

RESIDUAL EFFECT OF VARIOUS TYPES OF VERMICOMPOSTS ON GROWTH AND YIELD OF GREEN GRAM (*Vigna radiata* L.) IN RICE-PULSES CROPPING SYSTEM

¹B.S.R.Niivedidhaa,* ²N.Maragatham, ³N.Thavaprakaash, ²P. Santhy and ²M.Maheswari

¹PhD Scholar, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore.

²Professor, Tamil Nadu Agricultural University, Coimbatore.

³Associate Professor, Tamil Nadu Agricultural University, Coimbatore.

ABSTRACT

The residual effect of vermicomposts applied on preceding rice crop to the succeeding greengram under the rice- pulses cropping system was studied. The experiment was conducted at the wetland farms, Tamil Nadu Agricultural University, Coimbatore by following the randomized complete block design (RBD) with 11 treatments and replicated thrice. After harvest of rice, greengram was raised as residual crop. The treatments followed were vermicomposts prepared from *Eudrilus eugeniae* + paddy straw (T₁), *Eudrilus eugeniae* + coconut wastes (T₂), *Eudrilus eugeniae* + Vegetable wastes(T₃), *Eudrilus eugeniae* + farm wastes(T₄), *Eudrilus eugeniae* + farm yard manure (FYM) (T₅), *Eisenia foetida* + paddy straw(T₆), *Eisenia foetida* + coconut wastes(T₇), *Eisenia foetida* + vegetable wastes(T₈), *Eisenia foetida* + farm wastes(T₉), *Eisenia foetida* + farm yard manure (FYM) (T₁₀) and absolute control (T₁₁). The result indicated that there was a residual effect of vermicompost in the greengram crop after rice. The residual effect in the treatment T₂ (*Eudrilus eugeniae* + coconut wastes) found superior on growth parameters of greengram viz., plant height, drymatter production (DMP) and number of pods plant-1 and on seed and haulm yields than all other treatments. The treatment T₂ (*Eudrilus eugeniae* + coconut wastes) was comparable to the treatment T₇ (*Eisenia foetida* + coconut wastes). The lower growth and yield were found in the treatment Absolute control (T₁₁). Among the treatments, the coconut wastes with the earthworm species *Eudrilus eugeniae* and *Eisenia foetida* performed well with better growth and yield of the greengram crop than the other wastes.

Keywords: Vermicompost, rice, residual effect, greengram, growth and yield.

INTRODUCTION

Vermicompost is an utilizable organic source which is efficiently used by the plants due to its mucous coating in vermicast and slow release of the nutrients. India is having large potential for manurial sources like crop wastes, animal wastes, agro-industrial wastes and municipality wastes. Crop wastes have the most potential for recycling and have the highest nutritional availability of all of these sources. Vermicompost offers a good solution to tonnes of organic agro wastes that are being burnt by the farmers which can be easily recycled and reused in more efficient, economical and environmental friendly manner to increase agricultural production [1]. Vermicompost has a variety of micro sites for nutrient retention and exchange, as well as microbial activity [2]. Vermicompost

progressively releases nutrients into the soil [3], hence it has the residual effect on the succeeding plant [4]. It also improves the nutritional balance and ensures long-term viability of soil.

Rice-pulses cropping system is the most grown and preferred system in the Southern India. The inclusion of pulses in the rice cropping system have enhanced the soil mineral nitrogen which otherwise be lost in flooded rice system [5]. The cropping sequence of rice-legumes is viable, economically feasible and sustains the soil fertility, as the legumes have the capability to fix the atmospheric nitrogen and profusely make use of the nutrients present in the soil.

Greengram (*Vigna radiata* L.) is a prominent legume or pulse crop in Asia and it plays a significant role in the variety of cropping systems. Greengram was a short lived leguminous plant that can be adapt to drought and low soil fertility regions [6]. Including the legume in the cropping pattern will provide a significant amount of biomass and nitrogen to the soil, improving the soil fertility and crop productivity on a long term basis [7]. It contains high-protein, low- carbohydrate meal and has a protein content of roughly 25%, which is almost three times that of cereal grains. It meets the protein needs of the vegetarian population. It also contains essential amino acids such as leucine, phenylamine, lysine, valine, isoleucine and other amino acids [8].

