Effect of storage period on the productivity of several varieties of *Zea mays* L.

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Abstract

The effect of storage period on maize cultivars of Maha (MA), Sarah (SA) and Fajr (FA), were tested during growth at four storage period of one year (1Y), two years (2Y), three years (3Y) and four years (4Y). The results showed that the MA maize cultivar was significantly better than the other two varieties, SA and FA. Leaf area 499.0cm^2, ear length 17.87 cm, stem diameter 25.221mm, 500 grains weight 130.28 g, total seed yield 5.846 t.ha^{-1}and biological yield14.798t.ha^{-1} . The 1Y storage period also significantly outperformed the other storage years 2Y,3Y and 4Y, in all the characteristics covered by this study.

Keywords: Maize (*Zea mays L.*), cultivars, storage periods, growth properties and grain yield of maize crop .

Introduction

Yellow maize *(Zea mays.L)*, productivity depends on the stored seeds quality in terms of genetic and physical composition resulting from storage processes after harvesting to increase seed quality through treatment and storage conditions. (Tsedeke et al.,2015), Its one of the most important strategic and economic crops because the third most important cereal crop after wheat and rice in terms of cultivated area and production in the world (Arief et al, 2018). maize storage factors require suitable climatic conditions to ensure the germination process success and achieve the highest final production rates. Many implementer communicate that a complete style of forfeit in viability in grains quality is broadly subordinate on long storage time, and it could be understand on the ground of grains wet and heat, relative wet, storage heat and concluded that adoption of length of storage, type of grain and grain type . However storage is a basic exercise in the control of the physiological fineness of the grain and it is a method during which the viability of the grains can be recorded and their force kept at a recorded reasonable level during the time between plantation and harvesting. A few scholars can be conclude (Badawi et al.,2017) (Fufa et al.,2020). The requirements for successful storage under different climatic and environmental conditions are extremely important with limited storage operations and increasing population. Therefore, achieving food security has become a strategic goal that the technological methods adopted in agriculture seek to achieve by improving all agricultural requirements horizontally and vertically, since the grain is the basic element in achieving this goal, it was necessary to benefit from grain storage operations of strategic importance in providing food security. Extending the storage period negatively affects the decrease in germination rates, plumule length, and radical length. This is due to the fact that the long storage period is bad (Amer et al.,2023). Therefore, it has become necessary to store grains in the appropriate manner, which is of great importance to preserve the grain yield to ensure food security when the population increases.

Stored maize seeds have a high survivability and can withstand extreme storage conditions such as high temperatures and humidity.

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However, the seeds quality is controlled by users, whether farmers or industrialists, to obtain high quality seeds to achieve the highest growth and productivity results.(Niamketchi et al.,2016). It is estimated that good quality grains of improved varieties alone can contribute about 20 per cent increase in crop yield keeping all the other inputs constant. grains germination and vigor are important indicators of fineness which are substantially reduced during storage. grains aging and improper storage environment is recognized by some parameters like delay in germination and emergence, slow growth and increasing of susceptibility to environmental stresses in various periods of storage. grains fineness decreases under tall storage conditions due to tall seed storage period. It is the reason of declining in germination characteristics. tall grains storage time is manifested as reduction in germination percentage and those grains that do germinate produce weak seedlings (Birhanu, 2020).

Increasing the corn crops productivity requires a phased achievement for the ideal storage purpose, which is manifested in reducing the losses and damage that occur during the storage process (Mulhanga et al., 2022). Knowing the storage conditions according to the requirements of each crop is extremely important for every strategic agricultural product. Seed deterioration is an inevitable process and studies most conducted are to control the damage caused to stored seeds because seeds are vital inputs in agriculture that determine not only production but also the grain crop final productivity, it is necessary to maintain the seeds quality as well as the seeds strength during the storage stages as the basic means of preserving the seed and its vitality (Gebeeyehn ,2020). Storing process yellow corn crop depends mainly on modern techniques to preserve the stored grains from spoilage (FAO,2014),

Many studies have indicated that the genetic composition of maize varieties significantly affects growth characteristics and the final crop productivity (Khalid et al.,2018), The research results conducted confirmed, Wambugu et al.,(2009); Al Hade (2019), that extending the storage period has a negative effect on the plant's vegetative growth indicators, as a result of the aging process that occurs in seeds during long storage periods, this leads to the destruction of the cell membrane permeability and materials infiltration increased from the cell membrane. The production low problem in Iraq particular is due to the fluctuation of production every year is the varieties lack with high productivity, the investigation and study of possible scientific means that would raise any crop productivity and improve its quality. And the grain crops whose actual production hardly covers more than 30% of the real needs of the population, which makes them imported from exporting countries to cover this huge deficit (Sheteiwy et al.,2013). Objective of the current study focuses on determining the best storage period and variety that give the best results for growth characteristics and yellow corn yield

