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SORGHUM DOWNY MILDEW DISEASE IN RELATION TO GROWTH, NUTRITIVE VALUE AND FORAGE YIELD OF SOME SUDANGRASS VARIETIES

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ABSTRACT

Five local varieties of Sudan grass i.e; Giza 1, Giza 2, Giza 3, Piper and quena Sudan grass as well as two imported varieties i.e., Is22313 and Is 3310 were evaluated for downy mildew resistance, growth parameter, nutritive value and forage yield in disease nursery at Gemmeiza Agricultural Research Station, A.R.C., Egypt during 1999 and 2000 summer seasons.

Results of the combined data over the two seasons demonstrated that disease incidence increased by increasing the cutting numbers. On contrast, growth characteristics i.e.; plant height and stem diameter beside crude protein (CP), crude fiber (CF) and Ash% as well as forage yield were decreased by increasing the cutting numbers.

The selected varieties Is 22313 and quena proved to be highly resistant to disease while Giza2 variety was resistant and can be used as parents for production of resistant hybrids. In addition to the above mentioned varieties contained high level of CP, CF and Ash%, beside fresh and dry forage yield, compared with Giza 3 and Is 3310 which show highly susceptible varieties contained the lowest level of CP, CF and Ash%, beside fresh and dry forage yield.

Keywords: sorghum downy mildew, forage yield.

INTRODUCTION

Forage sorghum is considered to be the most important summer fodder crop in Egypt. Sorghum downy mildew (SDM) caused by *Peronosclerospora sorghi* (Weston and Uppal) Shaw is a serious disease to sorghum [*Sorghum bicolor L*. Moench] and maize [*Zea mays L.*] which decreases yield and nutritive value.

Frederiksen *et al*. (1973) indicated that symptoms of sorghum downy mildew may occur either systemically by the infestation of seedlings via oospores of the fungus borne in the soil or in localized form of the disease results from foliar infection by conidia.

In Egypt more efforts should be directed to select for disease resistance and to improve quantity and quality production of summer forage crops to meet the livestock needs. Gowda *et al*. (1989) tested a large number of maize genotypes against SDM disease under artificial infestation and classified them as fellow : highly resistant (disease incidence ranged from o.o to 5.0%), resistant (5.1 – 10.0%), moderately resistant (10.1 – 20.0%), moderately susceptible (20.1 – 30.0%), susceptible (30.1 – 50.0%) and highly susceptible (50.1 – 100.0%). Nakamura *et al*. (1981) found few number of the tested maize inbred lines exhibiting the highest genetic resistance and could be used as parents for the production of resistant hybrids. Screening for downy mildew resistance and forage production of local and imported sorghum genotypes were done by Mughogho *et al*. (1987), El.Kafrawy *et al*. (1994) and El-Shahawy and Tolba (1999). Marei and Mousa (1996) found that there were significant differences between the tested sorghum hybrids in fresh, dry, crude protein, crude fiber and ash yields and the highest respective yields were obtained by the local sorghum – sudangrass hybrid 102.

The presesnt investigation aims to study the relationship between SDM disease and growth, nutritive value and forage yield of some Sudan grass (*Sorghum Sudanense*) varieties.

MATERIALS AND METHODS

The present work was conducted at Gemmeiza Agricultural Research Station, A.R.C., during 1999 and 2000 successive summer seasons to evaluate local and imported Sudan grass germplasms as follow : 1) local varieties i.e., Giza1, Giza2, Giza3, Piper and quena sudangrass. 2) Imported varieties i.e; Is 22313 and Is 3310 for SDM resistance and its relation to growth, nutritive value and forage yield.

Soil contains a large number of downy mildew oospores coming from the annual infestation was planted. Seven sudangrass germplasms were planted in complete randomized blocks design with four replicates. Each plot area was 6m^2 (3.0 x 2.0m). Phosphorus and potassium fertilizers were added as single dose before sowing at a rate of 200 kg/food calcium superphosphate (15.5% P_2O_5) and 50 kg/fed. potasium sulphate (48% K_2O). Seeds were sown in beds 25 cm apart on June 5 and 25 in 1999 and 2000 seasons, respectively. Nitrogen fertilizer at a rate of 90 kg/fed as urea (46.5%N) three equal doses, applied 21 days after sowing, then after the first and the second cut. Three cuts were taken after 50, 85 and 120 days of sowing.

The systemic infection of sorghum downy mildew was recorded as a percentage before each cut. The terminal reading was considered to be the degree of genotypes resistance to the disease according to scale adopted by Gowda *et al*. (1989). Other agricultural practices were done as a recommended in the region. The following characteristics were considered

a- Growth:

Ten plants were randomly selected from each plot before cutting and the following characters were recordes.

