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Effect of organic manures and vermiwash on growth, yield and quality of cowpea [*Vigna unguiculata* (L.) Walp.] cv. Pusa Komal

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Abstract
The present investigation conducted during *kharif* 2019 at Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan. it is determined that under prevailing agro-climatic conditions, cowpea crop for green pods fertilized with 50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage proved most efficient in enhancing yield of cowpea and found economically viable treatment. This treatment application has produced maximum green pod yield 5206.00 kg ha^{-1} and gave highest gross and net return 104120.00 and 81782.30` ha^{-1} respectively with a benefit cost ratio of 3.66.

Keywords: cowpea, organic, Vermiwash, compost, farm yard manure

Introduction
Cowpea [*Vigna unguiculata* (L.) Walp.] commonly known as *Lobia*, southern pea, black eye pea, crowder pea and *chawla fali* belongs to family Leguminosae and having chromosome number 2n=22. Organic manures *viz*., FYM, vermicompost, poultry manure and oilcakes help in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micro-nutrients through enhanced biological processes, increases nutrient solubility, alter soil salinity, sodicity and ph. (Alabadan *et al*., 2009) [1]. Vermicompost contains plant nutrients including N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu and B, the uptake of which has a positive effect on plant nutrition, photosynthesis, the chlorophyll content of the leaves and improves the nutrient content of the different plant components (roots, shoots and the fruits). The high percentage of humic acids in vermicompost contributes to plant health, as it promotes the synthesis of phenolic compounds such as anthocyanins and flavonoids which may improve the plant quality and act as a deterrent to pests and diseases (Theunissen *et al.*, 2010) [8]. Earthworm secret body fluid through the dorsal pores to survive in the environment. The body fluid collected from the earthworm without harming them is called vermiwash. It contains enzymes which are secretions that stimulate the growth and yield of crops and even help to develop resistance in crops that receive this spray, such preparation would certainly have soluble plant nutrients apart from some organic acids and mucus of earthworms and microbes (Shivasubramanian and Ganesh Kumar, 2004) [6]. Therefore, the present investigation was planned for effect of organic manures and vermiwash on growth, yield and quality of Cowpea.

Materials and Methods
The experiment was conducted during June 2019–November, at Horticulture farm, Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur. The allocation of treatment combinations in the layout was done with the help of a random number table (Fisher, 1950) [2]. The experiment was laid out in Randomized Block Design with three replications. Comprising 13th treatments combinations. The gross plot size is 6 m^2, gross experimental area 312 m^2 and net experimental area 234 m^2 was maintained. The cowpea crop was sown in June, 2019 in lines having crop geometry as per treatments using a seed rate of 15 kg ha^{-1}. The crop was harvested manually. Before harvesting, ten tagged plants were pulled out from every plot to record observations on yield attributes. The yield attributes listed below were studied from the plant sample collected for dry biomass observation at the time of harvest.

Plant height at 60, 75 and at last harvest stage (cm)
The height of the main stem from randomly selected and tagged five plant was measured from ground level to top of the main shoot in centimeter. The mean plant height was calculated and recorded at 60, 75 and last harvest stage.

Number of leaves per plant at 60, 75 DAS
The number of leaves per plant from randomly selected and tagged five plant are counted. Mean number of leaves per plant was worked out and recorded.

Number of branches per plant at harvesting stage
The number of branches from the randomly selected five plants were counted. Mean number of branches per plant was worked out.

Days to first picking
The days to first picking from sowing to day of first picking of crop were counted.

Pod length (cm)
The pod length was measured from base to tip of the pod in centimeter from the five randomly selected plants. Mean pod length worked out and recorded.

Pod diameter
This was measured at the bottom, middle and tip of the pod from five randomly selected plants. Mean girth of the pod was presented in mm.

Number of picking
The number of picking were recorded from field in entire harvesting period.

Number of pods per plant
The total number of green pods picked from five tagged plants were counted and average value/plant was worked out and recorded from each treatment.

