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BIOTECHNOLOGICAL APPLICATION OF BIOFERTILIZER FOR PROBLEM PADDY SOIL AND CROP PRODUCTIVITY

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ABSTRACT

Fertilizers pose a number of health risks despite the fact that they are necessary for plants to utilize as a source of supplemental nutrients and that they are composed mostly of nitrogen (N), potassium (K), and phosphorous (P). Researchers have discovered that "bio fertilizer & quot; is an ideal alternative to chemical fertilizers. These fertilizers offer nutrients via the process of nitrogen fixation, solubilize phosphorus, and activate plant development through the manufacture of growth boosting essence. "Bio fertilizer & quot; is a fantastic alternative to chemical fertilizers, and researchers have found that it is an outstanding alternative. The study analyzes these constantly available and environmentally friendly nutrients, kinds, and their potential for crop development based on previous research and related literature that was conducted by a large number of researchers.

Keywords: *bio fertilizer, paddy soil.*

INTRODUCTION

These prospective biological fertilizers would play a vital role in the productivity and sustainability of soil in addition to protecting the environment by providing environmentally friendly and cost efficient inputs for farmers. According to Raja (2013), organic farming is one of these ways that not only assures the safety of food but also contributes to the biodiversity of soil. The use of bio-fertilizer on soil results in an increase in its biodiversity, which includes many different types of beneficial bacteria and fungus. These organisms include carbuncular mycorrhiza fungi (AMF), also known as plant growth promoting rhizobacteria (PGPR), and nitrogen fixers. There are a great number of different kinds of microorganisms that may be found growing in the soil, particularly in the rhizosphere of plants. A significant number of these microorganisms have a functional link with plants and together they make up a holistic system. They contribute to the overall health and well-being of the plant (Vessey, 2003). It has been around sixty years since the use of helpful microorganisms in agricultural techniques. It is now obvious that these beneficial microbes may also boost plant tolerance to unfavorable environmental conditions such as a lack of water and nutrients as well as heavy metal pollution.

According to Sinha et al. (2014), bio-fertilizers maintain a soil environment that is rich in all types of macro and micro nutrients via a variety of processes, including the fixation of nitrogen, the solubilization or mineralization of phosphorus and potassium, the release of plant growth-regulating chemicals, the synthesis of antibiotics, and the biodegradation of organic materials in the soil. When applied as seed or soil inoculants, biofertilizers proliferate, take part in nutrient cycling, and ultimately increase crop output. In most cases, only 10–40% of the entire fertilizer that is given to plants is absorbed by the plants, while the remaining 60–90% is wasted. According to Adesemoye and Kloepper (2009), bio-fertilizers have the potential to play an essential role in the integrated nutrient management systems that are necessary for maintaining agricultural production as well as a healthy environment. According to Vesey (2003), bio-fertilizers are products that include live cells of a variety of different microorganisms. These microorganisms have the potential to transform nutritionally necessary substances from an unavailable to an accessible form via the use of biological processes. The purpose of this review is to x-ray the role that biofertilizers play in sustainable agriculture in order to satisfy the needs of agriculturists and plant biologists whose work focuses on developing clean and efficient means of improving soil quality by nourishing and maintaining the beneficial and natural flora of microorganisms. This review will also meet the needs of those who are interested in sustainable agriculture. In addition to this, it discusses contemporary advancements in the area of agricultural management, which highlight the potentials of the use of bio-fertilizers in terms of higher plant growth and production, as well as a better tolerance to environmental stress.

