بسم الله الرحمن الرحيم `

Sudan University of Science and Technology

College of Graduate Studies

Addition of some Natural Plant Products for Efficient Nitrogen Uptake in Maize (*Zea mays* L.)

إضافة بعض مساحيق النباتات الطبيعية لزيادة إمتصاص النتروجين في الذرة الشامية (*Zea mays* L.)

A Thesis Submitted to the Sudan University of Science and Technology in Partial Fulfillment of the Requirements for the Degree of M.Sc. in Agriculture (Agronomy)

By:

Dalal Alsoni Abdelgader Eissa

B.Sc. in Agriculture , Agronomy,

Sudan University of Science and Technology, (2015).

Supervisor:

Prof. Dr. Yassin Mohamed Ibrahim Dagash

Department of Agronomy

January, 2020

الآية

قال تعالى:

﴿وَإِذْ قُلْتُمْ يَا مُوسَى لَنْ نَصْبِرَ عَلَى طَعَامٍ وَاحِدٍ فَادْعُ لَنَا رَبَّكَ يُخْرِجْ لَنَا مِمَّا تُنْبِتُ الْأَرْضُ مِنْ بَقْلِهَا وَقِثَّائِهَا وَفُومِهَا وَعَدَسِهَا وَبَصَلِهَا قَالَ أَتَسْتَبْدِلُونَ الَّذِي هُوَ أَدْنَى بِالَّذِي هُوَ خَيْرٌ اهْبِطُوا مِصْرًا فَإِنَّ لَكُمْ مَا سَأَلْتُمْ وَضُرِبَتْ عَلَيْهِمُ الذِّلَّةُ وَالْمَسْكَنَةُ وَبَاءُو بِغَضَبٍ مِنَ اللَّهِ ذَلِكَ بِأَنَّهُمْ كَانُوا يَكْفُرُونَ بِآيَاتِ اللَّهِ وَيَقْتُلُونَ النَّبِيِّينَ بِغَيْرِ الْحَقِّ ذَلِكَ بِمَا عَصَوْا وَكَانُوا يَعْتَدُونَ﴾

صدق الله العظيم

سورة البقرة الآية (61)

Dedication

To My:

Family,

Teachers

And all Friends.

Acknowledgment

First praise and thanks to ALLAH giving me strength and patience to complete this work successfully. I would like to express my deepest and sincere gratitude and thanks full to my Great Supervisor: **Prof. Dr. Yassin Mohamed Ibrahim Dagash** for his support, and kindness, a wonderful care in directing and supervising this work.. I would like to express my thank fullness to Dr. Kailane Adam for his kindness and help. I gratefully thanks to my family and my mother for take care and help and hope her health and happiness forever. Also thanks to staff in Sudan University of Science and Technology, College of Agricultural Studies Department of Agronomy for their advice and guidance of this work.

Table of Contents

List of Tables

Table No. **Title** **Page No.**

List of Figures

Fig. No. **Title** **Page No.**

Abstract

The experiment was carried out for season of (2018-2017)at the Demonstration Farm of Collage of Agricultural Studies Sudan University of Science and Technology at Shambat Sudan to study the Addition of Natural Plant Products for Efficient Nitrogen Uptake in Maize (*Zea mays* L.) The layout of the experiment was factorial in a randomized complete block design (RCBD) with three replications. Hudiba -1, cultivar was grown under two levels of nitrogen in (urea 45%) N_1 (40kgN/ Ha) and N_2 (80 kg N /ha) with five plant powder of the following plants 40kg/ ha): Neem seeds (*Azadirachtaindica* L., Mint leaves (*Menthaspicata* L.) Moringa leaves (*Moringa olifera* L.) and Shaih seeds (*Artimissiaannua* L.) with control. The treatment were ten combinations in a randomized as follows: Urea (40 kg N/ha), Urea (80kgn/ ha), Urea (40kgN/ ha+Neem powder),Urea (40kgN/ ha + Moringa powder), Urea (40kgN/ ha+ Mint powder), Urea (40 kg N/ha + Shaih powder), Urea (80kgN/ha+ Neem powder), Urea (80kgN/ha+ Moringa powder), Urea (80kgN/ha + Mint powder) and Urea (80 kg N/ha +Shaih powder). The results showed only significant difference in number of row per cob, length of cob, seed per plant and 100 seed weight. The natural products was significant for only number of seeds per row. 80 kg fertilization was generally better than 40 kg, fertilization. However, different plant products increased nitrogen uptake and utilization by maize plant. Neem at 80 kg nitrogen had the highest maize yield.

المستخلص

أجريت التجربة في موسم 2017-2018م بمزرعة كلية الدراسات الزراعية شمبات جامعة السودان للعلوم والتكنولوجيا لدراسة أثر إضافة المواد النباتية الطبيعية لتثبيت النتروجين وزيادة إمتصاصه بواسطة النبات لمحصول الذرة الشامي. صممت التجربة بواسطة التجربة العاملية بتصميم القطع العشوائية بثلاثة مكررات. زرعت الذرة الشامية صنف حديبة 1 تحت مستويات نتروجين (يوريا 45%) 40 كيلوجرام و 80 كيلوجرام للهكتار وخمسة مساحيق من بدرة النباتات (40 كلجم للهكتار) النيم، النعناع، المورينقا، الشيح مع شاهد بدون إضافة وكانت المعاملات 10 مكونات من اليوريا بمستويين و 5 نباتات طبيعية. أوضحت النتائج وجود فروقات معنوية لعدد الصفوف بالكوز وطول الكوز وعدد البذور بالنبات ووزن المائة بذرة. وكانت بدرة النباتات الطبيعية معنوية لعدد البذور في الصف.وكانت إضافة 80 كلجم للهكتار أفضل من 40 كلجم للهكتار. وقد زادت بدرة النباتات الطبيعية زيادة إمتصاص النتروجين بواسطة محصول الذرة الشامية. مسحوق النيم مع 80 كلجم للهكتار نتروجين أعطى أعلى معدل إنتاج.

CHAPTER ONE

INTRODUCTION

Maize or Corn (*Zea mays*) is one of the important cereal crops because of the increasing demand for food and livestock feed. It ranks as one of the world's three most important cereal crops. It is cultivated in a wide range of environments more than wheat and rice because of its greater adaptability. Maize is high yielding, easy to process, readily digested. It is also a versatile crop, growing across a range of agro ecological zone. Every part of maize plant has economic value: the grain, leaves, stalk, tassel, and cob can all be used to produce a large variety of food and non-food products. In industrialized countries, maize is largely used as livestock feed and as a raw material for industrial products, while in developing courtiers it is mainly used for human consumption. In Africa, maize is a staple food for 50% of the population. It is important source of carbohydrate, protein, vitamin B, and minerals. Green maize (fresh on the cob) is eaten boiled, playing an important role in filling the hunger gap. The crop is widely used as a food crop in many parts of the world especially in the tropical and subtropical countries. Maize is rich in starch (carbohydrates) with an average of about 70%, but low in protein (about 9.5%). The oil is concentrated mainly in the germ with an average of 4% of kernel weight. The composition of other components of the kernel is 1.4% sugars, 2.3 crude fiber and 1.4% ash. Maize seed enters also in livestock feeds, and in other industrial purposes as in the case of glucose, starch and edible oil industries. Maize is widely cultivated throughout the world, and a greater weight of maize is produced each year than any other grain. The United States produces 40% of the world's harvest; other top producing countries include China, Brazil, Mexico, Indonesia, India, France. In Sudan, although maize is of less importance than sorghum, wheat and millet as a staple human food. However, the crop plays a great role in food security for the people in Blue Nile and South Kordofan States. The crop is grown in the two states by traditional farmers in small-holdings under rain-fed. Now a days, different companies and individuals started to grow the crop at a large scale under irrigation or under rainfall in different parts of Sudan. However, the total cultivated area of maize in the Sudan increased from 17 thousand hectares in 1971 to 37 thousand hectares in 2010 (Ahmed, 2011). Yet, the average grain yield until was about 1894 kg/ha which is far below that of the world (6 t/ha) (AOAD, 2007). The low productivity of maize was attributed to the low yield ability of the local open pollinated cultivars that normally grown and the greater sensitivity of the crop to water stress (Saliem, 1991).Maize produces the highest yields when water is abundant and soil fertility is high, but maize is least tolerant to stress among cereals (Muchow, 1989). However, an estimated 80% of the maize crop suffers periodic yield reduction due to drought stress (Bolanos and Edmeades, 1993). Drought may occur at any stage of maize growth, but when it coincides with the flowering and grain filling periods it causes yield losses of 40-90% (Nesmith and Ritchie, 1992). Understanding of genetic basis of drought tolerance would be used in developing maize genotypes for drought prone areas.

Although, the research work in maize over the past fifty years did not continue at all times, but it was successful and recommended the key management practices and released six high yielding open pollinated varieties and five exotic maize hybrids. Yet, the average grain yield until now was very low compared with world production. However, maize breeders have aimed to generate hybrids with higher grain yield potentials, better grain yield stability and improved grain quality for consumers (Duvick, 1997).

1.2 The Objectives of the Research were:

1. To study the Effect of natural plant products on corn (*Zea mays*)

2. To determine the best nitrogen dose with the natural products.

3. To calculate the nitrogen use efficiency and the uptake of nitrogen.

CHAPTER TWO

LITERATURE REVIEW

Maize (*Zea mays* L.) is the world's widely grown highland cereal and primary staple food crop in many developing countries (Kandil, 2013). It was originated in America and first cultivated in the area of Mexico more than 7,000 years ago, and spread throughout North and South America (Hailare, 2000). In the world production, maize is ranked as the third major cereal crop after wheat and rice (Zamir *et al.,* 2013). In 2014, the United States topped the list of ten maize producing countries which includes China, Brazil, EU-27, Ukraine, Argentina, India, Mexico, South Africa and Canada with an amount of about 351 million metric tons (Statista, 2015). World production of white maize is currently estimated to be around 65 to 70 million tons. Among the individual geographical regions of the developing countries, white maize production has a paramount importance in Africa. The main white maize producers in Africa include Kenya, Tanzania, Zambia and Zimbabwe (Kidist, 2013). Planting density affects multiple aspects of maize. Modern farming techniques in developed countries usually rely on dense planting, which produces one ear per stalk. Stands of silage maize are yet denser, and achieve a lower percentage of ears and more plant matter.

