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Response of Halophyte Fodder Shrubs to Cutting Intervals and Organic Manure Application

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A FIELD experiment was carried out through two successive season out at 2002/2003 and 2003/2004 to determine the effect of three levels of sheep dung manure (0, 10 and 20 m^3 /fedden.), two cutting intervals (wet and dry seasons) and three leguminous shrubs i.e *Acacia saligna, Leucaena leucocephala* and *Prosopis chilensis* on fresh and dry shrubs yield, weight/shrub and chemical composition under the condition of Wadi Sudr Region (South of Sinai). The main results revealed the following:

1-Fresh and dry yield of shrubs (Ton/fedden) as well as weight/shrub (kg) responded insignificantly to apply organic manure up to 20m^3/fedden. Also, a significant increase obtained for each of crude protein,sodium and potassium percentages.

2-The highest values of forage yield,crude protein,crude fiber, sodium,potassium and TDN percentages, while the lowest value of Ash,EE and NFE were obtained from plants browsed of dry seasons comparing to wet seasons.

3-*Prosopis chilensis* was the best quantity shrub followed by *Acacia saligna* where, *Leucaena leucocephala* was the lowest one at first season while, *Acacia saligna* was superior than *Prosopis chilensis* followed by *Leucaena leucocephala* at second one.Concering the chemical content and nutritive value *Leucaena leucocephala* was the best than the two other shrubs .

4-The triple interaction had a significant effect on the chemical composition.

Keywords: Fodder shrubs, Halophyte, Cutting intervals, Organic manure

In large scale, the current under production of animal protein in the developing world is caused by lake of forage. Trees and shrubs play a dual role in the forage supply, serving both as shade for grasses and as a forage themselves. During the dry season, trees and shrubs provide green fodder often rich in protein and minerals. Supplying the only grazing during drought or periods of the year when other food is normally scarce.

Halophyte is a plant that,at any stage of its life,will tolerate this critical salt concentration which will not be tolerated by "a normal" non halophyte.

Halophytes in there saline environment are exposed not only to salt stress,the roots may also be exposed to asmotic water and low oxygen pressure stress (Pessarakli,1993).

Leucaena leucocephala is a tree legume widely cultivated in a tropical and sub-tropical countries.It is both salt and drought resistant.Leaves,pods and seeds are browsed by cattle, sheep and goats.Among nine tropical legumes tested in a forage production project, Leucaena showed the highest salt tolerance (Goodin *et al.*,1990) .

The great advantage of forage *Acacia* is for dry regions where pastures grow poorly or only seasonally. Most *Acccias* grow vigorously, coppice readily, and withstand heavy browsing. The leafy branches can also be cut for fodder. *Acacia saligna* is big perennial shrubs, have many branches. This tree tolerates all desert environmental conditions and it gives a successful growth under saline soils (Sheha, 1984). Also, it consider a multipurpose shrub which can be grown for wood and fodder (Foliage) production (El Lakany and Mahmoud, 1991).

Shrubs and trees of genus Prosopis are found through out arid and semiarid areas of the tropics. Since they fix nitrogen,they improve the soil and so supply part of their own nutrients (Felker *et al.*,1981).

Clipping date of fodder shrubs plays an important role for increasing forage production of these shrubs and enhancing their nutritive value. Webb (1988) showed that nutritional quality of browse trees (*Acacia tortilis, Leucaena leucocephala* and *Prosopis chilensis*) was higher than that of Sorghum, which is the main dry season fodder source and important source of fodder, particularly towards the end of the dry season. Abou Deya *et al.* (1990), Khalifa (1996) showed that fresh and dry weight of *Acacia saligna* (stems and leaves as well as total plant), gradually increased from winter through spring and summer and reached the maximum values during summer season.

Adding organic manure is considered one of the most important soil management for new reclaimed soil, especially at Wadi Sudr region (South Sinai) which characterized as a high calcareous soil. Applying organic manure as soil amendment would reduce crusting and high soil temperature at summer season (Follett *et al.*, 1981). Also, it supply some essential nutrients to the growing plants, increasing the cation exchange capacity and make phosphorus and most micro nutrients more available to plant over a wide range of high pH which inturns increase forage productivity (Follett *et al.*, 1981). Increasing organic manure up to $40m^3$/fed. increased the fresh and dry yield of *Acacia saligna* under rainfed conditions (El Toukhy, 1997).

