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Effect of Planting Dates and Nitrogen Fertilization Levels on Quality and Chemical Properties of Some Hybrids Yellow Maze (*Zea Mays* L.)

Ali Skor Essa*; Maha M. Abdalla and Ameen H. Bassiouny****

* Desert Research Center – Cairo University of Agriculture Egyptian, Egypt

** Faculty of Technology and Development, Plant Production Department - Zagazig University, Egypt

Corresponding author: Ali Skor Essa

a.shokr25@iars.zu.edu.eg, dr_maham.abdalla@yahoo.com, aminh@zu.edu.eg

ABSTRACT

The field trial was contacted at an extention field at Shiba-Elnakaria, Rejon, Zagazig (Sharkia Governorate), during two seasons of 2023 and 2024 to study the effect of planting dates (1st May, 15th May and 30th May), nitrogen levels zero (70, 100 and 130 kg N/fed) on quality and chemical of some yellow maize hybrids (176, 168 and payoneer 444).

The results showed that planting dates caused a significantly different in studied characters, i.e. germination percentage, good seedling%, poor seedling%, abnormal seedling %, root length (cm), shoot length (cm), carotene % and oil percentage. Since, May 1st date appeared higher than any other plantin dates in most studied characters.

Also, the results indicated that the tested yellow maize hybrids differed significantly in studied characters, i.e. viability, vigour and chemical, i.e. germination %, good seedling %, fair seedling %, poor seedling %, abnormal seedling %, root length, shoot length, protein %, carotene % and oil percentage for payoneer 444.

Increasing nitrogen levels from zero, 70, 100 and 130 kg N/fed. significantly increased the studied characters. Generally 130 kg N/fed. gave the highest values, followed by 100, 70 and zero kg N/fed. were gradually lowest in this concern, respectively.

Conclusively, all studied characters 1st May surpassed that 15th May and 30th May, when 130 kg/fed. gave the highest viability, vigour and chemical characters. Payoneer 444 gave the highest values in germination %, good seedling %, root length (cm), shoot length (cm), protein %, carotene % and oil %.

Keywords: Planting dates, yellow maize hybrids, nitrogen levels, germination, carotene, oil.

INTRODUCTION

According to FAO report, world population reached to 7.5 million tons corn (FAO, 2023) in Egypt. Maize is considered the third most important crop in Egypt and the world. Maize (*Zey mays* L.) is one of the most important food, forage staple crops, which has cultural, economic, environmental, and nutritional impact worldwide **(Abdoulaye *et al.*, 2018 and Tanumihardjo *et al.*, 2020)**. It is a major source of feed and industrial products. **Tan and Morrison (1979)** reported that corn grain of maize hybrid normally contains about 4% oil, 9% protein, 73% starch and 14% other constituents.

Seed quality of maize plays an important role in speed of germination, seedling vigour and subsequent growth of maize. The source of variation in seed quality from year to another year is difficult to pin point. Weather, fertilization and other agronomic practices influenced finally seed quality and chemical of maize.

Seed quality is one of the main factors that affect establishment and performance of crops, and it is related to sum of the genetic, physical, physiological and health aspects of seeds to give rise to high-yielding plants

(**Marcos-Filho, 2015)**. Physiological potential is related to the ability of the seed in preforming its vital functions, bringing together information of seed germination and vigor **(Carvalho and Nakagawa, 2012)**.

Many investigators had reported high variability on maize of quality and chemical characters **(El-Abady *et al.,* 2014; Ali *et al.,* 2020; Younis *et al.*, 2021; Ochieng *et al.,* 2021; Gbaraneh and Dumkhana, 2021; Dragičević *et al.,* 2022; Mekonnen *et al.,* 2023).**

Planting dates can play a major role in determining the grain yield, quality and chemical of maize hybrids. Some researchers pointed out that planting dates increased grain yield, quality and chemical content **(Dahmardeh, 2012; Abdrabbo *et al.,* 2013; Hassan, 2018; Hegab *et al.,* 2019; Salama, 2019; Chisanga *et al.,* 2020; Ali *et al.,* 2020 and El-Sabagh *et al.,* 2021)**.

Nitrogen has provide to be the most limiting factor to work agriculture especially in the drier regions. It is easily to be lost from the soil through leaching and cropping. Many areas have been more preferable to use nitrogen fertilizer for increasing grain yield, quality and chemical content of maize hybrids **(Khalil, 2019; Ochieng *et al.,* 2021; Dragičević *et al.,* 2022 and Popa *et al.*, 2025)**.

