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Improvement of the Unit Area Productivity from Forages by Agroforestry (*Leucaena leucocephala* (Lam.)De Wet) with Some Grasses Species

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THE PRESENT investigation aimed to determine the optimum productivity and increase the efficiency of saline soils of Wadi Sudr district, South Sinai, Egypt. A field experiment was performed on a saline soil at Ras Sudr Research Experiment Station,Desert Research Centre during two successive seasons 2005/2006 and 2006/2007 to study the effect of agroforestry systems and nitrogen rates on forage yields of Leucaena shrubs and the studied grasses , *i.e* Panicum,Kallar grass and Rhodes grass in a split plot design where main plots assigned for agroforestry systems: *i.e* single Leucaena , Leucaena + Panicum; Leucaena + Kallar grass; Leucaena+Rhodes grass , while nitrogen rates (60,90,120 kgN/fed) were allocated in the sub plots.The experimental work focused on the effect of integrated system and nitrogen fertilizer on growth,forage yield and its quality of shrub and grasses species.

The important results could be summarized as follows:
-Increasing nitrogen levels up to the highest rates (120 kgN/fed) significantly increased growth trait and forage yield of Leucaena . Meanwhile, chemical constitutes of Leucaena increased with the highest rate of nitrogen.

-Agroforestry systems between Leucaena and grasses affected on growth trait and forage yields.The forage yield of Leucaena monoculture was higher than that when intercropped with grasses. Leucaena that intercropped with Panicum gave higher yields than when intercropped with other species. Also crude protein and crude fiber increased with Leucaena intercropped with Panicum.

-The interaction between nitrogen rates and agroforestry system was significant on all studied traits of shrubs. Data obtained showed that, the highest value of shrubs with monoculture Leucaena with the highest rate of nitrogen, as compared with grasses Panicum with Leucaena which surpassed other species .

-Significant increase in growth trait,fresh and dry forage yield and chemical content of grasses as well as increase rate up to 120 kg N/fed.

-Agroforesty system affected on grasses species, where forage yield were increased when grasses were intercropped with Leucaena. Panicuum with Leucaena gave the highest crude protein.

Keywords: *Leucaena leucocephala* , Grasses, Nitrogen fertilizer , Growth criteria, Forage yield and its quality.

Ras Sudr soils are generally affected by salinity.These soils have been received a great attention during the last decades.Shrubs are important elements for vegetative development of semi- arid areas. They provide microhabitats for the establishment of many species under their canopies thus maintaining community structure and diversity.In these pattern Lu *et al.* (2006) observed that soil moisture (SM) content, pH, soil organic matter (OM) and available potassium (AK) were the most important factors to both, the explained ecological variation of herbs was lower than that of shrubs and understanding differences between strata layers in resource use can shed light on plant–environment relationships. Sustainability of forage production is affected by environmental and climatic variability. Complex forage mixtures may be better adapted than simple mixtures to variable environments and produce greater dry matter (DM) yield more evenly throughout the growing season, thereby increasing sustainability of forage production.In general, Deak *et al.* (2007) mentioned that regardless of the initial botanical composition, the predominant species in most mixtures by the end of the experiment were orchardgrass (*Dactylis glomerata* L.), tall fescue (*Festuca arundinacea* Schreb.), and white clover (*Trifolium repens* L.). Variation among mixtures was explained mainly by variation in the proportions of grasses and legumes,and conclude that when it comes to large yields , the most important consideration is the individual species, not the complexity of the mixtures.

At the beginning, studies related to getting benefit from the soils under the effect of salinity was done to determine the plants and to develop the plant specifications to be grown on this kind of lands. Chemical reclamation of sodic and saline-sodic soils has become cost-intensive, cultivation of plants tolerant of salinity and sodicity may mobilize the $CaCO_3$ present in saline-sodic soils instead of using a chemical approach. Qadir *et al* . (1998) showed that *Leptochloa fusca* produced 24.6 Mg ha^{-1} and emerged as the most suitable biotic material for cultivation on salt-affected soils to produce good-quality forage, and to reduce soil salination and sodication processes. Herbage in conventional pasture and agroforestry systems is managed for microclimate and spatial differences inherent to these systems. David & MacKown (2005) measure herbage N fertilizer recovery at two sites, an unshaded meadow and a shaded alley in 10-yr-old loblolly pine *(Pinus taeda* L.*)* with tall fescue *(Festuca arundinacea* Schreb.*)* and found cumulative herbage yield was much more responsive to added N than pine alley herbage. Ahmad *et al.* (2007) studied five treatments, three involved cropping: Sesbania *(Sesbania aculeata)*, Sordan *(Sorghum bicolor x Sorghum sudanese),* and Kallar grass *(Leptochola fusca)* and two were non-cropped (control) . Sesbania and Kallar grass were found to be effective biotic materials for soil reclamation. These plant species produced substantial biomass and also improved the soil environment by lowering the EC and SAR of the soil. Sordan was relatively less-effective due to its sensitivity to high temperature and sodicity during germination and early seedling stages.