This investigation was carried out to comparative the productivity and the quality of *Acacia saligna*, *Leucaena leucocephala* and *Prosopis chilensis* under different levels of organic manure and clipping date at Sudr region {(South of Sinai) (desert stress and saline conditions)}.

Materials and Methods

Throught two years, a field experiment was set up at the experimental station farm of the Desert Research Center (D.R.C.) at Wadi Sudr (South Sinai Governorate) during successive seasons 2002/2003 and 2003/2004. The soil of the experimental site is characterized as sandy clay texture and highly calcareous having (57% $CaCO_3$ with EC 8.3 mmoh/cm and pH value 8.0).

Nursery site: seeds of three leguminous shrubs (*Acacia saligna*, *Leucaena leucocephala* and *Prosopis chilensis*) seeded in green house under controlled conditions in polyethylene bags filled with sand and clay soil (1:1) in February 2001. After six month seedlings of shrubs species were transplanted in the permanent site at Wadi Sudr. Sheep dung manure at level of 10 and 20m^3/fedden mixed with soil surface during the soil preparation. Seedling were planted in the middle of the plot at distance of 2×2m (1050 shrubs/fedden). Plants were regularly irrigated weekly by brackish ground water (9000 PPM) with immersion methods. After seedlings establishment, eighteen month's of shrubs age, cutting was started in summer 2002, the cutting management of new growing branches (brows) was started in 2 clipping date *i.e.* summer (dry season) and winter (wet season). Eighteen treatments were the combinations between 3 shrubs (*Acacia saligna*, *Leucaena leucocephala* and *prosopis chilensis*), 3 levels of sheep dung manure (0, 10 and 20 m^3/fedden) and 2 clipping dates were arranged in split – split plot design with 3 replicates. The main plots were occupied by the species of the shrubs the sub plots were occupied by the organic manure and the sub - sub plots were occupied by clipping date. Fresh productivity (ton/fedden) was calculated by multiplying the average tender phytomass of the shrubs by the number of shrubs/fedden, dry productivity (ton/fedden) was determined by taking fresh samples in oven at 70°C till reach constant value. The dried matter was milled to fine powder and used for subsequent chemical analysis:

- Crude Protein: Total nitrogen was determined using the micro kjeldahl methods and multiplying by 6.25 (Tripathi *et al.*,1971).
- Crude Fiber, total Ash and ether extract were determined by using the method outlined by Association of Official Agricultural Chemist (1970).
- Sodium and Potassium were estimated by a Flame photometer according to Brown and Lilleland (1946).
- Total digestible nutrients were estimated by Farid *et al.* (1979).

The obtained data were statistically analysed using the COSTAT computer program according to procedures outlined by Snedecor and Cochran (1980). Means were compared by Duncan's new multiple range test as described by Duncan (1955). However in this text means having the same alphabetical letters were not significantly differed.

Results and Discussion

Forage Productivity

Results of the influence of defoliation seasons on forage yield shrubs in the two years of experimentation are presented in Table 1. Its evident from the data given that fresh and dry yields per fedden followed closely the same trend of fresh and dry yield per shrub in their response to defoliation season.However the highest values of the above mentioned traits were obtained from plants clipped in dry seasons.This trend holds fairly true with insignificant differences in the second season, while, opposite trend was obtained at first one .This may refer to that climatic conditions prevailed through out summer seasons were more suitable for growth rather than other seasons. In this concern, Khalifa (1996) clarified that the highest yields of dry matter per shrub and per fedden were obtained in summer. On the other hand, Abd-alla (1999) and Ibrahim (1999) showed that the fresh and dry production of *Acasia saligna* under rainfed conditions with different ages and sites was more in winter and spring seasons comparing with other seasons.

It is appeared from the results presented in Table 1 that fresh and dry forage yield of shrubs as well as weight/shrub were responded positively to increasing organic fertilization level up to 20 m^3 /fed .Such increments were insignificant in both seasons.This increase in shrubs yield may be attributed to ameliorating effect of organic manure on the physical,chemical and microbiological properties of soil as well as to stimulation of macro and micro nutrients release and their availability to the growing plants. Such favorable effect of organic fertilizer could be encourage to limit the application of chemical fertilization and consequently reduced the toxicity of chemical pollution and its harmful effect on animal nutrition.These finding are in harmony with those obtained by Khalifa (1996) and El-Toukhy (1997).

