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Potentiality Assessment of Non-Traditional Fodder for Conocarpus Trees with Saligna, Atriplex, And Adhatoda Shrubs under NPK fertilization levels

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Abstract

A 2-Yr study was conducted at the Agricultural Research and Experiments Farm at the Faculty of Agriculture , Benha University to evaluate the effect of NPK (low , medium and high) on vegetative growth , yield and chemical content of conocarpus tree and shrubs (saligna , atriplex and adhatoda). Conocarpus tree and shrubs (saligna , atriplex and adhatoda) were fertilized with high (90:60:30 NPK kg fa^{-1}) , medium (60:40:20 NPK kg fa^{-1}) and low (40:20:10 NPK kg fa^{-1}) in a split plot design where the conocarpus tree and shrubs (saligna , atriplex and adhatoda) were in the main plots , while the fertilization levels were placed in the sub plots , measurements were taken in autumn and spring during the two seasons of the study , the results show that, all data of vegetative growth , yield and chemical content gave positive results, the three levels of fertilization in both seasons under study and the increase was significant with the highest level of fertilization to obtain the highest productivity and high chemical content of the fodder conocarpus tree and shrubs (saligna, atriplex and adhatoda) and using them as non-traditional fodder.

Key words: conocarpus , saligna , atriplex , adhatoda , fertilization , yield , chemical content and non-traditional.

Introduction

In Egypt, the shortage of fodder sources is one of the main obstacles for the development of animal production. Non-traditional plants fodder may the deficit in animal feeds especially *Conocarpus lancifolius* tree non-traditional fodder in desert areas has the advantage of being sustainable , evergreen , has many branches and may be up to twenty meters long. Soft branches are used for animal feed especially for goats and camels (**Nelson , 1996).** The contribution of saligna to livestock nutrition is important in the marginal lands of arid and semi-arid regions (**El-Waziry *et.al.*, 2018).** Also , atriplex grows well in deep soils with only 150-200mm of rainfall annually and resists temperatures as low as 10 °C and as high as 50 °C (**Muthik *et.al.*, 2018) ,** while adhatoda belongs to family Acanthaceae is a small-evergreen shrub found in many regions of the world **(Gangwar and Ghosh 2014).** Fodder trees/shrubs may , in addition , be grown in an intercropping pattern with herbaceous forage crops. This is to maximize nutritional yield value and to minimize soil erosion. Leucaena (*Leucaena leucocephala*) was alley cropped in hedgerows with maize on N-deficient sandy soil in southern; Nigeria according to **(Kang *et.al.*, 1981).** Also, *L.leucocephala* foliage mulch rates and its hedgerows effects on maize yield were evaluated over a 4-Yr in a sandy soil in Kenya **(Mureithi *et.al.*, 1994).** Its hedgerows impact were tested on maize yield in loamy sandy soil in southern Egypt **(Ebeid *et.al.*, 2011).** However, despite the potentials of alley cropping , these are relatively less comparable to these of multi-canopy vegetation patterns. These patterns comprise over story trees , mid-story shrubs and annual/perennial ground cover forage crops grown in-between alleys of these trees and shrubs rows. Such patterns are more likely to main , to some extent , fodder yield over extended periods , stabilize net return income and sustain an ecosystem with its grown plant species. The concept of ‘ multi-functionality’ has been recently adopted , in which multiple ecosystems need ne considered as a management tool of fodder sources.

Materials and Methods

A field study was conducted at the Agricultural Research and Experiments Farm, Faculty of Agriculture, Moshtohor, Benha University, Qalyubia Governorate, Egypt, during successive seasons (2018/2019&2019/2020).

Physical and chemical characters of the used soil are shown in Table (a), physical analysis was estimated according to **Jackson (1973)** whereas, chemical analysis was determined according to **Black, *et. al*. (1982).**

Table a. Physical and chemical properties of the experimental soil units at Moshtohor Agric. Exp. Station during each of the two growing seasons,

Properties		Season 2018
Physical analysis:		
Coarse sand	(%)	2.09
Fine sand	(%)	23.94
Silt	(%)	21.74
Clay	(%)	52.23
Textural class		Clay
Chemical analysis:		
$CaCo_3$	(%)	1.05
Organic matter	(%)	2.09
N available	(mg/kg)	0.88
P available	(mg/kg)	0.31
K available	(mg/kg)	0.71
E.C	(ds. m^{-1})	0.93
pH		7.68

Table b. The prevailing Temperature (°C) at Qalyoubia Governorat during each of the two growing seasons**.**

Season	First season 2018		Second season 2019	
Month	**Max**	**Min**	**Max**	**Min**
January	19.5	12.0	18.2	9.5
February	23.7	13.9	20.3	11.1
March	27.9	15.9	22.4	13.2
April	29.2	18.4	26.8	15.5
May	33.1	22.4	34.5	20.0
June	35.4	24.4	35.5	23.7
July	35.9	25.4	35.9	25.2
August	35.5	25.6	35.9	25.6
September	34.0	24.8	33.0	23.7
October	30.2	21.3	30.8	21.7
November	25.6	16.0	27.2	17.7
December	20.9	13.5	20.5	12.7

The experiment included 12 treatments which were the combination of 3 intercropping (tree and shrubs) x 4 rates of complete fertilizer NPK treatments in 3 reps. *Conocarpus lancifolius was intercropped with 4 shrubs (Acacia saligna , atriplex nummularia* and *adhatoda vasica*). Seedlings of conocarpus, saligna, atriplex and adhatoda were obtained from the Agricultural Research Center farm at the Faculty of Agriculture at Moshtohor , Benha University and were planted in bags. The height of conocarpus was 70cm , and the height of saligna, atriplex and adhatoda was 20 cm. NPK fertilizer rates were control, low complete fertilizer rates (30:20:10 NPK kg fed^{-1}), medium complete fertilizer rates (60:40:20 NPK kg fed^{-1}) and high complete fertilizer rates (90:60:30 NPK kg fed^{-1}). Fertilizer was in the form of (ammonium sulfate 20.6%N), phosphorus (monocalcium superphosphate 15.5%P_2O_5) and potassium (potassium sulfate 48% K_2O). Fertilizers rates were applied in 6 doses three before autumn harvest and three before spring harvest. The experimental design was laid out in a spilt-plot design with 3 reps. The three tree-shrubs combination were the main plots and the NPK fertilizer rates were in the sub plots. The area of each experiment unit was $4m^2$. All management practices of growing fodder conocarpus and shrubs were applied regularly.

The studied parameters were on vegetative growth and yield characteristics

Two harvest were obtained for each study of the two growing seasons the first harvest was obtained at 6 months from planting (1/4/2018) then each of the subsequent second harvest was obtained later at 6 months intervals.

A conocarpus and four shrubs were randomly selected from each experimental unit in each of the two seasons for studying the following parameters plant height. Fresh forage yield of the grown fodder conocarpus and shrubs under study was determined for each plant of the subsequent harvests. In each experimental unit for each of the two studied seasons. Scale of 0.5gm sensitivity then fodder yield of conocarpus and shrubs were estimated. Samples of about 200gm of fresh fodder tree and shrubs were selected randomly from each experimental unit

accurately weighted using an electric balance of 0.01gm sensitivity such obtained fresh samples were dried in an air forced drying oven at 70 °C for 3 days till constant weight to determine the dry matter content then dry yield of tree and shrubs were estimated accordingly. Tree-shrubs fresh weight Mg fed^{-1}, tree-shrubs dry weight Mg fed^{-1} and tree-shrubs of yield fresh and dry weight Mg fed^{-1}. The chemical analysis of the plant samples, in addition to the statistical analysis of the study data as mentioned in the first study.

Chemical constituents

A random sample of fresh cladodes was collected from each experiment unit for each of the 2 harvests in each of the 2 years. About 200g was dried at 70 °C in an air-forced oven, till reaching a constant weight. Dried samples was finely ground till it path through a 40-mich screen and stored in a sealed plastic bags at 5°C for further chemical analyses.

Chemical analysis was performed for three replicates of each sample and data was reported based on the a average. Crude protein content (%), total nitrogen percentage was determined according to the modified micro kjeldahl method. Crude protein content was estimated by multiplying nitrogen percentage by 6.25 (A.O.A.C. 1990). Ether extract content (%), ether extract content was extracted using petroleum ether (40-60 °C boiling point) in a Soccelt apparatus provided with cold water condenser for 9 hours at a rate of 96 siphons/hour. Total carbohydrates content (%), it was estimated by subtracting the sum of the percentages of crude protein, crude fiber, ash and ether extract out of 100.

