Novelty Journals

International Journal of Novel Research in Life Sciences
Vol. 2, Issue 1, pp: (42-48), Month: January - February 2015, Available at: www.noveltyjournals.com

Effect of Poultry Manure and NPK (17-17-17) On Growth and Yield of Carrot in Rulindo District, Rwanda

[1]HABIMANA Sylvestre, [2]MUKESHIMANA Constance, [3] NDAYISABA Esdras, [4] NDUWUMUREMYI Athanase

[1, 2, 3] Department of Crop Science, College of Agriculture, Animal Sciences and Veterinary Medicine, University of Rwanda

[4]Rwanda Agriculture Board, Department of Natural Resource Management, Po BOX 5016, Kigali, Rwanda

Abstract: **In Rwanda, the farmers have been using the poultry manures some years back as an alternative to inorganic fertilizer for increasing the production of vegetables to small scale farmers. However, there is a lack of its fixed dose recommendation for vegetable and other crops in general. The aim of this study was to evaluate the effect of poultry manure and NPK (17-17-17) on growth and yield of carrot. A randomized complete block design experiment was conducted in December, 2013 to March 2014 in Rulindo District to The treatments used were 300NPK kg ha-1 (T1), 10t ha-1 Poultry manure (T2), combination of poultry manure (5tha-1PM and 150NPKkg ha-1) (T3) and control (T0). Number of leaves and plant height were recovered as growth parameters while tuber shoulder diameter, length of taproot and weight of taproots, marketable and non marketable yield, number of cracked and forked roots were evaluated as yield and yield component parameters. The results showed that 10 t ha-1 of poultry manure (PM) significantly ($p<0.05$) presented higher performance for all evaluated parameters; the highest mean data recorded at last day were 44.87.66cm (plant height), 14.6cm(length of taproot), 31.66tha-1(yield),29.16tha-1 (marketable yield),and was recorded with the 10tha-1PM recorded high root yield which on par with the combination of 5tha-1 PM+150kgha-1 NPK (28.83tha-1) followed by 300NPK kgha-1(24.35tha-1), while the lowest yield of 15.91tha-1was obtained in the control. Poultry manure generated may be considered as a good source of organic fertilizer as it contains considerable amounts of both macro and micronutrients which are crucial for the growth and yield of crops. Therefore this study recommends the use of poultry manure in carrot production at a dose of 10 t ha-1in Rulindo district.**

Keywords: **organic and mineral fertilizers, carrot, poultry manure, marketable, forked and cracked roots**.

1. INTRODUCTION

Carrot (Daucus carota L.) is essential root vegetable commonly used in the diet of human beings and is cultivated worldwide (Kwabena, 2011). It is characterised by relatively moderate requirements for climate and soil. Owing to their modest needs for cultivation and storage, they can be produced and sold fresh throughout the year. Carrot originated in Southwest Asia and later spread throughout China and the Mediterranean basin (Kwabena, 2011).

It is a major source of vitamin A and has a high carotene, a provitamin that is converted by the body into vitamin A and contains appreciable quantities of thiamine and riboflavin (Tindall et al., 1986).

Recognizing the nutritive value of carrots and its high demand, farmers have increased its production in the Rwanda. Carrot has relatively high demand for soil nutrients especially potassium and nitrogen (Bendel et al., 1992); the increased production in Rwanda has become feasible by the application of sufficient plant nutrients to depleted soils to improve soil fertility.

Rwanda has targeted horticulture industry among the priority because it offers considerable potential which may contribute significantly to poverty reduction and economic development if adequately exploited (MINAGRI, 2008).Carrot is among profitable vegetable product to promote due to its high nutritional value and it is predominantly produced in the

western province with 87% of Rwandan production. The dominance of the Western province is not surprising given that the carrot is cool season crop and conditions of the Western part of Rwanda are ideal, the other provinces also produce carrots but on little quantity than West one .

