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EFFECT OF PLANT DENSITY, SKIPPING ONE IRRIGATION AND THEIR INTERACTION ON GROWTH CHARACTERS, YIELD AND CHEMICAL COMPOSITION OF GRAIN SORGHUM

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ABSTRACT

Two field trials were carried out at Ebshway, Fayoum Governorate, during 2001 and 2002 to study the effect of plant density and skipping one irrigation as well as their interaction at different growth stages on growth, yield and chemical components of grain sorghum.

The main findings could be summarized as follows:

1. Increasing plant density from 70,000 to 140,000 plants/fed. significantly decreased TDW, LA, LAI, LAR, SLA, SLW, NAR, CGR,RGR, dry weight and grain weight/panicle, as well as straw yield/plant, shelling % and grain index, but plant height, grain, straw and biological yields ton/fed., as well as protein %, protein and carbohydrate yields/fed., increased significantly by increasing plant density whereas harvest index, total carbohydrate %, crude fiber and ash % were insignificantly differences.
2. Skipping one irrigation at different growth stages led to significant decreased in plant height, TDW, LA, LAI, SLA and SLW except LAR tended to increase. Greatly decreased in NAR, CGR, RGR, straw yield/plant, straw and biological yield/fed, were obtained when plants were exposed to omitting 3rd irrigation. Clear-cut reduction in dry weight and grain weight/panicle as well as grain index, grain yield ton/fed, and harvest index were recorded when sorghum plants exposed 4th watering. In addition protein percentage was increased when sorghum plants exposed to the skipping one irrigation, but total carbohydrate percentage, crude fiber and ash% don't effected. Also, total carbohydrate and protein yields and crude fiber were decreased by omitting one irrigation.
3. Interaction effects between plant density and skipping one irrigation was significantly decreased TDW, LA, LAI, SLA, SLW, NAR, CGR, RGR, straw yield/plant as well as straw and biological yields/fed, when sorghum plants exposed to 3rd and grown at 140,000 plants/fed., but when plants exposed to 4th irrigated and grown at 140,000 plants/fed. gave clear cut reduction in dry weight and grain weight/panicle as well as shelling %, grain index and grain yield/fed. Protein percentage increased by increasing plant density and skipping one irrigation, whereas protein and carbohydrate yields/fed., decreased but the total carbohydrate percentage, crude fiber and ash % no effect by the interaction effects between plant density and skipping one irrigation.

INTRODUCTION

Sorghum bicolor L. is an annual crop grown in different parts of the tropical and subtropical regions in the world. It is considered as the fifth leading cereal crop in total world production after rice, wheat, corn and barley and is typically grown under hot, dry conditions. The global sorghum cultivated, area were 44.23, 42.13 and 43.91 million hectare in the last three years 2001, 2002 and 2003 (FAO, Faostat, 2004).

It provides the staple diet for low income groups of African. In Egypt sorghum is widely cultivated in 390, 357 and 384 thousand feddan in 2000, 2001 and 2002 seasons, 70 % of these area cultivated in El-Fayoum, Assiut and Sohag Governorates.

Sorghum is a versatile plant which is grown for human consumption, animal feeds, poultry nutrition and for some industrial products (Gomaa, 1996). In Egypt the green plants after ears harvest used as animal forage in double use of short hybrids and varieties, also stems in tall varieties, making farm well and traverse wind.

Watering and plant densities are the important factors affecting sorghum growth, yield and its related components.

The productivity of sorghum plants depends on the available amount of light interception and water. To evaluate the yield of sorghum varieties, it is useful to estimate the ability of sorghum plants to accumulate dry matter. The dry weight/plant could be considered as dependent mainly on leaf area, net assimilation rate and relative growth rate especially around flowering and near maturity stages, Amal (1998).