Residual effect of nutrients may be more pronounced for organic sources of nutrients applied to the preceding crop, benefiting the succeeding crop to a greater extent [9]. In, India, green gram finds a place in almost all the rice based cropping systems of various regions. Generally rice fallow pulses are grown by utilizing the nutrients applied to rice crop. Since, pulses are grown as a residual crop to utilize the residual available nutrients and moisture, the study on the residual effect of fertilization to rice crops, in rice-pulse cropping system assumes significance. Though there are many reports in inorganic residual effects, under organic nutrient system especially with vermicompost, the information is scanty. In consideration to these, the experiment on the residual effect of vermicomposts on green gram was studied.

MATERIALS AND METHODS

The experiment was conducted at the Wetland farms, Tamil Nadu Agricultural University, Coimbatore during the year 2021. The texture of the soil was clay loam and the nutrient status of the soil was low in nitrogen, medium in phosphorus and high in potassium. The experimental design used in the field was randomized complete block design with 11 treatments and three replications.

T ₁	<i>Eudrilus eugeniae</i> + paddy straw
T ₂	<i>Eudrilus eugeniae</i> + coconut wastes
T ₃	<i>Eudrilus eugeniae</i> + vegetable wastes
T ₄	<i>Eudrilus eugeniae</i> + farm wastes
T ₅	<i>Eudrilus eugeniae</i> + farm yard manure (FYM)
T ₆	<i>Eisenia foetida</i> + paddy straw
T ₇	<i>Eisenia foetida</i> + coconut wastes
T ₈	<i>Eisenia foetida</i> + vegetable wastes
T ₉	<i>Eisenia foetida</i> + farm wastes
T ₁₀	<i>Eisenia foetida</i> + farm yard manure (FYM)
T ₁₁	Absolute control (without application of vermicompost)

Plot size used for this experiment was 8 m x 3 m. The experiment was carried out after the harvest of the rice crop. Vermicomposts were applied to the preceding rice crop and the succeeding

green gram utilizing residual nutrients. The field was left undisturbed after the harvest of rice. The rice stalks were cutted by using bush cutter and the irrigation channels were cleaned before sowing of the green gram crop. The green gram variety grown was CO 8 with the duration of 60 days. The seeds were sown at the spacing of 30cm x 10cm in between the rows of rice stalks in the plot. The other cultivation practices were followed as per the Crop production guide (CPG)[10].

Observations recorded

The observations were made by selecting five plants randomly from each plot. The plant height at harvest stage was measured from the tagged plants of each plot from the ground level to the tip of the last opened leaf. For drymatter production, five plants were collected randomly at harvest stage from the sample rows of each plot. The collected plants were cleaned, air dried and then oven dried at $65\pm 5^{\circ}$ C till a constant weight was obtained. The weight was measured and expressed in kg ha^{-1} . Number of pods was counted from the five tagged plants of each net plot. Seed yield was determined by harvesting the pods separately from each plot and threshed manually. The seeds were further cleaned, dried to 12 per cent moisture level and then weighed and expressed in kg ha^{-1} . The haulm yield after separating the pods from the plants were weighed and expressed in kg ha^{-1} .

Statistical analysis

The observed data were statistically analyzed for randomized complete block design given by [11]. The critical difference was worked out at five per cent probability level.

RESULTS AND DISCUSSION

Plant height

The residual nutrients from the various organic wastes vermicompost had positive impact on plant height of the succeeding greengram crop in all the treatments (Table 1) (Fig 1.). Taller plants were observed in coconut wastes decomposed by using the worms of *Eudrilus eugeniae* (T_2) and this was followed by the treatment *Eisenia foetida* used in coconut wastes decomposition (T_7). The least plant height was observed in the absolute control (T_{11}). Higher availability of residual nutrients in coconut residues based vermicompost applied to the preceeding crop which slowly released the nutrients and changed the soil environment that might have supplied to the succeeding crops. Similar findings were also observed by [12] and [13].

