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RESEARCH PAPER

Effect of plantation depth and density on the growth and yield in sweet corn (*Zea mays* saccharata Strut)

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A B S T R A C T:

The study was carried out to determine the differences in vegetative and yield characteristics of sweet corn (*Zea mays* L.). at different plant density and planting depths using Nelder wheel design, this design is used to create a continuous pattern of plant densities through sowing seeds on the circumference of concentric circles of varying radians, whereas five plant densities in addition to two buffer circles were sown at different depths., conducted according to a RCBD with Nelder wheel design in four replications for the both location Grda-Rasha and Hamza-kor regain in Kurdistan- Iraq. The result of the research shows that Hamza kor location was dominant in most studied traits over Grdarasha location. While different depths had no significant effect on the studied traits. It was determined that plant density positively affected each of node pedicel^{-1} and internode pedicel^{-1} of sweet corn. Nelder design is often applied to minimize the necessity of areas required area for the experiments, due to their simplicity and wider range of scale; Nelder circles are excellent for basic spacing for operational plantations.

KEY WORDS: Nelder design; planting depth; plant density; *Zea mays* L; grain .
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1.INTRODUCTION :

Sweet corn (***Zea mays*** *saccharata Strut*) is one of the most significant cereal crops, ranking third behind wheat and rice among cereal crops. Change in global food demand and consumer preferences, Makes maize to be widely miracle crop in many countries for the current time (Dhangada *et al*., 2021). It is a popular vegetable that produces sugar-rich kernels rather than starch. In recent years, it has become more expensive, it's eaten fresh, frozen, or canned, and it's also used in salads (Mohammad *et al*., 2017). Kumar et al., (2011) Maize is classified as a member of the Maydeae tribe of the Poaceae grass family.
"Zea" was derived from an antique Greek word for a food grass. The genus Zea contains four species, the most economically important of which being Zea mays L. Teosinte, the other Zea sp., is primarily a wild grass endemic to Mexico and Central America.

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(Class- Liliopsida, Order- Poales, Family- Poaceae, Genus- Zea, Species- mays) (Kingdom- Plantae, Division- Magnoliophyta, Class- Liliopsida, Order- Poales, Family- Poaceae, Genus- Zea, Species- mays).
Sweet corn is a short-season vegetable that can be planted in between two winter crops as part of a crop rotation. It will result in more efficient land and time utilization. One of the most crucial aspects of agricultural systems is the planting date. By choosing the right planting date, maize production will be maximized. Environmental conditions have an impact on grain biomass at all phases of development. Two essential parameters in maize planting are temperature and day duration (Imholte and Carter, 1987).Aziz and Al-Bawee (2019) founded that its establishing varies

allowing to water availability and temperature therefore it can be developed in different current environments and are measured to be subtropical and tropical yields which makes them general in several parts of the world, In the field, the space between plants is crucial in the struggle between maize and weeds it has been discovered that shortening the distance between plants can assist minimize weed density and spread in the field while also increasing yield.

The maize crop is one of the most important sources of protein for human and animal use since it includes 10 percent protein, 61 percent carbohydrates, and 4 percent oil in its seeds. It also provides a significant source of income for millions of people in a variety of countries. Despite an increase in worldwide maize output, which reached around 1670 million tons yearly in 2015, there is still a need to boost production due to an increase in maize usage accompanied by a significant population expansion. For the year 2018, the total area planted with this crop in Iraq is expected to be around 13.95 thousand hectares, with a productivity rate of 4.5 tons ha^{-1}(Abdul and Osama, 2018). Standard or sugary (Su), super sweet or shrunken (Sh_2), sugary enhanced (Se), and synergistic (Se) sweet corns are the four fundamental types (Scott and Eldridge, 2005).

Nelder plot (Nelder 1962) was a plot design that allows testing several tree spacing in a single plot. The plot has a circular shape with several concentric wheels or arcs extending outward and spokes linking the center. The tree places are the intersections of spokes and arcs. The plant density or spacing distance is represented by the plant position on different wheels. The necessity for separate experimental plots for each tree density is eliminated with this design. Nelder plots are challenging to create because of their unusual layout and complicated parameterization (Parrott *et al*., 2012). On the basis of the space gradient were based on inter-plant competition for light, nutrients, and water (Hameed and Ismaiel, 2010).By limiting the amount of non-experimental area, the design maximizes the efficient utilization of experimental material (Mead, 1979). Radosevich (1987) has also criticized the normal Nelder design for allowing density and proportion effects to be confounded, also reproved the design for failing to distinguish between intraspecific and interspecific interference. The aims of this study that effect of planting density and depth of a corn planting on the growth and yield in two locations by using Nelder design.

Materials and methods:

The current study was conducted at two locations, the first one is Grda-rasha, College of Agricultural Engineering Sciences research farm, Salahaddin University-Erbil, located at (Latitude 36.06 N and Longitude 44.00 E), and elevation of 415 meters above sea level, at semi insured rain water zone. The second is Hamza- Kor, located at (Latitude 36. 22 N and Longitude 44.00 E) and elevation of 410 meter above sea level,at insured rain water zone , distance 26.89 km meters. The experiment conducted during the summer growing season of (2021) Application of Nelder Wheel experimental design to studying maize (*Zea mays* L.) Planting depths and density, then planted on 10th July for Grda-Rash and 25th July for Hamza-Kor of 2021, furthermore harvested the plant in the fields at both locations were irrigated for best plowing for preparing the best seedbed and weed control. The soil was plowed twice at 25 cm depth by moldboard plow and, softened with Rotavator 48 h after to seeding, Then planted in three cycles each of them consist of four replication according table 1, 2 and fig 1.2

Table (1) the field layout of Grdarasha and HamzaKor

Radius m	Interval m	Spacing m	plant Density ha^{-1}
2			Buffer row
2.60	0.3	0.125	80000
3.20	0.4	0.149	67272
3.80	0.4	0.177	56569
4.40	0.45	0.21	47568
5	0.45	0.25	40000
5.40			Buffer row

Table (2) the geometer of experiment and plant density in m^2

Line (density)	Inter space	Intra space	Plant m^2
1	42	21	11
2	42	26	9
3	42	29	8
4	42	36	7
5	42	41	6

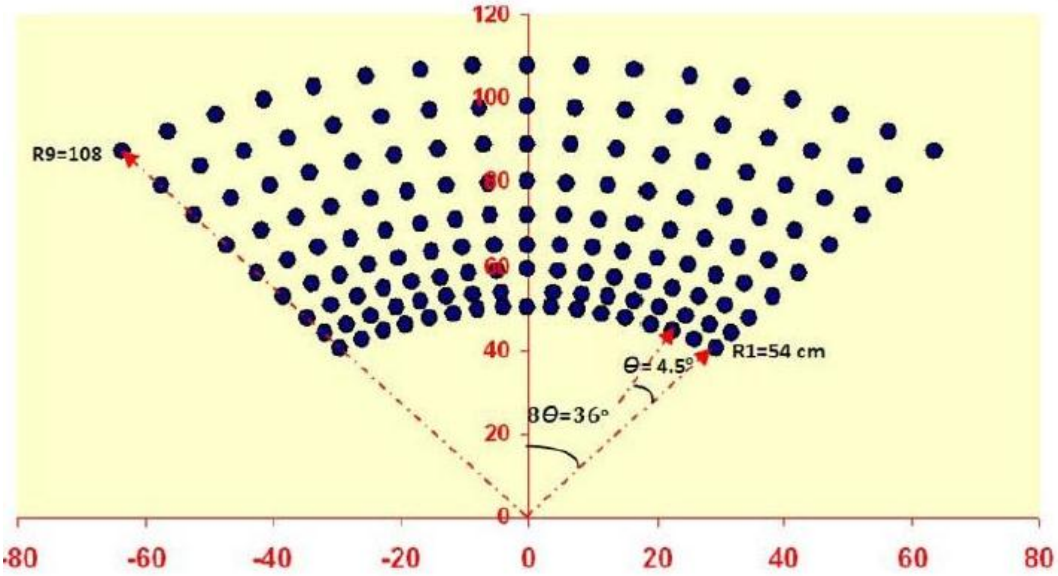

Fig. 1 example of kernel distributions (like a model)

The factorial experiment designed was randomized complete block design (RCBD) by Nelder wheel design by three factors A: depths, B: density and C: different locations by using Nelder design for planting, consisting 3 depths x 7 plant density in four replicates and in two varies location, half of which was grown on rows with north-south (N-S) direction, while the other half was grown on rows with east-west (E-W) direction. Two row act as Boundaries (Buffer row) in all replicates also depths consists of 3 cm, 6 cm, and 9 cm. by using a water distillation system in every rows. In this research was seed used to planting includes one Sweet corn Hybrid (Gloria, F1) which produced in Aristo seeds, Origin in Germany.

