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Influence of Methods and Time of Sowing on Growth and Forage Productivity of Sorghum and Pearl Millet Plants

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TWO FODDER species namely millets and sorghum grass were grown at Experimental Research – farm of Desert Research Centre at south of Sinai, Egypt (160 km north east of Cairo), during summer seasons 2004 and 2005. Objective of this study was to quantify growth, biomass production and chemical composition of two fodder species . Three sowing dates (1 April, mid- April and 1 May) and two sowing methods (row and in ridges) were tested under saline conditions.

The two plant species were irrigated with ground brackish well- water about 4000 p.p.m. Results summarized are as follows: The maximum yield and the most growth characters were obtained at sowing date mid-April followed by early May. The greatest yield was observed when sowing in hills on ridges methods. Growth characteristics were increased with sowing in hills on ridges comparing to sowing in rows. Millets was surpass in production, growth and chemical content on sorghum plants.

Interactions between the three main factors were significant for growth and productivity.

Keywords: Pearl millet, Sorghum, Biomass, Fodder, Saline, Rows, Ridges.

The pressure of human population is increasing at an alarming rate in developing countries. So, necessitates productivity increases of all production inputs, but particularly soils. The use of marginal lands for production is therefore also increasing. On such of waste lands in salt- affected soils such as the soil of Wadi Suder region (South of Sinai). The successive irrigation with the brackish – saline water from wells led to salt accumulation in the soils profiles. So the soil salinity is considered as the major problem in this area.

In summer season flocks suffer from lack in forage. Cultivated annual grasses species are commonly used to provide fodder such as sorghum or pearl millet plants, the two species under study have high dry matter production, drought tolerance and ability to regrowth after grazing or cutting.

In order to ameliorate and utilize the lands, certain agricultural productions techniques could be employed in order to incease productivity of saline soils. This includes aspects such as sowing dates and sowing methods because the yields are

largely influenced by the soil moisture content at sowing where the late of sown crop is usually subjected to moisture stress, the moisture stress at this stage had bad getting good germination due to moisture shortage.

On this connection, Almodares *et al.* (1994) showed that most of the cultivars of sorghum at Isfahan failed to grow when sown between 5 July and 5 Aug. sowing dates, Moretti & Conti (1997) found that time of emergence and increases of plant dry weight per day of sorghum were mainly dependent on sowing date and environmental temperature., Ohno (1998) noticed that early growth of sorghum was more rapid with later sowing (2 July), but period head emergence to flowering increased as sowing was delayed. Accumulated temperature for early growth decreased with delay in sowing. The number of heads decreased as sowing was delayed, and yield decreased 3.73 – 4.38 ton/ha (earliest sowing date) to 0.35 – 0.41 ton/ha (latest sowing date) in Japan, Choubey *et al.* (1999) in India showed that highest green forage of sorghum and dry matter yields were obtained when the crop was sown on 15 May. While Spehar (1999) found that the greatest production of sorghum dry mass was obtained with sowing on 22 August (13.32 ton/ha), Zherukov *et al.* (2004) reported that the highest field germination (54.6%) and fresh weight (7.15 ton/ha) were obtained using sowing date April 20 for Sudan grass in Russian.

Also, Mitharwal *et al.* (2007) in India reported that the maximum yield of pearl millet was obtained in crop sown on 17 June followed by 24 June, 1 July, 15 July and 8 July. The minimum loss of 2.49% was recorded in the crop sown on 17 June followed by 24 June (6.26%) , 1 July (30.26%), 15 June (32.27 %) and 8 July (35.42 %) and Muslimov & Alimirzaeva (2007) showed that sweet sorghum cultivars had the highest green mass and dry matter yield at sowing time of 1-5 May (48.3 and 14.2 ton/ha) in Dagestan.

With respect to sowing methods under salinity conditions it is better to place seeds on the ridge shoulders rather than the ridge top because the evaporation will concentrate more salts on the ridge top. Also, it is better to plant only on one shoulder of the ridge. In this context, Seif & El Hakeem (1990) showed that seed broadcasting of sorghum produced the lowest forage yield as compared with either row or furrow planting, Orevic-Milosevic *et al.* (1992) showed that weed competition was higher with sowing in wide rows for some sorghum and Sudan grass, Klaij & Hoogmoed (1993) found that the adverse effects of wind erosion were least when sowing in hills, crop stand survival and yield were better under pit planting than drilling seed of pearl millet, Tumbar & Bhoite (2000) showed that maximum yield of pearl millet was observed under broad bed furrow and ridges and furrow methods, compare to flat sowing. Gebrekidan (2003) showed that planting sorghum in furrow gave more yield than sowing in flat bed while, Yadav & Varshney (2005) found that fodder and biological yields of pearl millet were not affected by sowing methods.

Therefore, the objectives of this study were (i) To determine the most suitable sowing dates and sowing methods for obtaining the optimum growth, yield and

chemical content of sorghum and pearl millet, (ii) To determine the production capacity of the two plant species under saline conditions and the quality of sorghum and pearl millet under South Sinai conditions.

Materials and Methods

Two field experiments were set up under the saline conditions of Ras Suder Experimental farm, South Sinai in the two successive seasons, 2004 and 2005 to study the effect of sowing dates and sowing methods on fodder yield, growth characters and chemical content of sorghum [*Sorghum bicolar* (L.). Moench] and pearl millet [*Pennisetum glucum* (L). (R.PR)].

The mechanical and chemical analysis of the experimental soil and chemical properties of water irrigation was conducted and is shown in Table 1.

TABLE 1 . Mechanical and chemical analysis of the experimental soil and irrigation.