Material and methods

Experiment location

The research was carried out in Babylon Governorate, it is roughly 100 km south of Baghdad. Iraq (latitude 32.468191 and longitude 44.550193), during the Summer season 2023-24, in a silty clay sand soil, the specifications of which are shown in .Table .1

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Table 1. Soil physical and chemical characteristics

Depth	**Texture %**			
0-25 (cm)	**Clay**	**Silt**	**Sand**	
	480	305	215	Silt Clay loam
	Soil physical properties			
	Pb (Mg m^{-3})	**TSP (%)**	**SPR (Kpa)**	
	1.31	50.56	1506.22	field capacity %
	1.34	49.43	1611.86	34.22
	139	47.54	1722.50	31.67
VA	1.35	49.05	1613.52	
0-25	**Soil chemical properties**			
	E.C (ds\cm^{3})	**HP**	True Density (Mg.m-3)	
	2.44	7.01	2.65	
	Soluble cation meq\I			
	Na	**K**	**Ca+Mg**	
	8.33	12.45	56.34	
	O.C (%)	CEC Meq\100 g)	CaCo3 (%)	O.M (%)
	0.55	32.81	4	0.64

Soil preparing for agriculture -The MF- 285s tractor and the moldboard plow machine were used, tillage machine works to penetrate the soil to a depth of 25 cm. The field is then divided into several experimental plots with 24 experimental units, with dimensions 3x3.5m2, leaving gaps of 75 cm between the experimental units, 1m between the sectors. Used a locally designed fertilization machine to add triple phosphate fertilizer at a rate of 100 kg. ha^{-1} all at once and to a depth of 8cm before implantation, was planted manually at a rate of three seeds in each hole, with a distance of 20 cm between each hole and on rows at a distance of 75 cm between each row, after that, the field was watered to germinate the seeds, after that, the field was monitored to carry out crop service operations represented by weeding and thinning operations at a rate of one plant per hole.

The experiment include two factors:

The first factor maize varieties which include; Maha (MA), Sarah (SA) and Fajr (FA)

The second factor is the duration of seed storage: one year (1Y), two years (2Y), three years (3Y) and four years (4Y).

Characteristics studied

Ear length

It was measured by a metal ruler.. (Alsharifi et al.,2021)

Stem diameter

Measured from the area between the second and third nodes after removing the leaf sheath.(Shtewy et al.,202a; Alaamer etal.,2022)

Leaf area

It was calculated according to the method approved by (Shtewy et al.,2020b)

Yield characteristics

500Seeds weight

The threshing seeds of 1000 seeds were taken using the SATAK device and weighed using a

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sensitive electronic balance (Basso, and .Ritchie. 2018).

Grain yield

Was estimated by harvesting ten randomly selected plants for each experimental unit, then weighing them using a sensitive balance and converting the weight to tons.ha^{-1} (Makale et al.,2020; Singh et al.,2015).

Biological yield

It is calculated by harvesting one square meter for each experimental unit, with three randomly selected replicates. Then it was weighed using a sensitive balance and the weight was converted into tons.ha^{-1}.(Ghali et al.,2020).

The Genstat statistical program was used to analyze the data according to the complete randomized block design (RCBD), the differences between the means were tested statistically using the L.S.D=0.05 test to compare the means.

