International Journal of Environment and Climate Change

Volume 13, Issue 10, Page 3111-3116, 2023; Article no.IJECC.106177
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Influence of Organic Manures and Organic Sprays on Productivity and Economics of Summer Greengram [*Vigna radiata* (L.) Wilczek]

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i102979

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/106177

Original Research Article

Received: 02/07/2023
Accepted: 07/09/2023
Published: 13/09/2023

ABSTRACT

A field experiment was conducted to investigate the influence of organic fertilizers and organic sprays on the productivity and economic parameters of summer greengram (Vigna radiata) cultivation. The experiment was designed as a split-plot design with three replications. The primary plots encompassed four organic fertilizer treatments: Control (M1), Farm yard manure (M2), Vermicompost (M3), and Poultry manure (M4). The sub-plots included three organic spray treatments: Control (S1), Panchagavya (S2), and Jeevamrutha (S3).

The results of the experiment revealed that the combination of poultry manure as the organic fertilizer in conjunction with the application of Panchagavya spray had the most significant impact on both seed yield (779 kg ha-1) and haulm yield (1909 kg ha-1) for summer greengram cultivation. Furthermore, this specific combination demonstrated notably higher gross returns (₹48,648 ha-1), net returns (₹30,125 ha-1), and a favourable B C ratio of 2.60.

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Keywords: Greengram; organic sprays; panchagavya; jeevamrutha; seed yield; economics.

1. INTRODUCTION

"In India, the cultivation of pulses spans across approximately 23.55 million hectares, resulting in an annual production of 17.15 million tonnes, with an average yield of 728 kg per hectare. Specifically, in Andhra Pradesh, pulses are grown across 1.04 million hectares, yielding around 0.95 million tonnes and exhibiting a productivity of 911 kg per hectare" [1].

Within the rainfed and irrigated conditions of the Southern Agro-climatic zone of Andhra Pradesh, crops are sown during the kharif season to make use of rainfall and during rabi season to capitalize on residual moisture, allowing for fields to remain fallow in summer, from February to April. Recognizing this vacant period, the introduction of summer greengram into the cropping system is proposed to address the demand for pulses.

Summer greengram is a suitable addition due to its brief maturity period of only 60 to 65 days, allowing it to fit neatly within the available time frame. It thrives solely on residual moisture and requires minimal farming inputs. The rapid growth habit of summer greengram requires limited agronomic attention, while its ability to cover the ground swiftly handles weed issues, often within 2 to 3 weeks of sowing.

The extensive use of agricultural chemicals has weakened the ecological foundation and led to soil and water resource degradation, along with a decline in food quality. This has prompted a surge of interest in adopting "Organic Farming" as a solution to the challenges posed by modern chemical-based agriculture. Organic farming not only sustains crop production but also nurtures the environment.

Organic amendments like farmyard manure (FYM), vermicompost, and poultry manure improve soil organic carbon levels, enhance soil water retention, promote soil structure, and make micro and macro nutrients more accessible, ultimately boosting soil quality and crop output. These organic practices also stimulate soil microorganisms, which in turn enhance nutrient solubility and availability to plants. Organic products such as panchagavya and jeevamrutha play a significant role in promoting plant growth and immunity. They offer essential nutrients, growth-promoting hormones, and beneficial microorganisms like lactic acid bacteria, yeast, actinomycetes, and photosynthetic bacteria. These microorganisms, along with well-established fertilizers like azotobacter, azospirillum, and phosphobacterium, contribute to improving soil health, crop growth, and yield.

In light of these considerations, the integration of summer greengram and the adoption of organic farming practices present promising avenues for enhancing sustainable crop production and preserving the ecosystem.

2. MATERIALS AND METHODS

In the summer season of 2017, a field experiment was executed at S.V. Agricultural College Farm in Tirupati. The soil used for the experiment had a sandy loam texture, neutral pH (6.8), low organic carbon content (0.38 percent), and a limited availability of nitrogen (150 kg ha^{-1}). It featured a medium availability of phosphorus (12 kg ha^{-1}) and a high availability of potassium (161 kg ha^{-1}).

The experimental setup followed a split plot design with three replications. The primary plot encompassed four distinct organic manure treatments: Control (M1), Farm yard manure (M2) at a rate of 10 t ha^{-1}, Vermicompost (M3) at 2 t ha^{-1}, and Poultry manure (M4) at 2 t ha^{-1}. The sub-plots included three organic spray treatments: Control (S1), Panchagavya (S2) at a spray concentration of 3 percent, and Jeevamrutha (S3) as a direct spray without dilution at a rate of 200 l ha^{-1}.

The designated organic manures were thoroughly integrated into the soil 15 days before sowing the crop. Panchagavya was prepared a month ahead of its application, while jeevamrutha was prepared 2-5 days before being applied to the greengram crop. The application of panchagavya was initiated 10 days after sowing and continued until 10 days before the harvest period.

