Response of corn (Zea mays L) to different levels of nitrogen, manganese and their effect on vegetative and qualitative growth.

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Abstract

A field experiment was conducted during the autumn seasons 2020 and spring 2021 in the fields of one of the farmers of the village of Al-Jilawia in the Alexandria sub-district (30 km north of Babylon) in order to study the effect of two factors, namely nitrogen, where the recommended quantity was divided into (two batches, three batches, four batches) and its symbol (N1, N2, N3)The second factor was spraying manganese with three concentrations (0, 20, 40) mg. L-1 and its symbol (Mn0, Mn1, Mn2). The experiment was conducted according to a randomized complete block design (RCB D) according to factorial order. The following results showed: The nitrogen level (N3) was significantly excelled on the rest of the levels for all the studied traits except for the oil percentage, where the level (N1) was excelled by giving it the highest average for the trait. As for the effect of manganese, it exceeded the level (Mn2) for all the studied traits by giving it the highest averages for the autumn and spring seasons. As for the bi-interaction between nitrogen and manganese, the combination (N3XMn2) was superior by giving it the highest average for all the studied traits and for the autumn and spring seasons, except for the oil content of the grains, where the treatment (N1XMn2) was superior.

Key Words: bi-interference, R C B D, seasons , batches

DOI Number: 10.14704/NQ.2022.20.11.NQ66298 **NeuroQuantology 2022; 20(11):2893-2901**

Introduction

Corn , Zea mays L., is one of the plants of Poaceae family. It occupies an advanced position among the economic crops due to its great economic importance .It is involved in many industries, including the manufacture of paper, oil, dyes, medicines and medical drugs because they contain medically effective substances and a group of vitamins, including (A, B6, B12) and essential amino acids (Alchem, 2020). However, its productivity does not keep pace with global production, where the global production rate reached 12.480 tons. ha-1 (F.A.O, 2020) In Iraq, the average production was 4.210 tons. ha-1 (Central Statistics Directorate, Agricultural Statistics Department, 2020), Therefore, production had to be increased in several methods, including importing excelled cultivars or using concentrated fertilizers in different ways, including adding to the soil and others adding a spray on the leaves to reach higher levels of production and better quality, Nitrogen works to increase the percentage of chlorophyll in the leaf as it directly enters the chemical structure of the chlorophyll molecule, thus increasing the efficiency of the photosynthesis process, and this is reflected positively on the vegetative and fruitful growth of corn in terms of increasing the cob length and the number of grains in the cob and then increasing the total yield (Ali et al., 2014). As for the role of manganese in the plant, it is accompanied by 35 enzymes in the plant and plays an important role in the production of chlorophyll, although it does not enter into its composition directly and prevents its decomposition and delays senescence of the leaves compared to not adding it to the plant (Al Sultani, 2019). As for the interaction of manganese with nitrogen, it gave an increase in vegetative growth

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and production, because when they interact in addition to the plant, it increases the production of amino acids, and the latter is converted into protein and increases production (VERMA 2010.(

The lesson aims to:

•Determining the best level of nitrogen gives the highest yield and the best quality.

•Determining the level of manganese gives the highest yield and the best quality.

• Diagnosing the interaction between nitrogen and manganese, which gives the highest averages for vegetative and qualitative growth traits.

Materials and methods

A field experiment was carried out in Al-Jilawiyah region (30 km north of Babylon province) for the autumn seasons of 2020 and spring of 2021 in clay loam soil (Table 1)

The factorial experiment was Randomized Complete Block Design (RCBD), experiment factors which are:-