Its productivity is going reduced slowly due to poor application of combined fertilizers especially the animal manures which are highly recommended for such crops, poor agronomic practices, diseases and attack of some insects may also be the cause of decline of productivity to carrot (RHODA, 2008). Through the adequate use of fertilizers the productivity of carrot as well as the other roots vegetables should be increased considerably.

The farmers should maintain soil productivity by using combination of mineral fertilizers and organic fertilizers. Mineral fertilizers are expensive and the farmers are not able to afford them while organic manure are locally available and cheap, poultry manure one of that available organic manure; it can be used in production of vegetable (Win et al ,2008). However, the main constraint in using organic fertilizer in most part of the world is the determination of appropriate rate for a specific crop so that it remains with acceptable yield quantity and quality (Allemann and Young, 2001). Therefore more emphasis is to be placed on strategies and technologies to integrated use of both mineral and organic fertilizers. For this reason a research experiment was conducted to study the effect of poultry manure, NPK 17-17-17, and their combination on growth and yield of carrot in Rulindo District.

2. MATERIALS AND METHODS

The current experiment was established in Mbogo sector of Rulindo District which is one of the five districts of North Province. This district is blessed with moderate climate with annual temperatures vary between 16 and 19OC. Rainfalls are relatively abundant and vary between 1100 and 1500 mm during the year. Though abundant water is received in form of precipitation, the distribution of rainfall is not uniform.

The carrot variety (Nantes 2) seeds were sourced from Kenya seed Company and sown at rate of 1.8 kg per acre. The poultry manure used was purchased from the poultry farms at Kinini village of Rulindo District. The quantity used was 10 tons per hectare in the second treatment and a half of that fertilizer were used in the third treatment. The mineral fertilizer was purchased from Agro-Tech-Kigali. It is a blended mineral fertilizer that contains 17% of Nitrogen, 17% of Phosphorus and 17% Potassium in a sack of 100 kg. The 300kg ha-1 was applied in the first treatment and 150kg ha-1of NPK in the third treatment.

Soil samples were randomly collected in 0-30cm of depth using Edelman soil auger. The soil samples were collected in diagonals, five locations was selected in each plot, 4 locations in corners and one location in middle of plot and the soil samples collected was thoroughly mixed for homogeneity and a composite soil sample was analyzed for acidity (pH), organic carbon, total nitrogen, available phosphorus and exchangeable potassium . Before applying the poultry manures, a sample was taken and dried for being analyzed in laboratory in order to know the amount of mineral (NPK) contained.

The collected soil and poultry manure were analyzed in UR-CAVM soil laboratory. Soil sample was dried at air temperature, ground in a porcelain mortar with pestle porcelain and then sieved at 2mm and 0.5 mm diameter. Soil pH was analysed using electrical method. Organic carbon was analysed using walkley and black modified method while total nitrogen content by using Nessel method. The analysis of available phosphorus was done using Bray II method, in purpose of knowing the existing mineral (NPK) in the soil and the amount of mineral was applied.

Table 1: The results of laboratory of soil and poultry analysis

Soil analysed nutrients	Results obtained	Methods used
Available P	29.4	Bray II Method
Exchangeable K	0.41	-
Organic Matter	5.19	Calcinations method
pH H_2O	5.3	Glass electrode method(van Reeuwijk,1992)
Total nitrogen	0.25	Kjeldahl method
Poultry manure analysed nutrients		
Total nitrogen	2.66	Kjeldahl method

Carrot seeds were small and sown directly in the open field. It is therefore most important that the soil must be prepared thoroughly, with a level, fine, crumbly soil surface. Land was ploughed by first and second tillage; deep ploughing to loosen the soil to a depth of at least 30cm was important to allow good root aeration and development. The previous crop was maize belong to the poaceae family that can be rotated with tubers, roots, and legumes.

The experiment was laid out in RCBD with three replications and comprised four treatments such as T0: control, T1:NPK17-17-17(300kgha-1), T2 (10tha-1PM), T3 (5tha-1+150kgha-1) in total 12 treatments were studied.

