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GROWTH ANALYSIS, YIELD AND YIELD COMPONENTS OF SWEET CORN (Zea Mays L.) AS INFLUENCED BY INTER-ROW SPACING

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Abstract

This study aimed to investigate the effects of different inter and intra-row spacing on the growth analysis and some yield components of sweet corn (*Zea mays* L.). The experiment was conducted under field conditions at Qushtapa zones of northern Iraq in the main cropping season of 2020-21. Three different inter and intra-row spacing treatments 45, 60 and 75 cm and 10 and 15 cm were applied in a randomized complete block design (RCBD) with three replications, making a total of six plots, each plot on the field was measured 2m width by 3m length 6 m^2. The study assessed various growth parameters and yield attributes. The results indicated that inter-row spacing significantly influenced ear length (cm) number of kernels per ear, net assimilation rate (NAR) and light transmission ratio (LTR) which significantly possessed higher mean value at 75cm inter-row spacing. In contrast, interaction treatments of inter-row spacing ×intra-row spacing recorder highest mean values of ear length (cm), number of kernels per ear and light transmission ratio (LTR) at interaction treatments of (inter 75cm × intra 15cm) respectively. As for net assimilation rate (NAR) this trait postulate higher mean at treatment interaction of (inter 75cm × intra 10cm). These findings provide valuable insights into optimizing inter and intra-row spacing for hybrid maize cultivation to enhance productivity.

Keywords: Sweet corn, Inter-row spacing, Intra-row spacing, Growth analysis, Some yield components.

تحليل النمو ومكونات الحاصل للذرة الحلوة (*Zea mays* L.) تتأثر بالمسافة بين الخطوط

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الخلاصة

هدفت هذه الدراسة إلى معرفة تأثير المسافة بين الخطوط وبين النباتات على تحليل النمو وبعض مكونات الحاصل للذرة الحلوة (Zea mays L.). أجريت التجربة في ظروف حقلية بمنطقة قوشتبة شمال العراق في الموسم الزراعي الرئيسي لعام 2020–2021. تم تطبيق ثلاث مسافات زراعية مختلفة بين الخطوط 45، 60 و75 سم ومسافة زراعة بين النباتات 10 و15 سم في تصميم القطاعات الكاملة العشوائية (RCBD) بثلاثة مكررات، ليصبح مجموع الوحدات التجريبية ستة قطع، وكانت ابعاد الوحدة التجريبية بعرض 2 متر وطول 3 متر (6 متر مربع). أشارت النتائج إلى أن المسافة بين الصفوف قد أثر بشكل كبير على طول العرنوص (سم) وعدد الحبات في العرنوص، ومعدل الامتصاص الصافي (NAR) ونسبة انتقال الضوء (LTR)، إذ حققت المسافة 75 سم بين الخطوط أعلى المتوسطات في الصفات المذكورة اعلاه على التتابع. أما ما يخص معاملات التداخل فقد حققت معاملة التداخل 75 سم × 15 أعلى المتوسطات في الصفات: طول العرنوص (سم) وعدد الحبوب في العرنوص (حبة عرنوص–1) ونسبة انتقال الضوء، في حين كان أعلى متوسط لمعدل التمثيل الصافي عند معاملة التداخل 75 سم × 10 سم. توفر هذه النتائج رؤى قيمة في تحسين المسافات الزراعية بين الخطوط وبين النباتات لزيادة الانتاجية للذرة الحلوة لتعزيز الإنتاجية.

كلمات مفتاحية: ذرة الحلوة، مسافات بين الخطوط، مسافات بين النباتات، تحليل النمو، بعض مكونات الحاصل.

Introduction

Sweet corn (*Zea mays* L.) is a popular warm-season crop and an essential cereal crop known for its delicious taste and nutritional value, it is a member of the grass family (poaceae) and is closely related to field corn (1). It is cultivated worldwide and holds significant economic and nutritional importance (19). Growth analysis is a valuable tool used to understand the physiological processes and developmental stages of crops, it involves monitoring and evaluating various growth parameters to gain insights into plant growth patterns, resource allocation, and yield potential (13). By

analyzing growth patterns and resource allocation, farmers and researchers can optimize crop management practices to maximize yields and quality (4). To maximize the yield and quality of sweet corn hybrid maize, various agronomic practices, including inter and intra-row spacing, play a crucial role (6, 8 and 9). Inter-row spacing refers to the distance between rows in a crop field, proper spacing management has a significant influence on plant growth development, light interception, water uptake, weed competition, plant density, nutrient availability, and overall crop productivity (3 and 5). For conventional corn production, the recommended inter-row spacing is typically between 75-90 centimeters. This spacing allows for sufficient space between rows to facilitate machinery operation, weed control, and reduces competition for resources among plants (17). A wider inter-row spacing allows for more light penetration, reducing competition among plants and potentially resulting in larger, healthier plants. However, wider spacing can also lead to increased weed growth and may require additional weed management efforts (12). Conversely, a narrower inter-row spacing maximizes plant density, enhances light interception, and promotes efficient resource use. However, narrow spacing may increase competition for resources and necessitate careful nutrient and water management (11 and 16). The objective of this study is to evaluate the impact of different inter and intra-row spacing treatments on the growth, growth analysis, yield, and yield components of sweet corn.

