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EVALUATION OF PRODUCTIVITY FOR SOME FORAGE SORGHUM GENOTYPES SELECTED FOR DOWNY MILDEW DISEASE RESISTANCE

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ABSTRACT

Eight of forage sorghum genotypes were screened for their resistance against downy mildew disease during 1997 - 1999 growing seasons. In addition, a silage group (26 genotypes) also were evaluated during 1996 – 1999 seasons in the downy mildew disease nursery.

Seven and two selected genotypes from the first and second groups in respect, plus local hybrid-102 as a check, were sown in a field trial for the evaluation of their productivity during 1998 and 1999. A randomized complete block design with four replications was used.

The reaction of selected forage sorghum genotypes (7 genotypes) plus local hybrid-102 against the disease were ranged from highly resistant and resistant during the tested seasons. While, out of 26 silage sorghum genotypes, nine genotypes proved to be highly resistance, one genotype was resistant, the rest of silage genotypes were ranged from susceptible and highly susceptible to the disease, during 1996 and 1997 seasons.

The studied crop parameters were: plant height, stem diameter, fresh and dry leaf/stem ratio, dry matter percentage, crude protein content and fresh and dry forage yield.

The study gave evidence to the presence of significance among the tested genotypes in regard to the concerned parameters. Aon 404 and local hybrid-102 were the tallest plants at most cuts during the two seasons. The previous two genotypes plus MN 1279 exhibited the highest stem thickness in most cases. On the other hand, the genotype G.D. 47819 was distinctive in fresh and dry leaf/stem ratios with few exceptions. Genotypes IS 641, GD 47821 and MN 1279 exhibited the lowest level of dry matter percentage particularly at the first and second cuts during the two seasons.

The highest total fresh yield was recorded with Aon 404 and MN 1279 during 1998 and local hybrid-102 during 1999 growing seasons. Whereas the highest combined total fresh yield was recorded with MN 1279. As regard to total dry forage yield, Aon 404 and local hybrid-102 were superior during 1998 and 1999, respectively. The two genotypes gave best results regarding the combined total dry yield through out the two seasons. They gave also high crude protein content at the three cuts in both seasons. However, GD 47819 genotype had the highest crude protein content at all cuts in the two seasons.

General speaking, the genotype Aon 404 could be recommended as forage yield production as compared to the local hybrid 102. However, MN 1279 can serve as fodder yield production. Moreover, the selected nine genotypes could be utilized in the breeding program as parents for downy mildew resistance.

INTRODUCTION

Forage sorghum is one of the most important summer forage crops in Egypt. Sorghum is subjected to be attack of downy mildew disease, which decreases forage yield and quality. Sorghum is considered one of the downy mildew hosts of which it's pathogen can be transferred to maize causing great losses in grain yield.

Sorghum downy mildew (SDM) caused by *Peronosclerospora sorghi* (Kulk) Westan & Uppal., is a serious disease to sorghum [*Sorghum bicolor* (L.) Moench] and maize (*Zea mays* L.) in many parts of Asia, Africa and USA in 1928, sorghum downy mildew was identified in Egypt by Melchers, 1931. Planting cultivars resistant to the pathogen is likely to be a main component in any breeding program for disease resistance and to avoid pollution, however seed treatment with fungicides and special cultural practices have shown rather promising results in controlling SDM. However, because *P. sorghi* has shown variability in pathogenicity at the host species level and among sorghum cultivars, resistance break down due to the development and spread of more virulent races of the pathogen will probably complicate controlling procedures based on resistant cultivars (Craig and Frederiksen, 1980 and Frederiksen and Craig, 1981).

