Original Research Article

Effect of Fertilizers on nutrient uptake by the plant and grain of Green gram [*Vigna radiata* (L.) Wilczek] under Guava (*Psidium guajava* L.) based Agri-horti system in Vindhyan region of Eastern Uttar Pradesh

ABSTRACT

A field investigation was carried out in Factorial Randomized Block Design during kharif 2018 at agricultural farm, Rajiv Gandhi South Campus, Barkachha, Mirzapur (RGSC), Banaras Hindu University (U.P.) to explore the effect of fertilizer and biofertilizer on nutrient uptake by plant and grain of green gram (*V. radiata* L.) under guava (*P. guvajava* L.) based agri-horti system. The twelve year old guava orchard was established in August 2006 with spacing of 7m x 7m. Seven fertilizer combination *viz.*, control, Rhizobium culture, press mud, phosphorus solubilizing bacteria, Rhizobium culture + fertilizer, phosphorus solubilizing bacteria + fertilizer and press mud + fertilizer were applied. Among them application of press mud + fertilizer performed better by recording highest nitrogen content in grain (3.75), nitrogen content in grain (1.50), removal of nitrogen in grain (33.09) Removal of nitrogen in straw (33.03) and phosphorus content in grain (0.41) phosphorus content in straw (0.30), phosphorus uptake in grain (3.62), phosphorus uptake in straw (5.61), and found significantly superior to rest of the treatments.

Keywords – *Biofertilizer, Fertilizer, Green gram, Guava, Nutrient uptake*

INTRODUCTION

Given the demands of our nation's growing population, the production of pulses is extremely low and has become a challenging issue. In 1951, there were 69.9g of pulses available per person; this number dropped to 50g in 1971, 40g in 1982, and 27g in 2005. In comparison to the 85g per person per day that are needed for a balanced diet, pulse availability is currently extremely low. This production shortfall must be made up. It is now imperative to grow pulse crops on a larger scale and scientifically [1]. Green gram (*Vigna radiata* L.) is grown in tropical and subtropical areas of India as an important short duration pulse crop [2]. In many regions of the world when animal proteins are in short supply and expensive, pulses are consumed more frequently [3]. The green gram, also known as "Moong bean," has a protein content of 24.3%, is reasonably rich in carbohydrates, has a tiny amount of riboflavin and thiamine, and is also a good source of phosphorus and iron [1]. It also includes high-quality tryptophan (60 mg/g N) and lysine (4600 mg/g N), which are consumed as whole grains or in the form of Dal for eating. Mung bean is said to be easily digestive, which is why patients prefer it. Mung bean sprouted seeds are also a good source of ascorbic acid (Vitamin C) [4].

Guava intercropping is done not just to generate more revenue, but it also improves land utilisation through optimum production and protects soil health by reducing soil erosion [5]. Guava is one of many fruit trees that are perennial in nature and need few years' time to reach a commercial bearing stage. The farmers' income from the orchard area is quite meagre in this early, less productive stage. Intercropping has therefore been used with the primary goal of better utilising the soil resources available in the spaces between the fruit trees for generating additional revenue by cultivating additional crops [6]. The phosphorus requirements vary depending upon the nutrient content of the soil [7]. Phosphorus shortage restricts the plant growth and remains immature. Reduced leaf extension, darker green leaves with higher chlorophyll contents (often with red pigments from anthocyanins), and a higher root-to-shoot ratio are typical diagnostic features of phosphorus deficiency [8–9]. This is because root growth is much less impacted by phosphorus deficiency than shoot growth. Because legumes require a high phosphorus supply to nodulate, phosphorus deficiency can also significantly decrease biological nitrogen fixation [9]. In many agricultural soils, the availability of phosphorus is a restricting factor for plant growth [10]. Phosphorus deficiency is especially prevalent in those areas, where phosphorus fertilisers have never been used before [8]. Iron and aluminium oxides can fix a significant amount of applied fertiliser phosphorus, rendering it unavailable to plants [11]. These facts highlight the importance of sound phosphorus management, particularly in circumstances where funding for fertiliser purchases is constrained, such as in smallholder agriculture in tropical regions. Some of these obstacles can be solved with the intervention of agroforestry techniques [12]. However, significant applications of phosphorus fertilisers are required in permanent agriculture to ensure economic and ecological sustainability due to generally low phosphorus concentrations in mulch materials, low atmospheric inputs, and low release via mineral weathering [13].