Particle size distribution %			Texture class	Ec ds/m	pH	O.M%	$CaCO_3$%
Sand	Silt	clay					
82	6.0	12	SL	4.95	7.8	0.31	50.41

Average number of irrigation										
pH	Ec (ds-m)	T.D.S	Cations / (meg / l.)				Anione / (meg / l.)			
			Ca	Mg	Na	K	CO_3	Cl	HCO_3	SO_4
7.93	5.9	3773	13.8	14.58	33.69	0.55	-	56.86	1.61	4.25

The sowing dates were early sowing (1 April), mid – April and late sowing (1 May).

The sowing methods used were (a) Planting in rows (seeds were hand drilled in rows 50 cm apart in between and 3.5 meters in length and (b) Planting one third up of the ridges of hills (one side only) at a distance of 20 cm each of 3.5 meters in length and 50 cm in width using seeding rates of 20 kg/fed of sorghum and 15 kg/ fed of pearl millet. Seeds were covered with a thin layer of soil (10- 15 mm) for creating a firm seed bed. Plots were irrigated weekly using under brackish well- water which contains about 4000 ppm as dissolved salts. After the plants were well established the first plant samples were taken 60 days after sowing followed by a second harvest 45 day later.

TABLE 2. Meteorolgocial date of Ras Suder region at 2004 and 2005 seasons

Month	2004						2005					
	Av. temp.	T.sir kw/m^2	E.T. mm	Av. Ws km/h	Total rain (mm)	RH.	Av. temp.	T.sir kw/m^2	E.T. mm	Av. Ws km/h	Total rain (mm)	RH.
March	17.95	7.25	3.17	11.4	7.11	60.3	18.51	7.78	4.54	13.52	0	63.44
April	20.97	8.02	3.88	12.14	0	45.55	23.18	8.88	4.11	10.39	0	50.62
May	24.61	8.83	5.78	10.25	0	49.74	26.12	9.33	4.89	10.42	0	52.92
June	26.61	9.27	4.84	5.4	0	57.92	27.71	9.97	5.11	6.79	0	59.79
July	29.6	9.07	5.92	8.06	0	56.2	31.34	9.28	5.79	7.59	0	62.01
August	28.94	8.07	5.08	7.23	0	59.59	30.19	8.24	4.64	6.25	0	56.03
September	26.48	6.64	4.07	7.38	0	66.64	28.69	7.03	3.55	6.48	0	63.74

Representative random samples of five plant were taken from each experimental plot (10.5 m^2) before cutting to study the following vegetative: plant height (cm) from the soil surface up to the longest height, number of leaves / plant and leaf area (cm^2) of the leaf (using leaf area meter) were estimated.

All plants of each treatment were harvested to determine fresh and dry forage yield in ton/ fed. Samples of plant tops at each harvest were dried in an oven at 70°C to constant weight. The dried materials were milled to a fine powder for determining total nitrogen by using the modified micro- kjeldahl methods as by Peach & Tracey (1956). Crude protein percentage was calculated by multiplying the percent N by 6.25. Crude fiber and total ash were determined by using the method outlined by A.O.A.C. (1960).

The two sowing methods of the two grasses species and the three sowing dates were set up in 12 treatments in a split – split plot design with four replications in the two seasons. The main plots were devoted to plant species while, the sub plots were allocated to sowing dates whereas, the sub – sub plots occupied with sowing methods.

All data were statistically analysed using COSTAT computer program according to procedures outlined by Snedecor & Cochran (1980). Means were compared by using Duncan's new multiple range test (Duncan, 1955)

Results and Discussion

Forage yield component

Plant height

Results presented in Fig. 1 showed the effect of sowing time and sowing method on plant height of sorghum and pearl millet plants.

Data in Fig. 1 showed that pearl millet plants were taller than sorghum plants under saline conditions. This result was clearly true and significant for the two cuts of both seasons. Such results may be attributed to salinity depresses growth and photosynthesis in senstive species and drought resistance mechanisms vary with climatic and soil conditions (Taiz & Zeiger, 2002).

In regards to sowing date, data showed that the highest plant height was significantly obtained at sowing early May (126.9) at first season, while tallest plants were observed at sowing in mid- April (121.4) at second one. This trend may be attributed to the optimal temperature response which the capacities of the various steps of photosynthesis and elongation are optimally balanced (Taiz & Zeiger, 2002) . On this respect Mirhadi *et al.* (1979) found that the growth of sorghum plants were lower with sowing on 1 or 15 June than 1 or 15 May, Han & Ahn (1985) reported that maximum plant heights of sorghum plants were with sowing on 16 April and 14 May while, Cho-Namki *et al.* (2004) showed that the highest plant height of sorghum plants (222.9 cm) were recorded on (7 April) sowing date, while those of early (27 March) and late (27 May) sowings gradually decreased.