Many investigators recorded significant differences between maize hybrids in grain yield, quality, chemical and correlation **(El-Abady *et al.*, 2014; Ali *et al.,* 2020; Younis *et al.,* 2021; Dragičević *et al.,* 2022; Mekonnem *et al.,* 2023 and Popa *et al.,* 2025)**.

MATERIALS AND METHODS:

The field experiment was conducted at extension field in Shiba-Elnakaria, Village, Zagazig District (Sharkia Governorate) during growing two seasons of 2023 and 2024 to study the response of some yellow maize hybrids to planting dates and different fertilization systems.

The experiment included 36 treatments, which were the combinations of three planting dates (1st May; 15th May and 30th May), four levels of nitrogen fertilization (Zero, 70, 100 and 130 kg N/fed.) of urea (46% N) in two equal portions after planting and before the second irrigation on the three maize hybrids [168 (S.C.168) – 176 (S.C. 176) and payoneer 444 (S.C. 444)] during planting in two growing seasons.

A split-split plot design with three replicates were used with sub-sub plot area of 10.5 m^2 having 6 ridges in length 0.60 m in width (10.5 x 6 x 0.60).

Maize grains, were sown on (1st May, 15th May and 30th May) in two successful seasons were assigned to main plots, the sub-plots for three hybrids (168-176 and payoneer 444) and sub-sub-plots included four levels of nitrogen fertilizer (zero, 70, 100 and 130 kg N/fed.).

At harvest time, after 110 days from sowing, five guarded plants were randomly taken to determine the following yield, quality and chemical characters.

Viability and vigour measurements of harvesting:

Maize grain was estimated. Germinability was determined using of 25 grains each (total of 400 grain) for each variety tested. Then, three replications (100 grain each) were used to evaluate every grain test done on each treatment.

Seven days after planting, the seedling were evaluated and classified according to AOSA procedures (1981) as normal (good, fair and poor) or abnormal, dead seedling and dead grains.

Seedling measurements, i.e. shoot length (cm), root length (cm) and seedling weight (gm) **(AOSA, 1981)**.

Chemical analysis:

Oil%, was determined using Soxhelt method according to **A.O.A.C. (1980)**.

Protein content was determined using Kjelddahl method. Crude protein percentage was calculated by multiplying the total nitrogen by a factor of 6.25 according to **Nelson and Sommers (1973)**.

Total carbohydrates % was determined using phenol-sulfuric acid method. Method according to **Dubors *et al.* (1956);** carotine % was estimated according to **Rivera and Ramon (2012)** and Moisture % was estimated according to **Rowell (1994)**.

Seed viability and vigour were determined using 16 groups of 25 seed each (total of 400 seed for each treatment tested). Then, four replications of 100 seed each (4 groups) were used to evaluate every seed test done on each treatment investigated

The objectives of this study were to reach the influence of planting dates and N-fertilization on chemical and quality for three yellow maize hybrids under Sharkia Governorate conditions.

Statistical analysis:

The proper statistical analysis of split-split design using combined analysis was performed for the characters recorded in the two growing seasons.

Differences among treatments were Judged according to **Snedecore and Cochran (1982)**. Further, the correlation coefficients among all possible combinations of characters were calculated using the method descried by the Program of SPSS (2020). Statistical analysis was done by using the COSTAT system for windows, version 6:311 (Cohort Software, Berkeley, CA, USA, 2005).

RESULTS AND DISCUSSION:

A. Seed viability and vigour:

Data illustrated in Tables (1 and 2) show the influence of sowing dates, hybrids and nitrogen application on seed viability and vigour properties of maize hybrid.

1. Effect of sowing dates:

Concerning the combined data, sowing dates appeared high significantly affected in most of seed viability and vigour evaluated, where the early sowing of May 1st tended to that higher germination percentage, good seedling %, and abnormal seedling %, also, longest root length (cm) and shoot length (cm) and the most dense seeds, followed by the second sowing date of May 15th. Hence, the lowest averages were achieved by later sowing of May 30th. However, significant differences were observed between first and second sowing date regarding to poor seedling results. Generally, most of seed viability and vigour of maize hybrid appeared to be reduced with delaying of sowing. So, it could be concluded that sowing of maize hybrid early under such conditions could be greatly improve seed viability and physical properties and produce higher and longer seeds. **Mahmud A.A. Rahuma (2018), Călugăr *et al.* (2024), Popa *et al.* (2025),** came to the same conclusion. However, **Hegab *et al.* (2019)**, reported that later sowing tended to produce higher sound mature seeds which associated with temperature differences and photoperiodic effects during seed development. Such variant responses could be explained in terms of locations and environmental factors functions.