They are the most cost-effective source of plant nutrients, as well as highly major providers of micronutrients and organic matter, secretors of growth hormones, and contributors to mitigating the adverse effects of the use of artificial fertilizers. The Food and Agricultural Development report states that agriculture provides a viable source of income for 55 percent of the population in Africa (Ref). Agriculture is the primary means of subsistence for people in the majority of locations in Nigeria, particularly in the rural areas, and people are completely reliant on farmers for their food supply (Ifokwe, 1988). As a result of the recent decline in the price of crude oil, which is currently Nigeria's primary source of income, the President of Nigeria, Muhammadu Buhari GCFR, has emphasized that the nation must return to agriculture, particularly crop farming, which was the country's source of income prior to the discovery of crude oil (Daily Trust; September 9th, 2016). This was the source of income for the country before the discovery of crude oil. In order to provide food for Nigeria's bustling population, which the Nigerian population census from 2006 estimates will reach 221 million by the year 2020, there is a need for very rich soils as well as for the cultivation of crops in a manner that does not deplete natural resources. According to Khosro and Yousef (2012), the lack of fertility in the soil is the most significant factor that reduces agricultural output in underdeveloped countries across the globe, particularly among farmers who have limited access to resources. Therefore, preserving the quality of the soil may help alleviate the issues of land degradation, falling soil fertility, and fast falling output levels in huge portions of the globe that need the fundamental principles of sound agricultural management. According to Mfilinge et al. (2014), poor crop yield is a widespread issue that affects the majority of agricultural systems in Sub-Saharan Africa (SSA).These poor yields are especially noticeable in legumes and are often connected to a decrease in the fertility of the soil and a diminished capacity for nitrogen fixation as a result of both biological and environmental variables. One of the possible solutions is known as biological nitrogen fixation (BNF), which is also known as a vital source of nitrogen for farmers who use minimal fertilizer. Biological nitrogen fixation is also known as a critical role in the sustainable production of legumes and even non-legume crops. Because of a rise in population, one area of land has been continuously farmed over the years, which has led to a loss in the fertility of the soil to the point that, despite the use of chemical and inorganic fertilizer, very little is gained in return.

WHAT IS BIO-FERTILIZER?

A bio-fertilizer is simply a material that includes live microorganisms. When this substance is applied to the soil, a seed or the surface of a plant, it colonizes the rhizosphere and stimulates the development of the host plant by increasing the supply or availability of nutrients. According to Swathi a bio-fertilizer is an updated version of organic fertilizer that contains helpful microorganisms already present in the product. According to Hari & Perumal bio-fertilizer is most often understood to refer to specific strains of beneficial soil microorganisms that have been grown in the laboratory and packaged in appropriate carriers. According to Khosro and Youseff the word "bio-fertilizer" may be used in a broad sense to refer to any and all organic resources for plant development that are made accessible in a form that can be absorbed by the plant via the activities of microbes or plant associations or interactions.

OBJECTIVES

1. To the study of use of bio-fertilizer on soil results in an increase in its biodiversity.

2. To the study of release of plant growth-regulating chemicals.

RESEARCH METHODOLOGY

The present investigation was undertaken to study the “Effect of paddy residue management on soil fertility and crop productivity for sustainable nutrient management in paddy - paddy cropping system”. The details of the materials used and methods adopted are described in this chapter.

Site description

The field experiments were conducted in progressive farmer field at Gabbur village during kharif and rabi-summer of 2019-2020 and 2020-2021 situated in the North Eastern Dry Zone (Zone 2) of Karnataka at 16° 18' N latitude 77° 06' E longitude with an altitude of 393 m above mean sea level and it is 30 km away from MARS, Raichur.

Soil characteristics of experimental site

Initial composite soil sample was collected from experimental site at 0-15 cm depth and analyzed for its physical, chemical and biological properties. The procedure employed for analysis is given in Table 2 and the results are presented in Table 3.

Climatic data of experimental area

The monthly meteorological data for the period 2019-2020 and 2020-2021 was collected at meteorological observatory, Main Agricultural Research Station, University of Agricultural Sciences, Raichur and the data of last 2 years (2019-2021) on climatic parameters like rainfall, temperature and relative humidity are presented in Table 1 and depicted in Fig. 1 & 2.