Many authors in various parts of the world revealed the effect of plant density and skipping one irrigation as well as the interaction on sorghum plants. Azevedo *et al.* (1999), showed that crop yield of sorghum increased by increasing plant population of (10,000 or 20,000 plants/ha.). Rao (1999) reported that leaf area index (LAI), crop growth rate (CGR), net assimilation rate (NAR) decreased when sorghum plants exposed to water stress. Under water stress situations in sorghum grain yield is mostly controlled by grain number (greater sink capacity) and better partitioning. Also, El-Hattab *et al.* (2000) demonstrated that, skipping one irrigation at different growth stages led to significantly reduction in plant height, TDW, LA, LAI, RGR, CGR, NAR, weight of panicle, grain weight/panicle, seed index and straw yield/plant, grain, straw and biological yields/fed, as well as protein and total carbohydrate yields/fed. These results are in harmony with Berenguer and Faci, (2001), Elasha *et al.*, (2001), Nojima *et al.* (2001), Srimathi and Malarkodi (2001) and Lafarge and Hammer (2002).

Therefore, this study aimed to investigate the effect of plant density and skipping one irrigation as well as their interaction at different growth stages on leaf growth characters, grain yield and quality of sorghum plants.

MATERIALS AND METHODS

Two field experiments were carried out during two successive seasons of 2001 and 2002 seasons at Ebshway, Fayoum Governorate to study the effect of skipping one irrigation at different growth stages, plant density and their interactions on growth, yield and chemical components of sorghum grains.

The experimental design was a split plot design with four replications. Sub-plot size was 21 m^2 = 1/200 fed. (6 m in width and 3.5 in length), the distance between each row was 60 cm a part. Each sub-plot consisted of ten row, five rows were devoted for plant growth sampling, while the other five rows were left for yield and its components determinations, the main plots were located by irrigation treatments, while plant density were assigned in sub-plot. To avoid the interference between treatments 1.5 m^2 beds were left among experimental sub-plots. Sorghum grains cv. Horas were sown on 16th and 18th June in 2001 and 2002 seasons. After three weeks, plants were thinned to one and two plants/hill. Phosphorus was added in the form of super-phosphate (15.5 % P_2O_5) at the rate of 150 kg/fed., 80 kg N/fed. was applied in from of ammonium nitrate (33.5 % N) for plant density and irrigation skipping experiments. Nitrogen was added in two equal spilt applications before 1st and 2nd irrigations.

I- Irrigation treatments:

1. Normal irrigation, as a control, where six irrigations were applied during the seasons at 2 weeks intervals.
2. Skipping the third irrigation, plants were about beginning of flowering, head (panicle) extended into flag leaf sheath (at about 51 DAP).
3. Skipping the fourth irrigation, plants were at half bloom stage (at about 66 DAP).
4. Skipping the fifth irrigation plants were at soft dough stage (at about 81 DAP).

II. Plant density:

1. 70,000 plant/fed., 10 cm between hills and 1 plant/hill was left, (10 cm × 1 plant/hill).
2. 140,000 plant/fed., 10 cm between hills and 2 plants/hills were left, (10 cm 2 plants/hill).

At 90 days after planting the following growth attributed were recorded:

1. Plant height (cm), 2. Total dry matter accumulation (gm), 3. Leaf area per plant (LA/plant) (dm^2), 4. Leaf area index (LAI), 5. Leaf area ratio (LAR) (Blade leaf area in dm^2/the whole plant dry weight in gm), 6. Specific leaf area (SLA) (Blade leaf area in cm^2/leaf dry weight in gm), 7. Specific leaf weight (SLW) (leaf dry weight in gm/blade leaf area in cm). 8. Net assimilation rate (NAR) mg/dm^2/day = $[(W_2.W_1)\ (\log_e A_2-\log_e A_1)]/[(A_2-A_1)\ (t_2-t_1)]$, Greogory (1926). 9- Relative growth rate (RGR) for the source i.e. the whole plant (mg/d^2/day) = $(\log_e W_2 - \log_e W_1)/(t_2 - t_1)$, 10. Crop growth rate (g/m^2/day) = $(W_2 - W_1)\ (t_2 - t_1)$.

