



Effect of Cultivation Practices on Al-Safari (*Crotalaria senegalensis*) for Domestication as Forage Plant

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Abstract:

This study was conducted at Khartoum State, College of Forestry and Range Science Experimental Farm, Sudan. The study aimed to investigate the possibility of cultivating the “Al-Safari plant” (*Crotalaria senegalensis*) under irrigation system and to study the effect of some cultivation methods on its forage productivity, and nutritive value. The experiment was designed according to the randomized complete block design to study the effect of the spacing between plants, and the cultivation method on the productivity of “Al-Safari” forage. Two cultivation methods (ridges and plots) and spacing between plants (10, 20 and 30 cm) were used. The dry matter of the plant was analyzed using the Near Infra Red Spectrometer device (NIRS) to determine its nutritional value. The growth and yield parameters were measured four times during this study with intervals of 15 days. The statistical software program, SAS was used for the collected data by using Dunacan procedure. The study found that there was a significant effect of the cultivation methods and spacing between plants on different growth indicators, while the yield of green and dry fodder were not affected by the different cultivation method and spacing. The study concluded that the ridge method and the spacing 30 cm between plants were the best in terms of plant growth parameters. It is recommended to use the ridge method and spacing of 30 cm between plants to produce high forage productivity from “Al-Safari” plant. Also the study recommends the use of “Al-Safari” plant for forage production and application of various agricultural packages to increase its productivity.

Keyword: plot, ridge, plant height, number of leaves, and stem diameter

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Introduction

Natural rangelands are considered economically very important for livestock development, as a cheap source of feed compared to other sources, and they occupy large areas of Sudan. These rangelands have been subjected to intensive grazing pressure,

over grazing, in addition to climatic factors and the negative humanitarian activities on their resources, which led to their deterioration and low quality. This deterioration requires management interventions to improve the sources of fodder and raise the efficiency of utilization

of livestock to achieve sustainable production. The main that negatively affects rangeland condition is the overstocking of grazing animals and their husbandry systems, (Pande, 2010). The adequate nutrition provides high animal performance, (Taha and Khidr, 2011). There are various kinds of plants that are available in these rangelands, including weeds, grasses and fodder shrubs that feed the domestic animals and wildlife, and it is also considered the appropriate habitat for these animals. Some wild plants that grow in natural rangeland have grazing importance through continuous consumption of animals, thus contributing significantly to the range animal feeding. These plants need to be studied in detail; productivity, nutritional value and knowledge of the possibility of cultivating them because of their importance to livestock. On the other hand, the cultivation of fodder in Sudan has been characterized by traditional and non-diversity of crops, focusing only on two types of fodder crops without benefiting from plant species found in natural rangeland as alternative feed sources. There are wild plants in the natural rangeland, palatable to all grazing animals and have the ability to resist difficult environmental conditions and repeated removal by grazing. These characteristics make them promising plants that can become feed substitutes to fill the feed gap. "Al-Safari" (*Crotalaria senegalensis*) is one of the most promising plants that grow wild in the natural rangeland and is characterized by good productivity and very desirable for domestic animals. It was selected based on its high palatability and widespread in most rangeland environments of the Sudan. The study aimed at determining the forage productivity and its nutritive values under irrigated conditions to identify the possibility of growing it as green fodder.

Materials and Methods:

Plant Description:

"Al-Safari" (*Crotalaria senegalensis*), is an annual plant that grows naturally in most arid and semi-arid rangeland in Sudan, especially in Al-Butna plain, it is also known locally as "Al-Tagtaga". "Al-Safari" belongs to the family Leguminosae and the genus of *Crotalaria* is one of the largest genus in this family, (Polphill, 1982, cited by Odewo, *et al* 2015). It has a wide range found in Savannah and open forest areas, (Odewo, *et al* 2015). Species *senegalensis* one the most species found in different parts of the rangeland of Sudan, it can grow in semi desert and low rainfall savanna in sandy and clay soil. It is one of the annual plants that grows in the rainy season. It has many branches and dense leaves, the flowers are yellow, the fruit is a short pod that contains several brown seeds at full maturity.

The Study Area

The study was conducted in Khartoum State, Soba West, at College of Forestry and Range Science Experimental Farm, Sudan University of Science and Technology, which is located between longitude 32° 52' 98" E and latitude 15° 60' 40" N, (www.alhelalia.com, 2018).

The Study Concept

This study is an attempt to domesticate "Al-Safari" plant and determine its responsiveness to irrigation and other cultivation practices, and its impact on productivity and nutritive value of fodder.

Experimental Design

The experiment was designed using the Complete Randomized Design (CRD). The experiment was divided into two treatments cultivation methods, (Plots and Ridges) and the plant spacing (10, 20 and 30 cm), in six replicates.