{TCC % = 100 - (CP % + CF % + EE % + Ash %)}

Statistical analysis

Experiment previously presented was statistically analyzed individually according to the presented design for each of the two growing seasons (2018/2019 & 2019/2020) the analysis of variance was carried out according to the procedure described by **Snedecor and Cochran (1982)** L.S.D. test at 5% level was used to compare between means.

Results and Discussion

Vegetative growth

Plant height (cm)

Table (1) showed that conocarpus tree intercropped with atriplex shrubs gave the highest height in the first harvest (117.50 & 146.25 cm) and the second harvest (132.42 & 167.50 cm) in the first and second seasons respectively followed by the conocarpus tree intercropping with saligna shrubs in the first harvest (115.58 & 141.33 cm) and the second harvest (128.92 & 152.17 cm) in both growing seasons, the lowest in height were the conocarpus tree intercropping with adhatoda shrubs in the first harvest (111.50 & 135.75 cm) and the second harvest (124.92 & 145.00 cm) respectively in both growing seasons (2018/2019 & 2019/2020). Rates of NPK fertilizer were high (90:60:30 NPK kg fed^{-1}), medium (60:40:20 NPK kg fed^{-1}) and low (30:20:10 NPK kg fed^{-1}) significant increase in height for conocarpus tree intercropping on shrubs (saligna, atriplex and adhatoda), where the high rate of fertilizer was given in the first harvest (118.00 & 151.56 cm) and the second harvest (135.78 & 169.78 cm) in both growing seasons (2018/2019 & 2019/2020).

Table (1) showed that conocarpus tree intercropped with atriplex shrubs and fertilized at a high level (90:60:30 NPK kg fed^{-1}) had a significant increase in height in the first harvest (120.00 & 158.67 cm) and the second harvest (138.33 & 185.67 cm) respectively in both growing seasons while the low level of fertilization (30:20:10 NPK kg fed^{-1}) with conocarpus tree intercropping with adhatoda shrubs gave the least significant increase in the first harvest (111.00 & 133.67 cm) and the second harvest (123.33 & 140.33 cm) in both growing seasons (2018/2019 & 2019/2020). On the other hand the results in Table (1) showed that saligna shrubs intercropping with conocarpus tree had the highest significant increase in height in the first harvest (85.42 & 171.42 cm) and in the second harvest (99.58 & 203.00 cm), respectively compared to atriplex shrubs intercropping on conocarpus tree in the first harvest (68.83 & 117.17 cm) and the second harvest (78.42 & 227.75 cm) in both growing seasons respectively the lowest in height were the adhatoda shrubs intercropping with conocarpus tree in the first harvest (62.33 & 93.83 cm) and the second harvest (69.08 & 114.25 cm) respectively in both growing seasons (2018/2019 & 2019/2020).

In addition to the results in Table (1) showed that high, medium and low rates of fertilizer had a significant increase in height for shrubs (saligna, adhatoda and atriplex) intercropping on conocarpus tree where the highest rate of fertilizer was recorded in the first harvest (85.33 & 134.56 cm) and the second harvest (94.78 & 156.11 cm) compared to the control plants (without fertilization) in the first harvest (59.22 & 118.56 cm) and the second harvest (70.78 & 138.78 cm) in both growing seasons.

In addition to, the results in Table (1) showed that saligna shrubs intercropping with conocarpus tree and fertilized with a high level of NPK gave a significant increase in the height in the first harvest (95.00 & 185.00 cm) and in the second harvest (111.67 & 211.67 cm) respectively in both seasons and then the atriplex shrubs intercropping on conocarpus tree in the first harvest (84.67 & 121.00 cm) and the second harvest (93.00 & 134.33 cm) compared to the adhatoda shrubs intercropping on conocarpus tree in the first harvest (76.00 & 97.67 cm) and the second harvest (79.67 & 122.33 cm) in both growing seasons (2018/2019 & 2019/2020). This trend was in the two harvests in the two seasons

the other treatments occupied on intermediate position between the abovementioned treatments in the two seasons. These results were in agreement with **(Krebs *et.al*. 2007), (Roshdy *et.al*. 2013), (Shetta *et.al*. 2014) and (Bharat *et.al*. 2017).**

Yield

Table 1. Tree/shrubs plant height (cm) in response to various tree/shrubs set up and fertilization in two harvests (2018/2019 & 2019/2020).

Seasons	First Season (2018/2019)				Second Season (2019/2020)			
Treatments	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**
				Fodder tree				
	First harvest (Summer Autumn)							
F.0 (0.0)	**111.00**	**114.33**	**105.33**	**110.22**	**130.33**	**133.33**	**124.67**	**129.44**
F.1 (L.)	**115.33**	**116.33**	**111.00**	**114.22**	**139.33**	**142.33**	**133.67**	**138.44**
F.2 (M.)	**117.67**	**119.33**	**114.00**	**117.00**	**145.67**	**150.67**	**138.67**	**145.00**
F.3 (H.)	**118.33**	**120.00**	**115.67**	**118.00**	**150.00**	**158.67**	**146.00**	**151.56**
Mean	**115.58**	**117.50**	**111.50**	**====**	**141.33**	**146.25**	**135.75**	**====**
LS D. at 5% for	**A=2.00 ,**	**B=1.35 ,**	**AxB=2.33**		**A=2.92 ,**	**B=1.89 ,**	**AxB=2.23**	
	Second harvest (Winter Spring)							
F.0 (0.0)	**120.00**	**124.33**	**117.33**	**120.56**	**139.00**	**150.00**	**136.33**	**141.78**
F.1 (L.)	**127.67**	**129.00**	**123.33**	**126.67**	**146.33**	**161.00**	**140.33**	**149.22**
F.2 (M.)	**131.67**	**138.00**	**126.33**	**132.00**	**154.67**	**173.33**	**148.33**	**158.78**
F.3 (H.)	**136.33**	**138.33**	**132.67**	**135.78**	**168.67**	**185.67**	**155.00**	**169.78**
Mean	**128.92**	**132.42**	**124.92**	**====**	**152.17**	**167.50**	**145.00**	**====**
LS D. at 5% for	**A=1.04**	**B=1.33**	**AxB=2.31**		**A=2.07 ,**	**B=2.27 ,**	**AxB=3.92**	
				Fodder shrubs				
	First harvest (Summer Autumn)							
F.0 (0.0)	**75.00**	**51.67**	**51.00**	**59.22**	**155.67**	**111.67**	**88.33**	**118.56**
F.1 (L.)	**83.33**	**62.00**	**56.67**	**67.33**	**168.33**	**117.33**	**93.67**	**126.44**
F.2 (M.)	**88.33**	**77.00**	**65.67**	**76.00**	**176.67**	**118.67**	**95.67**	**130.33**
F.3 (H.)	**95.00**	**84.67**	**76.00**	**85.33**	**185.00**	**121.00**	**97.67**	**134.56**
Mean	**85.42**	**68.83**	**62.33**	**====**	**171.42**	**117.17**	**93.83**	**====**
LS D. at 5% for	**A=4.03 ,**	**B=2.30 ,**	**AxB=3.98**		**A=6.11 ,**	**B=2.00 ,**	**AxB=3.47**	
	Second harvest (Winter Spring)							
F.0 (0.0)	**88.33**	**64.67**	**59.33**	**70.78**	**194.33**	**119.67**	**102.33**	**138.78**
F.1 (L.)	**93.33**	**71.33**	**65.67**	**76.78**	**199.33**	**127.33**	**112.00**	**146.22**
F.2 (M.)	**105.00**	**84.67**	**71.67**	**87.11**	**206.67**	**129.67**	**120.33**	**152.22**
F.3 (H.)	**111.67**	**93.00**	**79.67**	**94.78**	**211.67**	**134.33**	**122.33**	**156.11**
Mean	**99.58**	**78.42**	**69.08**	**====**	**203.00**	**227.75**	**114.25**	**====**
LS D. at 5% for	**A=4.05**	**B=2.48**	**AxB=4.30**		**A=1.11**	**B=2.59 ,**	**AxB=4.49**	

F.0 = Control
F.1= Fertilization Low
F.2= Fertilization Medium
F.3= Fertilization High

C.+Sa. = Conocarpus+Saligna
C.+At. = Conocarpus+Atriplex
C.+Ad.= Conocarpus+Adhatoda

A= Tree and Shrubs
B= Fertilization
AxB = Tree and Shrubs x Fertilization

Fresh weight (Mg fed^{-1})

The results in Table (2) showed that the conocarpus tree intercropping on atriplex shrubs gave the highest yield of fresh fodder tree in the first harvest (6.21 & 13.72 Mg fed^{-1}) and the second harvest (6.39 & 15.77 Mg fed^{-1}) in the first and second seasons respectively followed by conocarpus intercropping on saligna shrubs in the first harvest (6.08 & 12.96 Mg fed^{-1}) and the second harvest (6.24 & 14.09 Mg fed^{-1}) in both growing seasons, the least of them in the fresh fodder tree crop was conocarpus tree intercropping with adhatoda shrubs in the first harvest (5.95 & 12.55 Mg fed^{-1}) and the second

harvest (6.13 & 13.07 Mg fed^{-1}) respectively in both growing seasons (2018/2019 & 2019/2020).