Since *Acacia mellifera* was less likely to grow within a vegetation patch containing large trees than in patches without large trees (Eccard *et al.*, 2006). During the rainy season, shrub presence had a considerable impact on the fate of the field soil moisture regime with shrub roots serving as pathways for deep profile recharge. Shrubs exploited the deeper profile (0.9–1.2 m) as opposed to the Pearl millet (0.2–0.5 m) suggesting that intercropping of annual crops with shrub stands could serve as an innovative and viable agronomic option in these vulnerable Sahel agro-ecosystems(Kizito *et al.*, 2006). Armstrong *et al.* (2008) found that the experiments show that lablab bean grown with corn has the greatest potential of the three beans to increase CP concentration above monoculture corn, without compromising forage yield and increasing forage nutrient value.

Nitrogen fertilization plays an active role for increasing forage yield and quality, particularly in the sandy soils that are poor in available nitrogen and an organic matter. Many authors dealt with the necessity application of fertilizers on sandy soils. One of the most important management factors influencing shrub growth and development in mixed grasses is nitrogen (N) fertilization. A vast number of studies have shown that the application of N fertilizer to a mixed sward generally has a positive effect on the growth of the grass component and a negative effect on that of the shrub component, the actual growing point density is determined by the balance between mortality and the outgrowth of branches from axillary buds. El-Saidy (2007) stated that growth and forage yield of Panicum significant with increasing nitrogen level up to 50 kg N/ cut / fed. The increament in accumulated fresh forage yield amounted 5.56 , 11.55, 16.61 % of the control (unfertilized treatment) under the used rates 30,40,50kg N/cut/fed. Sharief *et al.* (1996) reported that nitrogen fertilizer enhanced fresh and dry forage yields of the mixture of clover and ryegrass. Nitrogen hardening reduced shoot size, root collar diameter, leaf area, specific leaf area, and root growth potential of trees, seedlings deprived of N showed a higher survival range than those subjected to standard fertilization, nutrient hardening may enhance plant resistance to drought (Roman *et al.*, 2008).

This study was conducted to determine the influence of trees and agricultural crops on arthropod diversity in an alleycropping system (agroforestry) in Ras Sudr. Three agricultural crops (Panicum, Kallar grass and Rhodas grass) were assigned randomly to three individual plots within a block and replicated four times per treatment in *(Leucaena leucocephala)* plantation. Four non-tree plots were also established nearby the main research area and incorporated one Panicum, one Kallar grass, one Rhodas and one poplar tree plot as control treatment.

Materials and Methods

A field experiment was performed on a saline soil at Ras Sudr Research Experiment Station,Desert Research Centre during two successive seasons 2005/2006 and 2006/2007 to study the effect of agroforestry systems and nitrogen rates on forage yields of Leucaena shrubs and the studied grasses, *i.e* Panicum, Kallar grass and Rhodes grass.

The soil of the experimental site was calcareous having 56% $CaCo_3$ with electrical conductivity of 8.5 dS/m, with pH 7.9 and sandy clay in texture. The sole source of irrigation is brackish-saline water from wells which contains about 8000-9000 ppm dissolved salts.

Seedlings of *Leucaena leucocephala* (Lam.) De Wit. were sown in polyethylene bags (25 cm long and 12 cm diameter) containing a mixture of sand, clay soils and peat moss in 1:1:1 ratio. The seedling nursery was started on November 2003. Rizobium inoculation was carried out at sowing by dispensing 1ml of suspension(10^9cells/ml) of local rhizobia isolates specifically for *Leucaena leucocephala* . Homogeneous healthy of seven-month old seedlings were selected and transplanted into Ras Sudr Experimental farm (the permanent place) on June, 2004. Superphosphate (15.5%P_2O_5) and potassium sulphate (48%K_2O) were applied during land preparation at the rate of 150 and 50 kg/fed, respectively. The plot size was 3mx3m including 5 rows with 60 cm apart (3 for Leucaena shrubs alternated with 2 for each of the investigated grasses) . Each treatment was replicated 4 times in a split plot design where main plots assigned for agroforestry systems: *i.e.* single Leucaena , Leucaena + Panicum; Leucaena + Kallar grass; Leucaena+Rhodes grass, while nitrogen rates (60,90,120 kgN/fed) were allocated in the sub plots.

Seeds of Panicum(*Panicum antidotale Retz*), Kallar grass(*Leptochloa fusca* (L.) Kunth) and Rhodes grass (*Chloris gayana* Kunth) were sown on the 13^{th} of April, 2005 with the seeding rate of 6 kg/fed .Nitrogen fertilizer was added in the form of ammonium nitrate (33.5%). These rates were applied before the first irrigation(30 days from sowing) as well as after each cut before irrigation just in equal doses. Both Leucaena and grasses species were clipped on June 23^{rd} and August 25^{th} for the first and second cuts, respectively for the two seasons.

The following growth traits were measured immediately before clipping ; shrub height(cm), number of branches/shrub, fresh and dry shoot weights (ton/fed) were estimated. Samples of ten plants of each of the three grasses under investigation were chosen randomly from the interior part of the plot before each cut from each sub-plot to determine plant height(cm), number of tillers /1/ 8m^2. All plants of each experimental unit were clipped to determine fresh and dry forage yields in ton/fed. The vegetative samples from Leucaena and grasses were dried at 70°C until constant weight, then ground to a fine powder. The powder samples were stored in airtight containers until needed for subsequent chemical analysis. The percentage of total nitrogen was determined by the modified micro- Kjeldahl method as described by Peach & Tracey (1956), crude protein was accounted by multiplying total nitrogen percentage by the factor of 6.25. Crude fiber was determined according to A.O.A.C. (1990).