Where: (W_1, A_1 and W_2, A_2 respectively refer to dry weight and leaf area at time t_1 and t_2 in day).

At harvest about 120 DAP, ten individual guarded plants were taken randomly from each sub-plot of the other rows for determination of following variables.

1. Weight of panicle (g), 2. Grain weight/panicle (g), 3. Straw yield/plant (g), 4. Shelling %, 5. Grain index (1000 grain weight in g), 6. Straw yield/plant (g).

Whereas, on the basis of plot size the following traits were estimated:

1. Grain yield (ton/fed), 2. Straw yield (ton/fed), 3. Biological yield (ton/fed), 4. Harvest index % (grain yield/biological yield × 100).

The following chemical constituents in grain samples were determined as follows:

Total nitrogen was determined by micro-kjeldahl methods (A.O.A.C. 1980). Crude protein was calculated by multiplying the N values by 5.75 factor according to Baghott and Puri (1979). Total carbohydrate was determined according to Montgomery (1961).

Combined analysis was made for the two seasons according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

1- Growth characters of sorghum as affected by plant density and skipping one irrigation:

A- Plant Density:

Plant height, total dry weight, LA, LAI, LAR and SLA and SLW were significantly affected by plant density and distribution (Table 1). It could be observed that taller plants were recorded at the various growth stages when plants were grown at 140,000 plants/fed., (10 × 2) compared to 70,000 plants/fed (10×1).

Taller plants could be attributed to lower light intensity intercepted between plants due to smaller ground area occupied by the plant. Whereas shorter plants were obtained at 70,000 plants/fed., as a result of the increased in ground area occupied by the plant, leading to higher penetrated light intensity to the base of plants. This could be due to the intercepted light intensity between sorghum plants which was lower in the higher plant density than that of 70,000 plants/fed. (10 × 1), therefore to lower photosynthesis and this depressed DM accumulation, heavier plants in weight were on contrary significant during the various growth stages through growing sorghum plants at 70,000 plants/fed. (10 × 1) followed by 140,000 plants/fed. (10 × 2). In the first case, increase in TDW/plant could be due to higher light intensity intercepted between plants and better environmental conditions as a result of greater ground area/plants; leading to higher photosynthesis compared to the second case, lighter plants as a result of growing

140,000 plants/fed., could be attributed to lower light intensity penetrated to the bases of plants, leading to lower photosynthesis.

Table (1), could be observed that LA, LAI, LAR, SLA and SLW were significantly decreased as plant density increased. The various characters increased when sorghum plants were grown at 70,000 plants/fed., (10 × 1), compared to 140,000 plants/fed., (10 × 2). It could be noted that the increasing number of plants/hill and unit area decreased, plants competition for light, leading to lower photosynthesis.

Thickness of leaves in terms of SLA was greater when plants were grown at 70,000 plants/fed. (10 × 1), however, the least thickness of leaves was obtained when sorghum plants were grown at 140,000 plants/fed.(10 2). Greater SLA and similar SLW values indicate thinner leaves and vice versa.

These results are in harmony with those obtained by Azevedo *et al.*, (1999), Nojima *et al.*, (2001) as well as Lafarge and Hammer (2002).

B- Skipping one irrigation:

The general mean of plant height was significantly decreased when sorghum plants exposed to omitting the 3rd, 4th or 5th irrigations as compared with the control treatment.

Table (1): Growth attribute and leaf growth characters of sorghum plants at 90 days as affected by plant density and skipping one irrigation at various growth stages as well as their interaction (combined over two seasons).