- The nitrogen that was added in the form of urea CO (NH2) (46% active substance) was in three levels (two batches, three batches, four batches) and its symbol (N3,N2,N1), respectively.Soil examination: samples were taken from the soil of the field before planting it at a depth of (0-30) cm and for more than one sample from places from which the sample was taken randomly and mixed and cleaned well and some chemical and physical tests were conducted on it according to the softness described by (Page et al., 1982) in the laboratories of the Soil and Water Department at Al-Qasim Green University (Table 1)The experimental land was tillage perpendicular with Moldboard plows , then smoothed, levelled and divided into experimental units with dimensions (4 x 3) = 12 m2 and four furrows per unit. The distance between one rice and another is 75 cm and between pit and another 25 cm at average of (2-3) grains of one quality, then leave a distance of 1 m between an experimental unit and another and 2 m between one replicate and another to ensure that the spraying is conducted correctly. The two middle values were taken to study the required traits and nitrogen was added at a rate of 320 kg N.ha-1. At the first level, it was in two batches, the first after 20 days of germination and the second before flowering. As for the second level, it was in three batches, the first after 20 days of planting and the second after 20 days of the first and third batches at the beginning of flowering. As for the third level, it was added in four batches according to the following (15, 30, 45, 60) days from planting and before the manganese spraying process, the field is irrigated one day before for the purpose of opening the stomata for transpiration, and with the racists, the material of bubbler is added for the purpose of reducing the surface tension on the leaves. corn seeds were planted from the cultivar Al-Furat Hybrid, whose seeds were obtained from the Agricultural Research Directorate / Baghdad for the autumn season of 2020 on 7/15/2020, and for the second spring season of 2021 on 3/15/2021.In both seasons, the bush was controlled with atrazine (80% active substance) and 4 kg.ha-1 before germination, while continuing the weeding process as needed. The corn stem borer Sesamia Criteca was controlled using granulated diazinon (10% active substance) at an average of 6 kg.ha-1 by feeding the plants twice, the first time after 20 days of planting and the second two weeks after the first control. All crop service operations were conducted(Glo, 2016) .The vegetative growth traits were measured after taking (10) plants from the two middle lines, which are:

1) The plant height (cm) and the plant height is calculated from the surface of the soil to the last node of the stem bearing the male inflorescence, (Bachoit, Odongo,1995)

2) Leaf area: (cm2) and it was calculated by multiplying the square of the length of the leaf under cob x 0.75 and when flowering is completed (Al-Sahoki, 1983)

3) Chlorophyll content (SPAD) was measured using chlorophll-meters-502 device supplied by Minolta company.

4) The percentage of nitrogen in the leaves: Random samples were taken from the leaves of ten plants from each experimental unit, and they were washed after extraction with tap water and then with distilled water to remove dust and pollutants, then the roots were removed and the leaves were dried in an electric oven at 70 ° C until the weight was stable. Leaves samples were weighed separately and then ground with an electric grinder. Then 0.2 gm of the crushed samples were taken for each treatment and they were digested with concentrated sulfuric acid (98%) and hydrogen peroxide with heating until the extract became clear and transparent and the extract was transferred from Keldahl tubes to its bottles and completed the volume to 50 ml by adding distilled

water According to Gresser and Parsons. Nitrogen was estimated in the digested sample using the microcalcium apparatus as mentioned in Al-Sahaf (1989) by placing 10 mm of each digested sample in the evaporation flask and adding 10 ml of sodium hydroxide (40%) to it. The distillation process was coundected using the microcalcium device of German origin, where the ammonia liberated from the sample solution was collected into a glass beaker containing 20 ml of 2% boric acid in the presence of methyl red dye and bromcresol green pigment as a guide. Then the ammonia that was collected from hydrochloric acid was cleared according to the following equation: V1 X standard of hydrochloric acid X V2 X atomic weight of nitrogen X 100 / 1000 X B X A.

5) The percentage of protein in grain : the product of the percentage of nitrogen multiplied by 6.25% (1980, A.O.A.C)

6) Oil % (10) samples are taken for each experimental unit to estimate the percentage of oil in the seeds using a Soxliet device, according to what was mentioned in (A.A.E.E, 1976)

statistical analysis

The data were statistically analyzed using analysis of variance and according to the randomized complete block design (RCBD) for factorial trials, and the arithmetic means of the transactions were compared using the least significant difference (LSD) at a probability level of 0.05 using the statistical analysis program Genstate.

Table (1) Some physical and chemical properties of the soil in which the research was conducted.

Spring season	Autumn season	units	traits	No.
2.07	2.4	ds.m2	Ec	1
7.25	7.10		pH	2
1.52	1.33	kg.kg-1 soil	organic matter	3
51.27	48.11	mg.kg-1 soil	N availability	4
13.25	11.27	mg.kg-1 soil	P availability	5
76.22	70.70	mg.kg-1 soil	K availability	6
112	98	g.kg -1	Clay	7
407	445	g.kg -1	sand	8
461	457	g.kg -1	silty	9
		silty sandy loam	tuxtuer	10

Results and discussion

plant height (cm)

Appendices (1 and 2) show that there are significant differences between the levels of nitrogen and manganese fertilization for plant height traits for the autumn and spring seasons.