Results and Discussion

Vegetative growth characteristics

The statistical analysis results indicated that the maize cultivars differed significantly in the vegetative growth characteristics. MA cultivar achieved a significant superiority by recording the highest average leaf area of 499.0cm2, followed by the FA cultivar with an average of 484.2 cm^2, while the SA cultivar achieved the lowest average for this trait of 476.7 cm^2,. From Table. 2. As for the ear length and stem diameter, the MA maize cultivar outperformed with a significant increase of 17.87cm and 25.221mm, followed by the SA cultivar, which achieved an average of 17.09cm and 24.060mm, while the FA maize cultivar recorded the lowest average for the ear length and stem diameter, reaching 16.81cmand24.616mm. This helps to absorb a greater amount of effective light energy in the photosynthesis process when the stem diameter increases and in the presence of a suitable leaf architecture. This can lead to an increase in the rate of carbon fixation and the dry matter manufacture if the light efficiency increases with the increase in the stem diameter and leaf area, and this is positively reflected in the plant growth improvement, (Badawi et al.,2017). Storage periods also differed significantly in the vegetative growth characteristics, the 1Y storage period treatment achieved the highest average of 535.0cm^2, 18.23cm and 27.075mm, respectively, compared to other storage periods. The 4Y storage period treatment gave the lowest average for this trait, reaching 436.6cm^2, 15.67 cm and 22.440mm, respectively. This increase is due to the positive effect of the one-year storage period in obtaining the best light energy resulting from plant photosynthesis for the stem diameter and leaf area, which is reflected positively on improving the plant growth characteristics (Amer et al.,2023). The interaction was significant for this trait, the interaction of the MA maize cultivar with the storage period for the 1Y achieved the highest values of 557.7cm2, 19.87cm and 28.203mm compared to other interactions. The vegetative growth characteristics is shown in Figure 1 at different conditions for storage periods and maize cultivars.

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Table.2. Effect of storage periods on vegetative growth characteristics for some maize cultivars.

Cultivars	Storage periods	LA	EL	SD
SA	1 Y	513.3	18.17	26.363
	2 Y	500.0	17.83	25.287
	3 Y	450.3	16.80	22.817
	4 Y	443.0	15.57	21.775
FJ	1 Y	534.0	16.67	26.660
	2 Y	509.0	17.83	25.250
	3 Y	461.0	17.10	23.667
	4 Y	432.7	15.63	22.890
MA	1 Y	557.7	19.87	28.203
	2 Y	550.7	18.30	26.013
	3 Y	453.7	17.50	24.014
	4 Y	434.0	15.80	22.657
C	SA	476.7	17.09	24.060
	FJ	484.2	16.81	24.616
	MA	499.0	17.87	25.221
SP	1 Y	535.0	18.23	27.075
	2 Y	519.9	17.99	25.516
	3 Y	455.0	17.13	23.499
	4 Y	436.6	15.67	22.440
LSD=0.05	C	14.59	0.959	0.741
	SP	16.85	1.108	0.856
	C*SP	29.18	1.919	1.482

Maize cultivar Sarah ;SA,maize cultivar Fajr ;FA, maize cultivar Maha;MA, one year; 1Y, two years; 2Y, three years; 3Y, four years;4Y, leaf area; LA, ear length;EL, stem diameter; SD .

Yield characteristics

Table results .3, showed that the corn varieties differed significantly in the yield characteristics. The MA cultivar outperformed by achieving the highest averages for this characteristic, reaching , 130.28g, 5.846 t.ha^{-1}and 14.798 t.ha^{-1}, compared to the results obtained from the other study cultivars, SA and FA. These differences are caused by the genetic characteristics of the corn variety, including the nutrients it contains in the seeds, which leads to an increase in the seeds weight, stimulating the cells growth and tissues in the seeds, thus forming larger seeds, which is reflected in a larger yield (Makale et al.,2020). As for the seed storage treatments for different periods, the 1Y storage treatment achieved a significant increase in the yield characteristics with the highest average of 149.88 g and 6.717 t.ha^{-1}and 17.078 t.ha^{-1}, compared to the rest of the storage treatments for this study, which blackball in the 4Y with the lowest average of 9.11 g and 4.009 t.ha^{-1} and 9.636 t.ha^{-1}. The storage process in which all storage conditions are prepared, such as humidity and ventilation, the healthier the seeds will be and the stronger the plants will be produced, which will be positively reflected on the growth characteristics and the total corn yield (Singh et al.,2015). The interaction was significant for this trait, the interaction of the

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MA maize cultivar with the storage period for the 1Y achieved the highest values of 154.67g and 7.122t.ha^{-1}and17.747 t.ha^{-1}, compared to other interactions. The yield characteristics is shown in Figure 2 at different conditions for storage periods and maize cultivars.

Table.3. Effect of storage periods yield characteristics for some maize cultivars.

