 cm) may lack proper nutrients in stem necessary to produce adequate shoots and roots. On the other hand, the suckers with greater height (>100 cm) may be physiologically more mature and difficult to adjust

Table 2. Effects of sucker height including diameter on number of leaves produced and final jujube survival

Treatments	Sucker characteristics	Number of leaves produced	Survival rate (%)
T1	< 50 cm height with 0.15-0.35 cm diameter	109ab	56ab
T2	50-100 cm height with 0.36-0.75 cm diameter	133a	84a
T3	100-150 cm height with 0.76-1.25 cm diameter	110ab	67ab
T4	> 150 cm height with 1.26-2.45 cm diameter	43b	45b

Means with the same letters within each column are not significant ($P>0.05$) from each other.



Fig. 1. Jujube trees at Portales, New Mexico one year after transplantation in 2018.

to the environment. The study conducted by Khan and Tripathi (1986) in India on four forest tree species *Alnus nepalensis*, *Quercus dealbata*, *Quercus griffithii*, and *Schima khasiana* found that plants of height 25-50 cm with diameter 1.5-4.5 cm produce more suckers and survive better. The high wind conditions of New Mexico may be another reason for lower survival rate of tall suckers (>100 cm). O'Brien *et al.* (1995) in Panama also mentioned that wind determines the tree survivability. Costes *et al.* (2006) reported plant diameter is positively correlated with maturation of wood layers which finalize the plant survival. Jujube trees of different sizes one year after transplantation in Portales, NM are shown in Fig. 1.

Unique pattern of jujube survival in Portales, NM: A unique pattern was noticed in jujube sucker during study period. Although the top part of a transplanted sucker looks dead, it produced new shoots and survive even after one year of transplantation as shown in Fig. 2. It can be inferred that roots of the sucker remain alive in the soil for a long time resulting survival of this crop in harsh conditions.

In summary, sucker height and diameter play important role in jujube survival. Environmental factors such as soil and biotic stress including weeds affect sucker survival. Jujube is hardy and somewhat resistant to insects and pests as we observed no diseases and pests infestation during entire study period. Study revealed that jujube suckers of 50-100 cm height with 0.36-0.75 cm diameter are most suitable for transplantation. These findings are useful for growers planting jujube in the semi-arid regions like New Mexico.

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