

Effect of Poultry Manure Application Rate on the Growth and Yield of Cowpea under two Growing Season

Vandi Ibrahim Kallon^{1*}, Amara Vandi², James Kargbo¹, Saidu Omarr Jalloh³ and Dan David Quee²

¹Department of Crop Science, Njala University, Njala, Sierra Leone.

²Department of Crop Protection, Njala University, Njala, Sierra Leone.

³Sierra Leone Produce Monitoring Board (SLMB), Njala, Sierra Leone.

*Corresponding authors email id: vandiibrahimkallon723@gmail.com

Abstract – Poultry manure contains appreciable amounts of nutrients required by plants. It decomposed in the soil, releasing for plant uptake. A field experiments were conducted at the School of Agriculture and Food Sciences experimental research site to determine poultry manure rate and season that gives optimal yield in cowpea. The experimental was carried out using Randomized Complete Block Design (RCBD) in a split plot arrangement, replicated three times. The rates of well decomposed poultry manure levels (0 t ha⁻¹, 5 t ha⁻¹, 10 t ha⁻¹, and 15 t ha⁻¹) was the main plot treatment in both dry season and raining season. Plot size was 4m X 3m (8m²), with a total experimental area was 125.5m² (20.5 m x 11 m) with a planting spacing of 50 cm x 20cm in both season. However, cowpea growth and yield was significantly by poultry manure rate and season planted. Application of 15t/ha. Produced significantly (≤ 0.05) taller plants, more leaves, thicker stem, and broader leaves and pod yield/ha, grain yield/ha and biomass than either 0 or 5t/ha. Cowpea grown during the dry season with constant irrigation produced better cowpea growth and yield than planting in the raining season. Therefore, for optimal growth and yield of cowpea, it is appropriate to apply 15t/ha especially during the second planting season.

Keywords – Poultry Manure, Planting Season, Cowpea, Growth and Yield Component, Application Rate.

I. INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is an important grain legume in the world covering 12 .5 million hectares with annual production of about 3 million tons in the dry savannah of the tropic [1]. Cowpea (*Vigna unguiculata* (L.) Walp) is a major staple food crop in sub-Saharan Africa, especially in the dry savannah regions of West Africa. In Sierra Leone, cowpea is the second most important legume crop after groundnut (*Arachis hypogea*) [2] and many local and improved varieties of the crop are cultivated across the country. However, Soils of Sierra Leone have inherently low fertility and do not receive adequate nutrient replenishment, with many farmers typically applying insignificant amounts of fertilizers, coupled with continuous cropping, soil degradation and declining soil fertility continue to pose major threat to sustainable food production by smallholders [2]. Poultry Manure is the organic waste material from poultry, consisting of animal faeces and urine [3]. Demonstrated an excellent use of animal dung and plant residues to improve soil fertility, fruit nutrient composition, root growth and fruit weight of okra plant [4]. Poultry manure is a typical source of nutrient for plant growth, used commonly in the tropics due to high nutrient content, lack of weed seeds, cheapness and availability [5]. According to Adams [6], poultry manure increases plant height. Also, planting date is a key factor in the production of crops in semi-arid environment [7]. The crop yields are however, highly dependent on seasonal rainfall [8], which is affected by the period of planting. The time of planting is important in determining the final seed yield and is a useful agronomic practice as observed in other leguminous crops such as cowpeas [9], and bambara groundnut [10]. Planting time can also be used effectively to control several pests

in cowpea [11] and corn rootworm damage in maize crop. Considering the economic importance of cowpea, the unaffordability of inorganic fertilizers by smallholder Sierra Leonean farmers as well as the availability of poultry manure in the country, the present study was carried out with the objective of determining the most appropriate rate of application of poultry manure as well as the appropriate planting season for enhancing growth and yield of cowpea. Therefore, the technique can be a good agronomic practices as well as cultural control method of pest and diseases among subsistence farmers with limited access to resources.

