EVALUATING PRODUCTIVITY OF SOME FORAGE CROPS UNDER DIFFERENT IRRIGATION INTERVALS IN NEWLY RECLAIMED SOILS

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Abstract

Regarding to thesoil and water resources is limited, so we cultivate forage crops in new reclaimed soil with methods need low in water like foliar irrigation. Fieldexperiment was conducted during 2013/2014 and 20158 seasons was aimed to evaluate productivity of some forage crops i.e. two forage grasses and alfalfa as a control was tested under different irrigation intervals *i.e.* 5, 10, 15 and 20 days**.** The results clearly indicated thatRhodes grass had superior performance for all agronomic characters comparing with other genotypes and Blue panic grass had highest values of protein contentduring fives cuts.The results revealed that irrigation every five days significantly exceededchlorophyll, leaf area /plant, plant height, average of number of stem/m^2, forage green and dry matter yield/fed water use efficiency, crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages and yield/fed.The results showed that highest values of leaf area/plant, plant height, average of number of stem/m^2, forage green and dry matter yield/fed, crude protein, crude fiber, ether extract, ash content and nitrogen free extract were obtained from planting Rhodes grass. It could be concluded that highest values of water use efficiency, crude fiber and nitrogen free extract percentages were produced from sowing Rhodes grass.

1. Introduction

Egypt, like other developing countries located in the arid and semi-arid regions, faces four major problems namely: (i) high rate of population increase (ii) limited natural resources of good quality water, (iii) existence of salt affected soil and (iv) shortage of food and feed **(Ashour et al.,1994).** In Egypt, soil and water resources is limited, so we cultivate forage crops in new reclaimed soil with methods need low in water like foliar irrigation. Water use efficiency (WUE) depends on the amount of water available in the soil, plus the amount of water that enters the soil. Species with greater plant root depth can access more water, and others are more efficient at converting available water into plant dry matter. If the overall goal of a pasture system is to maximize the production from each millimeter of water, then species with deep plant roots and high WUE are desired**.**

New forage crops such as Rhodes grass *Chloris gayana*Kunthand Blue panic grass *Panicumantidotale* Retz. are an important tropical grass widespread in tropical and subtropical countries. It is a useful forage for pasture and hay, drought-resistant and very productive, of high quality when young **(Heuzé *et al.* (2015).** It is native in east, central and southern Africa where it occurs in open grasslands, but it can be found throughout the tropical and subtropical world as a naturalized species **(Cook *et al.* ,2005 and FAO, 2013)**. Rhodes grass is high drought and salt tolerant **(Moore *et al.*, 2006).**

Rhodes grass pastures endure for more three years, due to a combination of stresses. It resumes active growth in early spring, and grows opportunistically throughout summer depending on moisture availability. Rhodes grass very tolerant to low fertility, cutting or grazing and weed control. The stand should be maintained in a leafy condition by fairly regular cutting/slashing or grazing, as the feeding value declines rapidly with onset of flowering *i.e.* going into the mature stage **(Cook *et al.*, 2005 and FAO, 2013).** Too frequent cutting or overgrazing leads to production losses and stand decline. Rhodes grass makes good hay if cut at or just before very early flowering (20-30 cm tall).

Blue panic (*Panicumantidotale*, Retz.) is a native of Southeast Asia. It is a robust and shortly rhizomatous perennial grass that grows up to 1.5 m with very deep root system **(Jacobs and Wall, 1993).** It is an excellent sand binder and prefers arid and semi-arid conditions **(Cope, 1982)**. Blue panic has ability to withstand a variety of climatic conditions including severe environmental stresses like drought and salt stress **(Ahmad et al., 2010).** It can tolerate

salinity up to 15,000 mg L-1 and drought, using almost 50% less water than alfalfa. Blue panic is an ideal fodder grass because of its high protein contents (15-18%) **(Bokhari et al., 1988).**

Lucerne *Medicago sativa* L. is the main forage crop for ruminants, especially in temperate countries and its protein value might be reduced by nitrogen losses that occur during extensive rumen degradation. The diversity in the nutritive value of different feedstuffs need some easy and efficient method of them nutritional evaluation; therefore, some alternative laboratory methods are required.

Keftasa (1990) found that lucerne produced forage of high (crude protein) CP, low fibers, high organic matter digestibility (OMD), K, Mg, Ca and high lignin at all stages of growth and the minimum levels of CP & OMD reached due to advance in maturity were significantly higher than those of Rhodes grass. He added that maturity stage at cutting is the most important factor which determines the quality of Rhodes grass pasture and cutting at 10-50% heading or about 50 days regrowth period can be recommended. **Haffar and Alhadrami (1997)** summarized that it is recommended to store Rhodes grass hay at moistures up to 30% and even higher in the summer season in the case of variety Alimba.

Higher moisture contents at baling could preserve hay quality by minimizing shattering of leaves excessively dried under the prevailing haymaking conditions, especially in the variety Pioneer. Lower DM and CP contents in variety Pioneer suggest that this variety is more sensitive to over drying at baling and the possible occurrence of leaf shattering. **Homolka et al. (2008)** concluded that, although limited in the sample size, this report presents information on the decrease in amino acid contents and intestinal amino acid digestibility as growth proceeds in lucerne (var. Palava) produced in the Czech Republic, which could be utilized in the feeding of ruminants.

Hanson et al. (2008) reported that deficit irrigation reduced ET (Evapotranspiration) but the ET difference between fully-irrigated and deficit-irrigated alfalfa was site specific. Yields were reduced by deficit irrigation. **Shahbaz et al. (2011)** showed a significant reduction in plant fresh and dry biomass, chlorophyll pigments, photosynthetic and transpiration rates, while an increase in shoot N, P, K^+ and root K^+ was observed under water deficit conditions.

Elnazier-Sanaa (2010) stated that fresh and dry yields increased with deceased irrigation interval and seed rate. The protein content increased with decreased seed rate and increased irrigation interval. The fiber content increased with the increased seed rate and the longest irrigation interval.

Bakhashwain (2010) concluded that the lowest dry matter percentage was also observed for alfalfa sown alone, with high significant differences with all other sowing ratios. The crude protein (CP) (%), crude fiber (CF) (%) and ash contents (%) were significantly affected by the different sowing ratios. Alfalfa fodder (100%) contained the highest crude protein content (17.17%), and ash % (10.0%), while the highest crude fiber (%) was produced from the mixture of 75% and 100% Rhodes grass with values of 17.99% and 17.3% respectively.

Regarding to dry foragechemical content, **Bakhashwain et al. (2010)** found that alfalfa had the highest crude protein (CP) content but blue panic had the lowest CP content. The neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were higher in blue panic, canary grass, millet and alfalfa, while the moringa leaves showed the lowest content of the fiber constituents.

Arshadullah et al. (2009) found that fresh biomass production was highest in Blue panic followed by Finger grass during spring season. Dry matter yield was also higher in Blue panic than other grasses during spring 2006. In Monsoon season, more fresh biomass was produced by Finger grass followed by Vetiver grass and Pangola grass and more dry matter production by Finger grass followed by Vetiver grass. Buffel grass had the highest crude protein contents (9.24 %) along with highest total digestible nutrients (54.51%). Blue panic grass and Digitaria grass are recommended for semi-arid conditions of Kharian range.

