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Production of Organic Liquid Fertilizer from Agricultural Waste and their Evaluation on Growth Parameters of Cowpea *(Vigna unguiculata (L.)Walp.)*

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Abstract

Organic liquid fertilizers (OLF) are made up of essential plant nutrients that assist in plant growth and development and serves as a faster means of nutrients assimilation by plants. The purpose of this study was to determine the macronutrient content of organic liquid fertilizers and commercial liquid fertilizer and evaluate their growth performance on cowpea (Vigna unguiculata (L.)Walp.). Market wastes also known as vegetable wastes, cow dung and poultry faeces were utilized to produce organic liquid fertilizer and compare it to commercial liquid fertilizer. The fermentation ratios used for production of the liquid fertilizer were; 5kilograms of vegetable wastes, 3 kilograms of cow dung, 3 kilograms of poultry faeces and 15litres of water. The parameters determined in this study on OLF include; the nitrogen (N), phosphorus (P) and potassium (K). The OLF and commercial liquid fertilizer showed the ranges of pH values as 6.3 and 6.0 and electrical conductivity of 0.7 and 0.8. The chemical analysis results showed poultry faeces plus vegetable waste had the highest content of N(2.00%) while cow dung plus vegetable waste had the highest contents of P(1.73%) and K(3.30%) while plain vegetable waste had the highest calcium content of (3.10%) and magnesium content (0.30%) respectively. The results for the growth parameters showed that OLF made from the combination of vegetable wastes and either cow dung or poultry faeces demonstrated the best growth performance. The organic liquid fertilizers were produced after 40 days of fermentation and used at a dilution of 1:10. Thereafter, complete random designs were setup to monitor the growth performance of cowpea for two weeks. This study showed that organic liquid fertilizer produced was more effective than commercial liquid fertilizer.

Keywords: *Agricultural waste, Cowpea, Organic liquid fertilizers.*

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1. Introduction

The disposing of organic waste on land is seen as an appealing alternative due to the growing difficulty in locating suitable landfill sites and this affects groundwater quality because nutrients stored in the subsoil may eventually drain into groundwater and contaminate it. Unprocessed organic wastes can be directly incorporated into the soil which takes time before releasing nutrients into the soil before the plants can benefit from it. To make nutrients in the wastes especially nitrogen easily available for plant use, and to reduce phytotoxicity of compost to plant growth, it is extremely desired to stabilize organic wastes before applying them to the ground (Cheng *et al*., 2016).

The global trend is focused on improving the environment and human health and composting, as an organic fertilizer, plays a vital role in achieving this objective. By prioritizing composting over the use of chemical fertilizers, the release of toxic chemicals into the environment can be reduced thereby benefiting both the environment and human well-being (Oumarou *et al.,* 2018).

Organic fertilizers have various benefits which can increase soil fertility, improve the chemical, biological and physical properties of soil, the use of organic fertilizers is safe for humans and the environment because it does not cause residual effects and can increase agricultural production. If used in the long term it can increase land productivity and prevent land degradation so that it can help soil conservation efforts be better (Sentana, 2010).

According to Sihotang *et al.,* (2013), liquid organic fertilizer (LOF) contains more varied macro and micro nutrients. Liquid fertilizers are more easily absorbed by plants because the compounds inside are already decomposed and also easily assimilated by plants faster than solid fertilizer. Sihotang *et al.,* (2013) also mentioned that liquid organic fertilizer also has a binding material, so fertilizer solutions applied to the surface of the soil can be directly used by plants.

Organic fertilizers come in two varieties: liquid and solid, utilizing liquid organic fertilizer is one method for extending the shelf life of compost (Thangaraj, 2018). The producer can include more nutrients and inducers in liquid form as opposed to solid form. In addition to improving the macro- and micronutrient content of the soil, organic fertilizer has been used to promote plant development and boost soil organic matter by releasing antibiotics and biodegradation of products. For the purpose of multiple crop production and nutrient cycling, organic fertilizer can be added to the soil or used as seed inoculants and the extended application of organic materials has no negative effects on the ecosystem, which is an added benefit of using organic fertilizer (Megali *et al.,* 2015).