II. MATERIAL AND METHOD

2.1. Experimental Setup

The experiments were conducted at the School of Agriculture and Food Sciences experimental research site in two crop season (Raining Season and Dry Season) of year 2024. The area lies on an elevation of 54 m above sea level on latitude 8°6N and longitude 12°W of the equator. Njala experiences a distinct dry and wet season. The mean annual rainfall total was 3010 mm. The experimental design used was Randomized Complete Block Design (RCBD) with three replicates. Plot size was 4m X 3m (8m²), with a total experimental area was 125.5m² (20.5 m x 11 m). Three seeds of cowpea were planted per hole which was later thinned down to two plant per hole, two weeks after germination. The seeds were sown to the depth of about 4cm deep and planting spacing of 50 cm x 20cm was used. Four rates of well decomposed poultry manure levels (0 t ha⁻¹, 5 t ha⁻¹, 10 t ha⁻¹, and 15 t ha⁻¹) were used. Inherent N, P, and K for the soil types, soil pH, soil texture, organic matter content, and nutrient quality for manure were assessed before crop establishment. Before and after treatment, the nutrients (P, K, Ca, Zn, and pH) in the cattle dung were analyzed. Using hoes, the manure was mixed into the soil at a depth of 15 cm inside each plot after being equally distributed on the soil surface in accordance with application rates. In the control plots, manure was not applied. For the 0% manure control treatment, the natural manure found in the various soil types was utilized.

2.2. Statistical Analysis

All data collected were subjected two-way analysis of variance (ANOVA) using the STATISTICA software version 12 (Stat Soft Inc., Tulsa, OK, USA) and means were separated using the DUNCAN MULTIPLE RANGE TEST (DMRT) at 0.05 level of significant.

III. RESULTS AND DISCUSSION

3.1. Physico-Chemical Properties of Soil Sample of the Experimental Site for Raining and Dry Season Cropping Season

Prior to conducting the experiments, soil samples were collected at a 20 cm depth using a soil auger at different points within the site to assess physical and chemical parameters (Table 1). From the soil analysis, it was revealed that the nitrogen levels were considerably low compared to phosphorus and potassium. The soil of the experimental sites was, generally low in moisture, low nutrient status and highly acidic in both raining season and dry seasons which are below the optimum pH of 6.5. This result agreed with study by [2] that Soils of Sierra Leone have inherently low fertility and do not receive adequate nutrient replenishment. With many farmers typically applying insignificant amounts of fertilizers, coupled with continuous cropping, soil degradation and declining soil fertility continue to pose major threat to sustainable food production by smallhol-

-ders.

Table 1. Physico-Chemical Properties of Soil Sample of the Experimental Site for Raining and Dry Season Cropping Season.

Properties	Raining Season		Dry Season	
	Before Planting	After Planting	Before Planting	After Planting
Soil pH	4.4	6.0	6.0	5.8
Nitrogen (% N)	0.025	1.8	0.15	2.1
Phosphorus (P) (mg/soil)	8.26	8.0	6.50	8.0
Potassium (K) (mg/soil)	64.3	9.7	8.2	8.9
Electrical Conductivity (μ S/cm)	37	37	24	26
Soil organic Carbon (%)	3.84	2.66	2.87	2.90

3.2. Cowpea Growth Parameters

Poultry manure application rate significantly ($p < 0.001$) affected the growth parameters of Cowpea (plant height, stem girth, leaf number, leaf area) at both cropping season. All the parameters generally showed an increase with increased rates of poultry manure in both season. Significant variation ($p < 0.05$) in plant height was noted among the treatments, with 15 t /ha-1 recorded the taller plant height of 15.02 cm, 26.04 cm and 34.3cm at 4, 6 and 8 weeks after planting with the lowest being recorded on 0 t ha-1 as 1.89 cm, 8.99 cm and 14.02 cm. Treatment 0 t ha-1, (i.e. without poultry manure) could not support appropriate growth of the plants because the residual nutrient content of the soil was inappropriate to support growth of cowpea. Shows that lower nutrient content of the soil below critical level can enhance poor performance of crop thereby making the plants to produce shorter plant [12]. The result confirmed that Soils in Sierra Leone differ in their physical and chemical characteristics and productivity due to differences in physiography. Deficiencies of available major and micronutrients are widespread and information on soil fertility status is lacking. However, those plants that received 15 t ha-1 of poultry manure supplied enough nutrients that could support appropriate nutrition and growth of the test plant. Therefore, ability by these plants to photosynthesize, has led to an increase in growth and development of the crop resulting in the production of taller plant height per plant. These findings are in agreement with [13]; who observed that organic manures can sustain cropping systems through better nutrient recycling which would give rise to crop improvement in growth and development as well as yield. However, there was also a significantly ($p < 0.05$) affected the growth of cowpea as influence by the time of planting. From the result, cowpea planted during the second planting season (September) significantly produced taller plant compared to those in first planting season (June). This increment in plant height eventually could be due to that the second season was more favorable to cowpea growth since cowpea is a drought tolerant crop.