Al-Soqeerand Al-Ghumaiz (2012) reported that a significant effect for cuts, irrigation intervals and plant species on all on agronomic characters and some quality traits. Expanding irrigation intervals decreased irrigation intervals all agronomic characters and fiber content significantly, while ash**,** crude protein andether extractwere increased significantly**.** Rhodes grass had superior performance for all agronomic characters comparing with other genotypes. Blue panic grass had highest values of protein content**.**In addition**, Garg et al. (2012)** reported that chemical composition and energy values reported for various feed and fodders in this

communication could be used for formulating ration of field animals and under farm conditions for better utilization of these commonly available feed resources.

Water use efficiency (WUE) is best used to compare the relative efficiency of different species to produce plant dry matter at the same site each year. **Marais et al. (2006)** reported that water use efficiency (WUE) is a way to evaluate plant species in terms of their ability to produce with a certain amount water available. There are many factors affectingWUE, including the type of plant/plant community, soil type, soil depth, climatic conditions, frequency and intensity of watering and utilization practices.

Lawrence et al. (2008) and Owens et al. (2008) concluded that there was strongerresponse in grass speciesdry matter yield to irrigation treatment. They added that water use efficiency for 4 of the species *i.e.* Rhodes grass, buffel grass, butterfly pea and annual lablab was measured. **Al-Solaimani et al. (2009)** results revealed that decreasing irrigation interval ceased increasing forage yield and yield components of dry forage yield /ha. As irrigation interval increased from 4 to 6 to 8 days dry forage yield decreased from 11.4 to 10.3 to 9.27 t/ha, respectively. The interaction between irrigation intervals and sulphur rates had significant effects on dry forage yield. **Al-Soqeerand Al-Ghumaiz (2012)** reported thatwater use efficiency (WUE) as a result of decreasing the volume of irrigation.Protein content of the grasses tended to be more affected by amount water available.

2. Materials and Methods

This experiment aimed to evaluate productivity of some forage crops i.e. two forage grasses and alfalfa as a control was tested under different irrigation intervals. Three experiments were laid out in randomized complete block design with four replications. Each irrigation interval treatment was applied in a separate experiment and then combined statistical analysis for irrigation intervals experiments was done. Each experiment included three treatments:

1-Rhodes grass (*Chloris gayana*, Kunth)

2-Blue panic grass (*Panicumantidotale*, Retz.)

3-Alfalfa (*Medicago sativa*, L).

The three crops under study *i.e.* Rhodes grass, Blue panic grass and alfalfa were subjected to different water irrigation regimes. Sprinkler irrigation intervals included four irrigation

intervals *i.e.* 5, 10, 15 and 20 days. Plastic sheet put horizontally at depth 100 cm in soil between the irrigation treatments to prevent irrigation water movement. The normal cultural practices for growing Rhodes grass, blue panic grass and alfalfa were followed except the factors under study. During 2013/2014 season five cuts were studied and green fodder determined. Data was subjected to statistical analysis and means compare using LSD test at 5% level according to **Gomez and Gomez (1984).**The following data were collected in each cut in the three experiments:

1-Total chlorophyll (SPAD): Total chlorophyll (SPAD): Chlorophyll content in random samples of leaves was assessed by SPAD-502 (Minolta Co. Ltd., Osaka, Japan).

2-Number of stems per/m^2: Number of stems per plant counted per sample i.e. 0.25 m^2 and then transferred to number of stems/m^2.

3-Plant height (cm): Ten stems was taken at random from each plot. Stem length will be measured from base of stem till its end.

4-Leaf area/plant in cm^2 was measured using Field Portable Leaf Area Meter AM-300 (Bio-Scientific, Ltd., Great Am well, Herefordshire, England).

5-Forage green yield per faddan: Two random samples taken using a square wooden frame 100×100 cm from each plot. Samples cut by sickle at about 3 cm height from soil surface and then weighted. Mean weight per square meter calculated then transformed as forage yield/feddan.

6-Forage dry matter yield/feddan: Two random samples of known weight (100 gm) taken from each plot. These samples dried at 70 ˚ C for 24 hr and then at 105˚ C till reached a constant weight. The dry matter yield/feddan calculated using the following equation:

Dry matter yield/feddan = (Green yield per feddan) × (known weight of dry sample) ÷ (known weight of green sample).

7-Water use efficiency (WUE): Water use efficiency (kg/m^3) according to **Wright, 1988**. The consumed water (m^3/ha) was estimated as follows:

Consumed Water (m^3/ha) = (Moisture percentage in field capacity- soil moisture percentage) X root depth X Soil bulk density (1.76) X 10000

$$WUE = \frac{Total\ \ yield\ \ (kg/ha)}{Consumed\ \ water\ \ (m^3/ha)}$$

8-Crude protein (CP): The wet ash will have prepared and nitrogen be determined calorimetrically in the acid digest using the method recommended by **Kock and McMeekin (1924)**. Then crude protein percent was calculated by multiplying total nitrogen percent X 6.25 as described by Bolton (1962). Moreover, crude protein in kg/faddan was calculated by multiplying crude protein percent X dry matter yield in kg/faddan.

9-Ether extract (EE): Soxhelt apparatus was used for determination of ether extract percent, heating by electric heater; cold water at 80^{o} C was used through the condenser Ethyl ether that preferred for extraction which continued for not less than 8 hrs. (rate of siphoning is six per hr.) These methods are recommended by official and tentative methods of American Oil Chemists (2000). Moreover, ether extract in kg/faddan was calculated by multiplying ether extract percent X yield of dry matter in kg/faddan.

10- Crude fiber (CF): The usual Weende method was used for determination of fiber percent; boiling for 30 min took place in a suitable beaker under reflux. Filter medium is a suitable filter paper (corrugated and both acid and alkali resistant) be fitted into suitable Buckner flask attached to vacuum pump. Final washing after NaOH treatment was hot water, 5% HCl, hot water, alcohol and ether. Suction will be continued till almost dry, then the residue was quantitatively transformed out of the filter paper into a suitable crucible by gentle tapping and using a suitable brush. Drying at 105^{o} C before ashing in the usually way. Moreover, crude fiber in Kg/faddan was calculated by multiplying crude fiber percent X yield of dry matter in Kg/faddan.

11- Ash content: A 5 grams of dry matter was burned in a muffle furnace at 600^{o} C for four hrs. and then ash percent was calculated. Moreover, ash in Kg/faddan was calculated by multiplying ash content X yield of dry matter in Kg/faddan.

12- Nitrogen free extracts (NFE): It was calculated by using the following equation: Nitrogen free extract = 100 – (crude protein percent + crude fiber percent + ether extract percent + ash percent). Then, amounts per faddan was calculated by multiplying nitrogen free extract X yield of dry matter in Kg/faddan.