Maize is a facultative short-day plant and flowers in a certain number of growing degree days> 10 °C (50 °F) in the environment to which it is adapted. The magnitude of the influence that long nights have on the number of days that must pass before maize flowers is genetically prescribed and regulated by the phytochrome system. Photoperiodicity can be eccentric in tropical cultivars such that the long days characteristic of higher latitudes allow the plants to grow so tall that they do not have enough time to produce seed before being killed by frost. These attributes, however, may prove useful in using tropical maize for biofuels.

Immature maize shoots accumulate a powerful antibiotic substance, 2,4-dihydroxy-7-methoxy-1,4-benzoxazin-3-one (DIMBOA). DIMBOA is a member of a group of hydroxamic acids (also known as benzoxazinoids) that serve as a natural defense against a wide range of pests, including insects, pathogenic fungi and bacteria. DIMBOA is also found in related grasses, particularly wheat. A maize mutant lacking DIMBOA is highly susceptible to attack by aphids and fungi. DIMBOA is also responsible for the relative resistance of immature maize to the European corn borer (family Crambidae). As maize matures, DIMBOA levels and resistance to the corn borer decline.

2.1 Fertilizer

Farmers in Sudan are using a lot of fertilizers for their cereal crops . Most of the production cost goes to fertilization and there is a misuse in the application .Some farmers think adding more fertilizers will lead to more yield. Unfortunately , most of the nitrogen used is lost in one way or another. Only very little amount is utilized by the plant. Some chemical products are useful in more nitrogen uptake but they are expensive. Some plant products proved to do the same with little cost and without polluting the environment.

2.2 Nitrogen

Cereals are one of the important Food and feed crops because of the increasing demand for food and livestock feed. Nitrogen is an essential nutrient for plant growth and development in cereals (Upadhyay *et al*.,2011). Large quantities of chemical fertilizers are used to replenish soil N resulting in high costs and severe environmental contamination. Nitrogen is a major limiting nutrient for crop production. It can be applied through chemical or biological means. Over application can result in negative effects such as leaching, pollution of water resources, destruction of microorganisms and friendly insects, crop susceptibility to disease attack, acidification or alkalization of the soil or reduction in soil fertility thus causing irreparable damage to the overall system. Nitrification, a microbial process, is a key component and integral part of the soil nitrogen (N) cycle. It is the biological oxidation of ammonia (NH_3) to nitrate (NO_3^-) and is carried out by two groups of chemolithotrophic bacteria (*Nitrosomonas*s pp. and *Nitrobacter* spp.), which are ubiquitous on earth (Norton *et al*., 2002).

2.2.1 Effect of nitrogen on *Zea mays*

Nitrogen stress reduces grain yield by delaying plant growth and development. It plays an important role in crop development and final grain yield. Nitrogen for maize cultivation is very important to harvest maize yield potential. It is very essential for plant growth and makes up 1 to 4 percent of dry matter of plants. A linear relationship exists between N rates and days to tasseling, silking and maturity. The existing recommended dose of N (200 kg/ha) for hybrid maize production is low for Pakistani soils. However, grain yield positively increased up to 300 kg N per hectare . Quality characteristics in maize such as seed protein contents were improved with higher N level . Application of nitrogen at low rates decreased the grain yield by 43-74 percent and the number of grains per plant up to 33-65 percent Yield and protein contents in maize seed increased with increase in nitrogen rate .

2.2.2 Nitrogen use efficiency:

Moll *et al*. (1982) defined NUE as the yield of grain per unit of available N in the soil including the residual N present in the soil and fertilizer. NUE can further be divided into two processes: 1. Nitrogen uptake efficiency and 2. Nitrogen utilization efficiency. Nitrogen uptake efficiency is defined as a quotient of plant nitrogen uptake (Nupt) and total crop nitrogen supply (NSUP) (Fertilizer plus soil mineral nitrogen) (Samborski *et al*., 2008). Nitrogen uptake efficiency is also called nitrogen recovery efficiency (REN) which defines the capacity of the plant to a acquire nitrogen from the soil. According to Baligar *et al*. (2001) nitrogen uptake efficiency is attributed to morphological, physiological and biochemical processes in plants and their interaction with climate, soil, fertilizer , biological and management practices. Improved NUE can help to enhance yield under low nitrogen and thus improve crop nutritional quality and it will also reduce ground water contamination by excess nitrates (Hirel and Lemaire, 2005). Nitrogen use efficiency for production of cereals such as wheat, rice, corn, barley, sorghum , pearl millet is a approximately 33% and the remaining 67% goes as loss (Maduraimuthu and Desikan , 2013) Nitrogen use efficiency is necessary to secure staple food source for increasing population of the world , especially when there are challenges from global climate change , and higher cost of energy , fertilizers and water (Smith *et al* , 2012)

2.3 Neem

Neem is a fast-growing tree that can reach a height of 15–20 metres (49–66 ft), and rarely 35–40 metres (115–131 ft). It is evergreen, but in severe drought it may shed most or nearly all of its leaves. The branches are wide and spreading. The fairly dense crown is roundish and may reach a diameter of 15–20 metres (49–66 ft) in old, free-standing specimens. The neem tree is very similar in appearance to its relative, the Chinaberry (*Meliaazedarach*).The opposite, pinnate leaves are 20–40 centimetres (7.9–15.7 in) long, with 20 to 31 medium to dark green leaflets about 3–8 centimetres (1.2–3.1 in) long. The terminal leaflet often is missing. The petioles are short.The (white and fragrant) flowers are arranged in more-or-less drooping axillarypanicles which are up to 25 centimetres (9.8 in) long. The inflorescences, which branch up to the third degree, bear from 150 to 250 flowers. An individual flower is 5–6 millimetres (0.20–0.24 in) long and 8–11 millimetres (0.31–0.43 in) wide. Protandrous, bisexual flowers and male flowers exist on the same individual tree.The fruit is a smooth (glabrous), olive-like drupe which varies in shape from elongate oval to nearly roundish, and when ripe is 1.4–2.8 centimetres (0.55–1.10 in) by 1.0–1.5 centimetres

(0.39–0.59 in). The fruit skin (exocarp) is thin and the bitter-sweet pulp (mesocarp) is yellowish-white and very fibrous. The mesocarp is 0.3–0.5 centimetres (0.12–0.20 in) thick. The white, hard inner shell (endocarp) of the fruit encloses one, rarely two, or three, elongated seeds (kernels) having a brown seed coat.

2.4 Mint

Mentha (also known as mint, from Greek*míntha*, Linear B*mi-ta*) is a genus of plants in the familyLamiaceae (mint family). It is estimated that 13 to 18 species exist, and the exact distinction between species is still unclear. Hybridization between some of the species occurnaturally. Many other hybrids, as well as numerous cultivars, are known.The genus has a subcosmopolitan distribution across Europe, Africa, Asia, Australia, and North America.Mints are aromatic, almost exclusively perennial, rarely annualherbs. They have wide-spreading underground and overgroundstolons and erect, square, branched stems. The leaves are arranged in opposite pairs, from oblong to lanceolate, often downy, and with a serrated margin. Leaf colors range from dark green and gray-green to purple, blue, and sometimes pale yellow. The flowers are white to purple and produced in false whorls called verticillasters. The corolla is two-lipped with four subequal lobes, the upper lobe usually the largest. The fruit is a nutlet, containing one to four seeds.

While the species that make up the *Mentha* genus are widely distributed and can be found in many environments, most grow best in wet environments and moist soils. Mints will grow 10–120 cm tall and can spread over an indeterminate area. Due to their tendency to spread unchecked, some mints are considered invasive.

2.5 Moringa

Moringaoleifera is the most widely cultivated species of the genus *Moringa*, which is the only genus in the family Moringaceae. English common names include: moringa, drumstick tree (from the appearance of the long, slender, triangular seed-pods), horseradish tree (from the taste of the roots, which resembles horseradish), ben oil tree, or benzoil tree. (from the oil which is derived from the seeds). It is a fast-growing, drought-resistant tree, native to the southern foothills of the Himalayas in northwestern India, and widely cultivated in tropical and subtropical areas where its young seed pods and leaves are used as vegetables. It can also be used for water purification and hand washing, and is sometimes used in herbal medicine.

2.6 Shaih

Artemisia annua belongs to the plant family of *Asteraceae* and is an annual short-day plant. Its stem is erect brownish or violet brown. The plant itself is hairless and naturally grows from 30 to 100 cm tall, although in cultivation it is possible for plants to reach a height of 200 cm. The leaves of *A. annua* have a length of 3–5 cm and are divided by deep cuts into two or three small leaflets. The intensive aromatic scent of the leaves is characteristic. The Artemisinin content in dried leaves is in between 0% and 1.5%. New hybrids of *Artemisia annua* developed in Switzerland can reach a leaf artemisinin content of up to 2%. The small flowers have a diameter of 2–2.5 mm and are arranged in loose panicles. Their color is green-yellowish. The seeds are brown achenes with a diameter of only 0.6–0.8 mm. Their thousand-kernel weight (TKW) averages around 0.03 g (in comparison, wheat has a TKW of approximately 45 g).

CHAPTER THREE

MATERIALS AND METHODS

3.1 The Site of Experiment

The experiment was carried out for one season of 2016/2017 at the Demonstration Farm of Collage of Agricultural Studies Sudan University of Science and Technology at Shambat, Sudan to study the effect of natural plant products on maize yield, `Shambat is located (LAT: 15º 40'N LONG: 32º 32'E and ALT.: 380 M), and altitude 380 m above sea surface, it is climate is in semi-desert region (Adam, 2002). The soil of the site is described by (Abdelhafiz, 2001) as loom clay, it is characterized by a deep cracking moderately alkaline clay, and bad texture, water holding capacity, and low permeability, low nitrogen content and pH (7.5-8) and high exchangeable sodium percentage (ESP), in sub soil.

The layout of the experiment was a factorial with two factors in a randomized complete block design (RCBD) with three replications. Hudiba -1, cultivar was grown under five treatments and two, Nitrogen levels of (urea 46%) plant powder of the following plants (40kg/ Ha): was used:

1. Neem seeds (*Azadirachta indica* L.)
2. Mint leaves (*Mentha spicata* L.)…..
3. Moringa leaves (*Moringa olifera* L.)
4. Shaih seeds (*Artimissia annua* L.).
5. The treatment were ten combinations in a randomized complete block design (RCBD) with three replications as follows:

   1- (40 kg N/ha)

   2- (80kgn/ha)

3- (40kgN/ha+Neem powder)

4- (40kgN/ha +Moringa powder)

5- (40kgN/ha +Mint powder)

6- (40 kg N/ha +Linseed or Shaihpowder)

7- (80kgN/ha+Neem powder)

8- (80kgN/ha +Moringa powder)

9- (80kgN/ha +Mint powder)

10- (80 kg N/ha +Linseed or Shaih powder)

3.2 Source of seeds

Cultivar Hudiba -1, used in the experiment was obtained from Environmental Natural Resources and Desertification Research Institute, Khartoum, Sudan.

