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POTENTIAL FORAGE YIELD OF CANARY GRASS (*PHALARIS CANARIENSIS* L.) IN RELATION TO BIOFERTILIZER AND SOME MICRONUTRIENTS UNDER RECLAIMED SOIL CONDITIONS

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ABSTRACT

This investigation has been performed in Mariout Research Station, Desert Research Center (D.R.C.) throughout two successive growing seasons of 2002 / 2003 and 2003 / 2004. Canary grass plants were raised under 9 treatments which were the combinations of 3 biofertilizer sources i.e. *Azotobacter*, *Azospirillum* and uninoculated control and 3 micronutrients i.e. 2% $FeSo_4$, 1% $MnSO_4$ and control. The treatments were arranged in split-plot design with three replications.

The important results obtained can be summarized as follows:

1- Maximum values of all growth parameters tested of canary grass plants were obtained when seeds were inoculated with *Azotobacter* compared to inoculation with *Azospirillum* or uninoculated control. Fresh and dry forage yields followed the same trend of growth parameters in their response to the different biofertilizer resources.

2- All growth and forage yield traits of canary grass plants were increased when the plants were sprayed with 2% $FeSo_4$ compared to spraying with 1% $MnSo_4$ or control treatment.

Keywords: Canary grass, *Phalaris canariensis*, Biofertilizers, Micronutrients

INTRODUCTION

Ambitious agricultural expansion plans are imperative to meet the demands of the ever increasing population. These plans aim towards the attainment of maximum economical production through the utilization of the full potentials of soil, plant and management. The achievement of such goal under the conditions of highly calcareous soils needs thorough investigations of the various factors governing the availability of nutrients and its effects on crop production under these conditions.

Canary grass (*Phalaris canariensis* L.) is an important winter forage crop successfully used for pasture, hay and silage **(El-Houssini, 2000).** Generally, forage grasses responded well to nitrogen

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fertilization. However, increasing cost of chemical fertilization and their environmental polluted effects have reduced their use considerably. Under such situation, it is imperative to use natural available resources to meet partial nutritive requirements of the crop. *Azotobacter* and *Azospirllum* are the most important and well known heterotrophice bacteria which increased the yield of several crops by fixing the atmospheric nitrogen in soil **(Sheoran *et al* 1998)**.

Azotobacter inoculation significantly increased the green as well as dry matter and crude protein yields of *Avena sativa* over uninoculated control and *Azospirillum* inoculated treatments **(Sheoran *et al* 1998)**. They revealed also that the increase in yield was 13.7 , 18.4 and 26.8 percent for green fodder, dry matter and crude protein yields, respectively due to *Azotobacter* over the control .They added that there was no significant effect of *Azospirillum* inoculation on fodder and crude protein yields of oat. In a pot experiment conducted by **Kundu *et al* (1997)**, pearl millet (*Pennisetum glaucum*) seedlings were root inoculated with 1 of 8 strains of *Azospirillum brasilense*. They stated that N fixation was highest with inoculation with the mutant strain Sp 7-6M and this treatment also produced the highest plant dry weight. Furthermore, inoculating seeds of winter rye (*Lolium perenne*) and *Bromus inermis* with selected *Azospirillum* strains significantly increased N fixation in the root zone. Inoculation with *Azospirillum brasilense* or *Azospirillum lipoferum* increased fresh fodder yield of *Lolium perenne* by 24.2 and 15.7-25.7% and that of *B. inermis* by 21.9 and 29.6%, respectively. Also, inoculation increased herbage N content in both grasses **(Maltseva *et al* 1995)**.

In the highly calcareous soils, as in Mariout region soils, $CaCO_3$ is considered to be one of the most important factor which affects the availability of nutrient elements **(Khalil *et al* 1978)**. Also, manganese deficiency problems are common and widespread under the conditions of highly calcareous soils **(Wassif *et al* 1978)**. Additionally, several investigations suggested that the availability of manganese is greatly influenced by the Fe / Mn ratio in the plant **(Twyman, 1951)**. Foliar sprays with a mixture of 2 % $FeSo_4$ +0.4 % $MnSo_4$ was more effective in increasing the straw yield of sordan plants **(Khalil *et al* 1991)**. Moreover, **Withee** and **Carlson (1959)** pointed out that spraying chlorotic grain sorghum with 3 sprays of 4% ferrous sulfate was an effective method of improving the yield of grain. In addition, positive response in plant growth, dry matter and iron content were obtained when iron was added to corn plants. Spraying was the efficient method especially with $FeSo_4$, may be due to that spraying protect the iron from rapid oxidation or precipitation by $CaCo_3$ **(Abd-Elnaim *et al* 1974)**. Also, total plant weight per plant, plant height and yield of maize and its components were significantly increased with microelements i.e. Zn, Mn, Fe, Cu, B and Mo **(Glelah *et al* 1990)**.