3. Results and Discussion

3.1. *Cuttings effect:*

The results presented in Table (1) clearly indicated that total chlorophyll, leaf area/plant (cm^2), plant height (cm), average of number of stem/cm^2, forage green and dry matter forage

yield/fedsignificantly differed due to cuttings during 2013/2014 and 2014/2015 seasons. The results showed that highest total chlorophyll and Plant height were produced from the five cut, which were 14.33 and 43.47 cm, respectively. Highest values of leaf area/plant (cm^2) and number of stem/cm^2 were produced from the first cut, which were 15.09 and 205.1 stems/m^2, respectively.

In addition, highest forage green and dry matter yield/fed was obtained the fourth cut, which were 1708.8 and 1084.1 Kg/fed, respectively. However, the lowest values of total chlorophyll, leaf area/plant (cm^2), plant height (cm) and number of stem/cm^2 were produced from the third cut, which were 13.82, 13.83, 40.11 and 193.9, respectively. Moreover, the lowest forage green and dry matter yield/fed were recorded the first cut, which were 1539.3 and 1017.4 Kg/fed, respectively. The results in Table 2 showed that crude protein significantly differed by cuts the first cut recorded highest crude protein percentage, which was 14.36%.

Al-Soqeerand Al-Ghumaiz (2012) reported that a significant effect for cuts, irrigation intervals and plant species on all on agronomic characters and some quality traits. Expanding irrigation intervals decreased irrigation intervals all agronomic characters and fiber content significantly, while ash**,** crude protein andether extractwere increased significantly**.** Rhodes grass had superior performance for all agronomic characters comparing with other genotypes. Blue panic grass had highest values of protein content**.** The results in Tables 2 and 3 indicated that water use efficiency, crude fiber %, ether extract %, ash percentage and nitrogen free extract, crude fiber yield/fed, ether extract yield/fed, ash yield/fed and nitrogen free yield/fed insignificantly affected by different cuts.

Osman (1979) suggested that buffel grass, Rhodes grass, bambatsi panic grass, and green panic grass harvested at 4-week intervals would be the best choice for production of nutritious forage on irrigated pastures in the semiarid region. The former two species can even be harvested at a shorter interval of 2 weeks to secure a relatively higher CP percentage of the forage, but with moderate yields. **Al-Soqeer and Al-Ghumaiz (2012)** showed that a significant effect for cuts, irrigation intervals and plant species on all studied agronomic characters. Water use efficiency (WUE) as a result of decreasing the volume of irrigation.Protein content of the grasses tended to be more affected by amount water available.

3.2. *Irrigation intervals effect:*

Alfalfa *Medicago sativa* L. could be considered the most used forage legume in the middle east because of its high yield, excellent feeding value for ruminants and relatively long persistence especially in fertile, well drained soils. The results in Table (1) showed that irrigation intervals significantly affected total chlorophyll, leaf area in cm^2, plant height, average of number of stem/m^2, forage green and dry matter yield/fed.

The results revealed that irrigation every five days significantly exceeded total chlorophyll, leaf area /plant, plant height, average of number of stem/m^2, forage green and dry matter yield/fed which were 18.80, 23.61, 72.64, 320.7,3242.0 and 2103.0, respectively. However, irrigation every 20 days recorded the lowest total chlorophyll, leaf area /plant, plant height, average of number of stem, forage green and dry matter yield/fed, which were 10.87,8.30,20.34, 111.1, 468.0 and 315.5, respectively.

Tag EI Din and Assaeed (1995) found that expanding water irrigation intervals decrease forage fresh yield (FFY), forage dry yield (FDY), dry matter percentage (DM%), crude protein percentage (CP%) and crude protein yield (CPY). **Lawrence et al. (2008) and Owens et al. (2008)** concluded that there was strongerresponse in grass speciesdry matter yield to irrigation treatment. They added that water use efficiency for 4 of the species *i.e.* Rhodes grass, buffel grass, butterfly pea and annual lablab was measured.

Harmoney et al. (2013) investigated the effects of a subsurface drip irrigation system at three levels of water inputs *i.e.* 70, 85, and 100% of plant evapotranspiration rates (ETr) on resulting alfalfa production and nutritive value. They conclude that alfalfa can be irrigated with subsurface drip systems at 70 or 85% ETr without sacrificing yield or forage nutritive value.

Al-Soqeer and Nasser Al-Ghumaiz (2011) showed significant effects for cuts, irrigation intervals and species on all agronomic characters and some quality traits. The results in Table 2 indicated that water use efficiency, crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages significantly affected by irrigation treatments. The results revealed that irrigation every five days significantly exceeded water use efficiency, crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages, which were 8.64, 13.94, 23.39, 1.93, 10.82,49.90%, respectively.

However, irrigation every 20 days recorded the lowest values of water use efficiency, crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages, which were 1.25, 14.41, 23.90, 2.01, 10.72 and 49.92%, respectively. Efficient use of water

resources can be made possible through the assessment of crop water requirements and proper scheduling of irrigation.

In this respect, **Ali et al. (2007)** stated that temporal prediction of soil moisture and evapotranspiration (ET) plays a crucial role in irrigation water management. **Kamel et al. (2012)** demonstrated that optimal irrigation scheduling requires accurate estimates of crop evapotranspiration (ETc).

Hussein and Sabbour (2014) studied different irrigation intervals *i.e.* 7, 10, 13 and 16 days on yield of sorghum for fodder and stated that irrigation affected significantly the FMY in the 1st as well as 2nd seasons; however, the differences in the 2nd season were not significant. They added that the highest positive effect on fresh yield under 7 days intervals.

In addition, results in Table 3 indicated that water use efficiency, crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages significantly affected by irrigation treatments. The results revealed that irrigation every five days significantly exceeded crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages yields/fed, which were 27.4, 521.13, 40.25, 219.20 and 1057.40 Kg/fed, respectively.

However, irrigation every 20 days recorded the lowest values of crude protein, crude fiber, ether extract, ash content and nitrogen free extract yield/fed, which were6.5, 7.83, 3.10, 2.65 and 17.74 Kg/fed, respectively. Increasing irrigation interval decreased all agronomic characters and fiber content significantly. There was a stronger response in grasses species dry matter yield to irrigation treatment. Rhodes grass (Katambora cultivar) had superior performance for all agronomic characters comparing with other genotypes.

Al-Soqeer and Al-Ghumaiz (2012) showed that a significant effect for cuts, irrigation intervals on all studied agronomic characters. Expanding irrigation interval decreased all agronomic characters. There was a stronger response in grasses species dry matter yield to irrigation treatment. Rhodes grass had superior performance for all agronomic character comparing with other genotypes.

Moreover,**Abusuwar and KaramEldin (2013)** pointed out that irrigation every two days resulted in a significantly higher plant density, higher number of leaves per plant and higher fresh and dry yields compared to the longer irrigation interval (irrigation every 6 days). **Khattak and Naveed (2013)** stated that a longer irrigation interval of 15 days was found to be beneficial for increasing fodder yield and dry matter fodder yield.