The data obtained in Table (2) also, showed that rates of NPK fertilizer were high (90:60:30 NPK kg fed^{-1}), medium (60:40:20 NPK kg fed^{-1}) and low (30:20:10 NPK kg fed^{-1}) significantly increased the weight of fresh fodder tree for conocarpus tree intercropping on shrubs (saligna, atriplex and adhatoda) where the high rate of fertilizer was given in the first harvest (6.15 & 13.94 Mg fed^{-1}) and the second harvest (6.35 & 15.18 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020).

Table 2. Tree/shrubs fresh weight (Mg fed^{-1}) in response to various tree/shrubs set up and fertilization in both harvests in the two years (2018/2019 & 2019/2020).

Seasons	First Season (2018/2019)				Second Season (2019/2020)			
Treatments	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**
				Fodder tree				
	First harvest (Summer Autumn)							
F.0 (0.0)	**5.99**	**6.15**	**5.79**	**5.98**	**12.27**	**12.69**	**12.11**	**12.36**
F.1 (L.)	**6.07**	**6.18**	**5.96**	**6.07**	**12.69**	**13.44**	**12.32**	**12.82**
F.2 (M.)	**6.13**	**6.24**	**6.00**	**6.12**	**13.07**	**13.81**	**12.69**	**13.19**
F.3 (H.)	**6.14**	**6.26**	**6.05**	**6.15**	**13.81**	**14.93**	**13.07**	**13.94**
Mean	**6.08**	**6.21**	**5.95**	**=====**	**12.96**	**13.72**	**12.55**	**=====**
LS D. at 5% for	**A=0.07 ,**	**B=0.01 ,**	**AxB=0.01**		**A=1.19 ,**	**B=0.94 ,**	**AxB=1.09**	
	Second harvest (Winter Spring)							
F.0 (0.0)	**6.07**	**6.26**	**6.03**	**6.12**	**13.07**	**14.19**	**12.69**	**13.32**
F.1 (L.)	**6.24**	**6.37**	**6.09**	**6.23**	**13.81**	**15.31**	**13.07**	**14.06**
F.2 (M.)	**6.31**	**6.46**	**6.17**	**6.32**	**14.56**	**16.43**	**13.07**	**14.68**
F.3 (H.)	**6.35**	**6.48**	**6.23**	**6.35**	**14.93**	**17.17**	**13.44**	**15.18**
Mean	**6.24**	**6.39**	**6.13**	**=====**	**14.09**	**15.77**	**13.07**	**=====**
LS D. at 5% for	**A=0.01 , B=0.07 , AxB=0.05**				**A=0.67 , B=1.33 , AxB=1.54**			
				Fodder shrubs				
	First harvest (Summer Autumn)							
F.0 (0.0)	**5.56**	**4.55**	**4.64**	**4.92**	**17.93**	**11.91**	**16.02**	**15.29**
F.1 (L.)	**6.00**	**4.80**	**4.85**	**5.22**	**18.03**	**12.06**	**16.69**	**15.59**
F.2 (M.)	**6.36**	**5.04**	**5.15**	**5.52**	**18.13**	**12.08**	**18.08**	**16.10**
F.3 (H.)	**6.79**	**5.19**	**5.16**	**5.71**	**18.29**	**12.08**	**18.11**	**16.16**
Mean	**6.18**	**4.89**	**4.95**	**=====**	**18.10**	**12.03**	**17.23**	**=====**
LS D. at 5% for	**A=0.07 ,**	**B=0.04 ,**	**AxB=0.08**		**A=0.82 ,**	**B=0.51 ,**	**AxB=0.89**	
	Second harvest (Winter Spring)							
F.0 (0.0)	**5.75**	**4.76**	**4.82**	**5.11**	**16.83**	**13.81**	**19.92**	**16.85**
F.1 (L.)	**6.21**	**5.00**	**4.16**	**5.46**	**21.65**	**15.00**	**20.57**	**19.09**
F.2 (M.)	**6.51**	**5.25**	**5.47**	**5.74**	**23.89**	**15.00**	**21.85**	**20.64**
F.3 (H.)	**7.55**	**5.57**	**5.59**	**6.24**	**26.13**	**16.97**	**22.49**	**21.87**
Mean	**6.50**	**5.15**	**5.26**	**=====**	**22.13**	**15.49**	**21.21**	**=====**
LS D. at 5% for	**A=0.19 , B=0.16 , AxB=0.27**				**A=3.48 , B=1.52 , AxB=2.62**			

F.0 = Control
F.1= Fertilization Low
F.2= Fertilization Medium
F.3= Fertilization High

C.+Sa. = Conocarpus+Saligna
C.+At. = Conocarpus+Atriplex
C.+Ad.= Conocarpus+Adhatoda

A= Tree and Shrubs
B= Fertilization
AxB = Tree and Shrubs x Fertilization

In addition to the results in Table (2) showed that conocarpus tree intercropping on atriplex shrubs and fertilized at a high rate (90:60:30 NPK kg fed^{-1}) had a significant increase in the fresh yield of the fodder tree in the first harvest (6.26 & 14.93 Mg fed^{-1}) and the second harvest (6.48 & 17.17 Mg fed^{-1}) respectively in both growing seasons while the low rate of fertilizer (30:20:10 NPK kg fed^{-1}) with conocarpus tree intercropping with adhatoda shrubs gave the least significant increase in the first harvest (6.1 & 13.1 Mg fed^{-1}) and the second harvest (6.05 &

13.07 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020).

On the other hand the results in Table (2) showed that the Saligna shrubs intercropping with conocarpus tree had the highest significant increase in the fresh weight of the fodder shrubs in the first harvest (6.18 & 18.10 Mg fed^{-1}) and the second harvest (6.50 & 22.13 Mg fed^{-1}) respectively compared to adhatoda shrubs intercropping on conocarpus tree in the first harvest (4.95 & 17.23 Mg fed^{-1}) and the second harvest (5.26 & 21.21 Mg fed^{-1}) in both growing seasons respectively, the least of them were atriplex shrubs intercropping with conocarpus tree in the first harvest (4.89 & 12.03 Mg fed^{-1}) and the second harvest (5.15 & 15.49 Mg fed^{-1}) respectively in both growing seasons (2018/2019 & 2019/2020).

In addition to the results in Table (2) showed that high, medium and low rates of fertilizer significantly increased the fresh fodder shrubs of saligna, adhatoda and atriplex intercropping on conocarpus tree the high rate of fertilizer was recorded in the first harvest (5.71 & 16.16 Mg fed^{-1}) and the second harvest (6.24 & 21.87 Mg fed^{-1}) compared to control plants (without fertilization) in the first harvest (4.92 & 15.29 Mg fed^{-1}) and the second harvest (5.11 & 16.85 Mg fed^{-1}) in both growing seasons.

In addition to, the results in Table (2) showed that the saligna shrubs intercropping with conocarpus tree and fertilized with a high rate of NPK gave a significant increase in fresh fodder shrubs in the first harvest (6.79 & 18.29 Mg fed^{-1}) and the second harvest (7.55 & 26.13 Mg fed^{-1}) respectively in both seasons in comparison to adhatoda shrubs intercropping on conocarpus tree in the first harvest (5.16 & 18.11 Mg fed^{-1}) and the second harvest (5.59 & 22.49 Mg fed^{-1}) and then atriplex shrubs intercropping on conocarpus tree in the first harvest (5.19 & 12.08 Mg fed^{-1}) and the second harvest (5.57 & 16.97 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020). This trend was in the two harvests in the two seasons the other treatments occupied on intermediate position between the abovementioned treatments in the two seasons. These results were in agreement with **(Krebs *et.al.* 2007), (Roshdy *et.al.* 2013), (Shetta *et.al.* 2014) and (Bharat *et.al.* 2017).**

Dry weight (Mg fed^{-1}**)**

The results in Table (3) showed that the conocarpus tree intercropping on atriplex shrubs gave the highest yield of dry fodder tree in the first harvest (0.84 & 1.78 Mg fed^{-1}) and the second harvest (0.86 & 2.05 Mg fed^{-1}) in the first and second seasons respectively followed by conocarpus intercropping on saligna shrubs in the first harvest (0.82 & 1.69 Mg fed^{-1}) and the second harvest (0.84 & 1.81 Mg fed^{-1}) in both growing seasons, the least of them in the dry fodder tree crop was conocarpus tree intercropping with adhatoda shrubs in the first harvest (0.80 & 1.68 Mg fed^{-1}) and the second harvest (0.83 & 1.70 Mg fed^{-1}) respectively in both growing seasons (2018/2019 & 2019/2020).

