

Effect Of Irrigation Intervals, Nitrogen And Phosphorus Applications On Forage Yield, Carbohydrate and Protein Content Of Guar (*Cyanoposis tetragonoloba*) In The Central Region Of Saudi Arabia

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Abstract. Guar is summer annual leguminous forage, characterized as drought tolerant, deep rooted and seeds gum potentiality. It could be adapted the environmental of the Central region of Saudi Arabia. Two field experiments were carried out through 2000 and 2001 summer seasons to study the effect of expanding irrigation intervals, nitrogen and phosphorus fertilizers on yield parameters, protein and carbohydrate content in guar foliage. Treatments were irrigation intervals (5 and 10 days), nitrogen fertilizer (0 and 250 Kg/ha as ammonium nitrate 33% N) and phosphorus fertilizer (0, 125 and 250 Kg/ha super - phosphate 16% P₂O₅). Results showed that irrigation interval periods had highly significant effect on dry matter percentage (DM %), protein percentage (CP %) and carbohydrate %, while the effect was significant only at 5% on green forage, protein and carbohydrate yields. There was no-significant effect on dry forage yield. Application of nitrogen fertilizer had highly significant effect on all the parameters under study except dry matter percentage. The same trend was obtained when phosphorus fertilizer treatments were applied. There were no-significant differences between years except that for protein %, protein yield and carbohydrate yield.

Key words: Guar, irrigation intervals, forage yield, N and P fertilization.

Introduction

Guar (*Cyanoposis tetragonoloba* L. Taub) is a leguminous herb, characterized as a warm weather, drought tolerant, deep rooted, summer annual legume adapted to semiarid climates (Whistler and Hymowitz, 1979). Guar potentiality is in the gum of seeds. Its seed's gum is a polymer of galactose and manose, which is useful in the food industry for lotions and creams, stabilize drilling mud and waterproofing of explosives, (Allen 1964; Misra *et al.*, 1968; NAS, 1979 and Alexander *et al.*, 1988).

Guar is grazed in many region of the

world, usually after frost (to reduce bloat problems), and makes good forage. It is drought tolerant, performing well in areas having 400 - 900 mm of rainfall. Yields may double with irrigation. When moisture is short, growth stops until moisture again becomes available. Guar grows well in a variety of soils and thrives in alluvial and sandy loam with well drained subsoil, (NAS, 1979). Guar grows between summer gramineous crops like corn as all soil-improving crops. It provides the soil with nitrogenous materials similar to the main ingredients in fertilizers, (Whistler and Hymowitz, 1979). Tag El-Din and Assaeed (1995) showed that increasing P fertilizer

application to alfalfa increased fresh, dry and protein yield significantly. Little decrease but significant in fresh, dry and protein yield was associated with increasing irrigation intervals. They found that increasing P fertilizer compensated the effect of expanding irrigation intervals. The Central region of Saudi Arabia characterized as a hyper - arid environmental condition, with very high temperature and nil precipitation in summer season. Guar is summer annual forage and could compensate the decrease of Range forage production and expected to be adapted with this hyper - arid condition.

The objectives of this study were to determine: (i) the effect of irrigation intervals expanding on yield components, protein and carbohydrate contents of guar foliage for grazing and (ii) the previous mentioned parameters as affected by nitrogen and phosphorus fertilizers application treatments.

Materials and Methods

The study was conducted in 2000 and 2001 summer growing seasons at Al Muzahemia (The Ghatghat) Research Station of Prince Sultan Research Center for Environment, Water and Desert, King Saud University, located about 50 Km west of Riyadh (24° 27' N, 46° 18' E). The soil belongs to the Torripsmments great group and is characterized by a deep soil profile with a sandy to sandy loam texture. The soil is calcareous, very low in organic matter content, alkaline reaction with an electrical conductivity ranging from 0.8 to 3.8 dS/m, and a gypsum content ranging from 2.7 to 3.5%.

