RESULTS AND DISCUSSION

I- Effect of Ploughing, Row Spacing, Hoeing and Their Interactions on Growth Characters of Sugar Cane.

1- Germination percentage:

Results presented in Table (2) show the effects of ploughing number, row spacing and their interactions on germination percentage at 45 days from planting.

Effects of the main factors:

Regarding the effect of number of ploughings on germination percentage, the results showed that increasing ploughing number from two to three and four times increased germination percentage by 6.06 and 2.99 % in the 1st season, being 8.63 and 3.77 % in the 2nd one. The effect of ploughing number on germination percentage was significant in the 2nd season only. The highest value of germination percentage (34.9% and 40.07% in the 1st and 2nd seasons, respectively) at 45 day from planting was attained by carrying out the ploughing process three times.

The results showed that using the lower row spacing (100 cm) produced higher germination percentage in both season compared with the wider row spacing (125 cm). The increase in germination percentage was 5.43 and 1.26 in the 1st and 2nd seasons, respectively. These increases were significant in the 2nd season only.

Interaction effects:

The results indicated a significant interaction effect in the second season. The data in Table 2 showed that with 2 and 3 ploughings, the wider row spacing produced higher germination % compared with the narrower spacing,

Table (2): Effect of number of ploughings, row spacing, hoeing number and their interactions on germination percentage of sugar cane at 45 days from planting during 1997/98 and 1998/99 seasons

Number of ploughing	Row spacing	1997/98 season	1998/1999 season
2	100 cm	32.932	30.552
	125 cm	24.785	32.338
Average		28.858	31.445
3	100 cm	35.517	39.283
	125 cm	34.325	40.868
Average		34.921	40.076
4	100 cm	35.300	39.873
	125 cm	28.365	32.735
Average		31.832	36.304
Row spacing x Hoeing	100 cm	34.583	36.569
	125 cm	29.158	35.314
Total Average		31.871	35.942
L S D at 5 % level :			
Ploughing (P)		NS	2.101
Row spacing (R)		NS	0.597
P x R		NS	2.053

whereas with 4 ploughings an opposite trend was observed where the narrower spacing (100 cm) produced a marked significant increase in germination %. The maximum germination % in 1998/1999 season was 40.87% resulting from 3 ploughings combined with 125 cm row spacing (Table 2).

The increase in germination % resulting from 3 ploughings in both seasons of experimentation indicates that this practice in soil tillage is quite suitable for improving physical soil characters which in turn was reflected in increasing germination %. Further increase in ploughing intensity to 4 times negatively affected germination % perhaps due to negative effects on soil structure.

The results obtained by **Barbieri *et al* (1997)** revealed that the conventional tillage gave better results than the reduced tillage. On the other hand, **Glaz *et al* (1989)** showed that a minimum tillage of 2 shallow cultivations was enough to realize a high yield of sugar cane. Also, **Zerega *et al* (1998)** found that the best chemical changes in the soil were obtained with reduced tillage.

2- Number of stalks per one square meter:

Results presented in Tables (3 and 4) show the effects of number of ploughings, row spacing, hoeing and their interactions on the number of stalks per one square meter at 105 and 195 days from planting in the 1st and 2nd seasons.

Effects of the main factors:

Regarding the effect of number of ploughings, the results showed that increasing number of ploughing from two to three and four times increased number of stalks/m^2 by 12.99 and 18.26 % after 105 days from planting, being

Table (3): Effect of number of ploughings, row spacing, hoeing number and their interactions on number of stalks /m^2 of sugar cane at 105 and 165 days from planting during 1997/98 season

Number of ploughing	Row spacing	105 days		Average	165 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	4.923	5.323	5.123	11.900	12.093	11.997
	125 cm	6.037	6.170	6.103	10.493	11.293	10.893
Average		5.480	5.747	5.613	11.197	11.693	11.445
3	100 cm	6.830	6.067	6.448	12.923	12.380	12.652
	125 cm	6.247	6.227	6.237	10.913	11.253	11.083
Average		6.538	6.147	6.342	11.918	11.817	11.867
4	100 cm	8.070	6.997	7.533	15.233	13.473	14.353
	125 cm	5.543	5.943	5.743	10.877	10.693	10.783
Average		6.807	6.470	6.638	13.055	12.083	12.569
Row spacing x Hoeing	100 cm	6.608	6.129	6.368	13.352	12.649	13.001
	125 cm	5.942	6.113	6.028	10.761	11.080	10.921
Total Average		6.275	6.121	6.198	12.057	11.864	11.961

L S D at 5 % level :		
Ploughing (P)	0.339	0.544
Row spacing (R)	NS	0.997
Hoeing (H)	NS	NS
P x R	NS	NS
P x H	NS	NS
R x H	NS	NS
P x R x H	NS	NS

Table (4): Effect of number of ploughings, row spacing, hoeing number and their interactions on number of stalks /m^2 of sugar cane at 105 and 165 days from planting during 1998/99 season

Number of ploughing	Row spacing	105 days		Average	165 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	6.737	6.617	6.677	13.950	14.710	14.330
	125 cm	5.787	5.963	5.875	10.090	9.313	9.702
Average		6.262	6.290	6.276	12.020	12.012	12.016
3	100 cm	8.140	8.187	8.163	17.520	18.090	17.805
	125 cm	6.170	5.637	5.903	11.007	11.887	11.447
Average		7.155	6.912	7.033	14.263	14.988	14.626
4	100 cm	7.783	7.760	7.772	15.047	15.093	15.070
	125 cm	5.487	5.883	5.685	9.713	9.863	9.788
Average		6.635	6.822	6.728	12.380	12.478	12.429
Row spacing x Hoeing	100 cm	7.553	7.521	7.537	15.506	15.964	15.735
	125 cm	5.814	5.828	5.821	10.270	10.354	10.321
Total Average		6.684	6.674	6.679	12.888	13.159	13.024

L S D at 5 % level :		
Ploughing (P)	NS	1.315
Row spacing (R)	0.503	0.877
Hoeing (H)	NS	NS
P x R	NS	NS
P x H	NS	NS
R x H	NS	NS
P x R x H	NS	NS

3.69 and 9.76 % after 165 days from planting in the 1st season, respectively. These increases were significant.

In 1998/99 season, the results cleared that increasing ploughing intensity from two to three and four times increased number of stalks/ m^2 by 13.88 and 7.20 % after 105 days from planting , corresponding to 21.72 and 344 % at 165 days from planting, respectively. However, the increases in stalks number /m^2 in the second season were significant at 165 days from planting, whereas at 105 days the recorded differences failed to reach the level of significance.

The results indicate clearly the importance of increasing ploughing intensity in enhancy tillering in sugar cane due to the effects of ploughing in improving the physical, chemical and biological conditions of the soil. Also, 4 ploughings was the best treatment in 1997/98 season, whereas 3 ploughings was the optimum treatment in 1998/99 season as far as number of stalks/m^2 is concerned.

The results obtained by **Diaz and Somoza (1987)** showed no significant differences in cane yield in the minimum and conventional tillage. Also, **Pear *et al* (1992)** found no significant differences between a plot cultivated in the traditional manner and a low tillage plot.

Data given in Tables (3 and 4) cleared that row spacing had almost significant effect on number of stalks /m^2 . The results indicated that 100 cm row spacing increased the number of stalks significantly at 105 days in the second season and at 165 days in both seasons. Using 100 cm row spacing surpassed 125 cm by 5.64 and 29.48% at 105 days, being 19.05 and 52.59 % at 165 days, in the first and second season, respectively. The increase in number of stalks/m^2 by narrowing row spacing is a direct result of the increase in population density. It seams that at wider row spacing (125 cm) the increase in tillering capacity could not compensate the reduced population density.

Positive results were also reported by growing sugar cane at narrower spacing (**Gascho and Shih, 1981, Usman, 1989, Ahmed, 1995 and El-Sayed, 1996**).

The effect of hoeing intensity on number of stalks /m^2 was not significant in both seasons of experimentation either at 105 or at 165 days from planting. This result indicates that no relevance has been detected between hoeing intensity and number of stalks/m^2. It seems that 2 hoeings were quite effective in controlling weeds under the prevailing conditions.
Similar results were also reported by **Mehra *et al* (1990)** who found that hoeing twice gave the best results on growth of sugar cane and depressed weed growth.

Interaction effects:

As for the interaction effects among the studied factors, the results in Tables (3 and 4) cleared that none of the various combinations between the studied factors recorded a significant interaction on the number of plant/m^2 in both seasons.

This result indicates that each experimental factor acted independently in affecting number of stalks/m^2.

Generally, the maximum numbers of stalks/m^2 at 105 days from planting was 8.070 in 1997/98 resulting from 4 ploughing + 100 cm + 2 hoeings, being 8.187 in 1998/99 season which was produced by combining 3 ploughings + 100 cm + hoeings
At 165 days from planting, the same combinations producing the highest values at 105 days were also the best combinations at 165 days and the corresponding values of stalks/m^2 were 15.233 and 18.090 in the two successive seasons, respectively.

3- Stalk diameter:

Data presented in Tables (5 and 6) show the effect of number of ploughings, hoeing intensity, row spacing and their interactions on stalk diameter of sugar cane at different growth stages in 1997/98 and 1998/99 seasons.

Effects of the main factors:

Results showed that increasing ploughing number from 2 to 4 times insignificantly increased stalk diameter (cm) by 1.63 , 0.55, 0.86 and 6.21% at 150, 210, 270 and 330 days from planting, respectively, in the 1st season.

On the other hand, the results in Table (6) indicated that increasing the intensity of ploughing from 2 to 4 times significantly increased stalk diameter in 1998/99 season by 15.28 and 13.84 % at 150 and 210 days, respectively.

At 270 and 330 days from planting no significant increases is stalk diameter were recorded in the 2nd season.

It could be concluded that increasing ploughing intensity encourages sugar cane growth expressed as stalk diameter particularly at the early stages of growth. The positive effect of ploughing on sugar cane growth was also reported by **Barbieri *et al* (1997)**.On the other hand **Braunack (1994)** found that reducing the number of tillage operation did not affect final yield of sugar cane.

Concerning the effect of row spacing, results given in Tables (5 and 6) revealed that row spacing of 125 cm significantly increased stalk diameter in the 2nd season at various growth stages. The results indicated that wider row space of 125 cm significantly increased stalk thickness by 11.19, 9.32 , 7.58 and 8.2 % at 150, 210, 270 and 330 days from planting, respectively.

However, effect of row spacing on this trait was not significant at the different growth stages in the 1st season. These results are in agreement with those obtained by **Prasad *et al.* (1983)** who found that spacing of 90 cm gave

Table (5): Effect of number of ploughings, row spacing, hoeing number and their interactions on stalk diameter (cm) of sugar cane at 150, 210, 270 and 330 days from planting during 1997/98 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	1.822	1.878	1.850	2.157	2.212	2.184	2.475	2.491	2.484	2.768	2.771	2.769
	125 cm	1.855	1.800	1.828	2.154	2.121	2.137	2.431	2.391	2.411	2.744	2.654	2.699
Average		1.839	1.839	1.839	2.155	2.166	2.161	2.454	2.441	2.448	2.756	2.713	2.734
3	100 cm	1.822	1.833	1.827	2.110	2.131	2.121	2.391	2.434	2.413	2.791	2.864	2.828
	125 cm	1.811	1.844	1.828	2.120	2.201	2.161	2.378	2.501	2.439	2.701	2.844	2.773
Average		1.817	1.839	1.828	2.115	2.166	2.141	2.384	2.468	2.426	2.746	2.854	2.800
4	100 cm	1.844	1.856	1.850	2.134	2.134	2.134	2.468	2.524	2.496	2.768	3.014	2.891
	125 cm	1.900	1.878	1.889	2.211	2.215	2.213	2.444	2.601	2.523	2.824	3.011	2.918
Average		1.872	1.867	1.869	2.173	2.174	2.173	2.456	2.563	2.509	2.796	3.013	2.904
Row spacing x Hoeing	100 cm	1.830	1.856	1.843	2.134	2.159	2.146	2.445	2.483	2.464	2.775	2.883	2.829
	125 cm	1.856	1.841	1.848	2.162	2.179	2.170	2.418	2.493	2.458	2.757	2.837	2.797
Total Average		1.843	1.848	1.845	2.148	2.169	2.158	2.432	2.490	2.461	2.766	2.860	2.813

L S D at 5 % level :				
Ploughing (P)	NS	NS	NS	NS
Row spacing (R)	0.0618	NS	NS	NS
Hoeing (H)	NS	NS	NS	0.0683
P x R	NS	NS	NS	NS
P x H	NS	NS	NS	NS
R x H	NS	NS	NS	NS
P x R x H	NS	NS	NS	NS

Table (6): Effect of number of ploughings, row spacing, hoeing number and their interactions on stalk diameter (cm) of sugar cane at 150, 210, 270 and 330 days from planting during 1998/99 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	1.553	1.616	1.585	1.778	1.867	1.822	2.366	2.453	2.409	2.738	2.763	2.751
	125 cm	1.766	1.816	1.791	1.966	2.078	2.022	2.540	2.653	2.597	2.913	2.963	2.939
Average		1.659	1.716	1.688	1.872	1.973	1.922	2.453	2.553	2.503	2.826	2.863	2.845
3	100 cm	1.728	1.741	1.735	1.978	2.016	1.997	2.278	2.316	2.297	2.726	2.676	2.701
	125 cm	1.916	2.053	1.985	2.216	2.253	2.235	2.516	2.553	2.535	2.988	2.963	2.976
Average		1.822	1.897	1.860	2.097	2.135	2.116	2.397	2.434	2.416	2.857	2.820	2.838
4	100 cm	1.861	1.903	1.882	2.128	2.128	2.128	2.353	2.391	2.372	2.780	2.688	2.734
	125 cm	1.978	2.041	2.009	2.241	2.253	2.247	2.466	2.503	2.484	2.913	2.976	2.945
Average		1.920	1.972	1.946	2.184	2.191	2.188	2.409	2.447	2.428	2.847	2.832	2.839
Row spacing x Hoeing	100 cm	1.714	1.753	1.734	1.962	2.004	1.983	2.332	2.387	2.360	2.748	2.709	2.729
	125 cm	1.887	1.970	1.928	2.141	2.195	2.168	2.507	2.570	2.539	2.938	2.967	2.953
Total Average		1.800	1.862	1.831	2.051	2.099	2.075	2.420	2.478	2.449	2.843	2.838	2.841

L S D at 5 % level :				
Ploughing (P)	0.0087	0.0135	NS	NS
Row spacing (R)	0.2520	0.2930	0.0269	0.0109
Hoeing (H)	0.0171	0.0130	0.0199	NS
P x R	NS	NS	0.0466	0.0192
P x H	NS	NS	NS	NS
R x H	NS	NS	NS	NS
P x R x H	NS	NS	NS	NS

thicker canes than 70 cm. On the contrary, these results are not in agreement with those obtained **El-Sayed (1996)** who revealed that planting 1.5 drill significantly increased stalk diameter compared with planting two drills.