The collected data were statically analyzed using computer program Co-Stat according to procedures outlined by Snedecor & Cochran (1980).For means comparison, Duncan's multiple range test was used (Duncan,1955).

Results and Discussions

The available data will be discussed separately into the following two topics:
1-Effect on *Leucaena leucocephala* shrubs.
2- Effect on grasses.

Effect on Leucaena leucocephala shrubs

Effect of nitrogen rates on Leucaena leucocephala

Data in Table 1 demonstrated the effect of nitrogen rates on some growth traits, *i.e* plant height,number of branches/shrub, forage yield and chemical constitutes, *i.e* crude protein and crude fiber of Leucaena. Increasing the rate of nitrogen from 60 up to 120 kgN/fed significantly increased shrub height in both cuts of the two growing seasons. The increment in the second cut with the highest rate of nitrogen compared with that of the first cut amounted 25.2 %.In respect to the response of number of branches/shrub showed the same trend. These results agreed with Palacio & Montserrat-Martíi (2007) who attributed this increases to the significant variation of root growth throughout the growth period. The root system values during autumn being higher than in spring and summer. Moreover, the shoot growth reached its maximum in spring .

Results in Table 1 demonstrated the response of forage yield of *Leucaena leucocephala* shrubs to nitrogen rates applied throughout the growing season . Data revealed that fresh and dry forage yields per feddan of the second cut were almost doubled that produced in the first cut. This finding was more pronounced in the first season. The increment in yields of the 2 cut with the highest rate of nitrogen (120 kg/fed) compared with that of the first amounted 72.6, 53.8% (for fresh forage) and 96.9, 94.9% (for dry forage) in the first and second season, respectively. The superiority in yield of the 2^{nd} cut compared with that of the 1^{st} cut could be attributed to the habit of growth and the vigorously of vegetative and root systems. The increases in fresh yield with the increase of nitrogen levels might be attributed to the active role of nitrogen in enhancing the growth and development of despite mixture plants and to the role of bacterial nodules on Leucaena roots in nitrogen fixation from the surrounded atmosphere .

Data presented in Table 1 indicated that increasing the rate of nitrogen up to 120 kgN/fed significantly increased the studied chemical constitutes of Leucaena.The highest rate of nitrogen produced higher values of crude protein and crude fiber, this finding hold fairly true in both cuts for the two growing season. These results agreed with El-Saidy (2007), she found that crude fiber was higher in the 2^{nd} cut compared with that of the 1^{st} cut . Moreover, crude protein percentage decreased in the 2^{nd} season than in the 1^{st} season .

TABLE 1. Effect of nitrogen rates on growth, forage yield and chemical constitutes of *Leucaena leucocephala* during the growing seasons.

Traits	Shrub height(cm)		Number of branches/shrub		Shoot fresh weight (ton/fed)		Shoot dry weight (ton/fed)		Crude protein %		Crude fiber %	
	First Season											
Nitrogen rate(kg/fed)	1^{st} cut	2^{nd} cut	1^{st} cut	2^{nd} cut	1^{st} cut	2^{nd} cut	1^{st} cut	2^{nd} cut	1^{st} cut	2^{nd} cut	1^{st} cut	2^{nd} cut
60	212.7c	271.9c	5.43c	6.00c	1.73c	3.24c	0.641c	1.346c	11.39c	12.28c	15.83c	17.82b
90	220.6b	280.6b	6.68b	6.38b	1.89b	3.41b	0.748b	1.505b	11.51b	12.39b	15.93b	17.86b
120	230.1a	288.1a	6.84a	6.63a	2.08a	3.59a	0.820a	1.615a	11.64a	12.45a	16.01a	18.00a
	Second Season											
60	224.8c	274.6c	6.54b	7.50c	2.07c	3.33c	0.805c	1.756c	11.20c	12.17c	16.67c	18.70c
90	234.3b	282.7b	6.80ab	7.76b	2.22b	3.49b	0.935b	1.947b	11.23b	12.22b	16.81b	18.84b
120	240.9a	290.1a	6.98a	7.99a	2.38a	3.66a	1.064a	2.074a	11.30a	12.29a	16.93a	19.00a

Effect of agroforestry systems on Leucaena leucocephala

Data in Table 2 demonstrated the effect of agroforestry systems on the growth, forage and quality of Leucaena. Shrub height and number of branches reached the highest values when Leucaena grown as pure stand, while grown with grasses was less with different grasses whatever Leucaena grown with Panicum gave highest height with less number of branches . On the contrary, Leucaena grown with Rhodes gave the least height with the highest number of branches, this result was true for both cuts in the two growing seasons. This last finding could be mainly attributed to the high tillering capacity. Nor El-Din *et al.* (1992) found that the mixtures yields were significantly influenced by the kind of grass in the mixture. These results may be regarded to that when two forage species are grown together they can be compatible, compete, or allelopathic with each other. These may be regarded to fine root increment was quantified by optical root length determination at the beginning and the end of the experiment. By placing individual fine roots of a tree species together with a second conspecific or allospecific root, allows one to stimulate conditions of intra- and interspecific competition, and to test hypotheses on intensity and direction of root competition in the soil of mixed forests (Dietrich & Leuschner , 2006).