2. Influence of maize hybrids:

In both seasons and combined data in Tables (1 and 2) that the maize hybrids differed highly significant and significant in germination %, good seedling %, root length (cm) and shoot length (cm) when S.C. P444 was highest values followed by S.C.168 and S.C.176, while, S.C.P444 hybrid obtained the lowest values good seedling % and abnormal seedling %. Such results indicated that seed viability and vigour of maize hybrid was strongly influenced by genetical combination of maize hybrids. Similar trends were reported by **El-Abady *et al.* (2014), Mahmud A.A. Rahuma (2018)** and **Mekonnen *et al.* (2023)**.

3- Nitrogen levels effect:

Nitrogen fertilization had a significant effect on viability and vigour on germination %, good seedling %, fair seedling %, root length and shoot length (cm). In general 130 kgN/fed. have the highest values of germination %, good seedling %, root length (cm) and shoot length (cm), followed by 100 kgN/fed and 70 kgN/fed. while, zero kgN/fed. was the lowest in this respect regarding the two seasons and combined data. As shown in the combined data, the relative increase in germination % was 1.483%, 2.006% and 4.002%; good seedling % was 23.693, 34.450 and 52.388, root length (cm) was 7.955 (cm), 13.849 (cm) and 20.810 (cm) as well as it was 8.666 (cm), 23.489 (cm) and 37.970 (cm) for shoot lengthy to increasing N level from zero to 70, 100 and 130 kgN/fed, respectively. These results are in agreement with those obtained by **Chissanga *et al.* (2020), Ochieng *et al.* (2021)** and **Dragičević *et al.* (2022).**

Table 1: Germination (%), good seedlings (%), fair seedling (%) and poor seedlings (%) as influenced by planting dates and N-fertilization on some hybrids yellow maize in seasons and the combined.

Main effects and interactions	Germination (%)			Good seedling (%)			Fair seedling (%)			Poor seedlings (%)		
	First season 2023	Second season 2024	Comb.	First season 2023	Second season 2024	Comb.	First season 2023	Second season 2024	Comb.	First season 2023	Second season 2024	Comb.
Sowing date:												
May 1 (D_1)	94.69^{a}	93.91^{a}	94.3^{a}	68.05^{a}	60.69^{a}	64.37^{a}	10.49	25.23^{a}	17.87	15.6^{a}	7.97^{a}	11.78^{a}
May 15 (D_2)	94.11^{b}	90.69^{b}	92.4^{b}	62.25^{b}	58.69^{b}	60.47^{b}	17.77	21.54^{a}	19.65	14.76	10.22^{a}	12.49^{a}
May 30 (D_3)	80.30^{b}	86.02^{c}	87.16^{c}	59.13^{c}	56.00^{c}	57.56^{c}	19.9	19.53^{b}	19.72	9.86^{b}	10.22^{b}	10.04^{b}
F-test	*	**	**	**	**	**	NS	*	NS	*	*	*
Maize hybrid:												
S.C. 176 (H_1)	88.86^{c}	84.75^{c}	86.80^{c}	57.24^{c}	56.50^{a}	56.87^{b}	17.41^{c}	17.27^{a}	17.34^{b}	12.06^{a}	12.58^{a}	12.32^{a}
S.C. 168 (H_2)	93.86^{b}	91.05^{b}	92.45^{b}	62.22^{b}	58.05^{b}	60.14^{c}	22.27^{b}	22.29^{b}	22.28^{a}	9.28^{b}	10.36^{b}	9.82^{b}
S.C. P444 (H_3)	95.77^{a}	94.83^{a}	95.2^{a}	68.00^{a}	63.41^{c}	65.70^{a}	16.80^{a}	17.11^{c}	16.95^{c}	13.59^{c}	11.52^{c}	12.55^{c}
F-test	**	**	**	**	**	*	**	**	**	**	**	**
N-fertilization:												
0 kg N/fed. (N_0)	90.88^{c}	88.55^{c}	89.71^{c}	35.59^{b}	35.99^{d}	35.79^{c}	12.58^{c}	12.98^{b}	12.78^{b}	11.11^{b}	12.11^{a}	11.61^{a}
70 kg N/fed. (N_1)	92.46^{b}	89.62^{b}	91.04^{b}	42.23^{b}	46.32^{c}	44.27^{c}	13.00^{b}	13.88^{b}	13.44^{b}	7.61^{b}	7.34^{a}	7.47^{b}
100 kg N/fed.(N_2)	90.17^{b}	90.17^{b}	91.51^{b}	47.00^{b}	49.24^{b}	48.12^{b}	14.62^{a}	14.65^{c}	14.63^{c}	7.46^{a}	7.27^{b}	7.36^{a}
130 kg N/fed.(N_3)	92.49^{a}	92.49^{a}	93.3^{a}	54.33^{a}	54.76^{a}	54.54^{a}	16.00^{a}	16.53^{a}	16.26^{a}	7.49^{a}	7.59^{c}	7.57^{c}
F-test	*	*	*	*	**	*	*	*	*	*	*	*
Interactions:												
D x H	*	**	**	**	**	**	NS	*	NS	*	*	*
D x N	**	**	NS	**	**	*	**	**	**	**	**	**
H x N	*	*	NS	*	**	*	*	*	*	*	*	*
D x N x H	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Abnormal seedling (%), root length (cm), and shoot length (cm) as influenced by planting dates and N-fertilization on some hybrids yellow maize in seasons and the combined.