Materials and Methods

The experiment was conducted using a randomized complete block design (RCBD) with three replications at Qushtapa zones of northern Iraq in the main cropping season of 2020-2021. Treatments were three inter and two intra-row spacing's namely; Narrow (45cm×10cm), (45cm×15cm), Medium (60cm×10cm), (60cm×15cm) and Wide (75cm×10cm), (75cm×15cm), replicated thrice making a total of six plots. The gross plot size was (2.0 m × 3.0 m) = (6.0 m^2) and accommodating 7, 5 and 4 rows for all 45 cm, 60 cm and 75 cm inter-rows, respectively. Number of plants (20 and 13 plant per row) for all intra-row spacing (10 and 15 cm) respectively. Maize hybrid seeds (CASH F1) were sown uniformly according to the recommended plant density in the designated plots following standard agronomic practices. Adequate irrigation and pest control measures were implemented throughout the crop growth period. Table 1 shows analyze some physical and chemical properties for soil samples were taken at a depth 0 - 30 cm. Various yield and yield components, growth analysis collected and measured including, ear length (cm), number of kernels per ear, net assimilation rate (NAR) and light transmission ratio (LTR) were recorded during the crop growth cycle at regular intervals. Data collected and then subjected to analysis of variance (ANOVA) by using appropriate statistical software (15). Significant differences between means were determined using (2) at a p-value of 0.05.

Net Assimilation Rate (NAR): A measure of the average photosynthetic efficiency of leaves in a crop canopy called (NAR) net assimilation rate (18).

$NAR = (W_2 – W_1) / (T_2 – T_1)$

Where;

NAR = Net Assimilation Rate ($g/m^2/day$)

W_2 = Final biomass at time T_2

W_1 = Initial biomass at time T_1

T_2 = Final time

T_1 = Initial time

Light Transmission Ratio (LTR): Light intensity is expressed in K lux, and it is expressed as the ratio of quantum of light intercepted by crop canopy at top to the bottom (18).

LTR = (Transmitted Light / Incident Light) × 100

Where;

LTR = Light Transmission Ratio.

Transmitted Light = Intensity of light transmitted through the crop canopy.

Incident Light = Intensity on incident light on the top of the crop canopy.

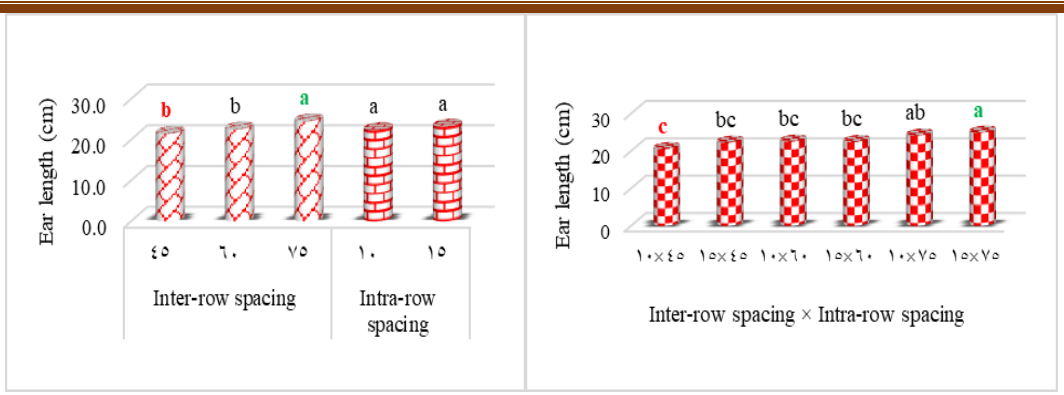
Table 1 Some physical and chemical properties for the soil of the Qushtapa experimental site.

Soil Properties	Sand%	Silt %	Clay %	Soil texture	Ec dSm^{-1}	pH	O.M (%)	N %	P (ppm)	K (ppm)
	16.2	43.1	40.7	Silty Clay	0.3	7.74	0.95	0.12	9.6	150

Results and Discussion

Some yield components of (a) inter and intra-row spacing, (b) interactions of (inter-row spacing × intra-row spacing) of sweet corn.