Data in Table 2 presented the effect of different grasses grown with Leucaena on both fresh and dry shoots . The highest fresh and dry forage yields were obtained with Leucaena grown single . This superiority could be mainly due to its superiority in shrub height and number of branches, when compared with different grasses grown under Leucaena. Panicum gave the highest values while Rhodes was the lowest . These results were in harmony with those of El-Toukhy & Abd-Alla (2002) who found that agroforestry system of Acacia with ryegrass was superior than Acacia with barley, Rizk *et al.* (2005) found significant superiority of berseem over either barley or ryegrass and highest forage yield with mixture of berseem + ryegrass. Also data cleared that forage yield was increased in the second season compared with the first season, the reduction amounted 13.9, 19.6 and 30.8 % when comparing Leucaena grown with Panicum, Kallar grass and Rhodas with single Leucaena, respectively. These results may be explained by Gurbachan *et al.* (2006) they found that growing of Kallar grass with Prosopis reduced pH and EC and improved organic C, available N and water intake capacity of a barren alkali soil. Further, the soil was improved to the extent that some moderately salt-tolerant crops.

Crude protein of Leucaena decreased in the second season while increased when agroforestry with grasses as shown in Table 2 . Crude protein of Leucaena increased when grown with Panicum followed by Kallar grass, Rhodes,while the lowest when Leucaena grown single, crude protein was higher in the second cut that result regarded to the behave of that shrub and also the suitable condition. Crude fiber increased in the second cut and also in the second season, crude fiber of Leucaena was superior when grown with Panicum than other treatments, the increment amounted 4.4, 5.7, 5.0, 9.9 % in the 1^{st} and 4.0, 4.2, 5.8,7.2% in the 2^{nd} cut when comparing the second season with the first season. These results were agree with those of Kevin *et al.* (2008) who studied the intercropping corn *(Zea mays* L.*)* with beans—Lablab bean *[Lablab purpureus* (L.) Sweet], the experiments showed that lablab bean grown with corn has the greatest potential and increase CP concentration above monoculture corn, without compromising forage yield .

TABLE 2. Effect of agroforestry systems on growth, forage yields and chemical constitute of *Leucaena leucocephala* during the growing seasons.

Traits	Shrub height(cm)		Number of branches/shrub		Shoot fresh weight (ton/fed)		Shoot dry weight (ton/fed)		Crude protein %		Crude fiber %	
	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
	First Season											
L	251.4a	322.2a	6.35a	7.43a	2.72a	3.89a	0.878a	1.772a	11.38c	12.24d	15.60d	17.65c
L.R	200.9d	246.4d	5.72b	6.32b	1.40d	3.17d	0.612d	1.297c	11.50b	12.28c	15.83c	17.80b
L.K	209.2c	269.3c	5.42c	5.92c	1.53c	3.22c	0.687c	1.408b	11.55ab	12.37b	16.07b	17.93b
L.P	223.0b	282.8b	5.10d	5.67c	1.97b	3.37b	0.768b	1.478b	11.61a	12.58a	16.20a	18.20a
	Second Season											
L	269.9a	305.8a	7.52a	8.48a	2.90a	3.62a	1.223a	2.225a	11.14d	12.09d	16.29d	18.36d
L.R	215.9d	264.8d	6.98b	7.67b	1.65d	3.36c	0.680d	1.592d	11.23c	12.17c	16.74c	18.55c
L.K	219.8c	270.8c	6.53c	7.52bc	2.04c	3.46bc	0.837c	1.818c	11.27b	12.25b	16.88b	18.97b
L.P	227.8b	288.3b	6.05d	7.33c	2.30b	3.53ab	0.998b	2.068b	11.32a	12.39a	17.81a	19.51a

L:Leucaena, L.R:Leucaena + Rhods, L.K:Leucaena + Kallar grass , L.P:Leucaena + Panicum

These results may be explained with that yields of mixtures tend to be greater compared with legume or grass alone. In most cases, legume forage crops have a higher feeding value than non legumes, due to a higher protein and minerals content. Also, legumes supply nitrogen to legume-grass mixtures so it may produce more forage yield than grasses grown alone. The yield of grasses in such mixtures may be greater than its yield when grown in pure stand. Grasses in legume mixtures also contain a higher percentage of protein.

Effect of the interaction between nitrogen rate and agroforestry systems on Leucaena leucocephala

Results in Table 3 indicated that the interaction between the main investigated factors (nitrogen rate and agroforestry system) had a significant effect on Leucaena shrub height in both cuts of both growing seasons. The response was more pronounced when shrubs was monoculture with the highest rate of nitrogen (120 kgN/fed) and with different rates of nitrogen comparing with Leucaena that intercropped with grasses. Shoot fresh and dry weights of Leucaena were significantly affected by this interaction and recorded the highest forage yield with 120 kgN/fed with Leucaena, while when comparing Leucaena that intercropped with grasses recorded the highest value when grown with Panicum , Kallar grass and Rhodas grass, respectively.