Main effects and interactions	Abnormal seedling (%)			Root length (cm)			Shoot length (cm)		
	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined
Sowing date:									
May 1 (D_1)	3.86^{a}	3.11^{a}	3.38^{a}	16.66^{a}	16.40^{a}	16.53^{a}	11.01^{a}	11.30^{a}	11.18^{a}
May 15 (D_2)	4.22^{b}	5.55^{b}	4.88^{b}	15.93^{b}	15.08^{b}	15.50^{b}	10.07^{b}	10.08^{b}	10.07^{b}
May 30 (D_3)	5.11^{b}	6.25^{c}	5.68^{c}	14.77^{c}	14.66^{c}	14.41^{c}	9.54^{c}	9.78^{c}	9.41^{c}
F-test	*	**	**	**	**	**	**	**	**
Maize hybrid:									
S.C. 176 (H_1)	3.31^{a}	3.20^{a}	3.25^{a}	15.55^{c}	14.92^{c}	15.21^{c}	9.78^{c}	9.34^{c}	9.56^{c}
S.C. 168 (H_2)	4.28^{b}	5.30^{b}	4.79^{b}	15.74^{b}	15.28^{b}	15.51^{b}	10.26^{b}	9.57^{b}	9.91^{b}

S.C. P444 (H_3)	3.61^c	5.43^c	4.52^c	16.07^a	15.94^a	15.97^a	10.29^a	9.88^a	10.08^a
F-test	**	**	**	**	**	**	**	**	**
N-fertilization:									
0 kg N/fed. (N_0)	4.92^a	4.62^a	4.77^a	14.41^d	13.76^d	14.08^d	8.68^d	8.87^d	8.77^d
70 kg N/fed. (N_1)	3.29^b	2.64^b	2.96^b	15.52^c	147.89^c	15.20^c	9.29^c	9.78^c	9.53^c
100 kg N/fed.(N_2)	3.10^c	2.64^b	2.96^b	16.21^b	15.85^b	16.03^b	10.78^b	10.88^b	10.83^b
130 kg N/fed.(N_3)	2.81^b	2.71^c	2.76^c	17.00^a	17.02^a	17.01^a	12.10^a	12.01^a	12.10^a
F-test	*	*	*	**	**	**	**	**	**
Interactions:									
D x H	*	**	**	*	*	**	*	**	**
D x N	**	**	**	**	**	**	**	**	**
H x N	*	*	*	**	**	**	**	**	**
D x N x H	NS	NS	NS	NS	NS	NS	NS	NS	NS

B- Seed chemical contents:

1. Effect of sowing dates:

It is clear from the results in Table (3) revealed that carotene percentage and oil content percentage appeared significantly affected by sowing dates, seeds of early sowing (May 1st) recorded the highest carotene and oil percentage during the two seasons and their combined. While, the lowest carotene percentage and oil content percentage was secured by seeds of the third sowing date (May 30th).