The need for new varieties, inbred lines and hybrids exhibiting resistance to downy mildew disease has been pointed out by many investigators. Thomas and Lengkeek (1979) showed that sorghum downy mildew incidence reached significant level in several localized areas in Kansas in 1978. They showed that both shuttercane (*Sorghum bicolor*) and Jahnsongrass (*S. halapense*) were found to be infected. However, Partridge and Doupnik (1979) stated that the disease was found on sorghum and shuttercane in Nebraska. Ial and Saxena (1983) mentioned that the disease favored the prevalence of low temperature (20-24°C) and high humidity (90% and above) in nights during seed germination and early period of plant growth. Frederiksen (1980) summarized the mode of sorghum downy mildew infection as follows: 1- Oospores on seed or with debris, by wind or in soil from infested areas, 2- Condia from infested plants, and 3- Mycelium in seed or in living hosts. Setty and Safeeulla (1981) suggested that plants inoculated just after emergence and up to 4-5 leaf stage were highly susceptible. Frederiksen *et al*. (1973 a) mentioned that symptoms of sorghum downy mildew disease may occur either systemically or in localized form. The systemic form of the disease is caused by the infestation of seedlings via oospores of the fungus borne in the soil or by conidia soon after seedling emergence from the soil. The localized form of the disease results from foliar infection by conidia. Frederiksen *et al*. (1973 b) reported that in most crosses of resistant by susceptible parents, the reaction of resulting hybrid proved to have intermediate response against the disease. Craig *et al.* (1977) and Nakamura *et al*. (1981) reported that most of maize hybrids and composites, introduced for commercial use were susceptible to *P. sorghi*. They also found few number of the tested maize inbred lines exhibiting the highest genetic resistance and could be used as parents to obtain resistant hybrids. Although, Gowda *et al*. (1989) tested large number of maize genotypes against sorghum downy mildew disease via artificial inoculation and classified them as follows: highly resistant (disease incidence ranged from 0.0 to 5.0%), resistant (5.1 – 10%), moderately resistant (10.1 – 20%), moderately susceptible (20.1 – 30%), susceptible (30.1 – 50%) and highly susceptible (50.1 – 100%). El-Shahawy and Tolba (1999) stated that some selected sorghum genotypes, which gave higher forage yield, can be used as parents in breeding sorghum program or used as cultivars for forage production. They reported also that the selected genotypes were significantly different in plant height, stem diameter, fresh and dry leaf/stem ratio and fresh and dry forage yield.

The main objectives of this work were to screen different genotypes from the world sorghum collection and silage sorghum group to obtain resistance sources of downy mildew disease, and evaluating those resistant genotypes for forage yield and quality.

MATERIALS AND METHODS

The present investigation was carried out at Sakha Agricultural Research Station during four successive seasons, 1996 – 1999. The materials included genetically diverse *Sorghum bicolor* (L.) Moench and *Sorghum sudanense* (Piper) Staph and a group of twenty six of silage sorghum genotypes were supplied from Forage Crops Section, A.R.C.

Sudangrass (*Sorghum sudanense*) variety Piper black was planted in single rows as a spreader at Sakha disease nursery during 1996 – 1999 period (Soil is known to contain downy mildew fungus oospores because of the annual artificial soil infestation). Each genotype was sown in a plot of 4.8 m^2 consisted of 2 rows with 4 m long and 60 cm apart with two replications. The trials were conducted in hills 20 cm apart. The hills were thinned to one plant/hill. All agricultural practices were performed as recommended. Disease assessment was estimated and expressed as infection percentage three times, viz. 45 days from sowing and 30 days intervals thereafter. The last reading was considered to be actual resistance exhibited by the entry according to the scale adopted by Gowda *et al*. (1989). At further growth stage, all genotypes were bagged to protect seeds from bird damage and to obtain the selfed seed.

During 1998 and 1999 seasons, the selected 7 and two resistance genotypes (MN1279 and Roma) from the first group and silage sorghum group, respectively, in addition to the local hybrid-102 were evaluated for fresh and dry forage yields. For the evaluation trials, a randomized complete block design with four replications was used. Plot area was $2m \times 3m = 6\ m^2$. Seeds were sown using the broadcasting method with 20 kg/fad. The two field trials were planted at June, 4^{th} and 6^{th} in 1998 and 1999 seasons, respectively. Phosphorus fertilizer was added at 20 kg P_2O_5 during land preparation and 30 kg N/fad was applied after 21 days of sowing, following the first and second cuts.

