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RESEARCH ARTICLE

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON PRODUCTIVITY OF GREEN GRAM (*Vigna radiata*)

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ABSTRACT

The present study is to evaluate the practice of Integrated Nutrient Management (INM) effect on growth and yield response of green gram and their effect on soil fertility. Field experiment was conducted using various INM treatments of combinations of organic and inorganic fertilizers and biofertilizers and recorded the observations on plant height, number of branches, leaf count, secondary root, leaf area and yield. The integrated treatments were satisfactory and provided positive response with respect to plant growth and productivity with the integrated application of partially reduced use of chemical fertilizers, vermicompost and biofertilizers. The study concluded that INM could be an efficacious practice for achieving promising yield of green gram.

Keywords: Crop Yield, Soil Fertility, Biofertilizer, Vermicompost, FYM, Integrated Nutrient Management, green gram, etc.

1. Introduction

Green gram (*Vigna radiata*) commonly called as Mung bean is one of the predominantly consuming legumes and being cultivated in the tropical and subtropical regions. It has high value for protein, digestibility, and lesser incidence of flatulence and, therefore, suitable for infants and convalescents [1]. The crop is also rich in lysine and consumed in various forms like whole beans, dhals, sprouts, and flour. A demand of green gram is gained importance to meet regular supply. Whereas the productivity faces not expected yield and productivity to quench the requirement. In this scenario, the approach called integrated nutrient management (INM) is a global agriculture strategy through which organic, inorganic, and biological inputs are combined to improve soil fertility for optimal productivity of crops under diverse environments[7],[16]. INM emerges as a sustainable strategy with balanced input from different sources, increased nutrient-use efficiency, and long-term maintenance of soil productivity [6]. The evil of chemical fertilizers is manifest in agriculture all over the world.

Integrated Nutrient Management (INM) has been recognized for enhancing the productivity and sustainability of green gram cultivation[20]. Application of Farmyard Manure (FYM) has been shown to improve soil fertility by its positive influence on physical, chemical, and biological properties [5][7][12]. Rhizobium fixes the atmospheric nitrogen by symbiotic means and increased root nodules. *Azospirillum* increased root elongation and fixed atmospheric nitrogen non-symbiotically[3]. Phosphorus Solubilizing Bacteria (PSB) made available fixed phosphorus and thus flowered [13]. Zinc, one of the essential micronutrients, is very much important for nodulation and nitrogen fixation of legumes [10]. Observatios were made the authors of [11][10][8], the application of zinc did not have a significant effect on the dry weight of root nodules, but it greatly enhanced their number and, thus, efficient nitrogen fixation.

2. MATERIALS AND METHODS

2.1. Experimental Site and Design

There were eight number of treatments planned with each treatment had three replications to ensure statistical reliability. Involves location-uniform soil conditions and the study was done under standard cultivation practices[2]. The soil was loamy and reasonable pH, with moderately available organic matter. The treatment details are: T1: Inorganic fertilizers - IOF (100%); T2: Organic Manure - OM (100%), T3: Biofertilizers - BOF (100%), T4: Inorganic fertilizers(IOF) + Organic Manure (OM)(50:50), T5: Organic Manure(OM) + Biofertilizers(BOF) (50:50)[19], T6: Inorganic fertilizers(IOF) + Biofertilizers (BOF)(50:50), T7: Inorganic Fertilizers(IOF) + Organic Manure (OM)+ Bio fertilizers(BOF) (33:33:33)[24] and T8: Untreated Control.

2.2. Observation of biometric parameters

After implement of treatments, the plants were uprooted and biometric and biochemical contents were analysed and observation taken on two months old plants. The plants were chosen for observation based on its healthy appearance and unbiased approach. The biometric parameters such as plant fresh weight (g), plant height (cm), number of branches and leaves per plant, yield per plot (kg), leaf area, and number of secondary roots.

2.3. Observation of chlorophyll & protein estimation

Chlorophyll content actually reflects photosynthetic activity under different nutrient-rich soil conditions since it can be enhanced through such characteristics. Similar effects on chlorophyll levels through improved nitrogen assimilation and availability of micronutrients occur due to integrated nutrient management. Freshly collected green leaves were taken for both chlorophyll and protein analysis from the pooled sample randomly collected from replicated of each treatment.