3.3. *Forage species effect:*

The results in Table (1) clearly indicated that forage species significantly differed in total chlorophyll, leaf area/plant, plant height, average of number of stem/m^2, forage green and dry matter yield/fed.Highest values of total chlorophyll was obtained from sown alfalfa, which was 15.76. whereas, the lowest values of total chlorophyll were produced from Blue panic grass (12.32).The results showed that highest values of leaf area/plant, plant height, average of number of stem/m^2, forage green and dry matter yield/fed were obtained from planting Rhodes grass, which were 18.80, 54.05, 296.9, 2288.0 and 1501.0, respectively.

The results indicated that sowing alfalfa produced the lowest values of leaf area/plant, plant height, average of number of stem/m^2, forage green and dry matter yield/fed., which were 10.84, 32.92, 108.3, 892.2 and 580.1, respectively. Lucerne is the most widely used forage crop and main source of protein in the world. It produces more protein per unit area as compared to other forage crops, characterized by high content of minerals and vitamins, resistance to drought, and when the moisture was restored, its growth activated. Blue panic (*Panicumantidotale*, Retz.) is a native of Southeast Asia. It is a robust and shortly rhizomatous perennial grass that grows up to 1.5 m with very deep root system **(Jacobs and Wall, 1993).**

It is an excellent sand binder and prefers arid and semi-arid conditions **(Cope, 1982)**. Blue panic has ability to withstand a variety of climatic conditions including severe environmental stresses like drought and salt stress **(Ahmad et al., 2010).** It can tolerate salinity up to 15,000 mg L-1 and drought, using almost 50% less water than alfalfa. Blue panic is an ideal fodder grass because of its high protein contents (15-18%) **(Bokhari et al., 1988).** Rhodes grass *Chloris gayana*Kunth is an important tropical grass widespread in tropical and subtropical countries.

It is a useful forage for pasture and hay, drought-resistant and very productive, of high quality when young **(Heuzé *et al.* (2015).** It is native in east, central and southern Africa where it occurs in open grasslands, but it can be found throughout the tropical and subtropical world as a naturalized species **(Cook *et al.* ,2005 and FAO, 2013)**.

Table 1: Averages of total chlorophyll (SPAD), leaf area (cm^2), plant height (cm), number of stems/m^2, forage green and dry matter yield/fed as affected by cuttings, irrigation intervals, forage species and their interactions for the five cuts during 2013/2014 and 2015 seasons.

Treatments	Total chlorophyll (SPAD)	leaf area/plant (cm^2)	Plant height (cm)	Number of stems/m^2	Forage green yield kg/fed	Dry matter yield kg/fed
C- Cuttings effects:						
1st cut	13.81	15.94	42.89	205.1	1537.9	1017.4
2nd cut	13.80	14.49	41.76	200.1	1560.8	1038.5
3rd cut	13.82	13.83	40.11	193.9	1546.7	1028.4
4th cut	14.30	15.57	43.24	202.4	1708.8	1084.1
5th cut	14.33	15.62	43.47	202.4	1687.3	1101.7
LSD at 5 %	0.18	0.26	1.0	2.3	4.8	9.1
I-Irrigation intervals:						
Every 5 days	18.80	23.61	72.64	320.7	3242.0	2103.0
Every 10 days	14.86	16.36	45.47	227.3	1789.2	1146.0
Every 15 days	12.82	11.41	30.73	144.1	983.9	652.4
Every 20 days	10.87	8.30	20.34	111.1	468.0	315.5
LSD at 5 %	0.17	0.23	0.77	0.9	5.1	8.1
F- test of C×I	*	*	*	*	*	*
F. Forage species:						
Alfalfa	15.76	10.84	32.92	108.3	892.2	580.1
Rhodes grass	13.98	18.80	54.05	296.9	2288.0	1501.0
Blue panic grass	12.32	15.14	39.91	197.2	1645.0	1081.0
LSD at 5 %	0.16	0.21	0.71	1.1	6.6	6.5
C×F	NS	*	NS	*	NS	NS
I×F	*	*	*	*	*	*
C×I ×F	NS	*	NS	*	*	*

Table 2. Averages of as affected by cuttings, irrigation intervals, forage species and their interactions for the five cuts during 2013/2014 and 2015 seasons.

Treatments	Water Use Efficiency WUE%	Crude Protein %	Crude Fiber %	Ether Extract %	Ash content %	Nitrogen free extract %
C- Cuttings effects:						
1st cut	4.18	14.36	23.70	1.94	10.89	49.22
2nd cut	4.18	14.15	23.63	2.0	10.86	49.26
3rd cut	4.22	14.17	23.56	1.97	10.79	50.14
4th cut	4.30	14.29	23.42	1.95	10.69	49.62
5th cut	4.31	13.85	23.61	2.0	10.71	50.32
LSD at 5 %	N.S.	0.05	N.S.	N.S.	N.S.	N.S.
I-Irrigation intervals:						
Every 5 days	8.64	13.94	23.39	1.93	10.82	49.90
Every 10 days	4.67	14.17	23.29	1.95	10.83	50.20
Every 15 days	2.57	14.16	23.77	2.01	10.80	49.71
Every 20 days	1.25	14.41	23.90	2.01	10.72	49.04
LSD at 5 %	0.17	0.23	0.36	N.S.	N.S.	N.S.
F- test of C×I	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
F. Forage species:						
Alfalfa	2.43	18.69	16.27	2.32	12.48	50.27
Rhodes grass	6.01	10.84	25.26	1.98	10.01	51.96
Blue panic grass	4.28	12.98	29.24	1.63	9.89	46.92
LSD at 5 %	0.14	0.23	0.29	0.23	0.13	1.12
C×F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
I×F	*	N.S.	N.S.	N.S.	N.S.	N.S.
C×I ×F	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 3. Averages of Crude Protein, as affected by cuttings, irrigation intervals, forage species and their interactions for the five cuts during 2013/2014 and 2015 seasons.

Treatments	Crude Protein yield Kg/fed	Crude Fiber Yield Kg/fed	Ether Extract Yield Kg/fed	Ash yield Kg/fed	Nitrogen free extract Yield Kg/fed
C- Cuttings effects:					
1st cut	136.9	260.25	18.76	110.69	522.60
2nd cut	136.5	259.65	21.72	109.04	523.30
3rd cut	136.5	258.45	19.76	109.31	533.17
4th cut	141.4	263.43	20.11	111.70	539.62
5th cut	138.0	266.65	21.22	112.16	546.14
LSD at 5 %	N.S.	N.S.	N.S.	N.S.	N.S.
I-Irrigation intervals:					
Every 5 days	270.4	521.13	40.25	219.20	1057.40
Every 10 days	155.8	286.40	22.34	122.96	594.49
Every 15 days	83.0	160.42	12.45	67.34	523.28
Every 20 days	41.9	78.78	6.22	32.38	156.69
LSD at 5 %	6.5	7.83	3.10	2.65	17.74
F- test of C×I	N.S.	N.S.	N.S.	N.S.	N.S.
F. Forage species:					
Alfalfa	111.8	97.10	13.86	75.06	306.56
Rhodes grass	162.2	375.7	29.07	149.90	785.38
Blue panic grass	139.5	312.3	18.03	106.80	506.96
LSD at 5 %	5.0	5.69	1.39	3.16	27.81
C×F	N.S.	N.S.	N.S.	N.S.	N.S.
I×F	*	*	*	*	*
C×I ×F	N.S.	N.S.	N.S.	N.S.	N.S.

