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Effect of Ascorbic Acid Concentration and Harvest Date on the Percentage Loss of Grain Yield in Corn (*Zea mays* L.)

Atheer S. Mustafa, Omar N. Ali, and Qatada I. Abdullah
Field Crops Department, Collage of Agriculture, Tikrit University, Tikrit- Iraq

***Correspondence: omarnali84@tu.edu.iq**

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ABSTRACT

To study the effect of ascorbic acid concentration and harvest date on the percentage of grain yield loss in corn, an experiment was conducted at the College of Agriculture Research Station, Tikrit University. The experiment included three local corn varieties (Baghdad, Sara, and Fajir), three concentrations of ascorbic acid (0, 100, and 200 mg L^{-1}), and three harvest dates (30, 40, and 50 days after pollination) during the fall season on 15/7/2023. The results showed no significant differences among the varieties for the traits studied. However, ascorbic acid had a significant effect on the percentage of broken grains and the weight of broken grains. Spraying with 200 mg L^{-1} resulted in the highest values 2.587% for broken grain percentage and 180.09 kg ha^{-1} for broken grain weight. This treatment also produced the highest net grain yield, reaching 6790.96 kg ha^{-1}. Harvest date significantly affected all measured traits. Moisture content decreased by 15% between the first and third harvest dates. The percentage of remaining grains on the cob after shelling, as well as their weight, increased with earlier harvests. Specifically, the remaining grain percentages were 0.5248%, 2.0922%, and 3.4085%, and their corresponding weights were 39.98, 149.33, and 222.2 kg ha^{-1} at harvests taken 50, 40, and 30 days after pollination, respectively. The percentage of broken grains increased from 0.7719% to 3.563%, and their weight rose from 54.23 to 232.94 kg ha^{-1} as harvest timing moved from 50 to 30 days after pollination. Total grain loss also increased from 1.301% to 6.972%, and from 94.21 to 457.02 kg ha^{-1}. Meanwhile, the net grain yield decreased from 7203.93 to 6080.55 kg ha^{-1} between the same two harvest dates.

تأثير تراكيز حامض الأسكوربيك وموعد الحصاد في نسبة الفقد لحاصل حبوب الذرة الصفراء (*Zea mays* L.)

أثير صابر مصطفى[1]، عمر نزهان علي[1] ، قتادة إبراهيم عبدالله[1]
[1]قسم المحاصيل الحقلية - كلية الزراعة - جامعة تكريت - العراق.

الخلاصة
لدراسة تأثير تركيز حامض الأسكوربيك وموعد الحصاد في نسبة فقد حاصل الحبوب في الذرة الصفراء، أُجريت تجربة في محطة أبحاث كلية الزراعة / جامعة تكريت. شملت التجربة ثلاثة أصناف محلية من الذرة الصفراء (بغداد، سارة، وفجر)، وثلاثة تراكيز من حامض الأسكوربيك (0، 100، و200 ملغم لتر$^{-1}$)، وثلاثة مواعيد للحصاد (30، 40، و50 يوماً بعد التلقيح) خلال الموسم الخريفي بتاريخ 2023/7/15. أظهرت النتائج عدم وجود فروق معنوية بين الأصناف في الصفات المدروسة. في المقابل، كان لحامض الأسكوربيك تأثير معنوي في نسبة الحبوب المكسورة ووزنها، إذ أعطى الرش بتركيز 200 ملغم لتر$^{-1}$ أعلى القيم، حيث بلغت نسبة الحبوب المكسورة 2.587% ووزنها 180.09 كغم هـ$^{-1}$. كما حققت هذه المعاملة أعلى حاصل حبوب بلغ 6790.96 كغم هـ$^{-1}$.
أثر موعد الحصاد معنوياً في جميع الصفات المدروسة، إذ انخفضت نسبة الرطوبة بمقدار 15% بين موعدي الحصاد الأول والثالث. وازدادت نسبة الحبوب المتبقية على العرنوص بعد التفريط وكذلك وزنها مع التبكير في الحصاد. إذ بلغت نسب الحبوب المتبقية 0.5248% و2.0922% و3.4085%، وأوزانها المقابلة 39.98 و149.33 و222.2 كغم هـ$^{-1}$ عند الحصاد بعد 50 و40 و30 يوماً من التلقيح، على التوالي. كما ازدادت نسبة الحبوب المكسورة من 0.7719% إلى 3.563%، وارتفع وزنها من 54.23 إلى 232.94 كغم هـ$^{-1}$ عند تغير موعد الحصاد من 50 يوماً إلى 30 يوماً من التلقيح. وازداد الفقد الكلي في الحبوب من 1.301% إلى 6.972%، ومن 94.21 إلى 457.02 كغم هـ$^{-1}$. في حين انخفض حاصل الحبوب الكلي من 7203.93 إلى 6080.55 كغم هـ$^{-1}$ بين موعدي الحصاد نفسيهما.