3. RESULTS AND DISCUSSION

3.1 Biometric parameters observation

INM treatments were given as per the treatments to green gram and the data were observed at 60 days after planting. Among the various INM treatments, organic and biofertilzers along with reduced level of chemical fertilizers registered the satisfied biometric results. Results showed that the highest plant height was recorded in T7 (34 cm) and lowest in T8 (23.5cm). Number of branches/plant peaked at 12.4 in T6. Leaf count reached a maximum of 07 in T1,T4 and T6 (Table 1), showing enhanced photosynthetic area. Number of secondary roots was observed more in T1. Shoot and root length were also enhanced (T1: 34 cm shoot, T7: 5.7 cm root). Dry matter weight was significantly higher under INM. Shoot height was noted in 100% chemical treatment followed by 33% each IOF, OM and BF treated green gram plants (Fig 1). Same trend of observation also was reflected in shoot and root fresh and dry weight biomass weight (Fig 2 & 3)

3.2 Estimation of chlorophyll content

Leaf chlorophyll content was noted in 100% chemical treatment followed by 33% each IOF, OM and BF treated green gram plants (Table 2). Increased chlorophyll content was recorded under the INM treatment of 33:33:33 (0.638 mg/g), indicating an increase in photosynthesis due to greater nitrogen and micro-nutrient uptake; this was followed by the treatment with inorganic fertilizer only (0.615 mg/g), while the lowest level was in the untreated control. With the Bradford assay, protein content also measured highest under the 33:33:33 treatment (0.993 mg/ml), reinforcing the fact of better nitrogen assimilation and metabolic efficiency over other treatments. They [17] reported that combining 75% RDF with *Azotobacter* and PSB treatments led to a significant increase in chlorophyll content due to improved uptake of magnesium and iron.

A study conducted by [21] also found that INM treatments produced maximum leaf area and chlorophyll levels relative to treatments with chemical fertilizers, which supports INM's efficacy in improving photosynthetic efficiency. In the field trials, INM treatments have shown superior performance. The increase in plant height, branching, leaf area, and dry matter with the treatment of 75 percent Recommended Dose of Fertilizers (RDF) with *Rhizobium*, PSB, and vermicompost has been reported by [22]. Similarly, they also [4] reported that dual inoculation of *Azospirillum* and PSB enhanced root and shoot growth over single treatments or control. They [6] reported that integration of 100% NPKS with biofertilizers and FYM significantly increased plant height, pod number, and dry matter accumulation. In the rice-green gram systems,[8] reported that combining chemical fertilizers with organic sources improved nitrogen uptake and contributed positively to soil nitrogen balance.

Foliar spraying with zinc has been effective. Foliar application of 1% $ZnSO_4$ at 25 days after sowing improved nodulation and grain yield, according to [18]. Co-inoculation of biofertilizers, like Rhizobium and PSB, along with mycorrhizae, further enhance phosphorus availability and nitrogen fixation [9]. They [23] documented a positive impact of vegetative mulching and application of biofertilizers on soil moisture conservation and water-use efficiency. Other studies have confirmed that phosphorus levels up to 40 kg/ha enhance nodulation, shoot height, and dry matter accumulation in green gram[19].

3.3 Estimation of Protein content

Similar trend like chlorophyll contents of observation also was reflected in protein content of the leaves (Table 3, Fig 4 & 5). Protein amount in green gram is closely related to nitrogen, and it has been observed that INM practices enhance protein concentration. The combined application of chemical fertilizers, organic manures, and biofertilizers resulted in higher nitrogen fixation and metabolic activity, thus a higher protein content [18];[15]. In accordance with this view, similar findings were recorded by [14], which confirmed that multi-strain microbial inoculation enhanced the uptake of nutrients and protein levels in legumes, proving that INM has the nutritional benefits.

4. CONCLUSION

An integrated application of fertilizers served as a great supplement for plant growth, yield, and soil fertility enhancement. Among the treatments, organic and biofertilzers along with reduced level of chemical fertilizers registered the satisfied biometric results. The INM could make possibility to stabilize the soil pH, increases microbial biomass, and serves as an economically viable alternative to chemical fertilizers in terms of sustainability. Future studies may look into multi-season studies, crop-specific INM protocols, and training of farmers to adopt these practices.