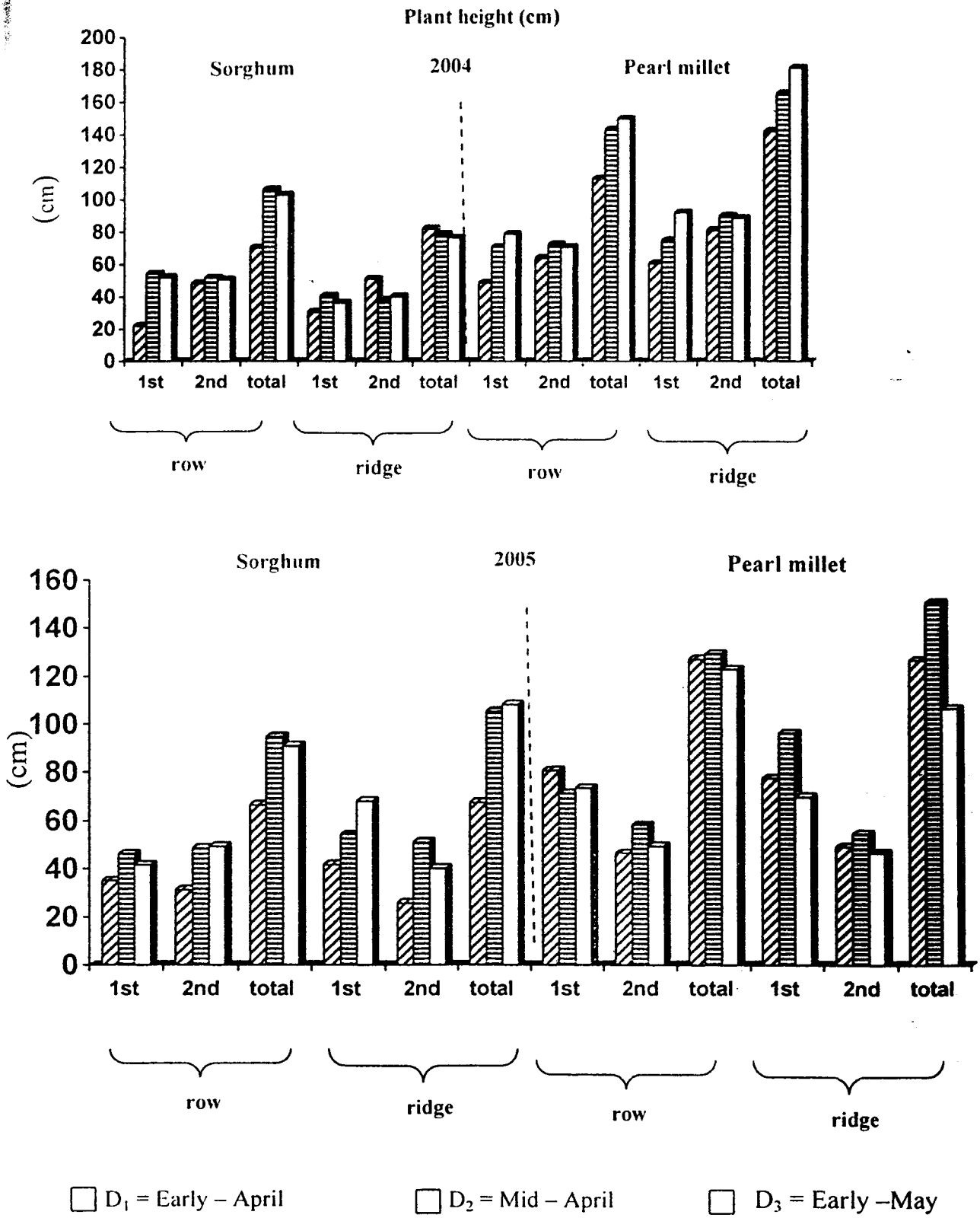

Fig 1. Effect of sowing date, sowing method and plant species on plant height (cm) in 2004 and 2005 growing seasons.

Regarding sowing methods, data revealed that sowing in hills of the ridge significantly obtained the highest tall of the plants comparing to sowing in rows methods. This results may be attributed to this trend may be returned to the higher density of plants within the hills on ridging produced taller plants which were competing and seeking for light while the even distribution of light when using rows seeding method produced the shortage plants. On this connection, Adjei-Twum (1987) showed that plant growth of sorghum was limited in the flat beds methods and sometimes in the tie- ridging treatments, while Seif & El- Hakeem (1990) concluded that sowing in rows produced the tallest plants of sorghum, comparing to furrows and broadcasting.

The interaction between plant species and sowing method was only significant at 1st cut of 1st season. The tallest plants of pearl millet was achieved by sowing in hills on ridging which increased significantly than sorghum.

Number of leaves / plant

Data recorded in Fig. 2 indicated that number of leaves of pearl millet plants was more than that of sorghum. This result may be returned to that plants with a determinate growth pattern, such as that of corn, lack that form of resistance to water stress. Indeterminate growth patterns such as that of sorghum allow these species to take advantage of temperature (Taiz & Zeiger, 2002). Such result was significant at both cuts and total number of first season while, no significant difference was found at second one.

Concerning of sowing dates, it appears from the data (Fig. 2) that sowing in mid April was the best date to obtain the greatest number of leaves / plant. Such increase was significantly obtained at second season and followed by sowing at early May at first one, this result may be attributed to heat stress which caused by high temperature inhibits photosynthesis and impairs membrane function and protein stability (Taiz & Zeiger, 2002) . On this respect, Uozumi *et al.* (1999) found that one group of sorghum cultivars, the number of leaves increased with temperature increased and in other group, temperature did not have a significant effect on the number of leaves, while Cho-Namaki *et al.* (2004) noticed that the highest number of sorghum leaves were recorded at sowing on (7 April) while these of early (27 March) and late sowing (on 27 May) gradually decreased.

Respect on sowing methods effect on the number of leaves/ plant, data revealed that no significant different was appeared between the two sowing methods at the two cuts of both season.

The interaction between plant species and sowing method was only significant at 1st cut of 1st seasons. The highest number of leaves was noticed as sowing pearl millet in hills on ridging .

