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Impact of Soil Parameters and Microbial Communities on Bael (*Aegle marmelos*) cv. NB-9 under Subtropical Conditions

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ABSTRACT

The present investigation entitled**"Impact of Soil Parameters and Microbial Communities on Bael (*Aegle marmelos*) cv. NB-9 under Subtropical Conditions"**was carried out during the year 2022-2024 at Main Experimental Station, Department of Fruit Science, College of Horticulture & Forestry, A.N.D.U.A.&T., Narendra Nagar (Kumarganj), Ayodhya, Uttar Pradesh, India (Lat 26.540849° Long 81.830421°). Application of various bio-formulations and boric acid with eco-friendly materials to study the differentsoilproperties-soil pH, electrical conductivity,organic carbon, available nitrogen, available phosphorus, available potassiumand microbial population i.e., bacteria, fungus and actinomycetesand effect on the vegetative growth of fruit. The experiment was laid down in randomized block design (RBD) with (12) treatments and (03) replications.The experiment consists of 12 treatments including control, T_1 (Control), T_2 (FYM 50 Kg), T_3 (FYM 100 Kg), T_4 (Boric acid 200g), T_5 (Boric acid 400g), T_6 (Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]), T_7(FYM 50Kg + Boric acid 200g), T_8 (FYM 50Kg + Boric acid 400g), T_9 (FYM 50Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]), T_{10} (FYM 100Kg + Boric acid 200g), T_{11} (FYM 100Kg + Boric acid 400g) and T_{12} (FYM 100Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]) was used for this study. The results revealed that treatment T_7 and T_{12} outperformed the rest with minimum soil pH (8.01),electrical conductivity (0.40 dSm^{-1}), fungal population (2.91 10^5cfu g^{-1}) and maximum organic carbon (0.60 %),available nitrogen (272.14 kg/ha), available phosphorus (19.68 kg/ha), available potassium (360.17 kg/ha),bacterial population (8.05 10^6cfu g^{-1}), actinomyctes population (7.29 10^5cfu g^{-1}),was most effective froma vegetative growth point of view. Thus, the treatment combination $T_7$and T_{12} is recommended for application to Bael trees in subtropical conditions to obtain good physical and chemical characteristics with better quality fruits.

Keywords: Available NPK, Azotobacter, Bael, Biofertilizer, Boric acid, PSB, Subtropical conditions.

1. INTRODUCTION

Bael is a well-known plant in the Rutaceae family, technically known as *Aegle marmelos* (L.) Correa. Originally from the Eastern Ghats and Central India, this fruit-bearing tree-also called the Bengal quince-is prized for its therapeutic and nutritional qualities. It is commonly grown at elevations of up to 1200 meters in tropical and subtropical countries (Singh et. al., 2014). Bael trees are exceptionally resilient and can endure hot, dry weather with little maintenance. There are several nations where this tree can be found, such as the Philippines, Cambodia, Malaysia, Java, Egypt, Surinam, Trinidad, and Florida. Previous studies (Nagar et. al., 2017) have indicated that it is also common in India, Sri Lanka, Thailand, Pakistan, Bangladesh, Myanmar, and Vietnam.

The Bael tree has thorny branches and can reach a maximum height of 762 cm. The leaves are made up of three leaflets on average, though they can occasionally have up to five leaflets organized in an alternating pattern. According to Bhar et. al., the leaflets are roughly 4-10 cm long and 2-5 cm wide (2019). The colour of the bael blossom is greenish-white. This plant is well-known for its actinomorphic, bisexual, ebracteate, and hypogynous forms in addition to its nice scent. Research by Sharma et. al. (2007) and Patel et. al. (2012) indicates that ten-flower lateral panicles are held in place by the leaf axil. The bael fruit has a diameter of 5.3-7.2 cm and is usually coloured yellowish green. Its capacity is 73.7 ml and its weight ranges from 1 to 2 kg on average. The sphericity of the fruit is $93.72 \pm 2.78\%$, as reported by Sonawane et. al. (2020). The pulp of the fruit has a gelatinous texture and a yellow colour. This object's exterior is covered in many hard seeds that are scattered throughout. The outer surface of these seeds has white thread-like hairs, as reported by Sonawane et. al. (2020) and Patel et. al. (2012).

Bael is highly valued for its hardiness and capacity to provide copious amounts of fruit even in difficult soil conditions. As such, it has become an essential component of traditional medicine, especially in Ayurvedic traditions. Originating in the Indian subcontinent, it is widely valued for both its religious importance and its many health advantages. Bael fruit is incredibly nutrient-dense, with a host of health benefits and a composition that includes minerals, vitamins, fibre, fatty acids, amino acids, and different organic acids (Bhardwaj, 2014). It is also a great source for extracting therapeutic chemicals and other economically significant herbal components, according to the WHO (2005). Particularly renowned for its remarkable fruit quality and subtropical climatic adaptability is the cultivar NB-9. These cause growers to suffer significant financial losses and interfere with the supply of this priceless commodity. These problems are caused by a number of variables, such as nutritional imbalances, physiological conditions, and environmental stressors; therefore, managing them is an intricate and important undertaking.