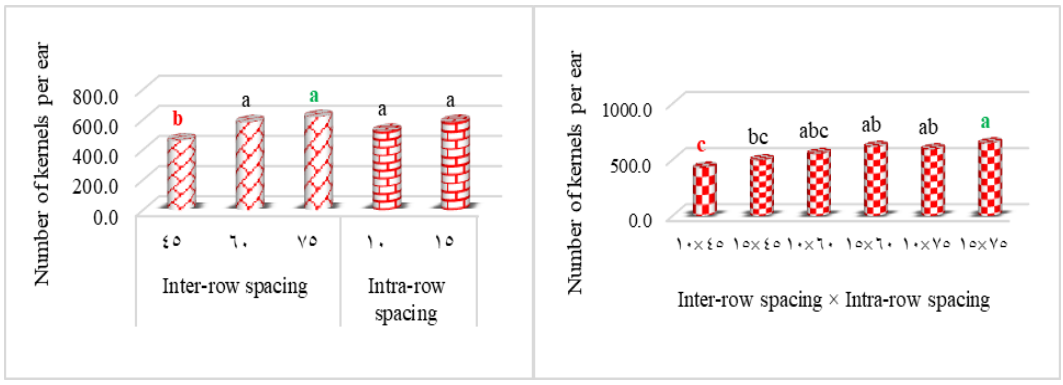
Ear length (cm): The ear length of hybrid maize was measured to assess the impact effects of inter-row spacing and interactions of inter-row spacing×intra-row spacing on this important yield component. The mean ear length data obtained from the study showed a significant difference ($P \leq 0.05$) between the different spacing treatments figure (1.a). The highest and lowest mean value of ear length (24.5 and 21.4 cm) was recorded at (75cm and 45cm) inter-row spacing. In addition, interactions of inter-row spacing×intra-row spacing treatment (75cm×15cm), where wider spacing was employed, the mean ear length was found to be (24.9 cm). This spacing allowed for greater light penetration and reduced competition among plants within rows. while, interactions of inter-row spacing×intra-row spacing treatment (45cm×10cm), which involved narrower spacing between individual plants within a row, resulted in a mean ear length of (20.5 cm) figure (1.b). The closer proximity of plants within rows in this treatment may have led to increased competition for resources, resulting in slightly shorter ears compared to the wider spacing treatment. (6 and 10) reported that variations in ear length of hybrid maize depend upon agro-climatic conditions.



(a) (b)

Figure 1 Effect (a) inter and intra-row spacing, (b) interaction (inter-row spacing×intra-row spacing) on ear length (cm) of sweet corn.

Number of kernels per ear: Number of kernels per ear contributes to the economic yield and represents the productive efficiency of any cereal crop or crop variety. Number of kernels per ear were significantly ($P \leq 0.05$) affected by inter-row spacing and interactions between different treatment inter-row spacing×intra-row spacing. Maximum and minimum number of kernels per ear was obtained at inter-row spacing (75cm and 45cm) their mean values 617.4 and 460.5 respectively (Figure 2.a). Significantly, a higher and lower number of kernels per ear 644.0 and 427.7 was recorded at interaction inter-row-spacing with intra- row spacing (75cm×15cm and 45cm×10cm) treatments respectively (Figure 2.b). Similarly, (9) found that the difference in number of kernels per ear obtained among different interaction inter-row spacing×intra-row spacing, might be due that number of kernels per ear depends upon many traits like ear length, ear diameter and kernel size which plant produced.



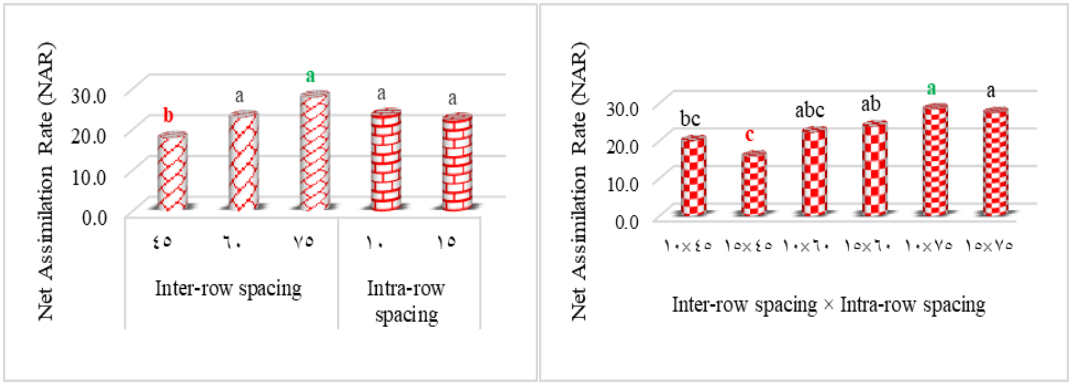
(a) (b)

Figure 2 Effect (a) inter and intra-row spacing, (b) interaction (inter-row spacing×intra-row spacing) on number of kernels per ear of sweet corn.