Cultural Practices

The soil was plowed, smoothed and flattened, and then divided into plots and ridges according to the design of the experiment. The plot area was 4 X 6 meters and the length of the ridge was 6 meters and the width 70 cm. Seeds were planted on top of the ridge at a depth of 5 cm.

The experiment was irrigated at the beginning of the crop establishment, every five days for three times, after the third irrigation, the crop was irrigated every 15 days until the end of the experiment. Weeds were removed manually, whenever appeared.

MeasurementsIn order to measure growth parameters, two plants were randomly selected from each replicate, to measure plant height (cm), number of leaves per plant, and stem diameter (mm). As for the yield parameters they were taken from harvested plants at maturity. These included wet weight, and after drying the plant material in an oven at a temperature of 105 C° (Abdelsalam and Elsaer, 2017), to get the dry weight.

Organic Matter Analysis

The dry matter was powdered and placed in the Near Infra Red Spectrometer (NIR) to determine the organic matter composition of the AL-Safari forage.

Data Analysis

The data were analyzed by using the SAS statistical program, Duncan multiple range test for mean separation was carried out.

Results and Discussion

Effect of Cultivation Methods on Growth Parameters of Al-Safari Plant

Results represented in Table (1), indicated that plant height, number of leaves per plant and stem diameter of “Al-Safari” plant were significantly affected by cultivation methods. The result found that the ridge practice it gave the high plant height (33.09) cm compared to plot plant height (30.76) cm. Also, there are significant differences in the number of leaves per plant and plant height between the two cultural methods, the ridge method gave the highest number of leaves per plant, compared to the plot method. This result agreed with Elhag, (2007), who found that the ridges sowing method led to an increase the plant height. Also Kutawa, *et al* (2017), stated that the sowing methods affected the plant height. Increasing the number of leaves per plant is a desirable, productive characteristic of the forage crop, this can be obtained when sowing “Alsafari” in ridges. Sowing in ridges increased the stem diameter of “Al-Safari” while the plot sowing method reduced the stem thickness.

Table (1) Effect of cultural practices on plant growth parameters.

Cultivation methods	Plant height /cm	Number of Leaf/plant	Stem diameter/ mm
Plots	30.76b	545b	6.40b
Ridges	33.09a	767a	7.27a

Means with the same letters are not significantly different at alpha 0.05

Effect of Spacing on Growth Parameters of “Al-Safari” Plant

According to the results shown on Table (2), there are significant differences between the different growth parameters due to spacing.

The space of 30 cm gave the best readings for plant height (34.55 cm), number of leaves per plant (917 leaves/plant) and stem diameter (7.69 mm) for “Al-Safari” forage. This result explains the positive effect of

increasing space between plants, where the increase in spacing, resulted in increased plant height and number of leaves per plant as well as the thickness of the stem. Worku, and Astatkie, (2011), reported that the space between plants is more effective than the spacing between rows. Elhassan, (2010),

found that stem diameter and number of branches per plant increased with increasing plant spacing. This result did not agree with Tanko, *et al* (2013), who found that plant height and number of leaves per plant were not affected by spacing between plants, (intra row spacing).

Table (2) Growth parameters and their effects by spacing.

Space /cm	Plant height (cm)	Number of Leaf/plant	Stem diameter (mm)
10	29.36b	463b	5.8b
20	31.89b	601b	7.06a
30	34.55a	917a	7.69a

Means with the same letters are not significantly different at alpha 0.05

Effect of Cultivation Methods on Forage Yield of “Al-Safari”:

Results on Table (3) showed no significant differences in green and dry fodder productivity of “Al-Safari” forage between plots and ridges. This result shows that the method of cultivation does not affect the forage production of “Al-Safari: plant.

Therefore, the cultivation of “Al-Safari” forage in either of the two cultivation methods yields close productivity of green and dry fodder. This result did not agree with Elhag, (2007), who found that sowing Alfalfa in ridges increases the dry matter production.

Table (3) Effect of Cultural practices on “Al-Safari” forage yield.

Cultivation Methods	Green forage (gm/m ²)	Dry matter (gm/ m ²)
Plot	355.54a	75.19a
Ridge	341.41a	55.39a

Means with the same letters are not significantly different at alpha 0.05

Effect of Spacing on Forage Yield of Al-Safari:

Table (4), showed that the spacing between the plants had not affected the productivity of “Al-Safari” plant, whether green or dry fodder. But it was observed that the spacing of 30 cm gave a relatively higher productivity of green forage and dry matter compared to the 20 cm and 10 cm spacing respectively. This result is not compatible with Tripathi, *et al* (2013), who found that

the spacing had significantly influenced the total biomass. The spacing 30 cm between plant gave about 8 tons, dry matter per hectare, without any adding fertilizers to the soil, compared to Alfalfa dry matter productivity (12.38 tons per hectare), which was reported by Muluaem, *et al* (2012). Thus, “Al-Safari” plant can be considered highly efficient for dry fodder production. Just needs wide spacing between plants to get many branches and thus increased leaves per plant.