Drymatter production (DMP)

Various organic substrates based vermicompost applied to the preceding rice crop influenced the drymatter production of succeeding greengram (Table 1) (Fig 2.). Significantly higher drymatter accumulation was obtained with the treatment *Eudrilus eugeniae* + coconut wastes (T_2) compared to the other treatments. This was followed by the treatment *Eisenia foetida* + coconut wastes (T_7). Application of the coconut leaf based vermicompost increased the nutrient uptake, improved the soil in its physical

and biological properties and beneficial growth promoting substances which might be led to the increase of drymatter accumulation. This was in line with the findings of [14] and [15]. The minimum drymatter production was noticed in the treatment Absolute control (T₁₁).

Number of pods plant⁻¹

The yield component of the crop greengram was statistically analyzed and found impact of residual nutrient on number of pods plant⁻¹ of the crop in all the treatments. Among the other treatment, the treatment *Eudrilus eugeniae* + coconut wastes (T₂) produced more number of pods plant⁻¹ and superior over the other. This was followed with the treatment *Eisenia foetida* + coconut wastes (T₇). Higher number of pods obtained might be due to the buildup of the soil fertility and increase in the microbial population due to the application of the coconut based vermicompost and increase in drymatter accumulation leads to higher yield attributes. Similar results were also found by [16] and [17]. The least number of pods plant⁻¹ was observed in Absolute control (T₁₁) which was not applied with any manure for both the crops.

Seed and Haulm yield

The residual effect of the applied vermicompost to the rice crop has greatly influenced the seed and haulm yields of the succeeding crop greengram (Fig 3.). The yield data were statistically analyzed and depicted in the Table 1. The treatment *Eudrilus eugeniae* + coconut wastes (T₂) was observed to produce higher seed yield, which was followed by the treatment *Eisenia foetida* + coconut wastes (T₇) compared to the other treatments. The seed yield was increased by 51.78 % over control. The treatment *Eudrilus eugeniae* along with the organic residue coconut wastes performed better due to the improvement in the yield components, prolonged availability of nutrients and improved physical and biological activities of the soil. This was in line with the findings of [4] and [18]. The haulm yield was also observed greater with the treatment *Eudrilus eugeniae* + coconut wastes (T₂). There was 45.40 % increase in the haulm yield with the treatment *Eudrilus eugeniae* + coconut wastes (T₂) over the treatment absolute control (T₁₁). This might be due to increased drymatter production and greater availability of residual soil nutrients. This was similar to the findings of [19]. Lower haulm yield was observed with treatment absolute control (T₁₁).

Conclusion

The present study suggests that the residual effect of vermicomposts had significant influence on the growth parameters such as plant height and drymatter production, yield parameter number of pods plant⁻¹, and yield of green gram under the rice- pulses cropping system. Among the vermicomposts prepared from earthworm species and organic wastes, the treatment *Eudrilus eugeniae* + coconut wastes (T₂) was found superior and *Eisenia foetida* + coconut wastes (T₇) was comparable to the treatment T₂ with the residual effect on growth and yield over the other treatments. Hence, application of the

vermicompost prepared from coconut wastes with both the species of earthworms has the greater residual impact on the green gram crop.

ACKNOWLEDGEMENT

The authors are thankful to the Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu for conducting the research work and providing all the necessary facilities.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

