



Pesticide Diminution in Paddy Grown in Cow Dung- enriched Soil for Sustainable Agriculture

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Sustainable agriculture is entrusted with the organic inputs utilized for crop production. Decomposed cow dung is one of the easiest available form of manures and having rich sources of plant nutrients and anti-pathogenic properties for plant protection. The study was conducted in paddy field (var. Satabdi) during boro season (2024-25) with six treatments and three replications using chemical fertilizers and decomposed cow dung at the different level to evaluate the effect of cow dung enrichment on pesticide requirements, yield, and economic efficiency in rice plants. Increase in cow dung content along with decrease in chemical fertilizers, the rate of the cost was diminishing. It was reduced from T1 to T5 (2475.333). But T6 showed it little bit higher (3338.33) because of that for the first time, only the cow dung was not sufficient to provide adequate nutrients to the plant. The pesticide quantity decreased with increase in cow dung content because cow dung has the pesticidal properties. The highest yield was observed in case of T1 (5.241267) whereas the lowest produce was obtained from the T6 (3.622667) because the paddy required high quantity of

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nutrients which could not be provided by only the source of 10-ton cow dung. Benefit-Cost Ratio was higher for the T4 (1.814) whereas it was the lowest for the T6 (1.171237). The ensured the cow dung enriched soil was having high productivity and anti-pathogenic properties that promote sustainable agriculture.

Keywords: Cow dung; pesticide diminution; sustainable agriculture.

1. INTRODUCTION

Soil is the life support for fertility which is providing adequate nutrients to living plants (Lichtfouse et al., 2009). The parent materials are transformed to soil when organic matter is added to it. The physical, chemical and biological properties of soil are governed by soil organic matter (Weil & Magdoff, 2004). These features combinedly build the soil health status which contributes the plant growth and development directly or indirectly (Reeve et al., 2016). Soil is suffering from the dearth of organic matter in major cultivated land in West Bengal (Sarkar, 2003). The plant health is deteriorating at great extension and is gradually losing its inherent immunity capability (Heckman, 2006). The weak plants entertain the pests (Hopkins, 2013). Their infestation is being encouraged by the malnutrition. Green Revolution (1964-66) insisted the farmers to use chemicals for increasing crop production of high yielding varieties. Crop production with reduced *pesticide use* can lead to changes in the profitability and in working time requirement. Pesticides can contaminate soil and water, negatively impact human health and harm the biodiversity. Reducing pesticide use is crucial for mitigating these impacts and to promote a more sustainable agricultural system (Dobermann & Fairhurst, 2000; Sumarno & Kartasasmita, 2012). As the adverse consequence of injudicious application of agro-chemicals inputs, the soil becomes unproductive, pest infestation has increased, yield decreases, cost of cultivation increases, environmental pollution enhances (Roos et al., 2011). The agricultural sustainability is being jeopardized. Decrease in organic matter in soil increases the intensity of pest attack. Crops grown in organic manured soils generally exhibit lower abundance of several insects (Phelan et al., 1995; Luna, 1988). Organic matter contributes the bio-environment of soil and reduces the abundance of pests (Pimentel & Warneke, 1989; Mehta et al., 2014). Cow dung derived from the indigenous cattle breeds of India, contains good quality of organic matter (Seiter & Horwath, 2004; Zehnder et al., 2006). It is rich sources of plant nutrients, beneficial microbes which contribute in mobilization of

insoluble elements and anti-pathogenic properties. Cow dung maintains a balanced soil ecosystem with all beneficial microbes. Hence, the study would help in bringing out some productive results through use of organic means for protection of crops grown in cow dung enriched soils for sustainable agriculture.