Highest numbers of cowpea 14.05, 22.08 and 24.89 was recorded at the rate 15 t ha-1 at 4,6 and 8 weeks after crop emergence followed by 10 t ha-1, which had the second highest number of leaves of 10.89, 16.35 and 18.13 compared to control gave the least number of leaves of 6.94, 7.25 and 8.89 (Table 1, 2, 3). However, between the two growing season, cowpea planted within the second planting season has more number of leaves produced compared to those planted during the first planting season. This implies that during the first season most of the photosynthetic dissimilate was used for leaf production while in the second season it was used for pod production. This is in agreement with the report given by [14], that leaves of cowpea plants sown in

September were smaller due to the effect of planting dates. Reported that delay in sowing of cowpea decreased the length of vegetative and reproductive growth stages of cowpea [15].

Table 2. Effect of Poultry Manure Application Rate on Cowpea Growth at 4WAP.

Treatments	Plant height 4WAP (cm)	Leaves Number 4WAP plan-1	Stem Girth 4WAP (cm)	Leaf Area 4WAP (cm ²)
0 tha-1	1.89	6.94	0.17	2.13
5 tha-1	8.35	8.5	0.28	3.16
10 tha-1	13.52	10.89	1.12	8.33
15 tha-1	15.02	14.05	1.34	12.08
Season				
Rain	18.3	27.1	32.7	20.29
Dry.	24.0	22.4	39.2	25.23
F-Statistics				
Treatment	0.25**	0.55**	ns	0.42**
Season	4.57**	2.22**	0.68**	2.90**
Treatment *Season	1.22*	0.232**	0.89**	0.90*

Table 3. Effect of Poultry Manure Application Rate on Cowpea Growth at 6WAP.

Treatments	Plant Height 6WAP (cm)	Leaves Number 6WAP plan- ¹	Stem Girth 6WAP (cm)	Leaf Area 6WAP (cm ²)
0 tha ⁻¹	8.99	7.25	1.09	6.01
5 tha ⁻¹	24.13	10.78	1.21	8.0
10tha ⁻¹	38.25	16.33	1.38	10.01
15 tha ⁻¹	52.37	22.08	2.03	15.13
Season				
Rain	23.01	33.9	39.61	26.44
Dry.	26.04	28.09	42.01	29.87
F-Statistics				
Treatment	2.34***	0.89*	ns	1.09**
Season	3.26**	3.51**	1.90**	2.90ns
Treatment *Season	4.02**	2.90*	1.67**	1.09**

Table 4. Effect of Poultry Manure Application Rate on Cowpea Growth at 8WAP.

Treatments	Plant Height 8WAP (cm)	Leaves Number 8WAP plan-1	Stem Girth 8WAP (cm)	Leaf Area 8WAP (cm ²)
0 tha-1	14.02	8.89	2.08	8.02

Treatments	Plant Height 8WAP (cm)	Leaves Number 8WAP plan-1	Stem Girth 8WAP (cm)	Leaf Area 8WAP (cm ²)
5 tha-1	32.04	13.9	2.68	12.08
10tha-1	48.05	18.13	3.05	15.12
15 tha-1	58.02	24.89	4.08	24.09
Season				
Rain	28.9	42.6	40.98	37.05
Dry.	34.3	32.1	45.6	42.17
F-Statistics				
Treatment	6.78*	4.90**	7.21*	8.21**
Season	5.52**	6.12***	3.23**	6.09**
Treatment *Season	0.45**	0.02**	0.041**	0.89**

These results are consistent with [13] who observed a similar trend when he was working with farmyard manure. These findings are also similar to those by [12] who observed highest leaf number in cucumber plants treated with the highest rate of 12 t ha⁻¹ while the least number was recorded at 0 t ha⁻¹ of poultry manure. Lowest leaf number recorded in the 0 t ha⁻¹ could be attributed to the fact that it could not support appropriate growth of the plants because the residual nutrient content of the soil was inappropriate to support growth of cowpea, probably the nutrient content of the soil was below the critical level hence poor performance of the crop. This means that the higher the nutrients applied to the soil, the higher the number of leaves/plant. This observation is consistent with works of [16]; [17].