3.3 The studied parameters include

Number of rows per cob (N.R.C.), length of cob (cm) (L.C.), number of seed per row (N.S.R.), seeds per plant (S/Plant), 100 seed weight (g), and grain yield (t/ha).

3.4. Land preparation and other process

The land was prepared by disc plough, disc harrowed and leveled ridging up north –south, the spaces between ridges (70 cm),holes (15cm),the size of the plot was ($4m^2$) .Crop was planted by hand 5 seeds/hole and then thinned to three seedling/hole, on 15 October , 2016. Irrigated immediately after sowing and then irrigation applied every 7 days. Weeds were controlled by hands. The different source of fertilizers mentioned above with it is doses were applied immediately after planting.

3.5. Data collection

Various samples and observations as shown below were taken, random sample of three plants in each plot were taken to collect data.

3.5.1 Plant height (Cm):at 30,45,60 and 75 days+ at maturity.

Plants height was measured in (cm) from the soil surface up to the collar of the last leaf on the plant, from three selected plants, then the mean plant height was calculated for each plot.

3.5.2Stem diameter (cm):measured on the stalk at the second internodes above the ground level using vernia instrument at maturity.

3.5.3 Number of cobs/plant

The harvested cobs of three plants were air dried and counted the average weight of number of cobs was calculated.

3.5.4 100 Seeds weight (g):

100-seeds were counted randomly then weighed for each plot of the three selected plants.

3.5.5 Grain yield (t/ha):

The harvest plants from each plot were threshed and seed yields for each plot were recorded, yield per hectare was then estimed. yield (t/ha) =

$$\frac{\text{Wt. of seeds perplot}}{\text{Area of the plot}} \times \frac{10000\ \text{m}^2}{1000\ \text{kg}}$$

3.5.6 Nitrogen use efficiency (NUE):

This was determined by dividing the grain yield by the N fertilizer applied, i.e., grain yield obtained per Kg N applied:

$$\frac{\text{Grain yield (k/ha)}}{\text{Kg N/ha}}$$

3.6. Statistical analysis

The collected data was analysised using Statistic (8) computer program. Analysis of variances (ANOVA) was performed to chech the significant and then the means were separated (using LSD).

CHAPTER FOUR

RESULTS

4.1 Vegetation growth of the farm Experiment

4.1.1 Plant height (cm)

From the analysis of variance it was clear that there were no significant differences in plant height after 15days or 45days between nitrogen levels plant products or their interaction in (Table 1).

However at 30days there was a significant difference (0.05)between nitrogen levels, highly significant difference (0.01) between plant products but no significant different for their interaction, At 60 days there was ahigh significant difference between nitrogen levels and significant difference plant products and the interaction , At 75 days there was significant difference between nitrogen levels and no significant difference between plant products or the interaction (Table1).The height at 80kg Nitrogen was higher than 40kg (87.78cm) At 15days and 75days (153.53cm) while at30,45and60days it was higher at 40kg.Shih had the height plant height (101.07cm) At15 days and 30days (152.47cm) (table 1).The neem gave the higher plant height At 45 days (152.97 cm)and of mint at 60 days (177.07cm)(table2). The interaction showed that shih At 80kg highest (108.07cm) and At 40kg at 30 days At 40kg gave the highest plant height (167.77cm) and 183.23 respectably Moringa At 40 kg gave the plant height(212.72) Shih had the height plant height at beginning the growth (figer 1) while mint gave the height plant height at maturity (Table 2).

Table 1. Plant Height (cm), number of leaves, Stem diameter (cm) , Fresh Weight(gm)and Dry Weight(gm) of maize in the two different Nitrogen Levels Forthe field.

Nitrogen levels	**Plant height (cm)**					**Number of Leaves**				
	15days	**30days**	**45days**	**60days**	**75days**	**15days**	**30days**	**45days**	**60days**	**75days**
40kg	84.08^{A}	131.17 ^{A}	146.36 ^{B}	172.89^{A}	178.81^{A}	8.96^{A}	9.63^{A}	9.97^{A}	10.06^{B}	10.63^{B}
80kg	87.78^{A}	123.58^{B}	151.59^{A}	153.53^{B}	159.49^{B}	6.83^{B}	9.41^{B}	9.80^{B}	10.38^{A}	11.20^{A}
Mean	85.93	127.37	148.97	163.21	169.15	7.89	9.52	9.88	10.49	10.91
CV%	29.44	18.64	18.30	15.05	19.88	15.31				
	Stem diameter					Fresh Weight	Dry Weight			
40kg	6.82^{B}	7.20^{B}	8.48^{A}	9.02^{A}	9.60^{B}	1.54^{B}	0.35^{B}			
80kg	7.38^{A}	7.94^{A}	8.09^{B}	8.40^{B}	10.06^{A}	1.83^{A}	0.50^{A}			
Mean	7.1	7.57	8.28	8.71	9.83	1.68	0.42			
CV%	95.32	19.01	13.41	9.26	8.86	24.42	59.73			

Means for each column followed by the same letter were not significantly different at 5% level LSD.

4.1.2 Number of Leaves/plant

Number of leaves/plant was not significant at 15,30days and 45days while it was significant at 60 days and hilly significant at 75days (Appendix 2). The high number of leaves was recorded at 75 days for 40kg and 80kg nitrogen (10.63-11.20)respectively (Table 1).Mint had the highest number of leaves at 75days from plant (11.01)(Table 2). The interaction showed that moringa at 80kg nitrogen had the highest number of leaves (12.06)(Table 3).Shih and mint had the highest number of leaves at 40kg nitrogen while neem and moringa gave the highest at 80kg nitrogen.

4.1.3 Stem Diameter (cm)

Stem diameter was no significant at 15,45 and 75days (Appendix 3),At 30days nitrogen levels was significant while it was highly significant at 60 days.

At 45days only the plant products were significant and at 60days nitrogen levels and plant products were highly significant while the interaction was significant (Table 3). Stem diameter is highe at 40kg in45 days and 60days and it was higher for 80kg At 15,30 days and 75 days .At 15 days stem diameter was higher for neem and had 45days ,60 days and 75 days highest stem diameter. Neemgave the highest stem diameter at the beginning of growth (Table 2) while at maturity neem gave the highest stem diameter (Figer 3).

4.1.4 Fresh and Dry Weight (cm)

The statistical analysis for the fresh weight was no significant in plant products and the interaction in nitrogen levels (Appendix 4) .The fresh weight in 80kg is higher than 40kg(Table 1) while it was higher for mint (1.96g) Mint had the highest fresh weight (Table 2). At 80kg nitrogenneem gave the highest fresh weight (12.53). The dry weight had no significant different in the three parameters(Appendix 4) .The dry weight in80kg is higher than 40kg(Table 1). while it was higher forneem had the heist dry (Table 2).

Table 2.Vegetative growth of Maize at Different Plant Products at the Field.

Products Plant	Plant height (cm)					Number of Leaves				
	15days	30days	45days	60days	75days	15days	30days	45days	60days	75days
Control	89.67^{AB}	117.53^{BC}	130.43^{A}	142.77^{B}	148.70^{B}	6.63^{C}	8.11^{A}	9.31^{AB}	9.38^{A}	10.96^{A}
Mint	83.82^{AB}	106.92^{C}	135.97^{A}	177.07^{A}	194.63^{A}	9.10^{A}	9.10^{A}	10.23^{AB}	10.46^{A}	11.01^{A}
Neem	61.53^{B}	139.75^{A}	152.97^{A}	168.87^{AB}	175.08^{A}	8.61^{AB}	9.36^{A}	10.86^{AB}	10.68^{A}	10.96^{A}
Moringa	93.57^{A}	137.58^{AB}	140.80^{A}	154.23^{B}	170.93^{A}	7.61^{BC}	8.46^{A}	8.96^{B}	9.55^{A}	10.95^{A}
Shaih	101.07^{A}	152.47^{AB}	159.85^{A}	164.52^{AB}	173.40^{A}	8.45^{AB}	9.38^{A}	9.85^{AB}	10.05^{A}	10.86^{A}
Mean	85.93	130.85	144.00	161.49	172.54	8.06	8.88	9.84	10.02	10.96
CV%	29.44	18.64	18.30	15.05	19.88	15.31	6.70	13.80	11.91	7.95
	Stem diameter(cm)					Fresh Weight(g)	Dry Weight(g)			
Control	6.25^{AB}	6.90^{AB}	7.20^{AB}	7.30^{B}	8.43^{A}	1.57^{A}	0.48^{A}			
Mint	6.88^{A}	8.75^{A}	7.51^{AB}	9.08^{A}	9.25^{A}	1.96^{A}	0.48^{A}			
Neem	7.23^{A}	8.73^{A}	9.00^{A}	9.31^{A}	14.23^{A}	1.49^{A}	0.51^{A}			
Moringa	6.93^{A}	7.28^{AB}	8.66^{A}	8.73^{A}	8.80^{A}	1.68^{A}	0.38^{A}			
Shaih	6.91^{A}	7.50^{AB}	8.26^{A}	8.70^{A}	9.00^{A}	1.73^{A}	0.29^{A}			
Mean	6.84	7.83	8.12	8.62	9.94	1.68	0.42			
CV%	95.32	19.01	13.41	9.26	8.86	24.42	59.73			

Means for each column followed by the same letter were not significantly different at 5% level LSD

Table 3.Interaction of Plant Height and Number of Leaves of maize for Nitrogen Levels and Plant Products in the Field