Table (3) Physical and chemical properties of experiment soil at a depth (0-25 cm) in both locations

Soil properties	Grda-rasha	Hmza-kor
EC dS.m-1	0.8	0.3
pH	7.43	7.76
N Total (%)	0.09	0.08
P Available (ppm)	9.5	9.7
K Available (ppm)	240	250
OM %	0.86	0.90
Sand %	28.3	42.7
Silt %	32.5	46.2
Clay %	39.2	18.8
Soil texture	Clay Loam	Silt Clay

Soil tests were analyzed at the Directorate of Agriculture Research Centre, Erbil

Table (4) Meteorological data for both locations during the study period at 2021

Parameters	July		August		September		October	
Location	GR	HK	GR	HK	GR	HK	GR	HK
average rainfall (mm)	0	0	0	0	1	0	28	23
Maximum Temp. °C	42	42	42	40	38	35	31	26
Minimum Temp °C	26	29	26	27	22	16	17	13

Atmosphere Relative Humidity %	15	16	15	14	19	17	30	26

Data gathering as an average of sampling of (ten plants) in each replication were made on number of node plant^{-1},internode plant $^{-1}$,inter node length cm, length of stem cm, number of leaves of plant $^{-1}$,ear of plant $^{-1}$,dry plant weight (g) (biological weight),number of kernel row^{-1},row ear^{-1},wet kernel weight g, kernel ear^{-1},wet ear weight g, kernel dry weight g, dry weight of calculated(cal.),number of node pedicel^{-1},internode pedicel $^{-1}$ (according fig. 2),pedicel length cm, Harvest index, Brix value % and kernel moisture %, and for weighting the samples used the sensitive balance.

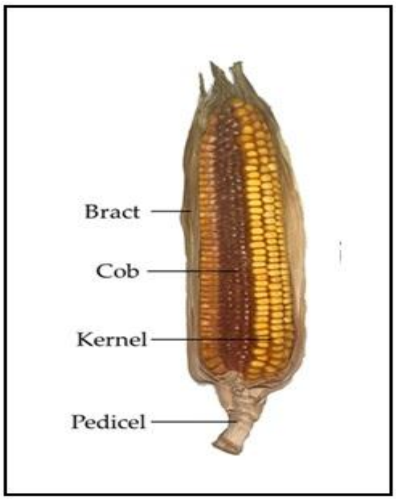

Fig.2. structure of corn cob

- Number of node plant $^{-1}$: number of node present in the stem of the plant.
- Internode length cm: This is the relation of the length of stem cm to number of internode plant $^{-1}$.
- Number of leaves plant $^{-1}$: Count the number of leaves, starting from the lowest (the coleoptile leaf with a rounded tip) to the last leaf that is arched over (tip pointing down).

- Dry plant weight (Biological yield) (g. plant^{-1}): This is the total plant weight above the ground which is equals to:

Biological yield = kernel yield + shoot yield (Donald and Hamblin, 1976)

- Ear of plant^{-1}(cub of plant): counted the number of ear (cub) for each plant.
- Number of kernel row^{-1}: Select one or two rows of kernels and count the number of kernels from the base to the tip of the ear.
- Row ear^{-1}: Select one or two columns of kernels and count the number of kernels for cycles of the ear.
- Wet kernel weight g: the yield of the corn kernels of the cub without covers after harvesting and before drying measure by sensitive tare.
- Number of node pedicel^{-1}: number of node present in the pedicel ears (ear shanks).
- Number of internode pedicel^{-1}: number of internode present in the pedicel ears (ear shanks).
- Pedicel length cm: determine the length (distance) of tap to bottom of the pedicel ears (ear shanks).
- Dry weight calculated (cal.): Can calculate by the wet kernel weight g divided to 5 then multiplied by kernel dry weight g.

Dry weight calculated= (wet kernel weight g/ 5)*kernel dry weight g.

- Brix value %: Brix value measured by Refractometer (The Refractometer, which measures Soluble solids concentration (SSC) (Brix), has been utilized as a rapid, pre-harvest method to determine sweet corn sugar content (Kleinhenz, 2003; Randle et al., 1984; Zhu et al., 1992)),
- Kernel moisture %: kernel moisture value measured by using a devise (A&D Moisture analyzer MF-50), which used to measure moisture ratio in kernel of sweet corn
- Harvest index (HI) %: This is the relation of the (economic yield or cub yield) to the total dry matter above ground (Biological yield).

HI % = (ear yield/ Biological yield) × 100 (Donald and Hamblin, 1976)

Statistical analysis: Results were obtained in the experiments are analyzed statistically using General Linear Model (GLM) according to the analysis of variance (ANOVA) using SPSS program (Statistical Package for Social Science) (SPSS, 2005) for RCBD design., Descriptive statistics were used for the analysis of the data result as follow Duncan test was used to determine significant differences at 0.05 levels among the different parameters (Duncan, 1955).

Results and Discussion:

Both Sites:

Location:

Table (5) showed that Hamzakor , had the highest significant in No of nod plant^{-1} , length of stem, No of leaves plant^{-1}, kernel in row $^{-1}$, row ear $^{-1}$, wet kernel weight g, ,wet ear weight g, wet cub weight g (wet weight for ear without husks, fresh weight), dry plant weight g , dry weight cal., the number of brix, in kernel dry weight g ,exceeding Grdarasha site .Also there was no significantly difference in internode length cm , kernel moisture and harvest index in both sites. Grdarasha location had higher significant difference obtained in the traits in number ear of plant, No of node pedicel^{-1}, No of internode pedicel $^{-1,}$ pedicel length cm.

Table (5) shows effect of location on the same traits of sweet corn

Location	Grdarasha	Hamza Kor
(Nod plant^{-1})	8.21 b	10.48 a
(Internode length cm)	14.97 a	18.97 a
(length stem cm)	107.46 b	179.31 a
(Leaves plant $^{-1}$)	7.76 b	9.86 a
(Ear of plant)	9.41 a	6.16 b
(Kernel row^{-1})	31.55 b	39.56 a
(Row ear^{-1})	14.53 b	15.5 a
(Wet kernel weight g)	36.7 b	208.45 a
(Wet ear weight g)	155.66 b	384.43 a
(Wet cub weight g)	96.7 b	293.9 a
(Dry plant weight g)	279.63 b	696.01 a
(Kernel dry weight g)	1.24 a	1.24 a
(Dry weight cal.)	9.01 b	51.79 a
(Node pedical^{-1})	7.38 a	5.48 b
(Internode pedical^{-1})	6.41 a	4.48 b
(pedicel length cm)	11.46 a	7.7 b
(Brix %)	14.93 b	21.5 a
(Kernel moisture %)	75.03 a	75.11 a
(Harvest Index)	0.03 a	0.07 a

Means with the same letters are not differed significantly

Planting depth:

In the table(6 , 7and 8) showed that there were no significant effect of depths on the vegetative, yield traits ,yield component and some other traits of sweet corn in three different depth (3 cm ,6 cm and 9 cm). In the result of this study observed that

those three depths there were no affected on these characters which studied, but only effected in time of seed emergence in depth 3 emerged before two other depths.