Three cuts were taken after 50 days from sowing, 40 days after first cut and 35 days after second cut through each season. The studied characters were: plant height (cm), stem diameter (cm), fresh and dry leaf/stem ratio (%), dry matter percentage (%) fresh and dry forage yield (ton/fad) and crude protein content (%) according to A.O.A.C. (1980). Combined analysis of each of total fresh and dry forage yield in both seasons was performed. The data was statistically analyzed using the M. STAT computer program. Duncan's multiple range test was used to compare means at 0.05 level of probability (Duncan, 1955).

RESULTS AND DISCUSSION

Screening for downy mildew resistance:

Data in Tables 1 and 2 revealed the disease expression in terms of infection percentage, the results indicated that out of 8 forage sorghum genotypes, 3 proved to be resistant (infection ranged from 5.1 to 10%), while the rest of tested genotypes were highly resistant (infection ranged from 0.0 to 5.0%) during 1998 and 1999 seasons according the scale adopted by Gowda *et al*. (1989). While, the results presented in table 2 showed that, out of 26 silage sorghum genotypes, nine genotypes proved to be highly resistant (infection ranged from 0.0 to 5.0%) while the rest of tested silage genotypes were ranged from resistant, moderately resistant, susceptible and highly susceptible.

Table (1): Evaluation of 8 selected sorghum genotypes against downy mildew in terms of percentage of infection during 1997-1999 seasons.

No.	Genotypes	1997	1998	1999	No.	Genotypes	1997	1998	1999
1	I.S. 8887	0.0	0.0	0.0	**5**	I.S. 641	8.2	8.4	3.8
2	Aon 404	6.6	0.0	0.0	**6**	G.D. 47819	0.0	0.0	0.0
3	R.G.O. 216	0.0	0.0	0.0	**7**	G.D. 47821	2.2	8.4	10.0
4	I.C.S.V. 93078	0.0	0.0	0.0	**8**	Local hybrid-102	0.0	6.1	0.0

Table (2): Evaluation of 26 silage sorghum genotypes against downy mildew in terms of percentage of infection during 1996-1999 seasons.

No	Genotypes	1996	1997	1998	1999	No.	Genotypes	1996	1997	1998	1999
1	MN 960	91.0	85.6	-	-	.	Roma (small white seed)	20.0	20.0	-	-
2	MN 1060	100.0	96.2	-	-	.	Roma (big red & white seed)	0.0	3.0	0.0	0.0
3	MN 1279	0.0	2.9	0.0	0.0	.	Rex	66.7	52.6	-	-
4	MN 2756	5.6	6.3	-	-	.	Rey	0.0	0.0	-	-
5	MN 3080	66.7	58.6	-	-	.	Romada	0.0	0.0	-	-
6	MN 4418 (red)	20.0	17.2	-	-	.	Wiley	42.9	35.5	-	-
7	MN 4418 (white)	25.0	22.0	-	-	.	Williams	0.0	0.0	-	-
8	MN 4490	66.7	58.5	-	-	.	Wroy	50.0	40.3	-	-
9	MN 4512	0.0	0.0	-	-	.	Brawly	100.0	89.7	-	-
10	MN 4514	100.0	91.0	-	-	.	Grassl	19.2	21.5	-	-
11	MN 5409	20.0	16.5	-	-	.	Honey	0.0	0.0	-	-
12	MN 1054	0.0	0.0	-	-	.	Grossi	10.0	12.1	-	-
13	MN 4414	100.0	89.0	-	-	.	Kollier	0.0	0.0		

The previous results show that most selected genotypes (first and second groups) evaluated in the disease nursery have reaction of 0.0 – 5.0 infection percentage to the disease, and can be used as parents for production of resistant hybrids. These results are in accordance with findings of Frederiksen *et al*. (1973 a) who found that in most crosses of resistant by susceptible parents, the reaction of resulting hybrid is intermediate in reaction. These results were also agreed with those of Frederiksen *et al*. (1973 b), Craig *et al*. (1977) and Nakamura *et al*. (1981), they tested a large number of maize and sorghum genotypes and found a few number of the tested genotypes had the highest genetic resistance, and can be used as parents for production of resistance hybrids.