Crude protein was significantly affected by the above interaction in the 1^{st} cut in both seasons, while crude fiber was affected in the first season only. It worth noticed that chemical constitute showed higher values with Leucaena grown mixed with grasses than monoculture especially that grown with Panicum.

The above significant effects mean that the performance of the two studied factors did not behave the same.

Effect on grasses

Effect of nitrogen rates on grasses

As illustrated in Table 4 plant height of grasses showed a positive response to increasing the nitrogen rate up to 120 kgN/fed. The response was more pronounced in the second season especially in the second cut. The increments amounted 4.6 and 9.1 % when compared the rates of 90 and120 kg N/fed with 60 kg N/fed. Also number of tillers were increased with increasing the rate of nitrogen in both cuts of the growing seasons. These results might be attributed to the role of N in building –up plant organs through the synthesis of amino acids and building –up new organs.

Results demonstrated the significant positive increase in fresh and dry forage yields as well as increasing nitrogen rates up to 120 kg N/fed. These increments were significant in all cuts .The average increases amounted 14.5,9.5 %(for fresh) and 10.9, 3.6% (for dry) in the second season when compare the rates of 120 and 90 kg/fed of nitrogen with that of 60 kgN/fed (low rate).These results were regarded to the increase in growth parameters. These results were agree with El-Saidy (2007) that found increasing nitrogen fertilizer up to 50kg N/cut / fed increased forage yield of Panicum .

TABLE 3. Effect of the interaction between nitrogen rates and agroforestry systems on growth, forage yields and chemical constitute of *Leucaena leucocephala*.

Nitrogen rate / Agroforestry	First season			Second season		
	60	90	120	60	90	120
	Shrub height(1st cut)			Shrub height(1st cut)		
L	230.6c	252.3b	271.2a	254.2c	272.9b	282.6a
L.R	197.5i	200.7hi	204.5gh	210.7h	217.3fg	219.8f
L.K	206.9fg	208.7fg	212.1ef	214.6gh	219.7f	225.1e
L.P	215.7e	220.7d	232.7c	219.7f	227.2e	236.5d
	Shrub height(2nd cut)			Shrub height(2nd cut)		
L	301.7c	323.6b	341.4a	293.7c	305.9b	317.9a
L.R	243.9i	245.7i	249.7i	257.5i	265.6h	271.0g
L.K	263.3h	270.3gh	274.5fg	263.7h	271.1g	277.7f
L.P	278.7ef	282.9de	286.8d	283.0e	288.0d	293.8c
	Shoot fresh weight(1st cut)			Shoot dry weight(1st cut)		
L	2.425c	2.705b	3.020a	1.005d	1.230b	1.435a
L.R	1.290k	1.410ij	1.490hi	0.595j	0.675i	0.770gh
L.K	1.400j	1.510h	1.670g	0.745h	0.825fg	0.940e
L.P	1.815f	1.940e	2.145d	0.875f	1.010d	1.110c
				Shoot dry weight(2nd cut)		
L	-	-	-	1.955e	2.270b	2.450a
L.R	-	-	-	1.467i	1.610h	1.700g
L.K	-	-	-	1.700g	1.810f	1.945e
L.P	-	-	-	1.905e	2.100d	2.200c
	Crude protein(1st cut)			Crude protein(1st cut)		
L	11.20f	11.37e	11.60bc	11.09g	11.12f	11.22d
L.R	11.34e	11.49d	11.69a	11.18e	11.21d	11.31b
L.K	11.49d	11.57cd	11.60bc	11.22d	11.27c	11.32ab
L.P	11.57cd	11.61abc	11.67ab	11.30bc	11.33ab	11.35a
	Crude fiber(1st cut)					
L	15.54h	15.60g	15.60g	-	-	-
L.R	15.76f	15.83e	15.91d	-	-	-
L.K	15.90d	16.11c	16.20b	-	-	-
L.P	16.11c	16.20b	16.30a	-	-	-
	Crude fiber(2nd cut)					
L	17.43h	17.71fg	17.81ef	-	-	-
L.R	17.65g	17.87de	17.87de	-	-	-
L.K	18.00cd	17.83ef	17.95cde	-	-	-
L.P	18.18b	18.03c	18.38a	-	-	-

L:Leucaena L.R:Leucaena + Rhodes
L.K:Leucaena + Kallar grass L.P:Leucaena + Panicum

TABLE 4. Effect of nitrogen rates on growth, forage yields and chemical constitutes of grasses during the growing seasons.