Weight of pod per plant (g)
The weight of pod per plant were calculated from randomly selected and tagged plants. Mean weight of the pods was presented in kilogram.

Number of seed per pod (average of 10 pods)
For counting number of seed/ pod 10 selected pods were taken and calculate mean of 10 pods seeds. The average number of seed/pods was worked out and recorded separately.

Yield of green pod per plot (kg)
Green pods were obtained from each net plot area during 1st, 2nd, 3rd and 4th picking. The pods obtained from each plot were weighted separately.

Yield of green pod per hectare
Pods obtained from all four picking were sum out and converted as total green pod yield (kg/plot) and work out on hectare basis.

Protein content (%) in pods
Protein content (%) in cowpea green pod and green seed was worked out by multiplying the N content of green pod and green seed with a factor 6.25. the concentration of N was determined through a modified Kjeldel procedure (Jackson, 1973) [3].

Chlorophyll content in leaves and pods
For estimation of chlorophyll content of fresh leaves at 50% flowering by using colorimetric method (Arnon, 1949). Total chlorophyll content was determined by using formula:

Results and Discussion

Effect on morphological characters of cowpea crop

Germination
The minimum days taken to germination (9.73 days) by crop was under the treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) and T_{11} (50% RDN through FYM + 50% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage), which was statistically at par with the application of treatment T_{12} (9.97 days), T_{10} (10.00 days).

Plant height
The maximum plant height at 60 DAS 35.75 cm was recorded under the application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was statistically at par with treatment T_{11}, T_{12} and T_{10}. At 75 DAS the maximum plant height 85.54 cm was obtained with application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was not differing significantly with the treatment T_{11}. At harvest the maximum plant height 86.67 cm was recorded under the application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage).

Number of leaves
The highest number of leaves plant^{-1}at 60DAS and 75 DAS (88.75 and 88.75) was found under the treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage).

Number of branches
The maximum number of branches plant^{-1} (10.20) with the application of treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) 60.54 per cent higher over the control treatment. *Azadirachta* seed cake increased the number of branches plant^{-1}, length of root and shoot and dry weight of crops compared to no application of neem cake. These results are close in conformity with Umadevi *et al.* (2019), Yadav *et al.* (2007), Rao *et al.* (2013) and Singh *et al.* (2015) [9, 10, 5, 7].

Days to first picking
The minimum time for first picking 50.33 days under the application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was statistically non-significant with T_{11} (50% RDN through FYM + 50% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage) (50.67).

Number of picking
The maximum number of picking 5.5 was taken with the treatment supplementation of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was statistically superior over rest of the treatments.

Pod length and Pod diameter
The results revealed that the application of various organic manures *viz.*, FYM, vermicompost, compost, neem cake etc.

along with or without spray of vermiwash did not show any significant effect on the length of pods and its diameter.

Effect on yield characters of cowpea crop

Number of pods

The maximum number of pods plant^{-1} (12.13) was obtained under the treatment application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was statistically at par with the application of T_{11} (10.73).

Weight of pods

The maximum weight of pods plant^{-1} (61.64 g plant^{-1}) was recorded with the application of treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage).

Number of seed pods^{-1}

The application of various organic manures *viz.*, FYM, vermicompost, compost, neem cake etc. along with or without spray of vermiwash did not show any significant effect on the number of seeds pod^{-1}.

Green pod yield

The utmost green pod yield (3.12 kg plot^{-1}& 5206.00 kg ha^{-1}) was recorded with the application of treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was statistically superior over rest of the treatments Continues use of organic fertilizers increase yield and soil nutrient status and help sustain crop productivity (Mottaghian *et al*., 2008) [4].

Effect on quality parameters of cowpea crop

TSS

The highest TSS of green seed 4.85 per cent was recorded under the treatment application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was not differing significantly with the treatment T_{11} (4.66%) and T_{12} (4.64%).The highest TSS of green pod was 2.80 per cent obtained under the treatment application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage).