Nitrogen levees	**Plant Products**	**Plant height (cm)**					**Number of Leaves**				
		15days	**30days**	**45days**	**60days**	**75days**	**15days**	**30days**	**45days**	**60days**	**75days**
40kg	Control	90.2^{AB}	135.77^{AB}	145.87^{AB}	151.1^{A}	145.1^{CDE}	7.96^{BC}	8.73^{BC}	8.76^{B}	10.30^{AB}	10.83^{ABC}
	Mint	82.77^{AB}	116.43^{AB}	132.53^{A}	171.7^{A}	192.63^{ABCD}	8.83^{BC}	10.06^{AB}	10.20^{ABC}	10.63^{AB}	11.30^{A}
	Neem	67.47^{AB}	121.73^{A}	162.20^{AB}	167.7^{A}	175.30^{ABC}	9.26^{AB}	10.73^{ABC}	10.73^{ABC}	10.40^{AB}	10.96^{AB}
	Moringa	85.90^{AB}	119.40^{AB}	133.53^{AB}	159.17^{A}	212.77^{A}	8.80^{BC}	8.86 ^{BC}	8.63^{A}	**9.13^{AB}**	10.40^{AB}
	Shaih	94.07^{AB}	147.20^{A}	167.77^{AB}	183.23^{A}	196.00^{AB}	9.20^{AB}	9.23^{ABC}	10.26^{ABC}	10.76^{AB}	11.30^{A}
	Mean	84.1	128.10	148.38	166.58	186.16	8.81^{BC}	9.52	9.71^{ABC}	10.24	10.95
	CV%	29.44	18.64	18.30	15.05	19.88	15.31^{ABC}	16.70	13.80^{ABC}	11.91	7.95
80kg	Control	89.13^{AB}	99.30^{BC}	115.0^{B}	134.43^{A}	143.3^{B}	5.30^{D}	7.93^{C}	9.10^{ABC}	9.86^{AB}	11.63^{AB}
	Mint	81.30^{AB}	84.87^{C}	155.5^{AB}	182.43^{A}	196.63^{A}	8.13^{BC}	9.20^{ABC}	10.30^{AB}	10.26^{AB}	10.63^{AB}
	Neem	55.60^{B}	143.73^{A}	157.77^{AB}	162.43^{A}	182.43^{AB}	7.96^{C}	8.00^{BC}	10.76^{AB}	10.96^{AB}	11.20^{AB}
	Moringa	101.23^{A}	129.10^{AB}	141.63^{B}	149.30^{A}	162.20^{AB}	6.10^{AB}	9.30^{AB}	10.30^{AB}	11.50^{AB}	12.06^{A}
	Shaih	108.07^{A}	145.8^{A}	150.80^{AB}	151.93^{A}	157.73^{AB}	6.63^{BC}	8.80^{B}	10.46^{AB}	10.50^{AB}	11.16^{AB}
	Mean	87.19	120.56	144.14	156.10	168.45	6.82	8.64	10.18	10.61	11.33
	CV%	29.44	18.64	18.30	15.05	19.88	15.31	16.70	13.80	11.91	7.95

Means for each column followed by the same letter were not significantly different at 5% level LSD

Table 4.Interaction of Stem Diameter of maize for Nitrogen Levels and Plant Products in the Field

Nitrogen levels	Plant Products	Stem diameter				
		15 days	30 days	45 days	60 days	75 days
40kg	Control	6.80^{B}	6.96^{AB}	8.60^{AB}	7.50^{AB}	9.76^{AB}
	Mint	6.33^{B}	7.63^{AB}	8.63^{AB}	8.90^{AB}	9.36^{AB}
	Neem	6.86^{B}	6.93^{AB}	8.96^{AB}	9.36^{AB}	10.10^{A}
	Moringa	6.76^{B}	6.80^{AB}	8.40^{AB}	8.96^{AB}	9.10^{AB}
	Shaih	6.76^{B}	7.23^{AB}	9.10^{A}	9.20^{A}	10.26^{A}
	Mean	5.33	7.11	8.37	8.78	9.71
	CV%	95.32	19.01	13.41	9.26	8.86
80kg	Control	5.30^{B}	6.83^{AB}	7.10^{AB}	7.10^{AB}	7.60^{AB}
	Mint	7.03^{A}	7.40^{AB}	8.60^{AB}	9.13^{A}	9.53^{AB}
	Neem	7.60^{A}	8.53^{AB}	8.50^{AB}	8.63^{AB}	21.53^{A}
	Moringa	7.06^{A}	7.80^{AB}	8.50^{AB}	8.50^{AB}	8.93^{AB}
	Shaih	7.10^{A}	7.33^{AB}	7.33^{AB}	7.76^{AB}	8.30^{AB}
	Mean	6.81	7.57	8.00	8.22	11.17
	CV%	95.32	19.01	13.41	9.26	8.86

Means for each column followed by the same letter were not significantly different at 5% level LSD

4.2 Yield and yield component s:

Number of row/cob showed that significant difference in plant products and no difference in nitrogen levels or the interaction(Appendix 4) .Number of row in cub at 40kg is more than 80kg nitrogen (12.20) (Table 5).while the number of row in cob was higher for shih (13.63)(Table 6).The interaction showed that shih at 40kg had the highest number of row in cob(Table 7).

Length of cob had a significant difference in nitrogen levels and no different in plant products or the interaction (Appendix 4). At 40kg the number of row in cob was more than 80kg nitrogen (12,20) (Table 5),while it was higher for moringa (Table 6) .The interaction showed that moringa at 80kg had the highest length of cob (Table 7).

Number of seeds per row had a significant different in plant products and no significant in nitrogen levels or the interaction(Appendix 4). Number of seeds per row at 40kg was more than 80kg nitrogen (Table 5),while the Number of seeds per row was higher for neem (24.30)(Table 6),The interaction showed that the highest number of seeds per row was (22.63)for shih (Table 7).

Weight of seed per plant at 80kg nitrogen was more than 40kgnitrogen (36.44g)(Table 5). While the weight of seed per plant was higher for moringa(Table 6).The interaction showed that neem at80kg had the heist weight per plant (Table 7).

100 seed weight was higher for 80kg nitrogen than 40kg while the control showed the highest 100 seed weight (Table 6) ,The interaction showed the control and mint at 80kg nitrogen had the highest 100seed weight(Table 7) .

Yield was higher for 80kg than 40kg(Table 5).while the yield of moringa was highest (Table 6),Interaction showed that neem At 80kg nitrogen had the highest (1.68t/h) (Table 7).

Table 5.Interaction of Yield and yield components of maize for Nitrogen Levels and Plant Products in the Field

Yield and yield components					
Seeds/ Plant	**100seeds Weight (g)**	**Number of Seed Per Cob**	**Length of Cob (cm)**	**Number of Row of cob**	**Yield (t/ha)**
22.98^{D}	18.77^{B}	11.96^{B}	18.63^{D}	21.20^{A}	0.86^{B}
35.03^{B}	17.97^{C}	12.60^{B}	22.66^{C}	13.86^{C}	1.32^{A}
21.03^{D}	17.67^{C}	11.30^{B}	23.96^{C}	21.96^{A}	0.79^{B}
30.53^{C}	17.13^{C}	11.30^{B}	22.63^{C}	16.26^{B}	1.59^{A}
28.52^{C}	15.50^{D}	13.86^{A}	22.30^{C}	17.86^{B}	1.20^{B}
36.88	12.91	8.33	15.15	23.17	1.15
34.99	19.99	13.87	25.06	22.86	34.6
28.9^{C}	21.30^{A}	10.83^{C}	25.83^{A}	19.73^{A}	1.04^{B}
33.55^{B}	21.17^{A}	11.63^{B}	24.30^{B}	15.53^{C}	0.96^{B}
43.05^{A}	16.63^{C}	13.20^{A}	23.86^{B}	18.86^{B}	1.68^{A}
31.95^{C}	19.27^{B}	11.63^{B}	26.40^{A}	18.86^{B}	1.50^{A}
44.72^{A}	21.03^{A}	13.40^{A}	25.16^{A}	22.63^{A}	1.34^{A}
36.43	19.95	12.13	25.11	19.12	1.30
36.88	12.91	23.17	15.15	8.33	34.6

Means for each column followed by the same letter were not significantly different at 5% level LSD

Table 6.Yield and Yield components of Maize at Different Nitrogen Levels At the farm

Nitrogen levels	**Yield and yield components**					
	Seeds/Plant	**100seeds weight**	**N of row / Cob**	**Length of Cob**	**N of Seed per row**	**Yield t/ha**
40kg	27.68^{B}	17.43^{B}	12.20^{A}	25.11^{A}	20.68^{A}	1.07^{B}
80kg	36.44^{A}	19.88^{A}	12.16^{B}	22.04^{B}	18.23^{B}	1.30^{A}
Mean	32.06	18.65	12.18	23.57	19.45	1.18
CV%	36.88	12.91	8.33	15.15	23.17	34.6

Means for each column followed by the same letter were not significantly different at 5% level LSD

Table 7.Yield and Yield components of Maize at Different Plant products At the farm

Plant Products	Yield and yield components					
	Seeds/Plant	**100seeds weight (gm)**	**N of seed per Cob**	**Length of Cob**	**N of S in R**	**Yield(t\ha**
Control	25.94^{B}	20.03^{A}	11.40^{B}	22.23^{A}	20.46^{AB}	0.95^{B}
Mint	34.46^{A}	19.53^{B}	12.11^{B}	23.48^{A}	14.70^{C}	1.14^{A}
Neem	32.04^{A}	17.15^{B}	12.25^{B}	23.91^{A}	24.30^{A}	1.24^{A}
Moringa	31.24^{A}	18.20^{B}	11.53^{B}	24.51^{A}	17.56^{BC}	1.33^{A}
Shaih	36.62^{A}	18.32^{B}	13.63^{A}	23.73^{A}	20.25^{AB}	1.27^{A}
Mean	32.06	18.64	12.18	41.59	19.45	25.73
CV%	36.88	12.91	8.33	15.15	23.17	34.6

Means for each column followed by the same letter were not significantly different at 5% level LSD