Total annual rainfall of 678.1 mm and 1252.8 mm was received during 2019-20 and 2020-21, respectively. The cropping period was from August 2019 to April 2020 and August 2020 to April 2021 for paddy-paddy cropping sequence. An amount of 488.6, 19.0, 674.2- and 4.6-mm rainfall was received during crop growth period i.e., August to December in kharif 2019 and 2020, January to May in rabi-summer 2020 and 2021, respectively. During cropping period, the mean maximum temperature (32.8 °C - August‟19, 39.3 °C - April‟20, 31.0 °C -

October‟20 and 38.6 °C - April‟21) and mean minimum temperature (19.0 °C - December‟19, 19.2 °C - January‟20, 16.4 °C –

Table 1: Monthly meteorological data for the experimental years 2019-20, 2020-21and mean of the previous 40 years (1980-2019) obtained at Main Agricultural Research Station, Raichur

Month	Rainfall (mm)			Temperature (℃)				Relative humidity (%)			
				Maximum		Minimum		Maximum		Minimum	
	1980-2019	2019-20	2020-2021	2019-20	2020-2021	2019-20	2020-2021	2019-20	2020-21	2019-20	2020-2021
April	16.6	13.5	19.0	40.8	39.3	26.2	25.8	50.0	54.4	19.1	23.5
May	38.2	10.4	130.4	41.4	40.3	27.6	26.8	52.8	64.5	18.6	26.9
June	97.1	67.0	128.0	37.3	34.8	25.2	24.7	75.1	84.8	37.8	46.2
July	109.2	79.6	296.6	34.0	32.0	24.1	23.4	81.8	90.5	47.3	61.4
August	127.7	46.0	164.4	32.8	30.3	23.7	23.2	83.8	91.7	47.5	67.4
September	152.7	312.2	317.6	31.7	30.7	23.1	23.3	89.1	92.1	59.1	68.6
October	103.2	130.4	179.6	30.6	31.0	22.8	22.5	91.3	92.6	64.0	63.9
November	18.6	0.0	12.6	31.1	30.3	20.8	19.2	85.9	85.7	50.2	50.4
December	4.9	0.0	0.0	29.8	29.9	19.0	16.4	83.1	83.5	47.2	38.7
January	3.1	0.0	1.2	31.6	30.8	19.2	18.4	78.5	84.1	37.3	37.9
February	2.6	0.0	0.0	33.2	31.8	20.1	18.1	70.1	70.4	28.9	26.8
March	9.9	0.0	0.6	36.4	36.7	23.8	21.9	58.0	55.4	25.6	17.8
April	16.5	19.0	2.8	39.3	38.6	25.8	24.9	54.4	56.2	23.5	22.4
Total	700.3	678.1	1252.8	-	-	-	-	-	-	-	-