Maintaining soil organic carbon (SOC) is crucial for the efficient cycling of plant nutrients and enhancing the physical, chemical, and biological characteristics of soils, particularly in subtropical regions such as Ayodhya. In this context, the use of farm-yard manure (FYM) can significantly contribute to the long-term sustainability of soil fertility and crop production [Meena et. al. (2018)]. FYM is a widely used and essential organic manure in the field of agriculture. The composition includes 0.5% nitrogen, 0.2% phosphorus pentoxide, and 0.5% potassium oxide. Utilizing organic manuring (FYM) is crucial for maintaining soil fertility and promoting sustainable crop production. FYM not only supplies essential nutrients to plants but also enhances soil structure by influencing soil aggregates. In supplement to their impact on soil properties, they can reduce electrical conductivity and increase water-holding capacity and phosphate availability in the soil. Furthermore, they contribute to improved fertilizer use efficiency, enhanced microbial activity, and increased soil porosity [Yawalkar et. al. (2002)].

Considering a specific focus on the Bael cultivar NB-9, this study aims to assess the efficacy of these techniques in subtropical climes. The goal is to provide insightful information on sustainable farming methods that can improve the quality of bael, improve farmers' livelihoods, and guarantee the availability of this nutrient-rich fruit. The research endeavours to provide inventive and environmentally sustainable answers to these problems by thoroughly examining experimental data and observations. The ultimate goal of this research is to create a Bael cultivation method that is more durable and fruitful.

2. MATERIALS AND METHODS

The present investigation was carried out at the Main Experiment Station, Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the years 2022-2024. The experiment was laid out in randomized block design with 12 Treatment, namely: T_1 (Control), T_2 (FYM 50 Kg), T_3 (FYM 100 Kg), T_4 (Boric acid 200g), T_5 (Boric acid 400g), T_6 (Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]), T_7(FYM 50Kg + Boric acid 200g), T_8 (FYM 50Kg + Boric acid 400g), T_9 (FYM 50Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]), T_{10} (FYM 100Kg + Boric acid 200g), T_{11} (FYM 100Kg + Boric acid 400g) and T_{12} (FYM 100Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]). Three replications of the experiment were conducted. Ayodhya district has a semi-arid climate with three different seasons: summer, which is hot, winter, and rainy or wet season. The area experiences 1200 mm of rain on average per year, with the wet season starting the last week of June and lasting until September or occasionally October. The average pH of the sandy loam soil in the region is 7.71. There are 22.76% silt, 14.95% clay, and 64.77% fine sand in the soil. Sixteen-year-old plants were employed in the experiment. The Bael plantation followed its schedule for routine cultural operations, plant protection measures, and basal application of manures and fertilizers.Soil parameters such as soil pH, Electrical Conductivity (dS/m), Organic carbon (%), Available Nitrogen (Kg/ha), Available Phosphorus (Kg/ha), Available Potassium (Kg/ha) and Microbial population (cfu per g) (bacteria, fungus and actinomycetes) were measured and recorded. Following Panse and Sukhatme's (1985) methodology, statistical analysis was performed on the experiment's data.

3. RESULT AND DISCUSSION

3.1 Effect of Bio-formulations and Boric Acid on Soil Parameter of Bael

3.1.1 Soil pH

The data significantly presented in **Table 1 and Graph 1** revealed thatthe treatment T_7 [FYM 50Kg + Boric acid 200g] recorded thetreatment T_7 [FYM 50Kg + Boric acid 200g], T_{10} [FYM 100Kg + Boric acid 200g] and T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] recorded the minimum soil pH [8.00 (2022-23), 8.01 (2023-24) and

8.01 (Pooled)] over all other treatments during both the years of study as well as pooled analysis. The 2nd best treatment combination was found to be treatment T_{11} [FYM 100Kg + Boric acid 400g] with [8.03 (2022-23), 8.05 (2023-24) and 8.04 (Pooled)] soil pH. The highest soil pH i.e., [8.13 (2022-23), 8.15 (2023-24) and 8.14 (Pooled)] was recorded in T_1 [Control] during both the years of study as well as pooled analysis.