Poultry manure was weighed and applied 3 weeks before sowing covered by 15mm of top soil, the NPK was weighed before application by electronic balance and applied by direct line dressing in depth of 1.5cm then it was covered with small layer of loosen soil on the same day of sowing. Carrots were directly sown at a depth of 1 cm in a well prepared seed bed. Seeds have been sown on drill of 20 cm apart. Mulching was performed by using well dried mulch to avoid pests and diseases transmission through no dried mulch and watering to speed up seed emergence. The weeding was done three times during growing season. First weeding at four weeks after sowing, second weeding at seven weeks after sowing while the third was performed after ten weeks after sowing, inter-cultivation followed by hand-weeding was done to ensure less competition of nutrients between carrot and weeds and allow a better aeration and development of carrot plants.

Thinning was done to reduce the density of plants in order to allow good growth pattern, this was done to an inter rows spacing of 5 cm when plants had 5 cm of height in order to reduce nutrients and light competition.

Earthing up was done after eight weeks of sowing to prevent roots from high soil temperatures and to encourage blanching and good drainage of excess water.

The harvesting was done at 120 days after sowing. Irrigation prior to lifting was done to reducing root damage. The roots were ready for harvesting when having at least 2 cm of diameter at the proximal end and when they turned bright orange. After watering soil, the roots were pulled up out of the ground by using a spade.

The biometric observations were recorded with different treatments on growth and yield of carrot: 5 times from 60th to 120th day after sowing for growth attributes and the data collected on 10 plants selected randomly in three middle rows of each plot. The economic analysis was worked out to assess the profitable practice for appropriate recommendation.

The collected data were analysed using GenStat 14th edition statistical package software for the analysis of variance (ANOVA) for both growth and yield parameters between different treatments. The level of significance on “F” test was tested at 5 per cent. The interpretation of data was done by using CD values calculated at p=0.05.

3. RESULTS AND DISCUSSION

Carrot plant height as influenced by poultry manure, N.P.K and their combination.

The results showed that fertilizers significantly ($p<0.05$) affected the plant height of carrot at different stages of growth (60, 70, 90,105 and 120 DAS) as presented in table 2.

At 60 DAS, treatment T2 (10tha-1poultry manure) recorded significantly higher plant height (19.18 cm) and was on par with T3 (150kgha-1NPK and 5tha-1 poultry manure) 18.57cm compared to the rest of all other treatments. While, control and T1 (300 kg ha-1 NPK) recorded significantly lower plant height 8.43cm, 9.08cm respectively.

At 75 DAS the plant height showed significant difference due to the fertilizer. Treatment T2 (10tha-1poultry manure) recorded significantly higher plant height (25.8cm) and was on par with T3 (150kgha-1NPK and 5tha-1 poultry manure) 25.36cm followed by T1 (300 kgha-1NPK) 16.94cm. While the lower plant height was noticed in Control (11.75cm).

At 90 DAS the plant height showed significant difference due to the fertilizer. Treatment T3 (150kgha-1NPK and 5tha-1 poultry manure) recorded significantly higher plant height (40.1cm) and was followed by T2 (10tha-1 poultry manure) 34.33cm, 22.55cm by T1 (300kgha-1NPK). While the lower plant height was recorded in Control (18.73cm).

At 105 DAS the plant height showed significant difference due to the fertilizer. Treatment T2 (10tha-1 poultry manure) recorded significantly higher plant height (44.85 cm) and was on par with T3 (150kgha-1NPK and 5tha-1 poultry manure) 44.77cm followed by T1 (300kgha-1NPK) 30.25cm. While, control recorded significantly lower plant height 22.37 cm).

International Journal of Novel Research in Life Sciences
Vol. 2, Issue 1, pp: (42-48), Month: January - February 2015, Available at: www.noveltyjournals.com

At harvest, plant height showed significant difference due to the fertilizer. Treatment T2 recorded significantly higher plant height (44.87 cm) and was similar with T3 (44.78cm), followed by T1 (30.27cm) and control recorded lower plant height 22.38cm.

