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Modulation of nutritional qualities of cucumber fruits by foliar application of naphthalene acetic acid and manganese

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Abstract

Cucumber is an important fruit vegetable for supply of essential nutrients to achieve balanced diets. Low soil micronutrients and poor flower induction have been attributed to low nutritional qualities of cucumber fruits. This study investigated the influence of foliar application of naphthalene acetic acid (NAA) and manganese (Mn) on nutritional qualities of cucumber fruits. Two varieties of cucumber were treated with three concentrations each of naphthalene and manganese. Proximate, manganese, magnesium and phosphorus contents of cucumber fruits were determined using atomic absorption spectrometry techniques and spectrophotometry. In *Poinsett* variety, application of NAA and Mn increased Mg content of cucumber fruit with highest Mg (17.4%) at 100 ppm of NAA and Mn. However, application of NAA and Mn decreased Mg content of cucumber fruit except at 50 and 100 ppm Mn alone in *Marketer* variety. Crude fibre of fruit increased in both varieties; *Poinsett* produced the highest crude fibre (17.87%) at 50 ppm Mn alone whereas *Marketer* produced highest crude fibre (19.75%) at 100 ppm NAA and 50 ppm Mn. Application of 100 ppm Mn alone produced the highest crude fat in both *Poinsett* (3.71%) and *Marketer* (3.59%). foliar application of NAA and Mn reduced moisture content of both *Poinsett* and *Marketer* by about 15%. High doses of NAA and Mn slightly increased carbohydrate content of *Poinsett* fruits and slightly decreased carbohydrate content of *Marketer* fruits. The study concluded that foliar nutrition of NAA and Mn could be used to achieve desired nutritional properties in cucumber fruits.

Keywords: Cucumber; Mineral content; External application; Phytohormone; Proximate analysis

Introduction

Cucumber (*Cucumis sativus* Linn) is one of the major vegetable crops cultivated in the temperate and sub-tropical zones of the world (Ibeawuchi et al., 2008; El-Wanis et al., 2012). It originated from Northern India and belongs to the gourd family Cucurbitaceae. In the world production, China leads the production of cucumber with a harvest of 54.32 million tons followed by Turkey, Iran, and the Russian Federation. In African, Egypt has the largest producer of cucumber with a harvest of 631,129 t/ha (FAOSTAT, 2018). In Nigeria, there was little or no production statistics like other fruit vegetables,but was reported to be cultivated mainly in the Northern and Eastern part of the country (Ekwu. et al., 2007) [1].

Van Luijk (2004) reported that more than 96% of edible unpeeled cucumber fruit is water. It is often eaten raw and used industrially in the manufacture of different cosmetics like perfumes, creams, soap and pesticides as a result of the presence of steroid content (Wang et al., 2007). Cucumber relaxes nerves, muscles and keeps blood circulating smoothly due to presence of magnesium in the fruit (Philip, 2010).

The vitamins in cucumber include vitamin A, B and C, as well as calcium and folic acid. Also, according to Kumar et al., (2010), traces of essential oils, amino acids, pectins, starch, sugar, and Cucurbitacins are found in cucumbers. Glycosides, steroids, flavonids, carbohydrates, terpenoids, and tannins were identified in an aqueous extract of the cucumber fruit) [2].

Plant growth regulators are organic compounds, other than nutrients modify plant physiological processes. They are normally active in low concentration in plants. Almost sixty plant regulators are commercially being used and several of them have reached considerable importance in crop production, thus influencing the crop yield and nutritional quality of the fruit crops (Al –Masoum and Al-Masri, 1999). Naphthalene acetic acid (NAA), is a plant growth regulator, that have been reported by Ajay et al., (2018), to play an important role in flower induction and fruit setting. Naphthalene acetic acid was reported to be involved in catalyzing cell division, cell elongation, elongation of shoot, photosynthesis, RNA synthesis membrane permeability and water uptake (Rafeekar et al., 2002). Also, Melissa and Nina (2005) reported that it has been used in several physiological processes such as banning of pre harvest fruit drop, fruit inducement and increased the yield of fruit crops) [3].