Liquid organic fertilizer is a type of fertilizer that is derived from living organism (namely; decayed plant debris and microorganisms) and can be soluble easily in the soil as well as contains some important nutrients for plant growth and development. This fertilizer has not been fully utilized by farmers whom still depend on chemical fertilizers which can lead to acidification of the soil and cause irreparable damage. The use of inorganic fertilizers continuously causes the fertilizer function to be ineffective. This is due to the residual effects of these chemicals which can cause soil biological ecosystems to become unbalanced and can have an impact on the soil, plants and the environment. One way to reduce the use of inorganic fertilizers is to combine them with organic fertilizers. Puspadewi *et al*., (2016), states that the combination of organic and inorganic fertilizers can create well-maintained soil conditions so as to increase plant productivity and efficiency in fertilizer use.

Compact organic fertilizer such as manure and compost have some disadvantages such as their low density and low nutrient content while liquid organic fertilizer have many advantages such as improving the physical properties, chemical properties, and biological properties of soil as well as faster nutrient supply compared to compact organic fertilizers. Organic liquid fertilizer is environmentally friendly and safer to use, the effect can be seen in a faster time than solid manure (Sihotang *et al*., 2013).

Cowpea (*Vigna unguiculata* (L.) Walp.) is an annual summer season crop generally grown in arid and semiarid regions. It is used as a vegetable and remains in consumption throughout the year. The seeds contain proteins, dietary fibers, carbohydrates, iron, magnesium, and various vitamins and are a rich source of essential amino acids: lysine, leucine, and phenylalanine (Bhat *et al.,* 2013). It is a legume crop that produces root nodules and contains nitrogen-fixing Rhizobium bacteria that fix atmospheric nitrogen into biologically useful ammonia that the host plant can assimilate. The ammonia produced in excess is expelled into the soil and plant tissues surrounding the nodule (Negi *et al.,* 2006). As legume crops need a high phosphorous requirement for nodule development and optimal growth, organic fertilizers can be a beneficial option in soils to fulfill this requirement to promote crop growth (Madukwe *et al.,* 2010; Zhang *et al.,* 2023).

Although inorganic fertilizers can enhance production, their application can destroy soil structure and pollute air and water (Lin *et al.,* 2019; Bisht and Chauhan, 2021). In contrast, organic fertilizers are reported to mitigate several harmful effects on crop plants (Bi *et al.,* 2009; Yan and Gong 2010: Lin *et al.,* 2019). A study carried out by Masarirambi *et al.,* (2010) on red lettuce, Abhas *et al.,* (2011) on mungbean as well as Jannoura *et al.,* (2013) and Wazir *et al.,* (2018) on peas displayed the advantageous effects of organic fertilizers. The enhanced growth and yield characteristics by organic fertilizers on food crops like wheat and vegetable crops like capsicum and carrot were recently investigated and proven to be beneficial (Balkrishna *et al.,* 2024 a, b, c).

Based on the advantages of organic farming on the growth and yield potential of different crops, this study aims at converting organic solid wastes namely; cow dung, vegetable waste and poultry faeces into liquid organic fertilizer and determine the physico-chemical properties of the produced liquid organic fertilizer as well as experimentally evaluate the performance of the produced fertilizer product on germination percentage and seedling growth of cowpea considering the safety and health of the environment, producers and consumers.

2. Materials and Methods

Study area

The work was centred in Maiduguri, Borno state, Nigeria. The area is positioned between the latitudes of 11°.83' to 13°.15' north of the equator and the longitudes of 11°50' to 13°09' east of the Greenwich meridian. The wet season in this region is characterized by hot, humid weather with predominantly cloudy skies while the dry season is marked by extremely hot temperatures and partly cloudy conditions. The temperature in this area ranges from 58°F to 106°F.