Regarding the effect of plant species on the productivity of shrubs, results in Table 1 showed that *Prosopis chilensis* followed by *Acacia saligna* were superior than *Leucaena leucocephala* under the conditions of the drought and salinity of South Sinai. This result was fairly true and significant at first season concerning of fresh and dry production as well as the dry weight/shrubs. On the other hand, *Acacia* sp. followed by *Prosopis* sp. were the highest production at second one these increase regard to the nature of plant species are different and this finding was agreed with those obtained by Sheha (1984) while the production of *Leucaena* sp. was the lowest one at both seasons. This result may be attributed to the sensitive or moderately sensitive of *Leucaena* sp. to salinity. The reduction in growth is evident by a decrease in leaf area and the development of smaller, and also shoots are generally more inhibited than roots. This result are agreed with those obtained by Tomer (1988), who revealed that *Acacia tortilis* was the best tree species in stabilizing sand dunes even at 300mm isohyets.

TABLE 1. Response of forage yield of shrubs to cutting date, organic manure and plant species during 2002/2003 and 2003/2004 growing season.

Trait	2002/2003							
	Cutting date		Organic manure m^3/fed.			Plant species		
	Dry	Wet	0	10	20	*Aca.*	*Leuc.*	*Pros.*
F.F.Y (Ton/fed.)	0.137 A	0.335 A	0.18 A	0.285 A	0.242 A	0.264 AB	0.150 B	0.292 A
D.F.Y (Ton/fed.)	0.049 A	0.157 A	0.072 A	0.129 A	0.108 A	0.114 AB	0.059 B	0.134 A
F.Y/shrubs(Kg/fed.)	0.143 A	0.319 A	0.192 A	0.272 A	0.228 A	0.252 A	0.165 A	0.276 A
D.Y/shrubs(Kg/fed.)	0.051 A	0.160 A	0.104 A	0.113 A	0.106 A	0.099 B	0.065 B	0.153 A
	2003/2004							
F.F.Y (Ton/fed.)	0.612 A	0.361 A	0.419 A	0.513 A	0.529 A	0.751 A	0.057 B	0.651 A
D.F.Y (Ton/fed.)	0.286 A	0.168 A	0.176 A	0.265 A	0.270 A	0.334 A	0.025 B	0.321 A
F.Y/shrubs(Kg/fed.)	0.660 A	0.652 A	0.442 A	0.594 A	0.887 A	1.08 A	0.146 B	0.695 AB
D.Y/shrubs(Kg/fed.)	0.282 A	0.179 A	0.157 A	0.321 A	0.412 A	0.355 A	0.049 B	0.289 A

F.F.Y Fresh Forage Yield D.F.Y Dry Forage Yield

F.Y/shrubs Fresh Yield/Shrubs D.Y/shrubs Dry Yield/Shrubs

* Means having the same capital letters are not statistically differ at 5% level of significancy.

Chemical Contents

Results of the influence of cutting date, organic manure and plant species on the chemical composition of shrubs during the two seasons are presented in Table 2. The same table, showed that the maximum values of CP, CF, Na, K and TDN% were obtained in dry season (summer) .

Such increment was insignificant at both seasons except of Na % which increased significantly at second season. However, the opposite trend was obtained for Ash, NFE and EE% which the lowest value of such constituent was obtained from shrubs browsed in dry season. In this connection, Abou-Deya *et al.* (1990) reported that leaves of *Acacia saligna* contained the highest CP, ash and sodium content during spring and summer seasons and it is considered suitable for animal feeding during the dry season.

As for effect of adding organic manure in relation to chemical content of forage shrubs, results in Table 2 elucidate that their was positive relationship between organic manure level and crude protein, sodium and potassium percentage meantime,crude fiber and total ash percentage decreased slightly by increasing organic manure level.This trend was observed in the browsing stage in

both seasons.The significant increase was detected only in the second season for CP,Na and K.Conferming results were reported by Khalifa (1996) who noticed that under the conditions of Ras Sudr, plants of *Atriplex sp.* and *Acacia sp.* which received the high organic matter level tended to accumulate lower ash content, compared to those received the lower level and the effect was more pronounced and significant through Na%, K% and Cl% tended to increase with increasing matter level.

TABLE 2. Response of chemical composition of shrubs to cutting date, organic manure and plant species during 2002/2003 and 2003/2004 growing seasons.