Manganese is an important plant mineral nutrient that plays a key role in several physiological processes, particularly photosynthesis, lignin synthesis and stress tolerance (Alloway, 2008). Also, manganese performs role in the enzyme activation during the nitrogen metabolism (glutamine synthetase, arginase), biosynthesis of fatty acid and RNA polymerization (Hansch and Mendel, 2009). Manganese sulfate is a common source of Mn fertilizer used in agricultural soil and it is required in low rate in foliar application. A suitable method for the correction or prevention of manganese deficiency in plants is the foliar application of ionic or chelated solution forms of this nutrient (Papadakis et al., 2007. Although the beneficial effect of Manganese nutrition in cucumber has been proved in numerous studies, inadequate information is available regarding the foliar application of manganese on nutritional qualities of cucumber) [4,5].

Minerals are inorganic substances, present in all body tissues and fluids and their presence is necessary for the maintenance of certain

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physicochemical processes which are essential to life. The mineral elements are separate entities from the other essential nutrients like proteins, carbohydrates, fats and vitamins. Minerals are chemical constituents, yield no energy but play an important role in many body activities. (Malhotra, 1998; Eruvbetine, 2003). Every form of living matter requires these inorganic elements or minerals for their normal life processes (Hays and Swenson, 1985; Ozcan, 2003). Minerals may be broadly classified as macro (major) or micro (trace) elements. The third category is the ultra-trace elements. The significance of the mineral elements in human, animal and plant nutrition has been well recognized (Underwood,1971;Darby,1976). Mineral elements also play important roles in health and disease states of humans and domestic animals. For example, iron deficiency anemia and goitre due to iodine deficiency are reported to be problems of public health importance in some communities (Partwardhan, 1961; Deosthale and Belavady, 1978)) [6, 7].

Phosphorus has been reported as a second most abundant mineral found in every cell of the body as part of DNA (Deoxyribonucleic acid) and RNA (Ribonucleic acid) which served as the building blocks of life and growth (Kathleen et al., 2009). Phosphorus, like calcium, also build bones and teeth. It is also important in the metabolism of ATP (Adenosine tri phosphate) in which bodies obtain and expend cellular energy from food. Additionally, vitamin B can only become active in the body when it is chemically attached to phosphates) [8].

In the human body, there are just 20 milligrams of manganese, primarily found in the bones and vital organs. However, this trace mineral is still crucial in the bone formation and metabolic functions. Manganese is readily found in nuts, whole grains, leafy and fruit vegetables and tea (Philip, 2010) [9].

Magnesium as the final major mineral found in the body is present only an ounce or less. While this amount is tiny compared to the amount of calcium, magnesium takes part in over 300 reactions in the body. In bones, more than half of the body's magnesium is found compared to other body parts. Calcium and magnesium complement one another by providing strength and elasticity to prevent injury. It also assists in muscle contraction, blood clotting, regulation of blood pressure and lung function. Magnesium can also be found in many foods such as whole grains, dark green vegetables, fruits and sea food (Philip, 2010)) [10].

Little or no information is available on the nutritional component of different cultivars of cucumber in Nigeria and little efforts have been made to evaluate the effect of manganese usage and naphthalene acetic acid on the proximate composition and mineral content of the crop as these will affect the nutritional quality of the cucumber varieties. Therefore there is need to evaluate the influence of application of naphthalene acetic acid and manganese on cucumber in order to document the effects on nutritional component of cucumber fruit. The objectives of this study were to determine the influence of naphthalene acetic acid and manganese foliar supplementation on manganese, magnesium and phosphorus and proximate composition of cucumber fruits) [11, 12].

Methodology

Fresh fruits of cucumber were used for the laboratory analysis. The proximate composition of the cucumber fruit was determined using AOAC procedure 2006.

Determination of Magnesium, Manganese and Phosphorus contents

Magnesium, Manganese and Phosphorus were determined from samples of cucumber fruits after they have been blended. The magnesium, manganese and phosphorus determination was carried out on digested samples of cucumber fruits using standard procedures as reported by Shumaila and Mahpara (2009). Manganese and Magnesium were determined using the Atomic Absorption Spectrometry Techniques while Phosphorus was determined using the Spectrophotometry) [13].

Procedure for determination of Manganese and Magnesium.

The digested samples were analyzed for manganese and magnesium contents in cucumber fruit by Atomic Absorption Spectrometry Techniques (Hitachi model 170-10) in the Central Science Laboratory, Obafemi Awolowo University, Ile-Ife. The absorption measurement of the manganese and magnesium were carried out on digested samples of cucumber fruit at 830 nm wave length) [14].

Different electrode lamps were used for each mineral. The equipment was run for standard solutions to check that it is working properly. For the dilution, 0.5 ml original solution of each element was added with enough distilled water to make the volume up to 100 ml) [15].

