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A STUDY ON THE PLANT NUTRIENT SYSTEM ON THE SOLUBILISATION OF THE PHOSPHORUS

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Abstract

During the 2019-20 rabies season at Botany Research Farm, College of Agriculture, Nagpur, the current investigation into the 'Impact of the Integrated Plant Nutrient System on Phosphorus Solubilization and Productivity of Wheat in Vertisols' was conducted. The results revealed that the use of ghanjivamrut @ 5 t ha-1 in combination with 50 percent RD of chemical fertilizers + bio-fertilizers for the incorporation of green manure is the appropriate nutrient source for maintaining the phosphorus nutrient available to the soil at the physiological growth stage and fertility status and also improves nutrient uptake and wheat yield. With the IPNS practice, the grain yield of wheat was 3.63, 4.52 and 14.40 percent higher than 100 percent RDF + GM, where 50 percent chemical fertilizers can be saved and solubility increased.

Keywords: *Azophos, Ghanjivamrut, INM, Jivamrut, Vermicompost, Wheat.*

I. INTRODUCTION

For total cereal production and global food security, wheat plays an important role. After rice, wheat is India's second most important crop and contributes nearly 35 percent to the national food basket. By 2020 A.D, India will need 109 million tons of wheat to feed the population of 1.25 billion, which can be accomplished with a growth rate of 2.2 percent, but just 1.0 percent of the current growth rate. The cultivation of wheat in India covers an area of 30.42 million hectares with a production of 99.87 million tonnes and a productivity of 32.83 q ha-1. India's wheat output is 99.87 million tons in 2017-18, which is 1.26 million tons higher than the production of 98.61 million tons achieved in 2016-17 [1]. India's wheat production is 99.87 million tons in 2017-18. It is very difficult to meet food demand in the future because land is shrinking and there is also growing pressure on productivity enhancement. There is a need to follow the notion of integrated nutrient management to curb this trend. For India's food and nutritional welfare, improving and sustaining soil quality for the enhancement and sustainability of agricultural production is of the utmost importance. The Integrated Plant

Nutrient System (IPNS) has become very important and plays a vital role in maintaining soil productivity.

Organic manures, however, particularly FYM, are significant components of integrated nutrient management. In many primary physiological processes, including photosynthesis, respiration, energy accumulation, cell division and cell enlargement, phosphorus plays a vital role. In addition, it is important for the formation of seeds and root development [2]. Phosphorus is the main nutrient-limiting plant growth, despite being abundant in soil in both organic and inorganic form, the P content in inorganic soil is around 0.5 percent (w/w), but due to its low solubility, availability and soil fixation, only 0.1 percent of the total P is available to plant. On an estimated 40 percent of the world's arable land, P limits the crop productivity factor. As bio-fertilizers, phosphate solubilizing bacteria (PSB) have been found to be efficient in solubilizing fixed soil P and applying phosphates, resulting in higher crop yields [3]. Appropriate nutrient management methods combined with organic resource technologies should therefore be practiced to demonstrate advancement in agriculture.

II. TESTING PLANT NUTRIENT SYSTEM

Botany Research Farm, College of Agriculture, Nagpur, conducted a field experiment entitled 'Impact of the integrated plant nutrient system on phosphorus solubilization and wheat productivity in Vertisols'. The soil of the experimental field was artificial in texture, slightly alkaline in reaction, medium in organic carbon, low in nitrogen available, medium in phosphorus available and high in potassium available [4]. The field experiment was performed in a randomized block configuration with seven treatments consisting of GM* + 100% RDF (T1), Ghanjivamrut 5 t ha-1 at incorporation of GM* + 50 percent RD of NP through inorganic fertilizer + jivamrut + Azophos (T2), Vermicompost 5 t ha-1at incorporation of GM* + 50 percent RD of NP through inorganic fertilizer + jivamrut + Azophos,(T3) Neem cake 2 t ha-1at incorporation of GM* + 50 percent RD of NP through inorganic fertilizer + jivamrut + Azophos,(T3) In which GM* means Sun hemp manuring green (Crotolaria juncea) [5].