The experiment includes 12 treatments, which were the combination of two irrigation interval treatments (5 and 10 days), nitrogen fertilizer application treatments (0 and 250 kg/ha as ammonium nitrate 33% N) and three phosphorus fertilization treatments (0, 125 and

250 kg/ha super phosphate 16 % P₂O₅). Seeds of Guar were sown on 20 and 23 June in 2000 and 2001 two seasons, respectively. The experimental design was split-split-plot design with three replicates where irrigation intervals treatments occupied the main plots, nitrogen fertilizer treatments in the sub - plots and phosphorus fertilizer treatments in the sub-sub plots. Irrigation interval treatment, and nitrogen fertilizer treatments were applied after stand establishment (3 weeks after seeding), while the phosphorus fertilizer was applied a week before seeding. The growing season till seed production of Guar reached about 160 days (Alexander et al., 1988). When about 75% of guar stands were flowered (after about three months), plots were harvested with a mower at a height of approximately 7 cm from soil surface. The green forage yield from each plot was weighed to determine the green forage yield/ha (GFY). Fresh forage samples weighing about 200-300 gm were oven dried at 60°C and weighed to determine dry matter % (DM %), dry forage yield/ha (DFY) and for chemical analysis. Samples were ground in a Wiley mill with 1 mm mesh screen to determine crude protein % (CP %) and carbohydrate %. Crude protein (N × 6.25) was determined by the iodometric method of Shaffer and Hartmann (1921), modified by Noakell and ElGawadi. Carbohydrate % was determined as mentioned in the official methods of analysis (AOAC, 1980). Crude protein yield/h and carbohydrate yield/ha were estimated from DM%, CP % and carbohydrate %.

Analysis of variance for each two year averages and between years were performed using the SAS statistical package (SAS, 1985). Means were compared using Duncan's multiple range test (Steel and Torrie, 1980), for each year

and the two years averages.

Results and Discussion

The significant influence of irrigation period intervals, nitrogen and phosphorus fertilizers application treatments on productivity parameters (green forage yield, dry matter % and dry forage yield), protein and carbohydrate percentages and contents, in two years, their average and their combined analysis are presented in Table 1. Combined analysis of different parameters for the two years indicated that significant variations between the first and second year were found for protein %, protein yield and carbohydrate yield parameters. Irrigation intervals treatments had highly significant effect on green forage yield, dry matter%, protein% and carbohydrates %, while its effect was not significant on dry forage yield only. Nitrogen and phosphorus fertilizers application treatments had highly significant affect on all the studied parameters except that for dry matter % and phosphorus application on dry forage yield in the second year. Interactions between treatments for each year and the combined had significant affect on all the studied parameters, except that between irrigation x nitrogen in the first year on dry matter % and the two years average of dry matter % and crude protein yield.

Green Forage Yield (GFY):

Effect of irrigation intervals and application of nitrogen and phosphorus fertilizers on green forage yield (GFY) in the two years average are presented in Table 2. There were no significant variance between GFY in the first year (30.5 ton/ha) and second year (31.1 ton/h). Irrigation intervals treatments

Table 1: Analyses of variance for some production traits of Guar as affected by Irrigation, N and P fertilizers

source	df	GFY			DM%			DFY			Protein %			Protein yield			Carbohydrate %			Carbohydrate yield				
		Y1	Y2	av	Y1	Y2	av	Y1	Y2	av	Y1	Y2	av	Y1	Y2	av	Y1	Y2	av	V1	V2	av		
year	1																							
Irr(1)	1	**	*	**	ns	**	ns	ns	**	ns	ns	**	ns	**	*	ns	**	*	ns	ns	ns	ns	*	
(N)	1	**	**	**	ns	ns	ns	ns	*	**	**	**	**	**	**	**	**	**	**	ns	ns	ns	**	**
(P)	2	*	**	**	ns	ns	ns	ns	ns	**	**	**	**	**	**	**	**	**	**	*	*	*	**	**
1×N	1	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
N×P	2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
1×P	2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
1×N×P	2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Y1: 1st year, Y2: 2nd year, av: two years average.
 ns: not significant at P=0.05, *: significant at P=0.05 or less, **: significant at P=0.01 or less

Table 2. Effect of irrigation intervals, N and P fertilizers on yield, protein and carbohydrate contents in two years (combined analyses).