The concentration of minerals recorded in terms of part per million (ppm) was converted to milligrams (mg) of the minerals by multiplying the ppm with dilution factor and dividing by 1000 as follows:

$$\text{Magnesium (mg/l)} = \frac{\text{absorbance (ppm) x dry weight x 10,000}}{\text{Weight of sample x 1000}}$$

$$\text{Manganese (mg/l)} = \frac{\text{absorbance (ppm) x dry weight x 100}}{\text{Weight of sample x 1000}}$$

Procedure for determination of Phosphorus

Phosphorus contents in cucumber fruit juice sample were determined by the method described by the Association of Agricultural Chemists (AOAC, 2006) using Spectrophotometry at Central Science Laboratory, Obafemi Awolowo University, Ile-Ife. Twelve grams of the ammonium molybdate was taken and mixed with 250 ml distilled water in a beaker (solution A). Then 0.2908 gm antimony potassium tartarate was weighed and dissolved in 500 ml H2SO4 (5N) solution in a volumetric flask. Enough distilled water was added to make solution up to 1000 ml (solution B). The solution was divided into two (solution A and B) and they were mixed with distilled water in a 2000 ml beaker. Thereafter, 0.739 gm of ascorbic acid was mixed with 140 ml of the mix reagent in a beaker and left until it was dissolved to make colour reagent and one milliliter of wet digested duplicate fruit sample was taken in a plastic bottle labeled properly and to it was added 4.0 ml distilled water to make a diluted volume of 5.0 ml. Lastly, five milliliters (5.0 ml) of colour reagent was added to this volume and the total volume of this mixture (final solution) was made up to 25.0 ml. The dilution factor of this solution was 2500 (100 x 25). After sometime, the colour of this final solution turned blue) [16, 17].

Phosphorus analysis: sample from final blue solution was taken in a cuvett and introduced to spectrophotometer. The readings of the phosphorus were recorded in part per million.

Calculation of phosphorus: The calculation for the total phosphorus intake was done by the formula given below:

$$\text{Phosphorus (mg/l)} = \frac{\text{absorbance (ppm) x dry weight x 10,000}}{\text{Weight of sample x 1000}}$$

Statistical Analysis

The data collected were subjected to descriptive and quantitative analysis using analysis of variance (ANOVA) using (SAS, 2003). Means of significant treatments were separated using the Fisher's Least Significant Difference at 0.01 and 0.05 probability level (Steel and Torrie, 1987) [18].

Results

Influence of foliar application of Manganese and naphthalene acetic acid on

Magnesium, Manganese and Phosphorus contents of cucumber variety

The Table 1 below shows the mean values and standard error of interaction of variety, naphthalene acetic acid and Manganese on Magnesium, Manganese and Phosphorus contents of cucumber fruit. As the concentration of manganese applied to Poinsett variety that received no naphthalene acetic acid (NAA) application increased, Magnesium content of cucumber fruit increase) [19]. However, the Magnesium content of cucumber fruit of Marketer variety that received no application of naphthalene acetic acid initially increased but remained constant thereafter. Furthermore, as the concentration of Manganese applied to Poinsett variety with 50 ppm NAA increased, Magnesium content of cucumber fruit initially increased but later reduced. Also, increase in concentration of Manganese applied with 50 ppm NAA to Marketer variety decreased the Magnesium content of cucumber fruit. Moreover, as the concentration of Manganese applied to Poinsett variety with 100 ppm NAA application increased, Magnesium content of cucumber fruit decreased thereafter increased. Also, the Magnesium content of cucumber fruit of Marketer variety in the first instance decreased but later increased with the increase in concentration of Manganese applied with 100 ppm NAA) [20].

Based on Manganese content of cucumber fruit, as the concentration of Manganese applied to Poinsett variety with no NAA application increased, Manganese content in cucumber fruit of Poinsett initially decreased and thereafter increased while in Marketer variety, Manganese content of the cucumber fruit drastically decreased as the concentration of Manganese applied increased with no NAA application. Similarly, as the concentration of Manganese applied to Poinsett variety that received 50 ppm NAA application increased, Manganese content of cucumber fruit increased thereafter reduced while in Marketer variety, the Manganese content of cucumber fruit decreased with the increased in Manganese concentration applied and 50 ppm NAA. Also, Manganese content of cucumber fruit of Poinsett variety initially decreased but later drastically increased with the increase in application of Manganese applied with 100 ppm NAA to Poinsett variety. However, the Manganese content of cucumber fruit of Marketer variety also decreased thereafter increased with increased in concentration of Manganese applied with 100 ppm NAA) [21].