Table 2: Carrot plant height

Treatments	Plant height (cm)				
	60DAS	75DAS	90 DAS	105 DAS	120DAS
T_0: control	8.43b	11.75c	18.73d	22.37c	22.38c
T_1:NPK	9.08b	16.94b	27.35c	30.25b	30.27 b
T_2: PM	19.18a	25.80a	34.33b	44.85a	44.87 a
T_3:NPK + PM	18.57a	25.36a	40.1a	44.77a	44.78 a
SEm±	0.790	1.41	1.62	1.54	1.56
CD(P = 0.05)	2.735	4.897	5.611	5.446	5.421
CV (%)	8.1	5.8	7.2	11.9	11.8

Carrot plant leaves as influenced by poultry manure, N.P.K and their combination:

The number of carrot leaves were significantly ($p<0.05$) increased by different fertilizers treatments (Table 3).

At 60 DAS the carrot plant leaves showed significant difference due to the fertilizer. Treatment T2 (10tha-1 of poultry manure) 6.500 and was on par with, T3 (150kgha-1 of NPK and 5tha-1of poultry manure) 6.200, andT1 (300kgha -1NPK) 5, were recorded significantly higher carrot plant leaves. While, control recorded significantly lower number of carrot plant leaves (4.833).

At 75DAS the carrot plant leaves showed significant difference due to the fertilizer. Treatment T2 (10tha-1poultry manure) recorded significantly higher carrot plant leaves (6.467) and was on par with T3 (150kgha-1NPK and 5tha-1 poultry manure) 6.433 followed by T1 (300kgha-1NPK) 5.233. While the lower carrot plant leaves was noticed in Control (4.70)

At 90 DAS the carrot plant leaves showed significant difference to the fertilizer. Treatment T3 (150kgha-1NPK and 5tha-1 poultry manure) recorded significantly higher carrot plant leaves (8.73) and was followed by T2 (10tha-1 poultry manure) 8.00, and T1 (300kgha-1NPK) 6.38. While the lower carrot plant leaves was recorded in Control (4.44).

At 105 DAS the carrot leaves showed significant difference due to the fertilizer. Treatment T2 (10tha-1 poultry manure) recorded significantly higher carrot plant leaves (5.233) and was on par with T3 (150kgha-1NPK and 5tha-1 poultry manure) 5.2 followed by T1 (300kgha-1NPK) 4.367 While, control recorded significantly lower plant leaves (3.367).

At harvest, carrot plant leaves showed significant difference due to the fertilizer. Treatment T2 recorded significantly higher carrot plant leaves (4.233) and was similar with T3 (3.967). While, T1 (300kgha-1NPK) and control recorded lower carrot plant leaves 2.867, 2.633, respectively.

Table 3: Effects of fertilizer treatments on carrot plant leaves

Treatments	Number of leaves				
	60DAS	**75DAS**	**90 DAS**	**105 DAS**	**120DAS**
T_0: control	4.833b	4.700c	4.44d	3.367c	2.633 b
T_1:NPK	5.000a	5.233b	6.38c	4.367b	2.867 b
T_2: PM	6.500a	6.467a	8.000b	5.233a	4.233 a
T_3:NPK+ PM	6.200a	6.433a	8.73a	5.200a	3.967 a
SEm±	0.085	0.031	0.20	0.156	0.04528
CD (P = 0.05)	0.58	0.3540	0.70	0.5400	0.4251
CV (%)	6.7	5.7	3.8	6.3	8.2

*Mean connected by same letter within column is not significantly different according to CD at 0.05 level of significance.

International Journal of Novel Research in Life Sciences
Vol. 2, Issue 1, pp: (42-48), Month: January - February 2015, Available at: www.noveltyjournals.com

The noticed effects of fertilizers treatments on carrot leaves were attributed to the overall attributes of poultry manure on soil fertility improvements. This corroborate with the findings of Frempong et al. (2006) who found that poultry manure increased the levels of organic matter, soil nutrients and cation exchange capacity in soil and ameliorate the growth of Okra.