Traits	Plant height(cm)		Number of tillers/1/8m^2		Fresh forage yield (ton/fad)		Dry forage yield (ton/fed)		Crude protein %		Crude fiber %	
Nitrogen rate(kg/fed)	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
	First Season											
60	77.02c	94.09c	48.21c	55.03c	3.683c	3.903c	1.607c	1.737c	9.92c	10.26c	30.25c	30.78c
90	82.23b	97.99b	54.45b	61.33b	3.950b	4.089b	1.704b	1.827b	10.17b	10.43b	30.48b	30.96b
120	87.28a	103.04a	58.08a	66.78a	4.117a	4.272a	1.798a	1.928a	10.41a	10.64a	30.83a	31.19a
	Second Season											
60	98.97c	111.90c	61.59c	77.68c	4.025c	3.991c	1.809c	1.899c	10.58c	10.47b	31.06c	31.31c
90	103.52b	116.65b	68.36b	83.43b	4.217b	4.372b	1.904b	1.967b	10.74b	10.39c	31.22b	31.47b
120	109.43a	122.04a	72.35a	88.22a	4.392a	4.568a	2.051a	2.106a	10.99a	11.18a	31.43a	31.74a

Data in Table 4 cleared that the forage quality of grasses was affected by the rates of nitrogen .Crude protein was significantly increased with increasing the rate of nitrogen up to 120 kgN/fed ,the highest crude protein was obtained in the second cut. Crude protein of grasses was higher in the second season. Crude fiber behaved the same trend of crude protein. These results were in agreement with those of Tolera *et al.* (2006) who showed that the highest crude protein content of Rhodes grass was obtained when 69 kg N/ha was applied. And El-Saidy (2007) on Panicum with adding 50kg N/ cut/ fed was increased crude protein . The dry matter content was increased with increasing age of regrowth. The crude protein yield did not vary between the different ages of regrowth as the increasing yield offset the decreasing protein content.

Effect of agroforestry systems on grasses

Data in Table 5 presented the effect of agroforesty systems on grasses. The grasses plant height were significantly taller when grown in pure stand. Panicum was the tallest followed by Kallar grass while the shortest was Rhodes. When grasses grown under intercropped Leucaena the yield was less when compare with the single grasses. The increments amounted 24.2, 16.9, 11.4% when compare Panicum , Kallar grass, Rhodes single with agroforestry. These results regarded to intraspecific competition on food, light and also integrate roots. Number of tillers investigated grasses was higher when intercropped with Leucaena than monoculture. The highest number of tillers was obtained with Panicum. These results are in agreement with Frame (1992) who reported that clover compatibility with grasses depend on the grass species which create densely tillered, close knite swards and all the least conductive to clover development due to inhibition of the growth of clover growing points by shading at ground level.

Fresh and dry forage yields were increased when grasses were grown and intercropped with Leucaena, Panicum was superior than other species, this could be mainly attributed to its high tillering capacity. The increments of fresh forage yield of Panicum when compared with Leucaena than the pure stand were amounted (30.1,23.3%) in the first season and (25.0,24.6%) in the second season. This may be due to the tolerance of Panicum is more than other species of grasses to Ras Sudr environmental conditions. Dry forage yields were increased in the second cut of the second season, when compare species of grasses under grown with Leucaena, Panicum and Kallar grass was greater than Rhodes. The increments amounted 57.3, 43.9% , respectively.

These results may be regarded to variations among grass species in their suitability as companion grasses with shrub. Seif & Sedhom (1988) and Holland & Brummer (1999) found that grass species differ in their suitability as companion grasses with clover, *i.e.* clover-oat mixture was superior to mixtures with triticale or barley. Rizk *et al.* (2005) mentioned that fresh forage yield of ryegrass was significant higher than that of barley.

TABLE 5. Effect of agroforestry systems on growth, forage yields and chemical constitutes of grasses during the growing seasons.

Traits	Plant height(cm)		Number of tillers/1/8m^2		Fresh forage yield (ton/fed)		Dry forage yield (ton/fed)		Crude protein %		Crude fiber %	
	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
	First Season											
R	81.37c	93.83c	44.25d	49.57e	1.849f	1.920e	0.978f	1.035f	6.70f	6.99e	25.67f	26.88e
K	86.00b	103.08b	46.38d	51.75d	3.419d	3.611c	1.152e	1.366e	8.04d	8.29c	28.51d	28.65d
P	92.98a	112.65a	54.30c	64.73b	4.510c	4.871b	1.759c	1.839c	14.99b	15.57b	36.04b	36.95a
R.L	71.07e	86.52d	52.10c	63.15bc	3.152e	3.272d	1.489d	1.514d	7.37e	7.49d	26.77e	26.92e
K.L	76.20d	92.22c	59.45b	62.27c	4.703b	4.850b	2.224b	2.485b	8.33c	8.46c	29.71c	29.87c
P.L	85.42b	101.95b	65.00a	74.80a	5.867a	6.006a	2.616a	2.743a	15.58a	15.88a	36.42a	36.58b
	Second Season											
R	104.43c	114.40c	56.23e	61.93f	1.993e	2.286f	1.107f	1.171f	7.37f	7.57c	27.28e	27.87e
K	107.77b	125.40b	62.28d	68.62e	3.691c	3.795d	1.494e	1.634e	8.42d	8.56b	28.85d	29.03d
P	113.60a	139.30a	71.30b	98.10b	4.986b	5.113b	1.896c	1.963c	15.83b	15.94a	37.14a	37.37a
R.L	93.67e	102.72e	66.67c	74.87d	3.388d	3.546e	1.717d	1.789d	8.32e	8.45b	27.31e	27.55f
K.L	100.22d	107.20d	67.42c	87.92c	4.975b	4.747c	2.542b	2.575b	8.61c	7.30c	30.11c	30.33c
P.L	104.13c	112.17c	80.70a	107.22a	6.233a	6.373a	2.774a	2.814a	16.06a	16.27a	36.71b	36.90b