2. MATERIALS AND METHODOLOGY

The study was carried out in rice field added with different doses of cow dung in soils during the winter season (2024-25) at RKMA Farm, Narendrapur, South 24 Parganas, West Bengal, India. The variety was Satabdi and the experiment was laid out in Randomized Block Design with six treatments and three replications. The chemical fertilizers (CF), decomposed Cow dung (DCD) were used in the treatments and their replications. The treatments constituted of T1 :100% CF + 0 ton DCD, T2: 80% CF + 2 ton DCD, T3: 80% CF + 2 ton DCD, T4: 60% CF + 4 ton DCD, T5: 40% CF + 6 ton DCD, T6 : 20% CF + 8 ton DCD, T7: 0% CF + 10 ton DCD. The plot size for each treatment and replication was 3m x 2 m with plant spacing 25 cm x 25 cm. The study location belongs to sub-tropical climate and new alluvial soil. The soil is clay loam. The recommended doses for the treatments were 200:150:150 NPK Kg ha⁻¹. Depending upon the deficiency symptoms of micronutrients at the different growth stages, their rectification was done from the external sources. Pesticides were used for plant protection when pest pollution crossed the economic threshold limits for each insect pest and pathogen. All the used components were quantified in terms of money. The costs of chemical fertilizers (10: 26: 26 Rs. 40/ Kg and Urea Rs. 10.81/ kg), decomposed cow dung (Rs. 400 per ton), micronutrients and growth promoting substances and pesticides were recorded for analysis. Yield data and return from paddy cultivation also evaluated by using ANOVA analysis.

3. RESULTS AND DISCUSSION

All the treatments with their replications were administered with the fixed rates of chemical fertilizers and decomposed cow dung. Therefore,

their costs did not have any variation in the replication. Each plot showed the different level of micronutrient deficiency and growth stages which were fortified with micronutrients and growth promoting substances (Table 1). For the T1, the cost of micronutrients and GPS was the highest (4988.00). Increase in cow dung content along with decrease in chemical fertilizers (Mubambwe et al., 2025), the rate of the cost was diminishing (Mehta et al., 2014). It was reduced from T1 to T5 (2475.333). But T6 showed it little bit higher (3338.33) because of that for the first time, only the 10-ton cow dung was not sufficient to provide adequate nutrients to the plant (Fig. 1).

Pest abundance was observed in the different treatments. Pesticides were applied when the threshold limit of each insect and pathogen exceeded. The doses and repetition of spraying do not depend on pest count. So cost of pesticides incurred was considered for study. The pesticide quantity decreased with increase in cow dung content because cow dung has the

pesticidal properties (Phalan et al., 1995; Luna, 1988). The total cost depicted the increasing trends (T1 to T6) with addition of cow dung into the soil, but use of pesticides decreased which ensured the less pollution, improvement of soil health, healthy food for the mankind (Pimentel & Warneke,1989; Mehta et al., 2014). These findings statistically significant for the variance.

The highest yield was observed in case of T1 (5.241267) whereas the lowest produce was obtained from the T6 (3.622667) (Table 2). It was due to fact that the paddy required high quantity of nutrients which could not be provided by only the source of 10-ton cow dung (Sachan et al., 2025). Yield decreased when the soil was applied with chemical fertilizers at the rate of less than 40% of the recommendation for Rabi Paddy (Var. Satabdi). T4 was found with the highest gross (131031.70) and net return (58803.00). Benefit-Cost Ratio was higher for the T4 (1.814) whereas it was the lowest for the T6 (1.171237) (Fig. 2).

Table 1. Cost of considered inputs for the treatments and their replicated plots

Treatment	Cost of Chemical Fertilizers (Rs. ha-1)	Cost of Decomposed Cow dung (Rs. ha-1)	Cost of Micronutrients and GPS (Rs.ha-1)	Cost of Pesticides (Rs. ha-1)	Total Cost (Rs. ha-1)
T1	25360	0	4988.000	8169.333	38517.33
T2	20288	8000	4422.667	7534.333	40245.00
T3	15216	16000	3835.333	6688.333	41739.67
T4	10144	24000	2848.667	5236.000	42228.67
T5	5072	32000	2475.333	4225.667	43773.00
T6	0	40000	3338.333	3987.333	47325.67
SEM			70.70892	77.01349	
CD 0.05			222.7945	242.6593	