INTRODUCTION

Corn (*Zea mays* L.) is an important crop in Iraq, cultivated during both the spring and fall seasons. Its significance lies in its direct use as human food and its incorporation into many food products. In addition, corn grain is widely used as feed for animals, poultry, and livestock due to its high nutritional value. Despite its importance, the cultivated area decreased to 76,000 hectares in 2016, with a productivity rate of 3.4 tons per hectare (FAO, 2022).

One of the main reasons for the decline in cultivation and the low productivity per unit area is the widespread presence of gypsum soils in Iraq, estimated at over 8 million hectares. These soils are characterized by low fertility and poor chemical and physical properties. Moreover, challenges related to planting and harvesting schedules in both growing seasons, along with issues of irrigation and water availability, further exacerbate the problem (Khairo, 2016). Other studies have shown that environmental factors such as temperature significantly influence early growth stages, including germination and root elongation, which ultimately affect crop development and yield potential (Ali, 2018).

Another significant issue affecting corn production is the harvest date and its related complications, such as high grain moisture content and yield loss during mechanical or manual harvesting, as well as during cleaning and shelling in processing facilities. Additionally, the efficient use of land for subsequent crops is affected by harvest timing. The availability and evaluation of locally developed genotypes suitable for cultivation in gypsum soils and under different harvest schedules without negatively impacting yield are essential for improving crop performance and minimizing yield losses. This is particularly important for newly developed varieties in Iraq, which require further study and evaluation under local growing conditions (Turner *et al.*, 2021).

To address these challenges, the use of plant growth stimulants such as plant growth regulators and vitamins has proven beneficial in enhancing yield. Among these, ascorbic acid (vitamin C) plays a vital role in promoting cell division and elongation, improving shoot and root growth, and activating photosynthesis by acting as an electron donor (Abrahamian and Kantharajan, 2011). Furthermore, to mitigate the adverse effects of gypsum soils, determining the appropriate harvest date is crucial to reduce yield damage and loss. The optimal harvest time occurs when grain moisture content drops to a harvestable level, typically below 20%, particularly for farmers who use artificial drying methods. While early harvesting reduces the field occupancy time and allows for timely planting of the next crop, it also results in high grain moisture and potentially greater yield losses during harvest and processing (Lindsey and Thomison, 2018). Conversely, delayed harvesting can similarly increase losses (Metz, 2006), who reported that high moisture content at harvest can raise loss percentages to 11.73% in mechanical harvesting.

Therefore, this study aims to examine the effect of three concentrations of ascorbic acid applied by foliar spraying on three locally cultivated corn varieties, and to evaluate the percentage of grain yield loss in relation to three different harvest dates.

MATERIAL AND METHODS

An experiment was conducted at the field crops research station- College of Agriculture, Tikrit University, in gypsum soil (17% gypsum) during the fall season of 2023 (Table 1). The experiment was carried out using a randomized complete block design (RCBD) with a split-split plot arrangement of treatments, in three replications. The treatments included three local corn varieties (Baghdad, Sara, and Fajir), three concentrations of ascorbic acid (0, 100, and 200 mg L^{-1}), and three harvest dates (30, 40, and 50 days) after pollination. The varieties were allocated to the main plots, ascorbic acid concentrations to the subplots, and harvest dates to the sub-sub plots.