Table (6) Shows effect of different depths on the same vegetative traits of sweet corn

Depth(A)	(nod plant^{-1})	Internode length cm	(length stem cm)	(Leaves plant $^{-1}$)	(Ear of plant)	(dry plant weight g)
3 cm	9.20 a	17.10 a	140.50 a	8.55 a	7.82 a	484.10 a
6 cm	8.17 a	16.66 a	145.25 a	8.90 a	8.17 a	501.18 a
9 cm	9.25	17.16	144.42	9.00	7.37	478.18

	a	a	a	a	a	a

Means with the same letters are not differed significantly.

Table (7) show the effect of depths on the yield traits of sweet corn

Depth	(Kernel row^{-1})	(Row ear^{-1})	(Wet kernel weight g)	(Wet Ear weight g)	(Wet cub weight g)	(Kernel dry weight g)	(Dry weight cal.)
3 cm	34.95 a	14.80 a	120.14 a	268.80 a	193.83 a	1.29 a	31.32 a
6 cm	36.57 a	15.12 a	128.64 a	274.55 a	200.91 a	1.21 a	30.61 a
9 cm	35.15 a	15.12 a	118.95 a	266.78 a	191.15 a	1.23 a	29.27 a

Means with the same letters are not differed significantly.

Table (8) effect different depths on the yield component and some other traits of sweet corn

Depth	(Node pedicel^{-1})	(Internode pedicel^{-1})	(pedicel length cm)	(Brix %)	(Kernel moisture %)	(Harvest Index)
3 cm	6.52 a	5.52 a	9.55 a	18.02 a	74.14 a	.05 a
6 cm	6.40 a	5.45 a	10.55 a	18.85 a	75.67 a	.05 a
9 cm	6.37 a	5.37 a	8.64 a	17.77 a	75.39 a	.05 a

Means with the same letters are not differed significantly.

Plant densities:

According both table (9 and 10) statistically there were no differences showed that in all study traits, while was not affected by plant density.

Table (9) effect of density on the same vegetative traits of sweet corn

Density	(Nod plant^{-1})	(Internode length cm)	(length stem cm)	(Leaves plant $^{-1}$)	(Ear of plant)	(dry plant weight g)
1.00	9.58 a	16.46 a	144.17 a	8.96 a	7.75 a	507.79 a
2.00	9.21 a	17.30 a	143.29 a	8.79 a	7.63 a	468.63 a
3.00	9.29 a	16.78 a	141.88 a	8.67 a	7.63 a	473.85 a
4.00	9.46 a	17.09 a	145.00 a	8.96 a	8.13 a	486.27 a
5.00	9.21 a	17.24 a	142.63 a	8.71 a	7.83 a	502.57 a

Means with the same letters are not differed significantly.

Density 1.00:11 plant, Density 2.00:9 plant, Density 3.00:8 plant, Density 4.00:7 plant, Density 5.00:6 plant

Table (10) effect of density on the yield traits of sweet corn

Density	(Kernel row^{-1})	(Row ear^{-1})	(Wet kernel weight g)	(Wet Ear weight g)	(Wet cub weight g)	(Kernel dry weight g)	(Dry weight cal.)
1.00	35.42 a	15.29 a	121.59 a	266.67 a	192.71 a	2.64 a	100.11 a
2.00	35.46 a	14.83 a	131.27 a	276.39 a	204.50 a	2.68 a	107.53 a
3.00	35.75 a	15.04 a	120.19	265.98 a	193.04 a	2.54 a	98.80 a
4.00	35.42 a	14.92 a	120.26 a	272.66 a	192.22 a	2.53 a	95.37 a
5.00	35.75 a	15.00 a	119.59 a	268.55 a	194.05 a	2.65 a	100.66 a

Means with the same letters are not differed significantly.

Density 1.00:11 plant, Density 2.00:9 plant, Density 3.00:8 plant, Density 4.00:7 plant, Density 5.00:6 plant

Table (11) showed that the node pedicel $^{-1}$ and internode pedicel $^{-1}$ affected by plant density which higher significantly difference obtained as a result of analysis in plant density (5.00) which were 6.83 and 5.83. Furthermore lower significantly difference obtained in density (3.00) which 5.96 and 4.96 respectively. But in pedicel length cm, Brix value %, kernel moisture% and harvest index there are non-significantly difference; it means the density of not affected.

Table (11) effect of density on the yield component and some other traits of sweet corn

Density	(Node pedicel^{-1})	(Internode pedicel^{-1})	(Pedicel length cm)	(Brix %)	(Kernel moisture %)	(Harvest Index)
1.00	6.54 a-b	5.54 a-b	8.38 a	18.00 a	74.01 a	0.05 a
2.00	6.29 a-b	5.38 a-b	9.92 a	18.25 a	73.62 a	0.06 a
3.00	5.96 b	4.96 b	8.56 a	17.71 a	75.64 a	0.06 a
4.00	6.54 a-b	5.54 a-b	10.19 a	18.58 a	76.22 a	0.05 a
5.00	6.83 a	5.83 a	10.85 a	18.54 a	75.87 a	0.05 a

Means with the same letters are not differed significantly.

Density 1.00:11 plant, Density 2.00:9 plant, Density 3.00:8 plant, Density 4.00:7 plant, Density 5.00:6 plant

Interaction of Location and Depth:

table (12) illustrations the interaction between location and depths, The highest significant No of nod plant^{-1}, length of stem cm and dry plant weight g production were obtained from the interactions of (HK. with 6 cm), also was obtained the higher significant of number of leaves^{-1} in(HK.*9 cm).behind that reached the highest significant different in interned length cm in (HK.* 3 cm), That is referring to ability of stem elongation when the stem is taller that refers to growth in number of nod, internode and leaves, also increase in dry plant weight. The lowest number of nod plant $^{-1}$, and length of stem cm obtained in (GR.* 6 cm).But the lowest production of dry plant weight g and internode length cm observed in (GR.* 3 cm). The higher significant ear of plant^{-1} was produced from interactions of location and depth in (GR.* 6 cm.), then the lower significant yield ear of plant^{-1} obtained in (HK.*9 cm).

Table (12) show interaction between location and depths on the same vegetative traits of sweet corn

Location*Depth	(Nod plant-1)	(Internode length cm)	(Length stem cm)	(Leaves plant -1)	(Ear of plant)	(Dry plant weight g)
GR.* 3 cm	8.40 c	14.71 b	108.50 c	7.75 b	9.25 a	263.70 b
GR.* 6 cm	8.10 c	14.78 b	104.30 c	7.80 b	10.20 a	294.04 b
GR.* 9 cm	8.15 c	15.42 a-b	109.60 c	7.75 b	8.80 a	281.15 b
HK.* 3 cm	10.00 b	19.48 a	172.50 b	9.35 a	6.40 b	704.51 a
HK.* 6 cm	11.10 a	18.55 a-b	186.20 a	10.00 a	6.15 b	708.32 a
HK.*9 cm	10.35 a-b	18.89 a	179.25 a-b	10.25 a	5.95 b	675.21 a

Means with the same letters are not differed significantly.

In table (13) that investigated result showed the number of kernel in row^{-1} ,row in ear $^{-1}$,wet kernel weight, wet ear weight g and wet cub weight g ,kernel dry weight g ,observed higher significant difference between location and depth (HK.* 6 cm), in number of kernel row^{-1} and row ear $^{-1}$ lower mean value reached in (GR.* 3 cm),while in other study traits lower mean obtained in(GR.* 6 cm).while there was no significantly effected in dry weight cal.in interaction

Table (13) interaction between location and depths on the yield traits of sweet corn.