Yield and yield attributes and economic analysis as influenced by poultry manure, N.P.K and their combination.

The results showed that the yield and yield attributes were significantly ($p<0.05$) differences among all the treatments. The benefit cost ratio was higher for poultry manure compared to the rest treatments (Table 4).

Treatment T2 (10tha-1 poultry manure) recorded significantly higher yield of carrot (31.66tha-1) and was similar with T3 (150kgha-1NPK and 5tha-1 poultry manure) 28.83tha-1, followed by T1 (300kg ha-1NPK) 24.35tha-1. The lower root yield was observed in control (15.91tha-1).

The shoulder diameters were affected significantly where T2 (10tha-1 poultry manure) recorded higher shoulder diameter (3.65cm) and was similar with T3 (150kgha-1NPK and 5tha-1 poultry manure) (2.67cm). While, T1 (300 kgha-1NPK) and control recorded lower carrot plant leaves 2.25cm, 1.75cm, respectively (Table 4). The higher length (14.16cm) of carrot was recorded in T2 (10tha-1 poultry manure), similarly, T3 (150kgha-1NPK and 5tha-1 poultry manure) and, T1 (300kgha-1NPK) had 10.83cm, and 8.60cm, respectively while the lower carrot root length, 7.52cm was recorded in control (Table 4). The higher marketable yield (29.16tha-1) of carrot was recorded in the Treatment T2 (10tha-1 poultry manure) and was statistically similar to T3 (150kgha-1NPK + 5tha-1 poultry manure) and T1 (300kg ha-1NPK) with 28.25t ha-1 and 23.33t ha-1, respectively. The lower marketable yield (13.91t ha-1) was obtained from control (Table 4) similar also by T1 (300kgha-1NPK)23.33tha-1 and control recorded lower marketable yields of carrot 13.91tha-1.

The T2 (10t of PM ha-1) and T3 (5tPMha-1 + 150kgNPK17-17-17ha-1) were statistical the same in highest mean number of cracked roots which recorded (16667 and) was recorded by the T2(10tPMha-1). On par with T3(5tPMha-1 + 150kgNPK17-17-17ha-1) had 15000, respectively. These two treatments were statistically different from T1 and control. The number of forked carrot roots from the T2 (10PMtha-1) treatment was higher (15000) followed by (5tPMha-1 + 150kgNPK17-17-17ha-1) 6667 the lowest were recorded on control and 300kg ha-1 both had same numbers (5000). 0f cracked roots statistical were no significant difference between them but there were significant difference from 300kgha-1 of NPK 17-17-17 (10000)and control(6667). The number of forked carrot roots from the T2 (10PMtha-1) treatment was higher (15000) followed by (5tPMha-1 + 150kgNPK17-17-17ha-1) 6667the lowest were recorded on control and 300kgha-1 both had same numbers (5000). The higher harvest index (HI) was recorded in Treatment T2 (10tha-1 poultry manure) and T3 (150kgha-1NPK and 5tha-1 poultry manure) with HI of recorded higher Harvest index (94.43 and) which was on par with T3 150kgha-1NPK and 5tha-1 poultry manure) (92.70, respectively (Table 4).), followed by T1 (300kgha-1NPK) 89.07 and control showed the lowest harvest index 82.40 was not statistically different.

Table 4: Carrot yield, yield attributes and economic analysis

Treatments	Yields (tha^{-1})	tuber shoulder diameter (cm)	tuber length (cm)	marketable yields (tha^{-1})	number of Cracked	number of forked	Harvest Index	Benefit Cost Ratio
T0:control	15.91c	1.753b	7.52b	13.91b	6667b	5000b	82.40b	1.17
T1: NPK	24.35b	2.250b	8.60a	23.68a	10000ab	5000b	89.07ab	1.50
T2:PM	31.66a	3.650a	14.16a	29.16a	16667a	15000a	94.43a	1.77
T3:NPK+ PM	28.83a b	2.677ab	10.83ab	28.53a	15000a	6667 b	91.47a	1.48
SEm±	5.645	1.018	4.059	1,9	1924.5	833.3	2.88	NA
CD(p=5%)	1.63.	0.29	1.73	6.8	6659.6	2883.7	9.96	NA
CV%	8.7	5.9	5.1	13	11.9	9.1	3.1	NA

Mean connected by same letter within column is not significantly different according to CD at 0.05 level of significance. NA=Not Analyzed statistically.

