



## Research Article

# EFFECT OF BIO-WASTES ENRICHED VERMICOMPOST ON GROWTH, YIELD PARAMETERS OF SOYBEAN AND SUCCEEDING WHEAT

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**Abstract:** The field experiment was conducted during *kharif* and *rabi* seasons of 2017-18 and 2018-19 at the Krishi Vigyan Kendra, Kasturbagram, Indore, M.P. to find out the effect of biowastes enriched vermicompost growth and productivity of soybean and succeeding wheat. Amongst the biowaste treatments, the farm waste enriched 2 t VC/ha (W<sub>2</sub>) increased the growth and yield parameters of soybean upto significant extent as compared to water hyacinth (W<sub>1</sub>) and soybean stover (W<sub>3</sub>) enriched VC treatments. The plant height was 46 cm, branches 4.65/plant, leaves 10.21/plant, DM 24.4 g/plant, grain yield 25.15 q/ha and straw yield 28.91 q/ha. In succeeding wheat, the plant height was 103 cm, 24 g DM/plant, root dry weight 4.02 g/plant, tillers 41.5/m row length, grain yield 42.29 q/ha and straw yield 59.65 q/ha in W<sub>2</sub> treatment. In case of additives enriched VC treatments (A<sub>1</sub> to A<sub>5</sub>), rock phosphate + PSB + *Trichoderma* combination performed the best with respect to growth and yield parameters of soybean and then succeeding wheat. The plant height of soybean was 45 cm, branches 4.41/plant, leaves 9.83/plant, DM 24.5 g/plant, grain yield 24.03 q/ha and straw yield 27.88 q/ha. In succeeding wheat, the plant height was 101 cm, 22.4 g DM/plant, root dry weight 4.09 g/plant, tillers 40.3/m row length, grain yield 42.10 q/ha and straw yield 59.45 q/ha in A<sub>5</sub> treatment.

**Keywords:** Bio-wastes, Enriched vermicompost, Soybean succeeding wheat

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## Introduction

In India, the integration of livestock and crops, use of natural organic manure as a source of nutrients were traditional practice of farming systems. But the development of chemical fertilizer industry during the green revolution period created a problem of increasing the price and imbalance use of fertilizers causes deterioration on soil health. Thus, an alternative use of nutrients through manures is gaining popularity, animal excreta like dung, urine, poultry drooping and litters as well as weeds and farm waste.

The use of vermicompost has long been recognized as an effective means of increasing crop yields through improved soil physical, chemical and biological properties. The use of earthworm as a bio-terminator may help in recycling of all type of biowaste quickly. The earthworms are an important living creator and have an ability to digest bio-degradable waste and can convert into valuable manure. Worm casts consist of organic matter that under goes physical and chemical breakdown through the activity of the muscular gizzard. In the processes of vermicompost making important nutrients (N,P,K and Ca) required by plant is released and make it available to plant by being more soluble [1].

The NPK percentages of manure/trash inoculated weigh *Trichoderma* were restively low, but their benefit lied in the slow release of organically bound N and P in the soil that plants could use more effectively. *Trichoderma viride*, lingo-cellulolytic microorganism increases the degree of humification of the organic matter present and improves its quality as oil amendment. Hence, conversion of weeds and farm wastes into vermicasts will not only solve the problem of waste disposal but also minimize the consumption of chemical fertilizers. Therefore, keeping the above facts in view, the present experiment was conducted.

## Materials and Methods

A field experiment was carried out during two years 2017-18 and 2018-19 at the Krishi Vigyan Kendra, Kasturbagram, Indore, M.P. The soil of the experimental site was clayey in texture and neutral in soil reaction (pH 7.78). The soil was low in nitrogen (235 kg/ha, medium in phosphorus (11.58 kg/ha) and high in potash (502 kg/ha). The total rainfall received during 2017-18 was 84.3 mm and 2018-19 crop season was 638 mm. There were 3 biowastes W<sub>1</sub> (water hyacinth), W<sub>2</sub> (farm wastes) and W<sub>3</sub> (soybean stover) enriched VC treatments @ 2 t/ha and 5 additives decomposer A<sub>1</sub> (No additive), A<sub>2</sub> (PSB), A<sub>3</sub> (rock phosphate + PSB) A<sub>4</sub> (PSB + *Trichoderma*) and A<sub>5</sub> (rock phosphate + PSB + *Trichoderma*) enriched VC treatments @ 2 t/ha. The experiment having 15 treatment combinations was laid out in factorial randomized block design with three replications. Before sowing of soybean crop, recommended dose of 20 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> + 20 kg K<sub>2</sub>O/ha was applied in T16 plots only through urea, SSP and MOP, respectively. The different types of VC were applied @ 2 t/ha on the equal moisture basis. Jawahar soybean JS-9560 was sown on 16 July in first year and 25 June in second year. The crop was harvested on 11 September, 2017 and 25 September, 2018. The succeeding wheat crop Hybrid Indore HI 1544 was sown @ 100 kg/ha on the same plots in which soybean was harvested. It was sown on 5 November, 2017 and on 10 November, 2018 and harvested on 10 April, 2018 and 15 April, 2019. Both the crops were grown as per recommended package of practices.