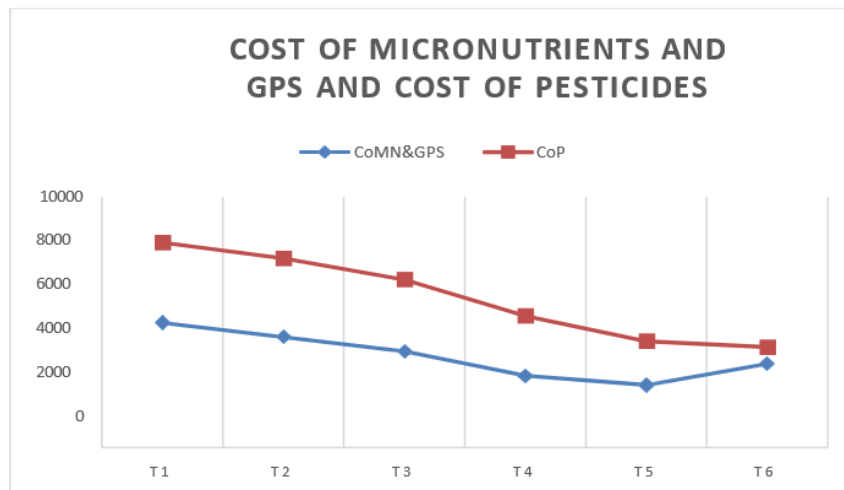


Fig. 1. Cost of micronutrients (MN) and GPS and cost of pesticide (CoP)

Table 2. Yield and Estimation of B: C ratio from the treatments

Treatment	Yield (t ha ⁻¹)	Gross return (Rs. ha ⁻¹)	Net Return (Rs. ha ⁻¹)	B: C Ratio
T1	3.980667	99516.67	30999.33	1.452431
T2	4.244333	106108.3	35863.33	1.510546
T3	4.741333	118533.3	46793.67	1.652270
T4	5.241267	131031.7	58803.00	1.814123
T5	4.608333	115208.3	41435.33	1.561660
T6	3.622667	90566.67	13241.00	1.171237
SEM	0.095615			
CD 0.05	0.301271			

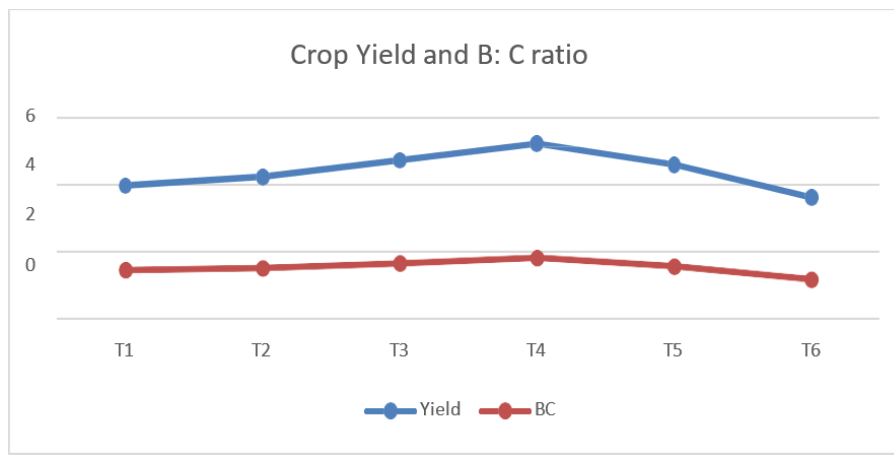


Fig. 2. Yield and Benefit- Cost Ratio of the treatments

4. CONCLUSION

Soil enriched with decomposed cow dung reduced the pest abundance in the paddy field. Cow dung improved the anti-pathogenic properties and nutrient content in the soil. In the study, the best treatment was T4 (40% chemical fertilizers + 6-ton Cow dung) with the highest yield and economic efficiency. It also enabled to make the farming lucrative and nature resilient. Only cow dung at initial stage was not sufficient to provide the adequate amount of nutrients to the crop. Use of cow dung will nourish the environmental and agricultural sustainability to encourage food security and bio-safety for the green world.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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