Otherwise, no clear trend and no significant differences could be detected among sowing dates regarding to grain moisture content percentage, protein percentage and carbohydrates percentage.

Generally, the obtained results indicate that early sowing tended to improve chemical properties of maize hybrids. In this concern, **Mahmud A.A. Rahuma (2018), Hegab *et al.* (2019), Elsabagh *et al.* (2021), Dragičević *et al.* (2022)** and **Mekonnen *et al.* (2023)** reported that seed chemical of maize hybrids significantly affect by sowing dates where early sowing tended to produce better chemical properties than later ones.

2. Influence of maize hybrids:

In both seasons and the combined, highly and significant differences among maize hybrids were observed in each of protein percentage carotene percentage and oil content percentage. It is a quite evidence from Table (3) that the S.C.P444 recorded the higher percentage, whereas the S.C.176 was the lower percentage among the test maize hybrids. On the other hand, the S.C.176 had the highest grain moisture content percentage and carbohydrates percentage.

This hybrid had moderate average all protein %, carotene and oil content percentage and had the highest protein %, carotene % and oil % (Table 3). Such criteria could account for the superiority of S.C. P444 among the tested maize hybrids in these properties.

Table 3: Grain moisture content (%), protein (%), carbohydrates (%), Carotene (%) and Oil content % as influenced by sowing dates and N-fertilization on some hybrids yellow maize in the growing seasons and the combined.

Main effects and interactions	Grain moisture content (%)			Protein (%)			Carbohydrates (%)			Carotene (%)			Oil content %		
	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined	First season 2023	Second season 2024	Combined

Sowing date:															
May 1 (D_1)	12.12^{a}	42.03	27.17	12.34	12.35	12.34	74.86^{a}	79.07	76.96	1.66^{a}	1.56^{a}	1.61^{a}	4.35^{a}	4.40^{a}	4.37^{a}
May 15 (D_2)	12.31^{b}	12.37	12.34	12.19	12.18	12.18	73.14^{b}	75.53	74.33	1.27^{b}	1.31^{b}	1.49^{b}	4.32^{b}	4.33^{b}	4.32^{b}
May 30 (D_3)	11.28^{b}	11.36	11.32	12.11	12.17	12.14	73.04^{c}	74.34	73.69	1.07^{c}	1.22^{c}	1.14c	4.28^{c}	4.26^{c}	4.27^{c}
F-test	*	NS	NS	NS	NS	NS	**	NS	NS	**	**	**	**	**	**
Maize hybrid:															
S.C. 176 (H_1)	11.95^{b}	42.31	27.13	10.01^{c}	10.02^{c}	10.01^{c}	71.54	80.66^{a}	76.1	1.11^{c}	1.04^{c}	1.07^{c}	4.26^{b}	4.20^{c}	4.23^{c}
S.C. 168 (H_2)	11.95^{b}	11.76	11.85	12.43^{b}	12.43^{b}	12.43^{b}	74.09	76.42^{b}	75.25	1.35^{b}	1.42^{b}	1.38^{b}	4.29^{b}	4.23^{b}	4.26^{b}
S.C. P444 (H_3)	12.00^{a}	11.68	11.84	14.24^{a}	14.25^{a}	14.24^{a}	75.71	71.86^{c}	73.78	1.53^{a}	1.62^{a}	1.57^{a}	4.35^{a}	4.25^{a}	4.30^{a}
F-test	*	NS	NS	**	**	**	NS	**	NS	**	**	**	*	**	**
N-fertilization:															
0 kg N/fed. (N_0)	11.90^{b}	11.63	11.77	11.50^{d}	11.50^{d}	11.05^{d}	73.09^{d}	74.36^{c}	73.72^{c}	1.25^{d}	1.22^{d}	1.23^{d}	4.18^{d}	4.16^{c}	4.17^{d}
70 kg N/fed. (N_1)	11.90^{b}	11.64	11.81	11.80^{c}	11.94^{c}	11.87^{c}	73.50^{c}	76.20^{b}	74.85^{b}	1.30^{c}	1.34^{c}	1.32^{c}	4.21^{c}	4.23^{b}	4.22^{c}
100 kg N/fed.(N_2)	11.97^{a}	11.71	11.84	12.57^{b}	12.54^{b}	12.55^{b}	73.91^{b}	76.80^{b}	75.36^{b}	1.36^{b}	1.36^{b}	1.36^{b}	4.28^{b}	4.26^{b}	4.27^{b}
130 kg N/fed.(N_3)	12.01^{a}	52.69	32.33	13.03^{a}	12.97^{a}	13.00^{a}	74.62^{a}	77.89^{a}	76.25^{a}	1.42^{a}	1.50^{a}	1.46^{a}	4.29^{a}	4.30^{a}	4.29^{a}
F-test	*	NS	NS	**	**	**	**	**	**	**	**	**	**	*	**
Interactions:															
D x H	*	NS	NS	NS	NS	NS	**	NS	NS	**	**	**	**	**	**
D x N	*	NS	NS	**	**	**	NS	**	NS	**	**	**	**	**	**
H x N	NS	NS	NS	**	**	**	**	**	**	**	**	**	**	**	**
D x N x H	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	**	**	NS	NS	NS