3.1.2 Electrical Conductivity (dS/m)

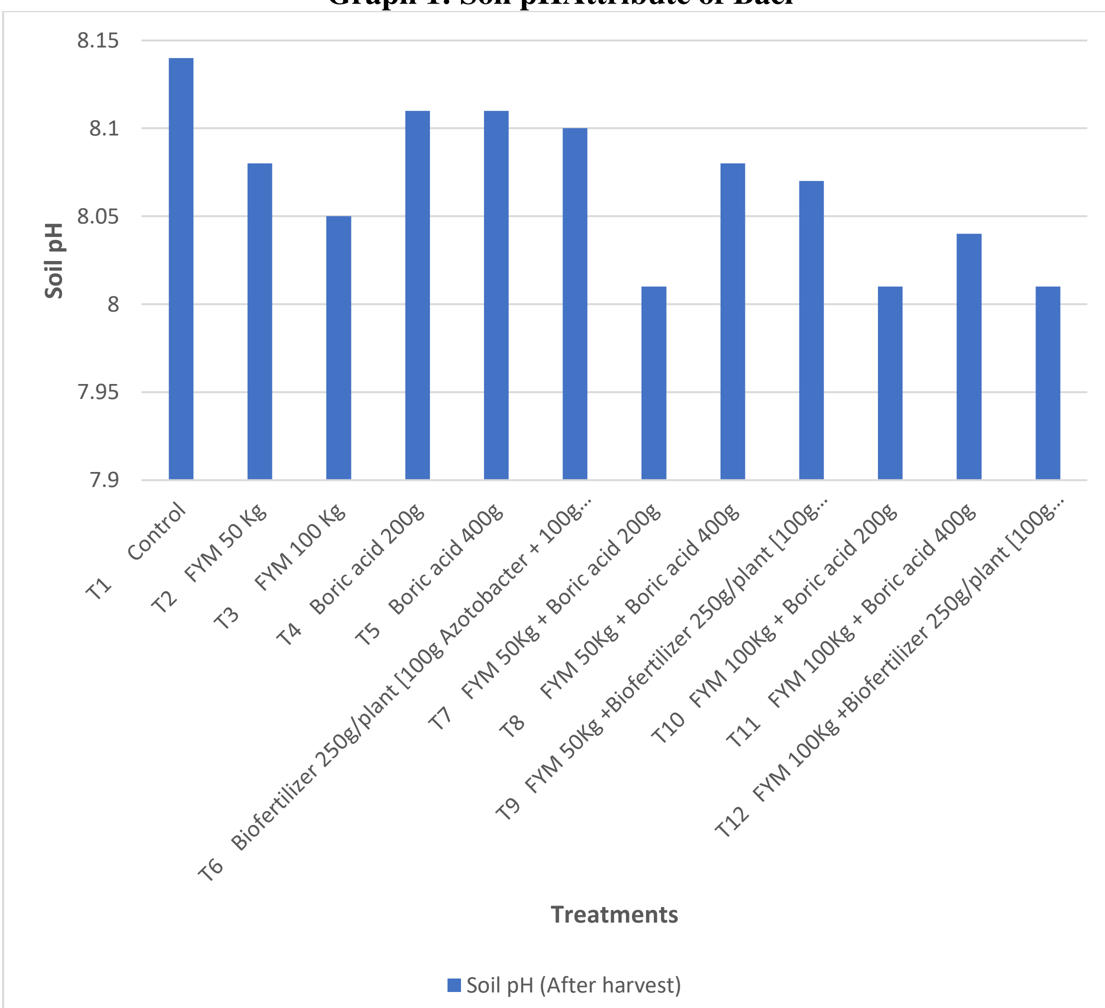
Data presented in**Table 1 and Graph 2**indicated thattreatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] recorded the minimum electrical conductivity (dSm^{-1}) i.e., [0.40 (2022-23), 0.40 (2023-24) and 0.40 (Pooled)] dSm^{-1} over all other treatments during both the years of study as well as pooled analysis. The highest electrical conductivity (dSm^{-1}) i.e., [0.45 (2022-23), 0.47 (2023-24) and 0.46 (Pooled)] dSm^{-1} was recorded in T_1 [Control] during both the years of study as well as pooled analysis.