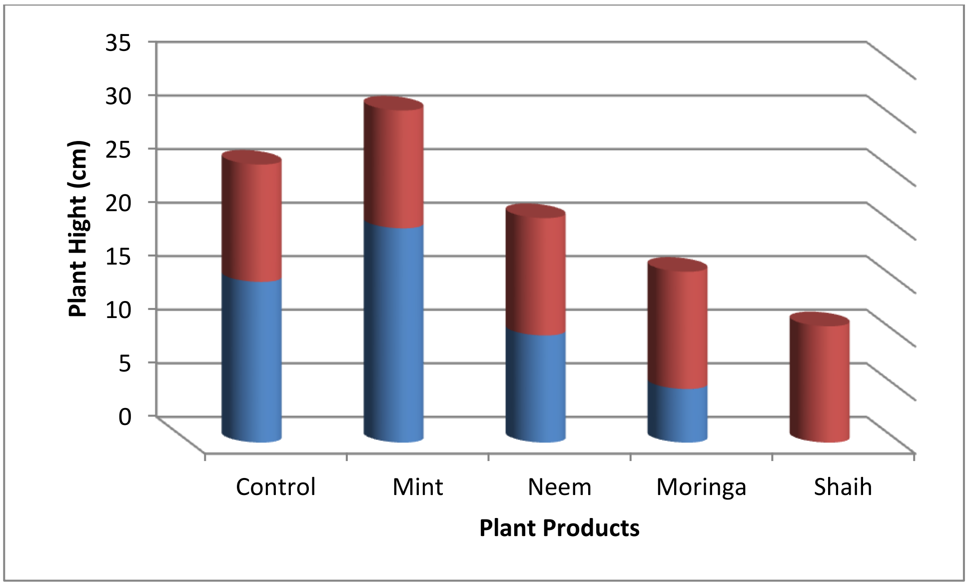

Figure 1. Plant height (cm) in the farm

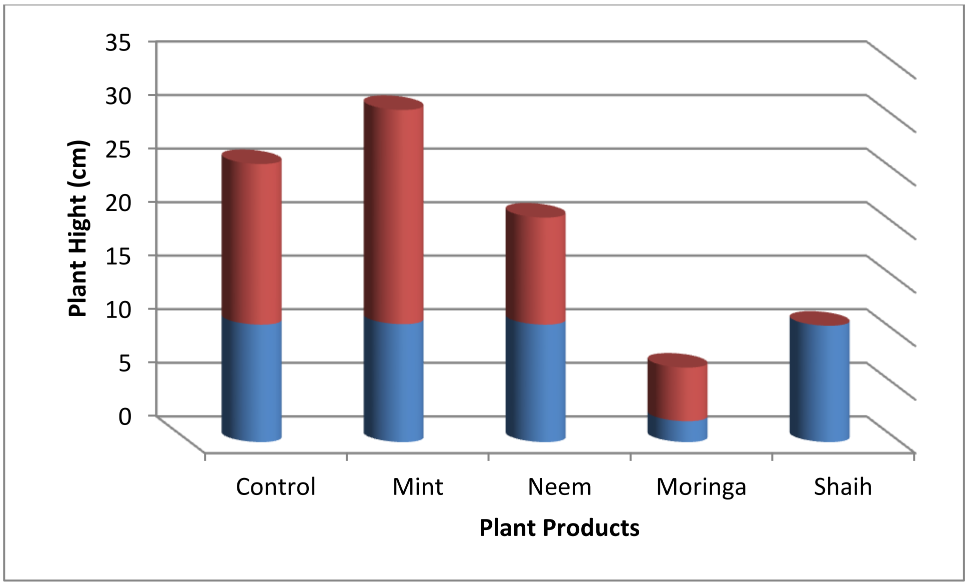

Figure 2. Number of leaves (cm) in the farm

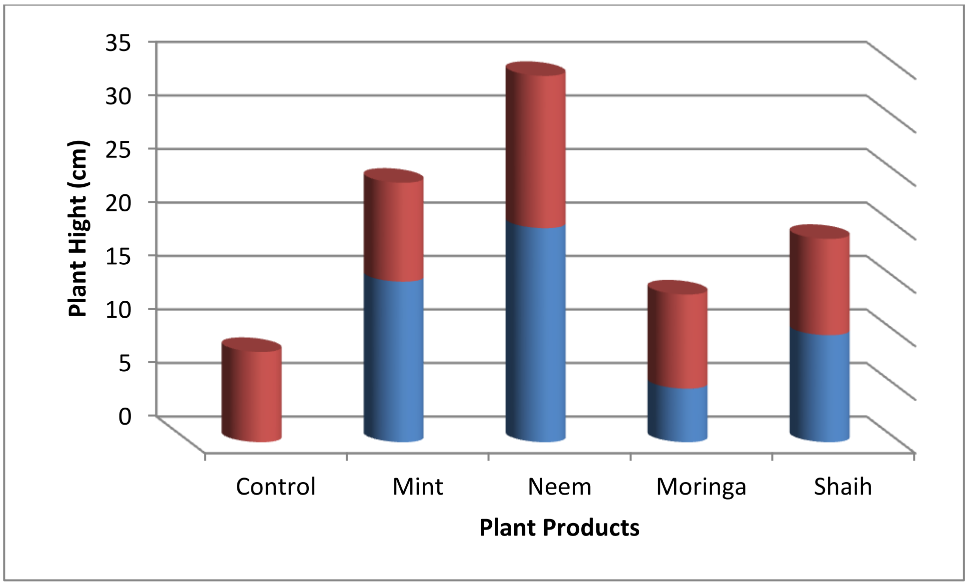

Figure 3. Stem diameter (cm) in the farm

4.2 Vegetation growth of the Nursery

4.2.1 Plant Height (cm)

From the analysis of variance it was clear that there were no significant difference in plant height after 15,30daysand 45 days between nitrogen levels plant products or their interaction (Appendix 5). However at 30 days there was a high significant difference between nitrogen levels, also a significant difference(0.05) between plant products but no significant difference for their interaction(Appendix 5). At60days there were a significant difference between nitrogen levels and plant products ,and a high significant difference between interaction. The plant height at 40kg is height than 80kg (15,30,45,60) (Table 8).Neem had the highest plant height at 15days while the control is highest at 30days 45,and60days . Neem gave the highest plant height At 15days in 40kg nitrogen At 30days the control at 40kg has the highest height (63,07cm).At45days the control at 80kg and 60days had the highest plant height (83,60cm) (Table 10). Genereally for the pot experiment control followed by moringa gave the highest plant height (figer 4).

4.2.2 Number of Leaves

From the statistic analysis of number of leaves were a significant at 30 days between nitrogen levels . 45 days no significant between nitrogen levels plant products and interaction(Appendix 6). At60days nitrogen levels, plant products were not significant but the interaction is a significant (Appendix 6). Number of leaves at 40kg is higher than 80kg in15,30,45,60 days. Number of leaves at 15days is higher in control (5.36) 30 days , 45days and 60days .Moringa had the heist number of leaves (8.18), at 80kg The control had the highest number of leaves in 15days(Table 8) .At 30days control had the highest number of leaves in 40kg .At45days control had the heist number of leaves in 40kg nitrogen (8.30) and 60 days (10.30)(Table 10). Generally the control gave the height number of leaves (figure 5).

Table 8. Plant Height (cm) , Number of Leaves and Fresh and dry weight of maize in the tow different Nitrogen Levels At Nursery

Nitrogen levels	Plant height (cm)				Number of Leaves			
	15days	30days	45days	60days	15days	30days	45days	60days
40kg	34.1^{A}	57.5^{A}	98.9^{A}	69.2^{A}	7.0^{A}	6.7^{A}	8.1^{A}	5.2^{B}
80kg	29.7^{B}	49.7^{B}	52.4^{B}	59.9^{B}	5.4^{B}	6.2^{B}	8.1^{A}	5.3^{A}
Mean	31.9	53.6	75.7	64.6	6.2	6.5	8.1	5.2
CV%	33.13	11.96	137.28	18.00	36.18	9.81	16.38	8.38
	Stem diameter(cm)				**Fresh Weight(g)**	**Dry Weight (g)**		
40kg	4.3^{A}	5.2^{A}	5.4^{A}	8.3^{A}	1.1^{A}	0.8^{A}		
80kg	3.4^{B}	4.6^{B}	4.6^{B}	7.4^{B}	0.8^{B}	0.2^{B}		
Mean	3.8	4.9	5.0	7.9	0.9	0.5		
CV%	40.19	7.28	13.28	13.74	101.12	157.05		

Means for each column followed by the same letter were not significantly different at 5% level LSD

4.2.3 Stem Diameter(cm)

Stem diameter was not significant at 15days (Appendix 7).It 30days nitrogen levels were higher significant ,plant products was not significant while interaction a significant, (Appendix 7). The treatment (40g*mint) gave the large mean(5.4cm) compared with other treatments. (Table 11) .Stem diameter is highest At 40kg in 15.30,45 days(Table 8).while is higher for 80kg at 60days (8.33cm).Control had the highest plant diameter At 15days while the Shih is highe. At 30days and 60days .At45days Moringa had the highet stem diameter .At15days control had the heist stem diameter At 40kg nitrogen. At 30days the control and mint had the highest stem diameter at 40kg and at 45days .At80kg mint had the heist stem diameter in60days(Table 11). Generally the control gave the highest stem diameter (figer 6).

4.2.4 Fresh Weight (g)

The analysis of variance showed no significant difference for the fertilizer interaction (Appendix 8).The fresh weight is higher for 40kg nitrogen than 80 kgnitrogen(Table 8). The fresh weight is higher for the control followed by shih (Table 9).The interaction showed higher fresh weight for the control at 40kg(2.10 g)followed by shih(Table 11).

4.2.5 Dry Weight (g)

The analysis of variance showed no significant difference for the fertilizer interaction (Appendix 8).The dry weight is higher for 40kg nitrogen than 80kgnitrogen(Table 8),Thedry is higher control followed by mint (Table 9).The interaction showed higher resells forcontrol at 40kg nitrogen (1.01 g)followed by moringa(Table 11).

Table 9.Plant Height (cm) of maize in the tow different Nitrogen Levels At Nursery

Products Plant	Plant height (cm)				Number of Leaves			
	15days	**30days**	**45days**	**60days**	**15days**	**30days**	**45days**	**60days**
Control	29.75^{AB}	58.46^{A}	63.97^{A}	77.71^{A}	5.4^{A}	6.5^{A}	8.1^{A}	8.8^{A}
Mint	31.85^{AB}	45.46^{B}	53.97^{A}	57.95^{BC}	4.8^{B}	4.5^{B}	6.5^{A}	7.9^{A}
Neem	40.18^{A}	49.48^{B}	52.26^{A}	53.88^{BC}	5.2^{A}	5.8^{B}	6.4^{A}	7.8^{A}
Moringa	26.65^{B}	54.18^{A}	57.08^{A}	67.65^{AB}	5.2^{A}	5.7^{B}	6.4^{A}	8.2^{A}
Shaih	32.81^{AB}	55.95^{A}	53.58^{A}	67.13^{AB}	5.2^{A}	6.2^{A}	6.5^{A}	7.7^{A}
Mean	32.24	52.70	56.17	64.80	5.2	5.7	6.8	8.1
CV%	33.13	11.96	137.28	18.00	36.18	9.81	16.38	8.38
	Stem diameter(cm)				**Fresh Weight(g)**	**Dry Weight(g)**		
Control	4.6^{A}	4.9^{A}	5.1^{A}	7.8^{A}	1.63^{A}	1.39^{A}		
Mint	3.3^{A}	4.8^{A}	4.9^{A}	8.1^{A}	0.15^{B}	0.35^{B}		
Neem	3.1^{A}	4.7^{A}	4.8^{A}	7.5^{A}	0.86^{AB}	0.32^{B}		
Moringa	3.8^{A}	5.1^{A}	5.2^{A}	7.8^{A}	1.01^{AB}	0.31^{B}		
Shaih	4.5^{A}	4.9^{A}	4.9^{A}	8.1^{A}	1.11^{AB}	0.24^{B}		
Mean	3.9	4.9	4.9	7.9	0.95	0.52		
CV%	40.19	7.28	13.28	13.74	101.12	157.05		