Plant height (cm):

Data presented in Table 3 show that there were significant differences among genotypes in plant height. The genotypes Aon 404 and local hybrid-102 were the tallest plants at all cuts in 1998 and 1999, except that of the first cut in 1998 and 1999 for local hybrid-102 and Aon 404, respectively. The genotypes No. 6, 6 and 5 and No. 5, 4 and 6 had the shortest plants at the first, second and third cuts in 1998 and 1999 seasons, respectively. El-Shahawy and Tolba (1999) obtained similar findings where their genotyeps differed significantly in plant height.

Stem diameter (cm) :

Genotypes Aon 404, local hybrid-102 and MN 1279 gave significantly the thickest stem diameter at the three cuts in both seasons, except at the third cut in 1998. In addition, genotype I.S. 8887 gave also thick stems at all cuts in both seasons, except that of the second cut in 1999 (Table 3). Sorghum genotypes No. 4, 4, 7 and 6, 4, 6 were the thinnest at the three cuts in 1998 and 1999, respectively. These results agreed with those obtained by El-Shahawy and Tolba (1999).

Fresh leaf/stem ratio (%):

Fresh leaf/stem ratio was significantly different among the selected sorghum genotypes at all cuts in both seasons where genotype G.D. 47819 had the highest ratios, except that of first cut in the first season (Table 3). Genotypes No. 7, 7, 2 and No. 7, 10, 10 gave the lowest ratios at the three cuts in 1998 and 1999, respectively. These results agree with that of El-Shahawy and Tolba (1999).

Dry leaf/stem ratio (%):

Dry leaf/stem ratio gave almost the same trend as fresh leaf/stem ratio where genotype G.D. 47819 had significantly the highest ratios at the three cuts in the two seasons, except that of first cut in 1998, sorghum genotypes 4, 4, 2 and 10,7,7 gave the lowest ratios, (Table 3).

Dry matter percentage (%):

Data in Table (4) indicated that genotypes IS 641, and MN 1279 had low dry matter percentage at the first and second cuts in both seasons. Roma silage genotype had low dry matter percentage at the first cut in the first season, and at the first and second cuts in the second season (Table 4).

Crude protein content (%):

Concerning the crude protein content, genotype G.D. 47819 gave the highest crude protein content, this could be attributed to it's highest fresh and dry leaf/stem ratio, and dry matter percentage in all cuts during both seasons. In general, the genotype G.D. 47821 gave the lowest crude protein content at most cases. The three genotypes Aon 404, MN 1279 and local hybrid-102 gave high crude protein content at most cuts in both seasons (Table 4).

Fresh forage yield (ton/fad.):

Data in Table (5) show that significant differences were detected among fresh forage yields of the selected sorghum genotypes at the three cuts, their total in both seasons and combined fresh total yield genotypes Aon 404 and MN 1279 gave the highest total fresh yield in 1998, i.e., 58.188 and 55.913 ton/fad., respectively. In 1999, local hybrid-102 produced the highest total yield (61.600 ton/fad.). Genotype MN 1279 resulted in the highest combined fresh total yield (56.219 ton/fad.). In this respect, the same three genotypes have the tallest and the thickest plants, therefore they resulted in the highest yields. Genotypes No. 5, 6, 7 and No. 6, 3, 7 had the lowest fresh yield at the three cuts in 1998 and 1999, respectively and genotype No. 5 gave the lowest total fresh yield in both seasons (37.406 and 31.150 ton/fad, respectively) and its combined total (34.278 ton/fad.). Similar results were obtained by El-Shahawy and Tolba (1999).