Protein content of seed

Highest protein content of pod 24.43 per cent was observed with application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) which was deliberately higher over rest of the treatments.

Chlorophyll content

The significantly higher chlorophyll content of green leaves was 3.171 mg g^{-1} of fresh leaves weight was recorded under the application of treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was significantly superior over rest of the treatments. The uppermost concentration of chlorophyll in green pods (2.467mg g^{-1}) of fresh leaves weight) was also recorded under T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage).

Keeping quality

The pods harvested from treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) retained fresh for 2.5 days which was maximum keeping time, which was statistically at par with the treatments T_{11} (2.33 days) and T_{12} (2.33 days).

Effect on economics of cowpea crop

Gross return

The maximum gross return 104120.00 ` ha^{-1} was obtained under the treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was significantly higher over rest of the treatments.

Net return

The highest net return 81782.30` ha$^{-1}$ was gained with the treatment application of $T_{13}$(50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was significantly higher over rest of the treatments, followed by $T_{11}$ (72803.33` ha^{-1}) and T_{12} (72585.87` ha^{-1}), which were differing significantly with each other and rest of treatment mean.

BC ratio

The greatest benefit cost ratio 3.66 was obtained under the application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was statistically at par with treatment T_5 (100% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) (3.22).

Effect on soil analysis

Nitrogen

The determined soil available nitrogen 221.28 kg ha^{-1} was recorded with the application of treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which differing significantly with control treatment (210.85 kg ha^{-1}).

Phosphorus

The maximum available soil phosphorus after harvest of crop was under T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) (24.72kgha^{-1}).

Potassium

The highest concentration of soil available potassium after the crop harvest was recorded with the application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) (265.08 kg ha^{-1}), which was not differing significantly with the treatments T_{11} (263.12 kg ha^{-1}) and T_{12} (256.80 kg ha^{-1}).

Sulphur

The highest concentration of soil available sulphur (11.11 kg ha^{-1}) after the crop harvest was recorded with the application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage).

Iron

Application of various organic manures and spray of vermiwash did not show any significant effect on soil available iron and zinc concentration of the soil.

Soil organic carbon

The highest organic carbon 0.71 per cent was analyzed under the application of T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was differing significantly with T_6 and control treatment but at par with rest of the treatment's application.

Soil electrical conductivity and Soil pH
The supplementation of cowpea crop with different organic manures and vermiwash did not affect the soil pH and electrical conductivity after the harvest when soil samples were analyzed.

Bulk density
The minimum bulk density of soil 1.479 Mg $m^{-3}$was recorded with the treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was not differing significantly with the treatments T_{11} (1.501 Mg m^{-3}).

Effect on microbial count of soil
Actinomycetes
The highest population of actinomycetes 34.25 *CFU*'s g^{-1} were recorded with the treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was not differing significantly with T_{11}(34.14 *CFU* g^{-1}.

Bacteria
The highest population of bacteria 29.33 CFU's g^{-1} were noted with the treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was not differing significantly with T_{11}(29.11 *CFU* g^{-1}).

Fungi
The highest population of fungi 25.32 *CFU* g^{-1} was observed under the treatment T_{13} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage), which was statistically non-significant with the T_{10} (50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage) (25.12 *CFU* g^{-1}).