Means for each column followed by the same letter were not significantly different at 5% level LSD

Table 10.Interaction of Plant Height and Number of Leaves of maize for Nitrogen Levels and Plant Products at the Nursery

Nitrogen levees	Plant Products	Plant height (cm)				Number of Leavespots			
		15days	30days	45days	60days	15days	30days	45days	60days
40kg	Control	32.73^{B}	63.07^{B}	64.30^{AB}	71.83^{ABC}	4.9^{BCD}	6.5^{A}	8.3^{A}	10.3^{A}
	Mint	34.73^{AB}	53.96^{B}	68.97^{A}	73.40^{AB}	4.9^{BCD}	6.3^{A}	7.3^{A}	8.5^{B}
	Neem	50.53^{A}	56.80^{B}	50.43^{B}	52.0 ^{CD}	5.6^{AB}	6.0^{A}	6.6^{A}	7.7^{B}
	Shaih	32.00^{B}	54.40^{B}	59.06^{AB}	73.50^{AB}	5.5^{AB}	6.3^{A}	6.9^{A}	8.3^{A}
	Mean	34.76	56.43	60.05	69.16	5.2	6.3	7.1	8.5^{A}
	CV%	33.13	11.96	137.28	18.00	36.18	9.81	16.38	8.38
80kg	Control	26.63^{B}	52.63^{B}	64.87^{A}	83.60^{A}	5.8^{A}	5.4^{A}	6.3^{A}	9.3^{A}
	Mint	28.96^{B}	36.96^{B}	38.97^{B}	42.00^{D}	4.5^{BCD}	4.6^{B}	5.7^{B}	7.3 ^{B}
	Neem	29.83^{B}	48.53^{B}	50.96^{AB}	52.53^{CD}	4.8^{BCD}	5.5^{B}	6.1^{A}	7.9^{B}
	Moringa	29.46^{B}	55.06^{B}	56.63^{B}	60.20^{BCD}	5.2^{BCD}	5.3^{B}	6.6^{A}	8.7^{B}
	Shaih	33.63^{AB}	52.77^{B}	52.83^{B}	60.76^{BCD}	4.9^{BCD}	5.9^{A}	6.1^{A}	7.1^{B}
	Mean	29.70	49.19	52.85	59.81	5.0	5.4	6.2	
	CV%	33.13	11.96	137.28	18.00	36.18	9.81	16.38	8.38

Means for each column followed by the same letter were not significantly different at 5% level LSD

Table 11.Interaction of Growth Stem Diameter and Fresh and Dry weight of maize for Nitrogen Levels and Plant Products at the Nursery

Nitrogen levees	Plant Products	Stem diameter(cm)					
		15days	**30days**	**45days**	**60days**	**Fresh weight(g)**	**Dry weight(g)**
40kg	Control	4.60^{AB}	4.80^{ABC}	5.13^{AB}	7.76^{AB}	2.10^{A}	2.10^{A}
	Mint	3.56^{AB}	5.36^{A}	5.80^{A}	7.20^{AB}	0.20^{B}	0.35^{B}
	Neem	3.30^{AB}	5.10^{ABC}	5.36^{A}	7.06^{AB}	0.73^{AB}	0.35^{B}
	Moringa	4.46^{AB}	5.20^{A}	5.46^{A}	7.00B	1.03^{AB}	0.53^{B}
	Shaih	5.66^{A}	5.16^{AB}	5.00^{AB}	8.06^{AB}	1.23^{AB}	0.37^{B}
	Mean	4.31	5.12	5.35	7.41	1.05	0.74
	CV%	40.19	7.28	13.28	13.74	10.12	15.7
80kg	Control	4.63^{AB}	4.93^{ABC}	5.03^{AB}	7.96^{AB}	1.16^{AB}	0.35^{B}
	Mint	2.93^{B}	4.13^{D}	4.10^{B}	9.00^{A}	0.10^{B}	0.35^{B}
	Neem	2.90^{B}	4.53^{CD}	4.10^{B}	7.96^{AB}	1.00^{B}	0.30^{B}
	Moringa	3.06^{AB}	4.86^{ABC}	5.00^{AB}	8.53^{AB}	1.00^{B}	0.10^{B}
	Shaih	3.36^{AB}	4.56^{BCD}	4.86^{AB}	8.20^{AB}	1.00^{B}	0.10^{B}
	Mean	3.37	4.60	4.61	8.33	0.85	0.24
	CV%						

Means for each column followed by the same letter were not significantly different at 5% level LSD

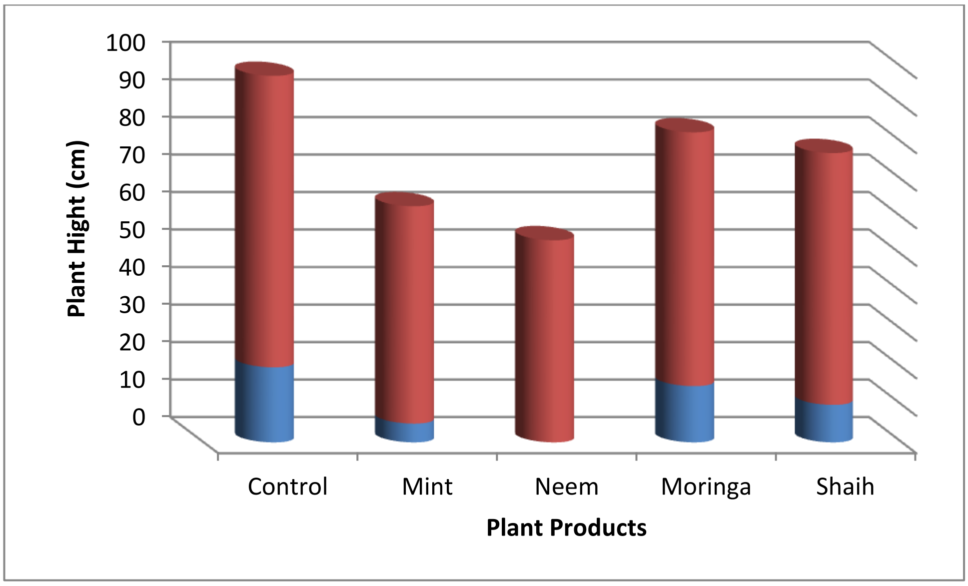

Figure 4. Plant height (cm) in the Nursery

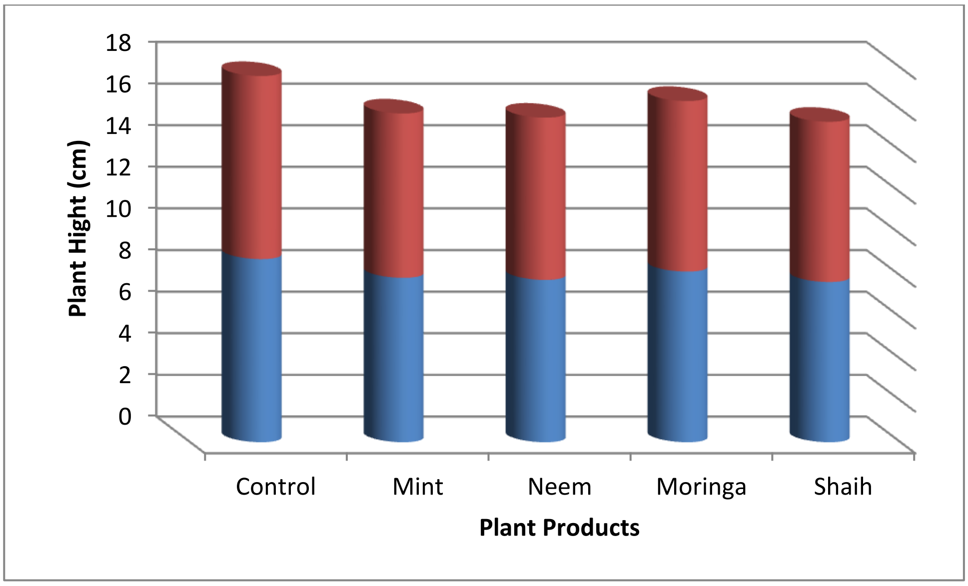

Figure 5. Number of leaves (cm) in the Nursery

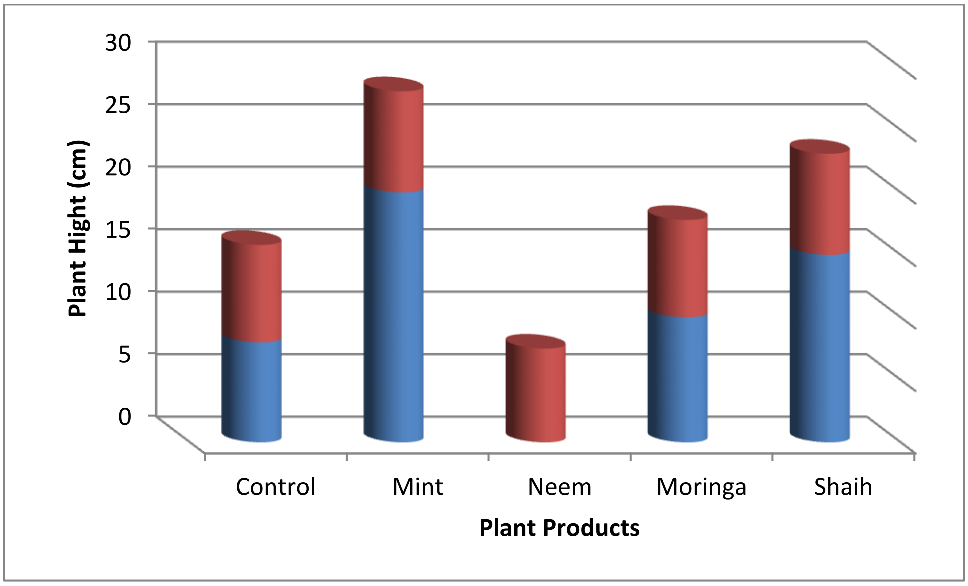

Figure 6. Stem diameter (cm) in the Nursery

CHAPTER FIVE

DISCUSSION

5.1 Vegetative Growth

Generally most of the growth attributes studied showed significant response to nitrogen in the vegetative growth with exception of plant height after 15days and 45 days, number of leaves after 15days and 45 days and stem diameter 15days ,45days and 75days. The increase in plant height with different nitrogen levels can be attributed to the fact that nitrogen promotes growth which results in progressive increase in plant height .similar results were reported by GoKmen *et al*.,(2001),Mahamoud *et al*., (2001), Bakht *et al*.,(2006), Dawadi and Sah (2012), Khan *et al*.,(2012)and Moraditochae *et al*.,(2012) indicated that nitrogen enhanced and significantly increased plant height .

