



Original Research Article

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## Effect of NPK Levels in Combination with *Rhizobium* and PSB Culture on Growth and Yield of Greengram (*Vigna radiata* L. Wilczek) under Subabul (*Leucaena leucocephala*) based Agroforestry Systems

Rajiv Umrao<sup>1</sup>, Deepak Kumar Chauhan<sup>2</sup> and Arvind Bijalwan<sup>3\*</sup>

<sup>1,2</sup>School of Forestry and Environment, SHIATS (Deemed to be University), Allahabad, Uttar Pradesh, India

<sup>3</sup>Indian Institute of Forest Management (IIFM), Nehru Nagar, Bhopal-462003, Madhya Pradesh, India

\*Corresponding author.

### Abstract

A field experiment was conducted to study the effect of NPK levels in combination with *Rhizobium* and PSB culture on growth and yield of green gram (*Vigna radiata* L. Wilczek) grown in the Subabul (*Leucaena leucocephala*) based agroforestry system during summer (Zaid) season of 2015 at Research farm of the Department of Agroforestry, School of Forestry and Environment, SHIATS Allahabad, UP, India. The soil of experimental field was sandy loam having medium to poor drainage, low in available nitrogen, medium in available phosphorus and fairly rich in available potassium with 7.5 pH. Nine treatment combination consisting of on variety viz., HUM-16, Four level of inorganic fertilizer and including control (F1: 20-20-10, F2: 30-30-15, F3:40-40-20, F4: 50-50-25) and seed inoculation with *Rhizobium* (MOR-1) and Phosphate Solubilizing Bacteria (PSB) were evaluated in Randomized Block Design. The result revealed that during summer season greengram cultivar of cv. HUM-16 performed best fertilized with T7 (30-30-15 kg NPK/ha) by dual seed inoculation of *Rhizobium* and PSB culture. This treatment combination was found more productive and economical, which was closely followed by the treatment combination of T4 (40-40-20 kg NPK/ha).

### Article Info

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### Keywords

Agroforestry  
Greengram  
Subabul  
Inorganic  
*Rhizobium* inoculation  
Phosphate solubilizing bacteria

### Introduction

Agroforestry means practice of agriculture and forestry on the same piece of land. Bene et al. (1977) defined agroforestry as a sustainable management system for land that increases overall production, combines agricultural crops, tree crops and forest plants and/or animals rearing simultaneously or sequentially and applies management practices these are compatible to the cultural pattern of the local population. Subabul (*Leucaena leucocephala*) belongs to the family Leguminosae. It is also known as 'miracle tree' due to its paramount economic importance. Its common name is ipil-ipil (Philippines). It is a fast growing thorn less, evergreen leguminous woody perennial plant species. The

leaves are bipinnate 15 to 20 cm long with 10 to 15 pairs of bipinnate leaves inflorescence is globular and the flower are white. Green gram (*Vigna radiata*) belongs to the family of Fabaceae. It is also known as mung or golden gram. It's native to the Indian subcontinent. Apart from India it is also cultivated in china, Thailand, Indonesia, Burma, Bangladesh and also in hot and dry region of southern Europe and southern United States. In India; green gram occupies 3.44 million hectares and contributes to 1.45 million metric tons in pulse production. The important green gram growing states are Orissa, Maharashtra, Madhya Pradesh, Uttar Pradesh, Rajasthan and Bihar. Mung bean contains 51% carbohydrate, 24–26% protein, 4% mineral, and 3% vitamins