3. Nitrogen level effect:

Regarding the effect of nitrogen fertilization on seed chemical content, the results showed that protein percentage, carbohydrates percentage, carotene percentage and oil content percentage were significantly increased by adding nitrogen. This result are true in both seasons and the combined. The relative increase was about in protein % 7.420, 13.275 and 17.647%; in carbohydrate % was 1.532%, 2.225% and 3.432%; in carotene % was 7.317%, 10.569% and 18.699% and oil content % of 1.199%, 2.342% and 2.8778% due to increasing N levels from zero, 70, 100 and 130 kgN/fed respectively. These results are in agreement with those obtained by **Mahmud A.A. Rahuma (2018), Hegab *et al.* (2019), Elsabagh *et al.* (2021), Dragicevic *et al.* (2022)** and **Mekonnen *et al.* (2023).**

C. The simple correlation coefficient:

Correlation coefficient was computed between all possible combinations of seed quality and chemical traits (Table 4). Highly positive significant correlation coefficients were observed between fair seedling % (0.806**) and good seedling %, abnormal seedling % (0.876**) and root length (0.836**) and good seedling %, shoot length and root length (0.949**) and germination % with protein % (0.786**) and carotene (0.971**). While it was significantly correlated with good seedling and germination % (0.639*) and root length and germination %

(0.708*), root length and fair seedling % (0.646*), shoot length and good seedling % (0.751*), grain moisture and good seedling % (0.728*) and shoot length (0.646*), carbohydrate with good seedling (0.755*) and a shoot length (0.709*) and poor seedling % (0.652*) and (0.694*) and shoot length (0.683*) carotene with good seedling % (0.671*), protein *0.765*), and oil % with good seedling % (0.703*) and root length (0.703*) shoot length (0.675*), and carotene (0.736*). The same results are by recorded **El-Abady *et al.* (2014)**. However, a negative correlations observed between poor seedling with germination %. Also, abnormal seedling with germination %, carotene with abnormal seedling (-0.246) and poor seedling (-0.240) and oil% with poor seedling (-0.053).

Table 4. Correlation coefficients between quality and chemical traits calculated from combined data

Items	Germination (%)	Good seedling (%)	Fair seedling (%)	Poor seedlings (%)	Abnormal seedling (%)	Root length (cm)	Shoot length (cm)	Grain moisture content (%)	Protein (%)	Carbohydrates (%)	Carotene (%)	Oil content %
1- Germination (%)	1											
2- Good seedling (%)	0.639*	1										
3- Fair seedling (%)	0.567	0.806**	1									
4- Poor seedlings (%)	-0.278	0.289	0.609	1								
5- Abnormal seedling (%)	-0.281	0.344	0.511	0.876**	1							
6- Root length (cm)	0.708*	0.836**	0.646*	0.072	-0.058	1						
7- Shoot length (cm)	0.570	0.751*	0.535	0.057	-0.090	0.949**	1					
8- Grain moisture content (%)	0.111	0.728*	0.513	0.454	0.433	0.604	0.646*	1				
9- Protein (%)	0.786**	0.257	0.004	-0.741*	-0.751*	0.549	0.497	-0.165	1			
10- Carbohydrates (%)	0.202	0.755*	0.709*	0.652*	0.600	0.694*	0.683*	0.818**	-0.156	1		

11- Carotene (%)	0.971**	0.671*	0.598	-0.240	-0.246	0.716*	0.613	0.104	0.765*	0.216	1	
12 Oil content %	0.703*	0.609	0.450	-0.053	-0.119	0.703*	0.675*	0.325	0.548	0.412	0.736*	1

** Correlation is significant at the 00.01 level .
* Correlation is significant at the 00.05 level .
Snedecore and Cochran (1982)

Such correlation results expressed the importance of some seed quality and chemical properties for improving and predicting viability and vigour of maize hybrid.