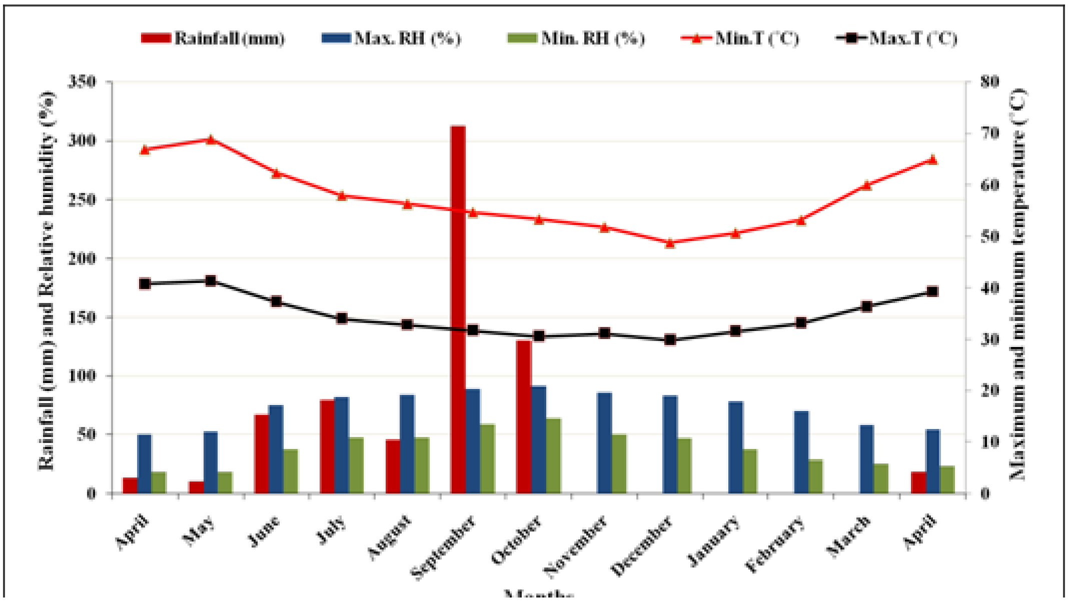

Fig. 1: Monthly meteorological data for the year 2019-20

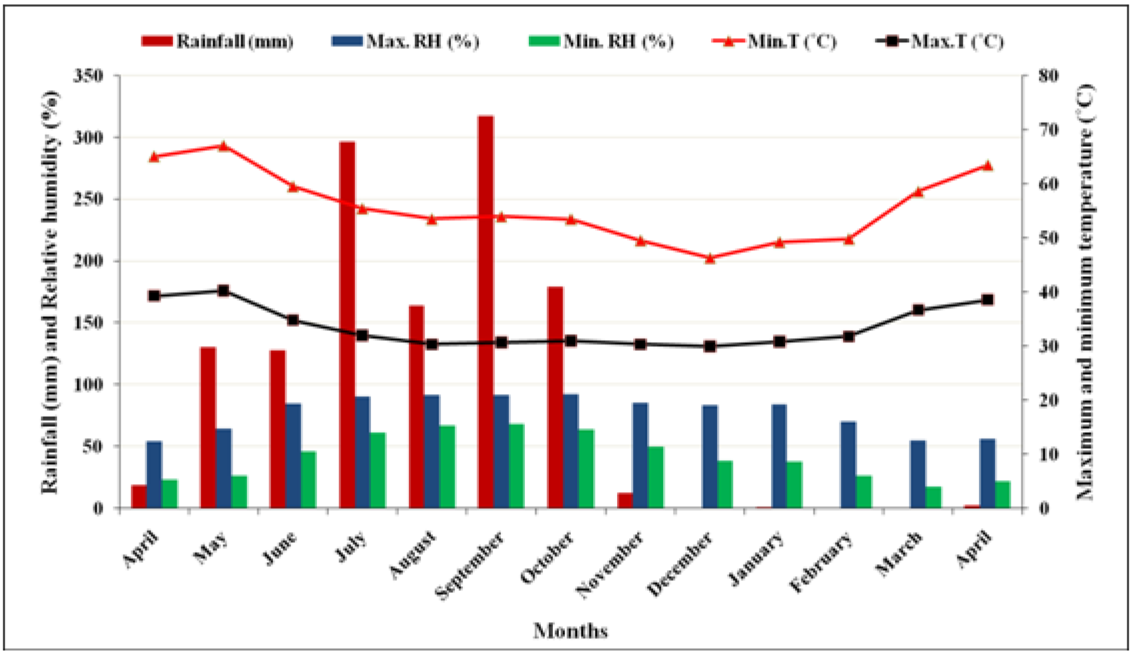

Fig. 2: Monthly meteorological data for the year 2020-21

December"20 and 18.1 °C - February"21) were recorded during kharif 2019, rabi-summer 2019-2020, kharif 2020 and rabi-summer 2019-2020, respectively. The average maximum monthly relative humidity was ranged from 50.0 to 91.3 per cent and 54.4 to 92.6 per cent during 2019-20 and 2020-21, respectively. While the minimum monthly relative humidity was ranged from 18.6 to 64.0 per cent and 17.8 to 68.6 per cent during 2019-20 and 2020-21, respectively

Cropping history

The experimental site selected for the study area was under transplanted paddy - paddy cropping system in previous years.