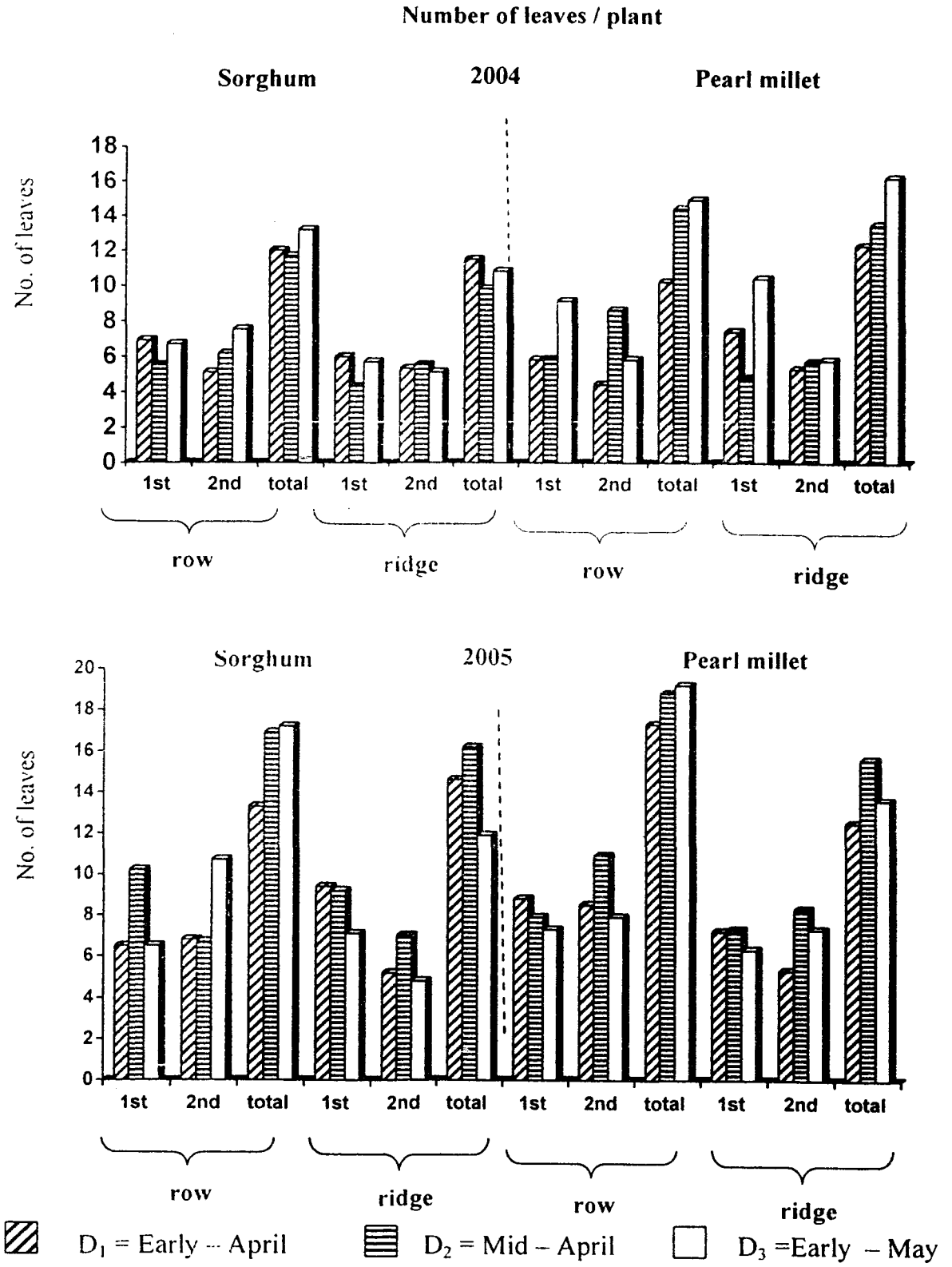

Fig. 2. Effect of sowing date, sowing method and plant species on number of levels / plant in 2004 and 2005 growing seasons.

Leaf area / plant

It is noticed from Fig. 3. that leaf area of pearl millet was higher than leaf area of sorghum plants. for both harvest total leaf area of first season and second cut and total leaf area of second one. This trend may be obtained by the inhibition of leaf expansion is one of the earliest responses to water stress. Occurring when decrease in turgor ensuing from water deficit reduce or eliminate the driving force of cell and leaf expansion (Taiz & Zeiger, 2002). On this respect Kim & Han (1999) found that pearl millet produced more leaf area and had a higher absolute growth rate than sorghum or maize.

On respect of sowing dates, it is appeared that sowing on mid-April produced significantly highest leaf area at 2^{nd} season while sowing in early may was the optimum date at 1^{st} one. Such result may be attributed to temperature responses of photosynthesis which reflect the temperature sensitivity of the biochemical reactions of photosynthesis, due to the role of photorespiration. (Taiz & Zeiger, 2002). Similarly Kim & Han (1999) noticed that pearl millet produced more leaf area and had higher absolute growth especially at later sowing date (5 June).

Concerning of sowing methods, data revealed that no significant effect was noticed for both methods of sowing except of sowing in hills on ridges were significantly increased at first cut of the second season. On this connection Adjei-Twum (1987) found that plant growth of sorghum was limited in the flat beds because of soil moisture deficiency and sometimes in the tie- ridging treatments due to water logging.

No significant interaction effect was obtained for sowing methods and sowing dates of the two plants on leaf area.

Fresh and dry forage yield

Data presented in Fig. 4, 5 showed that the fresh and dry forage yield of pearl millet plants surpassed sorghum plants. Such increase was significant for both cuts of both seasons under the circumstance of this experiment. This difference under salinity conditions may be due to the difference response, tolerance to salinity and environmental factors affecting developmental processes and ability to benefit from the available nutrients which led to increase in fresh and dry matter production. The same trend was obtained by Kim & Han (1990) showed that pearl millet produced more DM yield than sorghum or maize especially at later sowing date .