Experimental Materials

Collection and preparation of Composting Materials

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The compost mass is primarily composed of vegetable waste (VW), specifically cabbage, lettuce and russell, which were gathered at the Gomboru Moromoro market in Maiduguri. Partially decomposed cow dung (CD) and poultry faeces(PF) were obtained from the Faculty of Agriculture University of Maiduguri Animal Farm. Commercial organic liquid fertilizer (COLF) was bought at the Monday market in Maiduguri Metropolis. The manure from cow and poultry were crushed and allowed to air dry before being used in this experiment.

Composting Procedures

Fresh vegetable wastes were chopped into small pieces and deposited in three sets of buckets after being allowed to dry to 60% moisture content in the natural atmosphere for approximately one week. These were then thoroughly combined with 5 kg of plain vegetable waste and 3 kg of cow dung and 3 kg poultry faeces. The following formulations were produced after the materials were thoroughly mixed: (i) plain vegetable waste (V) (5 kg) (ii) Cow dung + vegetable waste (CV) (cow dung: vegetable waste = 3:2), and (iii) poultry faeces +vegetable waste (PV) (poultry faeces: vegetable waste = 3:2). The mixture was then stirred for a while in a single direction. Using midi-20-liter buckets, aerobic composting conditions were replicated in a lab setting. A container was placed underneath the openings in the setup buckets(already perforated) to collect the liquid.

Diluted activated microbiological formulation coagulated milk was sprayed onto the formulation (as a source of lactic acid bacteria). Nine sampling units were obtained by replicating the three recipes three times. The technological procedure of making fertilizer was completed by leaving the finished products in the open container. Based on its organoleptic properties (homogeneity, looseness, odourlessness) and physico-chemical properties, the fertilizer readiness was evaluated. A full technological cycle takes about 40 to 50 days to complete when the aforementioned criteria were met. The organic fertilizer (the collected liquid) was kept for additional examination.

Collection of soil sample and Preparation of Pots

Soil was collected at research farm of faculty of Agriculture university of Maiduguri. The soil sample that was gathered for the experiment was weighed (1 kg) and placed into two-litre plastic pots for each experiment. To enhance aeration and drainage, the pots were perforated.

Experimental design

In this study, a randomized block design sample was used consisting of three (3) treatments with three (3) replications and a control sample (with three replicates) for observation. In each pot, three cowpea seeds were planted at a depth of around 2.5 cm. Both commercial (in control pots) and organic liquid fertilizers were applied during the fertilizer application, sprayed at a 1:10 dilution factor during sowing process. Soil properties like pH, EC, Nitrogen, Phosphorus, Potassium, Magnesium and Calcium were analysed as per standard procedures (Jackson 1973). Observation and analysis of plant growth parameters were recorded.

Observation and analysis of plant growth parameters

Two weeks were dedicated to the study. The germination percentage was evaluated on three days, five days, seven days, and fifteen days respectively, in addition to measuring plant heights using a meter rule, counting the number of leaves per plant and measuring the plant biomass was also carried out.

Statistical analysis

Data obtained during the study were subjected to one-way analysis of variance (ANOVA) using Statistix10.0 analytical software and treatment means were compared using the Fisher protected Least Significant Difference (LSD) test.

3. Results and Discussion

pH and Electrical Conductivity of Organic Liquid Fertilizer

Chemical Composition of the prepared fertilizers made from several sources of organic materials shows that the pH of every organic liquid fertilizer in Table 1, falls into the category of "slightly acidic." Nonetheless, compared to other treatments, the pH of organic liquid fertilizers made from vegetable waste and cow dung plus vegetable waste was noticeably higher. Additionally, the electrical conductivity (EC) of the treatments varies significantly ($P < 0.05$).The organic liquid fertilizers' electrical conductivity results indicated that none of the treatments were saline. The table shows that, in contrast to the other treatments, the commercial organic fertilizer has the highest EC value (0.83 dS/m), making it more saline. Vegetable waste-based liquid organic fertilizer had the lowest EC value, measuring 0.59 dS/m.

