**Comparative analysis of the influence of Synthetic fertilizer and Chicken waste manure on soil fertility andthe growth rates of *Vigna radiata* and *Vigna aconitifolia***

**ABSTRACT:**

In terms of solid waste management, chicken waste manure appears to be a promising, innovative, sustainable waste treatment technology. *Gallus gallus domesticus* intestinal waste is broken down and converted into fertilizer or chicken manure over a period of 90 to 100 days. Globally, sustainable agricultural methods have been employed to reduce the adverse effects of synthetic fertilizers, which decrease soil fertility and organic matter. An annual herb, *Vigna radiata* is a member of the legume family. When fully matured, its seeds provide a valuable source of 85% digestible protein for human use. The high protein content and excellent amino acid, mineral, and vitamin profile of *Vigna aconitifolia* make it a popular choice for food and fodder. In addition to comparing the effects of synthetic fertilizer and chicken manure on soil fertility, the study aimed to examine the growth parameters of *Vigna radiata* and *Vigna aconitifolia* roots, leaves, plant height, pods, and seeds. In comparison to synthetic fertilizer, all treated groups who received a high dose of chicken waste manure after 120 days of the study showed significant increases in the number of nodes, leaves, roots, shoot length, number of pods, and number of seeds. The treatment groups that received a high dose of chicken waste manure during the 90-day pilot trial indicated significantly higher levels of organic carbon, NPK, and pH compared to those that received synthetic fertilizer.

**Keywords:** Chicken waste manure, Synthetic fertilizer, *Vigna radiata, Vigna aconitifolia ,* soil

Fertility, growth and yield

**INTRODUCTION:**

The increasing demand for chicken meat has contributed to a rise in **poultry production**, which increased the use of organic waste as fertilizer/manure (Namasiku Mufwanzala, et, al.,2010). An inventive and sustainable method with a bright future in solid waste management appears to be the utilization of chicken waste manure for waste treatment (Ayesha Rassool, et, al., 2023). It is the process of using a waste decomposer to break down the waste organ i.e. the intestine, and converting it into nutrient-rich material that can help to plants grow (Vaishnavi Ghadage, et, al., 2024). There is less demand for synthetic fertilizer since intestinal waste can convert organic waste into nutrient-rich material (Richa, et, al., 2020). The increasing range of poultry production might indicate the agriculture economy's improvement in many nations or towns (Renu Kumari, et, al., 2022).  Composting the continuous development in the poultry industry has caused some problems in terms of environmental pollution (Ali, et, al., 2003). The need and utilization of chicken waste manure/fertilizer have overtaken the use of other animal manure (e.g., pig manure) because of its high content of nitrogen, phosphorus, and potassium(Warman,1986).

Synthetic fertilizers are harmful to both human health and the environment because they reduce soil porosity, induce root burn, reduce the amount of water that plants can retain, kill microorganisms that are beneficial to the soil, lower soil fertility, alter soil pH, and contaminate air and water (Deepali chittora, et, al., 2023). The application of synthetic fertilizer often depletes the vital minerals and nutrients that are naturally present in the soil. Synthetic fertilizer is a major threat to the long-term, balanced growth of plants and the ecosystem in which they live (Rania E. Mohamed et, al., 2023).

The process of enhancing soil quality by the addition of organic matter, manure, and fertilizers is known as soil rejuvenating. Restoring soil fertility and production in agriculture involves soil regeneration, which returns nutrients, organic carbon, and other micronutrients. (Soad Moftah Ahmad Emshher, et, al., 2022). Composted chicken waste manure provides a slow-release source of macro-micronutrients and acts as a soil amendment. Compared to other manures, chicken manure and the associated litter are higher in nitrogen, potassium, phosphorus and calcium, and also rich in organic matter. (Zublena, 1993). Addition of organic matter to soils increases a soil’s water-holding capacity, improves aeration and drainage, reduces fertilizer leaching and improves a soil’s structure. Additionally, organic matter provides a food source for soil microbes, which increase soil biological diversity, accelerating the breakdown of organic nutrients into forms more radially available to plants. All of these factors can improve plant health. (Rosen, 2005).