As for the bi- interaction between the experimental factors, the differences were significant for the autumn season .In the spring season, the differences were not significant for the bi-interaction between nitrogen and manganese. Tables (2 and 3) indicate that nitrogen has a clear effect on the plant height traits, where the N3 level gave the highest average for the studied trait for the autumn season, which amounted to 200.30 cm.While the N2 level gave the highest mean for the trait studied in the spring season, 193.32 cm, while the N1 level gave the lowest average for the trait in the autumn and spring seasons, reaching (170.60, 159.93 cm) according to the order. The increase in plant height is due to the positive effect of nitrogen on the activity of meristematic tissues and its role in cell division. Its presence is necessary for the construction of amino acids such as tryptophan, which forms the basis for building auxin, which has an important role in cell division (Karasu et al., 2009). The increase in plant height is due to the positive effect of nitrogen on the activity of meristematic tissues and its role in cell division, and its presence is necessary for building amino acids (Al-Nasiri and Al-Abdullah, 2020). As for the effect of manganese, the level of Mn2 was distinguished in the autumn and spring seasons by giving them the highest mean of the trait amounting to (193.41 and 194.70) cm respectively, while the MnO level gave the lowest averages for the trait for the autumn and spring seasons, which are (178.51 and 163.82) cm, respectively. The results are in agreement with the findings of Al-Amiri et al. (2015) As for the interaction between the addition of nitrogen and manganese, the combination Mn2XN3 excelled (by giving the highest average for trait reached (208.77, 199.51)

cm for autumn and spring seasons) respectively. While the combination MnOXN1) gave the lowest averages for the trait (126.02 and 148.88) cm for the autumn and spring seasons, respectively.

Table (2) The effect of adding ground nitrogen fertilizer and spraying with manganese and their bi-interactions on the plant height (cm) for corn crop autumn season 2020

Average Mn	N3	N2	N1	N / Mn
178.51	191.32	181.87	162.02	Mn0
187.50	200.90	188.49	173.25	Mn1
193.41	208.77	199.60	176.53	Mn2
	200.30	188.32	170.60	Average
4.980	8.620			L.S . D

Table (3) Effect of adding ground nitrogen fertilizers and spraying with manganese and their bi-interactions for plant height (cm) for corn crop for spring season 2021

Average Mn	N3	N2	N1	N / Mn
163.82	166.08	176.80	148.88	Mn0
178.38	186.50	186.86	162.45	Mn1
194.70	199.51	216.30	168.48	Mn2
	183.86	193.32	159.93	Average
3.980	7.620			L.S . D

Leaf area (cm2)

Annexes (1 and 2) show that there are significant differences between the levels of nitrogen fertilization and the levels of foliar spraying with manganese for leaf area traits and for the autumn and spring seasons. As for the bi- interactions between nitrogen and manganese, the differences were significant for the autumn season, while for the spring season, the bi- interactions between nitrogen and manganese were not significant. As for tables (4 and 5), it is noted that the N3 level of nitrogen fertilization excelled on the rest of the levels, by giving it the highest average of traits for the autumn and spring seasons, which amounted to (6427.10, 6190.88) cm2, respectively. While the level N1 gave the lowest average for autumn and spring seasons, it reached (3725.66, 3921.11) cm2, respectively. It is possible to explain the increase in leaf area. Where the greater the amount of nitrogen absorbed will increase the growth of the vegetative parts, including an increase in the leaf area. Nitrogen enters the synthesis of nucleic acids and cytochrome enzymes responsible for respiration and photosynthesis and the activation of the necessary enzymes in the growth of the leaf and its role in the transfer of nutrients from the root to the leaves, thus increasing the leaf area (Ibrahim, 2019) This is also consistent with Kati' and Al-Asadi (2015), and Al-Amin (2018) indicated that plants whose leaves contain a high percentage of nitrogen will have higher rates of carbonization, resulting in an increase in vegetative and fruitful growth. As for manganese fertilization, the level of Mn2 was superior by giving it the highest average for the trait and for the autumn and spring seasons, which amounted to (5556.44, 5464.22) cm^2, respectively.While the level of MnO gave the lowest average for the autumn and spring seasons, it reached (4563.77, 4566.99) cm2 respectively. The results agreed with the findings of Muhammad and Abu Dahi (2013) and Saeed, yousefi (2012).While the interaction between nitrogen and manganese, the combination Mn2 X N3 outperformed that by giving it the highest average for both the autumn and spring seasons, which amounted to (6915.60, 6568.33) cm2, respectively, while the combination MnO X N1 gave the lowest average for the character and for both the autumn and spring seasons it reached (3249.3). , 3298.60) cm2, respectively.