1- Plant height in cm.

2- Stem diameter in mm. Was measured at the third internode.

b- Chemical analysis:

Plant samples were oven dried at 70c^o to the constant weight. The chemical contents i.e; crude protein CP, crude fiber CF and Ash% were determined as described by A.O.A.C., (1980).

c- Yield:

Plants were cut to a hight of about 10 cm above soil level and immediately weighted after each cutting to determine fresh forage yield, then converted to ton/fed.

Dry forage yield (kg / fed.) was calculated by multiplying fresh forage yield by dry matter percentage.

d. Statistical analysis:

Data were statistically analysed according to Snedecor and Cochran (1980) using the MSTAT computer program, V.4 (1986). The least significant difference test was used to compare means.

RESULTS AND DISCUSSION

Table (1) indicated that out of 7 genotypes, Is 22313 and quena Sudan grass proved to be highly resistant (0.0 and 5%), Giza 2 was considered resistant (6.5%) whereas Giza 1 and Piper were susceptible (43.25 and 31.75%). Giza 3 and Is 3310 was considered highly susceptible (53.5 and 78.5%) respectively.

SDM increased by increasing the cutting numbers. It may due to spore exciting and new infection that occurred on new tillers.

The previous results showed that selected genotypes, Is 22313, quena and Giza 2, as evaluated in the field trial, can be used as a parents for the production of resistant hybrids. These results are in accordance with findings of Fredriksen *et al*. (1973) who found that in most crosses made between resistant and susceptible parents, gave hybrids of intermediate reaction.

Table (1): Evaluation sorghum sudan grass Varieties for downy mildew resistance in 1999 and 2000 seasons.

Genotypes	% Infection									
	First season			Second season			Combined over seasons			
	1st rec.	2nd rec.	3rd rec.	1st rec.	2nd rec.	3rd rec.	1st rec.	2nd rec.	3rd rec.	Mean
Giza 1	33.00	42.50	46.50	25.50	40.00	4.00	29.25	41.25	43.25	37.92
Giza 2	2.00	5.00	6.00	1.50	7.00	7.00	1.75	6.00	6.50	4.70
Giza 3	25.50	52.00	57.00	21.00	50.00	50.00	23.25	51.00	53.50	42.58
Piper	22.50	22.50	34.50	18.00	29.00	29.00	20.25	25.75	31.75	25.92
Quana sudan grass	3.50	4.00	6.00	3.00	3.00	4.00	3.25	3.50	5.00	3.92
Is 22313	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Is 3310	30.00	73.00	76.50	29.50	75.50	80.50	29.75	74.25	87.50	60.83
LS.Dat 0. 05	8.92	9.90	6.00	3.88	8.57	6.43	7.02	8.63	9.48	
LS.Dat. 0.01	12.47	13.85	8.39	5.43	11.99	9.00	8.95	11.73	12.88	

Combined data in Table (2) show that Giza1 gave the maximum values of the plant height. It reached 150.3, 103.7 and 99.7 cm at the first, second ant the third cut, respectively, wherease Is 22313 gave the minimum values of the plant height. It were 88.0, 80.2 and 68.3 cm at the 1st, 2nd and the 3rd cut respectively. These significant differences in plant height may due tod iffferences in genetic agents between varieties.

Table (2): Plant height of sorghum sudangrass varieties in 1999 and 2000 seasons.

Genotypes	First season (cm)			Second season (cm)			Combined over seasons (cm)		
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
Giza 1	150.5	101.5	100.5	150.0	105.8	98.8	150.3	103.7	99.7
Giza 2	132.8	99.4	89.0	136.0	95.5	89.4	134.4	97.5	89.2
Giza 3	115.3	108.7	98.0	105.9	105.0	98.2	110.6	106.9	98.1
Piper	134.3	110.1	108.5	137.2	107.2	106.8	135.8	108.7	107.7
Quana sudan grass	124.9	99.9	98.7	123.8	104.9	102.4	124.4	102.4	100.6
Is 22313	91.4	78.9	69.6	84.5	81.4	66.9	88.0	80.2	68.3
Is 3310	124.9	77.3	73.5	115.7	80.0	75.5	120.3	78.7	74.5
L.S.Dat 0. 05	5.4	2.2	3.5	11.2	3.1	2.7	9.0	3.2	3.2
L.S.Dat. 0.01	7.6	3.1	4.8	15.7	5.6	3.8	12.2	4.3	4.3

Combined data presented in Table (3) indicated that Is 22313 which show highly resistant gave the maximum values of stem diameter. They were; 13.2, 12.1 and 10.9 mm. at the first, second and the third cut, respectively, whereease Is 3310 which show highly susceptible gave the minimum values of stem diameter. They were; 7.4, 7.2 and 6.4 mm. at the 1st, 2nd and the 3rd. cut, respectively. These significant results agreement with those found by Basarkar *et al* (1990) and Marei (1992) who stated that total free amino acid contents was highest in resistant sorghum cultivar DMRSI and converted into growth regulators which are responsible for increasing stem diameter.

