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Impact of different soil textures on the growth and yield parameters of green gram using Potculture experiment (*Vigna radiata*) on different soils of Namakkal district

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Abstract
Green gram (Vigna radiata), an important pulse crop, plays a vital role in nutritional security and sustainable agriculture. Its productivity is strongly influenced by soil texture, which governs soil moisture retention, nutrient availability, and root growth. A pot culture experiment was conducted during June–September 2024 at the Department of Soil Science and Agricultural Chemistry, PGP College of Agricultural Sciences, Namakkal, to evaluate the impact of different soil textures on the growth and yield of green gram. Eight soil types—clay loam (PGPCAS wetlands), sandy loam (Sendamangalam and Muthugapatti), silty loam (Belukurichi), loamy (Kalappanayaikenpatti), sandy clay loam (Akkiampatti), clay loam (Melapatti), and silty clay loam (Bommasanudram)—were collected and tested under a completely randomized design with three replications. The results indicated that clay loam soil of Melapatti and silty clay loam soil of Bommasanudram significantly enhanced growth parameters such as clusters $plant^{-1}$ (9.55), pod length (7.9 cm), pods $hill^{-1}$ (56.0), and dry matter production (16.78 g). Yield attributes, including panicles $plant^{-1}$ (21.7), pod length $hill^{-1}$ (13.08 cm), and grain yield $plant^{-1}$ (9.60 g), were also highest in these soils, followed by sandy clay loam soils of Kalappanayaikenpatti. Conversely, the red soils of Muthugapatti recorded the lowest performance. It can be concluded that clay loam soils of Melapatti are best suited for cultivating green gram, as they provide superior growth and yield attributes compared to other soil textures.

Keywords: Green gram, soil texture, clay loam, yield parameters, pot culture experiment

Introduction

Green gram (*Vigna radiata*), commonly known as mung bean, is an important legume crop cultivated in tropical and subtropical regions. It serves as a rich source of protein, vitamins, and minerals, contributing significantly to food and nutritional security, particularly in developing countries (Kumar *et al*., 2017) [6]. Its short duration, adaptability to diverse climatic conditions, and ability to fix atmospheric nitrogen make it a suitable component in crop rotations and intercropping systems, thereby enhancing soil fertility and promoting sustainable agriculture (Mula *et al*., 2020; Srinivas *et al*., 2018) [10, 19]. In addition, its high market demand supports the economic stability of smallholder farmers (Choudhury *et al*., 2019) [2]. The productivity of green gram is influenced by agronomic practices and environmental factors. Planting date is one of the most critical factors, directly affecting plant height, pod number, branching, and yield potential (Rehman *et al*., 2009; Singh and Singh, 2011) [15, 18]. Furthermore, variations in temperature, rainfall, and soil moisture considerably impact crop performance (Yadav *et al*., 2021) [21]. Globally, pulses are grown on about 85.40 million ha with a production of 87.40 million tonnes at an average yield of 1023 kg ha^{-1}. India accounts for 29.99 million ha of pulse cultivation, contributing 34% of global area and 6% of production. Among pulses, green gram ranks third after chickpea and pigeon pea, with 4.26 million ha area, 2.01 million tonnes production, and productivity of 472 kg ha^{-1} compared to the global pulse average of 835 kg ha^{-1} (Anonymous, 2019–20) [1]. Nutrient availability, especially nitrogen, phosphorus, and potassium, plays a pivotal role in plant metabolism and yield formation (Mathur *et al*., 2007) [9]. However, biological nitrogen fixation in mung bean is often limited during pre-nodulation and post-flowering phases, resulting in poor pod setting and grain filling. This highlights the need for balanced nutrient management integrating inorganic fertilizers, organic amendments, and biofertilizers (Das and Jana, 2015) [3]. Farmyard manure (FYM) supplies both macro- and micronutrients while improving soil physical and chemical properties, but its slow mineralization restricts immediate nutrient availability (Tilahun *et al*., 2013). [20] Thus, integrated use of organic and inorganic sources is essential for sustaining soil health and crop productivity.

Materials and Methods

A pot culture experiment was conducted at the Department of Soil Science, PGP College of Agricultural Sciences, Namakkal, during June–September 2024 to study the effect of soil texture on the growth and yield of green gram (*Vigna radiata* L.). Eight representative soils with different textural classes were collected from the surface layer (0–30 cm) of cultivated fields in Namakkal district, Tamil Nadu. The treatments included: clay loam (PGPCAS wetlands), sandy loam (Sendamangalam and Muthugapatti), silty loam (Belukurichi), loam (Kalappanayaikenpatti), sandy clay loam (Akkiampatti), clay loam (Melapatti), and silty clay loam (Bommasanudram).