The data obtained in Table (3) also, showed that rates of NPK fertilizer were high (90:60:30 NPK kg fed^{-1}), medium (60:40:20 NPK kg fed^{-1}) and low (30:20:10 NPK kg fed^{-1}) significantly increased the weight of dry fodder tree for conocarpus tree intercropping on shrubs (saligna, atriplex and adhatoda) where the high rate of fertilizer was given in the first harvest (0.83 & 1.83 Mg fed^{-1}) and the second harvest (0.86 & 1.97 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020).

In addition to, the results in Table (3) showed that conocarpus tree intercropping on atriplex shrubs and fertilized at a high rate (90:60:30 NPK kg fed^{-1}) had a significant increase in the dry yield of the fodder tree in the first harvest (0.84 & 1.94 Mg fed^{-1}) and the second harvest (0.87 & 2.23 Mg fed^{-1}) respectively in both growing seasons while the low rate of fertilization (30:20:10 NPK kg fed^{-1}) with conocarpus tree intercropping with adhatoda shrubs gave the least significant increase in the first harvest (0.78 & 1.64 Mg fed^{-1}) and the second harvest (0.81 & 2.65 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020) respectively.

On the other hand the results in Table (3) showed that the saligna shrubs intercropping with conocarpus tree had the highest significant increase in the dry weight of the fodder shrubs in the first harvest (0.74 & 2.17 Mg fed^{-1}) and the second harvest (0.91 & 3.14 Mg fed^{-1}) respectively compared to adhatoda shrubs intercropping on conocarpus tree in the first harvest (0.55 & 1.93 Mg fed^{-1}) and the second harvest (0.58 & 2.33 Mg fed^{-1}) in both growing seasons respectively, the least of them were atriplex shrubs intercropping with conocarpus tree in the first harvest (0.64 & 1.57 Mg fed^{-1}) and the second harvest (0.67 & 2.01 Mg fed^{-1}) respectively in both growing seasons (2018/2019 & 2019/2020).

In addition to the results in Table (3) showed that high, medium and low rates of fertilizer significantly increased the dry fodder shrubs of saligna, adhatoda and atriplex intercropping on conocarpus tree the high rate of fertilizer was recorded in the first harvest (0.69 & 1.76 Mg fed^{-1}) and the second harvest (0.75 & 2.61 Mg fed^{-1}) compared to control plants (without fertilization) in the first harvest (0.59 & 1.82 Mg fed^{-1}) and the second harvest (0.61 & 2.14 Mg fed^{-1}) in both growing seasons.

In addition to, the results in Table (3) showed that the saligna shrubs intercropping with conocarpus tree and fertilized with a high rate of NPK gave a significant increase in dry fodder shrubs in the first harvest (0.81 & 2.20 Mg fed^{-1}) and the second harvest (0.91 & 3.14 Mg fed^{-1}) respectively in

both seasons in comparison to adhatoda shrubs intercropping on conocarpus tree in the first harvest (0.58 & 2.05 Mg fed^{-1}) and the second harvest (0.62 & 2.47 Mg fed^{-1}) and then atriplex shrubs intercropping on conocarpus tree in the first harvest (0. 67 & 1.58 Mg fed^{-1}) and the second harvest (0.73 & 2.21 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020). This trend was in the two harvests in the two seasons the other treatments occupied on intermediate position between the abovementioned treatments in the two seasons. These results were in agreement with **(Krebs *et.al.* 2007), (Roshdy *et.al.* 2013), (Shetta *et.al.* 2014) and (Bharat *et.al.* 2017).**

Table 3. Tree/shrubs dry weight (Mg fed^{-1}) in response to various tree/shrubs set up and fertilization in both harvests in the two years (2018/2019 & 2019/2020).

Season	First Season (2018/2019)				Second Season (2019/2020)			
Treatments	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**
				Fodder tree				
	First harvest (Summer Autumn)							
F.0 (0.0)	**0.81**	**0.83**	**0.78**	**0.81**	**1.62**	**1.65**	**1.64**	**1.64**
F.1 (L.)	**0.82**	**0.84**	**0.81**	**0.82**	**1.65**	**1.75**	**1.65**	**1.68**
F.2 (M.)	**0.82**	**0.84**	**0.81**	**0.83**	**1.70**	**1.80**	**1.68**	**1.73**
F.3 (H.)	**0.83**	**0.84**	**0.82**	**0.83**	**1.70**	**1.94**	**1.75**	**1.83**
Mean	**0.82**	**0.84**	**0.80**	=====	**1.69**	**1.78**	**1.68**	=====
LS D. at 5% for	**A=0.01 , B=0.01 ,**		**AxB=0.01**		**A=0.20 , B=0.12 ,**		**AxB=0.13**	
	Second harvest (Winter Spring)							
F.0 (0.0)	**0.82**	**0.85**	**0.81**	**0.83**	**1.60**	**1.84**	**2.65**	**1.70**
F.1 (L.)	**0.84**	**0.86**	**0.82**	**0.84**	**1.80**	**1.99**	**1.70**	**1.83**
F.2 (M.)	**0.85**	**0.87**	**0.83**	**0.85**	**1.89**	**2.14**	**1.70**	**1.91**
F.3 (H.)	**0.86**	**0.87**	**0.84**	**0.86**	**1.94**	**2.23**	**1.75**	**1.97**
Mean	**0.84**	**0.86**	**0.83**	=====	**1.81**	**2.05**	**1.70**	=====
LS D. at 5% for	**A=0.01 , B=0.02 , AxB=0.01**				**A=0.14 , B=0.11 , AxB=0.12**			
				Fodder shrubs				
	First harvest (Summer Autumn)							
F.0 (0.0)	**0.67**	**0.59**	**0.51**	**0.59**	**2.15**	**1.55**	**1.76**	**1.82**
F.1 (L.)	**0.71**	**0.62**	**0.53**	**0.62**	**2.16**	**1.57**	**1.84**	**1.86**
F.2 (M.)	**0.76**	**0.66**	**0.57**	**0.66**	**2.18**	**1.57**	**1.99**	**1.91**
F.3 (H.)	**0.81**	**0.67**	**0.58**	**0.69**	**2.20**	**1.58**	**2.05**	**1.96**
Mean	**0.74**	**0.64**	**0.55**	=====	**2.17**	**1.57**	**1.93**	=====
LS D. at 5% for	**A=0.01 , B=0.01 ,**		**AxB=0.02**		**A=0.13 , B=0.05 ,**		**AxB=0.09**	
	Second harvest (Winter Spring)							
F.0 (0.0)	**0.69**	**0.62**	**0.53**	**0.61**	**2.43**	**1.80**	**2.19**	**2.14**
F.1 (L.)	**0.75**	**0.65**	**0.57**	**0.65**	**2.60**	**1.95**	**2.26**	**2.27**
F.2 (M.)	**0.78**	**0.68**	**0.60**	**0.69**	**2.87**	**2.10**	**2.40**	**2.46**
F.3 (H.)	**0.91**	**0.73**	**0.62**	**0.75**	**3.14**	**2.21**	**2.47**	**2.61**
Mean	**0.78**	**0.67**	**0.58**	=====	**2.76**	**2.01**	**2.33**	=====
LS D. at 5% for	**A=0.01 , B=0.02 , AxB=0.03**				**A=0.20 , B=0.10 , AxB=0.18**			

F.0 = Control
F.1= Fertilization Low
F.2= Fertilization Medium
F.3= Fertilization High

C.+Sa. = Conocarpus+Saligna
C.+At. = Conocarpus+Atriplex
C.+Ad.= Conocarpus+Adhatoda

A= Tree and Shrubs
B= Fertilization
AxB = Tree and Shrubs x Fertilization

Total yield fresh and dry weight (Mg fed^{-1})

The results in Table (4) showed that the conocarpus tree intercropping on the atriplex shrubs gave the highest yield of the total fresh fodder tree for the first and second harvests (12.60 & 29.49 Mg fed^{-1}) and the total dry fodder tree for the first and second harvests (1.70 & 3.83 Mg fed^{-1}) in the first and second seasons respectively followed by conocarpus tree intercropping on saligna shrubs for the total fresh fodder tree yield of the first and second harvests (12.32 & 27.05 Mg fed^{-1}) and the dry fodder tree crop for the first and second harvests (1.66 & 3.50 Mg fed^{-1}) in both growing seasons, the least of them in the fresh crop of the fodder tree was conocarpus tree intercropping with adhatoda shrubs in the total fresh yield of the first and second harvests (12.08 & 25.61 Mg fed^{-1}) the total dry yield of the first and second harvests (1.63 & 3.38 Mg fed^{-1}) respectively in both growing seasons (2018/2019 & 2019/2020).