Table (1). Physical and Chemical Properties of the Soil Sample for the experiment.

Property	Unit	Fall 2024 Value
pH	–	7.8
EC	dS m^{-1}	3.2
Nitrogen (N)	mg kg^{-1} soil	14.2
Phosphorus (P)	mg kg^{-1} soil	8.1
Potassium (K)	mg kg^{-1} soil	133
Calcium (Ca)	mg kg^{-1} soil	45
Sodium (Na)	mg kg^{-1} soil	91
Organic matter	%	0.82
Calcium carbonate ($CaCO_3$)	%	19
Calcium sulfate ($CaSO_4$)	%	25
Clay content	g kg^{-1}	19.1
Silt content	g kg^{-1}	25.2
Sand content	g kg^{-1}	53.4
Soil texture	—	Sandy loam

The planting date was 15/07/2023, with six rows per treatment, spaced 75 cm apart, and 25 cm between plants. Phosphate fertilizer (Super Calcium Phosphate, 18%P), 200 kg ha^{-1}, was applied with the first batch of nitrogen fertilizer (Urea 46% N) at the planting date. The second and third batches were applied at the six-leaf stage and the inflorescence stage, respectively, at a rate of 400 kg ha^{-1} in equal quantities for the three batches (Sharifi *et al.*,, 2024). Plants were sprayed with ascorbic acid at the four-leaf stage, along with a surfactant to reduce surface tension and facilitate the penetration and spread of the solution into the leaf tissues.

Once the plants reached the emergence stage of male and female inflorescences, paper bags were placed over them, and manual pollination was performed. The pollination dates were recorded, after which the bags were reapplied to the ears for two weeks. The harvest dates were determined as 20, 30, 40, and 50 days after the recorded pollination dates. Ears were harvested according to the treatment of the harvest date, with 10 plants randomly selected per treatment on the same day. A sample of seeds was taken from each harvested ear, representing one row of that ear. The seeds were weighed immediately after harvesting, then dried in an electric oven at 70°C until a constant weight was reached. Afterward, the seeds were weighed again using a sensitive scale. The moisture content of the grains was calculated using the following equation [1] (CGIAR Genebanks, 2008):

$$\%moisture = \frac{grain\ weight\ befor\ drying - grain\ weight\ after\ drying}{grain\ weight\ befor\ drying} \times 100 \qquad [1]$$

The ears were naturally dried to a moisture content of 14%, and then shelled using a shelling machine. The following measurements were recorded:

1- Percentage of Remaining Grains on the Cob After Shelling:This was determined by counting the total number of grains and the number of grains remaining on the cob after shelling. The percentage was then calculated using the following equation [2] (CGIAR Genebanks, 2008):

$$\%remaining\ grains\ in\ cob = \frac{Number\ of\ remaining\ grain\ in\ cob}{Total\ number\ of\ grain} \times 100 \qquad [2]$$

2- Weight of Remaining Grains on the Cob After Shelling:This was measured by weighing the grains that remained on the cob after shelling using a sensitive scale. The value was then converted to kg ha^{-1} based on plant density.
3- Percentage of Broken Grains:This was calculated by counting the number of broken grains and the total number of grains per ear. The percentage was then determined using the following equation [3] (CGIAR Genebanks, 2008):

$$\%broken\ grain = \frac{Number\ of\ broken\ grain}{Total\ number\ of\ grain} \times 100 \qquad [3]$$

4- Weight of Broken Grains:This was calculated by weighing the broken and incomplete grains using a sensitive scale, then converting the value to kg ha^{-1}.
5- Percentage of Total Loss:This represents the sum of the percentages of remaining grains on the cob and broken grains.
6- Weight of Total Loss (kg ha^{-1}):This represents the combined weight of the remaining grains on the cob and the broken grains, expressed in kg ha^{-1}.
7- Net Grain Yield (kg ha^{-1}):This represents the total yield of clean, undamaged grains and was converted to kg ha^{-1}.