REFERENCES

1. Borang B, Sharma YK, Sharma SK. Effect of various substrates on performance of earthworm and quality of vermicompost. *Annals of Plant and Soil Research*. 2016; 18(1):37-42.
2. Shi-Wei Z, Fu-Zhen H. The nitrogen uptake efficiency from ^{15}N labeled chemical fertilizer in the presence of earthworm manure (cast). *In: Advances in Management and Conservation of Soil Fauna*. Oxford and IBH publishing Co., Bombay. 1991; 539- 542.
3. Chaoui HI, Zibilske LM, Ohno T. Effects of earthworm casts and compost on soil microbial activity and plant nutrient availability. *Soil Biology and Biochemistry*. 2003; 35:295-302.
4. Nurhidayati N, Masyhuri M, Indiyah M. Direct and residual effect of various vermicompost on soil nutrient and nutrient uptake dynamics and productivity of four mustard Pak-Coi (*Brassica rapa* L.) sequences in organic farming system. *International Journal of Recycling of organic waste in Agriculture*. 2018; 7:173-181.
5. Singh NT. Organic matter and Rice. Indian Agriculture and Research Institute, New Delhi. 1984; 217-228.
6. Bourgault M, Madramootoo CA, webber HA, Stulina G, Horst MG, Smith DL. Effects of deficit irrigation and salinity stress on common bean (*Phaseolus vulgaris* L.) and mung bean (*Vigna radiate* L.) grown in a controlled environment. *Journal of Agronomy and Crop Science*. 2010; 196: 262-272.
7. Ali R I, Awan T H, Ahmad M, Saleem M U, Akhtar M. Diversification of rice- based cropping systems to improve soil fertility, sustainable productivity and economics. *The Journal of Animal & Plant Sciences*. 2012; 22(1): 108-111.
8. Vasanthi P, Saravana N, Kumaresan M, Balamurugan K, Udayakumar S. Vermicomposting by *Lampito Mauriti* cultured in vegetable market wates and the effect of vermicompost on growth and yield of greengram, *Vigna radiate*. *Journal of Applied Science and Computations*. 2019; 4(2): 126-135.
9. Hegde DM. Long term sustainability of productivity in rice (*Oryza sativa* L.) – Wheat (*Triticum aestivum*) system in sub humid ecosystem through integrated nutrient supply. *Indian Journal of Agronomy*. 1998; 43(2):189-198.

10. CPG. Crop Production Guide. Department of Agriculture, Govt. of Tamil Nadu, Chennai and Tamil Nadu Agricultural University, Coimbatore. 2020.
11. Gomez KA, Gomez AA. Statistical procedures for Agricultural Research. Vol. 2nd Ed., New Delhi, India: Wiley India Pvt. Ltd. 2010.
12. Ahmad MG. Effect of date palm wastes and rice hull mixed with soil on growth and yield of cucumber in greenhouse culture. International Journal of Recycling of Organic waste in Agriculture. 2013; 2:17.
13. Dash AC, Saren BK, Roul PK. Residual effect of nutrient management practices in hybrid rice under SRI on growth and yield of Greengram (*Vigna radiata* L.) in Rice-Greengram cropping system. International Journal of Bio-resource and Stress Management. 2017; 8(6):749-752.
14. Jeyabal A, Kuppuswamy G. Recycling of organic wastes for the production of vermicompost and its response in rice-legume cropping system and soil fertility. European Journal of Agronomy. 2001; 15:153-170.
15. Balasubramanian A, Stalin P, Saravanaperumal M, Vinothkumar SR. Residual effect of integrated nutrient management practices on growth and yield of rice fallow blackgram (*Vigna mungo* L.). Journal of Emerging Technologies and Innovative Research. 2016; 3(5):597-605.
16. Rajkhowa DJ, Sarma AK, Mahanta K, Saikia US, Krishnappa R. Effect of vermicompost on greengram productivity and soil health under hilly ecosystem of North East India. Journal of Environmental Biology. 2017;38:15-19.
17. Lakum YC, Patel HK, Patel GG, Patel PD, Patel DK. Residual effect of manure and fertilizers on growth, yield of chickpea and soil nutrient status under Maize-Chickpea cropping system. International journal of Current Microbiology and Applied Sciences. 2020; 9(4):2940-2945.
18. Thiagarajan M, Somasundaram E. Residual effect of organic manures on growth and yield of blackgram in Rice-Blackgram sequence. Madras Agricultural Journal. 2019; 106(4-6):369-372.
19. Bejbaruha R, Sharma RC, Banik P. Direct and residual effect of organic and inorganic sources of nutrients on Rice based cropping systems in the sub-humid tropics of India. Journal of Sustainable Agriculture. 2009; 33:674-689.