Table (4) Effect of adding ground nitrogen fertilization and manganese spray and their bi-interactions for leaf area characteristic (cm2) of corn crop autumn season of 2020

Average Mn	N3	N2	N1	N / Mn
4563.77	5363.66	4609.33	3249.33	Mn0
5013.77	6502.00	4925.66	3613.66	Mn1
5556.44	6915.66	5442.66	4311.00	Mn2
	6427.10	4992.55	3725.33	Average
242.70	419.80			L.S . D

Table (5) Effect of adding ground nitrogen fertilizer and manganese spray and their bi-interactions for leaf area traits(cm2) of corn crop for spring season 2021

Average Mn	N3	N2	N1	N / MN
4566.99	5832.00	4570.33	3298.60	Mn0
5126.99	6172.33	5338.60	4070.00	Mn1
5464.22	6568.33	5429.60	4394.60	Mn2
	6190.88	5046.22	3921.11	Average
300.40	520.30			L.S . D

Chlorophyll content in leaves (spad)

Annexes (1 and 2) indicate that there are significant differences between the levels of nitrogen fertilization and foliar spraying with manganese for chlorophyll content and for the autumn and spring seasons. As for the bi- interactions between nitrogen and manganese, it was not significant for the autumn season.As for the spring season, the differences were not significant for the bi-interaction between nitrogen and manganese.As for tables (6 and 7) they show the effect of adding nitrogen and manganese on the chlorophyll content in the yellow corn leaf. . The results agreed with the findings of Al-Amin (2018) and Singh (2018).

As for manganese, the treatment Mn2 was significantly superior by giving it the highest mean of the trait, which reached (43.37, and 40.80) spad for the autumn and spring seasons, respectively. While the MnO treatment gave the lowest mean of (39.53, 36.36) spad for the autumn and spring seasons, respectively. As for the interaction between nitrogen and manganese fertilization, the combination Mn2 X N3 was characterized by giving the highest averages for the trait amounting to 47.31 and 43.97 spad for the autumn and spring seasons, respectively.Whereas, the MnO X N1 combination gave the lowest averages for the trait, which reached (36.80, 34.77) spad for the autumn and spring seasons, respectively, and the differences were not significant for the two seasons.

Table (6) The effect of nitrogen fertilization and manganese spraying and their bi-interactions on chlorophyll content in corn leaves for the autumn season of 2020.

Mn average	N3	N2	N1	N / Mn
39.53	43.68	38.28	36.80	Mn0
42.03	45.60	40.83	39.65	Mn1
43.37	4731	42.20	40.63	Mn2
	45.53	40.43	39.02	Average
0.903	1.565			L.S . D

Table (7) The effect of nitrogen fertilization and manganese spraying and their bi-interactions on chlorophyll content in corn leaves for the spring season of 2021.

Mn average	N3	N2	N1	N / Mn
36.36	38.45	35.83	34.77	N1
39.01	40.67	38.89	37.47	N2
40.80	43.97	40.04	38.28	N3
	41.03	38.25	31.81	Average
0.783	1.35			L.S . D

protein percentage

It is clear from annexes (1) and (2) that there are significant differences between the levels of nitrogen and manganese fertilization for protein content and for the autumn and spring seasons. As for the bi- interactions between nitrogen and manganese, it was not significant. , As for the spring season, the bi-interaction was significant. It was found in Tables (8) and (9) that the N3 level significantly excelled in nitrogen fertilization, which amounted to (10.67, 10.40)% for the autumn and spring seasons, respectively. While the N1 level gave the lowest average for the trait, which reached (9.29, 8.95)% for the autumn and spring seasons, respectively. The results agreed with the findings of Adeniyan (2014) and when manganese was added on paper, the level of Mn2 was significantly excelled by giving it the highest mean of the trait amounted to (10.66, 10.32)% for the autumn and spring seasons, respectively, while the MnO treatment gave the lowest averages for the trait amounted to 9.16, 8.88% for the autumn and spring seasons, respectively.The results agreed with what was reached (El-Desouki, 2008) and the reason may be that manganese participates as a cofactor in many enzymes and stimulates the enzyme Hydroylamine reductase, which has a clear role in increasing the amount of protein in corn. As for the bi- interaction between nitrogen and manganese, the synthesis Mn2XN3) was distinguished. By giving it the highest mean for the trait that reached (11.82, 11.52)%, but it was not significant for the autumn and spring seasons, respectively.Whereas, the combination (MnOxN1) gave the lowest mean of the trait reached (874, 835) for the autumn and spring seasons, respectively.