Also there was a variation on the stem girth of cowpea from the different treatment, however, treatment with 15 t ha⁻¹ recorded thicker stem girth while the thinner stem were recorded at 0 t ha⁻¹. Result obtained can be attributed to the fact that the cowpea plants had enough nutrients for rapid growth and stem development considering the composition of the poultry manure having higher N content responsible for stem elongation. It was observed that the higher the nutrients in poultry manure applied, the thicker the stem produced per plant. However, all tested plant grown during the second planting season recorded thicker stem as compared to those in the first planting season period. The findings meant be attributed that the cowpea were able to utilize the nutrient more during the second planting season as there was a steady rainfall while those planted in the dry meant be due to erosion or other factors.

3.3. Cowpea Fruit Yield

There was significant difference ($p < 0.001$) in cowpea overall fruit yield. All the experimental plots generally showed an increase in number of pods, plant biomass, grain yield plan-1 and dry weight grains with increased rates poultry manure. Fruit yield increased as manure rates increased (Table 5) with the highest number of pods was produced from plant treated with 15 t ha⁻¹ (23.88g) with the lowest fruit production in 0 t ha⁻¹. However, 15 t ha⁻¹ significantly showed heavier biomass of 123.41g, heavier grain weight plan-1 and heavier dry weight of grains of 30.53g while the lowest yield was recorded at 0 t ha⁻¹ (Table 5). Low cowpea yields and little

vigorous growth obtained with low manure application rate of 0 t ha⁻¹ could be attributed to insufficient levels of nutrients supplied by 0 t ha⁻¹ to the plants for normal growth. The highest manure rate of 15 t ha⁻¹ significantly gave the highest yields and vigorous vegetative growth; this could be attributed to a high nutrient level supplied by the treatment per unit volume of soil resulting in high crop growth rate and vigor especially in the second planting season (September period). This observation may indicate that the increase in poultry manure resulted to significant increase in growth and higher fruit yield. This observation concurs with the works of [18] who earlier reported that an increase in manure among treatments will lead to a significant increase in treatment means. The results are also similar to [12] who observed the same trend when he studied the effect of different poultry manure levels on cucumber. Similar work by [19] indicated that higher fruit mass was obtained from cucumber plants that received 20 t ha⁻¹ of poultry manure possibly because higher rates of manure improved the soil conditions for crop establishment as well as released adequate nutrient elements for yield enhancement. Interestingly, result clearly showed that within the two planting season there was a significant yield variation with higher yield production of cowpea during the dry while low yield production was mainly in the first planting season. During the second season, the critical day length became shorter with high temperatures which led to quick stimulation of flowers leading to pod production. These results were in accordance with those of [2] that favorable climatic conditions prevailing during sowing dates reflected on the stimulation of cowpea production in Egypt. This high weight of fresh seeds was attributed to cold and moist conditions caused by frequent rainfall in the first season and [21] reported that differences in 100-seed weight of cowpea varieties may be due to rainfall as a major factor in the weather conditions experienced in the field.

Table 5. Effect of Poultry Manure Application Rate on Yield Component of Cowpea.

Treatment	Number of Pod/Plant (g)	Plant Biomass (g)	Grain Yield Plan ⁻¹	Dry Weight of Grains Plan ⁻¹
0 tha ⁻¹	8.07d	44.02d	22.02d	12.12d
5 tha ⁻¹	11.63c	78.85c	54.89c	16.23c
10tha ⁻¹	17.75b	101.13b	57.44b	20.88b
15 tha ⁻¹	23.88a	123.41a	60.12a	30.53a
Season				
Rain	88b	34.8b	38.7b	42.90b
Dry	98a	47.2a	52.2a	58.02a
F-Statistics				
Treatment	0.89**	0.68***	1.09**	1.21**
Season	2.48**	1.04**	2.09**	4.12***
Planting Season	2.08**	2.45**	3.67**	2.24**

IV. CONCLUSION

In this experiment, poultry manure was found to be a pool of essential nutrients that slowly extract minerals into a soil solution that can be extracted or dug by plant roots and used by the plant for body function, growth, and development throughout its life cycle. Studies have shown that cowpea yields can be increased by adding

animal manure especially poultry manure to ensure food security. However, result shows a strong linear relationship between growth rate and fruit yield of *cowpea*, manure application rates and time of planting. It was concluded that manure application rates and the appropriate time of planting had effects on *Vigna Unquiculata* growth rate and fruit yield in terms of plant height, leaf number, stem girth and leaf area, as well as the fruit yield including number of pods, grains produced per pods, grain weight, plant biomass etc. Cattle manure application rate of 15 t ha⁻¹ gave the highest growth rate and fruit yield of cowpea especially when planted during the second planting season (September) hence could be adopted by resource poor smallholder cucumber farmers in the country where the manure is readily available.