MATERIALS AND METHODS

The experiment was carried out in kharif (rainy) season of 2018 at the agricultural Farm of Rajiv Gandhi South Campus, Banaras Hindu University ((BHU), Barkachha, Mirzapur, U.PThe experimental site, was situated at 25o 10' latitude, 82o 37' longitude, and 147 metres above mean sea level comes under Vindhyan region of Mirzapur, which included an area of more than 1000 acres of land. The Mirzapur district is bordered by the Varanasi district to the north and north-east, the Sonbhadra district to the south, and the Prayagraj district to the north-west. The north and west have completely asymmetrical shapes. Mirzapur falls in a region with a semiarid to sub humid climate. In this region, the monsoon season often begins during the third week of June and lasts until the end of September, or perhaps even into the first week of October. Between the months of December and mid-February, there are frequently winter rains. March to May, however, is typically dry. The majority (75%) of the yearly rainfall, on average, falls between June and September. The coldest and hottest months are January and May, respectively. The temperature begins to rise from the month of February and reaches its maximum in May.

The twelve year old guava orchard which was established in August, 2006 with the spacing of 7m × 7m. Experiment was laid on randomized block design (RBD) with three replications and seven repeat treatment combination consisted T_1 control, T_2 Rhizobium culture, T_3 Phosphorus solubilizing bacteria, T_4 Pressmud, T_5 NPK +Rhizobium culture, T_6 NPK+phosphorus solubilizing bacteria and T_7 NPK+pressmud. To reach a reliable conclusion, the investigation's observations were tabulated and statistically examined. According to Gomez and Gomez's (1976) description of the "Analysis of Variance" (ANOVA) standard methodology, the data were analyzed . The 'F' test was applied to assess the treatment's significance (Variance ratio). In each case, the standard error of the mean was calculated. Where necessary, appropriate diagrams were used to depict the results as they were thus acquired.

Critical difference in the treatment was used to test for differences in treatment means, and the following formula revealed significant differences (CD) at the 5% level of probability:

$$S.Em.\pm = \sqrt{\frac{\text{EMS}}{\text{n}}}$$

C.D. at 5% = SEm.± × $\sqrt{2}$ × t value at 5% of error (a) degree of freedom

RESULTS AND DISCUSSION

Among Guava based agri-horti system the application of press mud along with recommended dose of fertilizers showed significantly higher nitrogen content in grain and straw, removal of nitrogen in grain, phosphorus content in grain and straw, phosphorus uptake in grain and straw over the control (Table 1 and 2). It was indicated that applying press mud along with the recommended dose of fertiliser significantly boosted the bacterial and fungal populations in the soil. These populations play important roles in the breakdown of organic matter to release nutrients necessary for plant growth and development. Additionally, changes in soil organic matter content brought on by microbial enzymatic activities were evident in the greater C biomass and N levels in the soils treated with press mud.