Rhodes grass is high drought and salt tolerant **(Moore *et al.*, 2006).Ibrahim *et al.* (1998)** investigated six genotypes of Rhodes grass and concluded that forage green yield of different cuts was increased gradually and reached its peak at the fifth cut later cuts during summer had the highest forage yield. **Abusuwar and KaramEldin (2013)** pointed out that the two grasses

(Teff and Rhodes grass) were more drought tolerant than the two legumes (alfalfa and Siratro) as they resulted in higher plant density, higher number of leaves and higher productivity under all treatments.**Osman *et al.* (2014)** concluded that rhodes grass significantly out yielded forage in all cuts other than the first one.

The results in Table (2) clearly indicated that forage species significantly differed on water use efficiency, crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages. Highest values of water use efficiency, crude fiber and nitrogen free extract percentages were produced from sowing Rhodes grass, which were 6.01, 25.26 and 51.96%, respectively. Moreover, Highest values of crude protein, ash content and ether extract percentages were obtained from sown Alfalfa, which were 18.69, 2.32 and 12.48 %, respectively.

Whereas, the lowest values of water use efficiency and crude fiber were produced from sowing Alfalfa, which were 2.43 and 16.27%, respectively. In addition, the lowest values of crude protein were produced from sown Rhodes grass, which was 10.84%. The lowest values of ether extract, ash content and nitrogen free extract percentages from sowing Blue panic grass, which were 1.63, 9.89 and 46.92%, respectively. The results in Table (3) clearly showed that forage species significantly differed crude protein, crude fiber, ether extract, ash content and nitrogen free extract yield/fed. The results showed that highest yield/fed of crude protein, crude fiber, ether extract, ash content and nitrogen free extract were produced from sowing Rhodes grass, which were 162.2, 375.7, 29.07, 149.9 and 785.38 Kg/fed, respectively. However, the lowest protein and fiber, ethereal extract, ash content and nitrogen free extract yields/fed were obtained from sown Alfalfa, which were 111.8, 97.1, 13.86, 75.06 and 306.56 Kg/fed, respectively. **Hashim et al. (2012)** determined the water requirements and crop water productivity of different seasonal and forage crops cultivated in Saudi Arabia and concluded that in forage crops, the water requirements varied from 962.75 mm in Sudan grass to 1922.50 mm in alfalfa. The total crop water consumption (mm) was highest in alfalfa (1922.50) followed by rhodes grass (1821.94), blue panic grass (1287.76) and Sudan grass (962.75). Blue panic grass can be recommended for cultivation as a forage crop.

3.4. *Interaction between cuttings and irrigation intervals effect:*

The interaction between cuttings and irrigation intervals significantly affected total of chlorophyll, as shown in Table (4). The results indicated that irrigated every 5 days and cutting at fourth cuts recorded highest values of total chlorophyll (18.56).However, the lowest

total chlorophyll values were obtained from the second cut and irrigation every 20 days, which was 9.98.

The interaction between cuttings and irrigation treatments significantly affected leaf area as presented in Table (5). The results revealed that highest values of leaf area/plantwere obtained from fourth or fifth cut and irrigation every 5 days without significant differences, which was 24.18 and 24.21, respectively. Whereas, the lowest leaf area/plant values were produced from the second or the third cut and irrigation every 20 days without significant differences, which were 8.12 and 7.65, respectively.

Table 4: Averages of total chlorophyll content as affected by the interaction among cuttings and irrigation intervals during 2013/2014 and 2015 season 2015.

Cuttings	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	17.54	14.61	12.92	10.21
2nd cut	18.31	14.69	12.25	9.98
3rd cut	17.54	14.61	12.92	10.21
4th cut	18.56	15.19	12.75	10.72
5th cut	18.04	15.19	13.35	10.74
LSD at 5 %	0.52			

Table 5: Means of leaf area/plant (cm^2) as affected by the interaction among cuttings, irrigation intervals during 2013/2014 and 2015 seasons.

Cuttings	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	23.55	16.88	11.57	8.37
2nd cut	23.53	15.34	10.96	8.12
3rd cut	22.60	14.55	10.53	7.65
4th cut	24.18	17.67	11.90	8.54
5th cut	24.21	17.38	12.05	8.84
LSD at 5 %	0.52			

The interaction between cuttings and irrigation intervals significantly affected plant height as presented in Table (6). The results showed that tallest plant was obtained from fourth or the fifth cut and irrigation every 5 days without significant differences, which were 73.65 and 47.45 cm, respectively. On the contrary, the shortest plants were obtained from the first or the third cut and irrigation every 20 days without significant differences i.e. 18.61 and 19.98 cm, respectively.

Table 6: Means of plant height (cm) as affected by the interaction among cuttings and irrigation intervals during 2013/2014 and seasons.

Cuttings	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	73.45	46.45	33.05	18.61
2nd cut	71.78	43.73	30.50	21.03
3rd cut	69.55	41.79	29.10	19.98
4th cut	73.65	47.48	30.50	21.03
5th cut	74.45	47.90	30.50	21.03
LSD at 5 %	1.88			

Regarding the interaction effect between cuttings and irrigation intervals on number of stems/m^2 the results in Table (7) clearly showed that this interaction significantly affected number of stems/m^2. Highest number of stems/m^2 was produced from the second cut and irrigation every 5 days, which was 326.3 stems/m^2. While, the lowest number of stems/m^2 produced from the third cut and irrigation every 20 days, which was 107.6 stems/m^2.

Concerning to the interaction effect among cuttings and irrigation intervals on forage green yield/fed, the results in Table (8) clearly revealed that this interaction significantly affected forage green yield/fed. Highest forage green yield/fed was obtained from the fourth or fifth cut and irrigation every 5 days without significant differences, which were 3402.7, 3403.5 kg/fed, respectively. Whereas, the lowest forage green yield/fed was produced from the first, second or third cuts when irrigated every 20 days without significant differences i.e. were 465.5, 463.3 and 450.4 kg/fed, respectively

Table 7: Averages number of stems/m^2 as affected by the interaction among cuttings, irrigation intervals during 2013/2014 and 2015 season.

Cuttings	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	319.5	240.3	146.9	113.5
2nd cut	322.3	224.5	143.5	110.0
3rd cut	310.7	217.4	139.9	107.6
4th cut	324.5	227.4	145.8	112.3
5th cut	326.3	226.6	144.5	112.1
LSD at 5 %	2.55			

Table 8: Averages of forage green yield/fed as affected by the interaction among cuttings and irrigation intervals during 2013/2014 and 2015 seasons.