Table (3): Stem diameter of sorghum sudangrass varieties in 1999 and 2000 seasons.

Genotypes	First season (mm)			Second season (mm)			Combined over seasons (mm)		
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
Giza 1	9.9	9.5	9.4	10.3	9.7	9.4	10.1	9.6	9.4
Giza 2	9.5	8.5	8.5	9.3	8.8	8.5	9.4	8.7	8.5
Giza 3	8.9	8.6	8.2	9.1	9.0	8.6	9.0	8.8	8.4
Piper	11.5	10.6	8.2	11.3	10.8	7.9	11.4	10.7	8.1
Quana sudan grass	10.2	9.9	9.5	9.7	9.3	7.4	10.0	9.6	9.4
Is 22313	13.2	11.9	10.7	13.2	12.2	11.0	13.2	12.1	10.9
Is 3310	7.5	7.3	6.3	7.3	7.0	6.5	7.4	7.2	6.4
L.S.Dat 0. 05	0.3	0.8	0.2	0.2	0.4	0.4	0.3	0.4	0.6
L.S.Dat. 0.01	0.5	1.1	0.3	0.3	0.6	0.6	0.4	0.5	0.8

Nutritive value of studied sorghum sudan grass was determined as percentages of CP, CF and ash. Table (4) showed that Is 22313 variety contained high level of CP being 9.92%, wherease Is 3310 contained the lowest being 9.16% Boyer (1995) mentioned that reducing protein synthetic activity could decrease the synthesis of metabolites and enzymes responsible for disease resistance. CF% considered non digested polysaccharides precipitated on cell walls. In this regard, Is 22313 contained high level of CF%

(26.28%) wherease Is 3310 contained the lowest one (24.38%). Ash % considered macro and micro elements nessary for enzymatic activity in plants which responsible for disease resistance. So, resistant variety Is 22313 contained high level of Ash %. It was 10.86% whereas highly susceptible variety Is 3310 contained the lowest level of Ash % It was 9.87%. previous results indicated that sorghum sudan grass contains of CP, CF and Ash % decrease by increasing number of cuts, in contrast of SDM incidence. These contents are responsible for SDM resistance, as well as its nutritive value to sorghum sudangrass.

Table (4): Crude protein, Crude fiber and ash percentages of sorghum sudan grass varieties.

Genotyps	Grude Protein %				Crude fiber %				Ash %			
	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
Giza 1	9.88	9.34	8.65	9.29	22.06	26.42	26.49	24.99	11.78	10.58	8.98	10.45
Giza 2	9.93	9.10	8.58	9.20	25.33	25.62	27.49	26.15	11.64	10.52	10.38	10.85
Giza 3	10.12	8.90	8.61	9.21	23.11	24.20	27.28	26.86	11.50	10.36	9.60	10.49
Piper	9.98	9.73	8.95	9.55	23.66	24.95	26.49	25.03	11.46	10.44	10.40	10.77
Quana sudan grass	9.98	9.53	9.00	9.50	23.97	26.06	26.35	25.46	10.94	10.64	9.68	10.42
Is 22313	10.17	9.54	9.05	9.92	25.70	26.42	26.71	26.28	11.74	10.44	10.40	10.86
Is 3310	9.99	9.00	8.50	9.16	22.14	24.80	26.21	24.38	10.98	9.52	9.10	9.87
L.S.Dat 0. 05	0.25	0.22	0.17		N.S.	0.02	0.02		0.02	0.01	0.01	
L.S.Dat. 0.01	N.S.	0.31	0.24		N.S.	0.03	0.03		0.03	0.01	0.01	

Significant differences were observed between combined data presented in Tables (5, 6) show that highly resistant variety Is 22313 gave that highest total fresh forage and dry yield. They were 37.9 ton/fed. and 5.089 ton/fed, respectively, whereas, Giza3 and Is 3310 which show highly susceptible varieties gave the lowest yield. They were; 26.9 and 27.4 ton/fed as total fresh yield, respectively and 4.221 and 4.159 ton/fed, as dry yield, respectively. Fresh and dry yield decreased also by increasing the number of cuttings.

