

Variation of some morphological characteristics of *Ziziphus spina-christi* (A.) Ritch. fruits among four provenances

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Abstract- The experiments of this work were conducted at the laboratory of the Tree Seed Centre, Khartoum, Sudan, on April 2013, to investigate the variation of of *Ziziphus spina-christi* A. Ritch fruit pulp weight /Kg., number of fruits/Kg. and number of seeds/kg. among four provenances; Daamazin, Sinar, Shambati and golo. The results showed very high differences between provenances in the pulp weight/Kg. ($P=0.0001$), and high differences in number of fruit/Kg. and number of seed/Kg. among provenances, and Damazin fruit source was the higher in fruit pulp weight, and has the larger size of fruits and seeds. The outcome of this work revealed the importance of these kinds of studies in encouraging tree improvement, genetic resource conservation and food industry of many forest tree fruits.

Index Terms- Variation, Provenance, selection, genetic resource.

I. INTRODUCTION

This article guides a stepwise walkthrough by Experts for writing a successful journal or a research paper starting from inception of ideas till their publications. Research papers are highly recognized in scholar fraternity and form a core part of PhD curriculum. Research scholars publish their research work in leading journals to complete their grades. In addition, the published research work also provides a big weight-age to get admissions in reputed varsity. Now, here we enlist the proven steps to publish the research paper in a journal.

Ziziphus spina-christi A. Ritch. (*var. microphyla*) is wide spread in Sahelian area, from Senegal to Sudan, and Arabia (Vogt., 1995). It is found in flooded riverbanks and at edges of cultivation areas (Bein et al., 1996). It is found in the short grass savanna, also along the Nile tributaries (Mahgoub.,2002), (El Amin., 1990). It is often allowed to remain within or on the vicinity of settlements because of its edible fruits (Vogt., 1995). It grows naturally throughout many zones of Sudan. This species needs rainfall ranges between (50-300) mm. altitude (0-600) m. It tolerates high temperatures and propagates (600-2,500) fruits/Kg (Vogt., 1995). The species also tolerates saline and limestone soils (Maydell., 1990). It is a shrub less in height than 5 m. long, bark is pale grey, fissured branches are intertwined, branchlets are pale or nearly white, glabrous. Leaves are less than 3 cm. long, they are ovate-lanceolate, with acute or obtuse apex (1-3.5) cm. broad, with slightly crenulated margin and three nerves from the base. Thorns in pairs are obviously seen, one straight (8 mm.) and the other recurved and shorter. Flowers are small (10-25) in

heads beside leaves, yellow green stalk and calyx hairy white. Flowering emergence (Aug.-Dec.). Fruits are round, varied in color, mostly brown, pale-brown, yellowish-brown or reddish-yellow (1-2) cm. in diameter, with edible flesh, and (1-2) seeds, rarely 3 seeds may be found.

Ziziphus spina-christi is a multipurpose shrub (Maydell., 1990). The preferred uses are fuel wood, amenity, dune control, charcoal, shade, fodder, shelterbelt, timber, pesticide, fruit, agroforestry and medicine (Vogt., 1995). The fruit which is known locally as "Nabak is a valuable food in Sudan (Abdelmuaty., 1991), the species has an edible fruit for both human and animal. Fruits are found in large quantities in local markets in Sudan. The fleshy part can be dried pulverized to be backed under the heat of the sun (Fichtl., 2006). The crude protein of *Ziziphus spina-christi* seeds was found to be (15.9%) (Nazif., 2001). Saeid et al, (2007) proposed *Ziziphus spina-christi* and other indigenous species to be the promising fruit trees for afforestation in northern Sudan, because they can play a vital role in land degradation and enhanced food production. Christ-thorn is one of the most important nectar and pollen sources.

The diversity of the fruits of this species is obviously observed, and the most important traits are their size and color. Traits like fruit pulp, size and color are strongly correlated to the genetic variability of the species (Wheelwright, 1993) (Mkwezalamba, 2015). However, the morphological characteristics of the fruit may reflect the genetic variation or environmental diversity and provenance, and enhance the opportunity of selection, tree improvement and genetic conservation (Wani et al).

