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Application of different N, P, K, levels on growth and yield of green gram (*Vigna radiate* L.) under Jatropha (*Jatropha curcas*) based agroforestry system

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Abstract
A field experiment was conducted at the Forest Nursery, college of forestry, SHUATS, Allahabad, India during the *kharif* 2017-18 to evaluate the "application of different N, P, K levels on growth and yield of green gram (*Vigna radiata* L.) under jatropha (*Jatropha curcas*) based agroforestry system". The experiment consisted of 9 treatments *ie.,* 3 levels of nitrogen (50%,75% and 100%), 4 levels of Phosphorous (25%, 50%, 75% and 100%) and 4 levels of potassium (25%, 50%, 75% and 100%), laid out in Randomized Block Design and replicated thrice. The study revealed that the treatment T_1:100% Nitrogen + 100% Phosphorous + 100% potassium gave higher growth parameters *viz.,* plant height (46.42), number of primary branches (12.50), number of secondary branches (9.40), number of trifoliate leaves plant^{-1}(11.16) and number of root nodules plant^{-1} (14.46) and higher yield attributes *viz.,* number of pods plant^{-1} (14.76), number of grains pod^{-1} (10.80), grain yield(7.48 q ha^{-1}), stover yield (16.63 q ha^{-1}) and consequently, harvest index (45.30).

Keywords: green gram, jatropha, nitrogen, phosphorus, potassium, growth and yield

Introduction
Agroforestry is the combination of agriculture and silviculture in one system, where the species changes between perennials, annuals, for example green manure, coppicing, diverging crop rotation, mulching, contour hedgerows or alley cropping. Agroforestry systems may be thought of as principle parts of the farm system itself, which contains many other sub-systems that together define a way of life.

Jatropha curcas L. is a monoecious shrub or small tree of on average 3-5 and up to 8 m height, with a single main straight stem and multiple secondary branches with leaves arranged alternately on the stem. The crop belongs to the genus *Euphorbiaceae* and can be found in many tropical and subtropical regions. Jatropha can be cultivated as a single tree, in hedges, in intercropping with other crops, or as a monoculture.

Greengram (*Vigna radiata* L.) is one of the important food legumes in India. It is the third most important pulse crop of India. Greengram is a rich source of protein (24%) and also contributes carbohydrates (60%), fat (1.5%), amino acids, vitamins and minerals. Area under greengram in India is 3.80 million hectares with an annual production of 1.1 million tonnes. Among different plant nutrients nitrogen is the most important nutrient for plant growth and development. Nitrogen as chief constituents of plant nutrition plays an important role in synthesis of chlorophyll and amino acid. Insufficient nitrogen may reduce yield drastically and deteriorates the quality of produce specially protein content.

Phosphorus is one of the important elements among the three macronutrients that plants must require for the growth and development of root system. It has positive and significant effect on nodulation, also it enables the activity of rhizobia present in root nodules.

Potassium is important nutrient for plant growth and vital for sustaining modern high yield agriculture. Plant needs large quantities of potassium which not only improves the crop yield, but crop quality also (Navsare *et al.,* 2018) [4]. Keeping this in view, the present experiment was undertaken to study the application of different N, P, K levels on growth and yield of green gram (*Vigna radiata* L.) under jatropha (*Jatropha curcas)* based agroforestry system.

Materials and Methods
The field experiment was during the *karif* 2017-18 on green gram crop at conducted at Forest Nursery, college of Forestry, SHUATS, Allahabad (U.P), which is located at 25^{0}24 ̍ 41.27" N latitude, 81^{0}51' 3.42" E longitude and 98 m altitude above mean sea level. The soil of experimental field was sandy loam having *p*H of 7.9, with 0.69 % of organic carbon, available