Table (5): Fresh forage yield of sorghum sudan grass varieties in 1999 and 2000 seasons.

Genotypes	First season (ton/fed)				Second season (ton/fed)				Combined over season (ton/fed)			
	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total
Giza 1	18.5	6.6	3.2	28.3	17.4	13.9	8.0	36.2	16.4	10.3	5.6	32.3
Giza 2	18.9	7.1	5.3	31.3	24.2	12.4	5.6	42.2	26.0	9.8	5.5	36.9
Giza 3	25.8	3.0	2.5	31.3	16.6	3.8	2.0	22.4	21.2	3.4	2.3	26.9
Piper	22.6	7.2	4.3	34.1	19.5	7.4	4.3	31.2	26.1	7.3	4.3	37.7
Quana sudan grass	22.9	9.4	4.1	36.4	17.5	12.4	6.2	36.1	20.2	10.9	5.2	36.3
Is 22313	26.1	9.1	3.0	38.2	25.6	8.8	2.9	37.3	25.9	9.0	3.0	37.9
Is 3310	24.6	4.3	1.4	30.3	18.2	5.1	1.1	24.4	21.4	4.7	1.3	27.4
L.S.Dat 0. 05	2.2	1.7	0.8	2.4	2.2	0.9	0.7	3.9	23.0	0.6	1.6	3.5
L.S.Dat. 0.01	3.0	2.4	1.2	3.4	3.0	2.1	0.9	5.5	3.1	0.8	2.2	4.8

6 الأصـــل

These results are in agreement with findings of Craig *et al*. (1989) who indicated that any differences in yield between resistant and susceptible populations were attributable to the disease. These changes may be caused by a reduction in chlorophyll content and photosynthesizing leaf area and for its reduced efficiency (Goodman *et al*., 1986).

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العلاقة بين الإصابة بمرض البياض الزغبى والنمو والقيمة الغذائية ومحصول العلف لبعض أصناف حشيشة السودان

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أجرى هذا البحث فى حقل الأمراض بمحطة البحث الزراعية بالجميزة فى موسمى 1999 ، 2000 بغرض تقييم 5 أصناف محلية من حشيشة السودان مثل جيزة 1، جيزة 2، جيزة 3، بايبر، وحشيشة سودان قنا بجانب صنفين مستودرين هما Is 22313 و Is 3310 وذلك ضد مرض البياض الزغبى، وقياسات النمو الخضرى، والقيمة الغذائية ومحصول العلف – وكانت النتائج تشير إلى الآتى:

- تزداد نسبة الإصابة بالمرض معنوياً بزيادة عدد الحشات وعلى العكس من ذلك تقل قياسات النمو مثل ارتفاع النبات وقطر الساق بجانب البروتين والألياف الخام والرماد وأيضاً يقل محصول العلف بزيادة عدد الحشات.
- كلا من الصنفين حشيشة سودان قنا و Is 22313 أبدت مقاومة عالية للمرض بينما صنف جيزة 2 الذى أظهر مقاومته للمرض من الممكن استخدامها كإباء فى إنتاج الهجن المقاومة بالإضافة كما ذكر سابقاً إحتوت تلك الأصناف على نسبة عالية من البروتين والألياف الخام والرماد بجانب اعطائها محصول كبير من العلف.
- بالمقارنة بما سبق نجد أن الصنفين جيزة 3 ، Is 3310 واللذين أظهرا حساسية عالية للمرض أحتوت على أقل قيم من البروتين والألياف الخام والرماد بجانب اعطائها محصول أقل من العلف.

Table (6): Dry yield of sorghum sudangrass varieties in 1999 and 2000 seasons.

Genotypes	First season (kg/fed)				Second season (kg/fed)				Combined over season (kg/fed)			
	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total
Giza 1	3950	483	215	4648	3066	593	159	3818	3508	538	187	4233
Giza 2	2646	918	697	4261	3556	1568	477	5601	3101	1243	587	4931
Giza 3	4078	398	360	4836	2768	516	322	3606	3423	457	341	4221
Piper	3318	976	693	4967	2755	803	738	4296	3037	890	706	4633
Quana sudan grass	3314	927	547	4788	2647	1400	1033	5080	2981	1164	790	4935
Is 22313	3601	853	427	4881	3661	1224	411	5296	3631	1039	419	5089
Is 3310	2756	745	432	3933	2134	1195	1056	4385	2445	970	744	4159
L.S.D at 0. 05	562	124	84	593	408	90	134	492	503	113	110	558
L.S.D at. 0.01	787	174	117	830	570	126	188	692	683	154	150	759