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Forage Growth and Yield of *Crotalaria senegalensis* and *Dactyloctenium aegyptium* in Mixtures and Purestand under the rainfed conditions.

Mona Elfadil Ismael[1],H. M. H Adar[2] and Mohammed Ibrahim Abdelsalam[2]

1.Range and Pasture Adminstration. Gadarif State
2.College of Forestry and Range Science, Sudan Unversity of Science and Technology
Corresponding Authar Email: hussadar@hotmail.com

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Abstract

A field experiment was carried out on a heavy cracking clay of Genan rain-fed agricultural area Gadarif State, east Sudan, to study growth and forage yield of *Crotolaria senegalensis* (*C. s*) and *Dactyloctinium aegyptium* (*D. a*)in mixture and pure-stand. Five cropping systems were used pure-stand of *Crotolaria senegalensis* (100% *C. s*), pure-stand of *Dactyloctinium aegyptium* (100% *D. a*), (75% *C. s* + 25% *D. a*), (50% *C. s* + 50% *D. a*) and (25% *C. s* + 75% *D. a*). The experiment was laid in a completely randomized design with four replicates. Parameters studied were plant density, plant height, No. of leaves per plant, No. of branches per plant, No. tillers per plant, plant dry weight and forage yield. Data were statistically analyzed using SAS software and mean separation was carried out using Duncan method (MDRT). Results revealed that purestand of *C. senegalensis* produced the highest crop density, when compared to purestand of *D. aegyptium* and mixtures. It was evident that increase of *C. senegalensis* in the mixture proportions, significantly increased crop height, no. of leaves/plant, plant dry weight and forage yield of *C. senegalensis* and total forage yield. Increase of proportion *D. aegyptium* in the mixture significantly increased its no. of tillers/plant, plant dry weight and forage yield, but decreased total forage yield of mixtures. The study concluded that the competitiveness of *C. senegalesis* was higher when compared to *D. aegyptium* under condition of the present study.

Keywords: Genan, crop density, mixture proportions, mixture components.

Introduction

Intercropping is growing of two or more crops simultaneously on the same area of ground. Willey (1979) Suggested that intercropping imply that crops are grown on separate rows and that any arrangement where there is irregular broadcasting or mixing within the rows should be defined as mixed cropping.Many crop Combinations are used, but parlicularly good combination is a cereal- legume mixture (Andrews, 1972; Willey, 1979). In This combination better use of resources above and below ground results in greater combined crop yield than when crops are grown in two mono cultural plots (Andrews, 1972; Osiru and Willey, 1972). Mixing grasses and legumes increased light interception (Azam-Ali *et al*, 1990), improved soil nitrogen (Singh *et al*, 1986) and improved overall physio- chemical properties of the soil (Prasad *et al*, 1990). The benefit obtained by grass- legume from

Symbiotic N- Fixation of legume is of great importance, (Skerman *et al,* 1985 and Papastylianou,1990). In Selecting mixtures, Purpose intended, adaptability of mixture components to the environment and their compatibility should be well known (Ahlgren, 1956). *Crotalaria* is a genus of 600 species. Spread in all the tropical areas of the world (Bhatt *et al,* 2009). Its a largest genus and has a wide range found in Savannah and open area, (Odewo, *et al* 2015). As a legume *Crotalaria* improves soil fertility through nitrogen fixation as their roots contain N-fixing bacteria. This plant survives in the harsh growing conditions through what is known as seed escape and also through seed dispersal mechanism (Bhatt *et al,* 2009). *Dactyloctenium aegyptium* is an annual rangeland forage species that is very palatable and with high nutritive value. It is widely spread in tropical area. In Sudan it is found in most of the grazing areas. In drought conditions seeds of *Dactyloctenium aegyptium* is used for human consumption to sustain lives. The objective of the present study was to study rainfed forage production of *Crotalaria seneglensis* and *Dactyloctenium aegyptium* in mixtures and purestand.

Material and Methods

Location:

The experiment was conducted at Gennan area 25 km south of Gadarif, the capital of Gadarif state, east Sudan, between Latitude 14.4 and 16.4N and Longitude 35° 36` and 33° 35` E.

Soil

The Land is a fertile heavy cracking clays. Soil anlysis was carried out for the determined experimental area.

Table (1): Soil analysis of the Experiment site.