Table (8) Effect of adding ground nitrogen fertilizer, manganese spray and their bi-interactions on the protein content of corn for the autumn season of 2020

Average Mn	N3	N2	N1	N / Mn
9.16	9.48	8.90	8.74	Mn0
9.81	10.64	9.48	9.30	Mn1
10.66	11.82	10.48	9.84	Mn2
	10.67	9.60	9.29	Average
0.427	1.281			L.S.D

Table (9): Effect of adding nitrogen fertilizer, manganese spray and their bi- interactions on the protein content of corn for the spring season of 2021.

Average Mn	N3	N2	N1	N / Mn
8.88	9.52	7.78	8.35	Mn0
9.48	10.17	9.38	8.90	Mn1
10.32	11.52	9.85	9.61	Mn2
	10.40	9.00	9.95	Average
0.422	0.731			L.S.D

Oil percentage (%)

Appendices (1) and (2) found significant differences between the levels of nitrogen and manganese fertilization for the oil content and for the autumn and spring seasons. As for the bi-interactions, they were significant for the autumn and spring seasons. Tables (10) and (11) show the effect of the addition of nitrogen and manganese fertilization on the trait of the percentage of oil in the seeds, so the level of N1 was significantly excelled, giving the highest average for the character reached (5.12, 5.07)% for the autumn and spring seasons, respectively. As for the N3 level, it gave the lowest average for the trait, which was (4.16, 4.41) % for the autumn and spring seasons, respectively. The results agreed with what was reached (Rieden et al., 2009). He justified his findings that the higher the amount of nitrogen absorbed, the lower the oil percentage, the higher the protein content in the grains.As for the addition of manganese, the treatment Mn2 was significantly excelled by giving it the highest mean of the trait (5.12, 5.6%) for the autumn and spring seasons, respectively. While the MnO treatment gave the lowest averages (4.26, 4.58) for the autumn and spring seasons, respectively. The results agreed with the findings (Orhum et al., 2013).As for the bi-interaction between the two factors nitrogen and manganese, the treatment (N1XMn2) was significantly excelled by giving it the highest averages for the trait amounted to (6.23, 6.09)% for the autumn and spring seasons, respectively. While the treatment (MnOX N3) gave the lowest averages (4.08, 4.66) for the autumn and spring seasons, respectively.

Table (10) The effect of adding ground nitrogen fertilizer and spraying the element manganese and their bi-interactions on the of oil percentage % in corn for the autumn season 2020

Average Mn	N3	N2	N1	N / Mn
4.26	4.08	4.43	4.22	Mn0
4.61	4.30	4.63	4.93	Mn1
5.12	4.12	5.04	6.23	Mn2
	4.16	4.70	5.12	Average
0.039	0.067			L.S.D

Table (11) The effect of adding ground nitrogen fertilizer and spraying manganese and their bi-interactions on the percentage of oil content in corn for the spring season 2021

Average Mn	N3	N2	N1	N / Mn
4.58	4.66	4.48	4.26	Mn0
4.56	4.38	4.63	4.87	Mn1
5.06	4.21	5.05	4.06	Mn2
	4.41	4.73	5.07	Average
0.067	0.1166			L.S.D

Leaves content of nitrogen (%)

Appendices (1) and (2) show that there are significant differences between the levels of nitrogen fertilization D and manganese for the leaves content of nitrogen and for the autumn and spring seasons. As for the bi- interaction between nitrogen and manganese, it was significant. Tables (12) and (13) indicated the effect of adding nitrogen and manganese, so it was found that the level of N3 significantly excelled on the other levels, giving the highest average percentage of nitrogen, which amounted to (1.70, 1.47)% for both autumn and spring seasons, respectively. While treatment N1 gave the lowest averages for the trait (1.29, 1.22)% for the autumn and spring seasons, respectively. The results agreed with the findings of (Al-Rafie, 2012) and (Jassem and Kateb, 2017) and they justified the increase in the percentage of nitrogen in the leaves as a result of the plant absorbing a greater amount of the absorbed nitrogen, because nitrogen increases the efficiency of the photosynthesis process and since the vegetative part is part of the plant and this has an effect on The percentage of nitrogen in the leaves and when manganese was added to the leaves by spraying, the Mn2 treatment excelled on the rest of the treatments, giving the highest averages for the trait (1.54, 1.41)% for the autumn and spring seasons, respectively. While the MnO treatment gave the lowest averages for the trait (1.37, 1.24)% for the autumn and spring seasons, respectively.The results agreed with the findings of Taiz (2017) and the bi-interaction between nitrogen and manganese, the combination Mn2 X N3 excelled by giving it the highest averages for the trait amounting to 1.84 and 1.63% for both autumn and spring seasons, respectively. While the combination (MnO X N1) gave the lowest averages for the trait (1.79, 1.56%) for the autumn and spring seasons, respectively.