Since little information are available with regard to the fertilizer requirements of canary grass plants at Mariout region, so the aim of this work was to investigate the effect of different sources of biofertilizer and micronutrients on growth and forage yield of canary grass.

MATERIAL AND METHODS

This study was carried out at Mariout Research Station, Desert Research Center (D.R.C.) throughout two successive growing seasons of 2002/2003 and 2003 / 2004. The objective of this investigation was to study the effect of micronutrients and different bio-fertilizer sources on growth and forage yield of canary grass (*Phalaris canariensis* L.). Soil at the experimental site is characterized as sandy clay loam texture with pH of 8.0, EC of 2.78 mmhos / cm and containing 46.50 % calcium carbonate.

A split-plot design with three replications was used. The main plots devoted to spraying with micronutrients, while the sub plots were occupied with biofertilizer resources.

Each experiment included nine treatments which were the combinations of three micronutrients (2% $FeSo_4$, 4% $MnSo_4$ and control), three bio-fertilizer resources (*Azotobacter, Azospirillum* and control). Plot size was 3×3.5 m (10.5 m^2) consisting of 6 ridges each of 60 cm apart.

Seeds of canary grass (*Phalaris canariensis* L.) were inoculated with different biofertilizer resources. Inoculation was performed by mixing canary grass seeds with the appropriate amounts of cerealin using Arabic gum as adhesive. The coated seeds were then air dried in the shade for 30 minutes and sown immediately with seeding rate of 15 Kg seeds / fed. on 15 and 18 November in the first and the second season ,respectively. Calcium superphosphate (15.5 % P_2O_5) was applied at rate of 120 Kg / fed. as a basal application during soil preparation.

Harvesting was initiated 70 days after seeding, when the first cut was taken at cutting height of about 5 cm above the ground surface. Clipping was repeated later by cutting interval of 45 days making three cuts at the first season and two cuts only at the second one.

Ten plants from the interior of the plot border were chosen at random before each cut, which plant height was measured from the top of plant to soil surfaces, No. of tillers / unit area "1/16 m^2", flag leaf area and specific leaf weight "S.L.W." were measured. All plants of each plot were harvested to determine fresh and dry forage yields in ton / fed. .

Data of growth and forage yield were statistically analyzed using computer statistical program Co-STAT according to procedures outlined by **Gomez and Gomez (1984)**. Differences between means were compared using L.S.D. value at 5% level.

RESULTS AND DISCUSSION

1- Effect of biofertilizer resources

Data presented in Table (1) show the effect of different bio-fertilizer resources i.e. *Azotobacter, Azosbirillum* and uninoculated control on some growth traits of canary grass plants grown under Mariout Province conditions.

It is quite clear from the data that all studied growth traits i.e. plant height, No. of tillers, flag leaf area and specific leaf weight were similar in their response to the used biofertilizer resources.

Maximum values of the previous growth traits were obtained when seeds of canary grass were inoculated with *Azotobacter* compared to that inoculated with *Azospirillum* or uninoculated control. Such trend towards increasing in all

Table 1. Effect of biofertilizer resources on some growth traits of canary grass plants at different cuts harvested during 2002 / 2003 and 2003 / 2004 growing seasons

Traits	No. of cut	Biofertilizer resources							
		At.	As.	Control	LSD 5%	At.	As.	Control	LSD 5%
		2002 / 2003				2003 / 2004			
Plant height (cm)	1st	77	76	77	NS	68	62	60	8.0
	2nd	85	82	84	NS	126	124	125	NS
	3rd	49	45	41	7.0	-	-	-	-
No. of tillers	1st	68	66	64	NS	64	62	62	NS
	2nd	53	53	43	NS	45	43	39	NS
	3rd	67	55	52	14.0	-	-	-	-
Flag leaf area	1st	53.86	48.13	47.19	6.29	53.44	45.78	35.00	17.51
	2nd	44.98	42.83	41.32	3.30	20.59	19.58	19.61	NS
	3rd	10.95	9.87	8.02	2.88	-	-	-	-
S.L.W. (mg/cm^2)	1st	3.39	3.08	3.10	0.28	3.27	3.03	2.94	0.29
	2nd	3.78	3.73	3.49	0.26	5.17	5.21	5.04	NS
	3rd	5.66	5.65	5.60	NS	-	-	-	-