Characters / Treatments		Plant height (cm)	TDW (g)	LA (dm^2)	LAI	LAR (dm^2/g)	SLA (cm^2/g)	SLW (mg/cm^2)
Plant density (A)	70 (10 × 1)	151.68	226.59	27.00	4.50	12.63	503.50	3.89
	140 (10 ×2)	154.67	211.73	24.89	4.15	11.81	404.59	3.18
L. S. D		2.12	13.20	2.07	0.31	0.63	74.33	0.25
Skipping one irrigatio	Control	161.12	231.80	30.23	5.04	11.79	485.96	3.89
	3rd	146.67	201.74	21.26	3.63	12.3	420.1	3.57
	4th	150.18	215.85	24.33	4.06	12.36	442.42	3.41
	5th	154.73	226.98	27.45	4.58	12.45	462.21	3.28
L. S. D		3.27	4.72	2.31	0.42	N.S.	11.22	N.S.
70 (A1×B)	Control	160.22	240.17	31.21	5.20	12.04	592.20	4.22
	3rd	145.11	210.11	23.27	3.88	12.75	463.40	3.92
	4th	148.12	220.27	25.32	4.22	12.82	452.21	3.81
	5th	153.27	235.81	28.18	4.70	12.91	513.20	3.62
140 (A2×B)	Control	162.11	223.92	29.24	4.87	11.53	436.71	3.56
	3rd	148.22	193.37	20.25	3.38	11.84	376.80	3.21
	4th	152.18	211.42	23.34	3.89	11.90	393.62	3.01
	5th	156.15	218.19	26.72	4.45	11.98	411.21	2.93
L. S. D		2.27	5.19	2.11	0.22	N.S.	12.60	N.S.

DM production at 90 DAP as affected by skipping one irrigation is shown in Table (1). Generally, significantly reduction in TDW was realized when plants were exposed to neglected the 3rd, 4th or 5th irrigations, compared with normal irrigation. More reduction in TDW was recorded at skipping the 3rd irrigation, but the least decline in TDW was obtained at skipping the 5th irrigation, whereas omitting the 4th watering gave the intermediate reduction.

Skipping the 3rd or 4th or 5th watering, led to declines in LA, LAI and SLA except LAR and SLW were tended significantly to increase by omitting the various irrigations.

Clear out reduction in the LA, LAI and SLA were recorded at skipping the 3rd irrigation, but the least reduction were obtained at omitting the 5th watering, while depriving 4th irrigation gave intermediate reduction.

Similar results were reported by Rao (1999) and El-Hattab *et al.*, (2000).

C- Interaction effects between plants density and skipping one irrigation:

The interaction effect between plants density and skipping one irrigation on plant height, TDW, LA, LAI and SLA were significant whereas, LAR and SLW insignificantly affected.

Skipping one irrigation i.e. the 3rd, 4th and 5th watering showed significant reduction in all studied characters when compared with control treatments. These results were true under 70 and 140 thousand plants respectively. The results added also that the reduction in all studied characters values were more pronounced at omitting the 3rd irrigations then become slower at 4th and 5th omitted irrigations.

It could be concluded that early omitting irrigation gave several reduction, while late omitting gave slower reduction in all the studied characters values with regard to control. These results are quite excepted however early omitting (3rd) could be considered optical concerning sorghum plants, hence this stage is more connected with rapid growth stage. These results were inagreement of those recorded by El-Hattab *et al.*, (2000) and Berenguer and Faci (2001).

II. Physiological characters of sorghum as affected by plant density and skipping, one irrigation at various stages:

1. Plant density:

NAR, RGR and CGR of sorghum plants were significantly affected by plant density and distribution (Table 2). Greater variables were significantly obtained when sorghum plants were grown at 70,000 plants/fed. However, the least values were registered when plants were grown at 140,000 plants/fed. It could be noted that NAR, RGR and CGR of sorghum plants decreased as number of plants/hill increased as a result of plant competition for light, nutrients and water. This might be attributed to lower light intensity penetrated to the bases of dense plants, leading to lower photosynthesis.