Sample	PH	EC Ob/m	N%	ppm	Ca Meg/l	Mg Meg/l	Hco3 Meg/l	CL Meq/l	Co3 Meq/l
1	7.94	0.34	0.014	2.2	1.0	1.0	0.5	3.0	0
2	8.05	0.34	0.014	2.3	1.5	1.0	1.0	2.5	0

Source: Mechanized Agricultural Cooperation. Soil Lap. Gadarif State (2017).

Rainfall

The Rainy season in the area extends from June to October. During the course of the experiment the rain fall was measured 2016 and2017 rainy seasons.

Table (2): Rainfall (mm) at Genan for 2016 and 2017during the rainy seasons.

Months / Years	June	July	August	September	October	Total
2016	88.3	122.5	321.2	107.2	-	639.2
2017	123.2	197.9	200	90.1	-	911.2

Source: Mahdi, I. (2017). Gadarif Meotrological Station.

Cultural Operations

Land was first ploughed by the wide- Leved disc at the first and third weeks of July 2016 and 2017 respectively. Then the area was ridged up at 70 cm and divided into plots 4 x 4m.

Seeds of both crops were sown on a continuous line at one side of the ridge- seed rate used for pure stands were 1 kg/ fed for both crops. At mixing seeds were sown according to ratios proposed as treatments.

Weed control was carried out whenever necessary.

Treatments:

Five cropping systems were studied:

1. Pure stand of *Crotalaria senegalensis* (100% *C.s*).
2. Pure stand of *Dactyloctenium aegyptium* (100% *D.a*).
3. 75% *Crotalaria senegalensis* + 25% *Dactyloctenium aegyptium.* (75% *C.s* + 25% *D.a*)
4. 50% *Crolalaria senegalensis* + 50% *Dactyloctenium aegyptium*. (50% *C.s* + 50% *D.a*)
5. 25% *Crotaria senegalensis* + 75% *Dactyloctenium aegyptium*. (25% *C.s* + 75% *D.a*)

The experiment was arranged in a completely Randomized Design (CRD) with four replicates. Statistical analysis was carried out using SAS Software and Mean Separation was carried out using Duncan multiple range test method. Parameters studied were crop density, Crop height, No. of leaves /plant, No. of branches/ plant, No. of tilters/ plant, plant dry weight, and forage yield.

Results and Discussion

Growth parameters of *C. Seneglergis* and D. aegyptum and their mixturers:

Crop Density:

Results represent in Table (3) showed that plant density of the mixture components were significantly different ($P<0.05$), according to mixture proportions studied at both seasons. Pure-stands recorded the highest plant density compared to components comprising the forage mixture, where it decreased gradually with th reduction of seed rate. Pure-stand of *C. senegalensis* produced higher crop density compared to *D. aegyptium* in both seesons. This result agreed with Bakhashwain, (2010), who found that the sowing ratio of 100% alfalfa (*Medicago sativa*), (purestand afalfa) gave the highest plant number. According to Atis *et al* (2012), stated that, the forange mixtures led to increased plant density.

Table (3): Plant Density (1000 plant/fed)

Sample	2016		2017	
	C.s	***D.a***	***C.s***	***D.a***
(100% C.s)	63.38a	-	35.3a	-
(75% *C.s* + 25% *D.a*)	52.5b	4.31b	38.0a	4.88c
(50% *C.s* + 50% *D.a*)	32.13c	5.13b	29.6ab	5.31c
(25% *C.s* + 75% *D.a*)	18.88d	5.38b	21.5b	7.0b
(100% *D.a*)	-	9.53a	-	12.0a
SE+	3.4	-	3.3	-

- **Key:** *C.s*: *Crotalaria senegalensis* *D.a*: *Doctyloctenium aegyptium*
- Means with the same letter are not significantly different at alpha 0.05

Plant height (cm)

According to results shown in Table (4), plant height of *C. senegalensis* was significantly affected negatively ($P < 0.01$) by mixing in 2016 season, where as that of *D. aegyptium* was significantly decreased in 2017 only. The mixture of 75% *C. senegalensis* 25% *D. aegyptium* produced the tallest plants of both mixture componerts. In both seasons plants of *C. senegalensis* were taller than that of *D. aegyptium* in all treatments. Aydemir *et al*, (2017) reported that, there are a significant decrease in plant height of forage *Sorghum* in mixed cropping compared to purestand. This may due to the interpecific competition btween mixure commponents.