Vigna radiata commonly known as mung bean plant is a plant that is upright and belongs to the legume family. In areas where meat is scarce or when the majority of people are vegetarians, the mature seeds offer a vital supply of digestible protein for humans. They contain 85% protein in total (Abdul Wahid Baghlami et, al., 2024).  It matures rapidly in tropical and subtropical climates, where ideal temperatures are consistently above 15°C and between 28°C and 30°C. The medicinal properties of Vigna radiata include improved skin health, blood pressure regulation, and red blood cells (Dianzhi Hou et, al., 2019). The Moth bean, or Vigna aconitifolia, is a small, drought-tolerant legume of the Fabaceae family (A.H.Sipai et,al., 2022). It is highly adaptable and can grow successfully in arid and semi-arid regions, primarily in different geographic areas of India and other Asian countries (Kanishka R.C. et, al., 2023). The Vigna aconitifolia commonly known as matki is consumed as food and fodder and is known for having a high protein content along with an excellent amino acid, mineral, and vitamin profile (Sathe, et, al.,2007). The lysine and leucine-rich moth beans and the sulphur-containing grains help to make up for each other's inadequacies in amino acids (Kanishka R.C. et, al.,2023). Moth bean provides anti-hypertensive, anti-oxidant, anti-cancer, antibacterial, diuretic, and hypocholesterolaemia effects among its pharmacological properties (Ma, D.Z et, al.,2023.).

A comparative study has been carried out to determine the comparison between chicken waste manure and commercial synthetic fertilizer (Maruti NPK fertilizer 20:20:0). Their effects on growth and yield of *Vigna radiata* and *Vigna aconitifolia* and also impact on fertility of soil*.* Specific objective is to increase the awareness of the importance of chicken waste manure for production of organically grown the plants and helps to reduce the load on solid waste management.

**MATERIALS AND METHODS:**

The intestine of an adult *Gallus gallus domesticus* specimen weighs 12.8 grammes. An enormous spherical plastic tank was used to store the manure. An organic waste decomposer and chicken intestinal waste were placed in a circular plastic tank. In a tank, this decomposer is mixed with chicken intestine waste; water is added as needed. Cover the tank with sheets so that proper decomposition can occur. Using a wooden rod, the decaying components were vigorously mixed once during the three days to ensure uniform decomposition. Once the decomposer is available, the decomposition process takes 90–100 days.

To analyse the micronutrients of soil, such as pH, N, P, K, and organic carbon, a soil detection kit can be used. Three tiny plastic containers were filled with 10 kg of soil samples from the drought area. The first container's barren soil was used as a control did not receive any fertilizer. While the second containers were treated with chicken manure, the third container's soil sample was treated with a suitable dose of synthetic fertilizer at 30-day intervals. Forty millilitres of synthetic fertilizer and forty millilitres of chicken waste manure were placed in the second and third plastic containers, respectively. A soil detection kit was used to test the soil samples for pH and micronutrients, including organic carbon, nitrogen, potassium, and phosphorus, over a period of 90 days after 120 millilitres of chicken waste manure and synthetic fertiliser were added to the second and third containers.

*Vigna aconitifolia* and *Vigna radiata* seeds were incubated in a water bowl for 24 hours before being transferred into six different plastic containers (10 seeds per container). After ten treatments, the first two plastic containers were treated with a 40% concentration of chicken waste manure at 10-days intervals. The seeds in two other groups received 40% commercial synthetic fertilizer (Maruti NPK fertilizer 20:20:0). The seeds of *Vigna radiata* and *Vigna aconitifolia* in the fifth and sixth groups were kept as controls and did not receive any fertilizer. The number of roots, nodes, leaves, pods, seeds, length of leaves and length of pods, and length of plant from root to apex were then tallied, along with all other characteristics associated with the *Vigna aconitifolia and Vigna radiata* plants, during a period of 10–10 days. After that, these outcomes were documented for comparison from day 0 to day 120.

**OBSERVATIONS AND RESULTS:**

**Fig 1**: Effect of chicken waste manure(T1) and **Fig 2**: Effect of chicken waste manure(T1) and

Synthetic fertilizer (T2) on the number of roots of Synthetic fertilizer (T2) on the plant height(cm) of *Vigna radiata* at different days of transplanting. *Vigna radiata* at different days of transplanting.

**Fig 3**: Effect of chicken waste manure(T1) and **Fig 4**: Effect of chicken waste manure(T1) and

Synthetic fertilizer (T2) on the number of leaves of Synthetic fertilizer (T2) on the number of pods of

*Vigna radiata* at different days of transplanting *Vigna radiata* at different days of transplanting.

**Fig 5:** Effect of chicken waste manure(T1) and

Synthetic fertilizer (T2) on the number of seeds of

*Vigna radiata* at different days of transplanting

**Fig 6**: Effect of chicken waste manure(T1) and **Fig 7**: Effect of chicken waste manure(T1) and

Synthetic fertilizer (T2) on the number of roots ofSynthetic fertilizer (T2) on the plant height(cm) of

*Vigna aconitifolia* at different days of transplanting. *Vigna aconitifolia* at different days of transplanting.