At. = *Azotobacter* As. = *Azospirillum* S.L.W. = Specific Leaf Weight

studied growth traits by using *Azotobacter* as a bio-fertilizer – was observed in all cuts harvested in both seasons. However, these increments were significant for plant height in the third and the first cuts of the first and second seasons, respectively. Whereas, No. of tillers in the third cut of the first season only was significantly decreased from 67 for *Azotobacter* treatment to 52 tiller / unit area for uninoculated one. Also, flag leaf area and specific leaf weight were significantly responded to change bio-fertilizer source. Such effect was noticed in all taken cuts in the first season and in the first cut of the second season for flag leaf area. Moreover, inoculation with *Azotobacter* significantly increased specific leaf weight. This trend was observed in the first cut of both seasons and in the second cut of the first season.

Thus, it could be inferred that using *Azotobacer* as biofertilizer for canary grass plants is considered the best biofertilizer treatment for maximizing their most growth traits. Therefore, it seams that a substantial amount of chemical fertilizer could be saved by using biofertilizer which in turn minimizes the production costs and pollution factors which can occur by the excess use of chemical fertilizers. These results are in accordance with those obtained by

Sheoran *et al* (1998) on *Avena sativa* plants.

Table 2. Effect of micronutrients on some growth traits of canary grass plants in different cuts harvested during 2002 / 2003 and 2003 / 2004 growing seasons

Trite	No. of cut	Micronutrients							
		$FeSo_4$	$MnSo_4$	Control	LSD 5%	$FeSo_4$	$MnSo_4$	Control	LSD 5%
		2002 / 2003				2003 / 2004			
Plant height (cm)	1st	76	80	73	NS	61	62	62	NS
	2nd	85	83	85	NS	122	130	123	NS
	3rd	46	44	44	NS	-	-	-	-
No. of tillers	1st	67	69	63	NS	63	67	58	NS
	2nd	59	44	46	NS	46	46	36	NS
	3rd	61	56	54	NS	-	-	-	-
Flag leaf area (cm^2)	1st	48.33	51.72	47.14	NS	67.30	40.70	30.22	36.62
	2nd	43.53	43.96	41.65	NS	21.70	19.76	18.31	NS
	3rd	10.83	9.35	7.17	3.36	-	-	-	-
S.L.W. (mg/cm^2)	1st	3.17	3.32	3.06	NS	3.32	3.18	2.74	NS
	2nd	3.65	3.76	3.59	NS	5.62	4.68	5.12	NS
	3rd	5.39	5.86	5.65	NS	-	-	-	-

Table 3. Effect of micronutrients and biofertilizer resources on fresh and dry forage yields of canary grass plants in different cuts harvested during 2002 / 2003 and 2003/2004 seasons

Traits	No. of cut	Micronutrionts			LSD 5%	Biofertilizers			LSD 5%
		$FeSo_4$	$MnSo_4$	Control		At.	As.	Control	
		2002 / 2003							
F.F.Y. (ton/fed)	1st	4.400	4.089	3.533	NS	4.467	4.022	3.533	0.912
	2nd	4.956	4.311	4.667	NS	4.822	4.800	4.311	NS
	3rd	3.111	2.644	2.467	NS	2.956	2.756	2.411	0.455
D.F.Y. (ton/fed)	1st	0.504	0.494	0.423	NS	0.515	0.488	0.424	0.090
	2nd	0.646	0.581	0.606	NS	0.689	0.647	0.507	0.172
	3rd	0.798	0.604	0.503	0.294	0.673	0.619	0.570	0.100
		2003 / 2004							
F.F.Y. (ton/fed)	1st	5.589	4.933	4.100	1.341	5.956	4.911	4.156	1.332
	2nd	14.844	13.400	13.600	NS	14.644	13.689	13.511	NS
	3rd	-	-	-	-	-	-	-	-
D.F.Y. (ton/fed)	1st	0.624	0.518	0.517	0.102	0.694	0.522	0.512	0.179
	2nd	3.748	3.398	3.487	NS	3.638	3.590	3.405	NS
	3rd	-	-	-	-	-	-	-	-

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

As for the effect of different biofertilizer sources on fresh and dry forage yields of canary grass plants, there was a tendency to the increase in the above mentioned traits when seeds of canary grass were inoculated with *Azotobacter* (Table 3). Such increments in studied forage yield parameters which occurred with using *Azotobacter* were significant in all cuts except in the second cut of both seasons for fresh forage yield and third cut of the second season for dry forage yield. Such significant effect was noticed between *Azotobacter* treatment and uninoculated treatment (control). Whereas, there was no significant difference between *Azotobacter* and *Azosbirilum* treatments on studied forage yield triats.