The data obtained in Table (4) also, showed that rates of NPK fertilizer were high (90:60:30 NPK kg fed-1), medium (60:40:20 NPK kg fed-1) and low (30:20:10 NPK kg fed-1) had a significant increase in the total fresh weight of the first and second harvests of conocarpus tree intercropping on shrubs (saligna, ataplex and adhatuda) where the high rate of fertilizer was given in the total fresh crop of the first and second harvests (12.50 & 29.12 Mg fed-1) and the total dry yield for the first and second harvests (1.69 & 3.80 Mg fed-1) in both growing seasons (2018/2019 & 2019/2020).

Table 4. Total fresh and dry yield (Mg fed^{-1}) of each of tree/shrubs in both harvests in the two years (2018/2019 & 2019/2020).

Season	First Season (2018/2019)				Second Season (2019/2020)			
Treatments	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**	**C.+Sa.**	**C.+At.**	**C.+Ad.**	**Mean**
				Fodder tree				
				Yield Fresh Weight Mg fa^{-1}				
F.0 (0.0)	**12.06**	**12.41**	**11.82**	**12.10**	**25.33**	**26.88**	**24.80**	**25.67**
F.1 (L.)	**12.31**	**12.55**	**12.06**	**12.30**	**26.51**	**28.75**	**25.39**	**26.88**
F.2 (M.)	**12.44**	**12.70**	**12.17**	**12.44**	**27.63**	**30.24**	**25.76**	**27.88**
F.3 (H.)	**12.49**	**12.73**	**12.28**	**12.50**	**28.75**	**32.11**	**26.51**	**29.12**
Mean	**12.32**	**12.60**	**12.08**	**=====**	**27.05**	**29.49**	**25.61**	**=====**
LS D. at 5% for	**A=0.07 , B=0.07 ,**		**AxB=0.08**		**A=1.11 , B=1.43 ,**		**AxB=1.65**	
				Yield Dry Weight Mg fa^{-1}				
F.0 (0.0)	**1.63**	**1.68**	**1.60**	**1.63**	**3.22**	**3.49**	**3.29**	**3.33**
F.1 (L.)	**1.66**	**1.69**	**1.63**	**1.66**	**3.45**	**3.74**	**3.35**	**3.51**
F.2 (M.)	**1.68**	**1.71**	**1.64**	**1.68**	**3.59**	**3.93**	**3.38**	**3.64**
F.3 (H.)	**1.68**	**1.72**	**1.66**	**1.69**	**3.74**	**4.17**	**3.50**	**3.80**
Mean	**1.66**	**1.70**	**1.63**	**=====**	**3.50**	**3.83**	**3.38**	**=====**
LS D. at 5% for	**A=0.01 , B=0.01 , AxB=0.01**				**A=0.24 , B=0.18 , AxB=0.20**			
				Fodder shrubs				
				Yield Fresh Weight Mg fa^{-1}				
F.0 (0.0)	**11.31**	**9.31**	**9.46**	**10.02**	**34.76**	**25.72**	**35.95**	**32.14**
F.1 (L.)	**12.21**	**9.80**	**10.01**	**10.68**	**39.68**	**27.05**	**37.26**	**34.66**
F.2 (M.)	**12.87**	**10.29**	**10.61**	**11.26**	**42.03**	**28.26**	**39.93**	**36.74**
F.3 (H.)	**14.33**	**10.76**	**10.81**	**11.97**	**44.43**	**29.05**	**40.60**	**38.03**
Mean	**12.68**	**10.04**	**10.23**	**=====**	**40.22**	**27.52**	**38.43**	**=====**
LS D. at 5% for	**A=0.15 , B=0.17 ,**		**AxB=0.29**		**A=3.27 , B=1.72 ,**		**AxB=2.97**	
				Yield Dry Weight Mg fa^{-1}				
F.0 (0.0)	**1.36**	**1.21**	**1.04**	**1.20**	**4.58**	**3.34**	**3.95**	**3.96**
F.1 (L.)	**1.45**	**1.27**	**1.10**	**1.28**	**4.76**	**3.52**	**4.10**	**4.13**
F.2 (M.)	**1.54**	**1.34**	**1.17**	**1.35**	**5.04**	**3.67**	**4.39**	**4.37**
F.3 (H.)	**1.72**	**1.40**	**1.19**	**1.44**	**5.33**	**3.78**	**4.52**	**4.55**
Mean	**1.52**	**1.31**	**1.13**	**=====**	**4.93**	**3.58**	**4.24**	**=====**
LS D. at 5% for	**A=0.01 , B=0.03 , AxB=0.05**				**A=0.20 , B=0.13 , AxB=0.23**			

F.0= Control
F.1= Fertilization Low
F.2= Fertilization Medium
F.3= Fertilization High

C.+Sa. = Conocarpus+Saligna
C.+At. = Conocarpus+Atriplex
C.+Ad.= Conocarpus+Adhatoda

A= Tree and Shrubs
B= Fertilization
AxB = Tree and Shrubs x Fertilization

In addition to the results in Table (4) showed that the conocarpus tree intercropping on atriplex shrubs and fertilized at a high level (90:60:30 NPK kg fed^{-1}) had a significant increase in the total fresh fodder tree for the first and second harvests (12.73 & 32.11 Mg fed^{-1}) and total dry weight yield for the first and second harvests (1.72 & 4.17 Mg fed^{-1}) respectively in both growing seasons while the low rate of fertilization (30:20:10 NPK kg fed^{-1}) was given with conocarpus tree intercropping with adhatoda shrubs had the least significant increase in the total fresh fodder tree yield for the first and second harvests (12.28 & 26.51 Mg fed^{-1}) and the total dry fodder tree yield for the first and second harvests (1.63 & 3.38 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020).

on the other hand the results in Table (4) showed that saligna shrubs intercropping with conocarpus tree had the highest significant increase in the total fresh fodder shrubs yield for the first and second harvests (12.68 & 40.22 Mg fed^{-1}) and the total dry fodder shrubs yield for the first and second harvests (1.52 & 4.93 Mg fed^{-1}) on the respectively compared to adhatoda shrubs intercropping on conocarpus tree in the total fresh fodder shrubs crop for the first and second harvests (10.23 & 38.43 Mg fed^{-1}) and the total dry fodder shrubs yield for the first and second harvests (1.13 & 4.24 Mg fed^{-1}) in both growing seasons respectively, the least of them were the atriplex shrubs intercropping with conocarpus tree in the total fresh fodder shrubs yield for the first and second harvests (10.04 & 27.22 Mg fed^{-1}) and the total dry fodder shrubs yield for the first and second harvests (1.31 & 3.58 Mg fed^{-1}) respectively in both growing seasons (2018/2019 & 2019/2020).

In addition to, the results in Table (4) showed that the intercropping of shrubs (saligna, atriplex and adhatoda) with high, medium and low rates of fertilizer significantly increased the total fresh and dry yield of fodder shrubs for the first and second harvests where the highest rate of fertilizer was recorded in the total fresh crop of fodder shrubs for the first and second harvests (11.97 & 38.03 Mg fed^{-1}) and the total dry crop of fodder shrubs for the first and second harvests (1.44 & 4.55 Mg fed^{-1}) compared to the control plants (without fertilization) in the total fresh fodder shrubs crop for the first and second harvests (10.02 & 32.14 Mg fed^{-1}) and the total dry yield of fodder shrubs for the first and second harvests (1.20 & 3.96 Mg fed^{-1}) in both growing seasons.