Statistical Analysis:

The data were statistically analyzed using the Statistical Analysis System (SAS) software, version 9.4. Analysis of variance (ANOVA) was performed according to a randomized complete block design (RCBD) with a split–split plot arrangement, to evaluate the effects of corn varieties, ascorbic acid concentrations, harvest dates, and their interactions on the studied traits. Mean comparisons were conducted using the Least

Significant Difference (LSD) test at the 0.05 probability level to determine significant differences among treatment means (Al-Rawi and Khalaf Allah, 1980).

RESULTS AND DISCUSSION

Table (2) shows that there were no significant differences among the varieties in the traits studied, and they responded similarly to the other factors examined (ascorbic acid concentration and harvest date). The average moisture content in the grains was 23.63%, 23.31%, and 22.82% for the Baghdad, Fajir, and Sara varieties, respectively. Additionally, there were no significant differences among the varieties in terms of total grain loss percentage, and the net grain yield was 6738.55, 6646.06, and 6695.28 $kg.ha^{-1}$, respectively. This result may be attributed to the fact that the three varieties (Baghdad, Sara, and Fajir) were derived from the same genetic origins and were developed under similar Iraqi conditions through testing, standardization, and selection.

Table 2: Effect of varieties on yield traits and post-harvest yield loss of corn.

Varieties	%Moisture	%Remaining grain.ear^{-1}	Grain weight. ear^{-1} (gm)	%Broken grain	Broken grain weight (kg.h^{-1})	%Total loss	Total weight loss kg.h^{-1}	Net grain yield kg.h^{-1}
Baghdad	23.63 a	1.9467 a	136.05 a	2.477 a	170.12 a	4.4056 a	308.041 a	6738.55 a
Sara	23.31 a	1.9959 a	134.70 a	2.352 a	159.33 a	4.3533 a	294.033	6646.06 a
Fajir	22.82 a	2.0830 a	140.84 a	2.351 a	161.51 a	4.4341 a	302.352 a	6695.28 a

Means with the same letters do not differ significantly according to the LSD test at $P \leq 0.05$

Table (3) presents the effect of ascorbic acid concentration on the studied traits. The data indicate that ascorbic acid concentration had a significant impact on the percentage of broken grains, broken grain weight, and net grain yield. Spraying with ascorbic acid at a concentration of 200 $mg.L^{-1}$ resulted in the highest values for broken grain percentage (2.587%) and broken grain weight (180.09 $kg.ha^{-1}$). This treatment also produced the highest net grain yield at 6790.96 $kg.ha^{-1}$. These results may be attributed to the role of ascorbic acid in stimulating biological processes, particularly nutrient absorption by the plant (Hussein *et al.,*, 2011), as well as promoting the development and dry weight of shoot and root systems (Atta Ullah *et al.,*, 2016). Additionally, ascorbic acid activates several enzymes (Tedone, 2004), preserves chlorophyll, enhances photosynthesis rates, and facilitates the translocation of dry matter to the grain (Shahnawas *et al.*, 2017). These physiological effects underline the contribution of ascorbic acid to improving corn grain yield.These findings are consistent with those of Darvishan *et al.,* (2013), who reported that foliar application of ascorbic acid significantly increased corn yield due to its vital physiological roles. The observed increase in grain yield following ascorbic acid treatment may also be associated with the higher values of broken grain percentage and weight compared to the control. This could be explained by the increased yield and rapid accumulation of dry matter, which tends to raise loss values, especially when harvesting is performed early.

In contrast, traits such as grain moisture content, loss due to unthreshed grains remaining in the cobs, total grain loss percentage, and total lost grain weight were not significantly affected by ascorbic acid concentration.

Table 3: Effect of ascorbic acid concentrations on yield traits and post-harvest yield loss of corn.