The available results in Tables (5 and 6) pointed out that increasing hoeing from two to three times almost increased stalk diameter in both seasons at all growth stages except at 330 days in the second season.

These increments were significant at 330 days in the 1st season and at 150, 210 and 270 days in the 2nd season. The increase was 3.39 % at 330 days from planting in the 1st season and in the 2nd season, the corresponding increases in stalk diameter due to raising hoeing number from 2 to 3 were 3.44, 2.34 and 2.39 at 150, 210 and 270 days from planting, respectively.

Interaction effects:

Tables (5 and 6) show the interaction effects between number of ploughings, row spacing and hoeing on stalk diameter in both seasons.

The results indicated that the interaction between ploughing intensity and row spacing at 270 and 330 days from planting in 1998/99 season was significant.The results showed that the thickest stalks were obtained from 2 ploughings + 125 cm row spacing at 270 DFP, being 2.60 cm. Whereas at 330 DFP, the thickest stalks recorded 2.98 cm resulting from 3 ploughings and 125 cm row spacing.

4- Stalk height:

Data presented in Tables (7 and 8) show the effect of number of ploughings, hoeing intensity and row spacing and their interactions on stalk height of sugar cane at different growth stages in 1997/98 and 1998/99 seasons.

Effect of the main factors:

Regarding the effect of number of ploughing, the results obtained showed that there was no general tendency due to the effect of ploughing number on stalk height. However, it could be noticed that ploughing two and/or three times attained the highest stalk length in both seasons throughout the different growth stages compared with four ploughings.

A general view to the results given in Tables (7 and 8) with respect to the last two growth stages i.e. when the plants aged 270 and 330 days, it could be noticed that almost there were no significant differences between ploughing sugar cane field twice or thrice with respect to their influence on stalk height. These findings were true in both seasons for the two growth stages.

However, both treatments significantly surpassed ploughing treatment 4 times. Ploughing sugar cane field twice increased stalk height at 270 days by 4.96 % and 4.84% in the 1st and 2nd seasons, respectively, compared with ploughing 4 times.

Meanwhile at 330 days from planting, ploughing sugar cane field twice produced a significant increase in stalk height of 5.22% and 3.35% in the 1st and 2nd seasons, respectively, compared with ploughing 4 times.

It could be concluded that 2 ploughings were effective as far as sugar cane growth is concerned. Excessive ploughing to 4 times reduced sugar cane plant height especially at later stages of growth. The results reported by **Glaz *et al* (1989)** showed that minimum tillage of two shallow cultivations are enough to realize a high yield of cane and sugar in Florida. Also **Braunack (1994)** reported that little or no benefit was obtained from increasing the number of cultivations in plant or ratoon cane.

The results in Tables (7 and 8) showed that using row spacing of 100 cm significantly increased stalk height by 4.46, 4.45, 2.74 and 3.35 % at 150, 210, 270 and 330 days respectively, in the 2nd season compared with the wider row spacing (125 cm). Moreover, in the 1st season, rows spacing of 100 cm increased stalk height by 1.76, 1.45, 0.85 and 0.88 % at 150, 210, 270 and 330

Table (7): Effect of number of ploughings, row spacing, hoeing number and their interactions on stalk height (cm) of sugar cane at 150, 210, 270 and 330 days from planting during 1997/98 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	216.200	209.800	213.000	277.233	265.000	271.117	307.900	301.767	304.833	339.433	340.000	339.717
	125 cm	199.300	197.867	198.583	265.233	261.700	263.467	300.433	291.100	295.767	339.967	315.000	327.483
Average		207.750	203.833	205.792	271.233	263.350	267.292	304.167	296.433	300.300	339.700	327.500	333.600
3	100 cm	216.500	210.800	213.650	271.100	256.100	263.600	306.867	288.667	297.767	345.000	314.467	329.733
	125 cm	199.600	217.200	208.400	248.900	276.133	262.517	298.333	315.900	307.117	322.233	344.667	331.950
Average		208.050	214.000	211.025	260.000	266.117	263.058	302.600	302.283	302.442	333.617	328.067	330.842
4	100 cm	202.200	199.667	200.933	253.900	257.233	255.567	294.967	289.200	292.083	318.900	313.900	316.400
	125 cm	205.000	214.400	209.700	255.000	251.000	253.000	281.667	286.700	284.183	316.100	319.433	317.767
Average		203.600	207.033	205.317	254.450	254.117	254.283	288.317	287.950	288.133	317.500	316.667	317.083
Row spacing x Hoeing	100 cm	211.633	206.756	209.194	267.411	259.444	263.428	303.244	293.211	298.228	334.444	322.789	328.617
	125 cm	201.300	209.822	205.561	256.378	262.944	259.661	292.478	297.900	295.689	326.100	325.367	325.733
Total Average		206.467	208.289	207.378	261.894	261.194	261.544	298.361	295.556	296.958	330.272	324.078	327.175

L S D at 5 % level :				
Ploughing (P)	NS	3.900	6.664	4.72
Row spacing (R)	2.603	NS	NS	NS
Hoeing (H)	NS	NS	NS	NS
P x R	4.508	NS	NS	NS
P x H	NS	NS	NS	NS
R x H	5.655	NS	6.603	NS
P x R x H	NS	NS	11.437	22.155

Table (8): Effect of number of ploughings, row spacing, hoeing number and their interactions on stalk height (cm) of sugar cane at 150, 210, 270 and 330 days from planting during 1998/99 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	188.067	194.567	191.317	224.633	231.167	227.900	287.267	293.733	290.500	329.600	338.067	333.833
	125 cm	185.533	184.300	184.917	217.867	219.267	218.567	281.100	281.600	281.350	321.100	314.167	317.633
Average		186.800	189.433	188.117	221.250	225.217	223.233	284.183	287.667	285.925	325.350	326.117	325.733
3	100 cm	196.600	201.600	199.100	235.767	241.400	238.583	291.267	287.000	294.133	330.500	326.133	326.817
	125 cm	188.433	185.467	186.950	226.833	224.400	225.617	281.367	279.767	280.567	315.667	315.000	315.333
Average		192.517	193.533	193.025	231.300	232.900	232.100	286.317	288.383	287.350	323.083	319.067	321.075
4	100 cm	201.200	201.933	201.567	231.367	227.767	229.567	281.767	266.633	274.200	311.333	313.933	312.633
	125 cm	198.200	191.433	194.817	225.400	218.900	222.150	277.267	270.600	273.933	306.667	310.767	308.717
Average		199.700	196.683	198.192	228.383	223.333	225.858	279.517	268.617	274.067	309.000	312.350	310.675
Row spacing x Hoeing	100 cm	195.289	199.367	197.328	230.589	233.444	232.017	286.767	285.789	286.278	323.811	325.044	324.428
	125 cm	190.722	187.067	188.894	223.367	220.856	222.111	279.911	277.322	278.617	314.478	313.311	313.894
Total Average		193.006	193.217	193.111	226.978	227.150	227.064	283.339	281.556	282.447	319.144	319.178	319.161

L S D at 5 % level :				
Ploughing (P)	1.496	1.501	3.659	2.415
Row spacing (R)	1.052	0.995	2.933	2.136
Hoeing (H)	NS	NS	NS	NS
P x R	NS	NS	5.080	NS
P x H	NS	3.879	5.227	NS
R x H	3.148	NS	NS	NS
P x R x H	NS	NS	NS	NS

days, respectively, compared with 125 cm rows spacing. These increases did not reach the level of significance in the last three growth stages.

The present results indicate that at narrower spacing sugar cane plants tended to elongate compared with plants grown at wider spacing. The elongation of cane plants is due to the increase in competition for light among growing plants at narrower spaces. Similar results were also obtained by **Ahmed (1995)** who found that using double drills increased stalk height compared with 1.5 drills.

Concerning the effect of hoeing number, the results in Tables (7 and 8) pointed out that practicing two or three hoeings, insignificantly affected stalk height of sugar cane plant in both seasons. Similar results were obtained by **Ismail (1991)** who found that hoeing twice produced the highest stalk length compared with untreated control.

Interaction effects:

The results in Tables (7 and 8) indicated some significant effects of ploughing X row spacing, ploughing X hoeing, row spacing X hoeing and ploughing X row spacing X hoeing on stalk height of sugar cane at some growth stages in both seasons.

In 1997/98 season, ploughing X row spacing significantly affected stalk height at 105 days from planting (Table 7). The results showed that with 2 and 3 ploughings, cane plants were taller under 100 cm row spacing, whereas with 4 ploughings taller cane plants were obtained under 125 cm row spacing.

Also, in that season, row spacing X hoeing significantly affected stalk height at 105 as well as at 270 days from planting. The results showed that 100 cm row spacing produced taller plants with 2 hoeings at both 105 and 270 days, whereas 125 cm row spacing produced taller plants with 3 hoeings at both growth stages.

The second order interaction significantly affected stalk height at 270 and 330 days in 1997/98 season. At 270 days, the tallest plants recorded 307.9 cm which were produced by combining 2 ploughings + 100 cm row spacing + 2 hoeings, whereas combining 3 ploughings + 125 cm row spacing + 3 hoeings produced the maximum stalk height at 330 days from planting, being 344.67 cm.

In 1998/99 season , ploughing X row spacing significantly affected stalk height at 270 days from planting (Table 8). The results showed that 100 cm row spacing produced taller plants under 2 and 3 ploughings, whereas under 4 ploughings both 100 and 125 cm produced about the same stalk height.

Also in 1998/99 season ploughing X hoeing numbers significantly affected stalk height at 210 and 270 days from planting. The results showed that under 2 and 3 ploughings taller plants were recorded by 3 hoeings whereas under 4 ploughings, 2 hoeings produced taller plants. This results was true at both 210 and 270 days from planting.

Also, a significant interaction was recorded between row spacing and hoeing on stalk height at 150 days in 1998/99. The results showed that 3 hoeings produced taller plants under 100 cm row spacing, whereas under 125 cm row spacing, taller plants were observed with 2 hoeings.

II- Effect of Ploughing, Row Spacing, Hoeing and Their Interactions on Weed Density in Sugar Cane.

1- Fresh weight of weeds (g/m^2):

Weeds prevailing in both seasons were:
Convolvulus arvensis, *Echinochloa colonum*, *Corchorus olitorius*, *Cyperus rotundus*, *Portulaca oleracea*, and *Xanthium spinosum*.

In addition *Cynodon dactylon* (Bermude grass), *Hibiscus trionum* and *Digitaria sangunalis* were also found in the first season, whereas *Eupharbia geniculata* was found in the second one only.

The results presented in Tables (9 and 10) show the fresh weight of broad-leaved, grasses and total weeds (g/m^2) collected at 135 days from planting in 1997/98 and 1998/99 seasons as affected by the experimental treatments.

Effects of the main factors:

The effect of ploughing intensity was not significant on weeds fresh weight in both seasons. Moreover, an increase was observed in the first season due to 4 ploughings in fresh weight of grasses and total weeds compared with 2 ploughings (Table 9). However, this increase was not significant. On the other hand, 4 ploughings insignificantly reduced weeds fresh weight (broad-leaved and grasses) compared with 2 ploughings in the second season, (Table 10).