Number of leaves per plant was significantly affected by nitrogen levelsin at 30days,60days and75days ,where the application of 80kg/ha increased number of leaves per plant over control. The increase in number of leaves per plant could be ascribed to the fact that nitrogen often increases plant growth Similar results were indicated by many researchers Ayub *et al*., (2003), Bakht *et al*.,(2006) and Nadeem *et al*.,(2009). The results of this study indicated significant differences in stem diameter. after 30days 80kg/ha with highest increase in stem diameter over control. The increase in stem diameter due to application of nitrogen can be explained by the fact that nitrogen promotes plants growth . similar result were reported by BaKht *et al*.,(2009) and Cheema *et al*.,(2010)who found that nitrogen significant increased stem diameter. Generally, the effect of the results of more nitrogen uptake was more pronouned in the field in the experiment as 80kg nitrogen gave better results than 40kg nitrogen.

5.2 Yield and Yield Components

Maize yield is high with fertilizer does as maize grain yield is highly responsive to supplemental nitrogen (Moose and Below,2008).In this study significant difference were detected in 100 seed weight , and grain yield and harvest index due to nitrogen fertilizer .significant only in nitrogen levels different in length of cub .there is not significant different in nitrogen levels ,plant products and interaction. plant products is a significant in number of seed per row.

The result of this study revealed a significant effect of number of rows per cob. between the fertilizers levels . Similar results were reported by Arif*et al*.,(2010), Hussin *et al*., (2010)who found significant effect of nitrogen on number of rows per cob.

The effect of plant products on some yield components were significant. There were significant effect in length of cub and number of row of cub. between the plant products. Length of cob ,number of seed per cob and number of seed per row were higher in 40kg than 80kg nitrogen but we add the plant products length of cob and was hiegher for all plant products and inconsistent for number of seed per row or per cob . The superiority of 80kg nitrogen was due to more nitrogen uptake as the result of the plant products .This was in line with Lata *et., al* (2004)and Patra *et al*(2006.2009) Who stated that some plants and their products inhibit nitrification and increased nitrogen uptake.

5.3 The Efficiency

The result of this study indicated that the difference plant products affects nitrogen uptake and increase it utilization by maize plant .yield was increased for the higher nitrogen application (80kg\ha)when we add Neem Moringa and Shaih However when Mint was added the yield of maize was higher at 40kg\ha nitrogen. Nitrogen use efficiency decreased significantly, with the increase of nitrogen rate. Probably this could be attributed to plants were unable to assimilate all of nitrogen taken up. Similar result was reported by Ciambalvo *et al*.,(2009) who indicated that nitrogen use efficiency decreased with the increase of nitrogen rate because the plant were unable to assimilate all of nitrogen taken up. Addition of plant products may increase this efficiency.

The result of this study showed that there were no significant differences between plant products in nitrogen use efficiency but there was a significant differences in the yield. Plant products, the treatment (80kg*neem) gave greater nitrogen use efficiency vegetative and yield growth other in the treatments.

Optimization of nitrogen used to sustain life and to minimize the negative impacts of nitrogen on the environment and human health is most important. Nitrogen use efficiency (NUE)which is considered an important factor in the management of nitrogen applications in crop production ,is expressed as the ratio between the grain yield and the total nitrogen accumulation. The assessment of the suitable nitrogen applications is a vital concern for. the nitrogen uptake efficiency. Nitrogen is lost merrily through leaching, denitrification ,volatilization crop removed sad erosion and run off . To minimize losses and increase nitrogen uptake, some plant products were used in this study to increase the efficiency and cut the cost of production. They act a natural nitrification inhibitors. The natural plant used showed a variable results. At 80kg nitrogen Moringa had the height and length of cub while neem gave the highest stem diameter and yield while shih the height seed per plant and seed per row. However at the pot experiment most of the nitrogen was lost and less nitrogen uptake was used by the plant at the lowest nitrogen rate (40kg). Moringa had the height plant height and the control showed the height number of leaves ,fresh and dry weight .This might be due to the lesser benifit of the nitrogen uptake by maize as most of the nitrogen is lost merrily through dnitification . This was supported by the findings of Raun and Johnson 2017,and Abera *et al* 2016.sevralother empirical studis have indicated that some plants and their byproducts inhibit nitrification (Lata *et al* 2004, Patra *et al* 2006,2009).

CONCLUSION AND RECOMMENDATIONS

The study was conducted during the seasons of 2017-2018 at the farm of Agricultural Studies ,Sudan University of Science and Technology to study the effect of plant natural products on nitrogen use efficiency yield and yield components of two maize (*Zea mays*. L) cultivar under irrigation .The following conclusions were reached.

1. The nitrogen significant increased most of vegetative growth characters.
2. Shaih gave the highest seed per plant of maize no significant difference between plant products.
3. Eighty kg\ha nitrogen was better for all character measured with the use of Plant products.
4. All plant products increase nitrogen uptake and utilization by maize.
5. Neem, Moringa and shaih gave the highest Maize yield at 80kgN\ha.
6. More studies are needed on the study of nitrogen use efficiency and nitrogen uptake.

References

Abdeihafiz, M. E., (2001). Effect of partially acidulated phosphate rocks and triple superphosphate and their combination on growth, mineral composition and yield of wheat, Ph.D. thesis, Sudan University of Science and Technology.

Abera, T, Wegry, D. and Debele,T.(2016).Varities and Nitrogen Rates on Grain yield and nitrogen use efficiency of highland maize in toke kutaye, Western Ethiopian .American journal of Experiment Agriculture .12(1);(1-16) .

Adam, H. S. **(2002).** Agroclimatology, Crop Water Requirements and water Management, Gezira Printing Company, Wad Medani, Sudan.

Ahmad, S. Q., Khan, S., Ghaffar, M., & Ahmad, F. (2011). Genetic Diversity Analysis for Yield and Other Parameters in Maize (Zea mays L.) Genotypes.

AOAC. (2007). Association of Official Analytical Chemist. Official Methods of Analysis. Assoc. of Analytical Chemist. 17th. Gaithersburg, DW. Washington. DC. USA.

Arif, M., M.T. **Jan**, N.U. **Khan**, H. **Akbar**, S.A. **Khan**, M.J. **Khan**, A. **Khan**, I. **Munir**, M. **Saeed** and A. **Iqbal**.(2010). Impact of plant populations and nitrogen levels on maize. Pak. J. Bot., 42(6): 3907–3913.

Ayub, M., R. **Ahmed** , M.A. **Nadeem**, B. **Ahmed** and R .M .A .**Khan**. (2003). Effect of different levels of nitrogen and seed rate on growth, yield and quality of maize fodder. Pak. J .Agric .Sci. 40: 140–143.

Bakhet, J., S. **Ahmad**1, M. **Tariq**, H. **Akber** and M. **Shafai**. (2006). Response of maize to planting methods and fertilizer n. J. of

Agricultural and Biological Science, 1(3): Sept., 1–14.

Bakht (2009). Response of maize (*Zea mays* L.) to seed priming with NaCl and salinity stress. DOI: 10.5424/sjar/20110901-113-10

Baligar, **V.C., N**.K. **Fageria, Z.L. He.** (2001). Nitrogen use efficiency in plants. Common Soil Plant Anal., 32: 921-950.

Bolanos and Edmeades (1993). Causes for Silk Delay in a Lowland Tropical Maize Population Article (PDF Available) in Crop Science 33(5) January 1993.

Cheema , M.A.,W .**Farhad** , M.F. **Salem** , H.Z. **Khan**, A .**Munir**, .M .A .**Wahid**, F.**Rasul** and H .M .**Hammad**. (2010). Nitrogen management strategies for sustainable maize production. Crop Environ. 1: 49–52

Dawadi, D. R. and S. K. **Sah.** (2012). Growth and yield of hybrid Maize (*Zea mays* L) in Relation to Planting Density and Nitrogen levels during Winter Season in Nepal. Trop. Agri. Res., 23 (3) : 218–227.

Duvick (1997). Post–Green Revolution Trends in Yield Potential of Temperate Maize in the North-Central United States. 39(6) ·

Giambalvo, D, **Ruisi** P, **Miceli** G .D, **Frenda** A. S, **Amato**, G. (2009). Nitrogen use efficiency and nitrogen fertilizer recovery of durum wheat genotypes as affected by inter specific competition. AgronomyJournal.2010;102(2):707715.DOI:10.2134/agronj2009. 0380.

Gokmen, S. O. **Sencar** and M.A. **Sakin**. (2001). Response of pop corn (Zeamays) to nitrogen rates andplant densities. Turkish J. of Agri.And Forestry. 25(1): 15 –23.

Hailare (2000). The Evaluation of Yield and Yield Component of Corn (Zea mays) and Peanut (Arachis hypogaea) Affect by Intercropping and

Manure. International Journal of Agriculture and Biosciences. P-ISSN: 2305-6622; E-ISSN: 2306-3599.

Hirel, B. and Lemaire, G. (2005). From agronomy and ecophysiology to molecular genetics for improving nitrogen use efficiency in crops. In: Enhancing the efficiency of nitrogen utilization in plants. S.S. Goyal, R. Tischner, and A.S. Basra (eds). Published by Food Products Press, NY, USA.

Hirel, B., J. **Le Gouis**, B. **Ney**, and A. **Gallais**. (2007). The challenge of improving nitrogen use efficiency in crop plants: towards a more central role for genetic variability and quantitative genetics within integrated approaches. J. Exptl. Bot., 58: 2369–2387.

Hirel, B., J. Le Gouis, B. Ney, and A. Gallais. (2007). The challenge of improving nitrogen use efficiency in crop plants: towards a more central role for genetic variability and quantitative genetics within integrated approaches. J. Exptl. Bot., 58: 2369–2387.

Hussian, N., Q. **Zaman**, M. A. **Nadeem** and A. **Aziz**.(2010). Response of maize varieties under agro ecological conditions of Dera Ismail Khan. J .Agric .Res, 48(1):59–63.