Table (2) : Growth analysis of sorghum plants as affected by plant density and skipping one irrigation as well as their interaction(combined of two seasons).

Treatments \ Characters / DAP		NAR mg/d^2/day		RGR mg/d^2/day		CGR g/m^2/day	
		60 - 75	75 - 90	60 - 75	75 - 90	60 - 75	75 - 90
Plant density (A)	70 (10 × 1)	502.50	293.55	152.91	89.56	18.07	9.07
	140 (10 × 2)	394.05	217.79	125.66	73.56	10.98	6.53
L. S. D		122.17	77.31	22.00	5.61	6.08	2.11
Skipping one irrigation	Control	653.06	375.20	173.85	132.53	23.57	12.84
	3rd	376.15	247.17	117.66	87.26.	8.73	7.58
	4th	315.62	171.65	126.37	48.67	11.28	4.12
	5th	-	228.67	-	57.75	-	6.60
L. S. D		52.11	11.02	4.61	5.57	2.81	1.37
70 (A_1 × B)	Control	723.80	422.72	195.30	147.73	26.62	15.92
	3rd	462.60	284.22	120.11	97.21	10.22	7.93
	4th	321.11	193.12	143.33	51.11	17.37	4.22
	5th	-	274.13	-	62.18	-	8.19
140 (A_2 × B)	Control	582.31	327.67	152.39	117.32	20.52	9.75
	3rd	289.70	210.12	115.20	77.38	7.23	7.22
	4th	310.13	150.17	109.38	46.22	5.19	4.01
	5th	-	183.21	-	53.31	-	5.13
L. S. D		10.02	20.71	3.81	5.13	2.01	1.02

2. Skipping one irrigation:

Data in Table (2) show a significant differences, in plant growth analysis between the various skipping one irrigation at different growth period.

With regard to NAR, RGR and CGR, it could be noted that skipping the 3rd and 4th irrigations during the growth of sorghum plant, greatly decreased NAR, RGR and CGR. The decline in plant growth analysis might be attributed to the reduction in leaf surface area.

These results were in harmony with those obtained by Rao (1999) and El-Hattab *et al.*, (2000).

3. The interaction between plant density and skipping one irrigation:

The interaction effects between plant density and skipping one irrigation on NAR, RGR or CGR of sorghum plants were significant as reported in Table (2). Higher values of NAR, RGR and CGR were supported by growing sorghum plants at 70,000 plants/fed. (10 × 1) at the two growth periods (60-75 days) and (75-90 days). However, the lower values of pervious characters were obtained when sorghum plants was grown at 140,000 plants/fed, with skipping 4th irrigation at the two growth ages (60-75 days) and (75-90 days).

III -Yield and yield components as affected by plant density:

A: Plant density:

The combined data in Table (3) revealed that a significant differences in yield and yield components as affected by plant density.

The results indicated that increasing plant density of sorghum plants from 70,000 plants /fed. to 140,000 plants/fed were decreased significantly the dry weight and grain weight/panicle as well as shelling %, grain index and straw yield/plant by (14.2, 11.5, 17.5, 7.9 and 5.9 %) respectively, but grain yield ton /fed, straw yield and biological yield ton/fed. were significantly increased by increasing plant density from 70,000 to 140,000 plants/fed. by (23.7, 31.0 and 29.9 %) respectively. Evidently, increasing number of plants/hill to two plants/hill gave higher grain, straw and biological yield /fed. compared to those having one plant/hill. Similar results were reported by Azevedo *et al.*, (1999), Berenguer and Faci, (2001) and Nojima *et al.*, (2001).

B- Skipping one irrigation:

Data in Table (3) show significant differences in all studied characters. It is obvious that skipping one irrigation, significantly decreased the different values of the different characters especially at omitting the 3rd or 4th irrigations. However, lower reduction were obtained in the various yield components at the 5th irrigation skipping.