It could be concluded that no clear effect for ploughing intensity on weeds fresh weight could be detected probably due to the smothering effect of sugar cane as a good competitor for weeds, particularly with advanced stage of growth.

The results reported by **Omran (1995)** showed that seedbed preparation significantly affected spread of weeds in soybean and intensive ploughing reduced markedly weed density in soybean .

The effect of plant spacing on weed fresh weight at 135 days was not significant in both seasons . It seems that the slight difference in the studied treatments (100 and 125 cm) was not that great to show a marked effect on weed density.

The effect of hoeing on weed fresh weight was significant in 1997/ 98 season (Table 9) . Three hoeings reduced fresh weight by 60, 56 and 57% for broad-leaved, grasses and total weeds, respectively, compared with 2 hoeings.

Table (9): Effect of number of ploughings, row spacing, hoeing number and their interactions on fresh weight of broad - leaved, grasses and total weeds (g/m^2) of sugar cane at 135 days from planting in 1997/98 season

Number of ploughing	Row spacing	Broad-leaved		Average	Grasses		Average	Total weeds		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	66.750	47.050	56.900	197.600	62.350	129.975	264.350	109.400	186.875
	125 cm	107.300	63.200	85.250	141.151	136.250	138.700	248.450	199.450	223.950
Average		87.025	55.125	71.075	169.375	99.300	134.337	256.400	154.425	205.413
3	100 cm	60.000	49.550	54.775	193.200	21.200	107.200	253.200	70.750	161.975
	125 cm	46.350	13.750	30.050	277.600	191.250	234.425	323.950	205.000	264.475
Average		53.175	31.650	42.413	235.400	106.225	170.812	288.575	137.875	213.225
4	100 cm	53.600	17.300	35.450	549.250	217.250	383.250	602.850	234.550	418.700
	125 cm	192.250	21.300	106.775	207.250	58.600	132.925	399.500	79.900	239.700
Average		122.925	19.300	71.112	378.250	137.925	258.087	501.175	157.225	329.200
Row spacing x Hoeing	100 cm	60.117	37.967	49.042	313.350	100.267	206.808	373.467	138.233	255.850
	125 cm	115.300	32.750	74.025	208.667	128.700	168.683	323.967	161.450	242.708
Total Average		87.708	35.358	61.533	261.008	114.483	187.766	348.717	149.842	249.279
L S D at 5% level :										
Ploughing (P)			NS			NS			NS	
Row spacing (R)			NS			NS			NS	
Hoeing (H)			NS			146.589			112.811	
P x R			NS			NS			NS	
P x H			NS			NS			NS	
R x H			NS			NS			NS	
P x R x H			NS			NS			NS	

Table (10): Effect of number of ploughings, row spacing, hoeing number and their interactions on fresh weight of broad - leaved, grasses and total weeds (g/m^2) of sugar cane at 135 days from planting in 1998/99 season

Number of ploughing	Row spacing	Broad-leaved		Average	Grasses		Average	Total weeds		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	145.800	121.250	133.525	188.350	73.750	131.050	334.150	195.000	264.575
	125 cm	100.700	80.050	90.375	205.700	83.850	144.775	306.400	163.900	235.150
Average		123.250	100.650	111.950	197.025	78.800	137.912	320.275	179.450	249.862
3	100 cm	102.900	166.700	134.800	80.650	71.950	76.300	183.550	138.650	211.100
	125 cm	61.650	70.550	66.100	60.100	63.350	61.725	121.750	133.900	127.825
Average		82.275	118.625	100.450	70.375	67.650	69.012	152.650	186.275	169.462
4	100 cm	22.700	66.550	44.625	138.650	57.200	97.925	161.350	123.750	142.550
	125 cm	90.950	44.700	67.825	99.300	69.150	84.224	190.250	113.850	152.050
Average		56.825	55.625	56.225	118.975	63.175	91.075	175.800	118.800	147.300
Row spacing x Hoeing	100 cm	90.467	118.167	104.317	135.883	67.633	101.758	226.350	185.800	206.075
	125 cm	84.433	65.100	74.767	121.700	72.117	96.908	206.133	137.217	171.675
Total Average		87.450	91.633	89.542	128.792	69.875	99.333	216.242	161.508	188.875
L S D at 5% level :										
Ploughing (P)			NS			NS			NS	
Row spacing (R)			NS			NS			NS	
Hoeing (H)			NS			NS			NS	
P x R			NS			NS			NS	
P x H			NS			NS			NS	
R x H			NS			NS			NS	
P x R x H			NS			NS			NS	

Also in the second season, a marked effect was only evident for hoeing on grassy weeds where 3 hoeings reduced fresh weight by 48 % compared with 2 hoeings. But an opposite trend was observed with broad-leaved weeds.

It could be concluded that hoeing intensity affected the spread of weeds in sugar cane. Similar results were also reported by **Shafshak *et al* (1975)** who found that 2 hoeings controlled 82 % of the total weeds in maize. Also **Omran (1995)** found that one hoeing reduced 73-76 % of the weed population of the unweeded treatment in soybean.

Interaction effects:

The results in Tables (9 and 10) showed that no any significant effect was detected for the interaction between the 3 factors on fresh weight of weeds at 135 days in both seasons. This results indicates the independence of the experimental factors in affecting this trait.

However, the lowest weed density (fresh weight) was recorded in both seasons by combining 4 ploughings + 125 cm row spacing + 3 hoeings, being 70.90 and 113.85 g/m^2 in the first and second season, respectively.

2- Dry weight of weeds (g/m^2):

The results in Tables (11 and 12) show the effects of ploughing, row spacing, hoeing and their interactions on the dry weight of weeds (g/m^2) in sugar cane field in the two successive seasons 1997/98 and 1998/99.

Effects of the main factors:

The results showed that ploughing intensity significantly affected grassy weeds in 1997/98 season only, where 4 ploughings caused a significant increase in grasses dry weight compared with 2 ploughings, the increase reached 85.69%.

Table (11): Effect of number of ploughings, row spacing, hoeing number and their interactions on dry weight of broad - leaved, grasses and total weeds (g/m^2) of sugar cane at 135 days from planting in 1997/98 season

Number of ploughing	Row spacing	Broad-leaved		Average	Grasses		Average	Total weeds		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	15.865	13.645	14.755	38.945	17.825	28.385	54.810	31.470	43.140
	125 cm	26.640	13.425	20.032	31.040	27.040	29.040	57.680	40.465	49.072
Average		21.252	13.535	17.394	34.992	22.432	28.712	56.245	35.967	46.106
3	100 cm	17.700	12.240	14.970	37.205	8.710	22.957	54.905	20.950	37.927
	125 cm	10.845	3.375	7.110	54.185	36.645	45.415	65.030	40.020	52.525
Average		14.272	7.808	11.040	45.695	22.677	34.186	59.967	30.485	45.226
4	100 cm	12.025	4.565	8.295	101.605	46.325	73.965	113.630	50.890	82.260
	125 cm	26.820	6.020	16.420	48.540	16.795	32.667	75.360	22.815	49.087
Average		19.422	5.293	12.357	75.072	31.560	53.316	94.495	36.852	65.674
Row spacing x Hoeing	100 cm	15.197	10.150	12.673	59.252	24.287	41.769	74.448	34.437	54.442
	125 cm	21.435	7.607	14.521	44.588	26.827	35.707	66.023	34.433	50.228
Total Average		18.316	8.800	13.597	51.920	25.557	38.738	70.236	34.435	52.335

L S D at 5% level :			
Ploughing (P)	NS	16.845	NS
Row spacing (R)	NS	NS	NS
Hoeing (H)	NS	NS	24.424
P x R	NS	NS	NS
P x H	NS	NS	NS
R x H	NS	NS	NS
P x R x H	NS	NS	NS

Table (12): Effect of number of ploughings, row spacing, hoeing number and their interactions on dry weight of broad - leaved, grasses and total weeds (g/m^2) of sugar cane at 135 days from planting in 1998/99 season

Number of ploughing	Row spacing	Broad-leaved		Average	Grasses		Average	Total weeds		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	23.310	18.960	21.135	34.975	14.725	24.850	58.285	33.685	45.985
	125 cm	15.620	13.150	14.385	38.065	16.755	27.410	54.185	29.905	42.045
Average		19.465	16.055	17.760	36.520	15.740	26.130	56.235	31.795	44.015
3	100 cm	16.465	26.915	21.690	14.840	13.985	14.413	31.305	40.900	36.102
	125 cm	12.640	11.960	12.300	11.055	12.320	11.688	23.695	24.280	23.987
Average		14.552	19.438	16.995	12.947	13.153	13.050	27.500	32.590	30.045
4	100 cm	4.750	11.250	8.000	25.995	10.520	18.258	30.745	21.770	26.257
	125 cm	14.920	7.900	11.410	19.340	13.005	16.173	34.260	20.905	27.583
Average		9.835	9.575	9.705	22.668	11.763	17.215	32.503	21.337	26.920
Row spacing x Hoeing	100 cm	14.842	19.042	16.942	25.270	13.077	19.173	40.112	32.118	36.115
	125 cm	14.393	11.003	12.698	22.820	14.027	18.423	37.380	25.030	31.205
Total Average		14.617	15.023	14.820	24.045	13.552	18.793	38.746	28.574	33.660

L S D at 5% level :			
Ploughing (P)	NS	NS	NS
Row spacing (R)	NS	NS	NS
Hoeing (H)	NS	NS	NS
P x R	NS	NS	NS
P x H	NS	NS	NS
R x H	NS	NS	NS
P x R x H	NS	NS	NS

The present result is mainly due to the presence of Bermuda grass in the experimental site only in the first season. The more frequent ploughing with the chisel plough caused a widespread in the rhizomes of the grass leading to an increase in the weed population. This weed was not found in the second season and the results showed a marked reduction in grassy weeds of 50 and 34 % due to increasing ploughing frequency from 2 to 3 and 4 times.

Concerning the total weeds dry weight, no significant effect was observed for ploughing frequency in spite of some increases in the first season, but some reductions in the second one due to intensive ploughing. It could be concluded that the weed flora in the field greatly determines the positive or the negative effects of ploughing.

The results reported by **Ismail (1991)** (on sugar cane), **Shafshak *et al* (1975)** (on maize) and **Omran (1995)** (on soybean) indicated a positive effect of intensive seedbed preparation on the spread of weeds.

Row spacing did not significantly affect weed density in sugar cane at 135 days from planting. There was slight and insignificant reduction of 8 and 14 % in the total weed dry weight in the first and second season, respectively, due to growing sugar cane at 125 cm row spacing compared with 100 cm.

The effect of hoeing frequency on the total weeds dry weight was significant in 1997/98 season where a reduction of 51 % in dry weight was recorded with 3 hoeings compared with 2 hoeings. Also, in 1998/99 season, 3 hoeings reduced total weeds dry weight insignificantly by 14 % compared with 2 hoeings. It could be concluded that the increase in hoeing frequency markedly reduced the spread of weeds in sugar cane.

The result reported by **Kumar and Strivastava (1991)** indicated that hoeing reduced DW and increased the number of millable canes and cane yields were also increased from 65 to 83 tons/ha. Similar results were also reported by **Shafshak *et al* (1975)** (on maize) and **Omran (1995)** (on soybean) who found that weed control by means of hand hoeing was efficient in contrally weeds.

Interaction effects:

None of the interactions between the experimental factors significantly affected dry weight of weeds in sugar cane Tables (11 and 12).
However, the lowest total weeds dry weight in both seasons was recorded by 4 ploughings + 125 cm row spacing + 3 hoeings, being 22.82 and 20.91 g/m^2 in the first and second season, respectively at 135 DFP.

III- Effect of Ploughing, Row Spacing, Hoeing and Their Interactions on Chemical Composition in Leaf and Juice at Different Growth Stages.

1- Nitrogen percentage in leaf at different growth stages:

Tables (13 and 14) show the influence of ploughing, row spacing, hoeing numbers and their interactions on nitrogen percentage of sugar cane leaves at various growth stages in the two growing seasons.

Effects of the main factors:

The results showed that ploughing intensity significantly affected N% in leaves at 150 and 330 days from planting in the first season, and at 330 days in the second season.