Nutrient Compositions of the Organic Liquid Fertilizer

The results as shown in Table 1 unequivocally demonstrated how mixtures of poultry feaces and vegetable waste differed markedly from the commercial liquid fertilizer; with a higher N content (2.00%) noted. It was revealed that the N content of every other treatment was statistically comparable. It was interesting to note that all liquid organic fertilizers have quite high nitrogen contents. The treatments' respective phosphorus contents varied significantly. Despite having statistically equal values, organic fertilizers made from cow dung plus vegetable waste and solely vegetable waste differed significantly from the other treatments. The commercial liquid organic fertilizer had the lowest phosphorus content. The potassium contents of the different treatments showed significant variations ($P < 0.05$). The mixture of vegetable waste and cow dung was found to record a substantially higher K (3.30) in comparison to all other treatments. Calcium contents of the various organic liquid fertilizers produced also presented in Table 1 showed that the calcium contents of the various sources were shown to differ significantly from one another. Among all the various sources, liquid fertilizer from vegetable waste recorded the highest Ca content (3.10%) whereas commercial liquid fertilizer was observed to record lowest Ca. Magnesium content of the liquid fertilizer sources were also determined. Among all the different sources of fertilizer, Poultry faeces + vegetable waste was observed to significantly record the highest Mg content while Commercial liquid fertilizer had the lowest Mg content.

Table 1: Selected Chemical Compositions of the Organic Liquid Fertilizer

Sources of Organic manure	pH (1:2:5)	Electrical conductivity	Nitrogen (%)	Phosphorus (%)	Potassium (cmol/kg)	Calcium (%)	Magnesium (%)
Poultry faeces +vegetable waste	6.00^{b}	0.75^{c}	2.00^{a}	1.40^{b}	1.50^{c}	2.60^{b}	1.00^{a}

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Cow dung+ vegetable waste	6.30^{a}	0.79^{b}	1.60^{ab}	1.73^{a}	3.30^{a}	1.40^{c}	0.80^{b}
Vegetable waste	6.30^{a}	0.59^{d}	1.68^{ab}	1.61^{a}	2.00^{b}	3.10^{a}	0.30^{c}
Commercial liquid fertilizer	6.04^{b}	0.83^{a}	1.43^{b}	1.10^{c}	1.18^{d}	0.93^{d}	0.12^{d}
SE±	0.072	0.010	0.243	0.082	0.1545	0.06	0.05

Mean within the same column with the same superscript indicate no significance difference while mean with the different superscript within a column indicate level of significance at 5 %probability level

Effects of Organic Liquid Fertilizer on Germination Percentage of Cowpea

The effects of organic liquid fertilizer on germination percentage of cowpea can be seen in Table 2, it was discovered that the seeds started to sprout on the third day in each treatment. Days 3, 5, and 7 showed significant differences in the number of seeds that germinated. Poultry faeces and vegetable waste significantly improved the percentage of seeds that germinated (at a germination rate of 70%) on the third day after sowing in comparison to all other treatments. The results showed that the commercial organic liquid fertilizer had the lowest level of effectiveness. On the fifth day, 96.33 percent of the beans germinated showing that the combination of vegetable waste and cow dung had a stronger effect on bean germination than the other treatments. When a liquid fertilizer combining cow dung and vegetable waste was applied, germination rose by 59.56% in comparison to the third day of germination. It was discovered that the germination statistics at day 7 and day 3 were identical.

Table 2: Effects of Organic Liquid Fertilizer on Germination Percentage of Cowpea

Treatments	DAY 3 Percentage Germination (%)	DAY 5 Percentage Germination (%)	DAY 7 Percentage Germination (%)
Poultry faeces +vegetable waste	70.0^{a}	90.00^{b}	90.00^{b}
Cow dung+ vegetable waste	36.67^{b}	96.33^{a}	96.33^{a}
Vegetable waste	53.33^{c}	86.67^{b}	86.67^{b}
Commercial liquid fertilizer	36.67^{b}	70.00^{d}	70.00^{d}
Control	50.00^{c}	80.00^{c}	80.00^{c}
SE±	1.963	2.403	2.403

Mean within the same column with the same superscript indicate no significance difference while mean with the different superscript within a column indicate level of significance at 5 %probability level.