Cultivars	Storage periods	500SW	TGY	BY
SA	1 Y	145.33	6.733	17.022
	2 Y	139.33	6.067	16.233
	3 Y	111.67	4.833	13.031
	4 Y	95.00	4.099	9.754
FJ	1 Y	150.00	6.297	16.467
	2 Y	140.67	6.033	15.920
	3 Y	121.33	5.013	12.448
	4 Y	99.00	3.788	9.134
MA	1 Y	154.67	7.122	17.747
	2 Y	147.67	6.690	17.228
	3 Y	126.00	5.432	14.200
	4 Y	103.33	4.140	10.020
C	SA	122.83	5.433	14.010
	FJ	127.75	5.282	13.492
	MA	130.28	5.846	14.798
SP	1 Y	149.88	6.717	17.078
	2 Y	142.55	6.263	16.460
	3 Y	119.67	5.092	13.226
	4 Y	9.11	4.009	9.636
LSD=0.05	C	4.145	0.383	0.412
	SP	4.786	0.244	0.475
	C*SP	8.290	0.469	0.824

500 seeds weight; 500SW, total grain yield; TGY, biological yield; BY.

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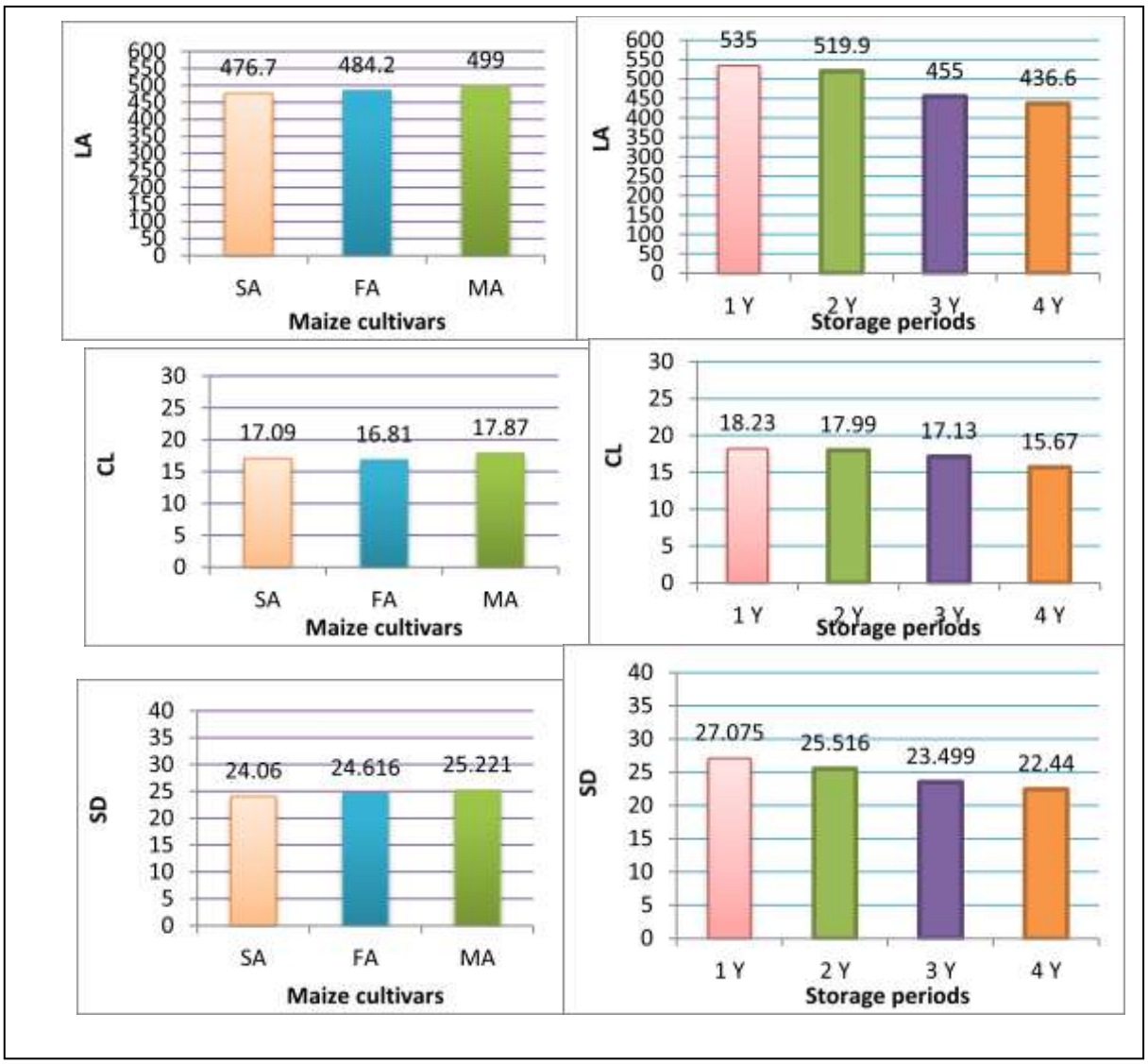