Skipping the 3rd or 4th or 5th irrigations led to declines in dry and grain weight/panicle compared to the normal irrigation. Moreover, shelling %, grain index and straw yield/plant were significantly decreased when plants were subjected to omitting the pervious irrigations.

Table (3) : Yield and yield components of sorghum plants as affected by plant density rates and skipping one irrigation as well as their interaction (combined of two seasons).

Treatments \ Characters		Dry weight/panicle (g)	Grain weight/panicle (g)	Shelling %	Grain index (g)	Straw yield/plant (g)	Grain yield (ton/fed)	Straw yield (ton/fed)	Bilogical yield (ton/fed)	Harvest index. %
Plant density (A)	70 (10 × 1)	74.06	42.08	14.49	28.22	240.82	2.11	12.05	14.16	14.98
	140 (10 × 2)	63.57	37.25	11.96	25.99	226.62	2.61	15.79	18.40	14.18
L. S. D		7.75	2.96	2.41	1.73	12.28	0.32	2.45	2.54	N.S.
Skipping one irrigation	Control	79.71	50.75	15.22	34.45	253.66	3.03	15.09	18.12	16.72
	3rd	63.38	36.17	12.56	24.71	215.79	2.14	12.88	15.02	14.25
	4th	54.39	27.43	9.79	22.52	225.53	1.64	13.50	15.14	10.83
	5th	75.29	44.32	14.17	26.60	237.51	2.63	14.20	16.83	15.63
L. S. D		3.72	5.34	1.92	1.75	8.26	0.32	0.41	0.02	1.00
70 (A_1 × B)	Control	89.20	52.93	19.85	35.18	266.71	2.65	13.34	15.99	16.57
	3rd	67.47	39.84	13.75	25.61	222.27	1.99	11.15	13.14	15.15
	4th	59.35	28.19	9.69	23.45	231.50	1.41	11.58	12.99	10.85
	5th	80.22	47.37	14.66	28.62	242.81	2.37	12.14	14.51	16.33
140 (A_2 × B)	Control	75.21	48.57	15.38	33.72	240.61	3.46	16.84	20.24	16.80
	3rd	59.29	32.50	12.08	23.81	209.31	2.28	14.65	16.93	13.43
	4th	49.43	26.67	9.89	21.71	220.35	1.87	15.42	17.29	10.82
	5th	70.36	41.27	10.49	24.73	232.20	2.89	16.25	19.14	15.10
L. S. D		7.43	3.67	1.83	1.37	4.55	0.45	1.01	0.42	N.S.

Grain, straw and biological yields as well as harvest index were significantly decreased by depriving one irrigation at the various stages. Sharp decline was observed at 3rd or 4th skipping irrigations in all studied characters. Great decline in grain yield/fed., and harvest index due to omitting the 4th irrigation and this might be due to reduction in dry weight of panicle and grain weight/panicle and grain index. On the other hand,, decline in straw and biological yields ton/fed. due to neglected one irrigation at the various stages especially at the 3rd irrigation treatments might be attributed to reduction in plant height, dry matter accumulation and straw yield/plant. Since the vegetative growth, as well as the accumulation of dry matter in stover, could be sustained earlier in the season. Therefore, the detrimental effect of early skipping of irrigation surpassed later skipping. The differential yield response with respect to skipping one irrigation, could be attributed to the time at which growth and development processes occurred.

These results were in harmony with those obtained by El-Hattab *et al.*, (2000) and Berenguer and Faci, (2001).

3. The interaction effect between the plant density and skipping one irrigation:

With regard to the interaction effect between plant density and skipping one irrigation, on some yield components (Table 3), it could be noted that when sorghum plants subjected to skipping the 4th watering and grown plants at 140,000 plants/fed, gave clear-cut reduction in dry weight and grain weight/panicle, shelling %, grain index, grain yield ton/fed, and harvest index, whereas the least decline were recorded at skipping 5th irrigation and the plant grown at 140,000 plants/fed., but deprived 3rd watering and the pervious plant density gave intermediate decline.