Effects of Organic Liquid Fertilizer on Number of Leaves per Plant

The effects of organic liquid fertilizer on the number of leaves on cowpea are shown in Table 3. There is a significant difference ($P < 0.05$) in the number of leaves per plant at 3DAS between the treatments, with an average of 2.4 leaves per plant at 3 DAS, the combination of vegetable waste and poultry faeces demonstrated a significant difference when compared to cow dung and vegetable waste, plain vegetable waste, commercial liquid fertilizer and the control. The results showed that leaf counts at 3DAS were comparable to those of the other treatments; the combination of vegetable waste and cow dung had the lowest value. When commercial liquid fertilizer and cow dung plus vegetable waste were used at 5 DAS, the number of leaves per plant differed very marginally between treatments. It was discovered that the number of leaves per plant at 5 DAS recorded statistically comparable values for every other treatment. According to Table 3, the organic liquid fertilizer had no significant effect on the number of leaves per plant at 7 DAS ($P > 0.05$), but after 15 DAS ($P < 0.05$). there was a significant shift in the number of leaves per plant. Among all the treatments, cow dung combined with vegetable waste significantly reported the highest value for the parameter under evaluation at the 5% probability level.

Table 3: Effects of Organic Liquid Fertilizer on Number Leaves of Cowpea

Treatments	Number of leaves per plant at 3 DAS	Number of leaves per plant at 5 DAS	Number of leaves per plant at 7 DAS	Number of leaves per plant at 15 DAS
Poultry faeces +vegetable waste	2.40^{a}	2.50^{ab}	3.00^{a}	5.70^{c}
Cow dung+ vegetable waste	1.10^{b}	2.90^{a}	3.00^{a}	7.00^{a}
Vegetable waste	1.50^{b}	2.60^{ab}	3.00^{a}	6.16^{b}
Commercial liquid fertilizer	1.40^{b}	2.20^{b}	2.90^{a}	5.59^{c}
Control	1.30^{b}	2.50^{ab}	2.90^{a}	6.33^{b}
SE±	0.355	0.210	0.410	0.090

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column indicate level of significance at 5 %probability level. DAS=Days after Sowing

Effects of Organic Liquid Fertilizer on Plant Height of Cowpea.

Table 4 showed how plant height changed with the application of organic liquid fertilizer at 7 and 15 days after seeding. The amount of organic liquid fertilizer applied had a substantial ($P<0.05$) effect on the height of the plants. Plants treated with organic liquid fertilizer derived from vegetable waste and poultry faeces produced the tallest plants followed by plants treated with an organic liquid fertilizer derived from vegetable waste. There were similarities between the two other treatments and the control treatments in terms of plant height at 7 DAS. The table also showed the effects of the treatments on plant height, as previously reported: however an analysis of variance showed that there were no significant differences between the mean values with $P>0.05$.

Table 4: Effects of Organic Liquid Fertilizer on Plant Height of Cowpea

Treatments	Plant Height at 7 DAS (cm)	Plant Height at 15 DAS (cm)
Poultry faeces +vegetable waste	5.00[a]	21.17[ab]
Cow dung+ vegetable waste	3.00[c]	22.26[ab]
Vegetable waste	4.02[b]	22.58[a]
Commercial liquid fertilizer	3.01[c]	20.33[b]
Control	3.02[c]	21.83[ab]
SE±	0.192	0.994

Mean within the same column with the same superscript indicate no significance difference while mean with the different superscript within a column indicate level of significance at 5 %probability level.DAS=Days after Sowing

Effects of Organic Liquid Fertilizer on Plant Biomass

The impact of organic liquid fertilizer on biomass of cowpea plant at 15 DAS is presented in Table 5. There were notable variations across the treatment methods, the Table indicates that the maximum biomass weight was considerably recorded in treatments treated with Cow dung + Vegetable waste (7.88g/plant) and Poultry feaces + Vegetable waste (7.63g/plant). At the 5% probability level, analysis of variance reveals that the other treatments were indistinguishable from the control treatment.