Table (4): Effect of mixing in plant height (cm) of *C.s* & *D.e*. at 2016 and 2017 seasons

Treatment	2016		2017	
	C.s	***D.a***	***C.s***	***D.a***
(100% *C.s*)	56.3a	-	27.5a	-
(75% *C.s* + 25% *D.a*)	59.4a	21.6a	32.6a	32.3a
(50% *C.s* + 50% *D.a*)	33.8b	20.7a	36.6a	30.0b
(25% *C.s* + 75% *D.a*)	39.1b	21.5a	35.8a	34.2c
(100% *D.a*)	-	22.5a	-	21.0d
SE+	2.2	1.3	2.4	0.5

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

Number of leaves/plant:

Based on the results obtained in Table (5), the treatments significantly affected the number of leaves per plant of *C. senegalensis* in 2017 only where as that of *D. aegyptum* was not significantly affected at both seasons. Purestand of *C. senegalensis* and (50% *C. senegalensis* + 50% *D. aegyptium*) mixture, significantly produced the largest number of leaves per plant of *C. senegalensis* . In 2016 season *C. senegalensis* produced more leaves compared to 2017 seeson, it may be due to hiegher rainfall in season 2017. The results showed that 75% *C. senegalensis* + 25% *D. aegyptium* gave largest number of leaves per plant compared to the others mixure proportions in the first season (2016). This result is in line with Bakhashwain, (2010) who found that increasing the ratio of legumes over grasses (Alfalfa over Rhodes), led to increase leaves per plant. The second season (2017) gave the lowest number of leaves per plant in both pure-stand and mixture crops. Its could hardly be explained as the larger rainfall in this season resulted in higher forage yield.

Table (5): No of Leaves/ Plant

Treatment	2016		2017	
	C.s	***D.a***	***C.s***	***D.a***
(100% *C.s*)	90.3a	-	50.1a	-
(75% *C.s* + 25% *D.a*)	90.6a	22.5a	43.8b	16.5a
(50% *C.s* + 50% *D.a*)	81.1a	19.6a	54.0a	17.8a
(25% *C.s* + 75% *D.a*)	73.9a	21.3a	41.9b	19.4a
(100% *D.a*)	-	22.8a	-	24.4a
SE+	-	1.7	-	0.6

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

Number of branches/ plant of *C. senegalensis* and number of tillers/ plant of *D. aegyptium*

According to results represented in Table (6) the treatments significantly affected (P<0.05) number of branches/ plant of *C. seneglensis* in 2017 season, where as the effect was not significant in 2016.

The highest number of branches/plant was recorded on the purestand of *C.senegalesis* and derceased gradually with the dercease of *C. senegalesis* ratio in the mixtures where the least number of branches/ plant was observed at (25% *C. senegalesis* + 75% *D. aegyptium*) mixtures components. In both seasons, purestand of *D. aegypytium* produced

significantly more tillers when compared to mixtures. It was evident that mixing decrease No. of branches/plant and No. of tillers/plant when compared to their pure stand.

Table (6): No of branches/plant for *C.s* and tillers for *D.a* :

Treatment	2016		2017	
	C.S	***D.a***	***C.s***	***D.a***
(100% *C.s*)	15.4a	-	16.5a	-
(75% *C.s* + 25% *D.a*)	15.0a	7.3bc	14.4b	10.5a
(50% *C.s* + 50% *D.a*)	15.5a	7.1c	10.3c	7.4b
(25% *C.s* + 75% *D.a*)	12.6a	9.2ab	9.1c	8.6b
(100% *D.a*)	-	10.0a	-	10.3a
SE+	0.7	0.7	-	0.5

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

Dry weight / plant (gm)

Resuls represented in Table (7) indicated that the treatments significantly affected (P< 0.05) on dry weight per plant of both mixtures compenents at both seasons. Mixtures of (75% *C. sengalensis* + 25% *D. aegyptium*) produced the largest plants of *C. senegslensis* in this study followed by the purestand. The smallest plants of *C. senegalensis* where observed at (25% *C. senegalensis* + 75% *D. aegyptium*) at both seasons. Plants of *C. senegalensis* were larger than that of *D.aegyptium* in all treatments. For *D. aegyptium* results were not consistent in 2016 and 2017 seasons. In 2016, the decrease of *D. aegyptium* plant density in the mixture, decreased intraspecific competition which can hasrdly be explained. The reverse was true in 2017 season.

