Overall Review Comments

1. Title is ok.

2. Abstract shows title matching, methodology outlined and conveys the main idea with conclusion aligning with the aim.

3. Introduction needs more recent relevant references, Acronyms to be written in full (first use - full form (small form)), at certain points technical terms to be explained in full.

4. Materials and Methods is ok

5. Manuscript needs a table showing Average of three replications for different parameters. Also Line or Bar graph will support the manuscript and its overall strength for statistical analysis, which is recommended.

6. Manuscript demands Original Figures in support of methodology, place of work, plots utilized with crops etc. which will enhance the overall quality of the manuscript.

7. Conclusion needs more elaboration in terms of methodologies and results discussed with better interpretation and future studies which can be conducted for the same.

8. References to be made as per Journals' Reference Style

8. Present study as shown by the manuscript is good and relevant, but including some figures of various experimental stages, two types of earthworms *Eudrillus eugeniae and Eisenia foetida* taken during the present study and some of the instruments / facilities utilized may enhance and will positively influence the overall impact of the research study / paper which is highly recommended.

Original Research Article

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

ABSTRACT

Aim: To study the residual effect of various organic wastes based vermicomposts on growth and yield of ~~Greengram~~Green gram (*Vigna radiata*) in Rice-Pulses cropping system.

Methodology: Vermicomposts were prepared using different waste~~s~~ materials and the two earthworm species and applied to the rice crop. The experiment was conducted by using randomized complete block design (RBD) with above mentioned 11 treatments and replicated thrice. After harvest of rice, greengram was raised as residual crop. The earthworm *Eudrillus eugeniae* species with organic wastes such as paddy straw (T_1), coconut wastes (T_2), vegetable wastes (T_3), farm wastes (T_4) and FYM (T_5) and *Eisenia foetida* was

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study design
place and duration of study
sample

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released the wastes like paddy straw (T_6), coconut wastes (T_7), vegetable wastes (T_8), farm wastes (T_9) and FYM (T_{10}) and absolute control (T_{11}).

Results: The result indicated that there was a residual effect of vermicompost in the greengram crop after rice. The residual effect in the treatment T_2 (*Eudrillus eugeniae* along with Coconut wastes) found superior on growth parameters of green-gram *viz*., plant height, DMP and number of pods plant^{-1} and on seed and haulm yields than all other treatments. This was followed by the treatment T_7 (*Eisenia foetida* + Coconut wastes). The least effect was found in Absolute control (T_{11}).

Conclusion: Among the organic wastes used for vermicompost with two different species, the coconut wastes produced by using *Eudrillus eugeniae* have more residual nutrients and had positive influence on growth and yield of green-gram crop than the other residues and earthworm species.

Keywords: Vermicompost, rice, residual effect, green-gram, growth and yield.

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INTRODUCTION

Vermicompost is an utilizable organic source which is efficiently used by the plants due to its mucous coatings in vermi-cast 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 tones 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 (Borang *et al*., 2016). Vermicompost has a variety of micro sites for nutrient retention and exchange, as well as microbial activity (Shi-Wei and Fu-Zhen, 1991). Vermicompost progressively releasesd nutrients into the soil (Chaoui *et al*., 2003)., hence it has the residual effect on the succeeding plants (Nurhidayati *et al*., 2018). It also improves the nutritional balance of soil and ensures long-term viability of ?.

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 (Singh, 1984). 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.

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 (Hegde, 1998). In, India, greengramgreen 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 utilise 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. Hence, the present study was made.

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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 of each. The treatment details followed were T_1 – ~~*Eudrillus*~~ *Eudrilus eugeniae* + paddy straw, T_2 - *Eudrillus eugeniae* + coconut wastes, T_3 - *Eudrillus eugeniae* + vegetable wastes, T_4- *Eudrillus eugeniae* + farm wastes, T_5 - *Eudrillus eugeniae* + FYM, T_6 – *Eisenia foetida* + paddy straw, T_7- *Eisenia foetida* + coconut wastes, T_8 – *Eisenia foetida* + vegetable wastes, T_9 – *Eisenia foetida* + farm wastes, T_{10} – *Eisenia foetida* + FYM and T_{11} - Absolute control (without application of vermicompost). Plot size used for the 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 greengram ~~used~~ utilizing the 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 greengram crop. The greengram variety grown was CO (GG) 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 each plot. The other cultivation practices were followed as per the CPG (2020).

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Observations recorded

The observations were made by selecting five plants randomly from each net 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 dry-matter 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±5º 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}.