R: Rhodes K: Kallar grass P: Panicum R.L:Rhodes+Leucaena K.L: Kallar grass + Leucaena P.L: Panicum+ Leucaena

Data presented in Table 5 indicated the effect of agroforestry on chemical composition of grasses grown single or agroforestry with Leucaena. It is obvious from the obtained results that crude protein was highest with Panicum that grown with Leucaena or single, followed by Kallar grass with Leucaena while single Rhodes was less in crude protein. Crude protein was increased in the second cut of the second season. Crude fiber followed the same trend with that of crude protein in grasses. These results may be explained to N-transfer from the legume to the non legume which that transfer ranged from 20-173 kg N/fed, that range depend upon the genotype of each partner, pattern of intercropping, population densities of plants and environmental conditions (Hegazi *et al.*, 1994). Abbas *et al.* (1998) found that the highest N yield (35 kg/plot) was reported for Rhodas mixed with Leucaena. This result was in agreement with El-Toukhy & Abd-Alla (2002) who found significant increase of some chemical percentage of grasses and Acacia shrubs.

Effect of the interaction between nitrogen rates and agroforestry systems on grasses

Data in Table 6 demonstrated the significant effect on traits that affected by the interaction .Number of tillers of grasses that grown under Leucaena shrubs and given the highest rate of nitrogen exhibited the highest number of tillers than monoculture. Data also showed that Panicum grown with Leucaena fertilized with 120 kg N/fed gave the highest value. On the other hand, the lowest value was obtained with the monoculture of grasses and the lowest rate of nitrogen, this was clear with single Rhodes with the rate 60kgN/fed. While plant height behaved opposite trend, monoculture of grasses with the highest rate of nitrogen (120 kg N/fed) was highest than mixed with Leucaena .

Fresh and dry forage yields recorded the highest value with integrated grasses with Leucaena and the highest rate of nitrogen 120 kgN/fed. This finding was true with Panicum as shown in Table 6 .

In respect to the effect of this interaction on chemical constituents, *i.e.* crude protein and crude fiber are presented in Table 7 . Data cleared that grasses intercropped with Leucaena and fertilized with the 120 kgN/fed showed the highest values .

Conclusion

It could be concluded that agroforestry Leucaena with perennial grasses were the best management for sustainable the highest crop production and improving the unit area of saline soil .

TABLE 6. Effect of the interaction between nitrogen rates(kg/fed) and agroforestry systems on growth, forage yields(ton/fed) of grasses.

Nitrogen rate / Agroforestry	First season			Second season		
	60	90	120	60	90	120
	Number of tillers(1st cut)			Plant height(2nd cut)		
R	38.9k	43.2j	50.7fg	109.8gh	115.0f	118.5e
K	43.9ij	46.8hi	48.6gh	120.1e	125.9d	130.3c
P	48.3gh	54.9e	59.7c	129.5c	139.8b	148.6a
R.L	46.8hi	53.9ef	56.2de	99.6j	100.6j	107.9gh
K.L	52.9ef	62.3bc	63.2b	104.2i	107.9gh	110.1gh
P.L	59.3cd	65.6b	70.2a	108.3gh	111.3g	116.9ef
	Fresh forage yield(1st cut)			Fresh forage yield(1st cut)		
R	1.73n	1.88m	1.94m	1.81m	1.98l	2.19k
K	3.12k	3.39j	3.74i	3.54hi	3.63h	3.90g
P	4.17h	4.62f	4.74e	4.78f	5.02e	5.16d
R.L	2.87l	3.19k	3.39j	3.19j	3.42i	3.55hi
K.L	4.53g	4.74e	4.83d	4.94e	4.98e	5.00e
P.L	5.68c	5.88b	6.04a	5.89c	6.26b	6.54a
	Fresh forage yield(2nd cut)			Fresh forage yield(2nd cut)		
R	1.84o	1.92n	2.00m	2.06n	2.28m	2.51l
K	3.36k	3.62i	3.84h	3.68i	3.72i	3.99h
P	4.68g	4.87f	5.06d	4.88g	5.11f	5.35d
R.L	2.99l	3.31k	3.50j	3.34k	3.57j	3.73j
K.L	4.75g	4.85f	4.96e	3.98h	5.06f	5.20e
P.L	5.78c	5.97b	6.26a	6.01c	6.48b	6.63a
	Dry forage yield(1st cut)			Dry forage yield(1st cut)		
R	0.866p	0.920o	1.146m	0.920m	0.960m	1.440k
K	1.020n	1.140m	1.290l	1.380l	1.480k	1.630j
P	1.680i	1.770h	1.830g	1.810h	1.940g	1.940g
R.L	1.470k	1.480k	1.520j	1.630j	1.700i	1.820h
K.L	2.120f	2.250e	2.300d	2.420f	2.570e	2.640d
P.L	2.490c	2.660b	2.700a	2.690c	2.780b	2.850a
	Dry forage yield(2nd cut)			Dry forage yield(2nd cut)		
R	0.880j	0.940j	1.280i	0.960l	0.980l	1.570k
K	1.240i	1.380h	1.480g	1.520k	1.650j	1.730i
P	1.730f	1.870e	1.920e	1.950f	1.970f	1.970f
R.L	1.490g	1.520g	1.530g	1.750hi	1.790gh	1.820g
K.L	2.370d	2.520c	2.560c	2.470e	2.590d	2.670c
P.L	2.700b	2.730b	2.790a	2.750b	2.820a	2.880a

R: Rhodes K: Kallar grass P: Panicum R.L:Rhodes+Leucaena K.L: Kallar grass + Leucaena P.L: Panicum+ Leucaena

TABLE 7. Effect of the interaction between nitrogen rates(kg/fed) and agroforestry systems on chemical constituents of grasses.