## Materials and methods

A field experiment was conducted during summer (Zaid) season of 2015 at Research farm of the Department of Agroforestry, School of Forestry and Environment, SHIATS Allahabad, UP, India to study the effect of NPK level in combination with *Rhizobium* and PSB culture on growth and yield of greengram (*Vigna radiata* L. Wilczek) grown in the Subabul (*Leucaena leucocephala*) based agroforestry system. The soil of experimental field was sandy loam having medium to poor drainage, low in available nitrogen, medium in available phosphorus and fairly rich in available potassium with 7.5 Ph. Nine treatment combination consisting of on variety viz., HUM-16, Four level of inorganic fertilizer and including control (F1: 20-20-10, F2: 30-30-15, F3:40-40-20, F4: 50-50-25) and seed inoculation with *Rhizobium* (MOR-1) and Phosphorus solubilizing bacteria (PSB) were evaluated in Randomized block design. The result revealed that during summer season greengram cultivar of cv. HUM-16 performed best fertilized with T7 (30-30-15 kg NPK/ha) with dual seed inoculation of *Rhizobium* and PSB culture. This treatment combination was found more productive and economical, which was closely followed by the treatment combination of T4 (40-40-20 kg NPK/ha). The seeds of greengram were sown on 01 April 2015 in row

having a depth of 2-3 cm. Row to row distance was 30 cm. The thinning was done at 15 day after sowing (DAS) to maintain 10 cm between plant to plant distances in each row. The crop field was weeded at 20 and 30 DAS. Irrigation was done as per requirement. Harvesting was done when 90% of pods become brown to black in colour. Five plants from each plot were randomly selected to the study of plant height (cm), number of trifoliate leaves per plant and number of pods per plant.

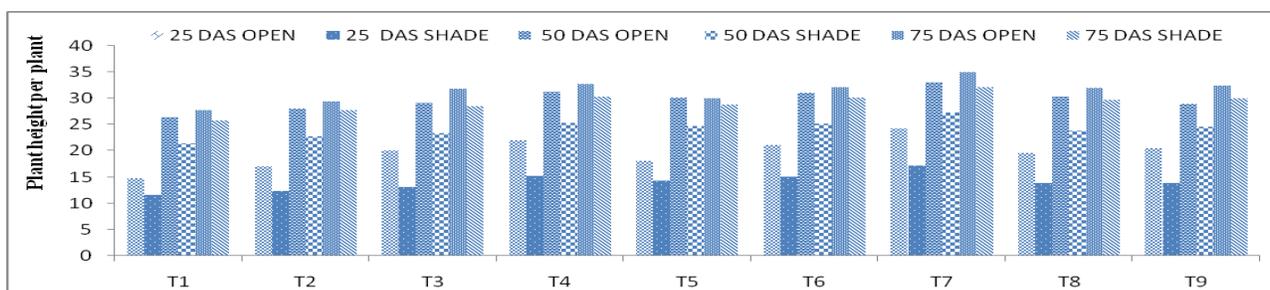
## Results and discussion

### Plant height (cm)

From the Table 1 and Fig.1, it was observed that the plant height (cm) was significantly influenced by different treatment combinations at different NPK levels with *Rhizobium* and PSB culture. At 25 DAS, it was observed that different treatment combination did significantly affect the plant height (cm). The maximum plant height (cm) was found in treatment T<sub>7</sub> (24.22 cm) followed by treatment T<sub>4</sub> (22.02cm) in open condition and minimum plant height was observed in T<sub>1</sub> (14.8cm). Maximum plant height under Subabul based agroforestry system is found in T<sub>7</sub> (17.24cm), followed by T<sub>4</sub> (15.33cm) and the minimum plant height was observed in T<sub>1</sub> (11.61cm).

**Table 1.** Effect of NPK level in combination with *Rhizobium* and PSB culture on plant height (cm) of greengram under Subabul based agroforestry system.

Treatment	Plant height (cm)					
	Shade condition			Open condition		
	25DAS	50DAS	75DAS	25DAS	50DAS	75DAS
T1	11.61	21.53	25.77	14.80	26.42	27.75
T2	12.42	22.86	27.80	17.08	28.16	29.44
T3	13.18	23.34	28.47	20.03	29.12	31.84
T4	15.33	25.33	30.38	22.02	31.24	32.73
T5	14.40	24.7	28.78	18.09	30.22	30.12
T6	15.07	25.18	30.13	21.14	31.07	32.09
T7	17.24	27.3	32.14	24.22	33.12	35.06
T8	13.90	23.87	29.71	19.64	30.36	31.97
T9	13.86	24.66	30.12	20.54	29.02	32.46
SEm±	0.27	0.25	0.47	0.46	0.32	0.38
CD (0.5%)	0.58	0.53	0.99	0.97	0.68	0.82



**Fig. 1:** Effect of NPK levels in combination with *Rhizobium* and PSB culture on plant height (cm) of greengram under Subabul based agroforestry system.