Table 1:Soil pHand Electrical Conductivity Attributes of Fruits of Bael

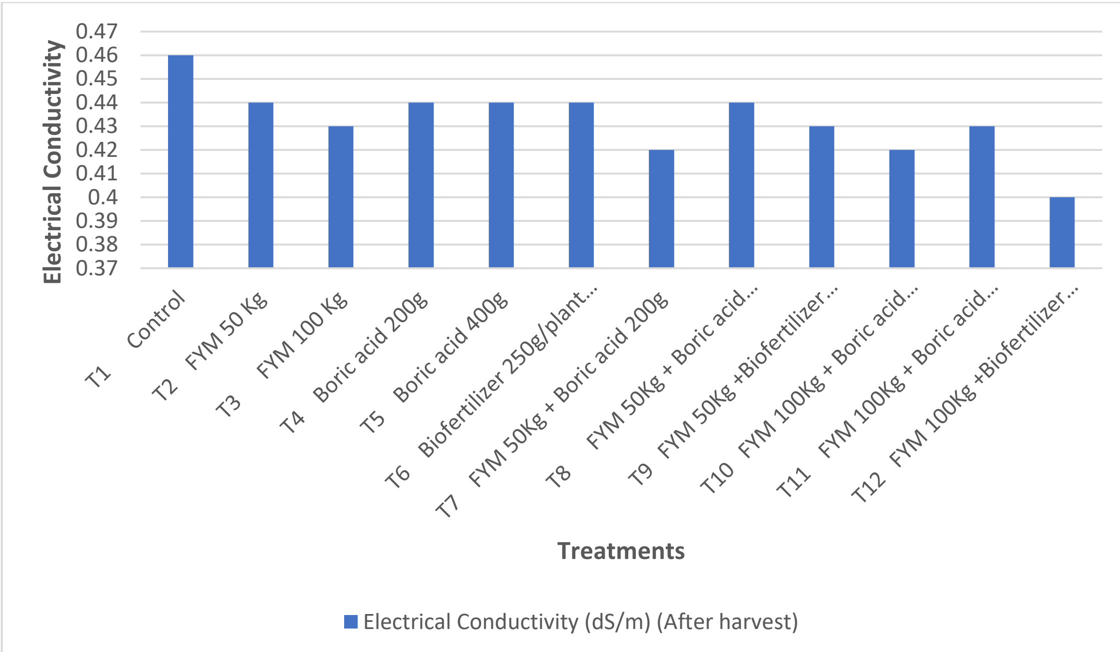
Treatments	**Soil pH (After harvest)**			**Electrical Conductivity (dS/m) (After harvest)**		
	(2022-23)	**(2023-24)**	**Pooled**	**(2022-23)**	**(2023-24)**	**Pooled**
T_1Control	8.13	8.15	8.14	0.45	0.47	0.46
T_2FYM 50 Kg	8.07	8.09	8.08	0.43	0.45	0.44
T_3 FYM 100 Kg	8.04	8.06	8.05	0.42	0.44	0.43
T_4Boric acid 200g	8.10	8.12	8.11	0.44	0.44	0.44
T_5Boric acid 400g	8.10	8.11	8.11	0.44	0.44	0.44
T_6Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	8.09	8.11	8.10	0.43	0.45	0.44
T_7FYM 50Kg + Boric acid 200g	8.00	8.01	8.01	0.41	0.43	0.42
T_8 FYM 50Kg + Boric acid 400g	8.07	8.09	8.08	0.43	0.45	0.44
T_9FYM 50Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	8.06	8.08	8.07	0.42	0.44	0.43
T_{10}FYM 100Kg + Boric acid 200g	8.00	8.01	8.01	0.41	0.42	0.42

T₁₁FYM 100Kg + Boric acid 400g	8.03	8.05	8.04	0.42	0.44	0.43
T₁₂FYM 100Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	8.00	8.01	8.01	0.40	0.40	0.40
SEm ±	**0.01**	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**
CD at 5%	**0.02**	**0.03**	**0.02**	**NS**	**NS**	**NS**

Graph 1: Soil pHAttribute of Bael



Graph 2: Electrical Conductivity Attribute of Bael



3.1.3 Organic carbon (%)

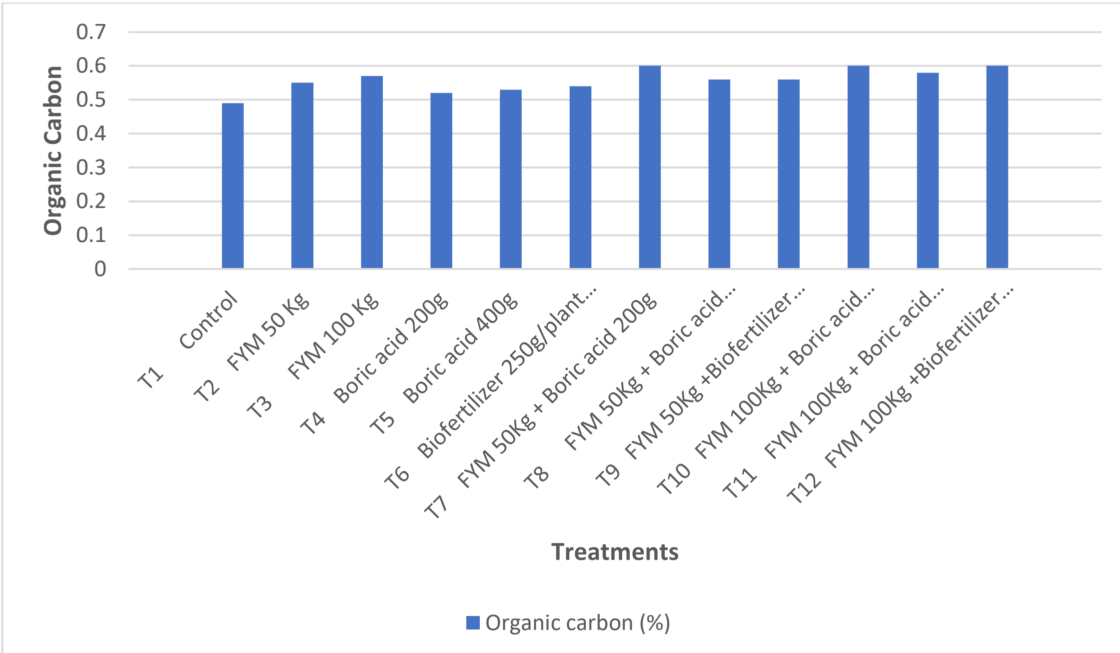
As presented in **Table 2 and Graph 3**thetreatment T_7 [FYM 50Kg + Boric acid 200g], T_{10} [FYM 100Kg + Boric acid 200g] and T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] recorded the maximum Organic Carbon (%) [0.59 (2022-23), 0.61 (2023-24) and 0.60 (Pooled)] % over all other treatments during both the years of study as well as pooled analysis. The 2nd best treatment combination was found to be treatment T_{11} [FYM 100Kg + Boric acid 400g] with [0.57 (2022-23), 0.59 (2023-24) and 0.58 (Pooled)] % Organic Carbon. The lowest Organic Carbon (%) i.e., [0.48 (2022-23), 0.50 (2023-24) and 0.49 (Pooled)] % was recorded in T_1 [Control] during both the years of study as well as pooled analysis.