The objective of this work was to investigate the variability of some morphological traits of *Ziziphus spina christi* vs. provenance variation. The experiments were carried out at the laboratory of National Tree Seed Centre, Forestry Research Centre, Khartoum-Sudan. Season April 2013. As a nutrient tropical species, these

Kinds of studies can be useful for developing future domestication programs and for promoting the consumption of these valuable indigenous fruits (Stadlmayr, 2013).

Materials and Methods

Fruits of *Ziziphus spina-christi* were collected from these provenances on December 2012-January 2013, where collected samples were stored in cotton sacks at the National Tree Seed Centre's cold store. Fruits were collected from 15 shrubs from each provenance.

Provenance	Rainfall	Latitude	Longitude
Damazin, Blue Nile State	600 mm	11° 53' N	34° 19' E
Sinar, Sinar State	450-600 mm	13° 33' N	33° 35' E
Shambat, Khartoum State	150 mm	15° 40' N	32° 32' E
Golo, North Darfur State	75-150 mm	13° 37' N	25° 21' E

Fruit pulp weights/Kg

Hundred fruits were drawn randomly from each sample lot. The fruit fleshes were extracted by hitting the fruits gently and weighed per Kilogram to compare between the four provenance fruit pulp weights.

Number of fruits/Kg

Eight random replicates each contains 100 fruits of *Ziziphus spina-christi* from each provenance sample lot were counted. Each replicate was weighed separately using a sensitive electric balance. The mean weight of each eight replicates was calculated to find the mean weight of 1000 fruits. Then the number of fruits/Kg was found according to the following equation:-

$$\text{Number of fruits/Kg} = \frac{1000 \times 1000}{\text{Mean Wt. of 1000 fruits}}$$

Number of seeds/Kg

Number of seeds/Kg was calculated using the same steps used with the number of fruits/ Kg.

Data analysis

JMP statistic package from SAS was used to analyze the results, analysis of variance (ANOVA) was done to find the significance of the variation of fruit pulp weight and number of fruits/Kilogram, Means comparison were made using Tukey-Kramer’s analysis procedure.

Results and Discussion

General morphological observations

Fruit color

The basic color of *Ziziphus spina-christi* fruits of the four provenances was brown, but there was variation in the color strength between these provenances, and to some extent, interference of pale reddishness may be observed. Damazin fruit source was dark brown, while Sinar and Shambat fruit sources were light brown and Golo fruit source was in between of dark and light brown. However, Bums and Dalen. 2002, reported that ecological and evolutionary processes responsible for fruit color remain elusive.

The pulp weight /Kg.

Fruit pulp weight/Kg. showed very high significant differences between the four provenance fruit sources (P=0.0001), and Damazin fruit pulp was the highest weight, whereas Sinar, Shambat and Golo sources were the same. This indicated that Damazin soil nutrients and rain fall amounts are the best, or may affected by the stronger genetic factors. Khurana and Singh, 2001, reported that seed traits of several tree species varied among provenances. Kumar et al, 2015 found that environment materials and genetic factors as well have their effects on fruit contents of natural forests. The higher pulp weight and quality reflects as well the higher seed quality because the larger size of seeds is expected to be found according to the large fruit size. Also the higher fruit size reveals the higher seed characters and biochemical constituents (Kumar et al, 2015).

However, the good fruit quality is industrially desirable (Kumar et al, 2015).