Additionally, the Phosphorus content of cucumber fruit decreased as the concentration of Manganese applied to Poinsett variety with no NAA application increased while in Marketer variety, increased in concentration of Manganese applied with no NAA application lead to initial decreased in Manganese content of cucumber fruit but later increased. Likewise, as the concentration of Manganese applied to Poinsett variety with 50 ppm NAA application increased, Phosphorus content of cucumber fruit increased thereafter decreased. Also, increase in concentration of Manganese applied to Marketer variety with 50 ppm NAA application resulted in increased in Phosphorus content of cucumber fruit thereafter decreased) [22].

Lastly, as the concentration of Manganese applied to Poinsett variety that received 100 ppm NAA application increased, Phosphorus content of cucumber increased thereafter decreased

Proximate analysis

Table 2 shows the mean values and standard error of interaction of variety, naphthalene acetic acid and Manganese on percentage crude protein, carbohydrate and ash content. As the concentration of Manganese applied to Poinsett variety that received no naphthalene acetic acid (NAA) application increased, percentage crude protein of cucumber fruit initially increased thereafter decreased. However, the percentage crude protein of cucumber fruit of Marketer variety with no NAA application increased but later decreased. Also, percentage

Table 1: Mean values and standard error of interaction of variety, naphthalene acetic acid and Manganese on Magnesium, Manganese and Phosphorus contents.

Interactions	Magnesium (mg/l) Content	Manganese (mg/l) Content	Phosphorus (mg/l) Content
P NAA_0 Mn_0	50.77±0.35	0.59±0.02	21.7±0.06
P NAA_0 Mn_{50}	51.03±0.35	0.36±0.02	19.11±0.06
P NAA_0 Mn_{100}	56.88±0.35	0.54±0.02	19.33±0.06
P NAA_{50} Mn_0	54.11±0.35	0.59±0.02	19.00±0.06
P NAA_{50} Mn_{50}	59.19±0.35	0.61±0.02	19.80±0.06
P NAA_{50} Mn_{100}	50.06±0.35	0.44±0.02	19.29±0.06
P NAA_{100} Mn_0	56.51±0.35	0.98±0.02	19.00±0.06
P NAA_{100} Mn_{50}	49.78±0.35	0.84±0.02	20.89±0.06
P NAA_{100} Mn_{100}	59.58±0.35	1.13±0.02	18.09±0.06
M NAA_0 Mn_0	51.57±0.35	0.71±0.02	21.75±0.06
M NAA_0 Mn_{50}	56.55±0.35	0.66±0.02	19.39±0.06
M NAA_0 Mn_{100}	56.88±0.35	0.41±0.02	19.92±0.06
M NAA_{50} Mn_0	44.75±0.35	0.48±0.02	18.82±0.06
M NAA_{50} Mn_{50}	39.94±0.35	0.37±0.02	19.44±0.06
M NAA_{50} Mn_{100}	36.47±0.35	0.28±0.02	18.57±0.06
M NAA_{100} Mn_0	44.75±0.35	0.38±0.02	19.02±0.06
M NAA_{100} Mn_{50}	40.78±0.35	0.29±0.02	21.26±0.06
M NAA_{100} Mn_{100}	42.78±0.35	0.43±0.02	21.00±0.06

P: Poinsett, M: marketer, NAA_0, NAA_{50}, NAA_{100},: naphthalene acetic acid at 0, 50 and 100 part per million, Mn_0, Mn_{50}, Mn_{100} : Manganese at 0,50 and 100 part per million.

Table 2: Mean values and standard error of interaction of variety, naphthalene acetic acid and Manganese on percentage crude protein, carbohydrate and ash content.