Table 1. Residual effect of various vermicompost on the growth at harvest stage, yield components and yield of greengram

Treatments	Plant height (cm)	Drymatter Production (kg ha ⁻¹)	Number of Pods plant ⁻¹
T ₁ - <i>Eudrilus eugeniae</i> + Paddy straw	46.85	2674	33.68
T ₂ - <i>Eudrilus eugeniae</i> + Coconut wastes	55.14	3245	36.89
T ₃ - <i>Eudrilus eugeniae</i> + Vegetable wastes	41.98	2387	32.82
T ₄ - <i>Eudrilus eugeniae</i> + Farm wastes	38.04	2225	32.25
T ₅ - <i>Eudrilus eugeniae</i> + FYM	45.32	2512	33.41
T ₆ - <i>Eisenia foetida</i> + Paddy straw	43.12	2435	33.17
T ₇ - <i>Eisenia foetida</i> + Coconut wastes	51.15	3016	35.23
T ₈ - <i>Eisenia foetida</i> + Vegetable wastes	39.12	2309	32.56
T ₉ - <i>Eisenia foetida</i> + Farm wastes	36.17	2144	32.08
T ₁₀ - <i>Eisenia foetida</i> + FYM	47.74	2795	34.12
T ₁₁ - Absolute control	31.67	1965	29.76
S.Ed	1.69	95	0.57
CD (p=0.05)	3.44	193	1.15