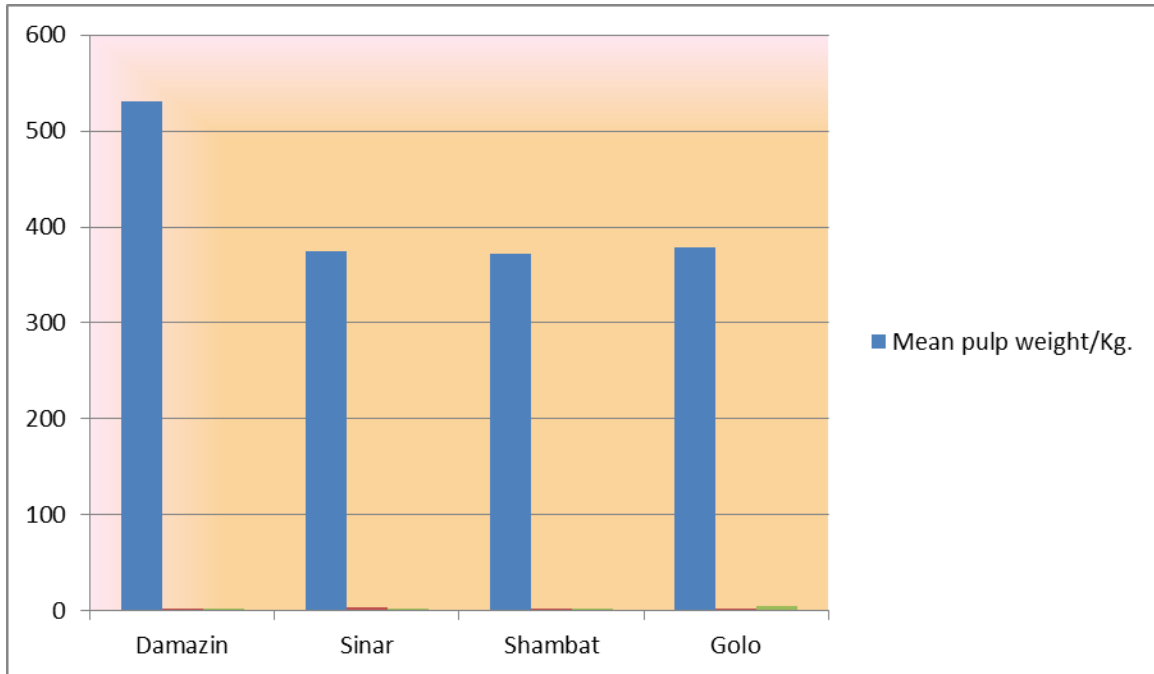
to enhance the efforts of some nutritional sectors to produce biscuits of “Nabak”

Ziziphs spp., specially for the marginal poor communities.

Table 1: The pulp weight g/100 fruits

Provenance	Mean pulp Wt. g/100 fruits
Damazin	530.8 a
Sinar	374.3 ab
Shambat	371.6 ab
Golo	379.3 ab
	P=0.0001 S.E.±4.97

Figure 1: Mean of pulp weight/Kg.



Number of fruits/Kg

Number of fruits/Kg. was varied and the highest mean number of fruit/Kg. indicates that the smallest fruit size was found in that source, and the smallest seed size may reflect poor seed quality. The results showed high significant differences among the four provenances (P=0.001), Sinar source was the highest number and Damazin source was the lowest, this indicated the big fruit size of Damazin. Shambat and Golo sources are likely to be the same. The estimated number of fruits/Kg. for *Ziziphus spina-christi* ranges between (600-2,500) (Vogt., 1995). This depends on many biological and ecological factors, which induce the species to resist the adverse conditions of the provenance, and/or depends on the genetic influence of the species, (Idah et al, 2015) reported that fruit shape, size and number has strong correlation with the genetic resources and environment.

Number of seeds/Kg.

There were high significant differences between the four seed sources in the number of seeds/Kg. (P=0.001). Sinar was

the highest number Golo and Shambat were the same and Damazin was the lowest number. Mahgoub, (2002), obtained (3090) seeds of *Ziziphus spina-christi* seeds per kilogram, and this confirmed the variation that found in the seed size as well as fruit size of the species. The relationship between number of seeds/Kg. and number of fruits/Kg. reveals the quality or the unquality of the seed source; the table below contains the both results for comparing the means of the both numbers of each provenance. However, the natural tropical tree populations have the higher seed and fruit quality, and *Ziziphus spina-christi* var. *microphyla* is usually grows naturally in Sudan, and this may enhance the opportunity of selection and conservation of its genotypes. As a promising future food for the poor communities, the species has been now planted in limited areas as an origin for grafting with other exotic *Ziziphus* species of Iranian and Indian origins. The number of fruits per tree and the fruit quality has to be the target for planters to select elite trees, and research has to encourage the efforts of tree improvement and conservation of genetic resources of this species.