Table 1.Influence of INM on biometric parameters of green gram

TREATMENTS	SHOOT LENGTH (cm)	ROOT LENGTH (cm)	No. OF LEAVES	SHOOT FRESH WEIGHT (g)	ROOT FRESH WEIGHT (g)	SHOOT DRY WEIGHT (g)	ROOT DRY WEIGH T (g)	No. OF SECON DARY ROOTS	Leaf area (sq mm)
INORGANIC FERTILIZER (IOF)	33.2	5.5	7	0.413	0.043	0.081	0.013	9	721
ORGANIC MANURE (OM)	27.6	2.8	4	0.275	0.028	0.048	0.003	5	503
BIOFERTILIZE RS (BOF)	26.5	3.3	5	0.283	0.035	0.051	0.005	5	398
IOF + OM	29.8	4.3	7	0.378	0.04	0.074	0.007	8	515
OM + BOF	28.4	3.6	6	0.348	0.038	0.058	0.005	6	571
IOF + BOF	28.6	4	7	0.374	0.039	0.069	0.011	8	539
IOF + OM + BOF	34.0	5.7	8	0.508	0.048	0.119	0.013	11	856
UNTREATED CONTROL	23.5	2.4	2	0.196	0.011	0.022	0.003	4	90

Values are mean of three replicates

Table 2. Effect of INM practice on chlorophyll content

Treatment	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total chlorophyll (mg/g)
Chemical fertilizers	0.496	0.727	0.615
Organic Manure	0.253	0.399	0.297
Bio fertilizers	0.247	0.395	0.289
Chemical fertilizers + Organic Manure	0.267	0.463	0.314
Organic Manure + Bio fertilizers	0.279	0.465	0.331
Chemical fertilizers + Bio fertilizers	0.268	0.448	0.301
Chemical Fertilizers + Organic Manure + Bio fertilizers	0.585	0.882	0.638
Untreated Control	0.105	0.113	0.111

Values are mean of three replicates

Table 3. Impact of INM Treatment on Protein content

Treatment	Protein Concentration (mg/g.fr wt)
Inorganic fertilizers (IOF)	0.957
Organic Manure (OM)	0.363
Biofertilizers (BOF)	0.578
IOF + OM	0.722
OM + BOF	0.899
IOF + BOF	0.863
IOF + OM + BOF	0.993
Untreated control	0.146