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N 53 kg/ha, available P is 28.7 kg/ha, available K is 231.8 kg/ha phosphorus. The experiment consisted of 9 treatments *viz.,* (T1: 100%N+ 100%P+ 100%K; T2.:75%N+ 100%P+ 100%K; T3:50%N+ 100%P+ 100%K; T4:100%N+ 75%P+ 100%K; T5.100%N+50%P+ 100%K; T6: 100%N+ 25%P+ 100%K; T7.100%N+100%P+75%K; T8:100%N+ 100%P+ 50%K; T9:100%N+ 100%P+ 25%K), laid out in Randomized Block Design and replicated thrice. Phosphorus and Potassium was applied as basal in full dose while, nitrogen was applied half dose as a basal at the time of sowing and remain half was applied at the span of flowering. The seeds was sown with seed rate of 8- 10 kg/ha. The seeds were sown with depth 3 to 4 cm, with inter row spacing 15cm. Required plant population was maintained by thinning out at 20 DAS. Weeding, irrigation and pesticide application were done under requisite. The crop was matured in 65 days and was harvested 1st week of August. After harvesting, the data on yield attributes *viz.,* number of pods plant[-1], number of grains pod[-1], grain yield, Stover yield and harvest index statistically analyzed and critical difference were calculated.

Table 1: Effect of application of different N, P, K levels on growth attributes of green gram (*Vigna radiata* L.) under Jatropha (*Jatropha curcas*)

Treatments	Plant height (cm) 60 DAS	Number of primary branches	Number of secondary branches	Number of trifoliate leaves plant[-1]	Number of root nodules plant[-1]
T1: 100%N+ 100%P+ 100%K	46.42	12.50	9.40	11.16	14.46
T2: 75%N+ 100%P+ 100%K	43.46	11.20	8.66	10.26	13.26
T3: 50%N+ 100%P+ 100%K	40.70	10.23	8.30	9.36	13.70
T4: 100%N+ 75%P+ 100%K	45.20	11.86	8.96	10.67	12.70
T5:100%N+ 50%P+ 100%K	42.06	10.60	8.33	9.80	12.63
T6: 100%N+ 25%P+ 100%K	40.36	9.70	7.83	9.10	12.33
T7: 100%N+ 100%P+ 75%K	45.80	12.16	9.16	10.80	13.86
T8: 100%N+ 100%P+ 50%K	44.43	11.56	8.86	10.56	13.63
T9: 100%N+ 100%P+ 25%K	42.63	10.70	8.50	9.83	13.40
F test	S	S	S	S	S
SED (±)	0.32	0.07	0.07	0.08	0.12
CD (P=0.05)	6.68	0.16	0.15	0.17	0.26

*DAS – Days after Sowing; N – Nitrogen; P – Phosphorous; K – Potassium.
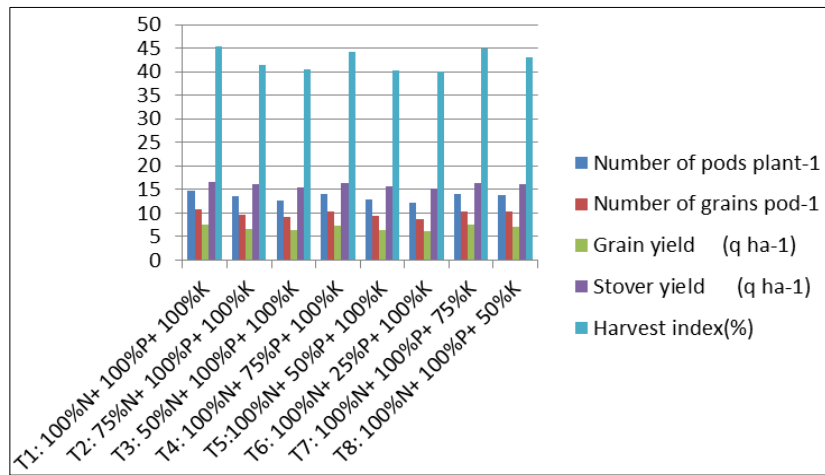
Table 2: Effect of application of different N, P, K levels on yield attributes of green gram (*Vigna radiata* L.) under Jatropha (*Jatropha curcas*).