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Statistical analysis

The observed data were statistically analyzed for randomized complete block design given by Gomez and Gomez (2010). The critical difference was worked out at five per cent probability level.

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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). Taller plants were observed in coconut wastes decomposed by using the worms of *Eudrillus 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 leaf 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 Ahmad (2017) and Dash *et al*. (2017).

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Dry matter production (DMP)

Various organic substrates based vermicompost applied to the preceding rice crop influenced the dry matter production of succeeding greengram (Table 1). Significantly higher dry matter accumulation was obtained with the treatment *Eudrillus 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 dry matter accumulation. This was in line with the findings of Jeyabal and Kuppuswamy (2001) and Balasubramanian *et al.* (2016). The minimum dry matter production was noticed in the treatment Absolute control (T_{11}).

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 *Eudrillus eugeniae* + coconut wastes (T_2) produced more number of pods plant^{-1} and superior over the other. This was followed with the treatment *Eisenia foetida* + coconut wastes (T_7). 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 coir based vermicompost and increase in drymatter accumulation leads to higher yield attributes. Similar results were also found by Rajkhowa *et al*. (2017) and Lakum *et al*. (2020). The least number of pods plant^{-1} was observed in Absolute control (T_{11}) which was not applied with any manure for both the crops.

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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. The yield data were statistically analyzed and depicted in the Table 1. The treatment *Eudrillus eugeniae* + coconut wastes (T_2) was observed to produce higher seed yield, which was followed by the treatment *Eisenia foetida* + coconut wastes (T_7) compared to the other treatments. The seed yield was increased by 51.78 % over control. The treatment *Eudrillus 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 activitiesy of the soil. This was in line with the findings of Nurhidayati *et al*. (2018) and Thiagarajan and Somasundaram (2019). The haulm yield was also observed greater with the treatment *Eudrillus eugeniae* + coconut wastes (T_2). There was 45.40 % increase in the haulm yield with the treatment *Eudrillus eugeniae* + coconut wastes (T_2) over the treatment absolute control (T_{11}). This might be due to increased dry matter production and greater availability of residual soil nutrients. This was similar to the findings of Bejbaruha *et al*. (2009). Lower haulm yield was observed with treatment absolute control (T_{11}).

Conclusion

It can be inferred that the application of vermicompost in the rice field has great impact on the succeeding greengram by efficiently using the residual nutrients. Among those, the vermicompost prepared from earthworm species *Eudrillus eugeniae* with the coconut wastes applied to the rice has enhanced the growth and yield of the succeeding greengram.

Comment [DPSP21]: Acknowledgments : A brief acknowledgment section may be given after the conclusion section just before the references. The acknowledgments of people who provided assistance in manuscript preparation, funding for research, etc. should be listed in this section.

REFERENCES

Comment [DPSP22]: References must be listed at the end of the manuscript and numbered in the order that they appear in the text. Every reference referred in the text must also present in the reference list and vice versa. In the text, citations should be indicated by the reference number in brackets

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Table 1. Residual effect of various vermicomposts' on the growth, yield components and yield of green-gram

Treatments	Plant height (cm)	Dry matter Production (kg ha^{-1})	Number of Pods plant^{-1}	Seed yield ha^{-1})	Haulm yield (ha^{-1}) (
T_1- *Eudrillus eugeniae* + Paddy straw	46.85	2674	23.96	483	1623
T_2 - *Eudrillus eugeniae* + Coconut wastes	55.14	3245	36.89	589	2066
T_3- *Eudrillus eugeniae* + Vegetable wastes	41.98	2387	19.05	399	1440
T_4 - *Eudrillus eugeniae* + Farm wastes	38.04	2225	15.07	328	1312
T_5 - *Eudrillus eugeniae* + FYM	45.32	2512	22.25	456	1568
T_6 - *Eisenia foetida* + Paddy straw	43.12	2435	21.49	429	1510
T_7 - *Eisenia foetida* + Coconut wastes	51.15	3016	30.93	542	1901
T_8 - *Eisenia foetida* + Vegetable wastes	39.12	2309	18.19	367	1385
T_9- *Eisenia foetida* + Farm wastes	36.17	2144	14.11	311	1250
T_{10}- *Eisenia foetida* + FYM	47.74	2795	26.14	501	1774
T_{11}- Absolute control	31.67	1965	11.16	284	1128
S.Ed	1.69	95	1.37	17	59
CD (p=0.05)	3.44	193	2.89	34	120

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