Table (13): Effect of number of ploughings, row spacing, hoeing number and their interactions on nitrogen percentage in leaf of sugar cane at 150, 210, 270 and 330 days from planting during 1997/98 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	3.267	3.367	3.317	3.167	2.967	3.067	2.567	2.267	2.417	1.800	1.500	1.650
	125 cm	3.167	2.867	3.017	3.267	3.267	3.267	2.367	2.067	2.217	1.800	1.867	1.833
Average		3.217	3.117	3.167	3.217	3.117	3.167	2.467	2.167	2.317	1.800	1.683	1.742
3	100 cm	2.767	2.967	2.617	2.967	2.967	2.967	2.067	2.567	2.317	1.867	1.467	1.667
	125 cm	2.767	2.367	2.567	3.567	3.467	3.517	2.167	2.367	2.267	2.000	1.800	1.900
Average		2.517	2.667	2.592	3.267	3.217	3.242	2.117	2.467	2.292	1.933	1.633	1.783
4	100 cm	3.367	2.567	2.967	2.867	3.467	3.167	2.567	2.467	2.517	2.367	1.933	2.150
	125 cm	2.667	2.967	2.817	2.967	2.967	2.967	2.267	2.267	2.267	1.800	2.000	1.900
Average		3.017	2.767	2.892	2.917	3.217	3.067	2.417	2.367	2.392	2.083	1.967	2.025
Row spacing x Hoeing	100 cm	2.967	2.967	2.967	3.000	3.133	3.067	2.400	2.433	2.417	2.011	1.633	1.822
	125 cm	2.867	2.733	2.800	3.267	3.233	3.250	2.267	2.233	2.250	1.867	1.889	1.878
Total Average		2.917	2.850	2.883	3.133	3.183	3.158	2.333	2.333	2.333	1.939	1.761	1.850

L S D at 5 % level :				
Ploughing (P)	0.289	NS	NS	0.058
Row spacing (R)	0.087	NS	0.045	NS
Hoeing (H)	NS	NS	NS	NS
P x R	NS	0.217	0.079	0.206
P x H	NS	NS	0.214	NS
R x H	NS	NS	NS	0.223
P x R x H	0.314	NS	NS	NS

Table (14): Effect of number of ploughings, row spacing, hoeing number and their interactions on nitrogen percentage in leaf of sugar cane at 150, 210, 270 and 330 days from planting during 1998/99 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	3.033	2.867	2.950	2.433	2.233	2.333	1.967	2.467	2.217	1.700	1.800	1.750
	125 cm	2.367	2.967	2.667	2.433	2.033	2.233	2.167	2.267	2.217	1.400	2.400	1.900
Average		2.700	2.917	2.808	2.433	2.133	2.283	2.067	2.367	2.217	1.550	2.100	1.825
3	100 cm	2.767	2.667	2.717	2.233	2.533	2.383	1.767	1.967	1.867	1.800	2.000	1.900
	125 cm	3.167	2.467	2.817	2.433	2.333	2.383	1.967	2.567	2.267	2.600	1.800	2.200
Average		2.967	2.567	2.767	2.333	2.433	2.383	1.867	2.267	2.067	2.200	1.900	2.050
4	100 cm	2.667	2.667	2.667	1.933	2.633	2.283	1.967	1.967	1.967	1.200	1.600	1.400
	125 cm	3.267	2.467	2.867	2.133	2.333	2.233	2.067	2.067	2.067	2.100	1.700	1.900
Average		2.967	2.567	2.767	2.033	2.483	2.258	2.017	2.017	2.017	1.650	1.650	1.650
Row spacing x Hoeing	100 cm	2.822	2.733	2.778	2.200	2.467	2.333	1.900	2.133	2.017	1.567	1.800	1.683
	125 cm	2.933	2.633	2.783	2.333	2.233	2.283	2.067	2.300	2.183	2.033	1.967	2.000
Total Average		2.878	2.683	2.781	2.267	2.350	2.308	1.983	2.217	2.100	1.800	1.883	1.842

L S D at 5 % level :				
Ploughing (P)	NS	NS	NS	0.199
Row spacing (R)	NS	NS	NS	0.188
Hoeing (H)	NS	NS	0.173	NS
P x R	NS	NS	NS	NS
P x H	NS	0.295	NS	NS
R x H	NS	NS	NS	NS
P x R x H	NS	NS	NS	0.565

In 1997/98 season, 2 ploughings recorded the highest N% in leaves, being 3.17 % at 150 days from planting, whereas 4 ploughings induced a significant increase in N% in leaves at 330 days, being 2.03 %.

In 1998/99 season, the only significant effect of ploughing intensity on N% was at 330 days from planting where 3 ploughing increased N% compared with 2 or 4 ploughings. N content averaged 2.05 % at this stage.

It could be concluded that no definite trend can be observed for the effect of ploughing intensity on N content in sugar cane leaves under the conditions of the present investigation.

The results in Tables (13 and 14) showed that row spacing had significant effect on N content in leaves at 150 and 270 days in the first season as well as at 330 days in the second one.

In 1997/98 season, higher N content in sugar cane leaves was recorded at 100 cm row spacing at 150 and 270 days from planting, whereas in 1998/99 season, 125 cm row spacing recorded higher N content in leaves at 330 days compared with 100 cm row spacing.

The present results show also that no definite effect for row spacing could be concluded on N% in leaves.

Concerning the effect of hoeing intensity on N% in leaves, the results in Tables (13 and 14) indicated no significant effect with one exceptional case at 270 days from planting in the second season where 3 hoeings recorded higher N% compared with 2 hoeings.

Interaction effects:

The results showed that ploughing X row spacing had significant effect on N% in leaves at 210, 270 and 330 days in the first season, but no significant effect was observed in the second one .

The results in Table (13) showed that the highest N% in leaves was recorded by 3 ploughings + 125 cm (3.52 %) at 210 days, 4 ploughings + 100 cm (2.52 %) at 270 days, and 4 ploughings + 100 cm (2.15 %) at 330 days.

Also, ploughing X hoeing had significant effect on N% in leaves at 270 days in the first season and at 210 days in the second one. The highest N% was recorded by combining 2 ploughings + 2 hoeings and /or 3 ploughings + 3 hoeings at 270 days in the first season, being 2.47 %. Whereas in the second season, the highest N% at 210 days was 2.48% which was recorded by combining 4 ploughings + 3 hoeings.

The interaction row spacing X hoeing was only significant for N% at 330 days only in the first season. The highest N% in leaves was recorded at this growth stage by combining 100 cm row spacing + 2 hoeings, being 2.01%.

The second order interaction significantly affected N% at 150 days in the first season as well as at 330 days in the second one. The highest N% at 150 days in the first season was 3.37 % which was recorded by combining either 2 ploughings + 100 cm + 3 hoeings or 4 ploughings + 100 cm + 2 hoeings. On the other hand, combining 2 ploughings + 125 cm + 3 hoeings was the best combination at 330 days in the 1998/99 season for N% with an average value of 2.4 % N content in leaves.

2- Potassium percentage in leaf at different growth stages:

Data given in Tables (15 and 16) reveal the effect of ploughing, row spacing, hoeing numbers and their interactions on potassium percentage (K %) in sugar cane leaves at the different growth stages.

Effects of the main factors:

The results showed that ploughing intensity significantly affected K% in leaves at 210 and 270 days from planting in the first season and at 150 days in the second one. The results cleared that 2 ploughings produced higher K% in the first season, being 2.11 and 1.79 % at 210 and 270 days, respectively. On the other hand, 3 ploughings in 1998/99 season produced a significant increase in K% in leaves at 150 days. The K content was 2.27 % which was higher than that recorded by 4 ploughings.

Table (15): Effect of number of ploughings, row spacing, hoeing number and their interactions on potassium percentage in leaf of sugar cane at 150, 210, 270 and 330 days from planting during 1997/98 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	2.157	2.103	2.130	2.177	2.187	2.182	1.667	1.877	1.772	1.470	1.570	1.520
	125 cm	2.417	2.107	2.262	1.900	2.177	2.038	1.823	1.790	1.807	1.403	1.650	1.527
Average		2.287	2.105	2.196	2.038	2.182	2.110	1.745	1.833	1.789	1.437	1.610	1.523
3	100 cm	2.050	1.947	1.998	2.020	1.987	2.003	1.533	1.697	1.615	1.353	1.550	1.452
	125 cm	2.100	2.000	2.050	2.010	1.877	1.943	1.463	1.683	1.573	1.347	1.690	1.518
Average		2.075	1.973	2.024	2.015	1.932	1.973	1.498	1.690	1.594	1.350	1.620	1.485
4	100 cm	2.060	1.777	1.918	1.860	1.610	1.735	1.677	1.673	1.675	1.610	1.670	1.640
	125 cm	2.160	1.977	2.064	1.977	1.487	1.732	1.523	1.723	1.623	1.520	1.410	1.465
Average		2.110	1.877	1.993	1.918	1.548	1.733	1.600	1.698	1.649	1.565	1.540	1.552
Row spacing x Hoeing	100 cm	2.089	1.942	2.016	2.019	1.928	1.973	1.626	1.749	1.687	1.478	1.597	1.537
	125 cm	2.226	2.028	2.127	1.962	1.847	1.904	1.603	1.732	1.668	1.423	1.583	1.503
Total Average		2.157	1.985	2.071	1.991	1.887	1.939	1.614	1.741	1.678	1.451	1.590	1.520

L S D at 5 % level :				
Ploughing (P)	NS	0.161	0.079	NS
Row spacing (R)	0.068	NS	NS	NS
Hoeing (H)	0.060	0.071	0.067	NS
P x R	NS	NS	NS	NS
P x H	NS	0.122	NS	NS
R x H	NS	NS	NS	NS
P x R x H	NS	NS	NS	NS

Table (16): Effect of number of ploughings, row spacing, hoeing number and their interactions on potassium percentage in leaf of sugar cane at 150, 210, 270 and 330 days from planting during 1998/99 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	2.127	2.383	2.255	2.347	2.513	2.430	1.763	2.277	2.020	1.307	1.370	1.338
	125 cm	2.473	2.043	2.258	2.217	2.527	2.372	2.157	1.683	1.920	1.170	1.457	1.313
Average		2.300	2.213	2.257	2.282	2.520	2.401	1.960	1.980	1.970	1.238	1.413	1.326
3	100 cm	2.253	2.343	2.298	2.310	2.737	2.523	1.997	1.617	1.807	1.877	1.767	1.822
	125 cm	2.253	2.217	2.235	2.400	2.337	2.363	1.817	1.847	1.832	1.587	1.393	1.490
Average		2.253	2.280	2.267	2.355	2.532	2.443	1.907	1.732	1.819	1.732	1.580	1.656
4	100 cm	2.330	2.123	2.227	2.607	2.140	2.373	1.787	1.660	1.723	1.317	1.447	1.382
	125 cm	2.263	2.173	2.218	2.173	2.307	2.240	1.867	1.603	1.735	1.307	1.557	1.432
Average		2.297	2.148	2.223	2.390	2.223	2.307	1.827	1.632	1.729	1.312	1.502	1.407
Row spacing x Hoeing	100 cm	2.237	2.283	2.260	2.421	2.463	2.442	1.849	1.851	1.850	1.500	1.528	1.514
	125 cm	2.330	2.144	2.237	2.263	2.387	2.325	1.947	1.711	1.829	1.354	1.469	1.412
Total Average		2.283	2.214	2.249	2.342	2.425	2.384	1.898	1.781	1.839	1.427	1.798	1.463
L S D at 5 % level :													
Ploughing (P)		0.018		NS			NS			NS			
Row spacing (R)		NS		0.035			NS			NS			
Hoeing (H)		NS		NS			NS			NS			
P x R		NS		NS			NS			0.158			
P x H		NS		0.162			NS			0.142			
R x H		0.130		NS			NS			NS			
P x R x H		0.225		0.228			0.362			NS			

The present results indicate that no marked effect could be detected by excessive ploughing (4 times) on K content in sugar cane leaves at the different growth stages.

Concerning the effect of row spacing on K content in leaves, the results presented in Tables (15 and 16) showed that wider row spacing favorably affected K% at 150 days from planting in 1997/98 season. On the other hand, 100 cm row spacing increased K content in leaves at all growth stages in 1998/99 season with a significant difference at 210 days where K% valued 2.44 %.

The effect of hoeing on K% in leaves was significant at 150, 210 and 270 days from planting in 1997/98 season, whereas in 1998/99 season, no significant effect was detected. Two hoeings were more effective at 150 and 210 days, whereas 3 hoeings favorably affected K content at 270 days from planting. It could be concluded that in general 2 hoeings were quite satisfactory and the increase in hoeing intensity is not needed under the conditions of the experiments.

Interaction effects:

The results in Tables (15 and 16) indicated a significant effect between ploughing intensity and row spacing at 330 days from planting in 1998/99 season on K% in leaves. The highest K content at this stage was 1.82% which was recorded by combining 3 ploughings + 100 cm row spacing.

Ploughings intensity X hoeing significantly affected K% at 210 days from planting in 1997/98 season as well as at 210 and 330 days in 1998/99 season.

The results showed that combining 2 ploughings + 3 hoeings at 210 days in 1997/98 season recorded the highest K% , being 2.18 %. On the other hand, the combination of 3 ploughings + 3 hoeings produced the highest K% at 210 days in 1998/99 season, being 2.53 %. Also, 3 ploughings + 2 hoeings was the best combination at 330 days in 1998/99 season, where K% was 1.73 %.

Concerning row spacing X hoeing, the only significant effect was detected at 150 days in the second season and the best combination was that including a row spacing of 125 cm + 2 hoeings with a K content of 2.33 %.

The second order interaction was significant on K content in sugar cane leaves at 150, 210 and 270 days from planting in 1998/99 season. The highest K contents were recorded by combining 2 ploughings +125 cm row spacing + 2 hoeings at 150 days, 3 ploughings +100 cm row spacing + 3 hoeings at 210 days and 2 ploughings +100 cm row spacing + 3 hoeings at 270 days. The K% was 2.47, 2.74 and 2.28 % at the three successive growth stages, respectively..