Nitrogen rate / Agroforestry	First season			Second season		
	60	90	120	60	90	120
	Crude protein(1st cut)			Crude protein(1st cut)		
R	6.44l	6.74k	6.91k	7.23l	7.39k	7.49k
K	7.78h	8.02g	8.33ef	8.14j	8.35hi	8.78f
P	14.57d	14.97c	15.44b	15.68e	15.84d	15.98c
R.L	7.20j	7.37j	7.57i	8.16j	8.28i	8.52g
K.L	8.17fg	8.30ef	8.50e	8.44gh	8.52g	8.88f
P.L	15.40b	15.60ab	15.74a	15.81d	16.09b	16.28a
	Crude fiber(1st cut)					
R	25.22q	25.48p	26.29o	-	-	-
K	28.22k	28.54j	28.76i	-	-	-
P	35.84e	35.99d	36.29c	-	-	-
R.L	26.50n	26.71m	27.10l	-	-	-
K.L	29.52h	29.70g	29.90f	-	-	-
P.L	36.18c	36.44b	36.64a	-	-	-
	Crude fiber(2nd cut)					
R	26.75mn	26.87m	27.02l	-	-	-
K	28.33j	28.72i	28.90h	-	-	-
P	36.78b	36.88b	37.17a	-	-	-
R.L	26.70n	26.82mn	27.24k	-	-	-
K.L	29.68g	29.89f	30.04e	-	-	-
P.L	36.40d	36.60c	36.80b	-	-	-

R: Rhodes K: Kallar grass P: Panicum R.L:Rhodes+Leucaena
K.L: Kallar grass + Leucaena P.L: Panicum+ Leucaena

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تحسين انتاجية وحدة المساحة من الأعلاف المنتجة من زراعة بعض الأنواع النجيلية تحت أشجاراللوسينيا

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تهدف هذه الدراسة إلى تعظيم إنتاجية وزيادة كفاءة الأراضى الملحية فى منطقة وادى سدر بمحافظة جنوب سيناء، لهذا الغرض أقيمت تجربة حقلية خلال موسمى٢٠٠٦، ٢٠٠٧ وذلك لدراسة تاثير زراعة الأعلاف النجيلية المعمرة تحت الشجيرة العلفية اللوسينيا مع استخدام معدلات من الأسمدة الأزوتية . وقد تضمنت الدراسة نظم تداخل بينهما (لوسينيا منفرد ، لوسينيا + البانيكم ، لوسينيا + كالرجراس ، لوسينيا + رودس) ومستويات من التسميد الازوتى (٦٠،٩٠،١٢٠) ووزعت هذة المعاملات فى تصميم قطع منشقة فى أربعة مكررات ، حيث وضعت نظم التداخل فى القطع الرئيسية والتسميد الأزوتى فى القطع الفرعية وقد تم أخذ حشتين.

ويمكن تلخيص اهم النتائج المتحصل عليها كالاتى:

١- ادت زيادة مستويات السماد الأزوتى الى١٢٠كجم/فدان إلى زيادة فى جميع صفات النمو الخضرى المدروسة على اللوسنيا وكذلك امكن الحصول على أعلى حاصل من العلف الغض والجاف بأستخدام أعلى مستوى من التسميد الأزوتى المستخدم وازدادت كل من النسبة المنوية للبروتين الخام والألياف الخام.

٢- اثر التداخل بين الشجيرات والنجيليات على النمو والحاصل العلفى . زراعة الشجيرة منفردة كانت أعلى فى الأنتاجية عن الزراعة مع النجيليات . اللوسينيا النامية مع البانيكم كانت أعلى فى الأنتاجية عن النامية مع الأنواع الأخرى ، كذلك حدثت زيادة فى نسبة البروتين والألياف فى حالة اللوسينيا النامية مع البانيكم.

٣- كان التفاعل بين التداخل بين الأشجار والنجيليات مع معدلات الأسمدة الأزوتية معنويا فى بعض الصفات ، وأتضح أن أعلى القيم ظهرت عند زراعة اللوسينيا منفردة مع المعدل العالى من التسميد الأزوتى وكذلك عند زراعة البانيكم مع اللوسينيا عن باقى المعاملات.

٤- حدثت زيادة فى صفات النمو والحاصل العلفى والمحتوى الكيماوى للنجيليات بزيادة مستويات السماد الأزوتى إلى١٢٠كجم/فدان.

٥- اثر التداخل بين الشجيرات والنجبليات على نمو الأنواع النجيلية . وكذلك ازداد الحاصل العلفى عند زراعة اللوسينيا مع النجيليات . كانت أعلى نسبة بروتين عند زراعة اللوسينيا مع البانيكم .