Cuttings	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	3069.5	1660.4	956.1	465.5
2nd cut	3171.0	1658.4	949.4	463.3
3rd cut	3163.0	1643.1	930.3	450.4
4th cut	3402.7	1866.8	1088.6	477.3
5th cut	3403.5	1867.5	955.2	482.3
LSD at 5 %	11.52			

With respect to the interaction effect among cuttings and irrigation intervals on forage dry matter yield/fed, the results in Table (9) clearly showed that this interaction significantly affected forage dry matter yield/fed. Highest forage dry matter yield/fed was obtained from the fourth or the fifth cut when irrigated every 5 days without significant differences, which was 2132.7, 2161.6 kg/fed, respectively. Whereas, the lowest forage dry matter yield/fed was produced from the first, second, third, fourth or the fifth cut when irrigated every 20 days without significant differences, which were 313.9, 320.6, 313.0, 313.9 and 313.9 kg/fed, respectively.

Table 9: Averages of forage dry matter yield/fed as affected by the interaction among cuttings and irrigation intervals during 2013/2014 and 2015 seasons.

Cuttings	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	2032.4	1094.4	628.7	313.9
2nd cut	2096.4	1106.7	631.9	320.6
3rd cut	2090.8	1097.1	610.6	313.0
4th cut	2132.7	1194.4	695.4	313.9
5th cut	2161.6	1236.1	695.4	313.9
LSD at 5 %	24.4			

3.5. *Interaction effect between cuttings and forage species:*

The results in Tables (1, 2 and 3) indicated that the interaction between cuttings and forage species had insignificant effected on total chlorophyll, plant height, forage green and dry matter yield/fed water use efficiency, crude protein, crude fiber, ether extract, ash content and nitrogen free extract percentages crude protein, crude fiber, ether extract, ash content and nitrogen free extract yields/fed during 2013/2014 and 2014/2015 seasons.

Regarding to the interaction between cuttings and forage species on leaf area/plant, the results in Table (10) clearly indicated that sowing Rhodes grass produced highest values of leaf area/plant (m^2) at fourth and the fifth cut without significant differences, which were 19.31 and 19.38 cm^2/plant, respectively. On contrary, the lowest values of leaf area/plant (cm^2) was produced from sowing alfalfa at the third cut, which was 10.25 cm^2/plant, respectively.

Table 10: Averages of leaf area/plant (cm^2) as affected by the interaction among cuttings and forage species during 2013/2014 and 2015 seasons.

Cuttings	Forage species		
	Alfalfa	Rhodes grass	Blue panic grass
1st cut	10.79	18.96	15.53
2nd cut	10.66	18.55	14.26
3rd cut	10.25	17.80	13.46
4th cut	11.14	19.31	16.28
5th cut	11.35	19.38	16.14
LSD at 5 %	0.46		

Concerning to the interaction effect between cuttings and forage species on number of stems/m^2, the results in Table (11) clearly showed that this interaction significantly affected number of stems/m^2. Highest number of stems/m^2 was obtained from the first cut and sowing Rhodes grass (302.3 stems/m^2). However, the lowest number of stems/m^2 was obtained from the second or the third cut and sowing alfalfa without significant differences, which were 106.5 and 105.4 stems/m^2, respectively.

Table 11: Means number of stems/m^2 as affected by the interaction among cuttings and forage species during 2013/2014 and 2015 seasons.

Cuttings	Forage species		
	Alfalfa	Rhodes grass	Blue panic grass
1st cut	112.1	302.3	200.7
2nd cut	106.5	296.2	197.5
3rd cut	105.4	288.1	188.2
4th cut	109.0	298.5	199.7
5th cut	108.5	299.0	199.8
LSD at 5 %	2.5		

3.6 *Interaction effect between irrigation intervals and forage species:*

Regarding to the interaction effect between irrigation intervalsand forage species on crude protein and fiber %, ash content and nitrogen free extract %, the results in Tables (1 and 2) clearly revealed that this interaction insignificantly affected crude protein and fiber %, ash content and nitrogen free extract %.

Regarding to the interaction between irrigation intervals and forage species on total chlorophyll, the results in Table (12) clearly showed that this interaction significantly affected total chlorophyll. The results indicated that irrigation every 5 days and sowing alfalfa produced highest values of total chlorophyll (20.37) and the lowest values of total chlorophyll was recorded from irrigation every 20 days which was 9.82.

Concerning the interaction effect between irrigation intervals and forage species on leaf area/plant (cm^2), the results in Table (13) clearly showed that this interaction significantly affected leaf area/plant (cm^2). The results revealed that highest leaf area/plant (cm^2) values was produced from irrigation every 5 days of all forage species and sown Rhodes grass (28.66

cm^2/plant). Whereas, the lowest leaf area/plant (cm^2) came from irrigation every 20 days sown alfalfa (5.56 cm^2/plant).

Table 12: Averages of total chlorophyll content (SPAD) as affected by the interaction among irrigation intervals and forage species, as average of three cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	20.37	16.90	14.70	11.05
Rhodes grass	18.58	14.65	12.44	10.23
Blue panic grass	15.05	13.02	11.36	9.82
LSD at 5 %	0.33			

Table 13: Means of leaf area/plant (cm^2) as affected by the interaction among irrigation intervals and forage species, as average of three cuts, during 2013/2014 and 2015 seasons.

Irrigation intervals	Forage species		
	Alfalfa	Rhodes grass	Blue panic grass
Every 5 days	17.92	28.66	24.27
Every 10 days	11.60	20.83	15.32
Every 15 days	8.28	14.04	11.43
Every 20 days	5.56	11.20	8.16
LSD at 5 %	0.55		

With respect to the interaction between irrigation intervals and forage species on plant height, the results in Table (14) showed a significant effect on plant height, the results clearly indicated that irrigation every 5 days and sown Rhodes grass produced the tallest plants (86.53 cm). Whereas, irrigation every 20 days and sowing alfalfa produced the shortest plants without significant differences, which were 14.93 and 14.39 cm, respectively.

Table 14: Means of plant height (cm) as affected by the interaction among irrigation intervals and forage species, as average of three cuts, during 2013/2014 and 2015 seasons.

Forage plant species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	56.30	36.67	23.33	14.93
Rhodes grass	86.53	55.05	43.67	25.19
Blue panic grass	65.15	30.93	25.27	14.39
LSD at 5 %	1.34			

Regarding the interaction effect between irrigation intervals and forage species on number of stem/m^2, the results in Table (15) showed that this interaction significantly affected number of stems/m^2. Highest number of stems/m^2 was obtained from irrigation every 5 days and sown Rhodes grass (444.8 stems/m^2). However, the lowest number of stems/m^2 was produced from irrigation every 20 days and sown alfalfa (54.9 stems/m^2).

Table 15: Means of number of stems/m^2 as affected by the interaction among irrigation intervals and forage species, as average of three cuts, during 2013/2014 and 2015 seasons.