Table 4.1: Effect of organic manures and vermiwash on germination and plant height of cowpea

Treatments		Days to germination	Germination %	Plant height (cm)		
				60 DAS	75 DAS	Harvest
T_1	Control	10.40	94.70	25.48	67.54	74.36
T_2	100% RDN through FYM	10.33	95.26	26.41	71.62	75.75
T_3	100% RDN through compost	10.32	95.50	27.27	72.22	75.75
T_4	100% RDN through vermicompost	10.17	96.01	27.47	73.66	75.89
T_5	100% RDN through neem cake	9.93	96.08	29.69	73.68	76.17
T_6	Vermiwash 10% spray at 10% flowering stage	10.37	94.80	26.18	70.33	74.80
T_7	100% RDN through FYM + Vermiwash 10% spray at 10% flowering stage	10.17	96.15	30.16	73.87	76.62
T_8	100% RDN through compost + Vermiwash 10% spray at 10% flowering stage	10.08	96.17	30.58	81.84	82.67
T_9	100% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	10.05	96.20	31.86	82.94	84.32
T_{10}	100% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	10.00	96.23	32.26	83.62	84.79
T_{11}	50% RDN through FYM + 50% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	9.93	96.27	33.84	84.97	86.12
T_{12}	50% RDN through FYM + 50% RDN through compost + Vermiwash 10% spray at 10% flowering stage	9.97	96.24	33.83	84.69	85.45
T_{13}	50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	9.73	96.43	33.95	85.54	86.67
	SEm±	0.463	0.746	1.199	3.564	1.684
	CD (p=0.05)	NS	NS	3.499	10.403	4.914

Table 2: Effect of organic manures and vermiwash on yield attributes of cowpea

Treatments		Pod length (cm)	Pod Diameter (mm)	Number of pod plant^{-1}	Weight of pods plant^{-1} (g)
T_1	Control	17.70	4.79	8.00	24.00
T_2	100% RDN through FYM	19.95	5.09	9.40	39.20
T_3	100% RDN through compost	20.05	5.13	9.27	38.55
T_4	100% RDN through vermicompost	20.38	5.28	8.60	35.63
T_5	100% RDN through neem cake	20.72	5.28	8.40	34.66
T_6	Vermiwash 10% spray at 10% flowering stage	19.24	5.07	8.13	33.35
T_7	100% RDN through FYM + Vermiwash 10% spray at 10% flowering stage	20.96	5.34	9.47	39.60
T_8	100% RDN through compost + Vermiwash 10% spray at 10% flowering stage	21.01	5.39	9.60	40.22
T_9	100% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	21.03	5.42	9.87	41.57
T_{10}	100% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	21.16	5.46	10.27	43.43
T_{11}	50% RDN through FYM + 50% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	21.18	5.49	10.73	48.69
T_{12}	50% RDN through FYM + 50% RDN through compost + Vermiwash 10% spray at 10% flowering stage	21.16	5.49	10.47	45.67
T_{13}	50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	21.23	5.50	12.13	61.64
	SEm±	0.973	0.182	0.06	0.33
	CD (p=0.05)	NS	NS	0.19	0.95

Table 3: Effect of organic manures and vermiwash on yield and yield attributes of cowpea

Treatments		Number of seed pod^{-1}	Green pod yield (kg plot^{-1})	Green pod yield (kg ha^{-1})
T_1	Control	10.30	1.68	2632.67
T_2	100% RDN through FYM	11.70	2.04	3397.95
T_3	100% RDN through compost	12.13	2.07	3451.33
T_4	100% RDN through vermicompost	12.15	2.15	3586.17
T_5	100% RDN through neem cake	12.42	2.22	3694.33
T_6	Vermiwash 10% spray at 10% flowering stage	11.53	1.94	3231.45
T_7	100% RDN through FYM + Vermiwash 10% spray at 10% flowering stage	12.49	2.27	3786.33
T_8	100% RDN through compost + Vermiwash 10% spray at 10% flowering stage	12.65	2.34	3893.67
T_9	100% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	12.73	2.60	4328.33
T_{10}	100% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	12.82	2.74	4562.33
T_{11}	50% RDN through FYM + 50% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	13.07	2.88	4791.67
T_{12}	50% RDN through FYM + 50% RDN through compost + Vermiwash 10% spray at 10% flowering stage	12.90	2.83	4717.33
T_{13}	50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	13.48	3.12	5206.00
	SEm±	0.318	0.01	22.81
	CD (p=0.05)	0.928	0.04	66.58