Table (4) Effect spacing between plant on the green and dry matter of Al-Safari.

Space/cm	Green forage gm/m ²	Dry matter gm/ m ²
10	220.49a	42.45
20	398.2a	82.26a
30	426.8a	86.16a

Means with the same letter are not significantly different at alpha 0.05

The Nutritive Value of “Al-Safari” Forage:

Results represented in Table (5), indicated that “Al-Safari” forage organic matter had a high nutritive value according to crude protein content, about (26.14%) and ash (11.64%), and also had appropriate sugar content (2.86%). From this result, it was observed that the percentage of Crude fiber(CP), acid detergent fiber (ADF) and neutral detergent fiber (NDF), were low. This finding shows the high nutritional value of “Al-Safari” fodder compared with the nutritional value of Alfalfa (*Medicago sativa*

L.), according to Kavut, and Avcioglu, (2015), who found the average crude protein content in alfalfa to be 20% and the average (ADF) about 48.81% and (NDF) between 35-38.67%. Therefore, the low percentage of Fiber (CF, ADF and NDF) and high crude protein content (CP) in “Al-Safari” forage, in addition to the appropriate sugar, indicated the nutritional value of this fodder. These advantages make “Al-Safari” a promising plant that can be used to produce quality fodder and increase diversity in forage crops.

Table (5) Organic matter contents of “Al-Safari” forage.

Elements	Percentage
ADF	46.8
Ash	11.64
Fat	3.64
CF	23.80
Moisture	6.32
NDF	49.99
CP	26.14
Sugar	2.86
ADF: Acid Detergent Fiber, NDF: Neutral Detergent Fiber, CF: Crude Fiber, CP: Crude Protein	

Conclusion

The study concluded that the ridges method and the spacing 30 cm between plants were the best in term of plant height, leaves number per plant and stem diameter of “Al-Safari” plant. “Al-Safari” has a high forage yield efficiency, which was characterized by good nutritive value. Domestication of “Al-Safari” is recommended so as to obtain high quality forage under irrigation system. Ridge method with the spacing of 30 cm can be recommended cultural practices.

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تأثير المسافات وطرق الزراعة على نبات الصفاري (*Crotalaria senegalensis*) لإستئناسه كنبات علفي

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المستخلص

أجريت الدراسة في مزرعة كلية علوم الغابات والمراعي التطبيقية بالسودان، الهدف من الدراسة هو التحقق من امكانية زراعة نبات الصفاري (*Crotalaria senegalensis*)، كنبات علفي تحت نظام الري، بجانب دراسة تأثير بعض طرق الزراعة والمسافات بين النباتات على انتاجية العلف وكذلك التعرف على القيمة الغذائية للعلف المنتج. تم تصميم التجربة بناءً على تصميم القطاعات العشوائية الكاملة، لدراسة تأثير المسافة بين النباتات وطرق الزراعة على انتاجية نبات الصفاري، كما تم استخدام معاملتين هما طرق الزراعة (طريقة السرايات وطريقة الأحواض) والمسافات بين النباتات (10 و 20 و 30 سم). كما تم تجفيف العلف المنتج وطحنه وتحليله بواسطة جهاز الأشعة تحت الحمراء (NIRS) لمعرفة القيمة الغذائية للعلف. تم أخذ قياسات معايير النمو اربع مرات خلال فترة الدراسة بواقع قراءة كل 15 يوم. تم استخدام نظام التحليل الإحصائي (SAS) باستخدام طريقة (Duncan) لتحليل بيانات الدراسة. وجدت الدراسة أن هنالك تأثير معنوي لطرق الزراعة والمسافات بين النباتات على مختلف مؤشرات النمو لنبات الصفاري، بينما الإنتاجية الخضراء والجافة للعلف لم تتأثر بمختلف طرق الزراعة والمسافات بين النباتات. خلصت الدراسة الى أن طريقة الزراعة في سرايات والمسافة بين النباتات 30 سم أعطت أفضل نتائج فيما يخص مؤشرات النمو المختلفة. توصي الدراسة باستخدام طريقة الزراعة في سرايات والمسافة بين النباتات 30 سم للوصول لأعلى انتاج علفي من نبات الصفاري، كما توصي الدراسة بزراعة نبات الصفاري لإنتاج الأعلاف وتطبيق مختلف الحزم التقنية الزراعية لزيادة انتاجية.