Trait	Cutting date		Organic manure m^3/fed.			Plant species		
	Dry	Wet	0	10	20	*Aca.*	*Leuc.*	*Pros.*
2002/2003								
CP%	14.33 A	10.93 A	11.61 A	13.04 A	13.23 A	10.4 B	15.04 A	12.45 AB
CF%	18.91 A	17.331 A	18.21 A	17.37 A	18.20 A	19.70 B	10.88 C	23.79 A
Ash%	5.52 A	8.09 A	7.37 A	6.62 A	6.42 A	6.90 A	8.29 A	5.132 B
EE%	7.44 A	9.28 A	8.54 A	8.25 A	8.3 A	6.12 B	10.68 A	8.29 AB
Na%	1.846 A	1.461 A	1.584 A	1.52 A	1.856 A	1.665 AB	1.983 A	1.312 B
K%	0.391 A	0.376 A	0.342 A	0.400 A	0.407 A	0.367 AB	0.482 A	0.301 B
NFE%	51.68 A	52.50 A	52.53 A	52.80 A	50.94 A	54.7 A	52.65 A	48.92 A
TDN%	61.16 A	55.0 A	56.83 A	59.04 A	58.37 A	59.33 A	57.3 A	57.61 A
2003/2004								
CP%	13.19 A	10.38 A	10.79 B	11.85 AB	12.7 A	9.75 C	14.29 A	11.3 B
CF%	19.48 A	17.72 A	19.38 A	18.11 A	18.31 A	16.35 B	14.73 B	24.71 A
Ash%	6.314 A	7.31 A	6.95 A	6.17 A	6.32 A	6.14 B	9.068 A	5.227 B
EE%	7.91 A	8.60 A	8.34 A	7.44 A	8.6 A	6.94 B	9.77 A	8.05 B
Na%	2.065 A	1.665 B	1.70 B	1.642 B	2.228 A	1.75 B	2.038 A	1.79 AB
K%	0.417 A	0.353 A	0.357 B	0.380 B	0.418 A	0.372 B	0.478 A	0.305 C
NFE%	50.63 A	54.41 A	52.54 AB	53.99 A	51.04 A	59.29 A	49.66 B	48.62 B
TDN%	58.72 A	56.38 A	56.55 A	59.15 A	56.95 A	60.21 A	56.11 B	56.33 B

* Means having the same capital letters are not statistically differ at 5% level of significancy.
CP:crude protein CF:crude fiber
EE:ether extract NFE:nitrogen free extract
TDN:total digestable nutrients

Concerning of the effect of plant species on the chemical content Table 2 noticed that *Leucaena sp.* contained the highest accumulated value of CP%, ash%, K%, EE% and Na% comparing to the other two shrubs *i.e. Acacia* sp. and *Prosopis* sp. This increment was fairly true and significant at both seasons. In this concern Tomer (1988) reported that the loppings of *Acacia tortilis* and *Prosopis sp.* were rich in CP% and are good feed for animals, Gill *et al.* (1987) showed that N, P, S and K% were significantly higher in *Acacia* plantation than *Eucalyptus litter.* The opposite was true for Ca, Mg, Na, Fe and Mn, Khalifa (1996) found that *Atriplex canescens* accumulated significantly higher in ash, Na, K and Cl compared to *Acacia saligna.* and Webb (1988) showed that nutritional quality of browse trees of (*Acacia tortilis, Leucaena leucocephala* and *Prosopis chilensis*) was higher than that of sorghum, which is the main dry season fodder source.

The interaction effect between the three main factors considered in this study had no statistical significant effect in the first season. Consequently, data of the insignificant interaction were excluded and the significant interaction will only be considered and discussed.

Table 3 showed the interaction effect between shrub species and cutting intervals on chemical content. It is appeared that *Leucaena* sp. tended to accumulate higher CP content compared to the other two shrubs. Such increament was significant at dry seasons. The same trend was obtained for TDN% .

TABLE 3. Effect of the interaction between shrub species and cutting intervals on CP.during 2003/2004 season.

Cutting intervals	CP%		
	Acacia sp.	*Leucaena sp*	*Prosopis*
Dry season	9.432 Ca	17.19 Aa	12.936 Ba
Wet season	10.06 Aa	11.398 Ab	9.668 Ab

Table 4 shows the interaction effect between organic manure and plant species in relation to chemical content and the response of *Leucaena* sp. to organic manure fertilization was more superior than the other two shrubs.The maximum value of crude protein and ash percentage were obtained from and *Leucaena sp.* tissue under added organic manure while the minimum value was occured for crude fiber percentage

TABLE 4. Effect of the interaction between organic manure (m^3/fed.) and shrub species on ash, CP and CF during 2003/2004 season.