Concerning of sowing dates, data showed that fresh and dry forge yield increased progressively with delaying sowing date from early April to early May. Such increase was significant at both cuts and total fresh and dry yield of first season (2.397, 1.23 ton/fed) respectively. On the second season, sowing in mid-April was the best date to obtain the maximum fresh and dry yield (3.39, 1.47 ton/fed) respectively.

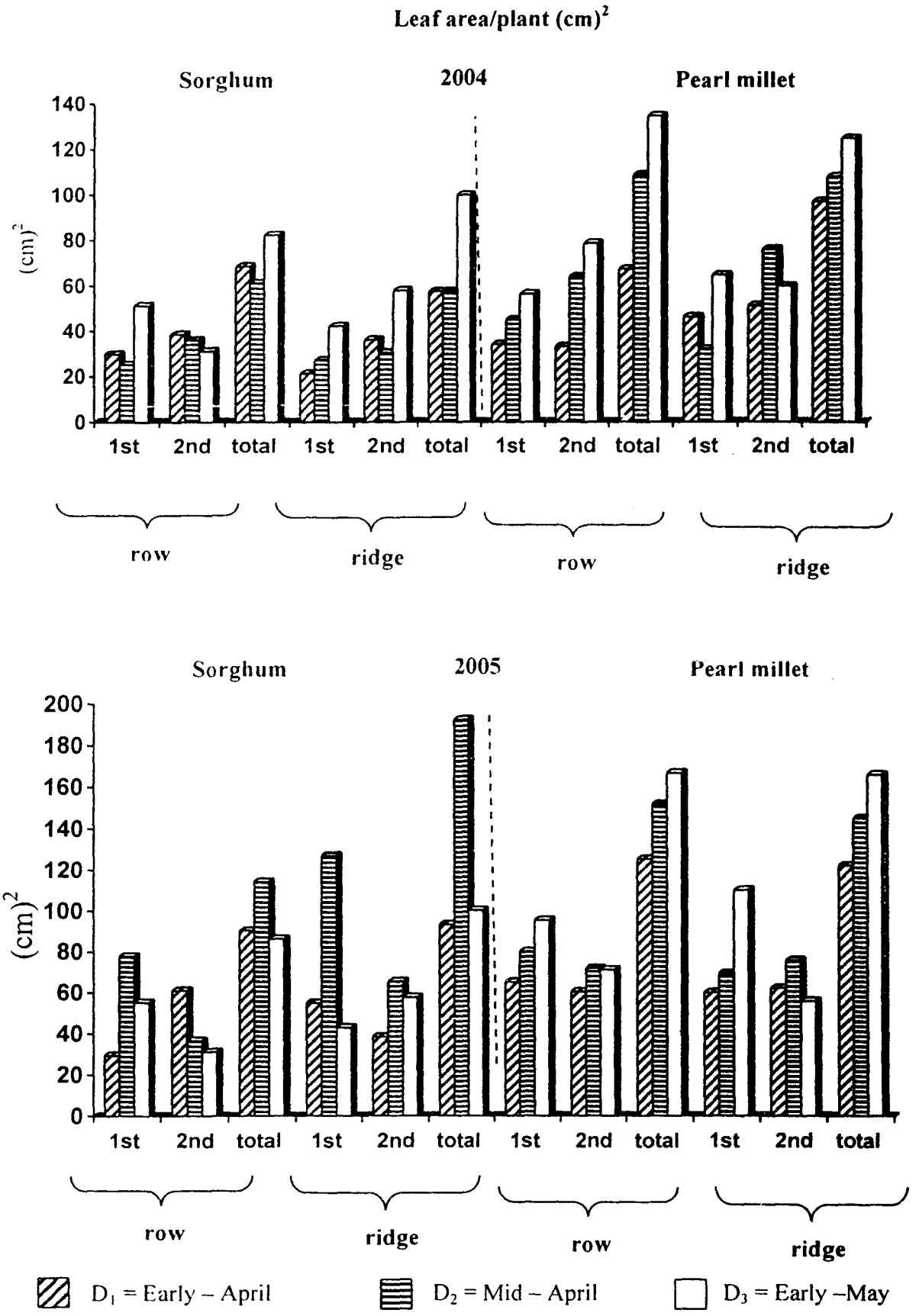

Fig 3. Effect of sowing date, sowing method and plant species on leaf area/plant (cm) in 2004 and 2005 growing seasons.