Table 1. "Effect of fertilizer and biofertilizer on content (%) and removal (kg ha^{-1}) of nitrogen at harvest of green gram [*V. radiata* (L.) Wilczek] under guava (*P. gujava* L.) based Agri-horti system"

Treatment	Nitrogen content (%)		Nitrogen removal (kg ha^{-1})		Total (Grain + Straw removal of nitrogen (kg ha^{-1})
	Grain	Straw	Grain	Straw	
Control	2.50	1.00	11.26	13.11	24.37
Rhizobium culture	2.98	1.10	18.74	18.38	37.12
Phosphorus solubilizing bacteria	2.70	1.03	14.87	15.26	30.13
Press mud	3.20	1.20	19.39	18.96	38.35
Rhizobium culture + Required dose of fertilizer	3.60	1.40	25.86	25.86	52.04

Phosphorus solubilizing bacteria + Required dose of fertilizer	3.40	1.30	25.30	25.30	49.91
Press mud + Required dose of fertilizer	3.75	1.50	33.09	33.03	66.12
SEM±	0.01	0.01	0.17	0.33	
CD (0.05)	0.04	0.04	0.52	1.01	

Table 2. "Effect of fertilizer and biofertilizer on content (%) and removal (kg ha^{-1}) of phosphorus at harvest of green gram [*V. radiata* (L.) Wilczek] under guava (*P. gujava* L.) based Agri-horti system"

Treatment	Phosphorus content (%)		Phosphorus removal (kg ha^{-1})		Total (Grain + Straw removal of phosphorus (kg ha^{-1})
	Grain	Straw	Grain	Straw	
Control	0.20	0.14	0.90	1.83	2.73
Rhizobium culture	0.23	0.16	1.27	2.36	3.63
Phosphorus solubilizing bacteria	0.26	0.19	1.64	3.17	4.81
Press mud	0.29	0.22	1.76	3.48	5.24
Rhizobium culture + Required dose of fertilizer	0.31	0.24	2.31	4.54	6.85
Phosphorus solubilizing bacteria + Required dose of fertilizer	0.35	0.26	2.51	4.86	7.37
Press mud + Required dose of fertilizer	0.41	0.30	3.62	5.61	9.23
SEM±	0.01	0.01	0.04	0.08	
CD (0.05)	0.02	0.02	0.14	0.26	

The findings showed that when chemical sources of nutrients were given consistently, improved soil physical conditions were mirrored by a lower bulk density of soil. In order to increase soil fertility and improve its physical condition, it has been discovered that integrating organic sources is more efficient than applying them only once. Neutral soil organic carbon accumulation was measured in comparison to treatment press mud and the appropriate fertiliser dosage. With the application of phosphorus, press mud, and PSB either separately or in combination the availability of nutrients N, P, and K in soil was increased [14]. The application of 60 kg of phosphorus either alone or in conjunction with PSB and press mud enhanced the nutrient's availability. Balachandran et al. [15] and Mishra [16] both noted a considerable increase in the availability of nitrogen, phosphorus, and potassium relative to the control. This may be as a result of the application of phosphorus, which promoted root growth and established sound root systems. The application of phosphorus encourages nodulation and nodulation bacteria to fix more nitrogen from the atmosphere, increasing the amount of nitrogen in the soil as a result. When phosphorus was applied with Rhizobium and PSB inoculation alone or in combination over control over both years, the maximum nutrient availability was noticeably higher. The amount of phosphorus, or its proportion, in the soil during harvest is affected by phosphorus press mud and seed inoculation with PSB. Chemical fertilizer application, either alone or in combination with pressmud and PSB, enhanced all phosphorus factions (Fe-P, Al-P and ca-P). With the application of inorganic fertilizer and their combined use with press mud over the control, the amount recorded in Fe-P, Al-P, and Ca-P from increases significantly. According to

Prasad et al. [17], the application of press mud @5 t/ha considerably increases variance of faction (Fe-P, Al-P, Ca-P, and Total P) and the allocation of recommended inorganic phosphoric fertilizer greatly increases soil P-faction (Fe-P, Al-P, Ca-P, and Total P).

CONCLUSION

Based on the above finding, it is concluded that the application of press mud along with recommended dose of fertilizer (20:40:10 NPK) greatly increased the nitrogen and phosphorus contents in the grains and straw of green gram. However, maximum uptake of nutrient grain and straw were noted under application of press mud along with recommended dose of fertilizer under guava based agri-horti system in vindhyan region of Mirzapur.

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