Table 5: Effects of Organic Liquid Fertilizer on Plant Biomass

Treatments	Plant Biomass at 15 DAS (g)
Poultry faeces +vegetable waste	7.63[a]
Cow dung+ vegetable waste	7.88[a]
Vegetable waste	5.29[b]
Commercial liquid fertilizer	5.43[b]
Control	5.11[b]
SE±	0.636

Mean within the same column with the same superscript indicate no significance difference while mean with the different superscript within a column indicate level of significance at 5 %probability level

Chemical Composition of the Liquid Organic Fertilizer

A slightly acidic organic liquid fertilizer was produced from vegetable waste despite significant differences in mean pH values, all liquid fertilizers derived from combinations of organic components were considered to be slightly acidic. The pH of the organic liquid fertilizer makes it favorable for growing crops in the savanna region as most arable crops grown in the region prefers slightly acidic to neutral pH. Data for soil pH of the savannah regions were reported by many authors to be slightly acidic to neutral, suggesting that addition of the organic liquid fertilizer produced will not pose a potential soil reaction. Although cow dung and poultry feaces were used by Adesida *et al.,* (2020) to create an organic liquid fertilizer, the material's pH was discovered to be alkaline. The alkalinity and acidity indicators show that the product is neither alkaline nor acidic; therefore utilizing it will not raise the risk of salinity or acidity in the soil.

Organic fertilizer can replace certain chemical fertilizers that include nitrogen because of its high concentration of nitrogen. In this study, 2.0% nitrogen was produced by the combination of poultry faeces and vegetable waste. Nitrogen in liquid organic fertilizers are expected to be easily converted to plant available forms of nitrogen (that is NH_4 and NO_3) than nitrogen from solid sources. This is because solubility of fertilizers or manure to release nitrogen might be hindered by so many factors. With organic liquid fertilizers, these challenges can be avoided. Growth parameters measured in this study evidently showed that nitrogen from organic liquid fertilizers produced were efficiently utilized by the cowpea. Poultry faeces have lower C/N ratio than other organic fertilizers (Aggarangsi *et al.*, 2023). As such, mineralization of nitrogen through microbial decomposition was observed to be higher when the manure was combined with vegetable wastes during composting. The lower C/N ratios of the vegetables used in combination with the poultry manure also greatly enhanced the nitrogen content.

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According to Enueke *et al.*, (2013), poultry faeces are cost-effective and essential for maintaining the proper soil physical conditions for plant growth. Ghanbarian *et al.*, (2008) found that poultry faeces have higher quantities of phosphate and nitrogen than other manures. However, Garg and Bahl (2008) suggested that phosphorus can be absorbed by plants more readily from poultry feaces than from other types of organic waste. This investigation revealed that the phosphorus and potassium concentrations of cow dung and vegetable wastes were higher than those of poultry feaces. This could be because the cows' diet included more P and K in the feed they consumed.

Effects of Organic Liquid Fertilizer on Germination Percentage of Cowpea.

Compared to the other groups, the seeds treated with organic liquid poultry feaces + vegetable waste had a higher rate of germination. This demonstrates how the nutrients in vegetable waste and poultry feaces helped the seeds sprout and stay viable. When cowpea seedlings were mixed with vegetable waste and poultry feaces, they germinated more quickly. The substantial nutrient content of the fertilizer supplied critical ingredients that sped up seed development and emergence, more so than other manure sources at the three data collection stations. Conversely, cowpea seed germination was positively impacted by liquid cow dung manure. Its influence on germination was gradual since it took longer than poultry faeces to give necessary elements including potassium, phosphate, and nitrogen. Both early seedling growth and seed germination are aided by these nutrients. Additionally, enhancing soil structure, water retention. and mnicrobial activity all of which are good conditions for germination is the organic component of liquid cow dung manure.