**Fig 8:** Effect of chicken waste manure(T1) and**Fig 9:** Effect of chicken waste manure(T1) and

Synthetic fertilizer (T2) on the number of leaves of Synthetic fertilizer (T2) on the number of pods of

*Vigna aconitifolia* at different days of transplanting *Vigna aconitifolia* at different days of transplanting

**Fig 10:** Effect of chicken waste manure(T1) and **Fig 11:** Effect of chicken waste manure(T1) and

Synthetic fertilizer (T2) on the number of seeds of Synthetic fertilizer (T2) on the pH of soil at different days of

*Vigna aconitifolia* at different days of transplanting. transplanting.

**Table 1: Soil nutrient composition under different concentration levels.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **barren soil (control)** | **Barren soil (40% concentration)** | **Barren soil (+40% concentration)** | **Barren soil (+40% concentration)** |
| **Organic Carbon** | **< 0.5** | **≤ 0.5 - 1.0 %** | **> 1%** | **> 1% - 2.5%** |
| **Nitrogen** | **0.55 g/N** | **0.63 g/N** | **0.90 g/N** | **1.15 g/N** |
| **Phosphorous** | **0.03 g/P** | **0.65 g/P** | **0.85 g/P** | **0.95 g/P** |
| **Potassium** | **0.06 g/K** | **0.10 g/K** | **0.45 g/K** | **0.63 g/K** |

The above figures show that over the period of 120 days, it was discovered that the 40% concentration of Compared to synthetic fertiliser, the growth rate of the plants was directly associated with the application of chicken waste manure to the *Vigna aconitifolia* and *Vigna radiata* seeds. On day 120 it was observed that, the slowest growth rate of the plant in terms of number of roots, leaves, pods, seeds, as well as height of plant, in the sample containing 40% synthetic fertilizer. This growth rate was faster than the control group but less than the samples containing 40% concentrations of chicken waste manure. However, when the sample was treated with a suitable concentration of chicken waste manure, it grew at the highest rate possible, outpacing both the control and the samples treated with synthetic fertilizer. It was determined that when a suitable concentration foliar spray of chicken waste manure was done over the course of 120 days, all the growth metrics of the *Vigna aconitifolia* and *Vigna radiata* plants increased significantly. The figure 11 show that, over the course of 90 days, it was discovered that, concentration of chicken waste manure that was applied to the barren soil directly correlated with the pH of the soil than synthetic fertilizer. On the day 90 it was observed that, the soil was treated with appropriate concentration of chicken waste manure(T1) appears to be the most suitable for sustaining plant growth, as it balances the pH reduction while improving fertility of soil. When soil sample was treated with suitable concentration of synthetic fertilizer(T2) may require pH management strategies such as lime application, to prevent excessive soil acidification and maintain plant health.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | ***Vigna aconitifolia* plant** | | | ***Vigna radiata* plant** | | |
| **Parameters** | **t value** |  | **Significance** | **t value** |  | **Significance** |
| **Number of roots** (Total number of days correlated with the 40% concentration of chicken waste manure.) | **12.56** | ***P*< 0.05** | **Significant** | **13.34** | ***P*< 0.05** | **Significant** |
| **Number of leaves** (Total number of days correlated with the 40% concentration of chicken waste manure.) | **-3.73** | ***P*< 0.05** | **Significant** | **-3.36** | ***P*< 0.05** | **Significant** |
| **Height of plant** (Total number of days correlated with the 40% concentration of chicken waste manure.) | **4.34** | ***P*< 0.05** | **Significant** | **4.50** | ***P*< 0.05** | **Significant** |
| **Number of Pods** (Total number of days correlated with the 40% concentration of chicken waste manure.) | **-3.56** | ***P*< 0.05** | **Significant** | **-3.48** | ***P*< 0.05** | **Significant** |
| **Number of Seeds** (Total number of days correlated with the 40% concentration of chicken waste manure.) | **-3.60** | ***P*< 0.05** | **Significant** | **-3.12** | ***P*< 0.05** | **Significant** |

**Table 2: variation in the values of regression coefficient**

The significance of variation in the values of regression coefficient was tested using the t-test and is presented in the Table 2. The regression values obtained were found to be highly significant (*P* < 0.05), showing a good relationship between Total number of days with 40% concentration of Chicken waste manure in the certain parameters like number of roots, number of leaves, height of plant, number of pods as well as number of seeds of plant *Vigna aconitifolia* and *Vigna radiata*.