## Results and Discussion

### Growth characters of soybean

The plant height and number of trifoliate leaves and branches per plant were enhanced significantly due to application of farm waste enriched VC treatment

Table-1 Growth and yield parameters of soybean and succeeding wheat under various treatments (Pooled for 2 years)

Treatments	Soybean						Succeeding wheat					
	Plant height (cm)	Leaves/plant	Branches/plant	Dry matter/plant(g) at harvest	Seed yield (kg/ha)	Straw yield (kg/ha)	Plant height (cm)	Dry matter/plant(g) at harvest	Dry weight of root/plant (g)	Tillers/m row length	Grain yield (kg/ha)	Straw yield (kg/ha)
Biowastes enriched residual 2 t VC/ha												
(W <sub>1</sub> ) Water hyacinth	34.9	8.13	3.35	19.4	1876	2251	80.9	17.8	3.67	33.7	3807	5381.3
(W <sub>2</sub> ) Farm wastes	48	10.21	4.65	24.4	2515	2891	103.0	24	4.02	41.5	4229	5965.7
(W <sub>3</sub> ) Soybean stover	39.6	8.75	63.84	21.8	2296	2620	91.9	18.7	3.76	36.5	4001	5641.9
C.D. (P=0.05)	2.24	0.5	0.12	0.69	70.6	82.7	3.16	1.1	0.11	1.17	119.5	187.7
Additives enriched residual 2 t VC/ha												
(A <sub>1</sub> ) No additive	35.7	8.42	3.32	19.3	2052	2396	82.5	18.1	3.43	34.3	3787	5361.3
(A <sub>2</sub> ) PSB	39.9	8.75	3.77	209	2154	2483	88.5	19.2	3.7	35.6	3948	5565.3
(A <sub>3</sub> ) RP + PSB	41.2	8.93	4.04	22	2270	2641	93.8	20.6	3.92	37.9	4058	5721.8
(A <sub>4</sub> ) Trich. + PSB	42.4	9.22	4.2	22.5	2266	2631	93.8	20.5	3.95	37.9	4058	5721.2
(A <sub>5</sub> ) RP + PSB + Trich.	44.9	9.83	4.41	24.5	2403	2788	101	22.4	4.09	40.3	4210	5945.1
C.D. (P=0.05)	1.6	0.34	0.15	0.89	91.2	106.8	6.66	0.8	0.15	1.51	154.3	252.4
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

RP = rock phosphate, Trich. = *Trichoderma*, PSB = Phosphate-solubilizing bacteria

(W<sub>2</sub>) in comparison to soybean stover enriched VC (W<sub>3</sub>) and water hyacinth enriched VC treatment (W<sub>1</sub>). The plant height was 48.0 cm, branches 4.65/plant and trifoliate leaves 10.21/plant and DM 24.4 g/plant. Whereas W<sub>1</sub> resulted in the significantly lowest all these growth parameters. The significant variation in growth characters due to different biowastes enriched VC might be attributes variations in their nutrient composition, decomposition of organic residues, carbon:nitrogen ratio, nutrient release pattern, climate and soil characteristics.

The enhanced vegetative growth (plant height and number of trifoliate leaves and branches per plant) due to farm wastes enriched VC (W<sub>2</sub>) may be because of the fact that this applied nutrient promoted plant growth by ensuring higher number of greener leaves with increased photosynthesis. Profuse root development particularly due to increased availability of multi-nutrients provide soil moisture, minerals and various nutrients from the deeper soil layers. These favourable physico-chemical and biological soil conditions brought about efficient utilization of plant nutrients accompanied by activating plant enzymes [2-4].