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

Yield parameters, encompassing pod count per plant, pod length, seed quantity per pod, and the test weight of greengram, exhibited discernible variations in response to diverse organic fertilizers and organic spray applications. Notably, the number of pods per plant was influenced not only by the distinct organic fertilizers and organic sprays applied individually but also by their interactive effects. In contrast, the seed count per pod remained unaffected by any of the organic treatments, as documented in Table 1.

Among the experimental treatments, plots enriched with poultry manure exhibited the most favourable yield parameters, surpassing all other treatments in performance. Subsequently, the integration of vermicompost yielded the next most favourable outcomes, followed by the utilization of farmyard manure. Conversely, plots devoid of any organic manure registered a reduced number of pods per plant. This phenomenon can be attributed to the robust and vigorous vegetative growth in these plots, thereby facilitating a more efficient allocation of nutrients from source to sink. These findings are in concordance with observations made by Yadav et al. [2]; Rao et al. [3].

Furthermore, higher yield attributes were evident in plots where panchagavya was utilized as a spray, closely followed by the effects of jeevamrutha spray. On the contrary, untreated plots showed inferior yield attributes. This outcome can be attributed to an enhanced supply of essential nutrients to the plants, which promoted robust vegetative growth, heightened photosynthetic activity, and efficient translocation and accumulation of photosynthates in economically valuable parts of the plant. This conclusion aligned with the findings of Patil et al. [4]; Chaudhari et al. [5]; [6].

The synergistic interplay between organic fertilizers and organic foliar sprays yielded significant outcomes, particularly with regard to the variable "number of pods per plant." Remarkably, the concurrent application of poultry manure and panchagavya foliar spray resulted in the highest recorded number of pods per plant, as elucidated in Table 2. This achievement marked a substantial enhancement compared to other combinations and notably surpassed the pod count obtained when neither organic manure nor organic spray was employed. These salient interactions observed between organic fertilizers and foliar sprays concerning yield attributes substantiated the findings documented by Rao et al. [3].

Table 1. Yield attributes of greengram as influenced by different organic manures and organic sprays

Treatments	Number of pods plant^{-1} *	Length of the pod (cm)	Number of seeds pod^{-1}	Test weight (g)
Organic manures				
M_1 – Control	18.9	8.6	11.8	22.70
M_2 - FYM @ 10 t ha^{-1}	26.0	8.8	12.3	23.03
M_3 - Vermicompost @ 2 t ha^{-1}	29.6	9.3	12.1	23.74
M_4 - Poultry manure @ 2 t ha^{-1}	31.7	9.4	12.6	25.50
SEm$\pm$	0.39	0.10	0.17	0.51
CD (P=0.05)	1.3	0.3	N.S.	1.8
Organic sprays				
S_1 - Control	23.2	8.8	11.8	21.87
S_2 - *Panchagavya* as 3 % spray	29.9	9.4	12.5	25.29
S_3 - *Jeevamrutha* without dilution @ 200 l ha^{-1}	26.6	8.9	12.3	24.07
SEm$\pm$	0.48	0.14	0.28	0.388
CD (P=0.05)	1.4	0.4	N.S.	1.16
Interaction				
S at M				
SEm$\pm$	0.68	0.17	0.30	0.879
CD (P=0.05)	2.9	N.S.	N.S.	N.S.
M at S				
SEm$\pm$	0.87	0.25	0.48	0.812
CD (P=0.05)	2.7	N.S.	N.S.	N.S.

** Interaction table furnished separately*

Table 2. Number of pods plant^{-1} of greengram as influenced by interaction of organic manures and organic sprays

Treatments	Organic manures				
Organic sprays	**M_1**	**M_2**	**M_3**	**M_4**	**Mean**
S_1	17.0	23.7	29.6	31.7	23.2
S_2	20.7	31.0	32.7	35.0	29.9
S_3	19.0	23.3	31.3	32.7	26.6
Mean	18.9	26.0	29.6	31.7	

3.2 Seed Yield and Haulm Yield

The incorporation of poultry manure yielded the highest seed yield among the experimental treatments, demonstrating significant superiority over the alternative options, as presented in Table 3. Subsequently, vermicompost showcased the next most favorable performance, while farmyard manure achieved a comparable outcome. Both of these treatments exhibited notable advantages over the control group. In terms of haulm yield, the poultry manure treatment outperformed the others, a performance akin to that of vermicompost and farmyard manure, and significantly surpassed the haulm yield of the control group. Conversely, the control group registered the lowest haulm yield.

The augmented seed and haulm yields can be attributed to the heightened provision of essential plant nutrients facilitated by the translocation of photosynthates, which accumulated due to the influence of organic nutrient sources. This translocation, coupled with subsequent accumulation in the economically valuable plant components, contributed to the improvement of yield attributes. Additionally, it led to heightened chlorophyll content and increased nitrate reductase activity, ultimately resulting in an enhanced grain yield. These findings are consistent with the observations reported by Anil Kumar et al. [7]; Rao et al. [3]; Singh et al. [8].