Interactions	% Crude Protein	% Carbohydrate	% Ash
P NAA_0 Mn_0	16.25±0.19	54.18±0.24	9.34±0.19
P NAA_0 Mn_{50}	17.87±0.19	53.56±0.24	9.02±0.19
P NAA_0 Mn_{100}	14.51±0.19	59.68±0.24	9.44±0.19
P NAA_{50} Mn_0	16.47±0.19	59.11±0.24	10.74±0.19
P NAA_{50} Mn_{50}	16.41±0.19	57.89±0.24	10.83±0.19
P NAA_{50} Mn_{100}	17.18±0.19	55.05±0.24	11.60±0.19
P NAA_{100} Mn_0	15.61±0.19	59.68±0.24	8.18±0.19
P NAA_{100} Mn_{50}	13.26±0.19	59.80±0.24	10.29±0.19
P NAA_{100} Mn_{100}	16.53±0.19	58.45±0.24	11.27±0.19
M NAA_0 Mn_0	14.81±0.19	59.21±0.24	9.32±0.19
M NAA_0 Mn_{50}	16.26±0.19	60.42±0.24	10.80±0.19
M NAA_0 Mn_{100}	16.08±0.19	55.59±0.24	11.48±0.19
M NAA_{50} Mn_0	15.25±0.19	59.99±0.24	10.32±0.19
M NAA_{50} Mn_{50}	16.98±0.19	58.88±0.24	9.32±0.19
M NAA_{50} Mn_{100}	16.19±0.19	59.88±0.24	10.02±0.19
M NAA_{100} Mn_0	15.86±0.19	55.59±0.24	12.42±0.19
M NAA_{100} Mn_{50}	19.75±0.19	54.14±0.24	13.36±0.19
M NAA_{100} Mn_{100}	19.75±0.19	56.36±0.24	13.36±0.19

P: Poinsett, M: marketer, NAA_0, NAA_{50}, NAA_{100},: naphthalene acetic acid at 0, 50 and 100 part per million, Mn_0, Mn_{50}, Mn_{100} : Manganese at 0, 50 and 100 part per million.

crude protein in cucumber fruit of Poinsett variety decreased thereafter increased as the concentration of Manganese applied increased with 50 ppm NAA application. Meanwhile, in Marketer variety, increase in concentration of Manganese applied with 50 ppm NAA application initially resulted in increase in percentage crude protein of cucumber fruit but later reduced. Similarly, as the concentration of Manganese applied to Poinsett variety with 100 ppm NAA application increased, percentage crude protein of cucumber fruit decreased but later drastically increased while the Marketer variety with 100 ppm NAA application, increased the percentage crude protein but remained stagnant thereafter) [23]. Furthermore, percentage carbohydrate in cucumber fruit decreased in Poinsett variety thereafter increased, as the concentration of Manganese applied with no NAA application increased while the percentage carbohydrate in cucumber fruit of Marketer variety with no NAA application increased but later decreased. Also, the percentage carbohydrate of cucumber fruit decreased as the concentration of Manganese applied to Poinsett variety that received 50 ppm NAA application increased whereas, in Marketer variety, increase in concentration of Manganese applied with 50 ppm NAA increased the percentage carbohydrate of cucumber fruit. Increase in concentration of Manganese with 100 ppm NAA application to Poinsett variety initially remained stagnant in percentage carbohydrate and thereafter increased. But in Marketer variety, increase in concentration of Manganese applied with 100 ppm NAA application decreased the percentage carbohydrate of cucumber fruit later increased. Likewise, as the concentration of Manganese applied to Poinsett variety with no NAA application increased, the percentage ash content of cucumber fruit decreased but later increased while in Marketer variety with no NAA application, percentage ash content increased. Also, increase in concentration of Manganese applied to Poinsett with 50 ppm NAA application, increased the percentage ash content of cucumber fruit while in Marketer variety, with 50 ppm NAA application, percentage ash content initially decreased thereafter increased. The percentage ash content of cucumber fruit in Poinsett variety increased as the concentration of Manganese applied increase with 100 ppm NAA. Marketer variety with 100 ppm NAA application increased the percentage ash content of cucumber fruit but remained stagnant thereafter) [24, 25].

Moreover, mean values and standard error of interactions of variety, naphthalene acetic acid and Manganese on percentage crude fat, crude fibre, moisture content and dry matter are shown in Table 3. As the concentration of Manganese applied to Poinsett variety with no NAA application increased, percentage crude fat of cucumber fruit decreased but later increased while the percentage crude fat in cucumber fruit of Marketer variety increased with no NAA application. The percentage crude fat of cucumber fruit of Poinsett variety decreased as the concentration of Manganese applied with 50 ppm NAA application to Poinsett variety increased, whereas in Marketer variety with the same level of NAA application, the percentage crude fat of cucumber fruit increased. As the concentration of Manganese applied with 100 ppm NAA application increased, the percentage crude fat of cucumber fruit of Poinsett variety increased. However, percentage crude fat of cucumber fruit of Marketer variety also increased with increased in concentration of Manganese applied with 100 ppm NAA application) [26, 27].