Treatments	Number of pods plant[-1]	Number of grains pod[-1]	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
T1: 100%N+ 100%P+100%K	14.76	10.80	7.48	16.63	45.30
T2: 75%N+ 100%P+ 100%K	13.53	9.70	6.71	16.17	41.46
T3: 50%N+ 100%P+ 100%K	12.60	9.16	6.27	15.49	40.47
T4: 100%N+ 75%P+ 100%K	13.96	10.22	7.23	16.31	44.30
T5:100%N+ 50%P+ 100%K	12.80	9.33	6.48	15.74	40.30
T6: 100%N+ 25%P+ 100%K	12.20	8.60	6.13	15.27	40.13
T7: 100%N+ 100%P+ 75%K	14.13	10.26	7.46	16.46	45.00
T8: 100%N+ 100%P+ 50%K	13.73	10.43	6.98	16.20	43.06
T9: 100%N+ 100%P+ 25%K	13.16	9.50	6.52	15.82	41.17
F test	S	S	S	S	S
SED (±)	0.14	0.12	0.09	0.08	0.53
CD (P=0.05)	0.31	0.26	0.20	0.18	1.13

*N – Nitrogen; P – Phosphorous; K – Potassium.
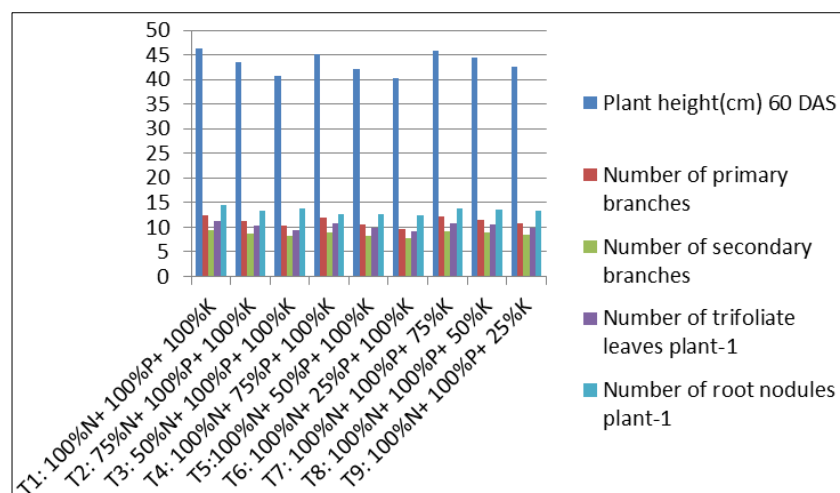
Fig 1: Effect of application of different N, P, K levels on growth attributes of green gram (*Vigna radiata* L.) under jatropha (*Jatropha curcas*).

Fig 2: Effect of application of different N, P, K levels on yield attributes of green gram (*Vigna radiata* L.) under jatropha (*Jatropha curcas*).

Results and Discussions

Growth attributes

Data pertaining to growth attributes are presented in Table 1, which revealed that the growth attributes like plant height (46.42 cm), Number of primary branches (12.50), Number of secondary branches (9.40), Number of trifoliate leaves plant^{-1} (11.16) and Number of root nodules plant^{-1} (14.46)) was recorded statistically significant with the treatment T_1: 100%N+ 100%P+ 100%K.These results are close conformity with (Malik *et al.,* 2003) [2]. Higher plant height, number of primary & secondary branches of green gram was increased due to optimum availability of nutrients as compared to treatment T_6: 100%N+ 25%P+ 100%K.

Yield attributes

As given in Table 2, the yield attributes *viz.,* number of pods plant^{-1}(14.76) and number of grains pod^{-1}(10.80) are significantly higher with the treatment T_1: 100%N+ 100%P+ 100%K. These results are very close with the findings of (Malik *et al.,* 2003) [2]. The grain yield (7.48q ha^{-1}), stover yield (16.63q ha^{-1}) and harvest index (45.30%) were also recorded higher under same treatment. Increasing yield attributes could be the requisite availability of essential nutrients, that directly effect on growth of crop, that ultimately diverted more energy under sink source relationship which helped in providing more yield. These results are corroborate with the findings of (Patel *et al.,* 2017).

Conclusion

From the above findings, it can be concluded that the treatment T_1: 100%N+ 100%P+ 100%K were recorded significantly higher growth and yield attributes of green gram. These findings are based on one-season, for best results it may need further trials.

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