Fig. 1. Effect of storage periods and maize cultivars on vegetative growth characteristics

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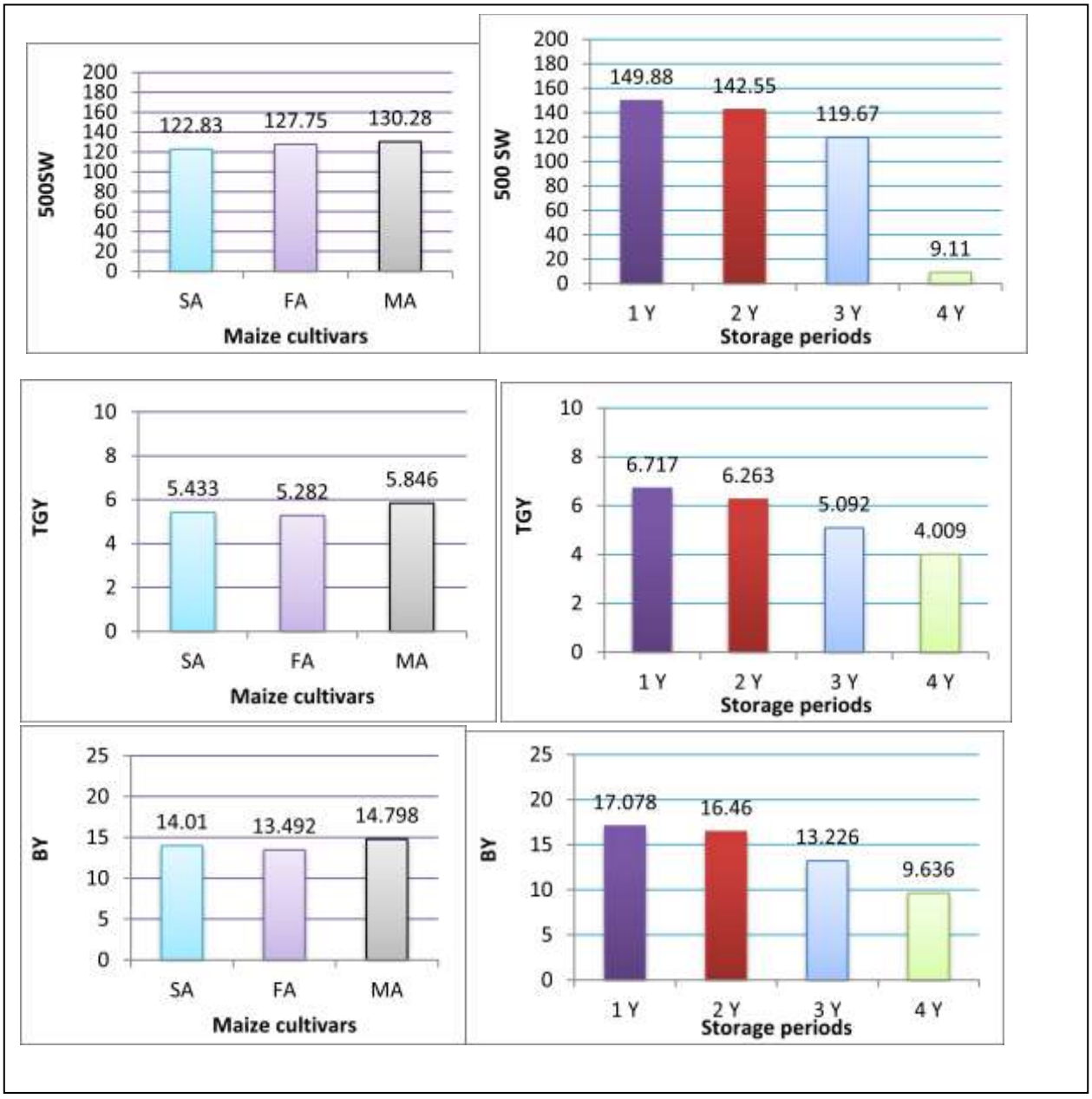

Fig. 2. Effect of storage periods and maize cultivars on yield characteristics

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Discussion

The MA cultivar is significantly better than SA and FA cultivars in all studied conditions. The one year was significantly superior to the other three storage period of tow years, three years and four years. The results showed better conditions for the overlap between the 1Y and, MA,SA and FA cultivars. The best result was obtained by MA cultivar at 1Y.

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