The poultry manure treatments improved the physical soil properties and increased the levels of soil nutrients which improved plant growth and increased the root size. These are in support with Asiedu et al,(2007) who reported the increased yield of carrot with the application of poultry manure and cow dung compared to the control. These results were in conformity with the findings of Dawuda et al,(2011) who noted that application of 10t ha-1 PM increase yield at 11.1t ha-1 while application of 300kg ha-1 of NPK (15-15-15) increase 9.9 tha-1 of root yield.

The rate of NPK supplied played a critical role in supporting growth and development.Abdel-Mawly et al, (2004) stated that an increase in nitrogen rate increased yield. Ali et al. (2003) also stated that high rate of nitrogen and phosphorus increased the root yield of carrot. The addition of organic amendments increased the total porosity which decreased bulk density thereby increasing root penetrability. This improved nutrient exploration by plants for better growth and yield. The decrease in bulk density made the soil to hold enough moisture which led to effective root development of carrot. Microbes produce plant growth regulators and photosynthetic activity, that is why vegetables would grow better at later growth of stage and result in higher yields which can be attributed to high nutrients sustainability organic fertiliser and improved biological properties of the soil (walker et al, 2004).

The results of effects of treatments on carrot shoulder diameters were correlated with the fact that the sufficient supply of Phosphorus affects the roots diameter of root crops. The best result found was concurred with the effects of organic manure being a major source of available Phosphorus (Raymond, 1990).

The length of carrot as affects by fertilizers treatments was attributed to the good moisture and soil permeability brought in by organic manure. This corroborate with the findings of Gajewski, et al.(2010) who stated that the application of poultry manure leads to ease of root penetration, erosion resistance and good soil moisture properties such as available water holding capacity and permeability, combined with adequate aeration. According to Moniruzzaman et al,(2013) addition of organic manure leads to soil physical properties including soil moisture retention capacity, ensures stability of soil structure and increased nutrient uptake.

The marketable yield of carrot obtained supported Sinnadurai, (1992) who stated that rich soils with a suitable pH between 5.8 to 7.0 produce smooth roots. . The addition of chicken and grasscutter manure released ammonium which raised the pH by reducing the acidity this support Dawuda et al., (2011) the combination of poultry manure and inorganic N provided a significant marketable root tuber crops.

The cracked and forked roots might be due to the increasing levels of poultry manure supplied to the plant. Large quantities of manure supplied to vegetables tend to result in their roots being cracked or forked. This agree with Asiedu et al., (2007) who observed that heavy application of manure results in cracking and forking of most root crops.

The significant difference of harvest index observed between fertilizers treatments is consistent with findings of Kwabena, (2011).

The beneficial cost of using poultry manure could be attributed to the fact that more marketable roots yield were produced per unit area, higher gross and net returns obtained from the best treatments. These findings are in conformity with Dawuda et al., (2011) who reported that 15t ha-1 and 20 t ha-1 of chicken manure gave more profit than the 300kg ha-1 NPK (15-15-15) and the control. This is an indication of the level of profitability of the animal manure treatments; these results also are consistent with Mehedi et al. (2012) who reported that a combination of cowdung and Nitrogen maximize the carrot production in field conditions.

4. CONCLUSION

Based on the current experimental results, with regards to the production as well as economic analysis, application of poultry manure at rate of 10tha-1 or a combination of 5 tha-1 of poultry manure with 150kgha-1 NPK 17-17-17 may be suggested for maximizing carrot production under Rulindo District condition and further investigations are needed to be conducted in other agro ecological zones of Rwanda.