At 50 DAS, it was observed that different treatment combination significantly affect the plant height (cm). The maximum plant height (cm) was found in treatment T<sub>7</sub> (33.12 cm) followed by treatment T<sub>4</sub> (31.24cm) and minimum plant height was observed in T<sub>1</sub> (26.42 cm). Maximum plant height under Subabul based agroforestry system is found in T<sub>7</sub> (27.3cm), followed by T<sub>4</sub> (25.33cm) and the minimum plant height was observed in T<sub>1</sub>(21.53cm).

At 75 DAS, it was observed that different treatment combination significantly affect the plant height (cm). The maximum plant height (cm) was found in treatment T<sub>7</sub> (35.06cm) followed by treatment T<sub>4</sub> (32.73 cm) and minimum plant height was observed in T<sub>1</sub> (27.75cm). Maximum plant height under Subabul based Agroforestry system is found in T<sub>7</sub> (32.14cm), followed by T<sub>4</sub> (30.38cm) and the minimum plant height was observed in T<sub>1</sub> (25.77cm). Similar findings were reported by Hussain (2011 and 2012), Thakur and Panwar (1995) who reported an increase in plant height by seed inoculation and NPK application.

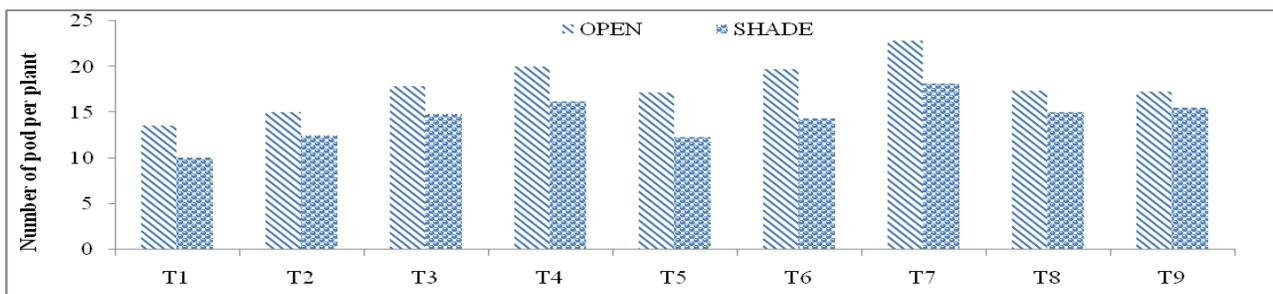
**Number of pods per plant**

From the Table 2 and Fig. 2, it was observed that the number of pods per plant was significantly influenced by different treatment combinations at different NPK level in combination with the *Rhizobium* and PSB culture.