Con. mg l^{-1}	**%Moisture**	**%Remaining grain.ear^{-1}**	**Grain weight. (gm)**	**%Broken grain**	**Broken grain weight (kg.h^{-1})**	**%Total loss**	**Total weight loss kg.h^{-1}**	**Net grain yield kg.h^{-1}**
0	23.33 a	2.200 a	149.66 a	2.377 ab	157.70 b	4.564 a	309.17 a	6557.17 a
100	23.05 a	2.064 a	140.36 a	2.217 b	153.18 b	4.280 a	293.17 a	6731.75 a
200	22.39 a	1.761 a	121.56 a	2.587 a	180.00 a	4.348 a	293.54 a	6790.96 a

Means with the same letters do not differ significantly according to the LSD test at $P \leq 0.05$

Table (4) shows that the timing of harvest had a significant effect on the studied traits. Moisture content decreased markedly from 31.40% to 16.27% when the harvest date was delayed from 30 to 50 days after pollination, a reduction of more than 15%. Delaying harvest increased grain loss due to shelling. The percentage and weight of grains remaining in the cob were higher when harvested earlier, reaching 3.4085%, 2.0922%, and 0.5248%, and 222.27, 149.33, and 39.98 kg.ha^{-1} at 30, 40, and 50 days after pollination, respectively.

Furthermore, the percentage and weight of broken grains, total loss percentage, and total grain weight lost during shelling all increased with delayed harvest. The broken grain loss rose from 0.7719% to 3.563%, while its weight increased from 54.23 to 232.94 kg.ha^{-1}. The total grain loss percentage and its weight increased from 1.301% to 6.972%, and from 94.21 to 457.02 kg.ha^{-1}, respectively, when the harvest was delayed from 30 to 50 days after pollination. Additionally, net grain yield decreased from 7203.93 to 6080.55 kg.ha^{-1} as the harvest date shifted from 50 to 30 days after pollination.

These results are consistent with those of Patel and Varshney (2014), who reported that higher moisture content leads to increased yield losses, potentially exceeding 11%. Mets (2006) suggested that the optimal harvest time for corn is when grain moisture content falls below 20%. Similarly, Siddique and Wright (2003) and Samara *et al.,* (2005) found that early harvesting results in higher grain moisture content, lower grain weight, reduced yield, and increased grain breakage during harvest and shelling. These findings also align with Vera *et al.,* (2006), who concluded that early harvest reduces yield due to incomplete dry matter accumulation in the grains.

Table 4: Effect of harvest date on yield traits and post-harvest yield loss of corn.

Days after pollination	**%Moisture**	**%Remaining grain.ear^{-1}**	**Grain weight. ear^{-1} (gm)**	**%Broken grain**	**Broken grain weight (kg.h^{-1})**	**%Total loss**	**Total weight loss kg.h^{-1}**	**Net grain yield kg.h^{-1}**
30	31.40 a	3.4085 a	222.27 a	3.563 a	222.27 a	6.972 a	457.02 a	6080.55 c
40	22.10 b	2.0922 b	149.33 b	2.846 b	149.33 b	4.920 b	353.19 b	6795.40 b
50	16.27 c	0.5248 c	39.98 a	0.7719 c	54.23 c	1.301 c	94.21 c	7203.93 a

Means with the same letters do not differ significantly according to the LSD test at $P \leq 0.05$

Table (5) shows the effect of the interaction between the studied varieties and the levels of ascorbic acid concentration on the examined traits. According to Duncan's test, there were significant differences in the interaction values for the percentage of broken grains, broken grain weight, and net grain yield.The interaction treatment of Baghdad × 200 mg.L⁻¹ showed superiority in terms of broken grain percentage and weight, recording the highest values of 2.854% and 200.92 kg.ha⁻¹, respectively. In contrast, the lowest values were observed in the Sara × 100 mg.L⁻¹ interaction, with 2.044% broken grains and 139.63 kg.ha⁻¹ broken grain weight. These results indicate that the interaction between variety and ascorbic acid concentration significantly influenced the traits of broken grain percentage, broken grain weight, and net grain yield, suggesting differential varietal responses to ascorbic acid levels. This variation in response contributed to the significant effects observed as confirmed by Duncan's test. For the other traits, however, the two factors, variety and ascorbic acid concentration, exhibited similar behavior, and there were no significant interaction effects, indicating a uniform response among varieties to ascorbic acid levels in those traits.