Table 2:Organic carbon Attribute of Bael

Treatments	**Organic carbon (%) (After harvest)**		
	(2022-23)	**(2023-24)**	**Pooled**
T_1Control	0.48	0.50	0.49
T_2FYM 50 Kg	0.54	0.56	0.55
T_3 FYM 100 Kg	0.56	0.58	0.57
T_4Boric acid 200g	0.51	0.53	0.52
T_5Boric acid 400g	0.52	0.54	0.53

T_6Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	0.53	0.55	0.54
T_7FYM 50Kg + Boric acid 200g	0.59	0.61	0.60
T_8 FYM 50Kg + Boric acid 400g	0.55	0.57	0.56
T_9FYM 50Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	0.55	0.57	0.56
T_{10}FYM 100Kg + Boric acid 200g	0.59	0.61	0.60
T_{11}FYM 100Kg + Boric acid 400g	0.57	0.59	0.58
T_{12}FYM 100Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	0.59	0.61	0.60
SEm ±	**0.01**	**0.01**	**0.01**
CD at 5%	**0.02**	**0.03**	**0.02**

Graph 3: Organic CarbonAttribute of Bael



3.1.4 Available Nitrogen (Kg/ha)

The data significantly presented in **Table 3 and Graph 4** revealed thatthetreatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] recorded the maximum Available Nitrogen (kg/ha) i.e., [267.67 (2022-23), 276.61 (2023-24) and 272.14 (Pooled)] kg/ha over all other treatments during both the years of study as well as pooled analysis. The 2nd best treatment combination was found to be treatment T_{10} [FYM 100Kg + Boric acid 200g] with [265.68 (2022-23), 274.55 (2023-24) and 270.12 (Pooled)] kg/ha Available Nitrogen. However, during both the years of study, the effect of treatment T_{10} [FYM 100Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] whereas according to pooled data effect of treatment T_7 [FYM 50Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB. The lowest Available Nitrogen (kg/ha) i.e., [214.37 (2022-23), 221.53 (2023-24) and 217.95 (Pooled)] kg/ha was recorded in T_1 [Control] during both the years of study as well as pooled analysis.

3.1.5 Available Phosphorus (Kg/ha)

As presented in **Table 3 and Graph 5**the treatmentT_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] recorded the maximum Available Phosphorus (kg/ha) i.e., [19.45 (2022-23), 19.91 (2023-24) and 19.68 (Pooled)] kg/ha over all other treatments during both the years of study as well as pooled analysis. The 2nd best treatment combination was found to be treatment T_{10} [FYM 100Kg + Boric acid 200g] with [19.36 (2022-23), 19.81 (2023-24) and 19.59 (Pooled)] kg/ha Available Phosphorus. However, during both the years of study as well as pooled data, the effect of treatment T_{10} [FYM 100Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer

250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] whereas according to both the years of study effect of treatment T_7 [FYM 50Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB. The lowest Available Phosphorus (kg/ha) i.e., [17.15 (2022-23), 17.55 (2023-24) and 17.35 (Pooled)] kg/ha was recorded in T_1 [Control] during both the years of study as well as pooled analysis.