Table 1: Experimental layout of different textural soils growing with green gram

Treatment	Texture of the soil
T1	Clay loam
T2	Sandy loam
T3	Silty loam
T4	Loamy
T5	Sandy loam
T6	Clay loam
T7	Sandy Clay loam
T8	Silty Clay loam

The experiment was laid out in a completely randomized design (CRD) with eight treatments replicated three times, making a total of 24 pots. Each earthen pot was filled with 10 kg of air-dried, sieved soil. Seeds of green gram variety VBN 11 were used. Ten seeds were sown per pot and later thinned to five healthy seedlings at the 5–6 leaf stage. The seeds were treated with *Azospirillum* or *Trichoderma viride* at 4 g kg^{-1} before sowing. Irrigation was applied as and when required, and no fertilizers were added to assess the sole influence of soil texture on crop performance.

Observations recorded

Growth parameters included plant height, number of leaves, leaf area, and biomass accumulation. Yield attributes measured were dry matter production, straw yield, number of pods per plant, seeds per pod, pod length, and grain yield per plant. The crop was harvested at physiological maturity, and data were statistically analyzed following CRD procedures.

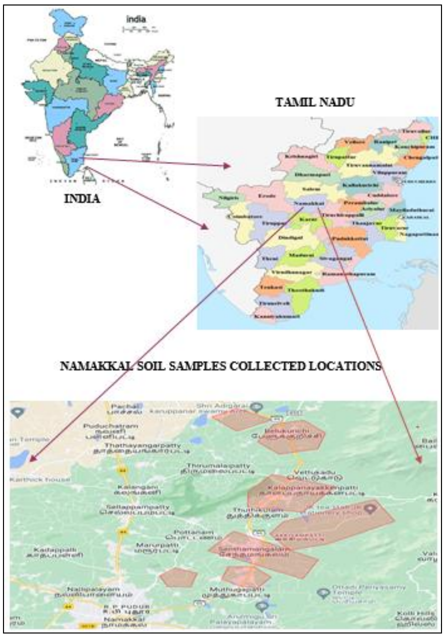

Fig 1: Location map of soil sample collection in Namakkal

Results and Discussion

Soil characteristics

The physical and chemical properties of the soil used in this trail are shown in Table 1. The texture of the soil collected from the wetlands of PGPCAS and Melapatti village is clay loam in nature, whereas it is sandy loam for the Red soils of the Sendamangalam village and Muthugapatti village. The soils obtained from Belukurichi village, Bommasanudram village, Akkiampatti village and Kalappanayaikenpatti village were sandy clay loam texture. The pH of the soils ranged from slightly alkaline to moderately alkaline (7.8-8.6) The salinity of the soils used in this investigation ranged from 0.31-0.98 dSm^{-1}, categorized as non-saline soil.

The organic carbon of the soils collected from wetlands of PGPCAS, Red soils of the Melapatti village, Red soils of Sendamangalam village and Muthugapatti village are low organic carbon in nature, whereas it was medium in the all other collected soils. The available nitrogen content of all the soils is categorized as low (<280 kg ha^{-1}) in all the collected soils which have a moderate amount of available nitrogen (376 kg ha^{-1}). The soils of all the treatments registered medium amount of available phosphorus, All the soils used in this experiment were high in available potassium. This could be attributed to balanced amounts of sand, silt and clay fractions, moderate quantity of available nitrogen, and high concentrations of organic carbon, phosphorus and potassium. Similar findings were realized by Shanmugasundaram and Savithri (2000) [17]. Sandy loam soils of Mettupalayam had low soil fertility, possibly due to high fractions of sand and unbalanced concentrations of NPK in the soils.

Plant height

The experimental results indicated that the plant height of green gram was significantly affected by different soil types. Among all the treatment plant height recorded Melapatti village Clay loam soil and Bommasanudram village Silty clay loam soil. Sarma *et al* 2000 [16], find improvement in these growth parameters might have led to higher interception and absorption of radiant energy, resulting in greater photosynthesis and finally dry matter accumulation.