Based on percentage crude fibre of cucumber fruit, as the concentration of Manganese applied to Poinsett variety with no NAA application increased, the percentage crude fibre of cucumber fruit of Poinsett variety initially decreased, thereafter increased. Also, the percentage crude fibre of cucumber fruit of Marketer variety that received no application of NAA in the first instance increased but later decreased. Similarly, the percentage crude fibre of cucumber fruit of Poinsett variety decreased with increase in concentration of Manganese applied and 50 ppm NAA application while in Marketer variety, there was drastical decrease in percentage crude fibre thereafter slightly increased with 50 ppm NAA application . Also, as Manganese concentration applied to Poinsett variety increase with 100 ppm NAA application, the percentage crude fibre of cucumber fruit of Poinsett variety increased. Meanwhile, Marketer variety with the same NAA application level resulted in initial decrease in percentage crude fibre and thereafter increased) [28].

Additionally, as the concentration of Manganese applied to Poinsett variety that received no NAA application increased, percentage

Table 3: Mean values and standard error of interaction of variety, naphthalene acetic acid and Manganese on percentage crude fat, crude fibre, moisture content and dry matter.

Interactions	% Crude fat	% Crude fibre	% Moisture Content	% Dry matter
P NAA_0 Mn_0	3.25±0.10	8.59±0.04	16.21±0.14	83.79±0.15
P NAA_0 Mn_{50}	2.10±0.10	8.00±0.04	10.38±0.14	83.60±0.15
P NAA_0 Mn_{100}	3.71±0.10	8.42±0.04	13.27±0.14	86.73±0.15
P NAA_{50} Mn_0	3.09±0.10	15.15±0.04	10.38±0.14	89.62±0.15
P NAA_{50} Mn_{50}	2.87±0.10	10.25±0.04	12.75±0.14	87.25±0.15
P NAA_{50} Mn_{100}	2.52±0.10	8.81±0.04	13.49±0.14	86.50±0.15
P NAA_{100} Mn_0	3.71±0.10	8.77±0.04	14.58±0.14	85.42±0.15
P NAA_{100} Mn_{50}	2.5±0.101	10.14±0.04	14.74±0.14	85.26±0.15
P NAA_{100} Mn_{100}	2.17±0.10	10.81±0.04	11.65±0.14	88.35±0.15
M NAA_0 Mn_0	2.18±0.10	3.46±0.04	14.19±0.14	85.81±0.15
M NAA_0 Mn_{50}	3.32±0.10	9.62±0.04	12.28±0.14	90.59±0.15
M NAA_0 Mn_{100}	3.59±0.10	7.57±0.04	13.45±0.14	86.52±0.15

moisture content of cucumber fruit decreased thereafter increased. Also, percentage moisture content of cucumber fruit of Marketer variety decreased but later increased with no NAA application. The percentage moisture content of cucumber fruit increased, as the concentration of Manganese applied to Poinsett variety with 50 ppm NAA application increased. Meanwhile, percentage moisture content of cucumber fruit of Marketer variety decreased with increased in concentration of Manganese applied and 50 ppm NAA application. Also, the percentage moisture content of cucumber fruit of Poinsett variety with increase in concentration of Manganese applied and 100 ppm NAA application increased and thereafter decreased. The percentage moisture content of cucumber fruit of Marketer variety was also increased initially but later decreased with increase in Manganese applied with 100 ppm NAA. Finally, as the concentration of Manganese applied to Poinsett variety with no NAA application increased, percentage dry matter slightly decreased and thereafter increased. However, the percentage dry matter of cucumber fruit of Marketer variety that received no NAA application initially increased but later decreased. Also, percentage dry matter of cucumber fruit of Poinsett variety increased with increase in concentration of Manganese applied and 50 ppm NAA application. Meanwhile, in Marketer variety, percentage dry matter of cucumber fruit increased in the first instance thereafter remained stagnant as the concentration of Manganese applied with 50 ppm NAA application increased . The percentage dry matter of cucumber fruit of Poinsett variety slightly decreased but later increased with an increase in concentration of Manganese applied and 100 ppm NAA application while in Marketer variety, increase in concentration of Manganese applied and 100 ppm NAA application increased the percentage dry matter of cucumber fruit and thereafter decreased it) [29].

Discussion

Plant nutrition is one of the most important problems in crop production which have important roles in quantitative and qualitative yield of agricultural produce. Mineral elements though usually form a small portion of total composition of most plant material and of total body weight; they are nevertheless of great physiological importance. Determination of mineral elements in plants is very important, since the quality of many foods and medicines depends upon the content and types of minerals.