REFERENCES

- [1] Adediran OA, Ibrahim H, Daniya E, Adesina OA, Alaaya SA. Effect of sowing dates on the growth and yield of cowpea varieties in Minna, Southern Guinea Savanna of Nigeria. *Protection of Agriculture and Technology*. 2018; 14: 92-101.
- [2] Aliyu, I. (2000). The effect of organic and mineral fertilizer on growth, yield and composition of pepper. *Biological Agricultural and Horticulture* 18 (1) 29-36
- [3] Atakora K, Essilfie ME, Agyarko K, Dapaah HK, Santo KG. Evaluation of yield and yield components of some cowpea (*Vigna unguiculata* (L.) Walp) genotypes in forest and transitional zones of Ghana, *Agricultural Sciences*. 2023; 14: 878-897.
- [4] Cobbinah FA, Addo-Quaye AA, Asante IK. Characterization, Evaluation and Selection of Cowpea (*Vigna unguiculata* (L.) Walp) Accession with Desirable Traits from Eight Regions of Ghana. *ARNP Journal of Agricultural and Biological Sciences*. 2011; 6:21-32.
- [5] EL-Sayed EA, EL-Sobky, Hend HM, Hassan. Optimizing cowpea productivity by sowing date and plant density to mitigate climatic changes. *Egypt. Journal Agronomy*. 2021;43(3)317-331.19.
- [6] Ezeaku IE, Echezona BC, Baiyeri KP, Mbah BN (2014). Seasonal and genotypic influence of insect pests, growth and yield of cowpea (*Vigna unguiculata* L. Walp.). *Am. J. Exp. Agric*. 4(12):1658-1667.
- [7] Ezeaku IE, Mbah BN, Baiyeri KP (2015). Planting date and cultivar effects on growth and yield performance of cowpea (*Vigna unguiculata* (L.) Walp.). *Afr. J. Plant Sci*. 9(11):439-448.
- [8] FAO (2005). Cowpea production database for Nigeria, 1990-2004. Food and Agricultural Organisation. <http://www.faostat.fao.org/>.
- [9] Hochmuth, G.J, Hochmuth, R.C. and Mylavarapu, R. 2009. Using Composted Poultry Manure (Litter) in Mulched Vegetable Production. University of Florida, IFAS Extension, SL 293. <http://edis.ifas.ufl.edu>.
- [10] International Institute of Tropical Agriculture (IITA), (2010). In: Annual Report for 1980 at the International Institute of Tropical Agriculture, Ibadan, Nigeria. http://www.iita.org/cms/details/cowpeaproject_details.aspx?zoneid=63andarticleid=269.
- [11] John Proctor, Ian D.E., Robert W.P., Laszlo N. Zonation of forest vegetation and soils of Mount Cameroon, West Africa. *Plant Ecology*. 2007;192(2):251-269.
- [12] Amara DMK, Kamara A, Momoh EJJ. Soil fertility status of three chiefdoms in Pujehun district of Southern Sierra Leone. *Res. J. Agric. Sci.* 2013; 4(4): 461-464
- [13] Mojaddam M, Nouri N. The effect of sowing date and plant density on yield and yield components of cowpea. *Journal of Fundamental and Applied Life Sciences*. 2014;4:461-467.
- [14] Moatshe O, Mashiqa P, Lekgari L, Ngwako S (2015). Effect of planting date on yield of maize varieties grown in the north-east region of Botswana. *Crop Res*. 49(1-3):8-11.
- [15] Ngwako S, Balole TV, Malambane G (2013). The effect of irrigation and planting date on the growth and yield of Bambara groundnut landraces. *Int. J. Agric. Crop Sci*. 6(3):116-120.
- [16] Shiringani RP, Shimelis HA (2011). Yield response and stability among cowpea genotypes at three planting dates and test environments. *Afr. J. Agric. Res*. 6(14):3259-3263.
- [17] Udoh, D.J., Ndon, B.A., Asuquo, P.E. and Ndaeyo, N.U. (2005). *Crop production Techniques for the Tropics*, Concept publication Lagos, Nigeria. Pp. 446.