**DISSCUSION:**

The purpose of the current study was to examine the effects of synthetic fertiliser and chicken manure (an organic fertiliser) on the growth rates of *Vigna radiata and Vigna aconitifolia*. Over the course of 120 days, the above study found that the application of manure made from chicken intestinal waste had a positive effect on all growth parameters of *Vigna aconitifolia and Vigna radiata*, significantly greater than plants that were treated with synthetic fertiliser. Poultry offal can be utilised in a variety of ways, including manifest, incineration, inhumation, restricted disposal sites, composting, and decomposition without oxygen which helpful to reducing pathogens acts as soil conditioner or fertilizer. (D. Thyagarajan., *et., al* 2013).

In comparison to the waste of other animal species, chicken intestine waste, also known as poultry waste, has higher concentrations of nitrogen, calcium, and phosphorus. The availability of these nutrients increases the motivation to use this resource. There have been numerous experiments in which plants have been grown in pots with different fertilizer / manure, where increases in plant growth have occurred. According to a comparative study that used different treatments of synthetic fertiliser and organic manure, the effects of synthetic fertilizer on growth rate significantly improved all growth parameters of *Vigna aconitifolia* plant but reduces the fertility of soil, while the plant treated with organic fertiliser experienced a not only significantly increases the growth rate of plant but also improve the fertility of soil (B.C.Sharma., *et., al* 2021).

In the Kharif season, Ruheentaj and his co-authors carried out a comparative analysis in 2020. In comparison to inorganic fertilisers and nitrogen treatment, they discovered that vermicompost and other organic fertilizers greatly enhance *Vigna aconitifolia* plant characteristics, including plant height at harvest, dry matter accumulation, pod number, pod length, grain yield, and straw yield. When compared to other inorganic fertilizers, Ozleum Atuntas and his coworkers in 2022 discovered that the effect of chicken waste manure on the growth rate of lettuce plants significantly increased the plant's parameters, including root length, leaf length, root wet weight, root dry weight, leaf counts, and stem diameter. Shubh Patel and the other researchers in 2023 claim that organic fertilizers significantly improved the *Spinacia oleracea L*. plant's root length, plant height, leaf length, and leaf weight. Furthermore,it was demonstrated that organic fertilizer is the greatest substitute for inorganic fertilizer. When vermicompost and poultry manure were applied together, the growth rate of *Vigna radiata* was much higher than when chemical fertilizer was used (H.R. Choudhary, *et al*., 2013).

In 2018, Aisha Wazir and her group carried out the comparative analysis. Research found that different organic fertilizers had a much better influence on the development and production of potato and pea plants compared to those treated with chemical fertilizers. In 2022, Varsha H. Perli and other researchers carried out a field experiment. When compared to various treatments of different organic manure and bio fertilizers, the study found that a combination of chicken manure and Rhizobium enhances the growth and productivity of *Vigna radiata* plant. Plant growth and the photosynthetic leaf pigment of *Vigna radiata* plant are enhanced by the application of a combination of NPK and organic fertiliser (Al-Jawhara A and Al-Owied 2016). Raksha Verma and her co-authors carried out the field study in 2022 during the kharif season. According to the study, the growth indices of the *Vigna radiata* plant, including plant height, number of nodules, branches, and pods, were considerably enhanced by the combined effects of chicken waste manure, Rhizobium, and vermicompost. Additionally, it was determined that applying Rhizobium and chicken waste manure resulted in increased seed yield, gross returns, and benefit-cost ratios when compared to other treatments. Similar research was conducted by chicken waste manure as a source of fuel. Research showed that acceptable dose of chicken waste on the different growth parameters of *Vigna aconitifolia* were significantly increases over the course of 150 days. It was also observed effect of chicken waste manure also improve the fertility of soil (V.Ghadage and B.M.Gore 2024).

**CONCLUSION:**

Chicken waste manure appears to be a new and efficient method to break down waste products, which reduces the strain on solid waste management (Keleher,*et.,al*, 2002). The comparative study found a direct correlation between the growth rate of *Vigna radiata* and *Vigna aconitifolia* seeds and appropriate concentration of chicken waste manure given to seeds. It was determined that, when acceptable concentration of chicken waste manure was added over the course of 120 days, all the growth indices of the *Vigna radiata* and *Vigna aconitifolia* plants such as number of roots, height of plants, number of leaves, number of pod and number of seeds increased dramatically than the seeds were treated by other synthetic fertilizer. Chicken waste manure treated biologically with the help of microbes to improves the micronutrients in the waste which can be used as chicken waste manure for sustainable agricultural purpose (V.Ghadage and B.M.Gore 2024).

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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