In addition to, the results in Table (4) showed that saligna shrubs intercropping with conocarpus tree and fertilized with a high rate of NPK gave a significant increase in the total fresh crop of the fodder shrubs for the first and second harvests (14.33 & 44.43 Mg fed^{-1}) and the total dry yield of the fodder shrubs for the first and second harvests (1.72 & 5.33 Mg fed^{-1}) respectively in both seasons compared to the shrubs adhatoda intercropping on conocarpus tree in the total fresh fodder shrubs yield for the first and second harvests (10.81 & 40.60 Mg fed^{-1}) and the total dry fodder shrubs yield for the first and second harvests (1.19 & 4.52 Mg fed^{-1}) then shrubs atriplex intercropping on conocarpus tree in the total fresh crop of fodder shrubs for the first and second harvests (10.76 & 29.05 Mg fed^{-1}) and the total dry crop of fodder shrubs for the first and second harvests (1.40 & 3.78 Mg fed^{-1}) in both growing seasons (2018/2019 & 2019/2020). This trend was in the two harvests in the two seasons the other treatments occupied on intermediate position between the abovementioned treatments in the two seasons. These results were in agreement with **(Krebs *et.al.* 2007), (Roshdy *et.al*. 2013), (Shetta *et.al.* 2014) and (Bharat *et.al.* 2017).**

Chemical constituents

Crude protein content (%)

Conocarpus tree intercropped with atriplex shrubs gave the highest percentage of crude protein content in the first harvest (9.63 & 8.00 %) and in the second harvest (8.54 & 7.77 %) in the first and second seasons (Table 5) respectively followed by conocarpus tree intercropping with saligna shrubs in the first harvest (8.49 & 7.89 %) and the second harvest (8.18 & 7.41 %) in both growing seasons and the lowest percentage crude protein was the conocarpus tree intercropping with adhatoda shrubs in the first harvest (7.87 & 7.76 %) and the second harvest (7.26 & 7.28 %) respectively in both growing seasons (2018/2019 & 2019/2020).

Also, the data obtained in Table (5) record that rates of NPK fertilizer were high (90:60:30 NPK kg fed^{-1}), medium (60:40:20 NPK kg fed^{-1}) and low (30:20:10 NPK kg fed^{-1}) had a significant increase in the percentage of crude protein content for conocarpus tree intercropping with shrubs (atriplex, saligna and adhatoda) where the high rate of fertilizer was given in the first harvest (9.06 & 8.05 %) and the second harvest (8.19 & 7.64 %) in both growing seasons (2018/2019 & 2019/2020).

In addition to the results in Table (5) showed that the conocarpus tree intercropping with atriplex shrubs and fertilized at a high rate (90:60:30 NPK kg fed^{-1}) had a significant increase in the percentage of crude protein content for the first harvest (10.07 & 8.23 %) and the second harvest (8.77 & 8.04 %) respectively in both growing seasons while the low level of fertilization (30:20:10 NPK kg fed^{-1}) with conocarpus tree intercropping with adhatoda shrubs gave the least significant increase in the first harvest (7.43 & 7.69 %) and the second harvest (7.03 & 7.21 %) in both growing seasons (2018/2019 & 2019/2020).

On the other hand the results in Table (5) showed that the atriplex shrubs intercropping with conocarpus tree had the highest significant increase

in the percentage of crude protein content for the first harvest (15.40 & 14.57 %) and for the second harvest (13.64 & 13.89 %) respectively compared to saligna shrubs intercropping with conocarpus tree in the first harvest (11.16 & 10.87 %) and second harvest (10.26 & 10.43 %) in both growing seasons respectively, the lowest percentage of crude protein content was the adhatoda shrubs intercropping with conocarpus tree in the first harvest (8.47 & 8.16 %) and the second harvest (7.88 & 8.02 %) respectively in both growing seasons (2018/2019 & 2019/2020).

Table 5. Tree/shrubs crude protein content (%) in response to various tree/shrubs set up and fertilization in both harvests in the two years (2018/2019 & 2019/2020).

Seasons / Treatments	First Season (2018/2019)				Second Season (2019/2020)			
	C.+Sa.	C.+At.	C.+Ad.	Mean	C.+Sa.	C.+At.	C.+Ad.	Mean
	Fodder trees							
	First harvest (Summer Autumn)							
F.0 (0.0)	8.13	8.88	7.43	8.14	7.81	7.65	7.69	7.72
F.1 (L.)	8.27	9.70	7.87	8.61	7.77	8.00	7.81	7.86
F.2 (M.)	8.63	9.90	8.00	8.84	7.92	8.11	7.65	7.89
F.3 (H.)	8.93	10.07	8.17	9.06	8.04	8.23	7.88	8.05
Mean	8.49	9.63	7.87	-----	7.89	8.00	7.76	-----
LS D. at 5% for	A=0.101 ,	B=0.230 ,	AxB=0.266		A=0.527 ,	B=0.477 ,	AxB=0.551	
	Second harvest (Winter Spring)							
F.0 (0.0)	8.03	8.33	7.03	7.80	7.33	7.48	7.21	7.34
F.1 (L.)	8.13	8.47	7.23	7.94	7.39	7.65	7.21	7.42
F.2 (M.)	8.20	8.60	7.30	8.03	7.44	7.92	7.29	7.56
F.3 (H.)	8.33	8.77	7.47	8.19	7.48	8.04	7.40	7.64
Mean	8.18	8.54	7.26	-----	7.41	7.77	7.28	-----
LS D. at 5% for	A=0.238 , B=0.163 , AxB=0.18				A=0.101 , B=0.066 , AxB=0.07			
	Fodder shrubs							
	First harvest (Summer Autumn)							
F.0 (0.0)	10.33	14.50	8.03	10.96	10.15	13.81	7.79	10.58
F.1 (L.)	10.97	15.13	8.33	11.48	10.48	14.48	8.23	11.06
F.2 (M.)	11.50	15.87	8.67	12.01	11.12	14.96	8.27	11.45
F.3 (H.)	11.83	16.10	8.83	12.26	11.73	15.04	8.35	11.70
Mean	11.16	15.40	8.47	-----	10.87	14.57	8.16	
LS D. at 5% for	A=0.238 ,	B=0.234 ,	AxB=0.406		A=0.172 ,	B=0.137 ,	AxB=0.237	
	Second harvest (Winter Spring)							
F.0 (0.0)	9.52	12.73	7.44	9.90	10.04	13.33	7.63	10.33
F.1 (L.)	9.98	13.48	7.80	10.42	10.33	13.83	8.08	10.75
F.2 (M.)	10.45	13.93	8.00	10.79	10.52	14.08	8.17	10.92
F.3 (H.)	11.10	14.43	8.30	11.28	10.83	14.29	8.19	11.10
Mean	10.26	13.64	7.88	-----	10.43	13.89	8.02	-----
LS D. at 5% for	A=0.323 , B=0.169 , AxB=0.29				A=0.108 , B=0.109 , AxB=0.18			

F.0 = Control
F.1= Fertilization Low
F.2= Fertilization Medium
F.3= Fertilization High

C.+Sa. = Conocarpus+Saligna
C.+At. = Conocarpus+Atriplex
C.+Ad.= Conocarpus+Adhatoda

A= Tree and Shrubs
B= Fertilization
AxB = Tree and Shrubs x Fertilization

In addition to, the results were recorded in Table (5) showed that high, medium and low rates of fertilizer a significant increase in the percentage of crude protein content for shrubs (atriplex, saligna and adhatoda) intercropping with conocarpus tree where the high rate of fertilizer was recorded in the first harvest (12.26 & 11.70 %) and the second harvest (11.28 & 11.10 %) compared to the control plants (without fertilization) in the first harvest (10.96 & 10.58 %) and the second harvest (9.90 & 10.33 %) in both growing seasons.

In addition to the results in Table (5) showed that the atriplex shrubs intercropping with conocarpus tree and fertilized with a high rate of NPK had a significant increase in the percentage of crude protein content in the first harvest (16.10 & 15.04 %) and in the second harvest (14.43 & 14.29 %) respectively in both seasons then saligna shrubs

intercropping on conocarpus tree in the first harvest (11.83 & 11.73 %) and the second harvest (11.10 & 10.83 %) compared to adhatoda shrubs intercropping with conocarpus tree in the first harvest (8.83 & 8.35 %) and the second harvest (8.30 & 8.19 %) in both growing seasons (2018/2019 & 2019/2020). This trend was in the two harvests in the two seasons the other treatments occupied on intermediate position between the abovementioned treatments in the two seasons. These results were in agreement with **(Krebs *et.al.* 2007), (Roshdy *et.al.* 2013), (Shetta *et.al.* 2014) and (Bharat *et.al.* 2017**).

Ether Extract content (%)

The results in Table (6) showed that planting conocarpus trees with atriplex shrubs gave the highest ether extract content in the first harvest (5.48 & 5.54 %) and the second harvest (5.36 & 5.43 %) in the first and second seasons followed by planting conocarpus trees with saligna shrubs which were recorded in the first harvest (5.30 & 5.35 %) and the second harvest (5.14 & 5.25 %) in both growing seasons, the lowest ash content was planting conocarpus trees with adhatoda shrubs, which gave in the first harvest (5.13 & 5.17 %) and the second harvest (5.01 & 5.14 %) respectively in the two growing seasons (2018/2019 & 2019/2020).

Table 6. Tree/shrubs ether extract content (%) in response to various tree/shrubs set up and fertilization in both harvests in the two years (2018/2019 & 2019/2020).