Table (4): Evaluation of yield productivity for ten resistant sorghum genotypes to sorghum downy mildew in terms of dry matter percentage and crude protein content at the three cuts in 1998 and 1999 seasons.

No.	Genotypes	1998			1999		
		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
	Dry matter (%)						
1.	Aon 404	11.0	11.2	13.6	13.8	12.4	13.7
2.	I.S. 641	9.5	10.7	13.7	11.0	11.2	13.5
3.	I.S. 8887	11.4	11.9	13.3	13.7	12.8	14.3
4.	R.G.O. 216	12.0	12.0	13.2	13.0	12.6	12.4
5.	I.C.S.V. 93078	11.3	13.5	16.3	12.3	15.8	16.5
6.	G.D. 47819	12.1	14.2	14.1	12.2	14.3	15.0
7.	G.D. 47821	10.7	10.1	13.3	11.5	11.4	12.6
8.	MN 1279	9.7	10.8	14.8	11.0	11.7	14.0
9.	Roma	9.9	12.7	13.5	11.8	11.7	13.0
10.	Local hybrid-102	13.3	11.1	13.4	12.0	12.8	14.1
	Crude protein content (%)						
1.	Aon 404	10.17	11.80	11.80	11.19	11.70	11.90
2.	I.S. 641	10.17	11.80	11.80	11.19	11.80	11.80
3.	I.S. 8887	10.17	11.70	11.70	11.19	11.70	11.90
4.	R.G.O. 216	10.68	11.19	11.90	10.17	11.70	11.80
5.	I.C.S.V. 93078	11.19	11.70	11.80	11.70	11.80	11.80
6.	G.D. 47819	11.19	11.80	11.80	11.70	11.80	11.90
7.	G.D. 47821	10.77	11.19	11.19	10.68	11.19	11.80
8.	MN 1279	10.17	11.80	11.80	10.17	11.70	11.90
9.	Roma	10.17	11.19	11.19	10.68	11.90	11.90
10.	Local hybrid-102	11.19	11.80	11.80	10.68	11.19	11.70

Dry forage yield (ton/fad.):

The results in Table (5) show that there were significant differences among dry yields of the selected genotypes, at the three cuts in the two seasons, where genotype Aon 404 and local hybrid-102 gave the highest total dry yields, 6.784 and 7.772 ton/fad. in the first and second seasons, respectively. Meanwhile the same two genotypes resulted in the highest combined total dry yield, where they produced 6.692 and 6.849 ton/fad., respectively.

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Although MN 1279 silage genotype produced the highest combined total fresh yield, it failed to show up in the total dry yield because of it's low content in dry matter at the first and second cuts in both seasons. On the other hand, the highest two genotypes in the total dry yield (Aon 404 and local hybrid-102) had high dry matter percentage. Genotypes No. 5, 3, 3 and

No. 5, 3, 7 had the lowest dry yield in the three cuts in both seasons, respectively, genotypes No. 3, 5 produced the lowest total dry yield (4.499, 4.454 ton/fad., respectively) and genotype No. 5 had the lowest combined total dry yield (4.659 ton/fad.). El-Shahawy and Tolba (1999) found similar results.

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تقييم الإنتاجية لبعض التراكيب الوراثية المنتخبة لمقاومة مرض البياض الزغبى فى سورجم العلف

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أجريت هذه الدراسة فى حقل الأمراض بمحطة البحوث الزراعية بسخا خلال الفترة من 1996 – 1999 لعدد 8 تركيب وراثى من سورجم العلف لاختبارها لمقاومة مرض البياض الزغبى بالإضافة الى 26 تركيب وراثى من سورجم السيلاج حيث تم التقييم للمجموعة الأولى خلال المواسم 1997- 1999 وللمجموعة الثانية خلال 1996 – 1999 للمقاومة لمرض البياض الزغبى.أظهرت النتائج أن استجابة الطرز الوراثية من سورجم العلف (8 طراز وراثى) ضد المرض تراوحت ما بين عالية المقاومة ومقاومة للإصابة. على الجانب الأخر وجد أن تسعة طرز وراثية من سورجم السيلاج كانت عالية المقاومة للمرض بالإضافة الى طراز وراثى واحد مقاوم للمرض بينما تراوحت بقية الطرز الوراثية من سورجم السيلاج ما بين قابلة للإصابة الى عالية القابلية للإصابة بالمرض خلال مواسم الدراسة.