Table 5: Effect of interaction between varieties × ascorbic acid concentration on the studied traits

Varieties	Concentration (mg l^{-1})	Traits							
		%Moisture	%Remaining grain.ear^{-1}	Grain weight. ear^{-1} (gm)	%Broken grain	Broken grain weight (kg.h^{-1})	%Total loss	Total weight loss kg.h^{-1}	Net grain yield kg.h^{-1}
Baghdad	0	24.58 a	2.0222 a	146.62 a	2.252 ab	147.81 b	4.219 a	299.88 a	6683.5 abc
	100	23.14 a	2.3079 a	157.79 a	2.326 ab	161.64 ab	4.633 a	319.43 a	6738.0 abc
	200	23.17 a	1.5100 a	103.73 a	2.854 a	200.92 a	4.364 a	304.81 a	6794.2 ab
Sarah	0	23.19 a	2.2567 a	151.01 a	2.480 ab	164.62 ab	4.751 a	315.63 a	6472.2 c
	100	23.91 a	1.8411 a	123.01 a	2.044 b	139.63 b	4.885 a	262.64 a	6708.9 abc
	200	22.83 a	1.8900 a	130.07 a	2.533 ab	173.75 ab	4.432 a	303.82 a	6757.1 abc
Fajir	0	22.21 a	2.3220 a	151.34 a	2.400 ab	160.67 b	4.722 a	312.01 a	6515.0 abc
	100	22.10 a	2.0422 a	140.28 a	2.280 ab	158.27 ab	4.322 a	298.56 a	6748.3 abc
	200	24.15 a	1.8844 a	130.89 a	2.373 ab	165.60 ab	4.258 a	296.49 a	6821.6 a

Means with the same letters do not differ significantly according to the LSD test at $P \leq 0.05$

The interaction between varieties and harvest date had a significant effect on the percentage of total grain loss. The highest value was recorded in the Fajir × 30 days after pollination treatment, which reached 7.215%. However, there was no significant difference between this interaction and those of the Baghdad and Sara varieties when harvested at the same date (30 days after pollination). This indicates that all three varieties exhibited similarly high grain losses when harvested early, highlighting the impact of early harvest timing on increasing total grain loss, regardless of varietal differences. Table (6) illustrates the significant effects of the interaction between varieties and harvest date on several studied traits. The highest moisture content (32.24%) was observed in the Baghdad × 30 days after pollination treatment. The Sara × 30 days after pollination interaction recorded the highest percentage of broken grains (3.07%) and their corresponding weight (238.48 kg.ha⁻¹). For traits related to the percentage of grains remaining in the ear, their weight, and total grain loss weight, the Fajir × 30 days after pollination interaction showed superiority, with values of 3.66%, 236.47 kg.ha⁻¹, and 468.87 kg·ha⁻¹, respectively. In terms of net grain yield, the highest value (7254.1 kg·ha⁻¹) was recorded in the Baghdad × 50 days after pollination treatment, while the lowest yield (6032.2 kg.ha⁻¹) was observed in the Sara × 30 days after pollination interaction. The significance of the Duncan test for these traits confirms that the interaction between variety and harvest date had a differential impact, indicating that the varieties responded differently to changes in harvest timing across the evaluated traits.

Table 6: Effect of interaction between varieties × harvest date on the studied traits

Varieties	Harvest date (days after pollination)	Traits							
		%Moisture	%Remaining grain.ear^{-1}	Grain weight. ear^{-1} (gm)	%Broken grain	Broken grain weight (kg.h^{-1})	%Total loss	Total weight loss kg.h^{-1}	Net grain yield kg.h^{-1}
Baghdad	30	32.24 a	3.066 a	201.83 ab	3.435 ab	227.94 a	6.502 a	435.21 a	6160.9 d
	40	22.27 b	2.103 b	150.31 b	2.980 bc	214.31 b	5.027 b	364.79 b	6800.7 bc
	50	16.39 c	0.670 c	56.01 d	1.017 d	68.11 b	1.686 c	124.12 c	7254.1 a
Sarah	30	31.43 a	3.499 a	228.51 a	3.700 a	238.48 a	7.199 a	466.99 a	6032.2 d
	40	22.31 b	1.921 b	136.25 c	2.669 c	18964 a	4.591 b	325.89 b	6781.0 c
	50	16.19 c	0.567 c	39.33 d	0.689 d	49.89 b	1.270 c	89.22 c	7125.0 ab
Fajir	30	30.52 a	3.660 a	236.47 a	3.555 ab	232.40 a	7.215 a	468.87 a	6048.6 d
	40	21.71 b	2.252 b	161.45 bc	2.889 bc	207.45 a	5.141 b	368.90 b	6804.6 bc
	50	16.23 c	0.336 c	24.60 d	0.609 d	44.69 b	0.945 c	69.29 c	7232.7 a