3.1.6 Available Potassium (Kg/ha)

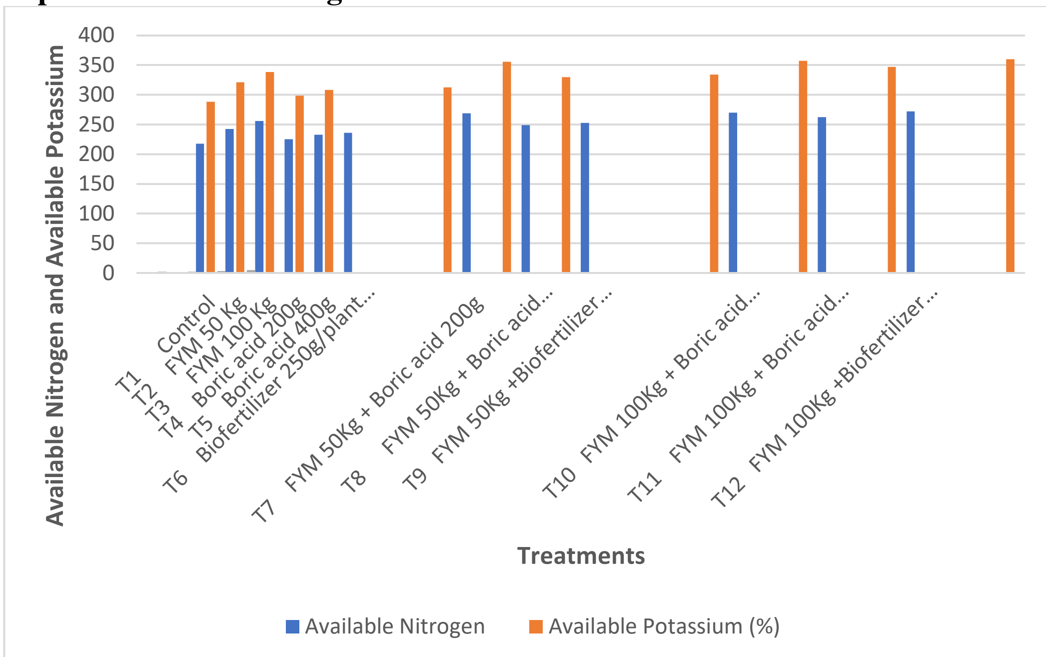
Data presented in**Table 3 and Graph 4** indicated thattreatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] recorded the maximum Available Potassium (kg/ha) i.e., [326 (2022-23), 364.33 (2023-24) and 360.17 (Pooled)] kg/ha over all other treatments during both the years of study as well as pooled analysis. The 2^{nd} best treatment combination was found to be treatment T_{10} [FYM 100Kg + Boric acid 200g] with [353.35 (2022-23), 361.62 (2023-24) and 357.49 (Pooled)] kg/ha Available Potassium. However, during both the years of study as well as pooled data, the effect of treatment T_{10} [FYM 100Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] whereas according to both the years of study effect of treatment T_7 [FYM 50Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB. The lowest Available Potassium (kg/ha) i.e., [285.11 (2022-23), 291.78 (2023-24) and 288.45 (Pooled)] kg/ha was recorded in T_1 [Control] during both the years of study as well as pooled analysis.

Table 3:Available Nitrogen, Available Phosphorus and Available Potassium Attributes of Bael

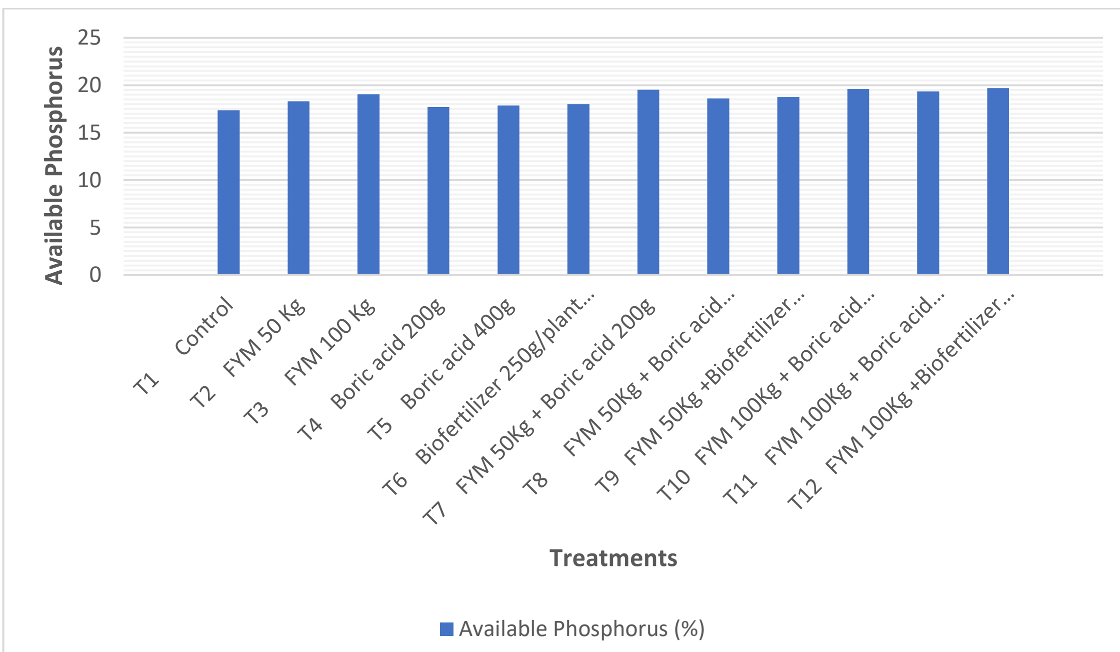
Treatments	Available Nitrogen (%) (After harvest)			Available Phosphorus(%) (After harvest)			Available Potassium (%) (After harvest)		
	(2022-23)	(2023-24)	Pooled	(2022-23)	(2023-24)	Pooled	(2022-23)	(2023-24)	Pooled
T_1Control	214.37	221.53	217.95	17.15	17.55	17.35	285.11	291.78	288.45
T_2FYM 50 Kg	238.69	246.66	242.68	18.10	18.52	18.31	317.46	324.89	321.17
T_3 FYM 100 Kg	251.68	260.09	255.88	18.84	19.28	19.06	334.73	342.57	338.65
T_4Boric acid 200g	221.70	229.10	225.40	17.51	17.92	17.71	294.86	301.76	298.31
T_5Boric acid 400g	229.03	236.68	232.85	17.65	18.06	17.86	304.61	311.74	308.17
T_6Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	232.36	240.12	236.24	17.80	18.22	18.01	309.04	316.27	312.65
T_7FYM 50Kg + Boric acid 200g	264.34	273.17	268.75	19.29	19.74	19.52	351.57	359.80	355.69