From the mineral identification analysis, 100 ppm Mn and 100 ppm NAA produced the highest Magnesium (59.58 mg/l) and Manganese (1.13 mg/l) in Poinsett while the least Magnesium (49.78 mg/l) and Manganese (0.36 mg/l) was observed from 100 ppm NAA and 50 ppm Mn, and 50 ppm Mn application, respectively. This implies that exogenous application of Manganese and naphthalene acetic acid increase the Manganese (mg/l) content, as well as of the cucumber varieties. Manganese is an essential mineral nutrients that have the key roles in the activation of enzymes needed for the digestion and utilization of foods and nutrients. It is also plays role in reproduction and bone growth. It is sometimes called the 'brain' mineral as it is important to mental function. Due to the importance of manganese in enzyme activation, a deficiency can adversely affect many bio-chemical processes in the body but may be difficult to determine. Because it is so necessary for the body's energy and heat, a person with a manganese deficiency will feel tired and weak (Philip, 2010) [30].

For phosphorus content, the highest was observed from control plot although it was not different from the interaction of 50 ppm NAA and 50 ppm Mn. This implies that application of treatments slightly decrease the Phosphorus content present in Poinsett variety.

However, in Marketer variety, the highest Magnesium (56.88 mg/l) was found in 100 ppm Mn while the interaction of 50 ppm NAA and 100 ppm Mn produced the least Magnesium content. On the other hand, control plot resulted in highest Manganese (0.71 mg/l) and Phosphorus (21.75 mg/l) respectively content. This implied that treatments applied decrease the presence of the two minerals in Marketer variety. Magnesium has been found to regulate and improve blood sugar content ,secretion and functioning of insulin to open cell membrane for glucose and insufficient of magnesium intake may cause the high blood sugar level (Philip, 2010). Akpanabiater et al. (1998) also reported that Magnesium is an essential cofactor in many enzymatic reactions in intermediary metabolism.

Phosphorus is an important constituent of nucleic acids and cell membrane, and is directly involved in all energy-producing cellular reactions (Knochel et al., 2006). Phosphorus also has been shown to play a vital role in normal kidney functioning and transfer of nerve impulses (Igile et al., 2013) [31].

According to the proximate analysis, 50 ppm Mn produced the highest percentage crude protein (17.87%) in Poinsett variety while in Marketer variety interaction of 100 ppm NAA and 100 ppm Mn gave the highest content of crude protein (19.97%). Proteins are essential components of diet needed for survival of animals and human beings whose basic function is to supply adequate amounts of required amino acids for nutrition (Pugalenthal et al., 2004). Protein deficiency causes growth retardation, muscle wasting, abnormally swelling of the belly and collection of fluids in the body (Perkins-Veazie et al., 2005).

The highest percentage carbohydrate in Poinsett variety (59.80%)

was produced from the application of 100 ppm NAA and 50 ppm Mn whereas in Marketer variety, 100 ppm NAA and 50 ppm Mn contributed to the highest carbohydrate (59.80%). The least amount of carbohydrate (53.56%) was produced from the Poinsett and 0 ppm NAA and 50 ppm Mn. It is important to note that samples with high carbohydrate content might not be best for diabetic and hypertensive patients requiring low sugar diets.

Furthermore, the highest percentage ash content was found in Poinsett interacting with 50 ppm NAA, and 100 ppm Mn. Also, the best ash content (13.96%) in Marketer variety was influenced by the application of 100 ppm NAA and 100 ppm Mn. The result was in agreement with the finding of Bello et al. (2008) that reported that high ash contents are expected to have high concentrations of various mineral elements, which are expected to speed up metabolic processes and improve growth and development.

Moreover, according to the results, the interaction of 0 ppm NAA and 100 ppm Mn with Poinsett produced the highest percentage crude fat (3.71%) in Poinsett variety, while in Marketer variety, Marketer 0 ppm NAA and 100 ppm Mn interaction gave the best percentage crude fat (3.59%). Despite the high content of crude fat obtained in some varietal treatments interaction, it is still low compared with protein contents recorded. Low crude fat obtained from this study in comparison to proteins, suggests that the Marketer and Poinsett of cucumber could be recommended as a good source of food supplement for patient with cardiac problems or at risk with lipids induced disorder.