Table (12) Effect of adding nitrogen fertilizer and spraying manganese and their bi-interactions for nitrogen percentage in corn leaves for the autumn season of 2020

Average Mn	N3	N2	N1	N / Mn
1.37	1.56	1.31	1.24	Mn0
1.46	1.71	1.38	1.30	Mn1
1.54	1.84	1.48	1.33	Mn2
	1.70	1.39	1.29	Average
0.063	0. 110			L.S.D

Table (13) Effect of adding nitrogen fertilizer and manganese spray and their bi-interactions for nitrogen percentage in corn leaves for spring season 2021

Average Mn	N3	N2	N1	N / Mn
1.24	1.34	1.23	1.17	Mn0
1.32	1.46	1.27	1.22	Mn1
1.41	1.63	1.49	1.38	Mn2
	1.47	1.33	1.26	Average
0.059	0.01028			L.S.D

References

Central Agency for Statistics and Information Technology, 2020. Cotton, corn and potato production report for the year 2019. Agricultural Statistics Directorate.

Ali, Nour El-Din Shawky, Hamdallah Suleiman Rahi, and Abdel-Wahhab Abdel-Razzaq Shaker. 2014. Fertility Education. Arab Society Library for Publishing and Distribution, Amman, Hashemite Kingdom of Jordan.

Katie, Khawla Daoud and Kazem Katami Al-Asadi, 2015. Effect of adding nitrogen and phosphate fertilizers on yield and its components of corn crop, optimum record for agricultural sciences. 4(1) 1-11.

Al-Nasiri Yahya Abdel-Razzaq Mohan and Sindi Abdel-Karim Al-Abdullah. 2020. Study of the growth and yield of yellow corn Zea Mays L. under levels of nitrogen and potassium fertilization. Al-Muthanna Journal of Agricultural Sciences. Volume (8) Issue 1 of 2020

Salem, Howrah Ghassan Hussein. 2017. Effect of foliar feeding of iron to reduce the effect of salt stress on some anatomical characteristics and yield components of corn plant (mays L Zea).

Jassem, Ali Hussein and Iman Majeed Kateb. 2017. Response of vegetative growth of four corn genotypes to levels of supplemental nitrogen fertilizer. Karbala University Scientific Journal. 5 (1) scientific. 2017.

Al-Zubaidi, Najm Abdullah and Ayman Ahmed Abdel-Karim Al-Abbasi. 2015. Effect of potassium and iron foliar feeding on vegetative growth characteristics of corn (mays L Zea) under drip irrigation system.

El-Desouky, Heshmat Suleiman Ahmed. 2008. Fundamentals of Plant Physiology. Island of Ward Library, Mansoura - Arab Republic of Egypt.

FAO. 2020. FAO STAT Agricultural statistics database http://www. Fao. Org.

Saeedipour. S. and F. Moradi. 2012. Relationship of endogenous ABA and IAA to accumulation of grain protein and starch in two winter wheat Cultirars under post-anthesis water deficit. Journal of Agricultural science. 4(2): 147-156p.

Singh, Rabish Datt Shukla and Kuldeep Singh.2018. Effect of fertilizer levels and Bio-fertilizer on green cob yield of corn (Zea mays L.).International Journal of Chemical Studies; 6(2): 2188-2190.

Orhum, G. E. (2013). Corn for life. Int. J. Food Sci . and Nut. Eng.3(2): 13-16

Adeniyan, O. N. (2014). Effect of different population densities and fertilizer rates on the perfor mance of different corn varieties in two rain forest agro ecosystems of South West Nigeria. African Journal of Plant Science. 8(8): 410-415

Taiz, L. and E Zeiger. 2010. plant physiology. 5" (ed). Sianauer Associates, Sunderland, UK:P.629.