تم انتخاب السبعة تراكيب وراثية فى المجموعة الأولى واثنين من مجموعة سورجم السيلاج المقاومة لمرض البياض الزغبى بالإضافة الى الهجين المحلى 102 كمقارنة. وأجريت تجربة حقلية لتقييم محصول العلف الأخضر والجاف ومحتوى البروتين الخام خلال الفترة 1998- 1999 فى قطاعات كاملة عشوائية ذات أربع مكررات. وتم دراسة صفات ارتفاع النبات وسمك الساق ونسبة الأوراق للسوق اخضر وجاف والنسبة المئوية للمادة الجافة ومحتوى البروتين الخام ومحصول العلف الأخضر والجاف. أظهرت الدراسة وجود فروق معنوية بين التراكيب الوراثية المنتخبة للمقاومة لمرض البياض الزغبى فى الصفات تحت الدراسة وكان التركيبان الوراثيان Aon 404 والهجين المحلى 102 هما أطول النباتات فى معظم الحشات خلال موسمى الدراسة وأعطى نفس التركيبان الوراثيان السابقان بالإضافة الى التركيب الوراثى MN 1279 أعلى سمك قطر للساق فى معظم الحشات.

ومن ناحية أخرى أعطى التركيب الوراثى G.D. 47819 أعلى نسبة أوراق/ الساق أخضر وجاف مع بعض الأستثناءات البسيطة. وقد أظهرت التراكيب الوراثية I.S. 641 ، MN 1279 G.D. 47821 أقل نسبة مئوية للمادة الجافة للعلف الأخضر خلال الموسمين خاصة فى الحشة الأولى والثانية. وأعطى التركيبان الوراثيان Aon 404 ، MN 1279 أعلى محصول علف أخضر كلى فى موسم 1998 وهجين محلى 102 أعلى محصول علف أخضر كمتوسط للموسمين 1999 بينما أظهر التركيب الوراثى MN 1279 أعلى محصول علف أخضر كلى مشترك. وبالنسبة لمحصول العلف الجاف الكلى كان Aon 404 متفوق فى موسم 1998 والهجين المحلى 102 متفوق فى موسم 1999 وأعطى التركيبان الوراثيان Aon 404 ، والهجين المحلى 102 أعلى محصول علف جاف كمتوسط للموسمين. كما أعطيا محتوى بروتينى خام مرتفع فى الحشات الثلاثة خلال موسمى الدراسة، رغم أن التركيب الوراثى G.D. 47819 كان الأعلى فى محتوى البروتين الخام فى كل الحشات خلال الموسمين.

وكتوصية عامة فإن التركيب الوراثى Aon 404 يوصى بزراعته مباشرة لإنتاج محصول علف يتساوى تقريباً مع الهجين المحلى 102، وأن التركيب الوراثى MN 1279 يمكن استخدامه لإنتاج محصول علف أخضر واكثر من ذلك يمكن استخدام التسع تراكيب الوراثية فى برامج التربية كأباء معطية للمقاومة لمرض البياض الزغبى فى السورجم.

Table (3): Plant height (cm), stem diameter (cm), and fresh and dry leaf/stem ratio (%) of the studied genotypes at the three cuts in 1998 and 1999 seasons.