Table 2: Number of fruits/Kg and seeds/Kg

Provenance	Number of fruits/Kg.	Number of seeds/kg.
Damazin	966 c	2383 b
Sinar	1359.5 a	2242 c
Shambat	1155.5 b	2368 b
Golo	1111 b	3580 a
	P=0.001 S.E.±22.30	P=0.001 S.E.±96.88

Figure 2: Number of fruits/Kg. and number of seeds/Kg.

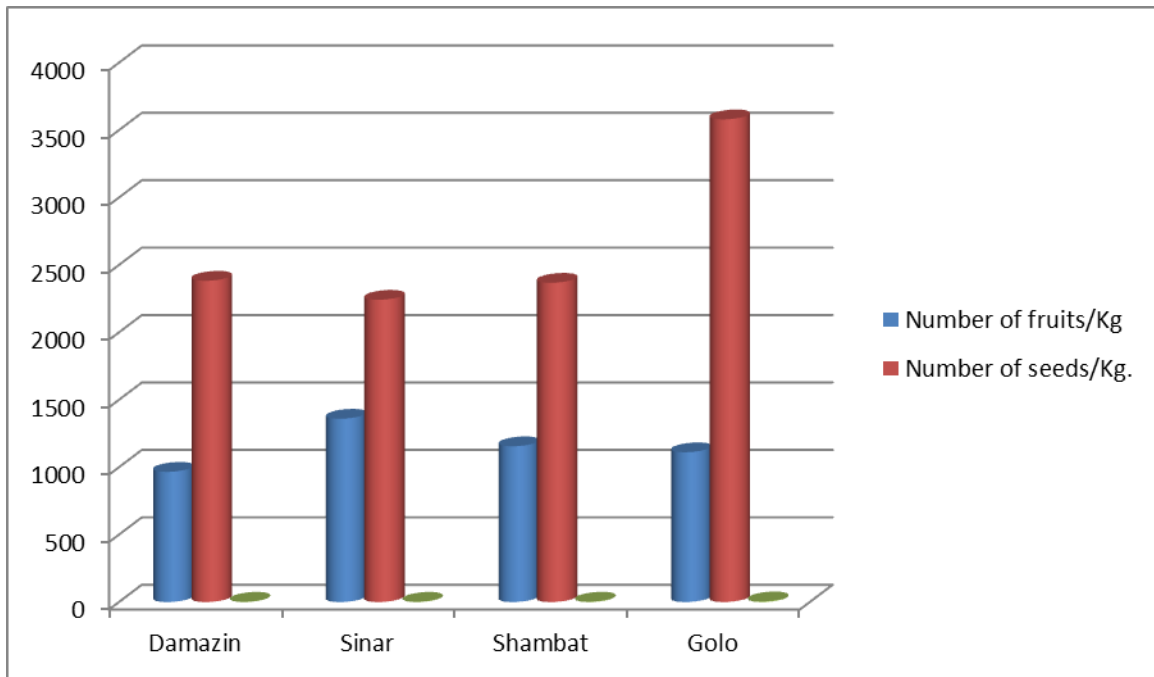
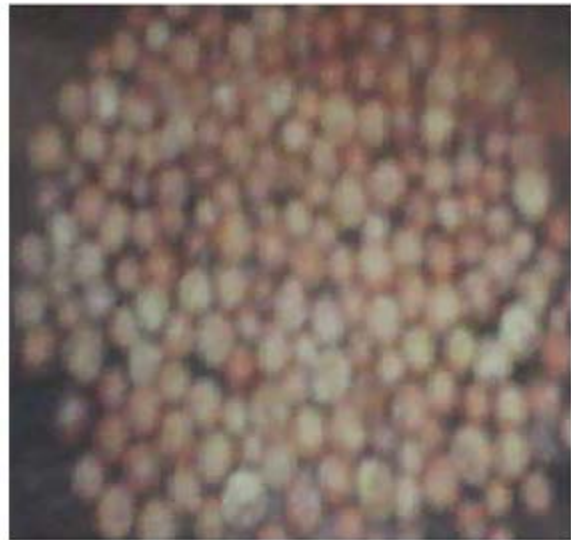


Figure 3: Variation in colors of fruit sources



a. Shambat fruit source



b. Damazin fruit source



Sinar fruit source

c.



d. Golo fruit source

Figure 4: Differences in fruit size of the same source



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