Treatment	(GFY) Ton/ha	DM %	(DFY) Ton/ha	CP %	CPY Kg/ha	Carb. %	Carb.y Kg.ha
Years							
1 st	30.5	37.9	11.6	17.4b	2018b	26.7	3097b
2 nd	31.1	39.6	12.3	18.9a	2325a	27.3	3358a
Irrigation Intervals							
5 days	33.3a	37 b	12.3	18.9 a	2300 a	25 b	3075 b
10 days	30.6 b	39 a	11.9	18.2 b	2166 b	27.1 a	3225 a
N level							
Without	28.6 b	38.6	11 b	17.2 b	1892 b	26 b	2860 b
250kg/ha	33 a	39.3	13 a	19 a	2470 a	27.9 a	3627 a
P level							
without	28.4 c	39.3	11.2 b	16.8	1882	25.1 c	2811
125kg/ha	30.3 c	28.2	11.6 b	18.2	2111	27.1 b	3144
250kg/ha	37.4 a	38.9	14.5 a	19.5	2828	4118	

Means in each column with different letters are significantly different at 5% level.

had also highly significant effect on GFY for each year and the two years average. GFY for the two years averages were 33.3 and 30.6 ton/h for the 5 and 10 days irrigation interval treatments, respectively. Application of N fertilizer significantly increased GFY of each year and year's average. GFY of the two years average increased, from 28.6 to 33 ton/ha, when N fertilizer applied. Also, application of P fertilizer increased significantly GFY in each year and the two years average. The two years averages of GFY were 28.4, 30.3 and 37.4 ton/h due to application of 0, 125 and 250 kg/ha super-phosphates respectively. There were non significant effects for the interactions between all different treatments on GFY.

Dry Matter Percentage (DM %):

Means of DM % as affected by irrigation intervals, nitrogen and phosphorus application in the two years average are shown in table 2. No significant variance of DM % was found between the two years, where it was 37.9 % in

the first year and 39.6% for the second year. Irrigation intervals treatments had highly significant effect on DM% for each year and the two years averages. DM% for the five days irrigation intervals (37%) was significantly lower than that when irrigated at ten days intervals (39%). Fertilizers application either with nitrogen or phosphorus had no significant effect on DM% for each year and the two years average. Interactions between different treatments on DM% had no significant effect, except the interaction between irrigation intervals X nitrogen application, which was significant in the first year at 5% level and for the two years average at 1% level.

Dry Foliage Yield (DFY):

Data in Table 2 indicated that DFY mean in the second year (12.3 ton/ha) was insignificantly higher than that for the first year (11.6 ton/ha). Also irrigation intervals treatments had no significant effect on DFY for each year and the two years average. DFY

combined averages were 12.3 and 11.9 ton/ha when irrigated at five and ten days intervals, respectively. Nitrogen fertilizer application with 250 kg/ha ammonium nitrate increased significantly DFY in both years and the two years average. DFY increased 118.2 % when nitrogen fertilizer was applied. Application of P fertilizer significantly increased DFY in the second year and the two years average. Increasing was non significant in the first year. For the two years average the significant increase was obtained with applying 250 kg super-phosphate while this increase was non significant when only 125 kg/ha was applied. DFY's were 11.2, 11.6 and 14.5 ton/ha obtained when 0, 125 and 250 kg/ha super-phosphate fertilizer was applied. These results are in agreement with those obtained by Tag El-Din and Assaeed 1995, they reported that increasing P application increased significantly fresh and dry yield of alfalfa. There were no significant interactions between all parameters under this study in each year and the two years averages.

Crude Protein Percentage (CP %):

The effect of irrigation intervals, N and P fertilizers on CP% for combined two years and their averages are presented in table 2. CP % was significantly lower in the first year (17.4%) than that of the second year (18.9%). Irrigation intervals treatments had significantly high effect on CP% in the first year and the two years average. The effect was non significant in the second year. CP % averages were 18.9 % and 18.2% for 5 and 10 days irrigation intervals treatment means, respectively. N and P fertilizers application had a highly significant effect on CP % in each year and the two years average. Application of 250 kg/ha ammonium nitrate increased CP % from 17.2% to 19.0% for the two years average. CP % for the two years

averages was 16.8 %, 18.2 % and 19.5 % when super-phosphate applications were 0, 125 and 250 kg/ha, respectively. There were no significant interactions between all different treatments under study either for each year or the two years averages

Crude Protein Yield (CPY):