No.	Genotypes	1998			1999			1998			1999		
		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
		Plant height						Stem diameter (cm)					
1.	Aon 404	121.5 a	116.5 a	148.4 ab	165.0 c	124.8 ab	117.8 a	1.00 ab	1.43 ac	1.45 bc	1.80 a	1.03 ac	1.35 a
2.	I.S. 641	124.5 a	107.8 cd	129.3 cd	160.3 d	100.0 c	103.3 de	1.00 ab	1.48 ac	1.43 bc	1.65 b	0.93 de	1.20 cd
3.	I.S. 8887	98.3 c	92.8 f	127.3 d	132.0 f	79.5 ef	106.3 cd	0.98 ab	1.55 ab	1.65 a	1.73 ab	0.98 ce	1.33 ab
4.	R.G.O. 216	99.5 c	107.0 d	132.8 bc	130.8 f	78.0 f	113.8 b	0.80 b	1.23 c	1.40 cd	1.65 b	0.90 e	1.20 cd
5.	I.C.S.V. 93078	89.8 d	98.3 e	99.5 f	94.8 h	89.3 d	104.0 be	1.10 a	1.50 ac	1.43 bc	1.80 a	0.98 ce	1.28 ac
6.	G.D. 47819	87.5 d	85.3 d	114.3 e	124.3 g	81.8 e	90.0 f	1.03 ab	1.40 ac	1.45 bc	1.63 b	0.98 ce	1.15 d
7.	G.D. 47821	124.3 a	117.3 a	136.5 b	182.8 b	101.8 c	102.0 e	1.00 ab	1.35 bc	1.30 d	1.78 a	0.98 ce	1.30 ac
8.	MN 1279	116.8 b	114.5 ab	136.0 b	160.8 d	91.3 d	108.8 c	1.03 ab	1.48 ac	1.53 b	1.83 a	1.08 ab	1.30 ac
9.	Roma	114.5 b	109.5 b	127.5 d	157.0 e	91.3 d	105.8 cd	1.05 a	1.55 ab	1.45 bc	1.63 b	1.00 bd	1.23 bd
10.	Local hybrid-102	100.0 c	112.8 a	152.8 a	187.0 a	127.0 a	118.5 a	1.03 ab	1.70 a	1.50 bc	1.73 ab	1.10 a	1.30 ac
		Fresh leaf /stem ratio (%)						Dry leaf/stem ratio (%)					
1.	Aon 404	43.67 d	51.72 d	41.75 c	41.13 e	46.25 bd	54.43 e	73.06 f	122.2 c	94.72 b	87.50 f	92.85 d	108.0 ef
2.	I.S. 641	49.60 c	43.08 d	28.17 e	37.13 f	39.60 cd	58.80 d	75.46 ef	93.90 d	50.70 c	85.85 f	81.75 e	112.0 de
3.	I.S. 8887	49.20 c	65.07 ab	62.32 a	47.70 bc	57.95 ab	54.63 e	81.23 d	145.9 b	122.8 a	114.0 b	124.8 b	106.9 f
4.	R.G.O. 216	46.72 cd	58.15 c	43.75 d	45.97 cd	51.58 ac	63.70 c	61.50 g	87.30 e	73.72 d	109.7 c	131.8 a	133.3 c
5.	I.C.S.V. 93078	47.80 c	46.13 de	57.28 b	50.65 ab	53.05 ab	75.68 b	87.75 c	94.93 d	94.25 b	97.85 d	109.3 c	142.6 b
6.	G.D. 47819	60.20 b	70.82 a	65.65 a	52.53 a	63.13 a	95.25 a	113.9 b	161.0 a	116.6 a	119.7 a	126.6 b	168.8 a
7.	G.D. 47821	32.83 f	29.67 f	31.90 de	29.00 g	38.80 d	48.35 f	79.25 de	90.30 de	72.65 d	77.05 g	64.03 g	89.80 g
8.	MN 1279	37.92 e	41.72 e	36.58 d	35.08 f	52.13 ab	48.55 f	81.08 d	94.00 d	71.93 d	84.68 f	93.00 d	90.35 g
9.	Roma	50.15 c	59.80 bc	43.55 c	44.13 de	51.72 ab	53.45 e	81.10 d	124.9 c	85.90 c	93.50 e	106.00d	115.9 d
10.	Local hybrid-102	72.30 a	51.13 d	28.75 e	29.73 g	36.53 d	47.10 f	150.2 a	95.55 d	53.50 e	63.50 h	74.95 f	94.15 g

Table (5): Fresh and dry forage yield (ton/fad.) of the studied sorghum genotypes at the three cuts and their total in 1998 and 1999 seasons and its combined.