All the applied dual or individual biofertilizers proved significantly superior to no additive enriched VC (control) treatment. However, amongst the additive biofertilizer treatments, combination of two biofertilizers with RP (A<sub>2</sub> to A<sub>4</sub>) proved almost significantly superior to most of the other treatments for increasing plant growth and development. The control treatment resulted in the minimum plant height, number of leaves and branches per plant. The boosted plant height and number of branches and leaves/plant due to dual biofertilizers (PSB + *Trichoderma*) + RP (W<sub>2</sub>) may be because of the fact that these combinations promoted plant growth by supplying additional multi-nutrients and available phosphorus thereby ensuring higher number of greener leaves with increased photosynthesis. The remarkable increase in these growth parameters may be on account of increased availability of phosphorus which caused acceleration of cell elongation and cell division. Similar findings have been reported in many crops by several research workers [5-8].

### Productivity of soybean

Application of farm wastes enriched VC (W<sub>2</sub>) resulted in the significantly higher grain and straw of soybean as compared to soybean stover or water hyacinth enriched VC (W<sub>1</sub> and W<sub>3</sub>). Thus, the grain and straw yield of soybean cv. JS 9560 was found significantly higher (2515 and 2891 kg/ha, respectively) due to W<sub>2</sub> over W<sub>1</sub> and W<sub>3</sub> treatments. The trend of increases in grain and straw yield obtained due to these treatments was exactly in accordance with the similar increases in the growth [3,4].

The significantly maximum increase in grain and straw yield (2403 and 2788 kg/ha, respectively) was obtained due to additives (RP + PSB + *Trichoderma*) enriched VC (A<sub>5</sub>) and then in other treatments lower yield was obtained. This was exactly in accordance with the similar increases in the yield attributing parameters viz. pods/plant, seed/pod and 1000-grain weight [8,9,12].

### Growth parameters of succeeding wheat

The residual effect of farm waste enriched VC resulted in significantly maximum

plant height (103.0 cm), dry matter (24.0/plant), dry weight of root (4.02 g/plant) and tillers 41.5/m row length. The encouraged vegetative growth (plant height and number of tillers/m length) due to farm wastes enriched VC may be because of the fact that the applied enriched VC promoted plant growth by ensuring higher number of greener leaves with increased photosynthesis as a result of increased metabolism of the absorbed plant nutrients; influencing cell membranes of leaves, forming longer and stronger root to absorb sufficient water and nutrients, profuse root development particularly due to increased availability of residual nutrients and physico-chemical properties insured more absorption of minerals, nutrients and soil moisture from the deeper soil layers. Such favourable soil conditions activate plant enzymes. The remarkable increase in plant height and formation of higher number of tillers/m length due to residual farm wastes enriched VC associated activities may be as a result of acceleration of cell elongation and cell division [10,11,14].

Amongst the residual effect of additives enriched residual treatments, A<sub>5</sub> (RP+ PSB + *Trichoderma*) resulted significantly higher plant height, effective tillers and dry weight/plant in comparison to A<sub>1</sub> (control) treatment. The second best was A<sub>4</sub> treatment having *Trichoderma* + PSB and the A<sub>3</sub> (RP + PSB). These treatments provided increased phosphorus absorption with other nutrients by increased roots development, photosynthates required for increased vegetative growth of plants. In fact, applied RP, PSB and *Trichoderma* applied in combination solubilized the native and applied P in increased amount and their availability increased for the actively growing plants. Phosphate-solubilizing microorganisms (PSB) and *Trichoderma* solubilized soil P through production of organic acids, chelating acids, phosphatase enzyme with net result of enhanced availability and uptake of P to the plants which increased the root biomass and then number of tillers.

### Productivity of wheat

Application of farm waste enriched VC (W<sub>2</sub>) significantly higher grain and straw yield of succeeding wheat as compared W<sub>1</sub> and W<sub>3</sub>. The overall grain and straw yield of wheat was found highest 4229 kg and 5966 kg/ha, respectively under W<sub>2</sub>. The trend of increases in grain and straw yield obtained due to enriched farm waste VC (W<sub>2</sub>) treatment was exactly in accordance with the similar increases recorded in the yield-attributing characters (seeds/spike, spike length, seed weight/spike and test weight and the increased vegetative growth [10,11,14].

### Conclusion

The residual effect of different additives enriched VC treatments on the productivity of succeeding wheat was found to be influenced upto significant extent. The treatment A<sub>5</sub> (RP + PSB + *Trichoderma*) resulted in significantly higher grain and straw yield (4210 and 5945 kg/ha, respectively). This was equally followed by A<sub>3</sub> and then A<sub>4</sub> treatments [10,11,13].

**Application of research:** Effect of vermicompost on different crop growth

**Research Category:** Natural Resource Management

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