Location*Depth	(Kernel row^{-1})	(Row ear^{-1})	(Wet kernel weight g)	(Wet Ear weight g)	(Wet cub weight g)	(Kernel dry weight g)	(Dry weight cal.)

GR.* 3 cm	30.85 b	14.10 c	38.03 c	157.35 c	101.22 c	1.27 a	9.63 b
GR.* 6 cm	32.15 b	14.40 b-c	25.93 c	140.10 c	80.38 c	1.25 a	6.80 b
GR.* 9 cm	31.65 b	15.10 a-c	46.15 c	169.52 c	108.50 c	1.21 a	10.61 b
HK.* 3 cm	39.05 a	15.50 a-b	202.25 b	380.25 a-b	286.45 b	1.31 a	53.01 a
HK.* 6 cm	41.00 a	15.85 a	231.35 a	409.00 a	321.45 a	1.17 a	54.42 a
HK.*9 cm	38.65 a	15.15 a-c	191.75 b	364.05 b	273.80 b	1.24 a	47.93 a

Means with the same letters are not differed significantly.

In table (14) showed that the highest significantly difference in number of node pedicel^{-1}, internode pedicel $^{-1}$ and pedicel length cm were observed in (GR.* 3 cm), 7.80, 6.80 and 12.40 respectively. Furthermore the lowest mean in node pedicel $^{-1}$ and internode pedicel $^{-1}$ observed in (HK.* 3 cm), 5.25 and 4.25 respectively, besides lowest mean in pedicel length cm observed in (HK.*9 cm) was 6.60 .in brix value higher difference reached in (HK.* 6 cm) was 21.95 and lower value in (GR.* 9 cm) is 14.10.also in harvest index the highest significantly difference obtained in interaction of both location and depth in(HK.* 3 cm) and (HK.* 6 cm) which was 0.08.

Table (14) interaction between location and depths on the yield component and some other traits of sweet corn

Location*Depth	(Node pedicel^{-1})	(Internode pedicel^{-1})	(Pedicel length cm)	(Brix %)	(Kernel moisture %)	(Harvest Index)
GR.* 3 cm	7.80 a	6.80 a	11.30 a-b	14.95 b	74.48 a	0.03 a-b
GR.* 6 cm	7.45 a	6.55 a	12.40 a	15.75 b	74.90 a	0.02 b
GR.* 9 cm	6.90 a	5.90 a	10.68 a-c	14.10 b	75.71 a	0.03 a-b
HK.* 3 cm	5.25 b	4.25 b	7.80 cd	21.10 a	73.79 a	0.08 a
HK.* 6 cm	5.35 b	4.35 b	8.70 c-d	21.95 a	76.45 a	0.08 a
HK.*9 cm	5.85 b	4.85 b	6.60 d	21.45 a	75.08 a	0.07 a-b

Means with the same letters are not differed significantly.

Interaction of Location and Density:

The data presented in table 15 obtained that higher significant difference in number of node plant^{-1} ,length of stem cm ,leaves plant^{-1} and dry plant weight g in (HK.*1.00) were 11.00,10.17,181.33,10.08 and 747.37 respectively ,lower mean value detected in (GR.*3.00) which 8.08,7.08,103.67 and7.67 respectively .excluding in production of dry plant weight g in (GR.*2.00) was 265.73.also in number of internode length cm observed higher mean resulted in (HK.*2.00) which was 19.93,lower in (GR.*2.00) was 14.60. Similarly reach higher significantly difference in number of ear per plant in (GR.*4.00) was 10.25, the lowest in (HK.*2.00) was 5.75. Although an increase in the number of plants per unit area resulted in increased competition among them for food, water, and light, resulting in a drop in most crop components (Al-Hameed and Adra, 2011, Sharifi et al., 2009). This could possibly be because the vegetative growth indices of plant height and number of leaves have increased, Thus in the productive stage of the plant, including flowers, increasing the photosynthetic products that move to new breeding sites, raising the fertility rate, which is represented in the weight of ear in the plant.

Table (15) interaction between location and density on the same vegetative traits of sweet corn

Location*Density	(Nod plant^{-1})	(Internode length)	(length stem cm)	(Leaves plant^{-1})	(Ear of plant^{-1})	(dry plant weight g)
GR.*1.00	8.17 c	14.94 c	107.00 b	7.83 b	8.92 b	268.22 c

GR.*2.00	8.33 c	14.60 c	106.50 b	7.92 b	9.50 a-b	265.73 c
GR.*3.00	8.08 c	14.71 c	103.67 b	7.67 b	9.42 a-b	274.75 c
GR.*4.00	8.33 c	15.31 c	111.08 b	7.92 b	10.25 a	293.08 c
GR.*5.00	8.17 c	15.30 c	109.08 B	7.50 b	9.00 a-b	296.37 c
HK.*1.00	11.00 a	17.98 b	181.33 a	10.08 a	6.58 c	747.37 a
HK.*2.00	10.08 b	19.93 a	180.08 a	9.67 a	5.75 c	671.53 b
HK.*3.00	10.50 a-b	18.85 a-b	180.08 a	9.67 a	5.83 c	672.95 b
HK.*4.00	10.58 a-b	18.87 a-b	178.92 a	10.00 a	6.00 c	679.45 b
HK.*5.00	10.25 b	19.19 a-b	176.17 a	9.92 a	6.67 c	708.77 a-b

Means with the same letters are not differed significantly.

Table 16 showed that the higher significant difference in interaction of location and density in the traits number of kernel row $^{-1}$ observed in (HK.*5.00) was 40.42, lower mean (GR.*4.00) was 30.58, in row ear $^{-1}$ the higher significant difference in (HK.*3.00) was 15.75, lower mean (GR.*4.00) 14.17, also in wet kernel weight g higher value (HK.*2.00) was 228.25, lower in (GR.*1.00) was 33.09, wet ear weight and wet cub weight get the higher significantly difference in (HK.*2.00) is 412.00 and 320.08 and the lower mean resulted in(GR.*1.00) is 138.59 and 81.83 respectively, also in kernel dry weight g in this table higher significantly difference in (GR.*1.00) was 1.37,lower in (GR.*3.00) was 1.15.bihaind that in dry weight cal. observed higher difference in (HK.*2.00) was 58.17,lower in (HK.*4.00) was 47.24.

Table (16) interaction between location and density on the yield traits of sweet corn

Location*Density	(Kernel row^{-1})	(Row ea^{r-1})	(Wet kernel weight g)	(Wet Ear weight g)	(Wet cub weight g)	(kernel dry weight g)	(dry weight cal.)
GR.*1.00	32.00 b	15.08 a-d	33.09 c	138.59 c	81.83 c	1.37 a	9.26 c
GR.*2.00	31.33 b	14.42 b-d	34.30 c	140.77 c	88.92 c	1.36 a	9.16 c
GR.*3.00	32.75 b	14.33 c	40.37 c	166.80 c	104.42 c	1.15 b	8.87 c
GR.*4.00	30.58 b	14.17 d	40.01 c	175.15 c	107.85 c	1.19 a-b	9.44 c
GR.*5.00	31.08 b	14.67 a-d	35.77 c	157.02 c	100.51 c	1.16 b	8.34 c
HK.*1.00	38.83 a	15.50 a-b	210.08 a-b	394.75 a-b	303.58 a-b	1.22 a-b	51.36 a-b
HK.*2.00	39.58 a	15.25 a-d	228.25 a	412.00 a	320.08 a	1.27 a-b	58.17 a
HK.*3.00	38.75 a	15.75 a	200.00 b	365.17 b	281.67 b	1.28 a-b	51.68 a-b
HK.*4.00	40.25 a	15.67 a	200.50 b	370.17 b	276.58 b	1.18 a-b	47.24 b
HK.*5.00	40.42 a	15.33 a-c	203.42 b	380.08 a-b	287.58 b	1.25 a-b	50.48 a-b

Means with the same letters are not differed significantly.