Table (7): Dry weight of plant (gm)

Treatment	2016		2017	
	C.S	***D.e***	***C.S***	***D.e***
(100% *C.s*)	62.5ab	-	68b	-
(75% *C.s* + 25% *D.a*)	69.0a	7.2a	84.6a	13.9a
(50% *C.s* + 50% *D.a*)	51.9b	10.0b	46.6c	12.4b
(25% *C.s* + 75% *D.a*)	83.1c	17.3b	33.4d	11.9b
(100% *D.a*)	-	13.8c	-	9.0c
SE+	4.4	0.8	3.5	0.4
-	*	*	*	*

Forage yield (ton/fed)

Results showed in Table (8) indicated that purestand of *C. senegalensis* and mixtures produced significantly (P<0.05) higher forage yield compared to purestand of *D.aegyptium* at both seasons. There were no significant differnces observed between purestand of *C. seneglensis* and mixtures in 2016 season. In 2017 season only (75% *C. senegalensis* + 25% *D. aegyptium*) was comparable to purestand of *C.senegalensis* in forage yield. In this season results clearly showed that increase of *C.senegalensis* in the mixture, significantly increased forage yield.

Gulwa et al, (2017) reported that the legume intercropping and season interaction had significantely influence on dry matter yield of forage crops, also Gulwa, et al (2018) reported that mixing grass and legume may produce more forage yield than grass grown alone, contradicing findings was reported by Cinar and Hatipoglu, (2014), who found that mixtures produced high dry matter compared to pure stand.

Table (8): Forage yield (ton/fed)

Treatment	2016			2017		
	C.S	***D.e***	***Total***	***C.S***	***D.e***	**Total**
(100% *C.s*)	2.43a	-	2.43a	7.75a	-	7.75a
(75% *C.s* + 25% *D.e*)	1.45a	0.9b	2.35a	6.86b	1.25c	8.1a
(50% *C.s* + 50% *D.e*)	1.54a	0.71c	2.25a	1.38c	2.1b	6.48b
(25% *C.s* + 75% *D.e*)	1.5a	1.06a	2.56a	2.48d	2.75a	5.23c
(100% *D.e*)	-	1.28a	1.28b	-	2.96a	2.69d
SX	0.23	0.17	-	0.44	0.23	-

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

Conclusion

The present study investigated the growth and forage yield of *Crotolariasenegalesis* (*C. s*) and *Dactyloctiniumaegyptium* (*D. a*) in pure stand and mixtures as a grass-legume mixed cropping system under the rain. Results revealed that the forage legume component (*C. senegalesis*) out yielded the forage grass component (*D. aegyptium*). It was evident that increase of *C. senegalesis* in the mixture ratio, increased forage yield and that pure stand of *D. aegyptium* and the mixture of the high ratio of this crop produced the least forage yield. It can be concluded that the competitiveness of *C. senegalesis* was higher when compared to *D. aegyptium* under condition of the present study.

Reference

Andrews D. J. (1972). Intercropping with sorghum in Nigeria. Exp. Agric. 8: 139-150.

Atist, I, Kokten, K, Hatipoglu, R, Yilmaz, S, Atak, M and Can E (2012). Plant density and mixture ratio effects on the competition between common vetch and wheat . AJCS 6(3):498-505.

Aydemir, S. K, Kizilsimsek, M and Turhal, K (2017). Effects of Different Sowing Design on Forage Yield and Yield Component of Sorgum and Soybeen Mixtures. Iğdır Univ. J. Inst. Sci. & Tech. 7(4): 265-270,.

Azam-Ali S. N; Mathews, R. B. and William, J. H. (1990). Light use water up take and performance of individual components of sorghum, groundnut intercrops. Exp. Agric. 26: 413-427.

Bakhashwain, A. A (2010). Fodder Yield and Quality of Rhodes Grass-Alfalfa Mixtures as Affected by Sowing Rates in Makkah Region. JKAU: Met., Env. & Arid Land Agric. Sci., 21 (1), pp. 19-33.

Bhatt, K. C; Padey, A., Dhariwa, O. P; Panwar, N. S. and Bhandari, C. (2009).Tum-thang (CrotolariatetragonaRoxb. exAndr.)A little known wild edible species in the

north-eastern hill region of India. Genetic Resource and Crop Evaluation, 56: 729-733.