Growth analysis of (a) inter and intra-row spacing, (b) interactions of (inter-row spacing × intra-row spacing) of sweet corn

Net Assimilation Rate (NAR): Net assimilation rate (NAR) is a crucial parameter that reflects the efficiency of carbon assimilation and biomass production in hybrid maize. In this study, NAR was measured to evaluate the interaction impact of inter-row spacing and interactions of (inter-row spacing×intra-row spacing) on this important growth parameter. The mean NAR data obtained from the study showed a significant

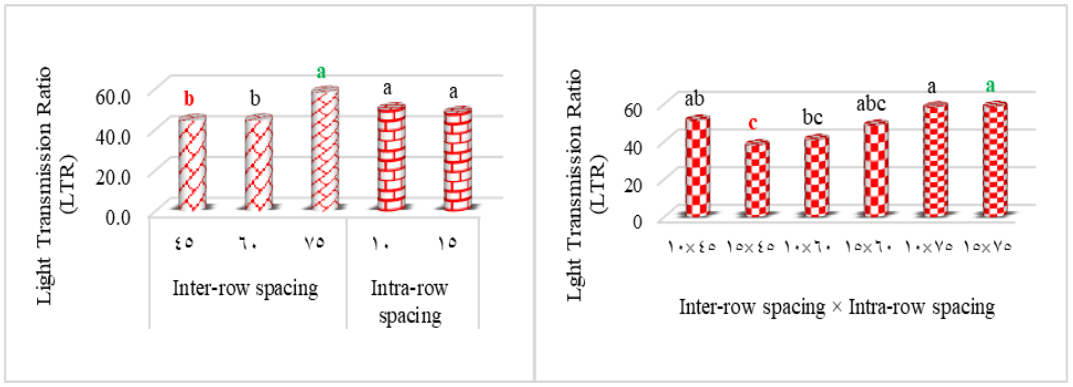
difference ($P \leq 0.05$) between the different inter-row spacing the higher and lower mean value (27.8 and 17.8 g/m^2/day) of this traits was recorded at (75cm and 45cm) inter-row spacing respectively (Figure 3.a). However, interaction treatments figure (3.b) showed that he higher mean NAR was found to be 28.3 g/m^2/day at interaction (inter 75cm×10cm intra-row spacing), in contrast lower mean NAR was found to be 15.7 g/m^2/day at interaction (inter 45cm×15cm intra-row spacing). These findings are in agreement with the previous research on the impact of spacing on NAR in hybrid maize (14).



(a) (b)

Figure 3 Effect (a) inter and intra-row spacing, (b) interaction (inter-row spacing×intra-row spacing) on net assimilation rate (NAR) of sweet corn.

Light Transmission Ratio (LTR): Light transmission ratio (LTR) is an important parameter that reflects amount of light that passes through the crop canopy and reaches the ground level. Inter-row spacing and interaction between inter and intra-row spacing postulate significantly positive effects ($P \leq 0.05$) on canopy transmittance. Inter-row spacing at (75cm and 45cm) showed maximum and minimum mean values 58.1 and 44.4 % Figure (4.a). In addition, light transmittance ratio obtained highest and lowest percentage at wider interaction (inter 75cm×15cm intra-row spacing) and narrower interaction (inter 45cm×15cm intra-row spacing) their mean values 58.2 and 37.8 % respectively (Figure 4.b). These findings postulate densification which can effectively reduce light transmittance of the maize canopy and let to interception more effective light radiation (7).



(a) (b)

Figure 4 Effect (a) inter and intra-row spacing, (b) interaction (inter-row spacing×intra-row spacing) on light transmission ratio (LTR) of sweet corn.

Conclusions: By understanding the growth patterns and optimizing inter and intra-row spacing, farmers and researchers can make informed decisions to enhance crop management and maximizing production. Additionally, to summarize the overall findings of this study, it was conducted in general that interactions of inter-row spacing×intra-row spacing narrower spacing (45cm×15cm) and wider spacing (75cm×15cm) was more superior than in comparison to other interactions.

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