Based on the crude fibre, highest percentage crude fibre (15.15%) was greatly influenced by the interaction of Poinsett and 50 ppm NAA and 0 ppm Mn in Poinsett variety whereas in the Marketer variety, application of 100 ppm NAA and 0 ppm Mn gave the highest crude fibre (14.77%). Fruit fibre has a better quality than other sources due to its high total and soluble fibre content, water and oil holding capacity and caloric fermentability, as well as a lower phytic acid and caloric value content (Figuerolla et al., 2005). Crude fibre obtained from this study suggests that cucumber is a potential source of dietary fibre (roughages). High level of fibre is known as anti-tumorigenic and hypo cholestrolaemic agent (Okoro and Achuba, 2012). It was also reported by Rodrigueze et al. (2006) that dietary fibre has the beneficial effects in the prevention of several diseases, such as cardiovascular diseases, constipation, irritable colon, colon cancer, and diabetes. This implies that the cucumber may be recommended for people with cholesterol related problem.

However, highest percentage moisture content (16.21%) and (14.19%) was found in the control plot of both Poinsett and Marketer varieties considered. This indicated that treatment applied had no significant impact on the moisture content. It was observed from this study, that moisture content was generally low. This could imply relatively longer shelf life in fruit, as the high moisture content could lead to high perishability and increase vulnerability to microbial attack if left for too long.

Lastly, Poinsett and 50 ppm NAA and 0 ppm Mn produced the best percentage dry matter (89.62%) in Poinsett variety. Meanwhile in Marketer variety, highest percentage dry matter (90.59%) was obtained from the interaction of Marketer and 0 ppm NAA, and 50 ppm Mn) [32].

Conclusions and Recommendation

In summary, highest content of Magnesium (59.58 mg/l) and Manganese (1.13 mg/l) in Poinsett variety were obtained by 100 ppm NAA and 100 ppm Mn interaction while in Marketer variety, exogenous application of 100 ppm Mn and 50 ppm NAA gave the highest Magnesium (56.88 mg/l) and Manganese contents. However, foliar application of Mn, or NAA alone and their interactions slightly decrease the Phosphorus contents present in cucumber fruits.

However, from the proximate analysis, it was discovered that; Poinsett and 50 ppm NAA showed the highest percentage crude protein while Marketer and 100 ppm NAA produced the highest crude protein. Percentage crude protein from varietal treatments interaction with naphthalene acetic acid and Manganese tested was highest in Poinsett and 50 ppm NAA and 100 ppm Mn and Marketer and 50 ppm Mn and 100 ppm NAA.

Marketer and 100 ppm Mn produced the highest crude fat while in Poinsett variety, application naphthalene acetic acid and Manganese tested, had no influence effect as the control plot performed best. But at varietal treatments interaction, Poinsett variety performed best at Poinsett and 50 ppm NAA and 50 ppm Mn.

Poinsett variety responded best to 100 ppm NAA and Poinsett and 50 ppm Mn and 100 ppm NAA to give the highest percentage carbohydrate content. According to the results, percentage carbohydrate content, Poinsett and 50 ppm Mn and 100 ppm NAA and Marketer and 50 ppm NAA and 100 ppm Mn produced the maximum out of the various level of naphthalene acetic acid and Manganese tested.

Additionally, highest percentage moisture content for Poinsett and Marketer varieties was produced from control, while on the Poinsett and Marketer varietal interaction with different levels of naphthalene acetic acid and Manganese tested, Poinsett and 50 ppm Mn and 100 ppm NAA, and Marketer and 50 ppm NAA and 100 ppm Mn.

The highest ash content for Poinsett was found in Poinsett and 50 ppm NAA, Poinsett and 50 ppm NAA and 100 ppm Mn, while in Marketer variety, Marketer and 100 ppm Mn and Marketer and 50 ppm Mn and 100 ppm NAA produced the highest ash content.

Similarly, highest crude fat was found for Poinsett variety, Poinsett and 50 ppm NAA, Poinsett and 50 ppm NAA and 50 ppm Mn. Marketer and 100 ppm Mn, Marketer and 100 ppm Mn and 100 ppm NAA showed the highest percentage crude fat content.

Lastly, Poinsett and Marketer accounted for the highest dry matter when treated with Poinsett and 50 ppm NAA, Poinsett and 100 ppm Mn and 100ppm NAA and Marketer and 50 ppm Mn and Marketer and 50 ppm Mn and 100 ppm NAA respectively.

Mineral identification and proximate analysis showed that separate application of Naphthalene acetic acid and Manganese and their interaction at different levels enhance the present of minerals and most secondary metabolites.

This result therefore suggest that fruit farmers who have intention of producing high quality

Cucumber fruit should adopt the use of Manganese at 50 ppm application for good quantity and quality.

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