After 30 days of sowing, Sunhemp was harvested and incorporated by tractor-drawn rotavetor into the field. The wheat seed was collected from the College of Agriculture's Agronomy Farm, Nagpur. To eliminate mistakes in seed germination, seeds were screened and freshly used for the experiment. The seeding of wheat (AKW-1071) was carried out by drilling at an experimental site on 15 November 2019. As per the treatment details, fertilizers and Ghanjivamrut (a combination of FYM and Jivamrut) were added. Nitrogen, phosphorus and potassium doses are applied via urea, DAP and MOP. Nitrogen was administered in two different doses, the first at the time of sowing and the second at 30 DAS. At the tillering and jointing stage of wheat, Jivamrut spraying @ 500 liters ha-1 was applied. Crop treatment with azophos (Azotobacter + PSB) biofertilizer @ 25 g kg-1 of seeds at the time of sowing. At physiological maturity, the wheat crop was harvested and yields (grain and straw) were reported. Using standard methodologies, grain and straw samples were analyzed for nutrient content.

III. EFFECT OF INTEGRATED PLANT NUTRIENT SYSTEM ON YIELD OF WHEAT (Q HA-1)

Grain yield of wheat (q ha-1):

Data on wheat grain yield as affected by different treatments are provided in Table 1. The result clearly showed that wheat grain yield was significantly affected by the use of green manure and the use of inorganic fertilizers in conjunction with organic manure and biofertilizers. With the application of Ghanjivamrut 5 t ha-1at incorporation of GM* + 50 percent RD of NP by inorganic fertilizer + jivamrut + Azophos, the highest grain yield of wheat (34.66 q ha-1) was obtained. It was found at par with 100 percent RDF + GM (33.40 q ha-1) and Vermicompost 5 t ha-1 when GM* + 50 percent RD of NP was integrated by inorganic fertilizer + jivamrut + Azophos [6]. It clearly indicates the decomposition of succulent green manure and well-decomposed ghanjivamrut, vermicompost that favoured better microbial activity functioning for greater nutrient release and continuous availability of primary, secondary and micronutrients in the soil to maintain higher wheat grain yield and inorganic fertilizer efficiency could also have been increased when applied. Ghanjivamrut 5 t ha-1 application with the incorporation of GM* + 50 percent RD of NP by inorganic fertilizer + jivamrut + Azophos (T2) achieved significantly higher wheat grain yields [7]. About 100% RDF + GM, which was 3.63, 4.52 and 14.40 percent higher. Vermicompost 5 t ha-1at GM* + 50 percent RD of NP incorporation by inorganic fertilizer + jivamrut + Azophos and Neem cake 2 t ha-1at GM* + Jivamrut + Azophos incorporation. At the tillering and jointing stage of wheat, Jivamrut spraying, i.e. 500 liters ha-1 was applied. Similarly, with the application of Ghanjivamrut 5 t ha-1at incorporation of GM* + 50 percent RD of NP by inorganic fertilizer + jivamrut + Azophos and Neem cake 2 t ha-1at incorporation of GM* + 50 percent RD of NP by inorganic fertilizer + Jivamrut + Azophos, respectively over treatment T2, the grain yield of wheat was decreased by 43.47, 37.97 and 44.49 percent. Singh et al. (2018) reported that with the application of 100% RDF + 2 t ha-1 vermicompost + PSB, wheat grain yield (48.45 q ha-1) and straw yield (62.82 q ha-1) were reported [8].

Organic acid decomposition during green manure and organic materials, which not only dissolves phosphate, but also reduces P fixation and increases the availability of native elements for crops, which depends on soil fertility status and management practices [9]. Increase in grain yield with organic manure and organic liquid spray due to overall plant growth as a portion of nutrient activity and absorption related to plant growth.