AUTHOR'S PROFILE



First Author

Vandi Ibrahim Kallon, Department of Crop Science, Njala University, Sierra Leone. Research and Academic experience: Vandi Ibrahim Kallon, is an emerging global agriculture and Crop scientist. He had acquired diverse knowledge and experiences in the field of agriculture at both University and Occupational level. He holds a Bachelor of Science degree in Crop Science and Masters of Science in Crop Science (Njala University). He is a research Scientist in Crop Science and Field Superintendent in Crop Science Department, School of Agriculture and Food Sciences, Njala University. Mr. Kallon has vast knowledge in the design and execution of research, developing projects in agriculture, data capturing, data analysis and reporting. Mr. Kallon has work with the crop science department for years and his major role is to train student on how to conduct research, data collection and analysis, thesis writing techniques and reporting.



Second Author

Vandi Amara, Department of Crop Protection, Njala University, Sierra Leone. Research and Academic experience: Vandi Amara, is an emerging global agriculture and Crop Protectionist. He had acquired diverse knowledge and experiences in the field of agriculture at both University and Occupational level. He holds a Bachelor of Science degree in Crop Protection and Masters of Science in Crop Protection (Njala University). He is a research Scientist and plant molecular biologist in Crop Protection. He is currently the Principal Laboratory in the West Africa Virus Molecular Laboratory in the Department of Crop Protection, Njala University. Mr. Amara has vast knowledge in the design and execution of research, developing projects in agriculture, data capturing, data analysis and reporting. Mr. Amara has work with the Crop Protection department and the West Africa Virus epidemiology project for years and his major role is to train student on how to conduct research, do molecular analysis data collection and analysis, thesis writing techniques and reporting.

**Third Author**

James Kargbo, PhD, Lecturer, Department of Crop Science, Njala University, Sierra Leone. Research and Academic experience: James Kargbo is an emerging global agriculture and Crop Scientist. He had acquired diverse knowledge and experiences in the field of agriculture at both University and Ministry of Agriculture and Food Security. He holds a Bachelor of Science degree in Agriculture General and Master of Science in Environmental Management and Quality Control (Njala University-Sierra Leone), Master of Business Administration (Business School Netherlands-Netherlands) and Doctor of Philosophy in Agriculture (Voronezh State Agrarian University-Russia). He is a research Scientist, Agronomist and Lecturer at the Department of Crop Science, Njala University. Dr. Kargbo has vast knowledge in the design and execution of research, developing projects in agriculture, data capturing, data analysis and reporting. Dr. Kargbo has worked with the Ministry of Agriculture and implementing projects for years and also train students on how to conduct research, data collection and analysis, thesis writing techniques and reporting.

**Fourth Author**

Saidu Omarr Jalloh, Regional Manager, Southern Region (Produce Monitoring Board). Saidu Omarr Jalloh is an experienced professional serving as the Regional Manager for the Southern Region at the Produce Monitoring Board. With a strong background in regional management and produce oversight, Mr. Jalloh is dedicated to ensuring the quality and safety of agricultural produce in his region. His leadership in the implementation of industry standards and monitoring practices has played a significant role in enhancing the efficiency and effectiveness of the board's operations. Outside of his professional life, Mr. Jalloh is a committed family man. He is married and blessed with three children, balancing his career with family responsibilities. His dedication to both his work and family highlights his values of responsibility, integrity, and community service. Mr. Jalloh's diverse experience and commitment to excellence make him a key figure in the produce monitoring sector.

**Fifth Author**

Mr. Dan David Quee, Crop Protection Department, School of Agriculture and Food Sciences, Njala University. Research and Academic Experience: Mr. Dan David Quee holds a Certificate in Agriculture General, Bachelor of Science in Agriculture General and Master of Science in Crop Protection (Njala University), and Master of Philosophy degree in Agronomy/Weed Science (Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana). He is a Research Scientist in Weed Science and Lecturer in Crop Protection Department, School of Agriculture and Food Science, Njala University. Mr. Dan David Quee has vast knowledge in the design and execution of research and development projects in agriculture, electronic data capturing, data analysis and reporting. Mr. Dan David Quee has also carried out collaborative research with other scientists and he is author or co-author of several refereed publications. Research experience: (i) Develops weed control products. (ii) Conduct research to diagnose problems in the field or establish weed management systems for private crop management or consulting companies. (iii) Identify invasive weed species for farmers. (iv) Work to find chemical formulations that are effective in killing resistant weeds. (v) Study environmental and human health impact of chemicals that could be used. (vi) Plant crop trials both in fields and greenhouses for research. (vii) Organize and analyze research data.