T_8 FYM 50Kg + Boric acid 400g	245.02	253.20	249.11	18.40	18.83	18.62	325.88	333.50	329.69
T_9FYM 50Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	248.35	256.64	252.50	18.54	18.97	18.76	330.31	338.03	334.17
T_{10}FYM 100Kg + Boric acid 200g	265.68	274.55	270.12	19.36	19.81	19.59	353.35	361.62	357.49
T_{11}FYM 100Kg + Boric acid 400g	258.01	266.63	262.32	19.14	19.59	19.36	343.15	351.18	347.17
T_{12}FYM 100Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	267.67	276.61	272.14	19.45	19.91	19.68	356.00	364.33	360.17
SEm ±	**1.48**	**1.57**	**1.08**	**0.07**	**0.08**	**0.05**	**1.51**	**1.55**	**1.08**
CD at 5%	**4.33**	**4.62**	**3.08**	**0.19**	**0.23**	**0.15**	**4.44**	**4.55**	**3.09**

Graph 4: Available Nitrogen and Available Potassium Attributes of Bael



Graph 5: Available Phosphorus Attribute of Bael



3.2 Effect of Bio-formulations and Boric acid on Microbial Population in Soil of Bael

3.2.1 Bacterial population (10^6cfu g^{-1} of soil), Fungal (10^5cfu g^{-1} of soil) and Actinomycetes population (10^5 cfu g^{-1} of soil)

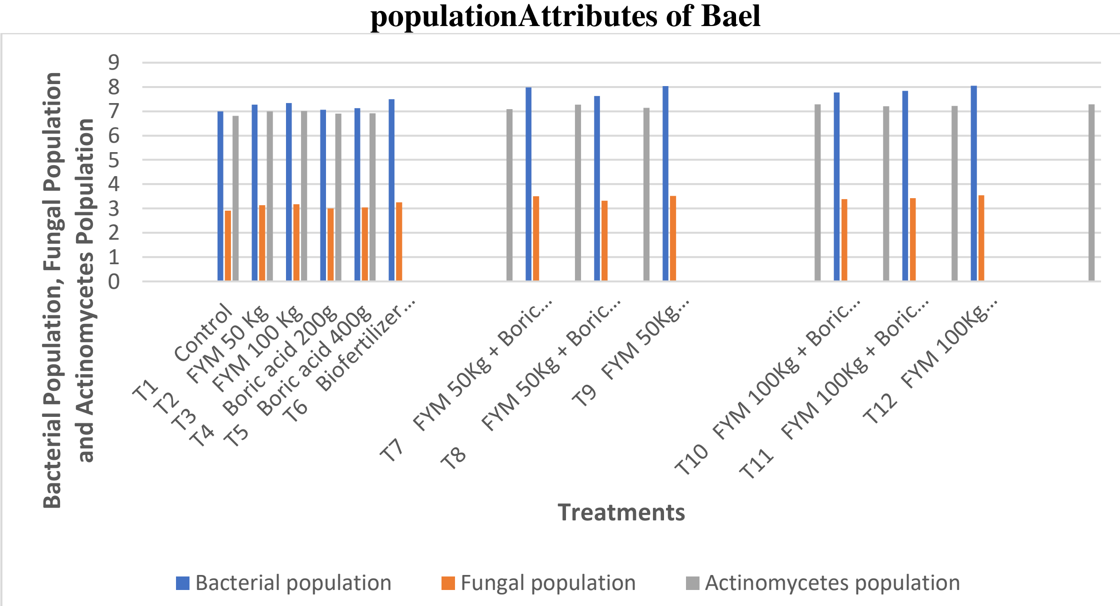
Data presented in**Table 4 and Graph 6**indicated thatthe treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] recorded the maximum Bacterial population (10^6 cfu g^{-1} of soil) i.e., [7.96 (2022-23), 8.15 (2023-24) and 8.05 (Pooled)] 10^6cfu g^{-1} of soil, Fungal population (10^5cfu g^{-1} of soil) i.e., [3.52 (2022-23), 3.57 (2023-24) and 3.54 (Pooled)] 10^5cfu g^{-1} of soil and Actinomycetes population (10^5cfu g^{-1} of soil) i.e., [7.24 (2022-23), 7.33 (2023-24) and 7.29 (Pooled)] 10^5cfu g^{-1} of soil over all other treatments during both the years of study as well as pooled analysis. However, during both the years of study as well as pooled data, the effect of treatment T_{10} [FYM 100Kg + Boric acid 200g] and T_7 [FYM 50Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB)] for Fungal (10^5cfu g^{-1} of soil) and Actinomycetes population (10^5cfu g^{-1} of soil) respectively whereas according to both the years of study and pooled data, effect of treatment T_{10} [FYM 100Kg + Boric acid 200g] was found at par with the treatment T_{12} [FYM 100Kg +Biofertilizer 250g/plant (100g Azotobacter + 100g Biovita + 50g PSB for the data of Bacterial population (10^6cfu g^{-1} of soil). The lowest Bacterial population (10^6cfu g^{-1} of soil) i.e., [6.82 (2022-23), 6.98 (2023-24) and 6.90 (Pooled)] 10^6 cfu g^{-1} of soil, Fungal population (10^5 cfu g^{-1} of soil) i.e., [2.89 (2022-23), 2.93 (2023-24) and 2.91 (Pooled)] 10^5cfu g^{-1} of soil and Actinomycetes population (10^5cfu g^{-1} of soil) i.e., [6.77 (2022-23), 6.86 (2023-24) and 6.81 (Pooled)] 10^5cfu g^{-1} of soil was recorded in T_1 [Control] during both the years of study as well as pooled analysis.