Shrub species	2003/2004								
	Ash%			CP%			CF%		
	0	10	20	0	10	20	0	10	20
Acacia saligna	7.058 ABa	7.125 Abc	4.155 Bb	10.605 Aa	7.73 Bb	10.903 Ab	15.17 Ab	18.52 Ab	15.368 Ab
Leucaena leucocephala	7.38 Ba	10.058 Aa	9.765 ABa	10.963 Ca	14.815 Ba	17.105 Aa	20.325 Aa	10.91 Cc	12.98 Bc
Prosopis chilensis	6.405 Aa	4.248 Bb	5.028 ABb	10.8 Ba	13.003 Aa	10.105 Bc	22.638 Aa	24.903 Aa	26.58 Aa

• Means having small letters in the same column and capital letters in the same row are not statistically differ at 5% level of significance.

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استجابة بعض الشجيرات الرعوية الملحية لفترات الحش وإضافة السماد العضوى

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اقيمت تجربة حقلية تحت ظروف الأراضى الجيرية بمنطقة رأس سدر (جنوب سيناء) بمحطة البحوث التابعة لمركز بحوث الصحراء فى الموسمين الزراعيين (٢٠٠٢/ ٢٠٠٣- ٢٠٠٣/٢٠٠٤) وذلك لدراسة تأثير ٣ مستويات من السماد العضوى (مخلفات الأغنام) صفر، ١٠ ،٢٠ م^{٣}/فدان و٣ أنواع من الشجيرات العلفية وهى الأكاسيا والبرسوبس واللوسينا وموسمين لحش تلك الشجيرات وهى الموسم الرطب (شتاء) والموسم الجاف (صيفا) على كلا من الأوزان الغضة والجافة لكل شجيرة على حدة وعلى الانتاجية الكلية/فدان وكذلك المكونات والمحتوى الكيماوى للشجيرات الثلاثة. تم زراعة نقاوى الشجيرات الثلاث فى صوبة مركز بحوث الصحراء فى فبراير ٢٠٠١ ثم تم نقلها بعد ٦ شهور الى الأرض المستديمة لمحطة بحوث رأس سدر وأضيف السماد العضوى للشجيرات بمعدل ١٠م^{٣}/فدان، ٢٠م^{٣}/فدان فى موسمى الزراعة. ووضعت الشجيرات فى أحواض مساحة الحوض ٢×٢م^{٢} وكانت تروى بالمياه الجوفية اسبوعياً وتركيز الأبار حوالى ٩٠٠٠ جزء فى المليون. عندما بلغت الشجيرات عمر حوالى ١٨ شهر بدأ حش النموات الغضة فى الموسم الصيفى ثم الموسم الشتوى لكل شجيرة لتقدير المحصول الغض والجاف وتم تجفيف العينة فى الفرن الى ان ثبت الوزن وذلك لتقدير النتروجين والالياف والرماد كذلك الصوديوم والبوتاسيوم ومستخلص الأثير فى كل موسم على حدى وقد أظهرت النتائج الأتى :

١- كان لاضافة السماد العضوى أثر فى زيادة المحصول الغض والجاف زيادةً غير معنوية للشجيرات. أيضاً كان للمحتوى الكيماوى استجابة غير معنوية نتيجة اضافة السماد العضوى ما عدا محتوى البروتين والصوديوم والبوتاسيوم التى زادت زيادة معنوية فى الموسم الثانى نتيجة إضافة السماد العضوى.

٢-أعلى قيمة لوزن الشجيرة الواحدة والمحصول الكلى / فدان تم الحصول عليه عند حش النباتات فى الموسم الجاف وادى الحش فى الموسم الجاف الى زيادة محتوى البروتين ،الصوديوم،البوتاسيوم،والمواد الكلية المهضومة للشجيرات .

٣-أعطت شجيرات البرسوبس أعلى محصول علفى غض وجاف يليها شجيرات الاكاسيا وأقلهم شجيرات اللوسينيا وذلك فى الموسم الأول فى حين تفوقت شجيرات الاكاسيا ثم البرسوبس يليهم شجيرات اللوسنيا فى الموسم الثانى وكانت اللوسنيا أفضل من الشجيرات الأخرى فى محتواها الكيماوى فى كلا من الموسمين.

٤-كان للتفاعل المشترك للعوامل الرئيسية الثلاث تأثير معنوى على المحتوى الكيماوى للشجيرات.