3- Sodium percentage in leaf at different growth stages:

Tables (17 and 18) show the effect of ploughing, row spacing, hoeing numbers and their interactions on sodium percentage in sugar cane leaves at the different growth stages of the two seasons.

Effects of the main factors:

The results in Tables (17 and 18) showed the neither ploughing intensity nor row spacing had significant effects on sodium % in sugar cane leaves at the different studied growth stages and in both seasons.

It could be concluded that this trait did not show any apparent response to ploughing or row spacing. It was observed that sodium content ranged between 0.56 and 0.58 % in the first season, and between 0.50 and 0.70 % in the second one.

Hoeing effect on sodium % in leaves was also not significant with one exceptional case at 330 days from planting in 1997/98 season, where 2 hoeings significantly increased sodium content by 0.05 % compared with 3 hoeings. It could be concluded that sodium % showed no marked response to tillage practices and row spacing.

Table (17): Effect of number of ploughings, row spacing, hoeing number and their interactions on sodium percentage in leaf of sugar cane at 150, 210, 270 and 330 days from planting during 1997/98 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	0.455	0.700	0.578	0.646	0.557	0.601	0.694	0.565	0.629	0.517	0.510	0.513
	125 cm	0.741	0.448	0.595	0.639	0.598	0.619	0.490	0.653	0.571	0.585	0.565	0.575
Average		0.598	0.574	0.586	0.643	0.578	0.610	0.592	0.609	0.600	0.551	0.537	0.544
3	100 cm	0.557	0.578	0.568	0.523	0.557	0.540	0.519	0.510	0.515	0.571	0.545	0.558
	125 cm	0.605	0.530	0.568	0.666	0.476	0.571	0.605	0.524	0.564	0.578	0.537	0.557
Average		0.581	0.554	0.568	0.595	0.516	0.555	0.562	0.517	0.539	0.575	0.541	0.558
4	100 cm	0.598	0.571	0.585	0.489	0.571	0.530	0.503	0.605	0.554	0.694	0.606	0.650
	125 cm	0.510	0.571	0.541	0.505	0.509	0.507	0.476	0.592	0.534	0.619	0.572	0.595
Average		0.554	0.571	0.563	0.497	0.540	0.519	0.489	0.598	0.544	0.656	0.589	0.623
Row spacing x Hoeing	100 cm	0.537	0.617	0.577	0.553	0.562	0.557	0.572	0.560	0.566	0.594	0.553	0.574
	125 cm	0.619	0.517	0.568	0.603	0.528	0.566	0.523	0.589	0.556	0.594	0.558	0.576
Total Average		0.578	0.567	0.572	0.578	0.545	0.561	0.548	0.575	0.561	0.594	0.556	0.575

L S D at 5 % level :				
Ploughing (P)	NS	NS	NS	NS
Row spacing (R)	NS	NS	NS	NS
Hoeing (H)	NS	NS	NS	0.028
P x R	NS	NS	NS	0.014
P x H	NS	0.052	0.042	NS
R x H	0.079	0.042	0.035	NS
P x R x H	0.136	0.073	0.060	NS

Table (18): Effect of number of ploughings, row spacing, hoeing number and their interactions on sodium percentage in leaf of sugar cane at 150, 210, 270 and 330 days from planting during 1998/99 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	0.564	0.707	0.635	0.635	0.969	0.824	0.632	0.578	0.605	0.714	0.388	0.551
	125 cm	0.761	0.537	0.649	0.625	0.876	0.750	0.619	0.408	0.514	0.537	0.605	0.571
Average		0.662	0.662	0.642	0.652	0.922	0.787	0.626	0.493	0.560	0.626	0.497	0.561
3	100 cm	0.557	0.856	0.707	0.794	0.632	0.713	0.388	0.659	0.523	0.496	0.558	0.527
	125 cm	0.557	0.721	0.639	0.632	0.639	0.635	0.449	0.463	0.456	0.476	0.442	0.459
Average		0.557	0.788	0.673	0.713	0.636	0.674	0.418	0.561	0.489	0.486	0.500	0.493
4	100 cm	0.727	0.702	0.714	0.592	0.564	0.578	0.489	0.476	0.483	0.387	0.483	0.435
	125 cm	0.800	0.489	0.645	0.713	0.652	0.682	0.428	0.388	0.408	0.503	0.607	0.555
Average		0.764	0.595	0.680	0.652	0.608	0.630	0.459	0.432	0.445	0.445	0.545	0.495
Row spacing x Hoeing	100 cm	0.616	0.755	0.685	0.688	0.722	0.705	0.503	0.571	0.537	0.533	0.476	0.504
	125 cm	0.706	0.582	0.644	0.657	0.722	0.689	0.499	0.420	0.459	0.506	0.551	0.528
Total Average		0.661	0.669	0.665	0.673	0.722	0.697	0.501	0.495	0.498	0.519	0.514	0.516

L S D at 5 % level :			
Ploughing (P)	NS	NS	NS	NS
Row spacing (R)	NS	NS	NS	NS
Hoeing (H)	NS	NS	NS	NS
P x R	NS	0.086	NS	0.015
P x H	0.162	NS	0.112	0.006
R x H	0.131	NS	NS	0.075
P x R x H	NS	NS	NS	0.005

Interaction effects:

The results presented in Tables (17 and 18) showed that the interactions between the experimental factors showed almost significant effects on sodium% in leaves at some growth stages.

Ploughings X row spacing significantly affected sodium% at 330 days in the first season as well as at 210 and 330 days in the second one.

The results showed that in 1997/98 season and at 330 days, higher Na% was recorded at 100 cm combined with 3 and 4 ploughings, whereas higher Na% was recorded at 125 cm with 2 ploughings.

The highest Na% was 0.62 % at 330 days from planting in the first season which was produced by combining 4 ploughings + 100 cm row spacing.

In 1998/99 season, about the same trend was observed at 210 days where higher Na% was recorded at 100 cm with 2 and 3 ploughings, whereas with 4 ploughings higher Na% was recorded with 125 cm. The highest Na% at this stage was 0.82 % resulting from 2 ploughings + 100 cm.
Also in 1998/99, a significant interaction was observed at 330 days where the maximum Na% was obtained by 2 ploughings + 125 cm, being 0.57 %.

The interaction between ploughing and hoeing was significant on Na% at 210 and 270 days in the first season and at 150, 270 and 330 days in the second one. The highest Na% was recorded by 2 ploughings + 2 hoeings at 210 days in 1997/98, being 0.64 % and by 2 ploughings + 3 hoeings at 210 days, being 0.61 %.

In 1998/99 season, the highest Na% was produced by 3 ploughings + 3 hoeings at 150 days (0.79 %), and by 2 ploughings + 2 hoeings at 270 days (0.63 %) and at 330 days (0.63%) as well.

Also row spacing X hoeing significantly affected Na% at 150, 210 and 270 days from planting in 1997/98 season, and at 150 and 330 days in 1998/99 season. The highest Na% in the first season was produced by combining 125 cm + 2 hoeings at 150 days and at 210 days, and by combining 125 cm + 3

hoeings at 270 days, being 0.62, 0.60 and 0.59 %, respectively at the three growth periods.

In 1998/99 season, the highest Na% in leaves at 150 as well as 330 days from planting resulted from combining 125 cm row spacing + 2 hoeings, being 0.71 and 0.55 %, respectively.

The second order interaction significantly affected Na% at 150, 210 and 270 days in the first season as well as at 330 days in the second one. Combining 2 ploughings + 100 cm row spacing + 3 hoeings at 150 days, 3 ploughings + 125 cm row spacing + 2 hoeings at 210 days and 2 ploughing + 100 cm row spacing + 2 hoeings at 270 days produced the highest Na% in 1997/98 season, being 0.70, 0.67 and 0.69 %, respectively.

In 1998/99, the second order interaction had significant effect on Na% in sugar cane leaves at 330 days. The highest Na% was recorded by combining 2 ploughings + 100 cm row spacing + 2 hoeings, being 0.71 %.

It could be concluded that the experimental factors did not singly affect Na%, but their effect was more apparent by the interaction with the other factors.

4- Nitrogen percentage (N %) in stalk at harvest:

Data presented in Tables (19 and 20) show that as ploughing intensity increased the values of N % in sugar cane stalk insignificantly decreased in the 1st season. However, the highest value of N % (1.6 %) was recorded with ploughing sugar cane 3 times in the 2nd season with significant differences compared with 2 and 4 ploughings.

Concerning the effect of row spacing on N %, the available data in Tables (17 and 18) cleared that row distance treatments had insignificant effect on this trait in the two growing seasons. This result is in agreement with that reported by **El- Sayed (1996)** who revealed that planting density had no significant effect on N % in sugar cane stalk at harvest.

As to the effect of hoeing number on the values of N % in sugar cane stalk at harvest, the results given revealed that hoeing sugar cane plant twice a season significantly increased N% compared with 3 hoeings.

Interaction effects:

The results in Tables (19 and 20) showed that ploughing X row spacing significantly affected N% in stalk at harvest in 1997/98 season. The highest N% was 1.92 % produced by 2 ploughings + 125 cm row spacing.

Ploughings intensity X hoeings had significant effect on N% in both seasons. The highest N% was recorded by 4 ploughings + 2 hoeings in the first season and by 3 ploughings + 2 hoeings in the second season, being 1.83 and 1.80 %, respectively.

Also row spacing X hoeing had a significant effect on N% in the second season. The highest N% in stalk at harvest was 1.57 % resulting from 100 cm + 2 hoeings.

The second order interaction had a significant effect on N % in both seasons. The highest value was 2.07 % in the first season which was recorded by 2 ploughings + 125 cm row spacing + 2 hoeings in 1997/98 season, whereas in 1998/99 season combining 3 ploughings + 100 cm row spacing + 2 hoeings produced the maximum N%, being 2.0 %.

5- Sodium percentage (Na %) in stalk at harvest:

It is well known that increasing the values of sodium Na^+ and potassium K^+ catuions in the extracted juice negatively affected the extracted sugar, where it is well proved that each molecule of Na^+ and or K^+ in the syrup of cane prevents four molecules of sucrose to crystallize during sugar extraction process.

Effects of the main factors:

The results obtained in Tables (19 and 20) clearly show that Na % of sugar cane stalk was significantly affected by ploughing intensity. The lowest value of Na % was obtained by ploughing twice in the 1st season and by ploughing 4 times in the 2nd season. This result showed that no specific trend for ploughing intensity could be detected on Na% in stalk at harvest.

The differences in the results in the two growing seasons may be due to the differences in climatic and environmental conditions

Regarding row spacing on Na % the results obtained cleared that row spacing significantly affected Na % in the 2nd season only and the lowest value of Na% (0.321%) was recorded at the lower row space (100 cm). This result is not in agreement with that reported by **El- Sayed (1996)** who revealed that planting density had no significant effect on Na %.

Results given in Tables (19 and 20) showed that hoeing number had no effect on the present of sodium in stalk at harvest. This finding was true in the both seasons.

Interaction effects:

The results presented in Tables (19 and 20) indicated that no any significant effect could be detected for the interaction among the 3 experimental factors on the Na% in stalk at harvest. It is clear that each experimental factors acted independently in affecting this trait.

6- Potassium percentage (K %) in stalk at harvest:

Tables (19 and 20) showed that K % of sugar cane stalk at harvest was significantly affected by ploughing number. This finding was only true in the 1st season.

The lowest values of K %, i.e. 0.68 % and 0.57 % were recorded by ploughing sugar cane field 4 times in the 1st and 2nd season, respectively.