In table 17 showed that the higher difference in node pedicel $^{-1}$, internode pedicel^{-1} ,pedicel length cm and kernel moisture % in(GR.*5.00),which 8.25,7.25,13.04 and 76.85 respectively ,and the lower in(HK.*3.00) was 5.00,4.00 and 5.92 respectively, excluding in the kernel moisture traits lower mean resulted in(GR.*2.00) which was 72.69 .similarly the higher significantly difference in Brix and harvest index mean observed in(HK.*2.00) were 21.42 and 0.09, lower mean resulted in(GR.*3.00) is 14.17.but lower mean in harvest index observed in(GR.*5.00) was 0.02.

Table (17) interaction between location and density on the yield component and some other traits of sweet corn

Location*Density	(Node pedicel^{-1})	(Internode pedicel^{-1})	(Pedicel length cm)	(Brix %)	(Kernel moisture %)	(Harvest Index)

GR.*1.00	7.58 a-b	6.58 a-b	9.00 b-d	14.42 b-c	72.57 b	0.04 b
GR.*2.00	7.00 b	6.17 b	11.75 a-c	15.08 b-c	72.69 b	0.04 b
GR.*3.00	6.92 b	5.92 b	11.21 a-c	14.17 c	76.92 a	0.03 b
GR.*4.00	7.17 b	6.17 b	12.30 a-b	16.00 b	76.15 a-b	0.03 b
GR.*5.00	8.25 a	7.25 a	13.04 a	15.00 b-c	76.85 a	0.02 b
HK.*1.00	5.50 c	4.50 c	7.75 cd	21.58 a	75.45 a-b	0.07 a
HK.*2.00	5.58 c	4.58 c	8.08 cd	21.42 a	74.56 a-b	0.09 a
HK.*3.00	5.00 c	4.00 c	5.92 d	21.25 a	74.36 a-b	0.08 a
HK.*4.00	5.92 c	4.92 c	8.08 cd	21.17 a	76.29 a-b	0.07 a
HK.*5.00	5.42 c	4.42 c	8.67 b-d	22.08 a	74.90 a-b	0.07 a

Means with the same letters are not differed significantly.

Interaction between depth and density

In the resulted of statistical analysis of interaction between depth and density according table 18 there are non-significantly differences in production of number node plant^{-1}, and the number of ear of plant $^{-1}$.also higher significantly difference in length of stem cm obtained in(9 cm*2.00) was 17.94,lower in (6 cm*3.00) was 16.13. Then in other study traits such as length of stem cm and leaves of plant -^{1} the higher significantly difference obtained in (6 cm*4.00) which was 150.38 and 9.25 respectively, in the lower mean of length of stem obtained in (3 cm*4.00) was 137.88. and the lower mean of leaves plant $^{-1}$ obtained in both interaction(3 cm*3.00 and 3 cm*4.00) was 8.38 , Also in production dry plant weight g the significantly difference perceived in(6 cm*5.00) was 533.80,the lower mean in(9 cm*5.00) was 449.58.

Table (18) interaction between depth and density on the same vegetative traits of sweet corn

Depth*Density	(Nod plant^{-1})	(Internode length)	(Length stem cm)	(Leaves plant $^{-1}$)	(Ear of plant^{-1})	(Dry plant weight g)
3 cm*1.00	9.50 a	16.35 a-b	140.75 a-b	8.88 a-b	7.88 a	508.40 a-b
3 cm*2.00	9.13 a	17.33 a-b	140.75 a-b	8.50 a-b	7.25 a	451.05 b
3 cm*3.00	9.00 a	17.63 a-b	141.00 a-b	8.38 b	7.88 a	459.78 a-b
3 cm*4.00	9.13 a	16.96 a-b	137.88 b	8.38 b	8.13 a	476.98 a-b
3 cm*5.00	9.25 a	17.23 a-b	142.13 a-b	8.63 a-b	8.00 a	524.33 a-b
6 cm*1.00	9.75 a	16.39 a-b	144.63 a-b	8.75 a-b	8.38 a	533.38 a
6 cm*2.00	9.63 a	16.62 a-b	145.63 a-b	8.88 a-b	8.38 a	493.05 a-b
6 cm*3.00	9.75 a	16.13 b	144.38 a-b	9.00 a-b	7.38 a	464.48 a-b
6 cm*4.00	9.63 a	17.33 a-b	150.38 a	9.25 a	8.50 a	481.20 a-b
6 cm*5.00	9.25 a	16.85 a-b	141.25 a-b	8.63 a-b	8.25 a	533.80 a
9 cm*1.00	9.50 a	16.64 a-b	147.13 a-b	9.25 a	7.00 a	481.60 a-b
9 cm*2.00	8.88 a	17.94 a	143.50 a-b	9.00 a-b	7.25 a	461.80 a-b
9 cm*3.00	9.13 a	16.58 a-b	140.25 a-b	8.63 a-b	7.63 a	497.30 a-b
9 cm*4.00	9.63 a	16.98 a-b	146.75 a-b	9.25 a	7.75 a	500.63 a-b
9 cm*5.00	9.13 a	17.65 a-b	144.50 a-b	8.88 a-b	7.25 a	449.58 b

Means with the same letters are not differed significantly.

In table 19 showed that the higher significantly difference in number of kernel row $^{-1}$ obtained in (6 cm*5.00) which was 38.00, lower mean value in (3 cm*2.00) was 33.88.In row ear $^{-1}$,wet ear weight g and wet cub weight g there were non-significantly deference are founded. However in the wet kernel wet g the highest significantly difference obtained in (6 cm*2.00) was 142.61, the lowest in (3 cm*5.00) which was 106.43.in kernel dry weight g higher difference obtained in (9 cm*2.00) was 1.36.lower in (6 cm*4.00) was 1.08.but in dry weight cal. there was no significantly difference according resulted in this table.

Table (19) shows interaction between depth and density on the yield traits of sweet corn.

Depth*Density	(Kernel row^{-1})	(Row ear^{-1})	(Wet kernel weight g)	(Wet Ear weight g)	(Wet cub weight g)	(Kernel dry weight g)	(Dry weight cal.)
3 cm*1.00	36.38 a-b	15.00 a	124.91 a-b	273.25 a	195.17 a	1.35 a	32.02 a
3 cm*2.00	33.88 b	14.63 a	126.36 a-b	274.53 a	205.87 a	1.35 a	35.33 a
3 cm*3.00	34.25 a-b	14.88 a	121.89 a-b	263.55 a	188.95 a	1.17 a-b	29.09 a
3 cm*4.00	35.50 a-b	14.88 a	121.13 a-b	269.77 a	193.06 a	1.30 a-b	30.24 a
3 cm*5.00	34.75 a-b	14.63 a	106.43 b	262.91 a	186.14 a	1.27 a-b	29.92 a
6 cm*1.00	35.38 a-b	15.75 a	126.05 a-b	276.42 a	197.53 a	1.28 a-b	30.58 a
6 cm*2.00	36.13 a-b	15.00 a	142.61 a	283.27 a	214.68 a	1.23 a-b	33.47 a
6 cm*3.00	36.13 a-b	14.88 a	129.86 a-b	267.99 a	201.68 a	1.22 a-b	33.45 a
6 cm*4.00	37.25 a-b	14.75 a	111.48 a-b	268.65 a	189.25 a	1.08 b	24.01 a
6 cm*5.00	38.00 a	15.25 a	133.21 a-b	276.44 a	201.45 a	1.24 a-b	31.55 a
9 cm*1.00	34.50 a-b	15.13 a	113.81 a-b	250.34 a	185.43 a	1.25 a-b	28.34 a
9 cm*2.00	36.38 a-b	14.88 a	124.86 a-b	271.36 a	192.96 a	1.36 a	32.19 a
9 cm*3.00	36.88 a-b	15.38 a	108.82 b	266.41 a	188.50 a	1.25 a-b	28.29 a
9 cm*4.00	33.50 b	15.13 a	128.15 a-b	279.55 a	194.34 a	1.16 a-b	30.77 a
9 cm*5.00	34.50 a-b	15.13 a	119.14 a-b	266.30 a	194.55 a	1.10 b	26.77 a

Means with the same letters are not differed significantly.