Seasons / Treatments	First Season (2018/2019)				Second Season (2019/2020)			
	C.+Sa.	C.+At.	C.+Ad.	Mean	C.+Sa.	C.+At.	C.+Ad.	Mean
Fodder trees								
First harvest (Summer Autumn)								
F.0 (0.0)	5.20	5.37	5.03	5.20	5.32	5.42	5.13	5.29
F.1 (L.)	5.27	5.43	5.13	5.28	5.35	5.56	5.16	5.36
F.2 (M.)	5.33	5.50	5.17	5.33	5.37	5.58	5.19	5.30
F.3 (H.)	5.40	5.60	5.20	5.40	5.37	5.59	5.20	5.39
Mean	5.30	5.48	5.13	-----	5.35	5.54	5.17	-----
LS D. at 5% for	A=0.203,	B=0.094,	AxB=0.109		A=0.007,	B=0.005,	AxB=0.005	
Second harvest (Winter Spring)								
F.0 (0.0)	5.03	5.24	4.90	5.06	5.20	5.35	5.07	5.20
F.1 (L.)	5.13	5.37	4.97	5.16	5.22	5.40	5.13	5.25
F.2 (M.)	5.18	5.40	5.07	5.22	5.29	5.47	5.17	5.31
F.3 (H.)	5.23	5.43	5.10	5.25	5.30	5.50	5.18	5.33
Mean	5.14	5.36	5.01	-----	5.25	5.43	5.14	-----
LS D. at 5% for	A=0.072,	B=0.066,	AxB=0.077		A=0.007,	B=0.005,	AxB=0.005	
Fodder shrubs								
First harvest (Summer Autumn)								
F.0 (0.0)	4.70	2.27	2.07	3.01	4.44	2.22	2.14	2.90
F.1 (L.)	5.00	2.33	2.17	3.17	4.43	2.28	2.20	2.97
F.2 (M.)	5.27	2.50	2.27	3.34	4.51	2.34	2.25	3.03
F.3 (H.)	5.40	2.57	2.40	3.46	4.75	2.48	2.29	3.18
Mean	5.09	2.42	2.23	-----	4.51	2.33	2.22	-----
LS D. at 5% for	A=0.095,	B=0.083,	AxB=0.144		A=0.004,	B=0.031,	AxB=0.055	
Second harvest (Winter Spring)								
F.0 (0.0)	4.43	2.13	1.97	2.49	4.31	2.21	2.05	2.86
F.1 (L.)	4.77	2.20	2.03	3.00	4.41	2.27	2.18	2.95
F.2 (M.)	5.00	2.27	2.13	3.13	4.47	2.30	2.20	2.99
F.3 (H.)	5.10	2.37	2.23	3.23	4.50	2.35	2.27	3.04
Mean	4.83	2.24	2.09	-----	4.42	2.28	2.17	-----
LS D. at 5% for	A=0.062,	B=0.063,	AxB=0.109		A=0.036,	B=0.031,	AxB=0.054	

F.0 = Control
F.1= Fertilization Low
F.2= Fertilization Medium
F.3= Fertilization High

C.+Sa. = Conocarpus+Saligna
C.+At. = Conocarpus+Atriplex
C.+Ad.= Conocarpus+Adhatoda

A= Tree and Shrubs
B= Fertilization
AxB= Tree and Shrubs x Fertilization

The data in Table (6) also, showed that all rates of NPK fertilizer were high (90:60:30 NPK kg fed^{-1}), medium (60:40:20 NPK kg fed^{-1}) and low (30:20:10 NPK kg fed^{-1}) had increase in ether extract content of all conocarpus trees planted with shrubs (saligna, atriplex and adhatoda) where the high rate of fertilizer was recorded in the first harvest (5.40 & 5.39 %) and the second harvest (5.25 & 5.33 %) followed by the medium and then the low rate of fertilizer compared to the control plants (without fertilizer) which were given in the first harvest (5.20 & 5.29 %) and the second harvest (5.06 & 5.20 %) in the two study seasons (2018/2019 & 2019/2020) respectively. In addition to, the results presented in Table (6) showed that an increase in the ether extract content of conocarpus trees planted with atriplex shrubs and fertilized at high rates in the first harvest (5.60 & 5.59 %) and the second harvest (5.43 & 5.50 %) during the two study seasons (2018/2019 & 2019/2020).

While the results in Table (6) showed that the conocarpus tree planted with adhatoda shrub and fertilized at a low rate had the lowest increase in ether extract content in the first harvest (5.13 & 5.16 %) and the second harvest (4.97 & 5.13 %) compared to the control plants that were not fertilized during the two study seasons (2018/2019 & 2019/2020) respectively.

Also, the results in Table (6) showed that the grown of saligna shrubs planted under conocarpus trees gave the highest ether extract content as it gave in the first harvest (5.09 & 4.51 %) and the second harvest (4.83 & 4.42 %) in the first and second seasons respectively followed by the grown of the planted atriplex shrubs with conocarpus trees, which were recorded in the first harvest (2.42 & 2.33 %) and the second harvest (2.24 & 2.28 %) in both growing seasons. The lowest ether extract content of adhatoda shrubs planted with conocarpus trees was given in the first harvest (2.23 & 2.22 %) and the second harvest (2.09 & 2.17 %) during the two growing seasons (2018/2019 & 2019/2020) respectively .

The data in Table (6) also, showed that all NPK fertilizer rates were high (90:60:30 NPK kg fed^{-1}), medium (60:40:20 NPK kg fed^{-1}) and low (30:20:10 NPK kg fed^{-1}) had an increase in ether extract content was recorded for all shrubs (saligna, atriplex and adhatoda) planted under conocarpus trees, where the high rate of fertilizer was recorded in the first harvest (3.46 & 3.18 %) and the second harvest (3.23 & 3.04 %) followed by the medium rate of fertilizer and then the low rate of fertilizer compared to the control (without fertilizer), which was recorded in the first harvest (3.01 & 2.90 %) and the second harvest (2.49 & 2.86 %) in the two study seasons (2018/2019 & 2019/2020) respectively.

In addition to, the results presented in Table (6) showed that planting saligna shrubs under conocarpus trees with high fertilizer rates increased the ether extract content was given in the first harvest (5.40 & 4.75 %) and in the second harvest (5.10 & 4.50 %) in the first and second seasons under study (2018/2019 & 2019/2020). While the results in Table (22) show that the adhatoda shrub planted under the conocarpus tree and fertilized at low rate had the lowest increase in ether extract content, while it was recorded in the first harvest (2.17 & 2.20 %) and the second harvest (2.03 & 2.17 %) during the two study seasons in comparison with the control plants that were not fertilized. These results were in harmony with **(Krebs *et.al.* 2007), (Roshdy *et.al.* 2013) , (Shetta *et.al.* 2014) and (Bharat *et.al.* 2017).**

Carbohydrates content (%)

The results in Table (7) showed that conocarpus tree intercropping with adhatoda shrubs gave the highest of total carbohydrate content in the first harvest (59.40 & 59.12 %) and the second harvest (59.47 & 59.08 %) in the first and second seasons respectively followed by conocarpus tree intercropping with saligna shrubs in the first harvest (56.84 & 56.93 %) and the second harvest (56.11 & 57.61 %) in both growing seasons and the lowest in total carbohydrate content were the conocarpus tree intercropping with atriplex shrubs in the first harvest (55.54 & 56.79 %) and the second harvest (55.97 & 56.92 %) respectively in both growing seasons (2018/2019 & 2019/2020).

While the data in Table (7) showed that all rates of NPK fertilizer were high (90:60:30 NPK kg fed^{-1}), medium (60:40:20 NPK kg fed^{-1}) and low (30:20:10 NPK kg fed^{-1}) no increase was recorded in the total carbohydrate content of all conocarpus tree intercropping with shrubs (saligna, atriplex and adhatoda) where the high rate of fertilizer was given in the first harvest (56.96 & 57.31 %) and the second harvest (57.30 & 57.80 %) compared to the control (without fertilization) which was given in the first harvest (57.77 & 58.12 %) and the second harvest (57.21 & 58.13 %) in both growing seasons (2018/2019 & 2019/2020) respectively.

In addition to the results in Table (7) showed that conocarpus tree intercropping with atriplex shrubs and fertilized at high, medium and low rates did not show an increase in the total carbohydrate content of the first and second harvests compared to the unfertilized control plants in the first and second harvests in both growing seasons (2018/2019 & 2019/2020).

The results in Table (7) also showed that adhatoda shrubs intercropping with conocarpus tree had the highest increase in total carbohydrate content for the first and second harvests respectively followed by atriplex shrubs intercropping with conocarpus tree in the first and second harvests, in both growing seasons (2018/2019 & 2019/2020).