Table (19): Effect of number of ploughings, row spacing, hoeing number and their interactions on nitrogen, sodium, potassium and fiber percentage in stalk of sugar cane at harvest in 1997/98 season

Number of ploughing	Row spacing	Nitogen %		Average	Sodium %		Average	Potassium %		Average	Fiber		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	1.567	1.467	1.517	0.473	0.431	0.452	0.917	1.007	0.962	12.080	12.153	12.117
	125 cm	2.067	1.767	1.917	0.438	0.452	0.445	0.720	0.830	0.775	12.737	12.693	12.715
Average		1.817	1.617	1.717	0.455	0.442	0.448	0.818	0.918	0.868	12.408	12.423	12.416
3	100 cm	1.667	1.600	1.633	0.588	0.561	0.574	0.830	0.813	0.822	12.433	12.260	12.347
	125 cm	1.400	1.567	1.483	0.595	0.527	0.561	0.777	0.663	0.720	12.183	12.200	12.192
Average		1.533	1.583	1.558	0.591	0.544	0.567	0.803	0.738	0.771	12.308	12.230	12.269
4	100 cm	2.000	1.467	1.733	0.554	0.527	0.540	0.787	0.597	0.692	11.937	12.117	12.027
	125 cm	1.667	1.467	1.567	0.547	0.493	0.520	0.573	0.757	0.665	12.297	11.740	12.018
Average		1.833	1.467	1.650	0.550	0.510	0.530	0.680	0.677	0.678	12.117	11.928	12.022
Row spacing x Hoeing	100 cm	1.744	1.511	1.628	0.538	0.506	0.522	0.844	0.806	0.825	12.150	12.177	12.163
	125 cm	1.711	1.600	1.656	0.527	0.490	0.508	0.690	0.750	0.720	12.406	12.211	12.308
Total Average		1.728	1.556	1.642	0.532	0.498	0.515	0.767	0.778	0.772	12.278	12.194	12.236

L S D at 5 % level :				
Ploughing (P)	NS	0.064	0.068	NS
Row spacing (R)	NS	NS	0.071	NS
Hoeing (H)	0.066	NS	NS	NS
P x R	0.109	NS	NS	NS
P x H	0.114	NS	NS	NS
R x H	NS	NS	NS	NS
P x R x H	0.162	NS	NS	NS

Table (20): Effect of number of ploughings, row spacing, hoeing number and their interactions on nitrogen, sodium, potassium and fiber percentage in stalk of sugar cane at harvest in 1998/99 season

Number of ploughing	Row spacing	Nitrgen %		Average	Sodium %		Average	Potassium %		Average	Fiber %		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	1.400	1.200	1.300	0.343	0.350	0.346	0.587	0.597	0.592	11.577	12.770	12.173
	125 cm	1.100	1.400	1.250	0.418	0.376	0.397	0.687	0.550	0.618	12.103	12.237	12.170
Average		1.250	1.300	1.275	0.380	0.363	0.372	0.637	0.573	0.605	11.840	12.503	12.172
3	100 cm	2.000	1.300	1.650	0.234	0.479	0.356	0.547	0.827	0.687	11.547	11.713	11.630
	125 cm	1.600	1.500	1.550	0.316	0.418	0.367	0.760	0.730	0.745	11.640	11.827	11.733
Average		1.800	1.400	1.600	0.275	0.448	0.362	0.653	0.778	0.716	11.593	11.770	11.682
4	100 cm	1.300	1.300	1.300	0.234	0.289	0.261	0.510	0.647	0.578	11.867	11.077	11.472
	125 cm	1.500	1.400	1.450	0.335	0.316	0.325	0.550	0.587	0.568	11.333	11.490	11.412
Average		1.400	1.350	1.375	0.284	0.302	0.293	0.530	0.617	0.573	11.600	11.283	11.442
Row spacing x Hoeing	100 cm	1.567	1.267	1.417	0.270	0.373	0.321	0.548	0.690	0.619	11.663	11.853	11.758
	125 cm	1.400	1.433	1.417	0.356	0.370	0.363	0.666	0.622	0.644	11.692	11.851	11.772
Total Average		1.483	1.350	1.417	0.313	0.371	0.342	0.607	0.656	0.631	11.678	11.852	11.765

L S D at 5 % level :				
Ploughing (P)	0.011	0.033	NS	NS
Row spacing (R)	NS	0.025	NS	NS
Hoeing (H)	0.004	NS	NS	NS
P x R	NS	NS	NS	NS
P x H	0.001	NS	NS	0.441
R x H	0.001	NS	0.079	NS
P x R x H	0.005	NS	NS	0.624

In regard to the influence of row spacing treatments on K %, the presented data showed that K % was significantly affected by row spacing in the 1st season only, where the wider row space (125 cm) produced lower value of K % (0.72 %).

Meanwhile the differences between row space treatments were not significant in the 2nd season. This result of the second season is in agreement with that reported by **El- Sayed (1996)** who revealed that planting density had no significant effect on K %.

The given data in Tables (19 and 20) revealed that K % was insignificantly affected by hoeing number. These results were true in both growing season.

Interaction effects:

The results in Tables (19 and 20) showed that all effects of the interaction between the studied factors on K% in sugar cane stalk at harvest were not significant except that between row spacing X hoeing in 1998/99 season.

The results showed that 100 cm row spacing recorded lower K% with 2 hoeings, whereas at 125 cm row spacing lower K% was recorded with 3 hoeings. The lowest K% was 0.55 % which was recorded by 100 cm + 2 hoeings in the second season.

7- Fiber percentage in stalk at harvest:

Results in Tables (19 and 20) show the effect of ploughing, hoeing number, row space and their interactions on fiber percentage in sugar cane stalk at harvest in 1997/98 and 1998/99 seasons.

The results showed that neither ploughings intensity nor row spacing significantly affected fiber % at harvest in both seasons.

Also hoeing intensity did not significantly affect this trait in both seasons. These results are in agreement with those reported by **El- Sayed (1996)** who revealed that planting density had no significant effect on fiber% .

Interaction effects:

The results presented in (Table 19) indicated that no significant effects could be detected for the interactions between the experimental factors on fiber% in 1997/98 season. On the other hand, ploughing X hoeing significantly affected fiber % in 1998/99 season.

The maximum fiber % in 1998/99 season was 12.50 % which was recorded by 2 ploughings + 3 hoeings treatment.

Also, the second order interaction indicated a significant effect on fiber % in 1998/99. The combination between 2 ploughings + 100 cm row spacing + 3 hoeings produced the highest fiber %, being 12.77%.

8-Total soluble solids percentage (TSS%) in juice at different growth stages:

The total soluble solids were estimated at three stages after 5, 7, 9 and 11 months from planting in both seasons.

Effects of ploughing number, row spacing, hoeing number and their interactions on the percentage of total soluble solids (TSS%) at the different growth stages are presented in Tables (21 and 22).

Effects of the main factors:

Data given cleared that ploughing sugar cane field three times attained a relative advantage in the values of TSS % over those of 2 and/or 4 times. These results were true at the different growth stages of the 1st season and at 210 days in the 2nd season .

The increments of the TSS % values due to ploughing intensity were significant in the 1st and 2nd growth stages in the 1st season and at the last stage of the 2nd season. However, this effect was insignificant at 150, 210 and 270 days from planting in the second season.

It is apparent from the present results that 3 ploughings were enough to ensure adequate growth and to develop a good root system of cane plants.
The results reported by **Diaz and Somoza (1987)** showed that there were no significant differences in pol% of sugar cane juice as well as cane yields due to minimum and conventional tillage.

As for the influence of row spacing on TSS %, the results obtained showed that row spacing of 125 cm increased TSS % of sugar cane juice. This finding was not significant almost at the various growth stages in the first season and reached the level of significance at 210, 270 and 330 days from planting in the second season, where an increase in this trail due to widening row spacing from 100 to 125 cm of 0.221, 0.340 and 0.597 % was recorded at the three respective growth stages.

The increase in TSS% in juice of sugar cane grown under wider spacing, i.e. 125 cm may be due to the reduced competition among growing plants leading to better growth and greater root system, concequently an increase in the absorption capacity of the plants would result. This result is in agreement with that reported by **Abd-El-Latif *et al.* (1998)** who found that increasing row spacing from 80 to 120 cm significantly increased TSS %.

The influence of hoeing number on TSS % at various growth stages is presented in Tables (21 and 22). It could be noticed that there was no positive response in the values of TSS % in the first season to hoeing treatments.
However, hoeing twice attained higher values in TSS% of sugar cane juice compared with hoeing thrice.
In the second season, the only significant effect of hoeing treatments was recorded in the 1st growth stage (150 days) where TSS% increased by 0.388%

Table (21): Effect of number of ploughings, row spacing, hoeing number and their interactions on total soluble solids % in sugar cane juice at 150, 210, 270 and 330 days from planting during 1997/98 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	15.183	14.347	14.765	18.257	17.747	18.002	20.333	19.313	19.823	22.420	21.067	21.743
	125 cm	14.980	14.637	14.808	18.197	18.290	18.243	20.100	20.300	20.200	21.757	21.910	21.833
Average		15.082	14.492	14.787	18.227	18.018	18.122	20.217	19.807	20.012	22.088	21.488	21.788
3	100 cm	14.880	14.457	14.668	18.490	18.513	18.502	20.300	20.457	20.378	22.190	22.513	22.352
	125 cm	14.873	15.030	14.952	18.687	18.357	18.522	21.033	20.653	20.843	22.667	22.623	22.645
Average		14.877	14.743	14.810	18.588	18.435	18.512	20.667	20.555	20.611	22.428	22.568	22.498
4	100 cm	14.570	14.090	14.330	18.410	18.200	18.305	20.890	20.943	20.917	22.710	22.433	22.572
	125 cm	13.663	15.303	14.483	18.420	18.287	18.353	20.163	20.277	20.220	22.200	22.147	22.173
Average		14.117	14.697	14.407	18.415	18.243	18.329	20.527	20.610	20.568	22.455	22.290	22.372
Row spacing x Hoeing	100 cm	14.878	14.298	14.588	18.386	18.153	18.269	20.508	20.238	20.373	22.440	22.004	22.222
	125 cm	14.506	14.990	14.748	18.434	18.311	18.373	20.432	20.410	20.421	22.208	22.227	22.217
Total Average		14.692	14.644	14.668	18.410	18.232	18.321	20.470	20.324	20.397	22.324	22.116	22.220

L S D at 5 % level :				
Ploughing (P)	0.211	0.181	NS	NS
Row spacing (R)	NS	NS	NS	NS
Hoeing (H)	NS	NS	NS	NS
P x R	NS	NS	NS	NS
P x H	NS	NS	NS	NS
R x H	0.498	NS	NS	NS
P x R x H	NS	NS	NS	NS

Table (22): Effect of number of ploughings, row spacing, hoeing number and their interactions on total soluble solids % in sugar cane juice at 150, 210, 270 and 330 days from planting during 1998/99 season

Number of ploughing	Row spacing	150 days		Average	210 days		Average	270 days		Average	330 days		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	14.850	14.197	14.523	16.817	16.417	16.617	18.220	17.913	18.067	20.597	21.447	21.022
	125 cm	15.250	14.417	14.833	17.583	17.903	17.743	19.470	19.633	19.552	22.697	22.403	22.550
Average		15.050	14.307	14.678	17.200	17.160	17.180	18.845	18.773	18.809	21.647	21.925	21.786
3	100 cm	14.633	14.233	14.433	17.697	17.283	17.490	18.750	18.333	18.542	21.263	21.083	21.173
	125 cm	14.833	14.617	14.725	17.183	16.767	16.975	18.300	17.633	17.967	21.847	21.833	21.840
Average		14.733	14.425	14.579	17.440	17.025	17.233	18.525	17.983	18.254	21.555	21.458	21.507
4	100 cm	14.520	14.413	14.467	17.833	16.997	17.415	19.000	18.150	18.575	23.067	21.583	22.325
	125 cm	14.633	14.517	14.575	16.703	18.230	17.467	17.870	19.440	18.655	21.363	22.483	21.923
Average		14.577	14.465	14.521	17.268	17.613	17.441	18.435	18.795	18.615	22.215	22.033	22.124
Row spacing x Hoeing	100 cm	14.668	14.281	14.474	17.449	16.899	17.174	18.657	18.132	18.384	21.642	21.371	21.507
	125 cm	14.906	14.517	14.711	17.157	17.633	17.395	18.547	18.902	18.724	21.969	22.240	22.104
Total Average		14.787	14.399	14.593	17.303	17.266	17.284	18.602	18.517	18.559	21.806	21.806	21.806

L S D at 5 % level :				
Ploughing (P)	NS	NS	NS	0.347
Row spacing (R)	NS	0.149	0.110	0.167
Hoeing (H)	0.142	NS	NS	NS
P x R	NS	0.258	0.191	0.290
P x H	0.245	NS	0.322	NS
R x H	NS	0.286	0.262	NS
P x R x H	NS	0.496	0.455	0.795

over that of hoeing thrice. This result is in agreement with that reported by **Ismail (1991)** who found that hand hoeing twice gave the highest TSS % at difference growth stages. .

Interaction effects:

The results in Table (21) indicated a significant interaction effect between row spacing and hoeing on TSS% at 105 days in 1997/98 season.

The data indicated that 2 hoeings produced higher TSS% at 100 cm row spacing, whereas 3 hoeings produced markedly higher TSS% under the wider row spacing (125 cm).

In 1998/99 season, ploughing X row spacing significantly affected TSS% at 210, 270 and 330 days from planting. The results showed that 2 ploughings produced higher TSS% at 125 cm row spacing after 210, 270 and 330 days from planting. Whereas 3 ploughings produced higher TSS% at 125 cm row spacing at 270 days from planting.

While with 4 ploughings, 100 cm positively affected TSS% at 330 days, but 125 cm was more effective on TSS% at 210 days from planting.

Also, ploughing X hoeing significantly affected TSS% in the second season at 210, 270 and 330 days, and row spacing X hoeing had significant effect on TSS% at 210 and 270 days from planting.

The second order interaction significantly affected TSS% in 1998/99 season at 210, 270 and 330 days.The results in Table (22) showed that the highest TSS% were recorded by combining 4 ploughings + 125 cm row spacing + 3 hoeings at 210 days, being 18.23 %. At 270 days, combining 2 ploughings + 125 cm row spacing + 3 hoeings recorded the maximum TSS%, being 19.63%. At 330 days, the highest TSS% was 23.07 % which was the result of 4 ploughings + 100 cm row spacing + 2 hoeings.It could be concluded that intensive ploughing combined with narrower spacing and 2 hoeings positively affected TSS% at 330 days, which will be reflected in

increasing sucrose and sugar recovery percentages, leading to improved crop quality.