ACKNOWLEDGEMENT

Authors are grateful to the University of Rwanda, College of Agriculture, Animal Sciences and veterinary Medicine (UR-CAVM) for the financial support.

REFERENCES

[1] Abdel-Mawly S.E., 2004. Growth, yield, n uptake and water use efficiency of carrot (daucus carota l.) plants as influenced by irrigation level and nitrogen fertilization rate. Ass. Univ.Bull.Envron.Res.7(1):111-121;

[2] Allemann and Young, B.W. (2001). Vegetable production guidelines for Kwazulu Natal, Department of agriculture and environmental affairs. Pietmaritzburg, Kwazulu Natal.

[3] Ali, A., M. A. Hossain, F. Mondal, and A. M. Farooque. (2003). Effect of nitrogen and Potassium on yield and quality of carrot. Pakistan Journal of Biological Sciences (6):1574–1577.

[4] Asiedu, E. K., Hemeng, O. B., Dawuda, M. M., Agbeko, Y. and Amponsah, E. K. (2007) Effect of poultry and sheep manure on growth and yield of carrot. Ghana Journal of Horticulture 6: 65 – 69;

[5] Bendel, V. A. C. S., Shaffeur. C and Maccleng, C. A. (1992). Poultry Manure, a vegetable Fertilizer. University of Maryland crop extension service fact sheet pp 39;

[6] Dawuda M. M., P. Y. Boateng, O. B. Hemeng, and G. Nyarko, (2011). Growth and yield response of carrot (Daucus carota l.) to different rates of soil amendments and spacing.Journal of science and technology. 31(2): 11-20;

[7] Frempong, M. E., Ofosu - Anim, J. and Blay, E. T. (2006). Nutrient supply strategies on growth and yield in okra (Abelmoschus esculentus.(L)) Moench. Ghana Journal of Horticulture 5: 73–81.

[8] Gajewski, M., Z.Weglarz, A. Serdea, M. Bajer, A. Kuczkowska, and M. Majewski, 2010. Carotenoid accumulation by carrot storage roots in relation to nitrogen fertilizer level.Notulae BotanicaeHorti Agrobotanici Cluj-Napoca 38:71–75.

[9] Kwabena, A., (2011). Influence of grass cutter, chicken manure and NPK amendments on soil characteristics, growth and yield response of carrot (Daucus carota) thesis, MSc level, university of Education, Winneba pp 73-76;

[10] Mehedi T. A., M. A. Siddique and Sonia B. Shahid (2012). Effects of urea and cow dung ongrowth and yield of carrot. J. Bangladesh Agril. Univ, 10(1): 9–13;

[11] MINAGRI, (2008). Annual report, Kigali.17 pp;

[12] Moniruzzaman M., M. H. Akand, M. I. Hossain, M. D. Sarkar and A. Ullah, 2013. Effect of Nitrogenon the Growth and Yield of Carrot (Daucus carota L.). The Agriculturists 11(1): 76-81;

[13] Raymond W (.1990). An introduction to soils on plants growth sixth edition.14-16pp;

[14] RHODA, (2008), Annual report Kigali; 21pp

[15] Sinnadurai, S. (1992). Vegetable cultivation, Asempa Publishers, Advent Press, Accra, Ghana;pp 129;

[16] Tindall, H. D. Rice, R.P. and Rice, J.W. (1986). Fruits and vegetables in the tropics. Macmillanpublishers Ltd; pp 380-390;

[17] Walker, D, J and bernal,MP(,2004).plant mineral nutrition and growth in a saline Mediterranean soil amended with organic wastes. Edition 35P495;

[18] Win, L.L., Keutgen, A.J., Pawelzik, E. (2008): Antioxidant properties of carrot cultivars from Myanmar and Germany as affected by different nitrogen levels of organic and mineral fertilizers. Agricultural Sci. J. 39(3) 449-453.