Table 1: Grain and straw yield of wheat (q ha-1) as influenced by integrated plant nutrient system

Treatment	Particulars	Yield ($q\ ha^{-1}$)	
		Grain	Straw
T_1	GM*+100%RDF	33.40	43.66
T_2	Ghanjivamrut 5 t ha^{-1}at incorporation of GM* + 50% RD of NP through inorganic fertilizer + jivamrut + Azophos	34.66	43.95
T_3	Vermicompost 5 t ha^{-1}at incorporation of GM* + 50% RD of NP through inorganic fertilizer + jivamrut + Azophos	33.09	42.68
T_4	Neem cake 2 t ha^{-1}at incorporation of GM* + 50% RD of NP through inorganic fertilizer + Jivamrut + Azophos	29.67	38.42
T_5	Ghanjivamrut 5 t ha^{-1}at incorporation of GM*	19.59	26.41
T_6	Vermicompost 5 t ha^{-1}at incorporation of GM* + Jivamrut + Azophos	21.50	28.23
T_7	Neem cake 2 t ha^{-1}at incorporation of GM* + Jivamrut + Azophos	19.24	24.18
	SE(m) ±	1.18	1.30
	CD at 5%	3.58	3.90

Changes in available phosphorus of soil (kg ha-1) during physiological growth stages of wheat influenced by integrated plant nutrient system:

Straw yield of wheat (q ha-1):

An evaluation of the data in table 1 showed that wheat straw yield was significantly affected by different treatments. Ghanjivamrut 5 t ha-1 at incorporation of GM* + 50 percent RD of NP by inorganic fertilizer + jivamrut + Azophos (T2) gave the highest straw yield (43.95 q ha-1) among the integrated plant nutrient system application, which was significantly higher than all other treatments except T1: GM*+100 percent RDF (43.66 q ha-1), which is at par with T2. The addition of ghanjivamrut with various amounts of fertilizer resulted in a higher straw yield than other treatments. The increase in grain and straw yield may be attributed to a sufficient and balanced proportion of plant nutrients supplied to crops during the growth cycle, resulting in a favorable increase in grain and straw yield.

Significant improvements have been found in the available soil phosphorus at the tillering and flowering stages of wheat. With application of vermicompost 5 t ha-1 at incorporation of green manure + 50 percent RD of NP through inorganic fertilizer + jivamrut + azophos, the significantly highest available P in soil (17.42 kg ha-1) at tillering and (19.01 kg ha-1) at flowering stage of wheat was recorded [9]. This may be attributed to the gradual release of phosphorus and the maintenance at the latter stage of the crop of a higher volume of P in the soil. The substantial release of available P due to the combined application of inorganic fertilizer and organic inputs clearly demonstrates that the integrated management of plant nutrients has a beneficial effect on the improvement of available in the soil during different stages of wheat development.

Table 2: Changes in available phosphorus of soil at tillering and flowering stage of wheat as influenced by integrated plant nutrient system

Treatment	Particulars	Available P (kg ha^{-1})	
		At Tillering	At Flowering
T_1	GM* + 100% RDF	16.85	17.99
T_2	Ghanjivamrut 5 t ha^{-1}at incorporation of GM* + 50% RD of NP through inorganic fertilizer + jivamrut + Azophos	17.40	18.30
T_3	Vermicompost 5 t ha^{-1}at incorporation of GM* + 50% RD of NP through inorganic fertilizer + jivamrut + Azophos	17.42	19.01
T_4	Neem cake 2 t ha^{-1}at incorporation of GM* + 50% RD of NP through inorganic fertilizer + Jivamrut + Azophos	16.81	17.93
T_5	Ghanjivamrut 5 t ha^{-1}at incorporation of GM*	16.15	17.53
T_6	Vermicompost 5 t ha^{-1}at incorporation of GM* + Jivamrut + Azophos	16.54	17.71
T_7	Neem cake 2 t ha^{-1}at incorporation of GM* + Jivamrut + Azophos	16.18	17.44
	SE (m) ±	0.27	0.16
	CD at 5%	0.84	0.51

IV. CONCLUSION

It can be concluded from the current study that the use of Ghanjivamrut @ 5 t ha-1 in combination with 50 percent RD of chemical fertilizers + biofertilizers for the incorporation of green manure is the appropriate nutrient source for maintaining the phosphorus nutrient available to the soil at physiological growth stage and fertility status. With the practice of IPNS, it also increases the absorption of nutrients and wheat yield, where 50 percent of chemical fertilizers can be saved and solubility increased.

V. REFERENCES

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