Means with the same letters do not differ significantly according to the LSD test at P ≤ 0.05

Table (7) shows that the interaction between ascorbic acid concentration and harvest date had a significant effect on several studied traits, as confirmed by Duncan's test. The treatment 100 mg.L⁻¹ × 30 days after pollination recorded the highest values for grain moisture content (31.57%), percentage of grains remaining in the cob (3.609%), and their weight (235.5 kg.ha⁻¹). The interaction 0 mg.L⁻¹ (control) × 30 days after pollination resulted in the highest values for broken grain percentage (3.777%), broken grain weight (243.2 kg.ha⁻¹), total grain loss percentage (7.188%), and total grain loss weight (474.5 kg.ha⁻¹). However, this same interaction recorded the lowest net grain yield, reaching only 5939.3 kg.ha⁻¹. These findings indicate that harvest date had a more pronounced effect than ascorbic acid concentration on traits such as moisture content, percentage and weight of grains remaining in the cob, and total grain loss percentage and weight. This explains the significant interaction effect for these traits. On the other hand, the significant influence of ascorbic acid concentration on broken grain percentage, broken grain weight, and net grain yield shows that both factors, ascorbic acid level and harvest timing, exerted distinct and varying effects depending on the trait, with differences in the degree of plant response.

Table 7: Effect of interaction between ascorbic acid concentration × harvest date on the studied traits

Concentration (mg l^{-1})	Harvest date (days after pollination)	Traits							
		%Moisture	%Remaining grain.ear^{-1}	Grain weight. ear^{-1} (gm)	%Broken grain	Broken grain weight (kg.h^{-1})	%Total loss	Total weight loss kg.h^{-1}	Net grain yield kg.h^{-1}
0	30	31.56 a	3.541 a	2258 a	3.777 a	243.2 a	7.318 a	474.5 a	5439.3 d
	40	22.06 b	2.411 b	168.7 bc	2.650 b	186.1 b	5.007 b	354.8 b	6650.9 c
	50	16.35 c	0.649 c	54.4 d	0.705 c	43.7 c	1.368 c	98.17 c	7081.3 ab
100	30	31.57 a	3.609 a	235.5 a	3.347 a	221.0 ab	6.956 a	458.5 a	6132.4 d
	40	21.45 b	2.042 b	146.6 c	2.622 b	188.8 b	4.664 b	335.4 b	6851.9 bc
	50	16.12 c	0.540 c	36.9 d	0.631 c	49.7 c	1.220 c	86.61 c	7210.9 a
200	30	31.05 a	3.075 b	203.4 ab	3.566 a	234.5 ab	6.642 a	437.9 a	6169.9 d
	40	22.78 b	1.823 b	132.6 c	3.265 ab	236.5 ab	5.089 b	369.28 b	6883.4 bc
	50	16.33 c	0.385 c	28.6 d	0.929 c	69.2 c	1.314 c	97.86 c	7319.6 a

Means with the same letters do not differ significantly according to the LSD test at $P \leq 0.05$

CONCLUSION

The main conclusion of this study was the superiority of the Baghdad variety in terms of performance under different ascorbic acid concentrations and varying harvest dates. Ascorbic acid had a positive effect on improving grain yield and reducing yield losses, particularly when corn was harvested early. However, early harvesting led to increased grain moisture, higher percentages of broken grains, and greater overall yield loss. Therefore, optimizing both ascorbic acid application and harvest timing is crucial for maximizing corn yield and minimizing post-harvest losses.

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