Cinar S and Hatipoglu, R (2014). Forange Yield and Botanical Composition of Mixtures of Some Perennial Warm Season Grasses with Alfalfa (Medicago sativa L.) Under Mediterranean Conditions. Turkish Journal of Field Crops. 19(1), 13-18

Gulwa, U, Mgujulwa, N and Beyene, N. T (2017). Effect of Grass-legume Intercropping on Dry Matter Yield and Nutritive Value of Pastures in the Eastern Cape Province, South Africa. Universal Journal of Agricultural Research 5(6): 355-362.

Gulwa, U, Mgujulwa, N and Beyene, N. T (2018). Benefits of grass-legume inter-cropping in livestock systems. African Journal of Agricultural Research. 13(26), pp. 1311-1319.

Mahdi, I. (2017). Gadarif Meotrological Station, perssonel communication.

Mechanized Agricultural Cooperation. Soil lab. Gadarif State, (2017).

Parsad, N. K; Bhagt, R. K; Singh, A. P. and Singh, R. S. (1990).Intercropping ofDenanath Grass (Pennisetumpediculatum) with cow pea (Vignaungiculata) for forage production. Indian J. of Agric. Sci. 60 (2); 115-166.

Singh, N. B; Singh, P. P. and Nair K. P. P. (1986).Effect of legume intercropping on enrichment of soil nitrogen, bacterial activity and productivity of associated maize. Exp. Agric. 22; 339-344.

Willey, R. W. (1979). Intercropping its importance and research need: Competition and yield advantage.Field crop abtracts.

Ahlgren, G. H. (1956). Forage Crops. 2nd edition McGraw Hill pp. 317-326 and 373.

Papastylianou, I. (1990). Response of pure stand and mixtures of cereals and legume to nitrogen fertilizer ad residual effect on subsequent barley.J. of Agric. Sci. Camb. 115: 15-22.

Osiru, D. S. O and Willey, R. W. (1972). Assessing yield advantage from intercropping. J. Agric. Sci. Camb. 79: 531-540.

Skerman, P. J. Cameron, D. J. and Rivers, F. (1988).Tropical forage legumes.FAO Plant Production and Protection Series No. (2). 2d ed. pp 87-102, 185-193, 311-319.

النمو والإنتاجية العلفية للصفاري (*Crotalaria senegalensis*) وأبو أصابع (*Dactyloctenium aegyptium*) في مخاليط علفية أو زراعة أحادية تحت ظروف الزراعة المطرية

منى الفاضل اسماعيل، حسين محي الدين حسين ومحمد ابراهيم عبدالسلام

جامعة السودان للعلوم والتكنولوجيا – كلية الانتاج الحيواني

المستخلص

أجريت التجربة لحقلية في تربة طينية متشققة في منطقة جنان بولاية القارف،، تحت ظرف الأمطار لدراسة معايير النمو والإنتاجية االعلفية للصفاري وأبو أصابع في زراعة أحادية وخليط علفي. تمت دراسة خمسة نظم محصولية وهي زراعة أحادية للصفاري (*C s* 100%) وزرعة أحادية لأبو أصابع (*D a* 100%) ثلاثة نظم محصولية كمخاليط (*D a* + 75% C s 25%) و(*D a* 50% + *C s* 50%) و(*D a* 75% + *C s* 25%). أستخدم التصميم العشوائي الكامل بأربعة مكررات. تم تحليل البيانات بإستخدام برنامج (SAS). أظهرت النتاج أن الزراعة الأحادية للصفاري أعطت أعلى كثافة نباتية وأعلى إنتاجية علفية مقارنة بالزراعة الأحادية لأب أصابع والمخاليط. أدت الزيادة في نسبة الصفاري في الخليط الى زيادة في طول النبات وعدد الأوراق في النبات والوزن الجاف للنبات والإنتاجية العلفية للصفاري. زيدة نسبة أبو أصابع في الخليط زاد من عدد الخلف في النبات والوزن الجاف للنبات لأبو أصابع لكن أدى لى تدني الإنتاجية. يمكن أن يستخلص من هذه الدراسة أن لنبات الصفاري قدرة تنافسية أعلى من نبات أبو أصابع.