Irrigation intervals	Forage species		
	Alfalfa	Rhodes grass	Blue panic grass
Every 5 days	164.3	448.8	349.0
Every 10 days	123.8	327.5	230.5
Every 15 days	90.3	222.4	119.8
Every 20 days	54.9	188.9	89.5
LSD at 5 %	2.27		

With respect to the interaction effect between irrigation intervals and forage species on forage green yield/fed, the results in Tables (16) revealed that this interaction significantly affected forage green yield/fed. Highest fresh forage yield/fed was obtained from irrigation every 5 days and sown Rhodes grass (4487.1 kg/fed). Whereas, lowest forage green yield/fed was produced from irrigation every 20 days and sown alfalfa (280.1 kg/fed).

Table 16: Averages of forage green yield/fed as affected by the interaction among irrigation intervals and forage species, as averages of three cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	1793.8	963.5	531.5	280.1
Rhodes grass	4487.1	2455.7	1515.5	693.4
Blue panic grass	3444.9	1798.5	904.7	430.7
LSD at 5 %	10.0			

Regarding to the interaction effect between irrigation intervals and forage species on forage dry matter yield/fed, the results presented in Table (17) clearly indicated that this interaction significantly affected forage dry matter yield/fed. Highest dry forage yield/fed was obtained from irrigation every 5 days and sown Rhodes grass (2929.0 kg/fed). Whereas, the lowest forage dry matter yield/fed was produced from those irrigated every 20 days and sown alfalfa (193.8 kg/fed).

Regarding to the interaction effect between irrigation intervals and forage species onwater use efficiency, the results presented in Table (18) clearly indicated that this interaction significantly affectedwater use efficiency.Highest water use efficiency values were obtained from irrigation every 5 days and sown Rhodes grass (11.75). However, the lowest water use efficiencywas obtained fromirrigation every 20 days and sown Alfalfa (0.77).

Table 17: Averages of forage dry matter yield/fed as affected by the interaction among irrigation intervals and forage species, as averages of fives cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	1143.9	630.4	351.9	193.8
Rhodes grass	2929.0	1626.0	996.1	452.8
Blue panic grass	2236.0	1181.0	609.2	299.9
LSD at 5 %	13.1			

Table 18: Averages of water use efficiency as affected by the interaction among irrigation intervals and forage species, as averages of fives cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	4.78	2.71	4.16	0.77
Rhodes grass	11.75	6.50	3.98	1.80
Blue panic grass	8.87	4.79	2.27	1.19
LSD at 5 %	0.29			

With respect to the interaction effect between irrigation intervals and forage species oncrude protein yield/fed, the results presented in Table (19) clearly indicated that this interaction significantly affectedcrude protein yield/fed**.** Highest crude protein yield/fed were obtained from irrigation every 5 days and sown Rhodes grass (315.5 Kg/fed). However, the lowest crude protein yield/fed were obtained fromirrigation every 20 days and sown Alfalfa (35.6 Kg/fed).

Table 19: Averages of crude protein percentage as affected by the interaction among irrigation intervals and forage species, as averages of fives cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	216.4	126.7	70.1	35.6
Rhodes grass	315.5	177.8	104.5	50.8
Blue panic grass	281.0	162.8	74.6	39.2
LSD at 5 %	10.1			

Concerning the interaction effect between irrigation intervals and forage species oncrude fiber yield/fed, the results presented in Table (20) clearly indicated that this interaction significantly affectedcrude fiber yield/fed**.** Highest crude fiber yield/fed were obtained from irrigation every 5 days and sown Rhodes grass (733.2 Kg/fed). However, the lowest crude fiber yield/fed were obtained fromirrigation every 20 days and sown Alfalfa (31.9 Kg/fed).

Table 20: Averages of crude fiber yield/fed as affected by the interaction among irrigation intervals and forage species, as averages of fives cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	186.7	109.3	60.3	31.9
Rhodes grass	733.2	398.9	254.3	116.3
Blue panic grass	643.4	35.9	166.5	88.0
LSD at 5 %	11.3			

Concerning the interaction effect between irrigation intervals and forage species onether extract yield/fed, the results presented in Table (21) clearly indicated that this interaction significantly affectedether extract yield/fed**.** Highest ether extract yield/fed were obtained from irrigation every 5 days and sown Rhodes grass (54.6 Kg/fed). However, the lowest ether extract yield/fed were obtained fromirrigation every 20 days and sown Alfalfa (4.3 Kg/fed).

Table 21: Averages of ether extract yield/fed as affected by the interaction among irrigation intervals and forage species, as averages of fives cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	27.3	15.4	8.2	4.3
Rhodes grass	54.6	32.4	19.9	9.2
Blue panic grass	38.7	19.1	9.1	5.0
LSD at 5 %	2.7			

Regarding to the interaction effect between irrigation intervals and forage species onash yield/fed, the results presented in Table (22) clearly indicated that this interaction significantly affectedash yield/fed**.** Highest ash yield/fed were obtained from irrigation every 5 days and sown Rhodes grass (290.7 Kg/fed). However, the lowest ash yield/fed were obtained fromirrigation every 20 days and sown Alfalfa (24.0 Kg/fed).

Regarding to the interaction effect between irrigation intervals and forage species onnitrogen free extract yield/fed, the results presented in Table (22) clearly indicated that this interaction significantly affectednitrogen free extract yield/fed**.** Highest nitrogen free extract yield/fed

were obtained from irrigation every 5 days and sown Rhodes grass (1535.7 Kg/fed). However, the lowest nitrogen free extract yield/fed were obtained fromirrigation every 20 days and sown Alfalfa (96.6 Kg/fed).

Table 22: Averages of ash yield/fed as affected by the interaction among irrigation intervals and forage species, as averages of fives cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	145.5	84.7	45.9	24.0
Rhodes grass	290.7	163.9	99.8	45.2
Blue panic grass	221.3	120.2	56.2	29.2
LSD at 5 %	4.7			

Table 22: Averages of nitrogen free extract yield/fed as affected by the interaction among irrigation intervals and forage species, as averages of fives cuts, during 2013/2014 and 2015 seasons.

Forage species	Irrigation intervals			
	Every 5 days	Every 10 days	Every 15 days	Every 20 days
Alfalfa	589.9	355.8	183.7	96.6
Rhodes grass	1535.7	856.5	518.5	230.8
Blue panic grass	1046.5	571.1	267.6	142.6
LSD at 5 %	41.3			

3.7. *Interaction effect between cuttings, irrigation intervals and forage species:*

Concerning the interaction between cuttings, irrigation intervals and forage species on total chlorophyll, plant height, water use efficiency, crude protein, crude fiber, ether extract, ash content nitrogen free extract percentages, crude protein, crude fiber, ether extract, ash content nitrogen free extract yield/fed, the results in Tables (1, 2 and 3) clearly showed that this interactions insignificantly affected total chlorophyll, plant height, water use efficiency, crude protein, crude fiber, ether extract, ash content nitrogen free extract percentages, crude protein, crude fiber, ether extract, ash content nitrogen free extract yield/fed.