According table 20 the higher significantly difference in node pedicel $^{-1}$ and internode pedicel $^{-1}$ observed in statistical result of study in (3 cm*5.00) were 7.13 and 6.13 then lower in (6 cm*3.00) were 5.50 and 4.50 respectively .likewise significantly difference in pedicel length cm in the interaction between depth and density in(6 cm*5.00) was 11.63,lower mean obtained in (3 cm*3.00) which was 6.44.also in the number of Brix the higher significant deference observed in both interactions in (6 cm*4.00, 6 cm*5.00) was 19.38.in other study traits higher significantly difference observed in (6 cm*4.00) which was 78.23 the lower was (3 cm*2.00) was 72.91**.**but in harvest index there was no significantly difference.

Table (20) shows interaction between depth and density on the yield component and some other traits of sweet corn.

Depth*Density	(Node pedicel^{-1})	(.Internode pedicel^{-1})	(Pedicel length cm)	(Brix %)	(Kernel moisture %)	(Harvest Index)
3 cm*1.00	6.75 a-b	5.75 a-b	7.38 a-b	18.13 a-b	72.96 b	.05 a
3 cm*2.00	6.63 a-b	5.63 a-b	11.75 a	18.63 a-b	72.91 b	.06 a
3 cm*3.00	5.88 a-b	4.88 a-b	6.44 b	17.38 a-b	76.54 a-b	.06 a
3 cm*4.00	6.25 a-b	5.25 a-b	10.44 a-b	17.63 a-b	73.80 a-b	.05 a
3 cm*5.00	7.13 a	6.13 a	11.75 a	18.38 a-b	74.50 a-b	.04 a
6 cm*1.00	6.50 a-b	5.50 a-b	10.00 a-b	18.25 a-b	74.26 a-b	.04 a
6 cm*2.00	6.13 a-b	5.38 a-b	9.13 a-b	18.38 a-b	75.24 a-b	.06 a
6 cm*3.00	5.50 b	4.50 b	10.13 a-b	18.88 a-b	75.49 a-b	.05 a

6 cm*4.00	7.00 a	6.00 a	11.88 a	19.38 a	78.23 a	.04 a
6 cm*5.00	6.88 a-b	5.88 a-b	11.63 a	19.38 a	75.18 a-b	.04 a
9 cm*1.00	6.38 a-b	5.38 a-b	7.75 a-b	17.63 a-b	74.81 a-b	.05 a
9 cm*2.00	6.13 a-b	5.13 a-b	8.88 a-b	17.75 a-b	72.72 b	.05 a
9 cm*3.00	6.50 a-b	5.50 a-b	9.13 a-b	16.88 b	74.90 a-b	.04 a
9 cm*4.00	6.38 a-b	5.38 a-b	8.26 a-b	18.75 a-b	76.62 a-b	.05 a
9 cm*5.00	6.50 a-b	5.50 a-b	9.19 a-b	17.88 a-b	77.94 a	.05 a

Means with the same letters are not differed significantly.

Interaction between Location, Depth and Density

In table 21 according the interaction among three factors location, depth and density observed higher significantly difference in number of node plant-[1] in (HK.*6 cm*3.00) which were 11.75 lower in (GR.*9 cm*2.00) were 7.75 and, in internode length cm the highest mean reached in (HK.*3 cm*2.00) was 20.63 the lowest in(GR.*6 cm*2.00) which 13.90.also the length of stem cm higher significantly difference obtained in(HK.*6 cm*3.00) was 192.75, lower in GR.*6 cm*3.00 was 96.00 . In the number of leaves $^{-1}$ higher significantly difference in (HK.*6 cm*3.00) was 10.50 and lower in (HK.*6 cm*3.00) which was 10.50, lower mean obtained in GH.*3 cm*5.00 was 7.50.therefore in number ear of plant $^{-1}$ higher significantly in GR.*6 cm*4.00 was 11.25 lower mean obtained in (HK.*6 cm*3.00) was 5.50,and higher significantly difference in dry plant weight g in(HK.*6 cm*5.00) was 784.05.the lowest mean reached in (GR.*3 cm*2.00) was 216.00.The increased number of leaves could be related to the fact that plants grown at short distances grow longer than those grown at great distances, This is caused by increased competition amongst plants for sunshine, nutrients, and water, which causes cell elongation and increased flexibility of cell walls, as well as a rise in the number of leaves, or it could be related to the intensity of the light, This is smaller in the event of high plant density, resulting in a reduction in the photo oxidation process (Mohammed and Elrais, 1982).

Table (21) show interactions between location, depth and density on the same vegetative traits of sweet corn

Location*Depth*Density*	(Nod plant^{-1})	(Internode length cm)	(Length stem cm)	(Leaves plant $^{-1}$)	(Ear of plant)	(Dry plant weight g)
GR.*3 cm*1.00	8.50 g-i	14.12 g	105.75 d-e	7.75 g-h	9.00 a-d	260.00 d
GR.*3 cm*2.00	8.50 g-i	14.03 g	104.75 de	7.75 g-h	8.50 b-d	216.00 d
GR.*3 cm*3.00	8.50 g-i	15.12 g	112.75 d	8.00 f-h	9.50 a-b	242.00 d
GR.*3 cm*4.00	8.25 h-i	15.10 g	109.50 d-e	7.75 g-h	10.00 a-b	275.50 d
GR.*3 cm*5.00	8.25 h-i	15.20 f-g	109.75 d-e	7.50 h	9.25 a-c	325.00 d
GR.*6 cm*1.00	8.00 i	14.89 g	104.25 d-e	7.75 g-h	10.00 a-b	292.05 d
GR.*6 cm*2.00	8.75 f-i	13.90 g	107.75 d-e	8.25 e-h	11.00 a	296.95 d
GR.*6 cm*3.00	7.75 i	14.29 g	96.00 e	7.50 h	9.25 a-c	287.65 d
GH.*6 cm*4.00	7.75 i	16.25 d-g	108.25 d-e	8.00 f-h	11.25 a	310.00 d
GR.*6 cm*5.00	8.25 h-i	14.55 g	105.25 d-e	7.50 h	9.50 a-b	283.55 d
GR.*9 cm*1.00	8.00 i	15.80 e-g	111.00 d-e	8.00 f-h	7.75 b-g	252.60 D
GR.*9 cm*2.00	7.75 i	15.88 e-g	107.00 d-e	7.75 g-h	9.00 a-d	284.25 d
GR.*9 cm*3.00	8.00 i	14.72 g	102.25 d-e	7.50 h	9.50 a-b	294.60 d
GR.*9 cm*4.00	9.00 e-i	14.57 g	115.50 d	8.00 f-h	9.50 a-b	293.75 d
GR.*9 cm*5.00	8.00 i	16.15 d-g	112.25 d	7.50 h	8.25 b-f	280.55 d
HK.*3 cm*1.00	10.50 a-d	18.57 a-c	175.75 b-c	10.00 a-c	6.75 d-g	756.80 a-b