Values are mean of three replicates

Fig 1. Influence of INM of shoot length of two months old green gram

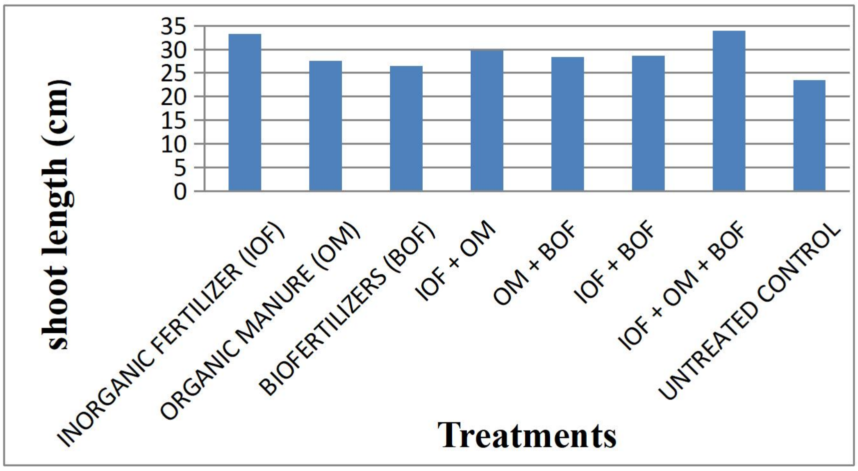


Fig 2. Influence of shoot fresh and dry weight of two months old green gram

Fig 3. Influence of root fresh and dry weight of two months old green gram

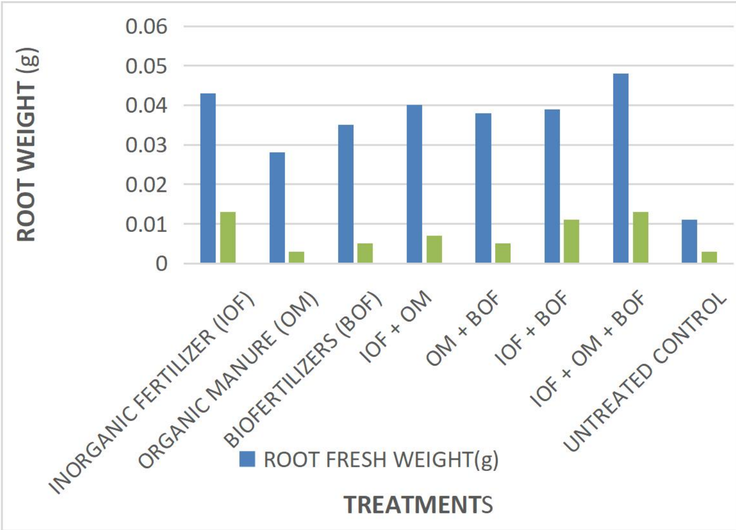


Fig 4.Effect of INM on Total chlorophyll content of green gram

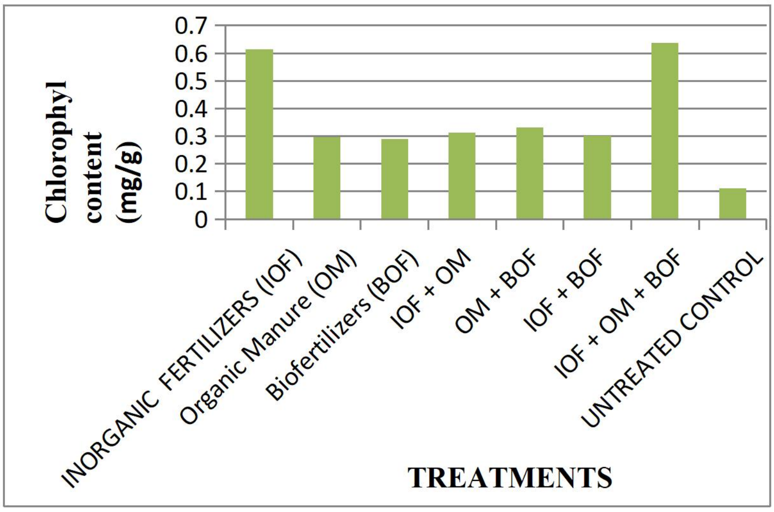
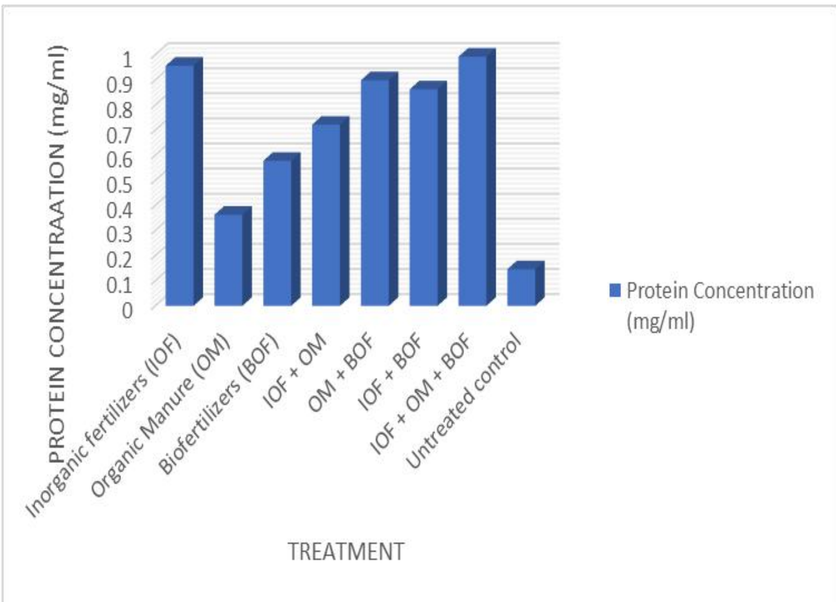


Fig 5. Effect of INM on protein



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