Regarding the interaction between cuttings, irrigation intervals and forage species on leaf area/plant (cm^2), the results in Table (23) indicated that this interaction significantly affected

leaf area/plant (cm^2). The results clearly showed that highest values of leaf area/plant (cm^2) was obtained from the second or the fifth cut of Rhodes grass and irrigation every 5 days of without significant differences, which were 29.10 and 29.05 cm^2/plant, respectively. On contrary, the lowest values of leaf area/plant (cm^2) was produced from the first and fourth cut of alfalfa and irrigation every 20 days without significant differences, which were 5.15 and 5.04 cm^2/plant.

Table 23: Averages of leaf area/plant (cm^2) as affected by the interaction among cuttings, irrigation intervals and forage species during five cuts of 2013/2014 and 2015 seasons.

Cuttings	Forage species	Irrigation intervals			
		Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	Alfalfa	17.80	11.95	8.25	5.15
	Rhodes grass	28.65	20.82	14.87	11.50
	Blue panic grass	24.17	14.87	1160	8.47
2nd cut	Alfalfa	17.60	10.95	8.15	5.95
	Rhodes grass	29.10	20.55	13.80	10.75
	Blue panic grass	23.90	14.53	10.95	7.67
3rd cut	Alfalfa	17.15	10.20	8.00	5.65
	Rhodes grass	27.60	19.90	13.45	10.25
	Blue panic grass	23.05	13.57	10.15	7.05
4th cut	Alfalfa	18.47	12.45	8.25	5.04
	Rhodes grass	28.90	21.70	15.12	11.50
	Blue panic grass	25.17	18.87	12.35	8.72
5th cut	Alfalfa	18.55	12.45	8.75	5.65
	Rhodes grass	29.05	21.15	15.32	12.00
	Blue panic grass	25.05	18.55	15.10	8.87
LSD at 5 %		1.24			

Regarding the interaction effect between cuttings, irrigation intervals and forage species on number of stems/m^2, the results in Table (24) clearly showed that this interaction significantly affected number of stems/m^2. Highest number of stems/m^2 was obtained from the first or the second cut and irrigation every 5 days of Rhodes grass without significant differences, which were 448.5 and 451.2 stems/m^2. However, the lowest number of stems/m^2

was produced from the second or the third cut and irrigation every 20 days of alfalfa without significant differences, which were 52.2 and 52.2 stems/m^2, respectively.

Table 24: Averages number of stems/m^2 as affected by the interaction among cuttings, irrigation intervals and forage species during five cuts of 2013/2014 and 2015 seasons.

Cuttings	Forage species	Irrigation intervals			
		Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	Alfalfa	163.0	131.7	96.5	57.5
	Rhodes grass	448.5	347.5	218.5	195.0
	Blue panic grass	347.2	241.7	125.7	88.2
2nd cut	Alfalfa	164.0	121.5	88.5	52.2
	Rhodes grass	451.2	323.0	223.2	187.5
	Blue panic grass	351.7	229.2	118.7	90.2
3rd cut	Alfalfa	161.7	120.5	87.2	52.2
	Rhodes grass	433.7	315.0	219.2	184.5
	Blue panic grass	336.7	216.7	113.2	86.2
4th cut	Alfalfa	187.0	166.5	123.0	90.2
	Rhodes grass	353.3	453.7	326.0	226.0
	Blue panic grass	353.2	233.0	226.0	121.0
5th cut	Alfalfa	122.5	156.0	89.2	56.0
	Rhodes grass	326.0	288.5	224.7	188.7
	Blue panic grass	231.5	226.0	119.7	91.7
LSD at 5 %		5.0			

With respect to the interaction effect between cuttings, irrigation intervals and forage species on forage green matter yield/fed, the results in Table (25) clearly indicated that this interaction significantly affected forage green yield/fed. The results clearly showed that highest fresh forage yield/fed was produced from the second cut and irrigation every 5 days of Rhodes grass (4531.0 kg/fed). Furthermore, the lowest forage green yield/fed was produced from the first or the third cut with irrigation every 20 days of alfalfa without significant differences, which were 264.5 and 263.8 kg/fed, respectively.

Table 25: Means of forage green yield/fed as affected by the interaction among cuttings, irrigation intervals and forage species during five cuts of 2013/2014 and 2015 seasons.

Cuttings	Forage species	Irrigation intervals			
		Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	Alfalfa	1596.6	866.5	456.8	264.5
	Rhodes grass	4363.0	2452.5	1545.3	704.9
	Blue panic grass	3249.0	1662.4	866.4	427.2
2nd cut	Alfalfa	1688.0	865.3	475.9	268.8
	Rhodes grass	4531.0	2455.2	1506.8	693.0
	Blue panic grass	3294.1	1654.7	865.6	431.1
3rd cut	Alfalfa	1683.8	855.4	468.4	263.8
	Rhodes grass	4514.7	2435.3	1471.8	663.2
	Blue panic grass	3290.9	1638.5	850.7	424.4
4th cut	Alfalfa	1995.5	1065.3	675.9	291.5
	Rhodes grass	4516.0	2465.2	1524.3	705.5
	Blue panic grass	3696.6	2069.7	1065.6	434.9
5th cut	Alfalfa	2005.5	1165.3	580.9	311.8
	Rhodes grass	4511.0	2470.2	1529.3	700.5
	Blue panic grass	3694.1	1976.2	875.6	436.1
LSD at 5 %		29.6			

Concerning to the interaction effect between cuttings, irrigation intervals and forage species on forage dry matter yield/fed, the results in Table (26) showed that this interaction significantly affected forage dry matter yield/fed.The results indicated that highest forage dry matter yield/fed was produced from the second or the third cut and irrigation every 5 days of Rhodes grass without significant differences, which were 2982.4 and 2981.7 kg/fed, respectively. Whereas, the lowest values of forage dry matter yield/fed were produced from the first and fourth cut and irrigation every 20 days of alfalfa, which were 180.6 and 180.6 kg/fed, respectively.

Table 26: Means of forage dry matter yield/fed as affected by the interaction among cuttings, irrigation intervals and forage species during five cuts of 2013/2014 and 2015 seasons.

Cuttings	Forage species	Irrigation intervals			
		Every 5 days	Every 10 days	Every 15 days	Every 20 days
1st cut	Alfalfa	1060.2	573.6	299.2	180.6
	Rhodes grass	2892.8	1620.5	1010.6	467.0
	Blue panic grass	2144.4	1089.1	576.5	294.1
2nd cut	Alfalfa	1114.9	578.0	348.0	217.0
	Rhodes grass	2982.4	1634.5	978.1	434.0
	Blue panic grass	2192.1	1107.7	569.6	310.4
3rd cut	Alfalfa	1117.1	578.2	314.0	210.2
	Rhodes grass	2981.7	1633.7	970.6	428.3
	Blue panic grass	2173.6	1079.4	547.1	306.4
4th cut	Alfalfa	1160.2	673.6	399.2	180.6
	Rhodes grass	2892.8	1620.5	1010.6	467.0
	Blue panic grass	2344.4	1289.1	676.5	294.1
5th cut	Alfalfa	1267.7	748.6	399.2	180.6
	Rhodes grass	2892.8	1620.5	1010.6	467.0
	Blue panic grass	2324.4	1339.1	676.5	494.1
LSD at 5 %		38.8			

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