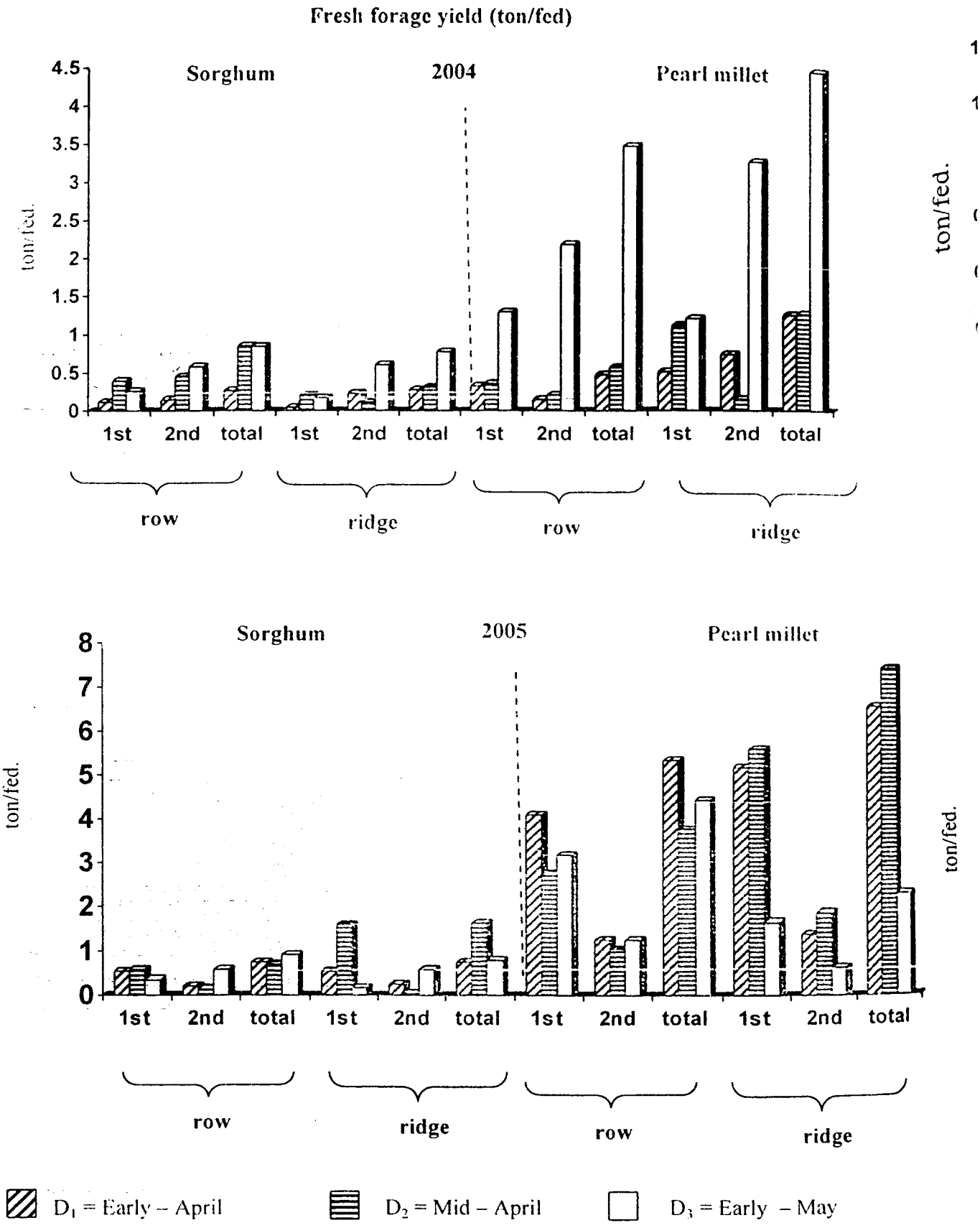

Fig. 4. Effect of sowing date, sowing method and plant species on fresh forage yield (ton/fed) in 2004 and 2005 growing seasons.