Table 4:Bacterial population, Fungal population and Actinomycetes populationAttributes of Bael

Treatments	Bacterial population (10^6cfu g^{-1} of soil) (After harvest)			Fungal population (10^5cfu g^{-1} of soil) (After harvest)			Actinomycetes population (10^5cfu g^{-1} of soil) (After harvest)		
	(2022-23)	(2023-24)	Pooled	(2022-23)	(2023-24)	Pooled	(2022-23)	(2023-24)	Pooled
T_1Control	6.82	6.98	6.99	2.89	2.93	2.91	6.77	6.86	6.81
T_2FYM 50 Kg	7.19	7.36	7.27	3.11	3.15	3.13	6.95	7.04	6.99
T_3 FYM 100 Kg	7.26	7.43	7.34	3.15	3.19	3.17	6.97	7.06	7.01
T_4Boric acid 200g	6.98	7.14	7.06	2.98	3.02	3.00	6.86	6.95	6.90
T_5Boric acid 400g	7.05	7.21	7.13	3.02	3.06	3.04	6.88	6.97	6.92
T_6Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	7.40	7.57	7.49	3.23	3.27	3.25	7.03	7.12	7.08
T_7FYM 50Kg + Boric acid 200g	7.89	8.07	7.98	3.48	3.53	3.50	7.22	7.31	7.27
T_8 FYM 50Kg + Boric acid 400g	7.54	7.72	7.63	3.30	3.34	3.32	7.09	7.18	7.14

T_9FYM 50Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	7.94	8.13	8.03	3.50	3.55	3.52	7.23	7.32	7.28
T_{10}FYM 100Kg + Boric acid 200g	7.68	7.86	7.77	3.37	3.42	3.39	7.15	7.24	7.20
T_{11}FYM 100Kg + Boric acid 400g	7.75	7.93	7.84	3.41	3.46	3.43	7.17	7.26	7.22
T_{12}FYM 100Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]	7.96	8.15	8.05	3.52	3.57	3.54	7.24	7.33	7.29
SEm ±	**0.03**	**0.04**	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**	**0.02**	**0.01**
CD at 5%	**0.09**	**0.11**	**0.07**	**0.05**	**0.07**	**0.04**	**0.04**	**0.04**	**0.03**

Graph 6: Bacterial population, Fungal population and Actinomycetes populationAttributes of Bael



4. CONCLUSION

Based on the ongoing summary of the current investigation, it can be inferred that soil parameters likeSoil pH, Electrical Conductivity (dS/m), Organic carbon (%), Available Nitrogen (Kg/ha), Available Phosphorus (Kg/ha), Available Potassium (Kg/ha) and Microbial population (cfu per g) (bacteria, fungus and actinomycetes) were recorded maximum in soilattributes likeorganic carbon, available nitrogen, available phosphorus, available potassium, bacterial population and actinomycetes populationbesides soil pH, electrical conductivity and fungal populationwas drastically reduced. It can be concluded that all the treatments show good effects on increasing fruit quality and minimizing inferior quality of fruit as compared to the control but T_7 (FYM 50Kg + Boric acid 200g)and T_{12} (FYM 100Kg +Biofertilizer 250g/plant [100g Azotobacter + 100g Biovita + 50g PSB]) was found to be more pronounced among all the treatments and can be used in increasing the qualityof Bael.

5. FUTURE SCOPE

Bio-formulation is a system designed to restore and maintain crop productivity while addressing emerging micronutrient deficiencies. To achieve this, it is crucial to reduce the reliance on chemical fertilizers by implementing integrated nutrient management and organic methods. This approach promotes better growth and higher yields in fruit crops.

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