9- Brix percentage in juice at harvest:

Results in Tables (23 and 24) show the effect of ploughing intensity, row spacing, hoeing numbers and their interactions on brix percentage of sugar cane juice at harvest in 1997/98 and 1998/99 seasons.

Effects of the main factors:

Regarding the effect of number of ploughings, the results in Tables (23 and 24) indicated that number of ploughing significantly affected brix% in both seasons. The results showed that 2 ploughings produced the highest brix percentage (22.06 %) in the 1st season. However, in the 2nd season, the results indicated that 4 ploughings produced the highest brix % which 20.27%.

Concerning the effect of row spacing, the results in Tables (23 and 24) showed that row spacing had no significant effect on brix % in both season. Row spacing of 100 cm in the 1st season produced higher brix percentage than 125 cm row space, meanwhile row space of 125 cm surpassed 100 cm in the 2nd season with respect to brix %. This result is not in agreement with that reported by **El- Sayed (1996)** who revealed that planting density had no significant effect on brix %.

Similarly, the effect of hoeing on brix % showed that three hoeings increased brix percentage by 0.61 % in 1997/98 season, compared with two hoeings. On the other hand, in 1998/99 season, two hoeings increased brix percentage by 0.29 % compared with three hoeings. It could be concluded that no relevance could be detected between row spacing or hoeing intensity and this trait.

Table (23): Effect of number of ploughings, row spacing, hoeing number and their interactions on brix and sucrose percentage in juice of sugar cane at harvest 1997/98 season

Number of ploughing	Row spacing	Brix %		Average	Sucrose %		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	21.773	22.940	22.357	16.650	17.343	16.997
	125 cm	21.783	21.723	21.753	16.473	17.013	16.743
Average		21.778	22.332	22.055	16.562	17.178	16.870
3	100 cm	20.993	22.063	21.528	17.893	17.167	17.530
	125 cm	21.240	21.227	21.233	18.397	16.943	17.670
Average		21.117	21.645	21.381	18.145	17.055	17.600
4	100 cm	21.650	21.307	21.478	18.593	18.703	18.648
	125 cm	21.133	22.997	22.065	18.233	17.253	17.743
Average		21.392	22.152	21.772	18.413	17.978	18.196
Row spacing x Hoeing	100 cm	21.472	22.103	21.788	17.712	17.733	17.725
	125 cm	21.386	21.983	21.684	17.701	17.070	17.386
Total Average		21.429	22.043	21.736	17.707	17.404	17.555

L S D at 5 % level :		
Ploughing (P)	0.344	0.215
Row spacing (R)	NS	NS
Hoeing (H)	NS	NS
P x R	NS	NS
P x H	NS	NS
R x H	NS	NS
P x R x H	NS	NS

Table (24): Effect of number of ploughings, row spacing, hoeing number and their interactions on brix and sucrose percentage in juice of sugar cane at harvest 1998/99 season

Number of ploughing	Row spacing	Brix %		Average	Sucrose %		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	20.083	19.023	19.553	18.203	15.243	16.723
	125 cm	20.873	20.860	20.867	18.043	17.160	17.602
Average		20.478	19.942	20.210	18.123	16.202	17.163
3	100 cm	18.787	19.913	19.350	16.423	16.933	16.678
	125 cm	20.477	20.173	20.325	18.453	17.363	17.908
Average		19.632	20.043	19.837	17.438	17.148	17.293
4	100 cm	20.190	20.453	20.322	17.233	18.490	17.862
	125 cm	21.097	19.343	20.220	18.863	17.050	17.957
Average		20.643	19.898	20.271	18.048	17.770	17.909
Row spacing x Hoeing	100 cm	19.687	19.797	19.742	17.287	16.889	17.088
	125 cm	20.816	20.126	20.471	18.453	17.191	17.822
Total Average		20.251	19.961	20.106	17.870	17.040	17.455

L S D at 5 % level :		
Ploughing (P)	0.0650	NS
Row spacing (R)	NS	0.326
Hoeing (H)	NS	0.631
P x R	NS	NS
P x H	NS	NS
R x H	NS	NS
P x R x H	NS	1.544

It seems that seasonal changes in climatic conditions as well as the differences in the experimental sites are responsible for the different results in both seasons.

Interaction effects:

The results in Tables (23 and 24) showed that all effects of the interaction between the studied factors on brix percentage were not significant in both seasons. Such results indicate that each experimental factor acted independently in effecting this trait.

10- Sucrose percentage in juice at harvest:

Results in Tables (23 and 24) show the influence of number of ploughings, hoeing treatments, row spacing and their interactions on sucrose percentage of sugar cane juice at harvest in 1997/98 and 1998/99 seasons.

Effects of the main factors:

The results revealed that increasing number of ploughing significantly increased sucrose % in the 1st season only. Whatever, the highest sucrose percentage was recorded in both seasons with the highest number of ploughing (4 ploughings) being 18.20 and 17.91 % in the 1st and 2nd season, respectively.

Data presented in Tables (23 and 24) cleared that row spacing had marked effect on sucrose %. The results indicated that 100 cm row space increased sucrose percentage by 0.34 % in the first season, compared with planting at 125 cm row space.

On the contrary row space of 125 cm in the second season increased sucrose percentage by 0.73 % compared with planting space of 100 cm. This increment of the second season was significant. This result is in agreement with that reported by **Abd-El-Latif *et al.* (1998)** who found that increasing row spacing from 80 to 120 cm significantly increased sucrose %.

Data presented in Tables (23 and 24) showed that two hoeings produced higher sucrose percentage in both season. The increase was 0.30 and 0.83 % in the 1st and the 2nd season, respectively, compared with three hoeings. This effect was significant in the 2nd season only. This result is in agreement with that reported by **Ismail (1991)** who found that hand hoeing twice gave the highest sucrose % compared to untreated control.

Interaction effects:

The results in Table (23) showed that none of the interactions between the 3 experimental factors significantly affected sucrose % in 1997/98 season. On the other hand, the second order interaction in 1998/99 season had significant effect sucrose % . The highest sucrose% in that season was 18.86 % which was produced by 4 ploughings + 125 row spacing + 2 hoeings.

11- Reducing sugar percentage (R.S. %) in juice at harvest:

It is evident from the industrial view that increasing reducing sugar in the extracted juice during manufacturing process decreased the extracted sugar, based on every molecule of reducing sugar prevents crystallization process for two sucrose molecules.

The results presented in Tables (25 and 26) show the effect of number of ploughings, hoeings, row spacing and their interactions on reducing sugar percentage at harvest in 1997/1998 and 1998/1999 seasons.

The results showed that none of the 3 experimental factors had significant effect on reducing sugar % at harvest in both seasons. This result indicates that this character is not governed by the cultural treatments applied in this investigation.

It seems that this character is mainly governed by the genetical constitution of the variety grown and some other major environmental factors (irrigation, fertilization .....etc).

However, the results reported by **Laila Saif *et al* (1999)** indicated that increasing plant population in terms of buds/fed decreased reducing sugar % in the juice.

Interaction effects:

The results in Table (25) showed that ploughing x row spacing, ploughing X hoeing as well as row spacing X hoeing significantly affected reducing sugar % in 1997/98 season.

The results indicated that the lowest value of reducing sugar % was 0.34% which was recorded by 3 ploughings + 100 cm row spacing. Also ploughing x hoeing interaction showed that combining 2 plounghings + 2 hoeings produced the lowest reducing sugar % in 1997/98 season, being 0.37% .

The row spacing X hoeing interaction revealed that 100 cm row spacing decreased the reducing sugar % with 2 hoeings, whereas 125 cm row spacing + 3 hoeings markedly decreased reducing sugar %. The minimum value of reducing sugar % was 0.37% in 1997/98 season which was recorded by 100 cm row spacing + 2 hoeings.

12-Purity percentage in juice at harvest:

Tables (25and 26) indicate the effects of number of ploughings, hoeings, row spacing and their interactions on purity percentage in 1997/98 and 1998/99 seasons.

Effects of the main factors:

The results showed that number of ploughing recorded a significant effect on purity % in the first season only. It could be noticed that the highest purity percentage was recorded with the highest number of ploughing (four times) being 83.81 and 87.94 % in the first and second season, respectively.

Table (25): Effect of number of ploughings, row spacing, hoeing number and their interactions on reducing sugar, purity and sugar recovery percentages in juice of sugar cane at harvest in 1997/98 season

Number of ploughing	Row spacing	Reducing sugar%		Average	Purity%		Average	Sugar recovery %		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	0.383	0.707	0.545	76.807	75.657	76.232	09.707	09.937	09.822
	125 cm	0.357	0.437	0.397	75.567	78.427	76.997	09.483	10.147	09.815
Average		0.370	0.572	0.471	76.187	77.042	76.614	09.595	10.042	09.818
3	100 cm	0.303	0.383	0.343	81.523	77.057	79.290	11.080	10.347	10.714
	125 cm	0.547	0.363	0.455	86.657	80.397	83.527	12.120	10.407	11.263
Average		0.425	0.373	0.399	84.090	78.727	81.408	11.600	10.377	10.988
4	100 cm	0.417	0.503	0.460	86.257	87.740	86.998	12.160	12.490	12.325
	125 cm	0.453	0.387	0.420	86.273	74.950	80.612	12.317	09.820	11.068
Average		0.435	0.445	0.440	86.265	81.345	83.805	12.238	11.155	11.697
Row spacing x Hoeing	100 cm	0.368	0.531	0.449	81.529	80.151	80.840	10.982	10.925	10.953
	125 cm	0.452	0.396	0.424	82.832	77.924	80.378	11.307	10.124	10.716
Total Average		0.410	0.463	0.437	82.181	79.038	80.609	11.144	10.524	10.834

L S D at 5 % level :			
Ploughing (P)	NS	1.879	0.417
Row spacing (R)	NS	NS	NS
Hoeing (H)	NS	NS	NS
P x R	0.055	3.418	0.600
P x H	0.078	NS	NS
R x H	0.063	NS	NS
P x R x H	NS	NS	NS

Table (26): Effect of number of ploughings, row spacing, hoeing number and their interactions on reducing sugar, purity and sugar recovery percentages in juice of sugar cane at harvest in 1998/99 season

Number of ploughing	Row spacing	Reducing sugar%		Average	Purity%		Average	Sugar recovery %		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	0.520	0.517	0.518	90.657	77.313	83.985	12.427	09.397	10.912
	125 cm	0.507	0.720	0.613	86.350	84.803	85.577	11.857	10.810	11.333
Average		0.513	0.618	0.566	88.503	81.058	84.781	12.142	10.103	11.122
3	100 cm	0.640	0.680	0.660	86.133	84.533	85.333	10.687	10.958	10.822
	125 cm	0.637	0.577	0.607	81.883	86.103	83.993	11.390	11.237	11.313
Average		0.638	0.628	0.633	84.008	85.318	84.663	11.038	11.097	11.068
4	100 cm	0.547	0.797	0.672	85.710	88.350	87.030	11.179	12.610	11.895
	125 cm	0.647	0.440	0.543	89.337	88.363	88.850	12.647	11.303	11.975
Average		0.597	0.618	0.608	87.523	88.357	87.940	11.913	11.957	11.935
Row spacing x Hoeing	100 cm	0.569	0.664	0.617	87.500	83.399	85.449	11.431	10.988	11.209
	125 cm	0.597	0.579	0.588	85.857	86.423	86.140	11.964	11.117	11.541
Total Average		0.583	0.622	0.602	86.678	84.911	85.795	11.698	11.052	11.375

L S D at 5 % level :			
Ploughing (P)	NS	NS	NS
Row spacing (R)	NS	NS	NS
Hoeing (H)	NS	NS	NS
P x R	NS	NS	NS
P x H	NS	3.907	1.070
R x H	NS	NS	NS
P x R x H	0.123	NS	1.513

The results in Tables (25 and 26) showed that neither row spacing nor hoeing intensity had a significant effect on purity % in both seasons. It seems that cultural practices applied in the present study could not apparently affect this trait compared with the major environmental factors. However, **Laila Saif *et al* (1999)** reported that increasing plant population density in terms of number of buds/fed, increased purity % of sugar cane juice.

Interaction effects:

In 1997/98 season, ploughing X row spacing significantly affected purity%. Higher purity % was recorded at 125 cm with 3 ploughings and at 100 cm with 4 ploughings whereas with 2 ploughings both row spacings produced about the same purity %. The highest purity % was 87.00 % which was recorded by combining 4 ploughings + 100 cm row spacing.

In 1998/99 season, ploughing X hoeing significantly affected purity %. The highest purity % was that produced by combining 2 ploughings + 2 hoeings, being 88.50%.

13- Sugar recovery percentage S.R.%:

The results presented in Tables (25 and 26) indicate the effects of number of ploughing, row spacing, hoeing and their interactions on sugar recovery percentage in 1997/98 and 1998/99 seasons.

Effects of the main factors:

The results showed that number of ploughing recorded a significant effect on sugar recovery percentage in the 1st season only. Whatever, the highest sugar recovery percentage was recorded in both seasons with the highest number of ploughings being 11.70 % and 11.94 % in the 1st and the 2nd season, respectively.