Effects of Organic Liquid Fertilizer on Growth of Cowpea.

Organic liquid fertilizer had a substantial (P <0.05) effect on the number of leaves per plan1 at 3 and 5 DAS; however, at 7 DAS, all treatment values were equal. The mean values of the number of leaves on plants at 15 DAS showed highly significant differences (Table 3).During the early growth stages (3 DAS), it was discovered that liquid fertilizer composed of organic materials and poultry faeces increased the number of leaves more quickly than other treatments. Poultry feaces have been demonstrated to release nutrients like N and P more quickly than other manure sources (Brady and Weil, 2012). Because of the significant mineralization of N from the faeces, poultry faeces frequently have a lower C/N ratio than cow dung or other manure sources. Elevated levels of N mineralization are generally correlated with increased chances of N volatilization. The results in Table 3 indicated that the number of leaves on cowpea development was longer to respond to liquid fertilizers derived from cow dung or cow dung mixed with vegetable waste. However, at 7 DAS, there were no significant changes in the mean values of the number of leaves at 5% level of probability. At 15 DAS, it was evident that liquid manure generated from cow dung and vegetable waste increased the number of leaves in cowpea more than any other treatment. Similar findings to this experiment were reported by Adesida *et al.*, (2020), who noted non-significant variations in the number of leaves per plant after applying treatments involving liquid cow dung and poultry faeces at early stage of growth.

Different growth responses of cowpea following application of liquid manure were observed over the course of multiple monitoring periods. Liquid manure had a significant effect on plant height at 7 DAS, with the highest value (5.00 cm) coming from poultry feces plus vegetable waste (Table 4). The treatments' effects on plant height at 15 DAS were not statistically significant (P>0.05). When cowpea was treated with vegetable waste and poultry feaces, the results were clearly different from when it was treated with other liquid manure sources. Cowpea treated with poultry faeces outperformed those treated with other manure sources, according to Subedi *et al.*, (2022). The easier availability and nutrient absorption of the manure was credited with the crop's increased performance. Furthermore, Singh *et al.*, (2011) discovered that cowpea plants cultivated with poultry faeces grew significantly taller than those produced with other sources of manure.

At harvest, the treatments significantly affected the biomass yield of cowpea (P <0.05). Despite having similar plant biomass values, the treatments including cow dung plus vegetable waste and poultry faeces plus vegetable waste differed significantly. Similar outcomes were observed when comparing the biomass yield of control treatments, commercial organic liquid fertilizers and vegetable waste alone.

4. Conclusion

This research demonstrated that organic liquid fertilizer solution from agricultural wastes through 50 days of fermentation is more effective than commercial liquid fertilizer. It contains all the nutrients required for plant growth. According to the findings of the nutritional characterization carried out with the application of poultry feaces + vegetable waste and cow dung + vegetable waste contained every primary macronutrient. The growth performance of cowpea by the use of produced OLF was observed for 15 days. The results proved that the analysis by calculating the average height of the plants, number of leaves and germination percentage in OLF wick system were almost similar to the plants in the nutrient solution wick system..

Agricultural waste increases the availability and concentration of nutrients hence enhancing the agricultural value of the waste when used as fertiliser and contributing to a more bio-based circular economy. The conversion of vegetable waste into beneficial resources, such as organic fertilizer or organic compost, is a viable technique for preventing additional environmental deterioration caused by inappropriate waste management and disposal. In addition, organic liquid fertilizer may continue to be used as a source of plant nutrients for vegetable production and other plant types. Organic liquid fertilizer not only minimises the cost of fertilizer but is also the best option for repairing the commercial hydroponic nutrient solution. The organic liquid fertilizer may also be applied to soils, resulting in sustained soil production and soil health. Producing organic liquid fertilizer from agricultural wastes and using it in agriculture and hydroponic remediation is thus recommended in order to reduce the amount of waste sent to landfills, reduce environmental pollution and degradation, and increase agricultural land productivity.

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