These results may support the findings of increasing sorghum grain yield/fed, and its related components under the normal irrigation. The opposite were registered when one irrigation was omitted at the various growth stages particularly when plants were between blooming and soft dough stages.

Also, it could be seen that plants subjected to deprive of the 3rd watering and sorghum grown at 140,000 plants/fed, gave clear-cut reduction in straw yield/plant, straw and biological yields/fed., whereas the least decline were recorded at omitting 5th irrigate at the pervious plant density, but the omitting 4th irrigation and the same plant density gave intermediate decline. Since the vegetative organs such as plant height and leaves are formed during the vegetative growth, as well as the accumulation of dry matter in stover.

IV. Chemical composition:

A. Plant density:

Combined data in Table (4), show significant differences increased between the plant density in protein percentage, protein and total carbohydrate yields as well as total carbohydrate percentage, but crude fiber and ash percentage insignificantly differences between plant density. Also protein % and total carbohydrate yields increased by increasing plant density.

It could be concluded that increasing protein and total carbohydrate yields/fed, might be due to increased in grain yield ton/fed. (Table 3). These results are in the same trend to those reported by Amal (1998).

2. Skipping one irrigation:

Table (*A*) show increase significant differences between the omitting one irrigation in the protein percentages, yield as well as total carbohydrate yield but total carbohydrate percentage, crude fiber and ash percentage were insignificant differences compared to the control treatment.

3. Interaction effects:

The interaction effect between plant density and skipping one irrigation on protein percentage was significantly increased by increasing plant density and omitting one irrigation, whereas, total carbohydrate percentage and crude fiber or ash percentage insignificantly differences by the interaction effects between plant density and omitting one irrigation, but protein and total carbohydrate yields/fed . were significantly decreased by the interaction effects. This might be due to the decline in grain yield/fed. (Table 3). These results are in the some trend to those reported by El-Hattab *et al.*, (2000) and Singh *et al.*, (2002).

Table (4): Protein , total carbohydrates % and their yields as well as crude fiber (CF) and ash % in sorghum grains as affected by plant density rates and skipping one irrigation.
(combined over two seasons).

Characters / Treatments		Protein		Carbohydrate		CF %	Ash %
		%	yield "ton/fed"	%	yield "ton/fed"		
Plant density (A)	70 (10 × 1)	11.80	24.90	84.70	178.72	2.46	1.05
	140(10×2)	12.34	32.21	84.29	220.00	2.31	1.06
L.S.D		0.62	5.23	N.S.	30.72	N.S.	N.S.
Skipping one irrigation	Control	11.86	35.94	84.50	256.04	2.60	1.05
	3rd	12.09	25.82	84.49	180.81	2.41	1.02
	4th	12.12	19.88	84.49	138.56	2.33	1.07
	5th	12.21	32.11	84.52	222.45	2.21	1.07
L.S.D		0.02	2.11	N.S.	28.65	N.S.	N.S.
70 (A1×B)	Control	11.70	31.01	84.60	224.19	2.70	1.00
	3rd	11.78	23.44	84.69	168.53	2.52	1.06
	4th	11.82	16.67	84.72	119.46	2.40	1.06
	5th	11.88	28.16	84.80	200.98	2.23	1.09
140 (A2×B)	Control	12.01	40.83	84.40	286.96	2.50	1.09
	3rd	12.39	28.25	84.28	192.16	2.30	1.03
	4th	12.42	23.23	84.25	157.55	2.25	1.08
	5th	12.54	36.24	84.23	243.42	2.18	1.05
L.S.D		0.06	2.42	N.S.	15.55	N.S.	N.S.