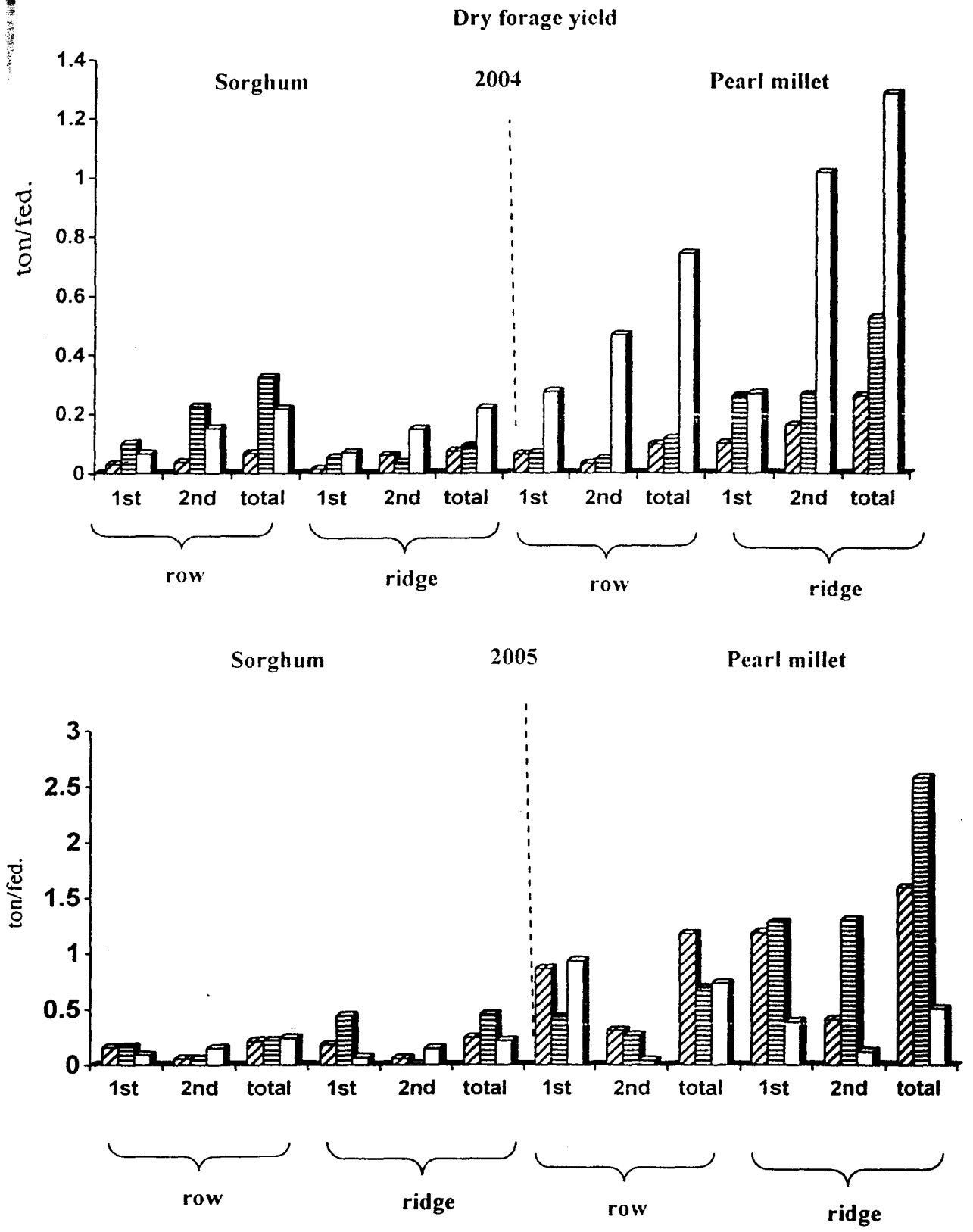

Fig. 5. Effect of sowing date, sowing method and plant species on dry forage yield (ton/fed) in 2004 and 2005 growing seasons.

Such result may be returned to the increase of the previous yield component under the same date which reflect on the productivity, also may be returned to changes in photosynthetic properties in response to temperature which plays an important role in plant adaptations to different environments and plants are remarkably plastic in their adaptations to temperature (Taiz & Zager, 2002). This is supported by Moretti & Conti (1997) who found that time of emergence of sweet sorghum and increase of plant dry weight per day were mainly dependent on sowing date and environmental temperature.

Regarding sowing methods, data showed that sowing in hills on ridging methods increased the fresh and dry yield comparing to sowing in row methods. Such result were true and significant at 2^{nd} cut of first season and total fresh and dry yield of second one (3.242 , 0.765 ton/fed) respectively. However, seeds sowing in rows method produced low forage yield comparing with sowing hills in ridging methods. This inferiority could be due to the unfavourable microenvironment for growth within the plants and their canopies. This result was agreement with those of Klaij & Hoogmoed (1993) who found that, establishment crop stand survival, and yield of pearl millet were better under hill planting than drilling seed and the adverse effect of wind erosion were least when sowing in hills, Tumbar & Bhoite (2003) reported hat ridging and furrow method of sowing recorded higher yield of pearl millet than flat bed method of sowing.

The interaction between plant species and sowing method was only significant for total fresh yield at 2^{nd} of first season. The highest fresh yield was obtained as sowing pearl millet in hills on ridge, the interaction between plant species and time of sowing was significant at 2^{nd} cut of 1^{st} seasons, it was noticed that the highest fresh forage yield was obtained as delaying date to early May for both plants and the interaction between sowing method and sowing date was only significant at 1^{st} cut of 2^{nd} season, it was clear that higher values of dry yield were achieved when the plants were sown early April in rows while delaying time to mid- April acted together with sowing in hills on ridges.

Chemical composition

Crude protein, crude fibre and total ash contents were analysed for the obtained forage of each individual cut for the two growing seasons on dry matter basis. Meanwhile, combined analysis data was conducted, the results could be presented as follow:

Crude protein content

Concerning of Table 3 showed that crude protein content of pearl millet was higher than that of sorghum plants. Such increase was significant at both cuts. This increase may be returned to the increase of both dry matter and crude protein percent of pearl millet under the circumstance of this experiment. Habib *et al.* (2007) noticed that millets showed higher CP content than sorghum and Sudan grass .

TABLE 3. Effect of sowing date, sowing method and plant species on total crude protein, crude fiber and ash content (kg/fed) of forage plants (combined analysis over 2004 and 2005 seasons).

Sowing method	CP (kg/fed)				CF (kg/fed)				Ash (kg/fed)			
	1st cut		2nd cut		1st cut		2nd cut		1st cut		2nd cut	
	Sorg.	Pearl m.	Sorg.	Pearl m.	Sorg.	Pearl m.	Sorg.	Pearl m.	Sorg.	Pearl m.	Sorg.	Pearl m.
	Early –April											
Row	13.38	75.02	14.67	131.78	19.85	87.12	20.58	142.39	12.13	64.51	9.69	126.4
ridges	13.47	97.0	16.25	140.27	22.09	132.9	20.72	162.45	12.23	99.66	13.32	118.2
	Mid –April											
Row	17.12	50.78	19.79	111.38	23.35	61.20	35.63	122.29	20.93	40.58	25.04	54.68
ridges	32.10	117.95	33.61	298.08	54.39	186.45	48.64	275.53	25.68	128.64	26.45	254.74
	Early – May											
Row	18.48	106.54	23.5	206.22	27.93	125.66	42.88	176.51	14.68	89.30	17.98	200.8
ridges	8.89	57.95	8.69	163.95	14.51	89.64	18.28	201.36	10.60	69.52	14.89	131.83
Plant species	S_1=17.24b		S_1=19.42b		S_1=27.02b		S_1=31.12b		S_1=16.08b		S_1=17.9b	
	S_2=84.2a		S_2=175.28a		S_2=113.83a		S_2=163.42a		S_2=82.03a		S_2=147.8a	
Sowing date	D_1 = 49.72a		D_1 = 75.74a		D_1 = 65.49a		D_1 = 86.53a		D_1 = 47.03a		D_1 = 66.89 a	
	D_2 = 54.48a		D_2 = 115.71a		D_2 = 81.35a		D_2 = 120.53a		D_2 = 53.95 a		D_2 = 90.24a	
	D_3 = 47.96a		D_3 = 100.59a		D_3 = 64.43a		D_3 = 109.76a		D_3 = 46.03a		D_3 = 91.38a	
Sowing method	M_1 = 46.88a		M_1 = 84.56a		M_1 = 57.52a		M_1 = 90.04a		M_1 = 40.4 a		M_1 = 72.4a	
	M_2 = 54.56a		M_2 = 110.14a		M_2 = 83.33a		M_2 = 121.16a		M_2 = 57.7 a		M_2 = 93.2a	