Regarding the organic sprays, panchagavya application led to higher seed and haulm yield, on par with the results obtained from jeevamrutha application, with no significant difference between the two. Conversely, the control group yielded lower seed and haulm yield. The increased seed and haulm yield in response to panchagavya could be attributed to the presence of IAA and GA in the spray, stimulating plant responses and leading to increased production of growth regulators within the cellular system. The ensuing action of these growth regulators within the plant system encouraged essential growth and development processes, along with improved translocation and accumulation of photosynthates from source to sink, ultimately enhancing grain yield. These findings correlate with the outcomes of studies conducted by Somasundaram et al. [9]; Swaminathan et al. [10]; Chaudhari et al. [5]; Yadav and Tripathi [11].

When considering the combined effect of organic manures and organic sprays, the application of poultry manure in conjunction with panchagavya spray resulted in the highest seed yield (779 kg ha^{-1}) and haulm yield (1909 kg ha^{-1}) for summer greengram, outperforming the individual application of organic manures and organic sprays.

3.3 Economics

The application of poultry manure resulted in the highest gross returns among the experimental treatments, markedly surpassing all other alternatives, as indicated in Table 4. Subsequently, vermicompost emerged as the next favorable option, closely aligned with farmyard manure. In contrast, the control treatment yielded a lower gross return. Significantly, the poultry manure treatment also led to the highest net returns and benefit-cost (B C) ratio, distinctly outperforming all other treatments. Farmyard manure treatment followed, and the subsequent best results were observed in the control group. Vermicompost treatment yielded comparatively lower net returns and B C ratios. The augmented gross return can be attributed to the enhanced crop nutrition, resulting in improved grain and haulm yields. Similar observations have been reported by Yadav and Tripathi [11]; Rao et al. [3]; [12].

Concerning the application of organic sprays, panchagavya application resulted in higher gross returns, net returns, and B C ratios, equivalent to the performance achieved with jeevamrutha. In contrast, the control group exhibited a lower gross return. The elevated gross return can be attributed to enhanced crop nutrition facilitated by consistent application of organic sprays, leading to heightened grain and haulm yields.

Table 3. Seed yield and haulm yield (kg ha^{-1}) of greengram as influenced by different organic manures and organic sprays

Treatments	Seed yield	Haulm yield
Organic manures		
M_1 – Control	444	1023
M_2 - FYM @ 10 t ha^{-1}	642	1635
M_3 - Vermicompost @ 2 t ha^{-1}	670	1816
M_4 - Poultry manure @ 2 t ha^{-1}	726	1852
SEm$\pm$	8.9	27.5
CD (P=0.05)	31	95
Organic sprays		
S_1 - Control	529	1482
S_2 - *Panchagavya* as 3 % spray	672	1642
S_3 - *Jeevamrutha* without dilution @ 200 l ha^{-1}	660	1620
SEm$\pm$	5.6	17.4
CD (P=0.05)	17	52
Interaction		
S at M		
SEm$\pm$	15.5	47.6
CD (P=0.05)	N.S.	N.S.
M at S		
SEm$\pm$	12.9	39.6
CD (P=0.05)	N.S.	N.S.

Table 4. Gross return (ha^{-1}), net return (ha^{-1}) and B C ratio of greengram as influenced by different organic manures and organic sprays

Treatments	Gross return	Net return	B C ratio
Organic manures			
M_1 - Control	27,683	12,440	1.79
M_2 - FYM @ 10 t ha^{-1}	40,343	19,989	1.99
M_3 - Vermicompost @ 2 t ha^{-1}	42,016	10,824	1.30
M_4 - Poultry manure @ 2 t ha^{-1}	45,429	27,936	2.56
SEm$\pm$	577.7	411.4	0.044
CD (P=0.05)	1,994	1420	0.15
Organic sprays			
S_1 – Control	33,235	14,173	1.80
S_2 - *Panchagavya* as 3 % spray	41,962	19,831	1.99
S_3 - *Jeevamrutha* without dilution @ 200 l ha^{-1}	41,406	19,389	1.94
SEm$\pm$	353.7	302.7	0.031
CD (P=0.05)	1,060	907	0.09
Interaction			
S at M			
SEm$\pm$	1000.7	712.7	0.077
CD (P=0.05)	2,281	1,927	0.20
M at S			
SEm$\pm$	817.0	643.2	0.068
CD (P=0.05)	2,634	2,047	0.21

4. CONCLUSION

The experiment established that achieving high greengram production is attainable through the pre-sowing incorporation of poultry manure at a rate of 2 t ha^{-1}, coupled with the application of 3% panchagavya spray at 10 days intervals.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/106177