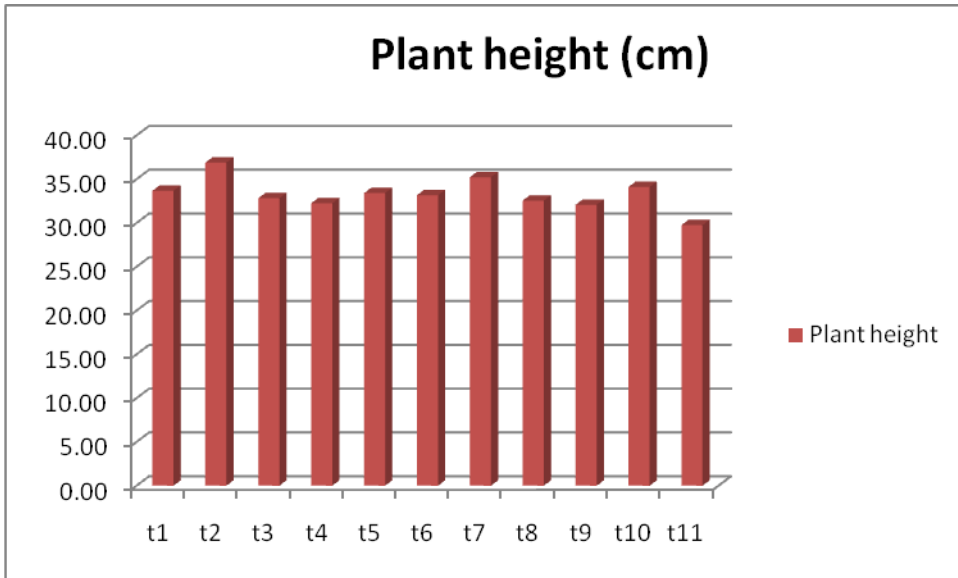


Fig 1. Residual effect of vermicomposts on plant height of green gram

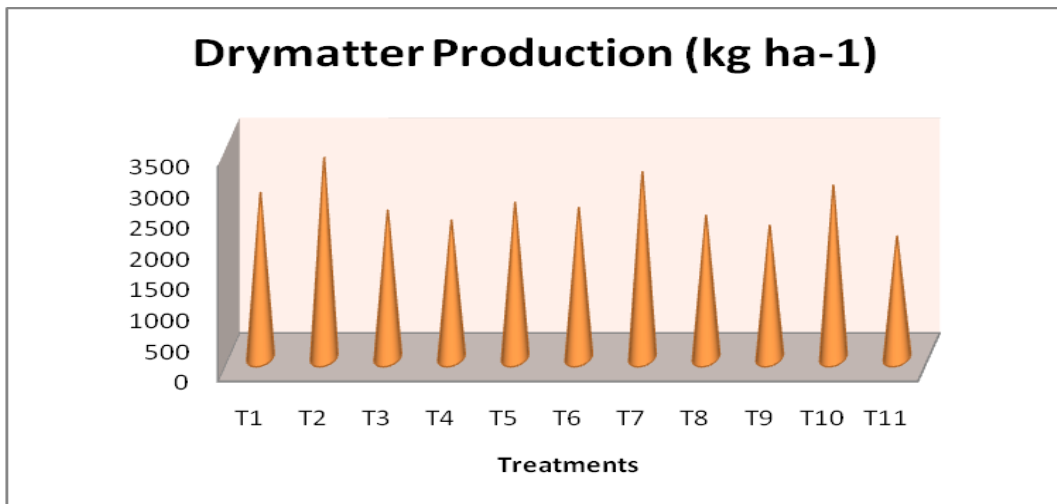


Fig 2. Residual effect of vermicomposts on drymatter production of green gram

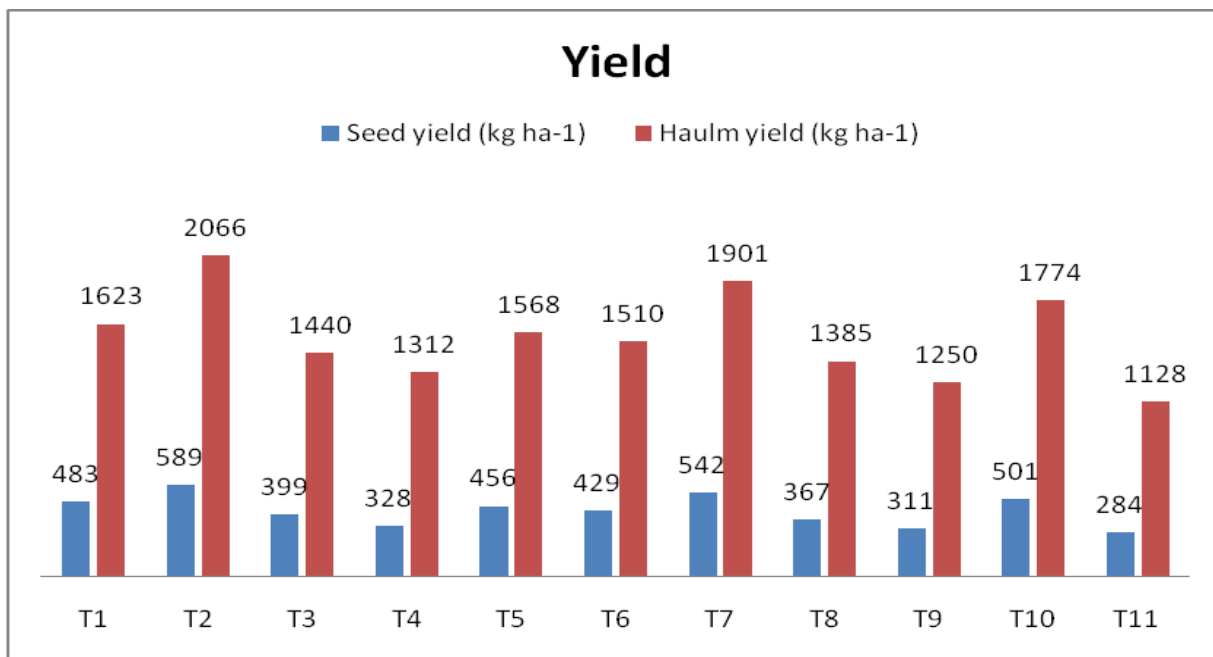


Fig 3. Residual effect of vermicomposts on yield of green gram

View of the experimental field