These results may be attributed to nitrogen fixation by non-symbiotic bacteria present in the bio-fertilizer cerealin, which produce some growth hormones and consequently increase nutrients uptake by plants **(Kotb 1998)**. These results agreed with those of **Sheoran *et al* (1998)** on oat plants. Whereas, **Maltseva *et al* (1995)** worked on *Lolium perenne* and *Bromus inermis* and found that inoculating with *Azospirillum* strain significantly increased N fixation in root zone and increased fodder yield of both grasses.

2- Effect of micronutrients

It can be observed from data given in Table (2) that studied growth traits of canary grass plants i.e. plant height, No. of tillers / unit area, flag leaf area and specific leaf weight were increased with $FeSo_4$ spray compared to spraying with $MnSo_4$ or control treatment. In most cases, the above mentioned increments in growth traits are below the level of statistical significant. This trend was noticed in most cuts taken in both seasons ,however, flag leaf area was significantly increased by about 51% in the third cut of the first season and by about 122% in the first cut of the second one compared with control. These findings are in harmony with the results reported by **Khalil *et al* (1991)**.

Considering the effect of spraying with micronutrients on fresh and dry forage yields of canary grass plants, it can be observed from data in Table (3) that the greatest values of both fresh and dry forage yields were achieved when canary grass plants were sprayed with 2%$FeSo_4$ while the lowest values of these traits were obtained with control treatment. Spraying canary grass plants with different micronutrients had a significant effect on dry forage yield. Such significant effect was observed in the third and first cut of first and second seasons ,respectively. Whereas, fresh forage yield was significantly responded to micronutrients in the first cut of the second season only. These results agreed with findings of many investigators among whom **Withee** and **Carlson (1959)** and **Khalil *et al* (1991)**.

It is noteworthy to mention that the interaction between the two main factors under the present study i.e. biofertilizer resources and micronutrients seemed to be without effect on all tested growth and forage yield criteria. So, data of the interaction were excluded and implies that each factor acts independently.

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مجلة اتحاد الجامعات العربية للدراسات والبحوث الزراعية ، جامعة عين شمس ، القاهرة ،١٤(١) ، ٢٠٥-٢١٢ ، ٢٠٠٦

الكفاءة الإنتاجية العلفية لنبات الفلارس وعلاقتها بالتسميد الحيوى وبعض العناصر المغذية الصغرى تحت ظروف الاراضى المستصلحه

[١٣]

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١- وحدة المراعى – مركز بحوث الصحراء – المطريه – القاهرة

أجرى هذا البحث بمحطة بحوث مريوط التابعة لمركز بحوث الصحراء خلال موسمى ٢٠٠٢/٢٠٠٣ و ٢٠٠٣/٢٠٠٤. وقد طبقت تسع معاملات على نبات الفلارس وهى عبارة عن التوافيق بين ثلاث مصادر للتسميد الحيوى هى التلقيح ببكتريا الازوتوبكتر و الازوسبيرلم وبدون تسميد حيوى (معاملة المقارنة) وكذلك ثلاث مغذيات صغرى هى كبريتات الحديد ٢% و كبريتات المنجنيز ١% ومعاملة المقارنة وقد رتبت هذه المعاملات فى تصميم قطع منشقه مرة واحده فى ثلاث مكررات .

ويمكن تلخيص أهم النتائج المتحصل عليها كالآتى :

١- أمكن الحصول على أعلى القيم لكل صفات النمو المدروسة عندما لقحت بذور نبات الفلارس قبل زراعتها ببكتريا الازوتوبكتر وذلك بالمقارنه بالتلقيح ببكتريا الازوسبيرلم وكذلك معاملة المقارنة . هذا وقد أخذت صفات الحاصل العلفى الغض والجاف نفس الاتجاه .

٢- أدى رش نباتات الفلارس بمحلول كبريتات الحديد ٢% الى زيادة كل صفات النمو المدروسه وكذلك صفات الحاصل العلفى الغض والجاف وذلك بالمقارنه برش النباتات بكبريتات المنجنيز ١% وكذلك معاملة المقارنه.

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