HK.*3 cm*2.00	9.75 c-g	20.63 a	176.75 b-c	9.25 b-e	6.00 f-g	686.10 a-c
HK*3 cm*3.00	9.50 d-h	20.14 a-b	169.25 b-c	8.75 d-g	6.25 e-g	677.55 a-c
HK.*3 cm*4.00	10.00 c-f	18.81 a-c	166.25 c	9.00 c-f	6.25 e-g	678.45 a-c
HK.*3 cm*5.00	10.25 b-e	19.27 a-c	174.50 b-c	9.75 a-d	6.75 d-g	723.65 a-c
HK.*6 cm*1.00	11.50 a-b	17.88 b-e	185.00 a-b	9.75 a-d	6.75 d-g	774.70 a
HK.*6 cm*2.00	10.50 a-d	19.34 a-c	183.50 a-b	9.50 a-d	5.75 g	689.15 a-c
HK.*6 cm*3.00	11.75 a	17.97 b-e	192.75 a	10.50 a	5.50 g	641.30 c
HK.*6 cm*4.00	11.50 a-b	18.40 a-d	192.50 a	10.50 a	5.75 g	652.40 b-c
HK.*6 cm*5.00	10.25 b-e	19.16 a-c	177.25 a-c	9.75 a-d	7.00 c-g	784.05 a
HK.*9 cm*1.00	11.00 a-c	17.48 c-f	183.25 a-b	10.50 a	6.25 e-g	710.60 a-c
HK.*9 cm*2.00	10.00 c-f	20.00 a-b	180.00 a-c	10.25 a-b	5.50 g	639.35 c
HK.*9 cm*3.00	10.25 b-e	18.44 a-d	178.25 a-c	9.75 a-d	5.75 g	700.00 a-c
HK.*9 cm*4.00	10.25 b-e	19.39 a-c	178.00 a-c	10.50 a	6.00 f-g	707.50 a-c
HK.*9 cm*5.00	10.25 b-e	19.14 a-c	176.75 b-c	10.25 a-b	6.25 e-g	618.60 c

Means with the same letters are not differed significantly.

The number of yield in kernel row^{-1} which presented in table 22 showed that the higher significantly difference in (HK.*6 cm*5.00)was 42.25, lower obtained in (GR.*9 cm*4.00) which was 28.25, the number of row ear $^{-1}$ higher significantly difference in (HK.*3 cm*4.00) was 16.50 lower mean obtained in (GR.*3 cm*4.00)

which was 13.25, also in wet kernel weight g higher mean reached in both interaction (HK.*6 cm*2.00) was 246.75 lower in(GR.*6 cm*1.00) was 17.61. in wet ear weight and wet cub weight g were higher mean obtained in (HK.*6 cm*2.00) which was 434.00 and 342.00,lower in(GR.*6 cm*1.00)were 129.59 and 63.07.also in kernel dry weight g higher observed in (GR.*3 cm*1.00) was 1.47,lower in (HK.*6 cm*4.00) was 1.05.and in dry weight cal. higher difference obtained in (HK.*3 cm*2.00) was 62.65,lower mean in (GR.*6 cm*1.00) was 4.39.In the number of Kernel row^{-1},Row ear^{-1}, wet kernel weight g, Kernel ear^{-1},Wet ear weight g ,Wet cub weight g, Kernel dry weight g, Dry weight cal., Increased photosynthesis in the plant and conversion of the products to orgasm sites in the grain (kernel) may be due to an increase in the number of leaves and the exposure of most leaves to light, which helped to increase the process of photosynthesis in the plant and then convert the products to orgasm sites in the grain (kernel) (Sharifi et al., 2009), It is also thought that the increase in ankle weight is related to an increase in the average weight of the ear across a large distance due to a lack of competition between the plants. Pollen sterility can be caused by low temperatures during pollination. As a result, fertility is lower, and less grain is produced.

Table (22) shows interactions between location, depth and density on the yield traits of sweet corn.

Location*Depth*Density	(Kernel row^{-1})	(Row ear^{-1})	(Wet kernel weight g)	(Wet Ear weight g)	(Wet cub weight g)	(Kernel dry weight g)	(Dry weight cal.)
GR.*3 cm*1.00	34.00 c-h	14.50 a-e	39.57 d-e	153.00 d-e	93.33 e-f	1.47 a	11.92 e
GR.*3 cm*2.00	28.75 h	14.00 c-e	31.47 d-e	138.81 d-e	94.75 e-f	1.29 a-c	8.01 e
GR.*3 cm*3.00	31.50 f-h	14.25 b-e	59.53 d-e	176.85 d-e	120.66 e-f	1.12 a-c	12.74 e
GR.*3 cm*4.00	30.50 g-h	13.25 e	31.27 d-e	155.05 d-e	94.87 e-f	1.37 a-c	8.88 e
GH.*3 cm*5.00	29.50 g-h	14.50 a-e	28.37 d-e	163.07 d-e	102.53 e-f	1.10 b-c	6.61 e
GR.*6 cm*1.00	31.00 g-h	15.25 a-e	17.61 e	129.59 e	63.07 f	1.33 a-c	4.39 e
GR.*6 cm*2.00	31.25 g-h	14.25 b-e	38.46 d-e	132.54 e	87.36 e-f	1.34 a-c	10.54 e

GR.*6 cm*3.00	31.75 f-h	13.50 de	29.71 d-e	141.48 d-e	79.35 e-f	1.17 a-c	7.42 e
GH.*6 cm*4.00	33.00 f-h	14.25 b-e	24.21 d-e	164.05 d-e	96.25 e-f	1.12 a-c	6.30 e
GR.*6 cm*5.00	33.75 d-h	14.75 a-e	19.67 d-e	132.88 e	75.90 e-f	1.28 a-c	5.37 e
GR.*9 cm*1.00	31.00 g-h	15.50 a-d	42.11 d-e	133.17 e	89.11 e-f	1.30 a-c	11.47 e
GR.*9 cm*2.00	34.00 c-h	15.00 a-e	32.96 d-e	150.96 d-e	84.66 e-f	1.45 a-b	8.93 e
GR.*9 cm*3.00	35.00 c-h	15.25 a-e	31.89 d-e	182.08 d-e	113.25 e-f	1.15 a-c	6.46 e
GR.*9 cm*4.00	28.25 h	15.00 a-e	64.55 d	206.34 d	132.43 e	1.07 c	13.15 e
GR.*9 cm*5.00	30.00 g-h	14.75 a-e	59.28 d-e	175.10 d-e	123.09 e-f	1.08 b-c	13.06 e
HK.*3 cm*1.00	38.75 a-d	15.50 a-d	210.25 a-c	393.50 a-c	297.00 a-d	1.23 a-c	52.12 a-d
HK.*3 cm*2.00	39.00 a-d	15.25 a-e	221.25 a-c	410.25 a-c	317.00 a-d	1.41 a-c	62.65 a
HK*3 cm*3.00	37.00 a-f	15.50 a-d	184.25 c	350.25 c	257.25 d	1.21 a-c	45.43 b-d
HK.*3 cm*4.00	40.50 a-b	16.50 a	211.00 a-c	384.50 a-c	291.25 a-d	1.24 a-c	51.61 a-d
HK.*3 cm*5.00	40.00 a-b	14.75 a-e	184.50 c	362.75 b-c	269.75 b-d	1.45 a-b	53.23 a-d
HK.*6 cm*1.00	39.75 a-c	16.25 a-b	234.50 a-b	423.25 a-b	332.00 a	1.23 a-c	56.77 a-c
HK.*6 cm*2.00	41.00 a	15.75 a-c	246.75 a	434.00 a	342.00 a	1.12 a-c	56.40 a-d
HK.*6 cm*3.00	40.50 a-b	16.25 ab1	230.00 a-b	394.50 a-c	324.00 a-c	1.27 a-c	59.49 a-b
HK.*6 cm*4.00	41.50 a	15.25 a-e	198.75 b-c	373.25 a-c	282.25 a-d	1.05 c	41.72 cd
HK.*6 cm*5.00	42.25 a	15.75 a-c	246.75 a	420.00 a-c	327.00 a-b	1.19 a-c	57.74 a-c
HK.*9 cm*1.00	38.00 a-e	14.75 a-e	185.50 c	367.50 a-c	281.75 a-d	1.21 a-c	45.20 b-d
HK.*9 cm*2.00	38.75 a-d	14.75 a-e	216.75 a-c	391.75 a-c	301.25 a-d	1.27 a-c	55.46 a-d
HK.*9 cm*3.00	38.75 a-d	15.50 a-d	185.75 c	350.75 c	263.75 c-d	1.35 a-c	50.12 a-d
HK.*9 cm*4.00	38.75 a-d	15.25 a-e	191.75 b-c	352.75 c	256.25 d	1.26 a-c	48.40 a-d
HK.*9 cm*5.00	39.00 a-d	15.50 a-d	179.00 c	357.50 b-c	266.00 c-d	1.12 a-c	40.49 d

Means with the same letters are not differed significantly.