RESULTS AND DISCUSSION

EFFECT OF RESIDUE AND NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF PADDY

Tables 9 through 20 provide information about the development and production of paddy, respectively. In both the kharif and the rabi-summer studies, there was a small but noticeable change in crop growth, yield, and yield characteristics; nevertheless, the pattern of response was quite similar. Because of this, the chapter solely makes use of the combined data from the two years in order to highlight the findings.

Growth parameters of paddy

Present the growth parameters of paddy, including plant height (cm), leaf area (cm2 hill-1), number of tillers hill-1, and total dry matter production (g hill-1), as influenced by various residue and nutrient management options across the growth stages during both kharif and rabi-summer.

Plant height (cm)

The management of paddy's residue and nutrients had a major impact on the plant height at a variety of development phases, and the results of that analysis are shown below.

Kharif (cf. Table 9)

A considerable variance in plant height was discovered throughout the several development phases of paddy, and it was shown to be related to the management of residue and nutrients in various ways. Regardless of the treatments, the plant height measured 41.26, 72.59, 82.90, and 84.40 cm at 30, 60, and 90 days after transplanting (DAT), respectively, was considerably greater when residue incorporation was combined with compost culture (M3).

On the other hand, residue removal (M1) resulted in a lower value of 37.60, 67.75, 76.42 and 77.98 cm at 30, 60, 90 DAT and at harvest, respectively; this value was comparable to that of residue burning (M4: 38.04, 68.03, 76.87 and 78.42 cm, respectively).

Table 2: Plant height as a function of kharif residue and fertilizer management at different phases of paddy development

				Plant heig			ht (cm)					
Treatment	30 DAT			60 DAT			90 DAT			At harvest		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled

Residue management (M)

M1: Residue removal	37.55	37.64	37.60	67.66	67.83	67.75	76.31	76.53	76.42	77.86	78.10	77.98
M2: Residue incorporation (RI)	39.25	39.94	39.59	69.60	70.82	70.21	79.00	80.47	79.74	80.28	81.80	81.04
M3: RI + Compost culture	40.64	41.88	41.26	71.56	73.62	72.59	81.79	84.01	82.90	83.31	85.50	84.40
M4: Residue burning	37.99	38.10	38.04	67.87	68.18	68.03	76.70	77.05	76.87	78.16	78.69	78.42
S.Em.±	0.24	0.23	0.23	0.35	0.32	0.30	0.41	0.59	0.34	0.49	0.64	0.40
C.D. at 5%	0.82	0.81	0.79	1.21	1.12	1.04	1.43	2.03	1.17	1.69	2.20	1.40

Table 3: Plant height at different growth stages of paddy as influenced by residue and nutrient management during kharif

				Plant heig			ht (cm)					
Treatment	30 DAT			60 DAT			90 DAT			At harvest		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled

CONCLUSION

The present investigation entitled "Effect of paddy residue management on soil fertility and crop productivity for sustainable nutrient management in paddy - paddy cropping system" was carried out in progressive farmer field of Gabbur village, Tq: Devadurga, Dist: Raichur, during kharif and rabi-summer of 2019-2020 and 2020-2021. The field experiment consisted of four levels of residue managements in the main plots and five levels of nutrient management approaches in the sub plots. The experiments were conducted to identify the suitable residue and nutrient management options for enhancing production potentials of paddy, to monitor selected soil properties, nutrient status & its balance, uptake pattern & use efficiencies of different nutrients and profitability in paddy - paddy cropping system. The salient findings of this study are summarized here.

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