The results in Tables (25 and 26) showed that neither row spacing nor hoeing intensity had significant effect on sugar recovery % in both seasons. However, 2 hoeings slightly raised sugar recovery % over 3 hoeings, but without significant differences.

Interaction effects:

The results showed that ploughing X row spacing significantly affected sugar recovery % in 1997/98 season.

Data in Tables (25) showed that the highest sugar recovery % was 12.33% which was produced by combining 4 ploughings + 100 cm row spacing. In 1998/99 season, the significant interactions were those between ploughing X hoeing as well as the second order interaction.

Ploughing X hoeing indicated that the best combination was that between 2 ploughings + 2 hoeings, which recorded a maximum value of sugar recovery %, being 12.14 %.

The best combination of the 3 factors in 1998/99 season was that including 4 ploughings + 125 cm row spacing + 2 hoeings, and the maximum sugar recovery % was 12.65%.

IV- Effect of Ploughing, Row Spacing, Hoeing and Their Interactions on Yield and Yield Components of Sugar Cane.

1- Number of millable cane:

Number of millable cane at harvest is considered the corner stone and the reflected mirror which throw some light on the distinctly expected cane yield.

Data presented in Table (27) show the effect of number of ploughings, hoeings, row spacing and their interactions on millable cane number / fed at harvest.

Effects of the main factors:

Regarding the effect of number of ploughings, the results showed that increasing ploughing number from two to three and four times increased number of millable cane by 17.6 % and 27.26 % in the first season, being 6.06 % and 15.33 % in the second one. The effect of ploughing number on number of millable cane/fed was significant in the 1st season only. The increase in number of millable cane was associated with the increase in ploughing number. This result could be attributed to the fact that increasing ploughing frequency improves soil properties, such as aeration and water movement which enhance cane roots to expand horizontally and to penetrate vertically which in turn increase shoot sprouting and cane growth
and the final plant population i.e., millable cane number /fed. This result is not in agreement with that reported by **Braunack *et al* (1999)** who found that reducing the number of tillage operations did not affect final yield.

The increase in stalks/m^2 at 105 as well as at 165 days due to the increase in ploughing number contributed to an increase in number of millable cane.

As for the effect of row spacing on number of millable cane, it could be noticed that spacing cane rows at 100 cm width produced higher number of millable cane/fed, by 3.78 % and 6.24 % in the first and second season, respectively, compared with 125 cm. However, these increases were not significant. This finding was probably due to better use of land area in case of furrowing at 100 cm. Also the results presented in Tables (3 and 4) showed that narrower row spacing significantly increased number of stalks/m^2, contributing in turn in a marked increase in number of millable cane/fed.
Positive results were reported by growing sugar cane at narrower row spacing (**Gascho and Shih, 1981, Usman, 1989, Ahmed, 1995 and El-Sayed, 1996**).

Table (27): Effect of number of ploughings, row spacing, hoeing number and their interactions on number of millable cane / fed of sugar cane at harvest 1997/98 and 1998/99 seasons

Number of ploughing	Row spacing	1997/98 season		Average	1998/99 season		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	46750	50733	48741	46066	47633	46850
	125 cm	45933	43600	44766	42533	44800	43666
Average		46341	47166	46754	44300	46216	45258
3	100 cm	54433	57400	55916	48333	50183	49308
	125 cm	53333	54800	54066	45833	47550	46691
Average		53883	56100	54991	47083	48916	48000
4	100 cm	59533	58866	59200	52966	54433	53700
	125 cm	58333	61266	59800	50300	51100	50700
Average		58933	60066	59500	51633	52766	52200
Row spacing x Hoeing	100 cm	53572	55666	54877	49122	50783	49952
	125 cm	52533	53222	52877	46222	47816	47019
Total Average		53052	54444	53748	47672	493000	48486

L S D at 5 % level :		
Ploughing (P)	7182.2	NS
Row spacing (R)	NS	NS
Hoeing (H)	NS	NS
P x R	NS	NS
P x H	NS	NS
R x H	NS	NS
P x R x H	NS	NS

Concerning hoeing effect, the results in Table (27) indicated that practicing three hoeings insignificantly produced higher number of millable cane/fed in both seasons. The fruitful effect of hoeing induced an increase in millable cane number/fed amounted to 2.62 and 3.41% compared with two hoeings in the 1st and 2nd season, successively. Increasing hoeing number leads to reduction in weed density, consequently a reduction in competition between sugar cane plants and weeds for growth elements (water, light and nutrients) which will be reflected in better growth and tillering of cane plants. This result is in agreement with that found by **Ismail (1991)** and **Singh *et al* (1995)** who found that millable canes were increased by weed control treatments.

Interaction effects:

The results in Table (27) showed that all the effects of the interaction between the studied factors on number of millable cane/fed at harvest were not significant in both seasons of experimentation. These results indicate that each experimental factors acted independently in affecting this trait.

In general, the highest number of millable cane in 1997/98 season was 61266 which was produced by planting sugar cane in rows of 125 cm + four ploughings and three hoeings. Another trend was observed in 1998/99 season where the maximum number of millable cane/fed was 54433 which was produced by planting sugar cane in rows of 100 cm + four ploughings and three hoeings.

2- Cane yield (tons / fed):

Yield of sugar cane stalks is considered the economical part of sugar cane plants as well as it is the final expression for the interaction of the gen make-up of the cultivated variety and the environmental factors. Results presented in Table (28) indicate the effects of ploughing, row spacing, hoeing and their interactions on cane yield in 1997/98 and 1998/99 seasons.

Effects of the main factors:

Regarding the effect of number of ploughings, the results showed that increasing ploughing number from two to three and four times increased cane yield by 16.54 % and 24.9 % respectively, in the 1st season, corresponding to 6.21 % and 13.42 % in the 2nd season. The effect of ploughing number on cane yield was significant in the first season only.

The increase in cane yield is expected as a result of the positive effects of intensive ploughing on germination %, number of stalks/m^2, stalk height, stalk diameter, total soluble solids %, N% in leaf and number of millable cane/fed. The pronounced effect of the increase in the number of ploughing on net cane yield is mainly due to the improve in physical properties of soil which in turn is reflected on better root system distribution and air exchange. The results obtained in the present study are in good agreement with those obtained by **Garcia and Lawas (1986), Agrawal *et al* (1986), Uddin and Murayama (1993)** and **Barbieri *et al* (1997)** who found that intensive tillage increased cane yield compared with minimum tillage.

On the other hand, **Evans (1963), McIntyre *et al* (1984), Pear *et al* (1992), Lopez *et al* (1993)** and **Braunack *et al* (1999)** found that reducing number of tillage operations did not affect final cane yield.

Concerning the effect of row spacing, results given in Table (28) revealed that no significant difference in case of planting sugar cane in rows 100 or 125 cm apart. However it could be noted that 100 cm row space increased cane yield by 4.13 and 6.13 % in the first and second season, respectively over 125 cm.

The increase in cane yield due to growing at 100 cm is mainly due to better use of land area and to the distinct effect on the number of millable cane/fed and number of stalks/m^2 compared with plants grown under 125 cm.. These results are in line with those obtained by **Suryani (1997)** who demonstrated that sugar cane yield was highest with a row spacing of 110 cm compared to that of 110 and 130 cm.

Table (28): Effect of number of ploughings, row spacing, hoeing number and their interactions on cane yield (tons/fed) of sugar cane at harvest 1997/98 and 1998/99 seasons

Number of ploughing	Row spacing	1997/98 season		Average	1998/99 season		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	51.500	56.000	53.750	51.133	53.860	52.497
	125 cm	51.833	49.167	50.500	48.147	50.477	49.312
Average		51.667	52.583	52.125	49.640	52.168	50.904
3	100 cm	60.000	63.917	61.958	54.420	56.737	55.578
	125 cm	58.417	60.667	59.542	51.687	53.417	52.552
Average		59.208	62.292	60.750	53.053	55.077	54.065
4	100 cm	66.167	65.583	65.875	58.993	59.957	59.475
	125 cm	63.167	65.500	64.333	55.687	56.320	56.003
Average		64.667	65.542	65.104	57.340	58.138	57.739
Row spacing x Hoeing	100 cm	59.222	61.833	60.528	54.849	56.851	55.850
	125 cm	57.806	58.444	58.125	51.840	53.404	52.622
Total Average		58.514	60.139	59.326	53.344	55.128	54.236

L S D at 5 % level :		
Ploughing (P)	5.813	NS
Row spacing (R)	NS	NS
Hoeing (H)	NS	NS
P x R	NS	NS
P x H	NS	NS
R x H	NS	NS
P x R x H	NS	NS

Concerning hoeing effect, the results in Table (28) showed that practicing three hoeings insignificantly produced higher cane yield /fed in both seasons. This increase amounted to 2.77 % and 3.34 % compared with two hoeings in the first and second season, respectively. The increase of cane yield in case of hoeing three times could be due to improving tillering capacity and consequently increasing number of millable cane/fed. This result was in agreement with that reported by **Ismail (1991)** and **Toor *et al* (1996)** who found that weeding twice resulted in the highest sugar cane yields.

Interaction effects:

The results in Table (28) indicated that all effects of the interaction between all experimental factors on sugar cane yield were not significant in both seasons. This result indicates clearly that each experimental factor acted independently in affecting cane yield.

The results showed, in general, that the maximum yield in 1997/98 season was 66.2 tons/fed which was produced by the combination between four ploughings, rows at 100 cm apart combined with two hoeings.

In 1998/99 season, four ploughings, row of 100 cm apart and three hoeings produced the maximum cane yield, being 60 tons/fed.

3- Sugar yield (tons/ fed):

Data given in Table (29) indicate the effects of ploughing, row spacing, hoeing and their interactions on sugar yield tons / fed at harvest in 1997/98 and 1998/99 seasons.

Effects of the main factors:

Regarding the effect of number of ploughings, the results showed that increasing ploughing number from two to three and four times increased sugar yield by 29.28 % and 48.43 % in the 1st season, corresponding to 5.98 % and 22.16 % in the 2nd season, respectively.

Table (29): Effect of number of ploughings, row spacing, hoeing number and their interactions on sugar yield (tons/fed) of sugar cane at harvest 1997/98 and 1998/99 seasons

Number of ploughing	Row spacing	1997/98 season		Average	1998/99 season		Average
		2 hoeings	3 hoeings		2 hoeings	3 hoeings	
2	100 cm	4.987	5.550	5.268	6.353	5.083	5.718
	125 cm	4.923	5.013	4.968	5.763	5.447	5.605
Average		4.955	5.282	5.118	6.058	5.265	5.662
3	100 cm	6.603	6.603	6.608	5.847	6.240	6.043
	125 cm	7.080	6.170	6.625	5.910	6.010	5.960
Average		6.842	6.392	6.617	5.878	6.125	6.002
4	100 cm	8.023	8.183	8.103	6.673	7.593	7.133
	125 cm	7.790	6.390	7.090	7.040	6.363	6.702
Average		7.907	7.287	7.597	6.857	6.978	6.917
Row spacing x Hoeing	100 cm	6.538	6.782	6.660	6.291	6.306	6.298
	125 cm	6.598	5.858	6.228	6.238	5.940	6.089
Total Average		6.568	6.320	6.444	6.264	6.123	6.194

L S D at 5 % level :		
Ploughing (P)	0.520	NS
Row spacing (R)	NS	NS
Hoeing (H)	NS	NS
P x R	NS	NS
P x H	NS	NS
R x H	NS	NS
P x R x H	NS	NS

The effect of ploughing number on sugar yield was significant in the 1st season only. The increase in sugar yield due to the intensive ploughing is mainly due to the positive effects of ploughing number on cane yield, sucrose%, purity % and sugar recovery %.

The results obtained in the present study are not in agreement with those obtained by **Glaz *et al.* (1989)** who showed that a minimum tillage of two shallow cultivations was enough to realize a high yield of sugar yield.

As for, the effect of row spacing, results given in Table (29) showed that no significant difference in case of planting sugar cane in rows 100 or 125 cm apart, with relation to sugar yield tons/fed. However, planting sugar cane in rows of 100 cm increased sugar yield by 6.93 and 3.43 % in the first and second season, respectively over 125 cm. These results are not in agreement with those obtained by **Abd-El-Latif *et al.* (1999)** who found that sugar yield was significantly increased when it was grown at 120 cm row spacing for the plant cane crops when they planted three row spacings (80, 100 and 120 cm).

Concerning hoeing effect, the results in Table (29) indicated that practicing two hoeings insignificantly increased sugar yield/fed in both seasons. This increase amounted to 3.92 and 2.23 % compared with hoeing sugar cane field three times in the first and second season, respectively. These results are in agreement with those obtained by **Quintero and Rodriguez (1982)** who concluded that highest yields of sugar were given by 2 hoeing treatments (14.8 tons sugar/ha).

Interaction effects:

Results in Table (29) indicated that the interactions between the experimental factors had no significant effect on sugar yield in both seasons.

In general, the maximum sugar yield in 1997/98 season was 8.2 tons/fed which was produced by four ploughings, 100 cm row space and three hoeings.

However, in the second season, four ploughings + 100 cm row space and three hoeings produced the maximum sugar yield, being 7.59 tons/fed.

SUMMARY