Table 3: Effect of different soil textures on growth, yield and quality parameters of green gram

Treatments	No. of clusters hill^{-1}	Length of pod (cm)	No. of pods hill^{-1}	No. of seeds pod^{-1}	100 seed weight (g)	Plant dry weight (g)	Biomass Production (g plant^{-1})	Test weight (g)
T1	4.55	7.6	24.2	11.5	3.25	12.82	11.94	28.83
T2	4.80	7.8	37.4	12.2	3.32	12.84	20.43	29.10
T3	4.98	7.5	40.9	11.8	3.24	14.62	21.25	29.13
T4	5.60	7.6	56.8	12.3	3.25	12.24	23.64	29.60
T5	7.04	7.6	31.4	12.3	3.25	11.66	26.26	29.70
T6	9.35	7.9	38.3	14.0	3.21	15.60	28.52	30.43
T7	7.99	7.7	49.4	12.0	3.28	12.32	27.22	29.87
T8	8.74	7.6	75.3	12.0	3.24	11.69	28.32	29.93
Mean	4.55	7.6	24.2	11.5	3.25	12.82	23.45	29.58
S.Em (±)	1.64	3.77	2.00	0.01	0.5	22.53	1.69	0.54
CD (5%)	2.07	7.40	4.99	0.03	1.12	15.72	4.22	1.35

Length of pod (CM)
Among the eight treatments the green gram pod length recorded Melapatti village Clay loam soil and Bommasanudram village Silty clay loam soil for highest length of pods and T_3 recorded lowest pod length. This is in agreement with Manivasagaperumal *et al*. (2011) [8]. Nandal and Singh (2005) [12] reported green gram & lentil are shade sensitive which results poor branching and pod settings in pulses.

No of pods per hill
Among the eight treatments the green gram pod length recorded Melapatti village Clay loam soil and T_4 for highest length of pods and T_1 and T_5 recorded lowest pod length. The yield reduction in pulses in intercropping with trees also reported by Pandey *et al*. (2002) [13], Jama *et al*. (1991) [4] and Nandal & Hooda (2005) [11]. But Korwar *et al*. (1999) [5] in Faidherbia albida with pulses reported that grain yield is higher for green gram and black gram in lower canopy density than the monocrops and higher canopy density, which support that if canopy is properly managed the yield reduction in intercropping with trees can be reduced.

Number of seeds per pod
Among the eight treatments the green gram pod length recorded Melapatti village Clay loam soil and Bommasanudram village Silty clay loam soil for highest length of pods and T_1 recorded lowest pod length. This reason may be owing to their genetic variability. This finding is in corroborated with the findings of Kumar *et al*. (2013) [7].

Hundred seed weight
Among the eight treatments the green gram pod length recorded Melapatti village Clay loam soil and T_8 for highest length of pods and all other treatment recorded medium weight of seeds

Plant dry weight
Among the eight treatments the green gram pod length recorded Melapatti village Clay loam soil and $T_2$for highest length of pods and T_1 and T_5 recorded lowest pod length. Similar kind of results were reported by Pramanik *et al*. (2013) [14]. The results indicated that clay loam soil of Melapatti and silty clay loam soil of Bommasanudram significantly enhanced growth parameters such as clusters plant^{-1} (9.55), pod length (7.9 cm), pods hill^{-1} (56.0), and dry matter production (16.78 g). Yield attributes, including panicles plant^{-1} (21.7), pod length hill^{-1} (13.08 cm), and grain yield plant^{-1} (9.60 g), were also highest in these soils, followed by sandy clay loam soils of Kalappanayaikenpatti. Conversely, the red soils of Muthugapatti recorded the lowest performance. It can be concluded that clay loam soils of Melapatti are best suited for cultivating green gram, as they provide superior growth and yield attributes compared to other soil textures.

Summary and Conclusion
The present study revealed a significant variation in the growth and yield characteristics of Green gram. Among eight soils the wetlands of PGPCAS and Melapatti village is clay loam soils in low growth and yield attributes registered, whereas it is sandy loam for the Red soils of the Sendamangalam village and Muthugapatti village registered the medium growth and yield parameters. (Yoganathan. G *et al* 2025) [22].
The soils obtained from Belukurichi village, Bommasanudram village registered highest growth and yield of green gram as compare to Akkiampatti village and Kalappanayaikenpatti village were found moderate growth and yield. Similar findings were realized by Shanmugasundaram and Savithri (2000) [17]. Sandy loam soils of Mettupalayam had low soil fertility, possibly due to high fractions of sand and unbalanced concentrations of NPK in the soils. The study revealed that soil's physical and chemical characteris- tics, along with fertility status, influence the production of Green gram. The interaction of soil texture and crops can be utilized for maximum gain by technological interventions and good agricultural practices. The growth and yield parameters of Green gram irrespective verities were found maximum under sole cropping compared to intercropping with soil textures However, contrary the growth and yield parameters of Clay loam soil texture were found maximum pod yield of green gram.

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