In table 23 showed that the higher significantly difference obtained in number of node pedicel^{-1} ,internode pedicel^{1} and pedicel length cm in (GH.*3 cm*5.00) were 9.75,8.75and 16.50 respectively, lower obtained in (HK*3 cm*3.00) were 4.50,3.50 and 4.25.in number of Brix value had significantly difference higher mean in (HK.*6 cm*5.00)was 22.75,lower in(GR.*9 cm*3.00) was 12.25,also in kernel moisture higher significantly in(HK.*6 cm*4.00) was 78.99,lower mean value in (GR.*3 cm*1.00)was 70.55.also in harvest index higher significant difference obtained in both interactions (HK.*3 cm*2.00) and (HK.*6 cm*3.00) were 0.09,lower in (GR.*6 cm*1.00) was 0.01.Harvest index is affected by plant density,

water and resources ability and air temperature during growing season, This parameter is the index of grain production or remobilization coefficient of assimilates between economical organs and other parts of crop (Donald and Hamblin 1976).

Table (23) shows interactions between location, depth and density on the yield component and some other traits of sweet corn.

Location*Depth*Density	(Node pedicel^{-1})	(Internode pedicel^{-1})	(Pedicel length cm)	(Brix %)	(Kernel moisture %)	(Harvest Index)
GR.*3 cm*1.00	7.75 b-d	6.75 b-d	8.00 c-d	14.00 b-c	70.55 d	.04 b-g
GR.*3 cm*2.00	7.25 b-e	6.25 b-e	13.00 a-c	16.25 b	74.04 a-d	.03 c-g
GR.*3 cm*3.00	7.25 b-e	6.25 b-e	8.63 c-d	14.25 b-c	77.45 a-d	.05 a-f
GR.*3 cm*4.00	7.00 b-f	6.00 b-f	10.38 a-d	15.50 b	72.40 a-d	.03 d-g

GH.*3 cm*5.00	9.75 a	8.75 a	16.50 a	14.75 b-c	78.00 a-c	.02 f-g
GR.*6 cm*1.00	8.00 b-c	7.00 a-c	11.00 a-d	15.00 b-c	73.32 a-d	.01 g
GR.*6 cm*2.00	6.75 b-g	6.25 b-e	10.00 a-d	15.00 b-c	73.03 a-d	.03 c-g
GR.*6 cm*3.00	6.25 b-h	5.25 b-g	13.00 a-c	16.00 b	76.50 a-d	.02 e-g
GH.*6 cm*4.00	8.25 a-b	7.25 a-b	16.25 a-b	16.75 b	77.47 a-d	.02 f-g
GR.*6 cm*5.00	8.00 a-c	7.00 a-c	11.75 a-d	16.00 b	74.21 a-d	.02 f-g
GR.*9 cm*1.00	7.00 b-f	6.00 b-f	8.00 c-d	14.25 b-c	73.86 a-d	.04 b-g
GR.*9 cm*2.00	7.00 b-f	6.00 b-f	12.25 a-c	14.00 b-c	71.00 c-d	.03 d-g
GR.*9 cm*3.00	7.25 b-e	6.25 b-e	12.00 a-c	12.25 c	76.81 a-d	.02 g-f
GR.*9 cm*4.00	6.25 c-h	5.25 b-g	10.28 a-d	15.75 b	78.57 a-b	.04 a-g
GR.*9 cm*5.00	7.00 b-f	6.00 b-f	10.88 a-d	14.25 b-c	78.33 a-b	.04 a-g
HK.*3 cm*1.00	5.75 d-h	4.75 d-g	6.75 c-d	22.25 a	75.38 a-d	.06 a-d
HK.*3 cm*2.00	6.00 c-h	5.00 c-g	10.50 a-d	21.00 a	71.78 b-d	.09 a
HK*3 cm*3.00	4.50 h	3.50 g	4.25 d	20.50 a	75.63 a-d	.06 a-d
HK.*3 cm*4.00	5.50 e-h	4.50 e-g	10.50 a-d	19.75 a	75.20 a-d	.08 a-b
HK.*3 cm*5.00	4.50 h	3.50 g	7.00 c-d	22.00 a	71.00 c-d	.07 a-c
HK.*6 cm*1.00	5.00 f-h	4.00 f-g	9.00 b-d	21.50 a	75.20 a-d	.07 a-c
HK.*6 cm*2.00	5.50 e-h	4.50 e-g	8.25 c-d	21.75 a	77.45 a-d	.08 a-b
HK.*6 cm*3.00	4.75 g-h	3.75 g	7.25 c-d	21.75 a	74.47 a-d	.09 a
HK.*6 cm*4.00	5.75 d-h	4.75 d-g	7.50 cd	22.00 a	78.99 a	.06 a-e
HK.*6 cm*5.00	5.75 d-h	4.75 d-g	11.50 a-d	22.75 a	76.15 a-d	.07 a-c
HK.*9 cm*1.00	5.75 d-h	4.75 d-g	7.50 c-d	21.00 a	75.77 a-d	.06 a-e
HK.*9 cm*2.00	5.25 e-h	4.25 e-g	5.50 c-d	21.50 a	74.45 a-d	.08 a
HK.*9 cm*3.00	5.75 d-h	4.75 d-g	6.25 c-d	21.50 a	72.99 a-d	.07 a-c
HK.*9 cm*4.00	6.50 c-h	5.50 b-g	6.25 c-d	21.75 a	74.68 a-d	.06 a-d
HK.*9 cm*5.00	6.00 c-h	5.00 c-g	7.50 c-d	21.50 a	77.56 a-d	.06 a-d

Means with the same letters are not differed significantly.

6. Conclusions:

Results achieved in the present study for effect of the depths and density in maize showed that the depths are not significant effect on all studies traits in Nelder design. Using Nelder wheel designs an experimental examination of individual interactions in populations that are (density dependent) and (depths dependent) has proven to be a versatile and valuable approach. Then Nelder designs was important to apply different densities in a small area, According to both locations data, while the Hamza- kor dominant to Grda-rasha site in most study traits but in some other traits like ear of plant $^{-1}$, node pedicel^{-1}, internode pedicel^{-1}and pedicel length cm which were Grda-rasha site was dominant., also conferring 5 different density there were no effect, only in node pedicel^{-1} and internode pedicel^{-1} have positively effects. The interaction of three factors (location*depth *and density) the higher significantly difference in ear of plant^{-1} in (GR.*6cm*4.00), dry plant weight g, kernel ear^{-1} and Brix value in (HK.*6cm*5.00).in kernel moisture (HK.*6 cm*4.00) and in harvest index in both interactions (HK.*3cm*2.00) and (HK.*6cm*3.00).

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