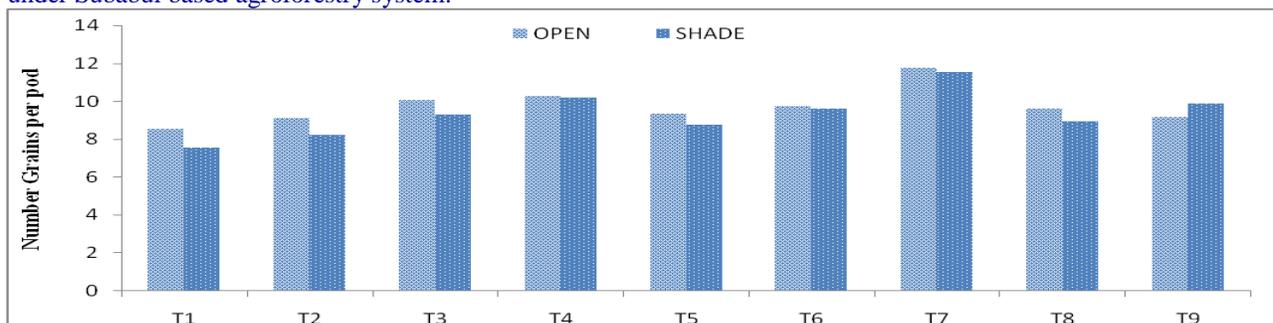
It was observed that different treatment combination significantly affect the number of pods per plant. The maximum number of pods per plant was found in treatment T<sub>7</sub> (22.87) followed by treatment T<sub>4</sub> (20.0) and minimum number of pods per plant was observed in T<sub>1</sub> (13.54). Maximum number of pods per plant under Subabul based Agroforestry system is found in T<sub>7</sub> (18.2), followed by T<sub>4</sub> (16.2) and the minimum number of pods per plant was observed in T<sub>1</sub> (10.07). Similar findings were reported by Malik et al. (1990 and 2002) and Ali et al. (2000).

**Table 2.** Effect of NPK levels in combination with *Rhizobium* and PSB culture on number of pods per plant of greengram under Subabul based agroforestry system.

Treatment	Number of pods per plant	
	Shade condition	Open condition
T1	10.07	13.54
T2	12.54	15.00
T3	14.87	17.87
T4	16.20	20.00
T5	12.27	17.14
T6	14.40	19.74
T7	18.20	22.87
T8	15.06	17.40
T9	15.54	17.27
SEm (±)	0.60	0.42
CD (0.5%)	1.28	0.88



**Fig. 2:** Effect of NPK level in combination with *Rhizobium* and PSB culture on number of pods per plant of greengram under Subabul based agroforestry system.



**Fig. 3:** Effect of NPK level in combination with *Rhizobium* and PSB culture on number of grains per pods of greengram under Subabul based agroforestry system.

## Number of grains per pod

From the Table 3 and Fig. 3 it was observed that the number of grains per pods plant was significantly influenced by different treatment combinations at different NPK level and combination with the *Rhizobium* and PSB culture. It was observed that different treatment combination significantly affect the number of grains per pods. The maximum number of grains per pods was found in treatment T<sub>7</sub> (11.76) followed by treatment T<sub>4</sub> (10.26) and minimum number of grains per pods was observed in T<sub>1</sub> (8.54).

**Table 3.** Effect of NPK level in combination with *Rhizobium* and PSB culture on number of grains per pods of greengram under Subabul based agroforestry system.

Treatment	Number of grains per plant	
	Shade condition	Open condition
T1	7.54	8.54
T2	8.20	9.13
T3	9.27	10.06
T4	10.20	10.26
T5	8.74	9.33
T6	9.60	9.73
T7	11.54	11.76
T8	8.94	9.60
T9	9.86	9.14
SEm (±)	0.23	0.42
CD (0.5%)	0.49	0.88

Maximum number of grains per pods under Subabul based Agroforestry system is found in T<sub>7</sub> (11.54), followed by T<sub>4</sub> (10.2) and the minimum number of grains per pods was observed in T<sub>1</sub> (7.54). Similar findings were reported by Vikram and Hamzehzarghani (2008) and Namvar et al. (2011).

## Conclusion

The present study concluded that the experimental observations obtained during the investigation, highlights that treatment T<sub>7</sub> (N30 P30 K15 + *Rhizobium* + PSB culture) emerged as the most superior over all the other NPK level with regard to its growth performance and yield attributes both in open condition and under Subabul

based agroforestry system. So this NPK level with *Rhizobium* and PSB culture of green gram is highly recommended for cultivation under Subabul based agroforestry system during Zaid season in Allahabad conditions of India.

## Conflict of interest statement

Authors declare that they have no conflict of interest.

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