No.	Genotypes	1998				1999				Combined
		1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	Total	
	Fresh forage yield (ton/fad.)									
1.	Aon 404	27.891 b	16.953 a	13.344 a	58.188 a	27.475 d	14.525 c	7.350 cd	49.350 d	53.769 b
2.	I.S. 641	33.250 a	10.391 e	7.766 d	51.407 b	32.900 ab	16.275 b	4.725 g	53.900 c	52.654 b
3.	I.S. 8887	21.656 c	8.750 g	7.438 d	37.843 de	31.675 b	9.800 g	6.125 e	47.600 d	42.722 d
4.	R.G.O. 216	22.313 c	14.219 c	11.484 b	48.038 c	28.700 cd	12.425 de	6.650 de	47.775 d	47.907 c
5.	I.C.S.V. 93078	19.578 c	9.734 ec	8.094 d	37.406 e	14.350 f	11.900 ef	4.800 fg	31.150 f	34.278 f
6.	G.D. 47819	21.656 c	9.078 fg	10.063 c	40.797 d	21.875 e	10.675 fg	5.775 ef	38.325 e	39.561 e
7.	G.D. 47821	25.703 b	15.859 b	7.438 d	49.000 bc	31.500 b	13.300 cd	3.325 h	48.125 d	48.563 c
8.	MN 1279	27.781 b	15.969 b	12.141 b	55.913 a	33.775 a	13.825 c	8.925 ab	56.525 b	56.219 a
9.	Roma	26.250 b	15.531 b	9.844 c	51.625 b	32.725 ab	13.475 cd	8.225 bc	54.425 bc	53.025 bc
10.	Local hybrid-102	19.7897 c	12.359 d	13.672 a	54.850 c	29.750 c	22.225 a	9.625 a	61.600 a	53.725 b
	Dry forage yield (ton/fad.)									
1.	Aon 404	3.068 ab	1.901 a	1.815 a	6.784 a	3.792 bc	1.801 b	1.007 b	6.600 b	6.9692 a
2.	I.S. 641	3.159 a	1.112 e	1.064 d	5.334 c	3.619 cd	1.823 b	0.638 d	6.080 c	5.707 d
3.	I.S. 8887	2.469 cd	1.041 e	0.989 d	4.499 d	4.339 a	1.254 d	0.876 c	6.469 b	5.484 d
4.	R.G.O. 216	2.678 c	1.706 b	1.522 b	5.906 b	3.731 bd	1.566 c	0.825 c	6.122 c	6.014 c
5.	I.C.S.V. 93078	2.212 d	1.314 d	1.319 c	4.845 d	1.765 f	1.880 b	0.809 c	4.454 f	4.650 f
6.	G.D. 47819	2.621 c	1.289 d	1.419 bc	5.329 c	2.669 e	1.527 c	0.866 c	5.062 e	5.196 e
7.	G.D. 47821	2.750 bc	1.713 b	0.989 d	5.452 c	3.623 cd	1.516 c	0.419 e	5.558 e	5.505 d
8.	MN 1279	2.695 c	1.725 b	1.797 a	6.217 b	3.715 bd	1.618 c	1.250 a	6.583 b	6.400 b
9.	Roma	2.599 c	1.972 a	1.329 c	5.900 b	3.862 b	1.577 c	1.069 b	6.508 b	6.204 bc
10.	Local hybrid-102	2.633 c	1.458 c	1.834 a	5.925 b	3.570 d	2.845 a	1.357 a	7.772 a	6.849 a