D_1 = Sowing Early April
D_2 = Sowing Mid April
D_3 = Sowing Early May

M_1 = Sowing in rows
M_2 = Sowing on ridges

S_1 = Sorghum plants
S_2 = Pearl millet

Crude protein content increased when delaying sowing date from 1 April to mid- April. (Table 3). However, the further delaying from mid-April to early May decreased the total crude protein of the individual two cuts.

This means that sowing in mid- April was the best time to produce higher content of CP. Similarly , Cho-Namki *et al.* (2004) found that the highest CP and total digestible nutrients were recorded on (7 April) sowing date.

There were no significant difference between the two methods on CP content, while sowing in hills ridging produced the highest CP content (110) kg/fed than sowing in rows (84.5) kg/fed at second cut.

Crude fibre content

Table 3 indicated that crude fibre content of pearl millet surpassed CF content of sorghum plants. Such result was significant at both cuts of both seasons and it may be returned to the tallest pearl millet plants than the sorghum plants (Fig. 1).

About the effect of sowing date on CF content, it appeared that no significant different response under different sowing date (Table 3). In general delaying

sowing date from early April to mid- April increased CF content while delaying from mid April to early May decreased CF content. This means that (mid- April) was the favourable date. This trend may be returned to the effect of temperature and solar radiation at early date, the temperature was low which lower the growth of the plants, meanwhile early May, may be to high temperature and high solar radiation which lower the biomass but mid April was the optimum date due to lower incident solar radiation which hastend crop growth (Table 2) Cho-Namki (2004) found that total digestible nutrients (TDN) were recorded on 7 April sowing for sorghum plants and delaying to 27 May decreased CF content.

Results also, indicated that sowing in hills on ridges produced more higher CF content than sowing in rows without no significant difference.

Ash contents

Ash contents of pearl millet surpassed the ash contents of sorghum plants under the circumstance of this experiments this increase was significant for both average cuts, while neither sowing dates nore sowing methods were affected significantly ash content but in general sowing in hills on ridges was the best comparing to sowing in rows.

No significant interaction effect was obtained for sowing dates and sowing methods of the two plants on chemical composition.

Conclusion

The descriptive study investigates the influence of sowing date and seed bed preparation on the growth of two forage grasses (Millet and Sorghum) grown with brackish irrigation under desert harsh conditions of marginal lands summer season. The experiments were laid out in a split- split plot design. The obtained results could be summarized: Millet exceeded the other sorghum plants in all growth, forage and chemical composition, most of growth parameters studied were increased by delaying sowing dates from early April to early May, fresh and dry forage yield followed closely the same trend of growth at first season. Meanwhile, sowing in mid. April was the best date to obtain the maximum growth, fresh and dry forage yield as well as chemical composition amount at another season. Sowing in hills on ridging increased most of growth parameters and fresh or dry forage yield comparing of sowing in rows methods. Most of growth characters and the productivity were affected by the three order interactions.

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تأثير طرق ومواعيد الزراعة على النمو والانتاجية العلفية لنباتات السورجيم والدخن

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أقيمت التجربة فى الأراضى الجيرية بجنوب سيناء والتى تروى بمياه الآبار المالحة والتى تحتوى حوالى ٤٠٠٠ جزء فى المليون.

تمت الزراعة فى موسمين زراعيين ٢٠٠٤، ٢٠٠٥ وذلك لدراسة اثر مواعيد الزراعة (أول أبريل – نصف أبريل – أول مايو). كذلك تأثير طريقة الزراعة وتشمل الزراعة فى صفوف نثرا والزراعة فى جور فى الثلث الأول من جانب الخط مع استخدام نوعين من النباتات (الدخن والسورجيم) . تم اخذ عدد ٢ حشة فى الموسم لتقدير المحصول الغض والجاف ، ارتفاع النباتات ، عدد الأوراق ومساحة الورقة وكذلك تقدير المحتوى الكيماوى للحشات من (بروتين – الياف- رماد).

وتم الحصول على النتائج الاتية:

١- تم الحصول على أعلى محصول غض وجاف للنباتات التى زرعت فى منتصف أبريل كذلك أرتفاع النبات ، مساحة الورقة وعدد الأرواق.
٢- كانت طريقة الزراعة فى جور على جانب الخط أفضل من الزراعة نثرا على صفوف وذلك للحصول على أعلى انتاجية وكذلك صفات النمو .
٣- تفوق الدخن فى الأنتاجية الغضة والجافه كذلك صفات النمو من أرتفاع النبات ، عدد الورق و مساحة الورقة. وأيضا المحتوى الكيماوى من (البروتين والألياف والرماد). مقارنة بنباتات السورجيم تحت ظروف منطقة جنوب سيناء.
٤- تفوق المحتوى الكيماوى فى ميعاد الزراعة فى منتصف أبريل لكلأ من البروتين والألياف والرماد.

وكان للتفاعل بين العوامل الرئيسية (ميعاد الزراعة – طريقة الزراعة- نوعية النباتات) أثر معنوى على الأنتاجية العلفية وصفات النمو.