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تأثير الكثافة النباتية وتحريم رية والتفاعل بينهما على النمو والمحصول والمحتوى الكيماوى لحبوب الذرة الرفيعة

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أجريت تجربتان حقليتان عام ٢٠٠١، ٢٠٠٢ بأبشواى – محافظة الفيوم بهدف دراسة تأثير الكثافة النباتية وتحريم رية والتفاعل بينهما فى مراحل النمو المختلفة على بعض الصفات الخضرية والفسيولوجية والمحصول ومكوناته وكذلك بعض الصفات الكيميائية لحبوب الذرة الرفيعة- وتتلخص أهم النتائج المتحصل عليها فيما يلى:

١. زيادة الكثافة النباتية من ٧٠ ألف إلى ١٤٠ ألف نبات للفدان أدت إلى نقص معنوى فى الوزن الجاف للنبات ومساحة الأوراق للنبات ودليل مساحة الأوراق ونسبة مساحة الأوراق والمساحة النوعية للورقة والوزن النوعى للورقة والكفاءة التمثيلية والسرعة النسبية للنمو وسرعة نمو المحصول والوزن الجاف الكلى للنورة وحبوب النورة وكمية القش للنبات ووزن الألف حبة ونسبة التصافى وزاد كل من طول النبات وكمية المحصول للفدان وكمية القش للفدان والمحصول البيولوجى للفدان ونسبة البروتين وكذلك محصول البروتين والكربوهيدرات بزيادة الكثافات النباتية ماعدا دليل الحصاد ونسبة الكربوهيدرات ونسبة الألياف الخام والرماد لم تتأثر بزيادة الكثافات النباتية .

٢. بالنسبة لتحريم الرى أدى إلى نقص معنوى فى طول النبات والوزن الجاف للنبات ومساحة الأوراق ودليل مساحة الأوراق والمساحة النوعية للورقة والوزن النوعى ولكن نسبة مساحة الأوراق تزداد بتحريم الرى . أما الكفاءة التمثيلية وسرعة نمو المحصول والسرعة النسبية للنمو ووزن القش للنبات ومحصول القش للفدان والمحصول البيولوجى حدث نقص معنوى عند تحريم الرية الثالثة – أما عند تحريم الرية الرابعة أدى إلى نقص معنوى فى الوزن الكلى للنورة ووزن حبوب النورة ووزن الألف حبة ومحصول الحبوب للفدان ودليل الحصاد ونسبة البروتين ومحصول البروتين للفدان . أما نسبة الرماد الخام فتزداد بتحريم رية واحدة ولكن النسبة المئوية للكربوهيدرات الكلية ومحصول البروتين والكربوهيدرات الكلى ونسبة الألياف الخام والرماد الخام تقل بتحريم رية واحدة.

أدى التفاعل بين الكثافات النباتية وتحريم رية واحدة إلى نقص معنوى فى الوزن الجاف للنبات ومساحة الأوراق ودليل مساحة الأوراق والمساحة النوعية للورقة والوزن النوعى للورقة والكفاءة التمثيلية والسرعة النسبية للنمو وسرعة نمو المحصول ووزن القش للنبات ومحصول القش والمحصول البيولوجى للفدان عند تعرض الذرة الرفيعة لإسقاط الرية الثالثة مع زيادة الكثافة إلى ١٤٠ ألف نبات ولكن عند تعرضها لتحريم الرية الرابعة مع زيادة الكثافة إلى ١٤٠ ألف نبات أدى إلى حدوث نقص معنوى فى الوزن الجاف للنورة ووزن حبوب النورة ونسبة التصافى ووزن الألف حبة ومحصول الحبوب للفدان ودليل الحصاد ولكن نسبة البروتين تزداد بزيادة الكثافات النباتية عند تحريم أى رية بالإضافة إلى ذلك فإن محصول البروتين والكربوهيدرات تقل بالتفاعل بين الكثافات وتحريم الريات ولكن نسبة الكربوهيدرات ونسبة الألياف والرماد لا تتأثر بالتفاعل بين الكثافات وتحريم الريات.