Table 7. Tree/shrubs total carbohydrates content (%) in response to various tree/shrubs set up and fertilization in both harvests in the two years (2018/2019 & 2019/2020).

Seasons	First Season (2018/2019)				Second Season (2019/2020)			
Treatments	C.+Sa.	C.+At.	C.+Ad.	Mean	C.+Sa.	C.+At.	C.+Ad.	Mean
	Fodder trees							
	First harvest (Summer Autumn)							
F.0 (0.0)	57.16	56.30	59.86	57.77	57.30	57.74	59.32	58.12
F.1 (L.)	56.93	55.34	59.54	57.28	56.94	56.71	58.83	57.49
F.2 (M.)	56.79	55.28	58.94	57.04	56.78	56.45	59.36	57.51
F.3 (H.)	56.49	55.26	59.05	56.96	56.69	56.25	58.99	57.31
Mean	56.84	55.54	59.40	-----	56.93	56.79	59.12	-----
LS D. at 5% for	A=0.613,	B=0.521,	AxB=0.602		A=0.762,	B=0.583,	AxB=0.673	
	Second harvest (Winter Spring)							
F.0 (0.0)	56.40	55.82	59.42	57.21	57.70	57.30	59.39	58.13
F.1 (L.)	55.98	56.03	59.44	57.15	57.48	57.06	59.03	57.85
F.2 (M.)	55.87	55.96	59.36	57.07	57.27	56.71	59.07	57.68
F.3 (H.)	56.17	56.08	59.63	57.30	57.98	56.60	58.82	57.80
Mean	56.11	55.97	59.47	-----	57.61	56.92	59.08	-----
LS D. at 5% for	A=0.775,	B=0.244,	AxB=0.282		A=0.878,	B=0.348,	AxB=0.402	
	Fodder shrubs							
	First harvest (Summer Autumn)							
F.0 (0.0)	56.60	56.41	68.03	60.33	52.88	56.96	62.37	57.41
F.1 (L.)	56.10	56.17	67.60	59.96	52.50	55.34	61.97	56.60
F.2 (M.)	55.09	55.20	67.33	59.21	51.87	55.72	61.96	56.52
F.3 (H.)	54.53	54.47	67.47	58.83	51.12	56.74	62.08	56.65
Mean	55.57	55.56	67.61	-----	52.09	56.19	62.10	-----
LS D. at 5% for	A=0.271,	B=0.531,	AxB=0.921		A=0.196,	B=0.680,	AxB=1.177	
	Second harvest (Winter Spring)							
F.0 (0.0)	57.24	58.53	68.73	61.50	53.42	57.70	62.83	57.98
F.1 (L.)	56.54	57.35	68.07	60.65	52.87	57.24	62.64	57.59
F.2 (M.)	55.12	56.94	67.47	59.84	52.98	57.10	62.68	57.59
F.3 (H.)	54.87	56.40	67.37	59.54	52.96	56.83	62.82	57.54
Mean	55.94	57.31	67.91	-----	53.06	57.22	62.74	-----
LS D. at 5% for	A=0.667,	B=0.318,	AxB=0.551		A=0.143,	B=0.125,	AxB=0.217	

F.0 = Control **C.+Sa. = Conocarpus+Saligna** **A= Tree and Shrubs**
F.1= Fertilization Low **C.+At. = Conocarpus+Atriplex** **B= Fertilization**
F.2= Fertilization Medium **C.+Ad.= Conocarpus+Adhatoda** **AxB = Tree and Shrubs x Fertilization**
F.3= Fertilization High

In addition to, the results in Table (7) did not record any increase in the total carbohydrates content of plants fertilized with high, medium and low rates of fertilizer compared to the control (unfertilized plants) in the first and second harvests in both seasons (2018/2019 & 2019/2020). The results in Table (23) also showed that the atriplex shrubs intercropping with conocarpus tree and fertilized with a high rate of NPK were the lowest treatments under study in the absence of an increase in the total carbohydrate content compared to the other treatments and control in the first and second harvests for both seasons of the study (2018/2019 & 2019/2020). These results were in agreement with **(Krebs *et.al.* 2007)**, (**Roshdy *et.al.* 2013)**, (**Shetta *et.al.* 2014) and (Bharat *et.al.* 2017).**

Conclusion

The study recommended that using (90:60:30 NPK kg fed^{-1}) with conocarpus tree intercropped with Acacia saligna for producing the highest values of vegetative growth, yield, yield components and chemical constituents.

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التقييم الكمي والنوعي لأعلاف غير تقليدية لأشجار كينوكاربس

مع شجيرات ساليجنا وآتربلكس وأدهاتودا تحت مستويات تسميد (NPK)

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قسم المحاصيل – كلية الزراعة – جامعة بنها

أجريت التجربة في مزرعة البحوث والتجارب الزراعية بكلية الزراعة بمشتهر جامعة بنها خلال موسمي (2020/2019&2019/2018) ، بهدف تقييم قياسات النمو والإنتاجية المحصولية والمحتوى الكيماوى لأشجار كينوكاربس المنزرعة مع شجيرات ساليجنا وآتربلكس وأدهاتودا تحت ثلاث معدلات تسميد هي، عالي (90:60:30 كجم NPK/فدان)، متوسط (60:40:20 كجم NPK/فدان)، منخفض (30:20:10 كجم NPK/فدان) بالإضافة للكنترول (بدون تسميد) خلال موسمي الدراسة.

ويمكن تلخيص أهم النتائج المتحصل عليها في الآتي

– **طول النبات:** سجلت زراعة أشجار كينوكاربس مع شجيرات أتربلكس أعلي إرتفاع لاشجار كينوكاربس ثم كينوكاربس مع شجيرات ساليجنا وكان أقلهم زراعة كينوكاربس مع شجيرات أدهاتودا كما سجلت زراعة شجيرات ساليجنا المنزرعة مع أشجار كينو كاربس أعلي إرتفاع لشجيرة ساليجنا تلتها شجيرات أتربلكس ثم شجيرات أدهاتودا المنزرعة مع أشجار كينو كاربس كما أشارت النتائج الى حدوث زيادة فى إرتفاع النبات نتيجة إستخدام معدلات التسميد المرتفعة أيضا نتج عن تأثير التفاعل بين زراعة أشجار كينوكاربس مع شجيرات (ساليجنا وآتربلكس وأدهاتودا) مع التسميد بالمستوي الثالث من التسميد أعلي أرتفاع للنبات بالمقارنة بباقي المعاملات في كلا موسمي الدراسة.

– **المحصول الطازج والجاف للعشب لكل فدان:** أشارت النتائج المتحصل عليها الى أن الزيادة في الوزن الطازج والجاف للعشب/فدان نتجت من إستخدام معدلات التسميد المرتفع من المخلوط السمادي (NPK) كما نتج عن تأثير التفاعل بين زراعة أشجار كينوكاربس مع شجيرات (ساليجنا وآتربلكس وأدهاتودا) ومستوي التسميد المرتفع أعلي وزن طازج وجاف للعشب لكل فدان في الحصاد الاول والثاني في كلا موسمي الدراسة.

– **قياسات المحتوي الكيماوي:** أوضحت النتائج المتحصل عليها الى أن إستخدام معدلات التسميد المرتفع من المخلوط السمادي سبب زيادة معنوية في محتوي النبات من البروتين الخام ومستخلص الأثير والكربوهيدرات كما سجلت زراعة أشجار كينوكاربس مع شجيرات أتربلكس أعلي نسبة من البروتين الخام ومستخلص الأثير والكربوهيدرات والرماد كما سجلت شجيرات ساليجنا المنزرعة مع أشجار كينوكاربس أعلي نسبة من البروتين الخام ومستخلص الأثير والكربوهيدرات كما أشارت النتائج الى زيادة فى نسبة البروتين الخام ومستخلص الأثير والكربوهيدرات عند التسميد بمخلوط السماد المرتفع كذلك أعطت معاملات التفاعل بين زراعة أشجار كينوكاربس مع شجيرات أتربلكس المسمدة بالمستوي المرتفع أعلي نسبة من البروتين الخام ومستخلص الأثير والكربوهيدرات بالمقارنة بباقي المعاملات تحت الدراسة خلال موسمي الدراسة.

توصي الدراسة بإستخدام المستوي العالي من التسميد من المخلوط السمادي (90:60:30 كجم NPK/فدان) بهدف الحصول علي أعلي إنتاجية من العشب الطازج والجاف لكل فدان كذلك محتوي كيماوي مرتفع لأشجار كينوكاربس وشجيرات ساليجنا وآتربلكس لإستخدامها كأعلاف غير تقليدية لتقليل الفجوه العلفية في نقص الأعلاف الحيوانية.