References

1. **A.O.A.C. (1980)**. Official Methods Analysis of the Association of Official Analytical Chemists, 20th ed, Arligton, Virginia, USA.
2. **A.O.S.A. (1981)**. Rules for testing seeds. Seed Technol, 6.
3. **Abdoulaye, T.; T. Wossen and B. Awotide (2018).** Impacts of improved maize varieties in Nigeria: ex-post assessment of productivity and welfare outcomes, Food Secur., 10 (2): 369–379. https://doi.org/10.1007/s12571-018-0772-9.
4. **Abdrabbo, M.A.; F.A. Hashem; M.L. Elsayed; A.A. Farag; M.A. Abul-Soud; M.M. Hamada and K.M. Refaie (2013).** Evaluation of CSM-Ceres-Maize Model for ssimulating maize production in Northern Delta of Egypt. Life Sci. J., 10 (4): 3179-3192.
5. **Ali, A.; M.S. Hayyat; M. Adnan; M.E. Safdar; M. Asif; M.A.B. Khan; M.A. Javed; F. Rehman; M. Abdullah; Q. Mumtaz and R. Ahmad (2020)**. Effect of various planting dates on performance of different maize hybrids. AGBIR, 36 (5): 75- 79.
6. **Călugăr, R.E.; A. Varga; C.D. Vana; L.A. Ceclan; I. Racz; F. Chetan; A. Simon; C. Popa; N. Tritean, F. Ressu, et al. (2024).** Influenced Changing Weather on Old and New Maaize Hybrids: A Case Study in ROmina. Plant, 13, 3322.
7. **Carvalho, N.M. and J. Nakagawa (2012).** Sementes: ciência, tecnologia e produção. 5. ed. Jabotcabal: FUNEP, 590p
8. **Chisanga, C.B.; E. Phiri; V.R.N. Chinene and L.M. Chabala (2020).** Projecting maize yield under local-scale climate change scenarios using crop models: Sensitivity to sowing dates, cultivar, and nitrogen fertilizer rates. Food and Energy Security, 9:1-12.
9. **Costat Statically Computer Program (2005).** CoHort software, copy right (c) 1998-2005, PMB320, Monterey, CA, 93940.USA.
10. **Dahmardeh, M. (2012).** Effects of sowing date on the growth and yield of maize cultivars (*Zea mays* L) and the growth temperature requirements. Afr. J. of Biotechnology, 11 (61): 12450-12453.
11. **Dragičević, V.; M. Brankov; M. Stoiljković; M. Tolimir; P. Kanatas; I. Travios and M. Simić (2022)**. Kernel color and fertilization as factors of enhanced maize quality. Frontiers in Plant Science, 10.3389/fpis.2022.1027618.
12. **Dubois, M.; K.A. Gilles; J.K. Hamilton; P.A. Rebers and F. Smith (1956).** Colorimetric method for determination of sugars and related substances. Analytical Chemistry, 28 (3): 350-356.
13. **El-Abady, M.L.S.; S.E. Seadh and A.A.M. El-Eman (2014).** Use of some seed laboratory tests during storage to predict field emergence of maize. Res. J. of Seed Sci., 7 (2): 39-51.
14. **El-Sabagh, A.I.T.; N.Kh.B. El-Gizawy, M.M.I. Elhabbaq and S.A.S. Mehasen (2021).** Impact of Climate Change on Maize Productivity in Egypt. Annals of Agric. Sci., Moshtohor, 59 (3): 689-694.
15. **Gbaraneh, L.D. and K. Dumkhana (2021).** Effects of planting dates on the growth and yield of late season maize (*Zea mays* L.) cultivated in the high rain forest of south-south Nigeria. International Journal of Agriculture and Earth Science, 7 (1): 30-43.