Table 4: Effect of organic manures and vermiwash on quality of cowpea crop

Treatments		TSS		Protein content in pod (%)
		Green seed	Green pod	
T_1	Control	4.13	1.83	22.40
T_2	100% RDN through FYM	4.28	2.23	22.80
T_3	100% RDN through compost	4.30	2.30	23.00
T_4	100% RDN through vermicompost	4.31	2.33	23.03
T_5	100% RDN through neem cake	4.34	2.37	23.13
T_6	Vermiwash 10% spray at 10% flowering stage	4.24	2.00	22.77
T_7	100% RDN through FYM + Vermiwash 10% spray at 10% flowering stage	4.40	2.43	23.23
T_8	100% RDN through compost + Vermiwash 10% spray at 10% flowering stage	4.52	2.47	23.47
T_9	100% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	4.54	2.53	23.67
T_{10}	100% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	4.54	2.57	24.00
T_{11}	50% RDN through FYM + 50% RDN through vermicompost + Vermiwash 10% spray at 10% flowering stage	4.66	2.77	24.17
T_{12}	50% RDN through FYM + 50% RDN through compost + Vermiwash 10% spray at 10% flowering stage	4.64	2.73	24.03
T_{13}	50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage	4.85	2.80	24.43
	SEm±	0.114	0.027	0.328
	CD (p=0.05)	0.333	0.079	0.958

Conclusion

On the basis of results emanated from the present investigation conducted during *kharif* 2019 it is determined that under prevailing agro-climatic conditions, cowpea crop for green pods fertilized with 50% RDN through FYM + 50% RDN through neem cake + Vermiwash 10% spray at 10% flowering stage proved most efficient in enhancing yield of cowpea and found economically viable treatment. This treatment application has produced maximum green pod yield 5206.00 kg ha^{-1} and gave highest gross and net return 104120.00 and 81782.30` ha^{-1} with a benefit cost ratio of 3.66.

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References

1. Alabadan BA, Adebayo PA, Florunson EA. Effect of different poultry wastes on physical, chemical and biological properties of soil. Caspian Journal Environment Science 2009;7:31-35.
2. Fisher RA. The significance of deviations from expectation in a poisson series. Biometrics 1950;6:17-24.
3. Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi 1973.
4. Mottaghian A, Pirdashi H, Mohammad AB. Leaf & seed accumulation in soyabean cultivars in response to integrated & chemical fertilizers application. Pakistan Journal of Biological Science 2008;11(9):1227-1233.
5. Rao KT, Rao AU, Reddy DS. Residual effect of organic manures on growth, yield and economics of green gram in maize-Sunflower-green gram system. International Journal of Agricultural Sciences 2013;9(1):275-279
6. Shivasubramanian K, Ganesh Kumar M. Influence on biological productivity of marigold. Madras Agriculture Journal 2004;91:221-225.
7. Singh RV, Tripathi SK, Singh RP. Effect of integrated nutrient management on productivity, nutrient uptake and economics of green gram Vigna radiata L. in custard apple-based agri-horti system under rain fed condition.

Current Advances in Agricultural Sciences 2015;7(1):76-78.
8. Theunissen J, Ndakidemi PA, Laubscher CP. Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. International Journal of the Physical Sciences 2010;5(13):1964-1973.
9. Umadevi GD, Sumathi V, Reddy PKA, Sudhakar P, Kumari KL. Effect of organic manures and phosphorus on cowpea and their residual effect on succeeding little millet. Journal of Pharmacognosy and Phytochemistry 2019;8(3):2236-2239.
10. Yadav AK, Varghese K, Abraham T. Response of bio fertilizer, poultry manure and different levels of phosphorus on nodulation and yield of green gram *Vigna radiata* L. CV. K-851. Agricultural Science Digest 2007;27(3):213-215.