Kandil (2013). Response of some maize hybrids (*Zea mays* L.) to different levels of nitrogenous fertilization. 9(3):1902-1908 ·

Khan, N.W., N.K. **Ijaz**, A. **Khan.** (2012). Integration of Nitrogen Fertilizer And Herbicides For Efficient Weed Management In Maize Crop. Sarhad J. Agric., 28(3).

Kidist (2013). Simulating the impact of climate change on maize production in Ethiopia, East Africa. DOI: 10.1186/s40068-018-0107-z

Lata, J.C., Degrange, V., Raynaud, X., Maron, P.A., Lensi, R., and Abbadie, L. 2004. Grass populations control nitrification in savanna soils. Funct. Ecol., 18: 605–611.

Maduraimuthu and Desikan (2013). Foliar application of nutrients and plant growth regulators on growth and yield of finger millet. Journal of Pharmacognosy and Phytochemistry 2018; 7(3): 3032-3035.

Mahmoud (2001). Nutritional Status and Growth of Maize Plants as Affected by Green Microalgae as Soil Additives. Journal of Biological Sciences Year: 2001 | Volume: 1 | Issue: 6 | Page No.: 475-479. DOI: 10.3923/ jbs.2001.475.479.

Moll, R.H., E.J. **Kamprath**, and W.A. **Jackson**.(1982). Analysis and interpretation of factors which contribute to efficiency of nitrogen utilization.Agro. J., 74: 562–564.

Moose, S. and Below, F.E. (2008). Biotechnology approaches to improving maize nitrogen use efficiency. In: Molecular genetic approaches to maize improvement. Kriz, A.L. and B.A. Larkins (ends).Springer Berlin Heidelberg (Publisher).Volume 63. Part II.

Moraditochaee, M., M.K. Motamed, E. Azarpour, R.K. Danesh and H.R. Bozorgi. (2012). Effects of nitrogen fertilizer and plant density Management in corn farming. ARPN Journal of Agricultural and Biological Science, 7(2): 133–137.

Muchow, R.C. (1989). Comparative productivity of maize, sorghum and pearl millet in a semi-arid tropical environment. II. Effect of water deficits. Field Crops Res., 20: 207-219.

Nadeem, M .A .,Z .Igbal , M. Ayub , K .Mubeen and M .Ibrahim. (2009). Effect of nitrogen application on forage yield and quality of maize sown alone and in mixture with legumes. Pak. J. life soc.Sci. 7: 161–167.

Nesmith and Ritchie (1992). Short and Long-Term Responses of Corn to a Pre-Anthesis Soil Water Deficit in Agronomy journal 84(1) · January 1992.

Norton, J.M., Alzerreca, J.J., Suwa, Y., and Klotz, M.G. 2002. Diversity of ammonia monooxygenase operon in autotrophic ammonia oxidizing bacteria. Arch. Microbiol., 177: 139–149.

Patra, D.D., Kiran, U., Chand, S., and Anwar, M. 2009. Use of urea coated with natural products to inhibit urea hydrolysis and nitrification in soil. Biol. Fertil. Soils, 45: 617–621.

Patra, D.D., Kiran, Usha, and Pande, Preeti. 2006. Urease and nitrification retardation properties in natural essential oils and their by- products. Commun. Soil Sci. Plant Anal., 37: 1663–1673.

Raun, WR and Jonson , JV. (2017). Improving Nitrogen use efficiency for Cereal production. Oklahoma Experimental Oklahoma. U.S.A.

Salim (1991). Comparative studies of Mountain Maize (Zea mays L.) ecotypes in Kotli District, Azad Kashmir, Pakistan. ISSN: 1745-1604 (Print) 1745-1590 (Online) Journal homepage: https://www. tandfonline. com/loi/tbsm20.

Samborski, S., M. Kozak, R.A. Azevedo. (2008). Dose nitrogen uptake affect nitrogen uptake efficiency, or vice versa? Acta Physiol. Plant., 30: 419 –420.

Simith (2012). The stomatal complex consists of a pair of guard cells bracketed by a pair of subsidiary cells, which help regulate aperture size. Nov 21, 2012 - 2012 Nov;24(11):4577-89.

Slime,G.andAune,J.B (1991). Maize response to fertilizer Dosing at three Sites in the central |Rift valley of Ethiopia. Agronomg J.4:436-451.

Statista (2015). Forecast volume of maize produced in the European Union (EU 28) European Union-28: maize production volume forecast 2015-2027 Published by Nils-Gerrit Wunsch, Nov 5, 2016.

Upadhyay, R. K.; Patra, D. D. and Tewari, S. K. 2011. Natural Nitrification Inhibitore for High Nitrogen Use Efficiency, Crop Yield and for Curtailing Global Warming. J. Tropical Agric. 49(1-2):19-24.

Zamir (2013). Growth and yield behaviour of two maize hybrids (Zea mays l.) towards different plant spacing. Cercetari agronomice in moldova (agronomic research in moldavia)44(2).

Appendices

Appendix 1: F. Value of Plant Height for maize Field Experiment:

Source	D.f	15 days	30 days	45days	60days	75days
		F-table	F-table	F-table	F-table	F-table
Replication	2	2.71	0.14	0.05	0.38	0.51
Fertilizer	1	0.16^{NS}	6.15^{*}	1.45^{NS}	8.74^{**}	4.68*
Natural Product	4	2.11^{NS}	4.84**	2.06^{N}	3.75*	$0.29*^{NS}$
F*N	4	0.30^{NS}	1.20^{NS}	0.36^{NS}	4.07*	1.19
Error	18	-	-	-	-	-
Total	29	-	-	-	-	-
CV%		29.44	18.64	18.30	15.05	19.88
EMS	-	640.14	632.84	925.42	619.44	142.35

Appendix 2: F.Value of Number of leaves for maize Field Experiment:

Source	D.f	15 days	30 days	45days	60days	75days
Replication	2	1.60	3.51	0.23	8.63	0.94
Fertilizer	1	0.76^{NS}	0.44^{NS}	0.26^{NS}	61.12**	3.19^{*}
Natural Product	4	0.76^{NS}	0.75^{NS}	1.98^{NS}	7.8^{**}	0.14^{NS}
F*N	4	0.93^{NS}	2.54*	1.54^{NS}	0.59^{NS}	1.09^{NS}
Error	18	-	-	-	-	-
Total	29	-	-	-	-	-
CV%	-	15.31	16.70	13.8	11.9	21.10
EMS	-	1.97904	2.88	1.87	0.96	0.75

Appendix 3: F.Value of Steam Diameter for maize Field Experiment:

Source	D.f	15 days	30 days	45days	60days	75days
Replication	2	0.88	1.52	2.40	0.04	0.82
Fertilizer	1	1.21^{NS}	6.02^{*}	0.03^{NS}	14.17^{**}	0.58^{NS}
Natural Product	4	0.97^{NS}	0.23^{NS}	2.75*	7.65^{**}	0.81^{NS}
F*N	4	0.94^{NS}	0.65^{NS}	1.68^{NS}	3.85*	0.85^{NS}
Error	18	-	-	-	-	-
Total	29	-	-	-	-	-
CV%	-	95.32	19.01	13.41	9.26	8.86
EMS	-	64.77	2.82	1.28	48.29	0.418

Appendix 4: F.Value of Fresh, Dry Weight ,length of cob , Number of seed per row, Number of row of cob for maize Field Experiment :

Source	D.f	FRESH	DRY	N.of row / cob	Length of cob	N.of seed per row
Replication	2	2.05	2.24	0.28	0.22	0.98
Fertilizer	1	3.62^{*}	2.49^{NS}	0.01^{NS}	5.55^{*}	2.21^{NS}
Natural Product	4	1.15^{NS}	0.71^{NS}	4.58^{*}	0.33^{NS}	3.79^{*}
F*N	4	0.55^{NS}	0.72^{NS}	2.28^{NS}	0.87^{NS}	0.48^{NS}
Error	18	-	-	-	-	-
Total	29	-	-	-	-	-
CV%	-	24.4	59.73	8.33	15.15	23.17
EMS	-	0.17	0.066	1.03	12.75	20.31

Appendix 5: F.Value of Plant Height for maize Nursery Experiment :

Source	D.f	15 days	30days	45days	60days
Replication	2	0.52	1.83	1.20	0.61
Fertilizer	1	1.70^{NS}	11.09^{**}	1.51^{NS}	4.75^{*}
Natural Product	4	1.33^{NS}	3.50^{*}	1.07^{NS}	4.27^{*}
F*N	4	1.33^{NS}	1.80^{NS}	1.07^{NS}	2.92^{**}
Error	18	-	-	-	-
Total	29	-	-	-	-
CV%	-	33.13	11.96	37.28	18.00
EMS	-	114.14	41.08	10.77	135.04

Appendix 6: F. Value of Number of Leaves for maize Nursery Experiment:

Source	D.f	15 days	30days	45days	60days
Replication	2	0.49^{*}	2.86	4.48	2.00
Fertilizer	1	3.77^{NS}	5.09^{*}	0.01^{NS}	0.46^{NS}
Natural Product	4	1.28^{NS}	0.05^{NS}	0.68^{NS}	1.72^{NS}
F*N	4	0.87^{NS}	2.19^{NS}	1.08^{NS}	4.23^{*}
Error	18	-	-	-	-
Total	29	-	-	-	-
CV%	-	36.18	9.81	16.38	8.38
EMS	-	5.04	0.39	1.74	0.18

Appendix 7: F. Value of Steam Diameter for maize Nursery Experiment:

Source	D.f	15 days	30days	45days	60days
Replication	2	2.09	0.82	1.63	0.09
Fertilizer	1	2.77^{NS}	14.45^{**}	10.50^{**}	5.34^{*}
Natural Product	4	1.23^{NS}	0.83^{NS}	0.40^{NS}	0.33^{NS}
F*N	4	0.53^{NS}	3.10^{*}	1.62^{NS}	0.73^{NS}
Error	18	-	-	-	-
Total	29	-	-	-	-
CV%	-	40.19	7.28	13.28	13.74
EMS	-	2.39	0.13	0.43	1.17

Appendix 8: F. Value of Fresh and Dry Weight for maize Nursery Experiment:

Source	D.f	Fresh weight	Dry weight
Replication	2	1.50	0.52
Fertilizer	1	0.34^{NS}	3.53^{NS}
Natural Product	4	1.84^{NS}	2.08^{NS}
F*N	4	0.32^{NS}	1.64^{NS}
Error	18	-	-
Total	29	-	-
CV%	-	10.11	15.05
EMS	-	0.94	25.57