Crude protein yield (CPY) represents the total protein of leaves and shoots which animals could be utilized per hectare. Data in Table 2 indicated that CPY of the second year (2325 kg/ha) was significantly higher than that in the first year (2018 kg/ha). Expanding the irrigation period intervals from 5 to 10 days decreased CPY significantly in the first year and the two years averages, while it was non significant in the second year. CPY's were 2300 and 2166 kg/ha when irrigated at 5 to 10 days intervals, respectively. Application of N and P fertilizers significantly increased CPY in each year and the two years average. For the two years average, it was increased from 1892 to 2470 kg/ha when 250 kg ammonium nitrate was applied. CPY's were 1882, 2111 and 2828 kg/ha when 0, 125 and 250 kg/ha super-phosphate were applied. These results are in harmony with those of Tag El-Din and Assaeed (1995) who found that increasing P application increased CPY of alfalfa significantly. Interactions between different parameters under study were non significant except that for irrigation X nitrogen only at 5% level.

Carbohydrate Percentage:

The difference in carbohydrate% in plant tissue was not significant between the first year averages (26.7 %) and that for second year (27.3 %). Expanding irrigation intervals from 5 to 10 days increased significantly carbohydrate% from 25 to 27.1%. The increase of carbohydrate% may be due to compact drought, as

increasing of carbohydrate %, increased osmotic pressure by which the plant could absorb more water from the soil. Application of N and P fertilizers had a highly significant effect on carbohydrate% in each year and the two years averages. Application of 250 kg/ha ammonium nitrate increased carbohydrate% from 26 to 27.1%. Also, carbohydrate % was 25.1, 27.1 and 28.4 % when 0, 125 and 250 kg/ha super-phosphate were applied. No significant interactions between all different treatments under study either for each year or for the two years averages were found.

Carbohydrate Yield:

Carbohydrate yield in second year was significantly higher than that of the first year, Table 2. The effect of irrigation intervals on carbohydrate yield was non significant in the first year, while, it was highly significant in the second year and the two years averages. Expanding irrigation intervals from 5 to 10 days increased carbohydrate yield from 3075 to 3225 kg/ha for the two years averages. N and P application increased significantly carbohydrate yield in each year and the two years averages. It was increased from 2860 to 3627 kg/ha when 250 kg/ha ammonium nitrate was applied. Also, carbohydrate yield averages were 2811, 3144 and 4118 kg/ha when 0, 125 and 250 kg/ha super phosphate were added. All interactions between different treatments under study on carbohydrate yield were not significant.

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تأثير فترات الري والتسميد الأزوتي والفوسفاتي على المحصول العلفي والمحتوي البروتيني والكربوهيدراتي لنبات الجوار بالمنطقة الوسطى للمملكة العربية السعودية

عبدالمك بن عبدالرحمن إسحاق آل الشيخ

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المملكة العربية السعودية

الملخص : يتميز نبات الجوار بأنه نبات صيفي حولي ، مقاوم للجفاف وذات مجموع جذري طويل ، بالإضافة إلى إمكانية الاستفادة من الصمغ المستخرج من بذوره . أجريت تجربتين حقليتين في الموسم الصيفي لعامي ٢٠٠٠ و ٢٠٠١م لدراسة تأثير فترات الري ، والتسميد الأزوتي والفوسفاتي على المحصول والمحتوي البروتيني والكربوهيدراتي لنبات الجوار العلفي . حيث كانت معاملات الري كل ٥ ، ١٠ أيام ، والتسميد الأزوتي صفر ، ٢٥٠ كجم نترات أمونيوم (٢٣%) للهكتار والتسميد الفوسفاتي صفر ، ١٢٥ كجم ، ٢٥٠ كجم سوبر فوسفات أحادي الكالسيوم (١٦%) وبثلاثة مكررات. أوضحت النتائج أن فترات الري ذات تأثير عالي المعنوية على النسبة المئوية للمادة الجافة ونسبة البروتين والكربوهيدرات المئوية. بينما كان التأثير معنوياً فقط بمستوى ٥% على المحصول الأخضر ومحصول كل من البروتين والكربوهيدرات. كما كان التأثير غير معنوي على المحصول العلفي الجاف . كما أوضحت النتائج أن التسميد الأزوتي كان له تأثير عالي المعنوية على جميع العناصر تحت الدراسة عن النسبة المئوية للمادة الجافة. كذلك فإن تأثير التسميد الفوسفاتي له نفس الاتجاه لتأثير التسميد الأزوتي . ولا يوجد اختلافات غير معنوية بين سنتي الدراسة إلا في نسبة وإنتاج البروتين.