16. **Hassan, M.H.K. (2019).** Response of some maize varieties to organic fertilizer and mineral nano fertilizer under saline conditions at siwa oasis. Ph.D Thesis, Faculti of Agriculture, Ain Shams University.
17. **Hassan, M.A. (2018).** Response of some yellow maize hybrids (*Zea mays* L.) to sowing date under Toshka conditions. J. Plant Production, Mansoura Univ., 9 (6): 509-514.
18. **Hegab, A.S.A.; M.T.B. Fayed; M.M.A. Hamada and M.A.A. Abdrabbo (2019).** Growth parameters, irrigation requirements and productivity of maize in relation to sowing dates under north-delta of Egypt conditions. AUJAS, Ain Shams Univ., Cairo, Egypt, Special Issue, 27 (1): 289-298.
19. **Karuma, A.N.; C.K.K. Gachene; P.T. Gicheru; P.W. Mtakwa and N. Amuri (2016).** Effects of tillage and cropping systems on maize and beans yield and sselected yield components in a semi-arid area of Kenyaa. Tropical and Subtropical Agrocossystems, 19: 167-179.
20. **Khalil, M.H.; A.F. Abou-Hadid; R.Th. Abdrabou; S.H. Abd Al-halim and M.Sh. AbdElMaaboud (2019).** Response of two maize cultivars (*Zea mays* L.) to organic manur and mineral nano nitrogen fertilizer under Siwa Oasis conditions. AUJAS, Ain Shams Univ., Cairo, Egypt, Special Issue, 27(1):299-312.
21. **Mahmud A.A. Ramhuma (2018).** Sowing dates on growth and grain yield of some maize hybrods. Alenxandria Science Exchange Journal, 39 (2): 244-514.
22. **Marcos-Filho, J. (2015).** Fisiologia de sementes de plantas cultvadas. 2. ed. Londrina: ABRATES, 660p.
23. **Mekonnen, T.W.; A. van Biljon; G. Geronio and M. Labuschagne (2023).** Effects of planting date, environments and their interaction on grain yield and quality traits of maize hybrids. Heliyon, 9, e21660.
24. **Nelson, D.W. and L.E. Sommers (1973).** Determination of total nitrogen in plant material. Agronomy Journal, 65 (1): 109-112.
25. **Ochieng, I.O.; H.I., Gitari; B. Mochoge; E. Rezaei-Chiyaneh and J.P. Gweyl-Onyango (2021).** Optimize maize yield, nitrogen efficacy and grain protein content under different N forms and rates. Journal of Soil Science and Plant Nutrition, 21: 1867-1880.
26. **Popa, C.; R.E. Călugar; A. Varga; E. Muntean; I. Băcilă; C.D. Vana; I. Racz; N. Tritean; I.V. Berindean; A.D. Ona and L. Muntean (2025).** Evaluating maize hybrids for yield, stress tolerance and carotenoid content: Insights into breeding for climate resilience. Plants, 14, 138.
27. **Rivera, S. and R. Canela (2012).** Influence of Sample Processing on the Analysis of Carotenoids in Maize. Molecules, 17: 11255-11268.
28. **Rowell, D.L. (1994).** Soil Science: Method and applications. Longman Publishers, Singapore: 350 pp
29. **Salama H.S.A. (2019).** Yield and nutritive value of maize (*Zea mays* L.) forage as affected by plant density, sowing date and age at harvest. Italian J. of Agronomy, 14:114-122.
30. **Snedecore, G.W. and W.G, Cochran (1982).** Statistical Methods 6th ed. Iowa State University Press, Ames, Lowa, USA.
31. **SPSS (2014).** Statistical Package for Social Science, Version 14, Chicago, USA.
32. **Tan, S.L. and W.R. Morrison (19s79).** Lipids in the germ endosperm and pericarp of the develop maize kernel. J. Am. Oil Chem. Soc., 56: 759-764.
33. **Tanumihardjo, S.A.; L. McCulley; R. Roh; S. Lopez-Ridaura; N. Palacios-Rojas and N.S. Gunaratna (2020).** Maize agro-food systems to ensure food and nutrition security in reference to the Sustainable Development Goals, Global Food Secur., 25: 1–9. https://doi.org/10.1016/j.gfs.2019.100327.
34. **Younis, A.S.M.; A.M.M. EL-Naggar; B.A. Bakry and S.M.A. Nassar (2021).** Maximizing maize grain, protein, oil and starch yields by using high plant density and stress tolerant genotype. Asian Journal of Plant Science, 20 (1): 91-101.