A COMPARATIVE STUDY OF BIOFERTILIZERS AND BIOINOCULANTS ON YIELD PARAMETERS, NUTRIENT STATUS AND SOIL MICROORGANISMS OF MANGO CV. MALLIKA IN MIDDLE GUJARAT CONDITION

ABSTRACT

Nutrient status of leaf and soil microorganisms have directly influence on the nutrient-absorption rate and translocation in the tree system which ultimately increases the production of fruit crops. Therefore, Yield, nutrient status of leaf and soil microorganisms were counted after harvesting of crop under different biofertilizers and bioinoculants treatments and effects were determined. A two year field experiment was conducted at Horticultural Research Farm, Department of Horticulture, B.A.C.A, AAU, Anand, Gujarat, India during year 2019-20 and 2020-21 on mango cv. Mallika. The experiment was laid out in factorial CRD with four biofertilizers *viz*., D_1: Bio NPK Consortium (10 ml/tree), D_2: VAM (10 g/tree), D_3: Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree) and D_4: No biofertilizers which were given as a soil drenching at pea stage *i.e*., March and four bioinoculants *viz.*, S_1: Seaweed extract (0.2 %), S_2: Novel organic liquid nutrient (2 %), S_3: Jeevamrut (10 %) and S_4: No bioinoculants which were sprayed in two frequencies at 2nd week of April and 1st week of May. Among biofertilizers, D_3 recorded maximum fruit weight, diameter, number of fruits per tree, yield as well as nitrogen, phosphorus and potassium content in leaf. Among bioinoculants, S_2 showed higher fruit weight in pooled result, fruit diameter, number of fruits per tree, yield, nitrogen, phosphorus and potassium content in leaf. D_3S_2 resulted maximum yield and potassium content in leaf in pooled whereas, nitrogen and phosphorus content in leaf during both the years and pooled data. Similarly, D_3S_2 also recorded maximum soil microorganisms.

Key words: Biofertilizers, soil drenching, bioinoculants, nutrient status, soil microorganisms

1. INTRODUCTION

Mango (*Mangifera indica* L.) is one of the major fruit crops of the family *Anacardiaceae.* Mango is the national fruit of India. It is originated in the South-East Asia or Indo-Burma region. Besides it's fine taste, high palatability, sweet fragrance, attractive colour and nutritional value, so it is known as "King of Fruits". Mango fruit contains unique nutritional and medicinal properties. Every 100 g mango pulp contains 0.8 g protein, 15 g carbohydrates, 0.4 g fat and 1.6 g dietary fiber. It is also good source of vitamin A and C. It is highly invigorative, laxative and diuretic (Bal, 2006). A single fruit can provide up to 40 % dietary fiber (Sing *et al*., 2005). In India, the major mango growing states are Uttar Pradesh, Andhra Pradesh, Bihar, Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Orissa and West Bengal. Among the various states, Uttar Pradesh has the largest area followed by Andhra Pradesh and Karnataka. In Gujarat, mango is cultivated in Valsad, Navsari, Junagadh, Surat, Bharuch, Kutch and Jamnagar districts because of favourable agro-climatic conditions.

Indiscriminate use of chemical fertilizers, pesticides and herbicides in horticultural crops affected the soil fertility, biodiversity, ground water pollution and human health. Now, it has become a challenge for the orchardists, registered growers and exporters of our country to produce quality fruits having the international standards for export. Demand of chemical free mangoes has increased and farmers are able to receive higher

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prices by exporting of mango fruits and farmers are also diverted towards the INM cultivation. Biofertilizers are the living microorganism which add, conserve and mobilize the plant nutrients in the soil (Yawalkar *et al*., 1996). Biofertilizer based on renewable energy sources are cost effective supplement to chemical fertilizers (Motsara *et al*., 1995) and these organic sources of microbial inoculants are choices of the farmers (Kumar *et al*., 2009; Srivastava *et al*., 2009). Among different biofertilizer *Azotobacter* and *Azospirillum* have good nitrogen fixation ability. Bio NPK consortium provide nutrients to the soil and Vesicular Arbuscular Mycorrhiza (VAM) helps to absorb and mobilize primary phosphorus (Aal *et al*., 2020; Kour *et al*., 2019).

Pre-harvest application of bioinoculants has also become an alternative approach to minimize the use of chemical fertilizers (Sathyanarayana *et al.*, 2018). Several growth regulating bioinoculants like seaweed extract, Novel organic liquid nutrient and jeevamrut have potential in increased growth and development of fruit crops. Seaweed extract had higher amounts of macro nutrients, trace elements, organic substances like amino acids, antioxidant, organic acid and plant growth regulators such as auxin, cytokinin and gibberellins are applied to improved nutritional status, vegetative growth, fruit quality and yield in plants (Crouch *et al*., 1992). Novel organic liquid nutrient is a good source of plant nutrient along with growth promoting substances like cytokinin, GA_3, *etc.* Jeevamrut is a fermented liquid product prepared by mixing up cow dung with cow urine, jaggery, legume flour and handful of live soil (Palekar, 2006). It promotes immense biological activity in soil and enhance nutrient availability to crop (Gore and Sreenivasa, 2011). Keeping in the view the A comparative study of biofertilizers and bioinoculants on yield parameters, nutrient status and soil microorganisms of mango cv. Mallika in Middle Gujarat condition was determined.

2. MATERIALS AND METHODS

The present investigation was carried out at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India during the year 2019-20 and 2020-21. Anand is situated in the Western Indian state of Gujarat and geographically at 22º35' North latitude and 72º56' East longitude with an altitude of about 45.1 m above the mean sea level. The climate of middle Gujarat zone is semi-arid and subtropical type. October to May is sunny months generally receiving an average of eight hours sunshine per day. Temperature during hot weather commences by end of February and ends by about middle of June. Winter sets in the middle of October and continues till the end of February. Monsoon is generally starts from second fortnight of June and retreats by middle of September with an annual rainfall of 860 mm. The soil of the experimental site was loamy sand, locally known as *"Goradu"* with pH 7.14 and consisted of 0.23 $dS.m^{-1}$ electrical conductivity (EC). The available N, P and K of the field soil were 320.00, 34.35 and 442.10 kg ha^{-1}, respectively with 0.46 % organic C.

The experimental design was Completely Randomized Design (CRD) with factorial concept with three repetitions. The recommended dose of Farm yard manure 100 kg/tree and fertilizers [N (as Urea), P_2O_5 (as SSP) and K_2O (as MOP) @ 750:160:750 kg ha^{-1}] were applied. Full dose of FYM, phosphorus, potash and half dose of nitrogen were given after harvest of the crop *i.e.,* June. Remaining half dose of nitrogen was given at pea stage *i.e.,* March. Uniform size with same age *i.e.,* 21 years trees of mango cv. Mallika was selected as an experimental material which were planted at 8 × 8 m spacing. One tree was selected per treatment and total sixteen treatment combinations were carried out.

Treatment details are as under:

Factor A. Drenching of biofertilizers (D)

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D_1: Bio NPK Consortium @ 10 ml/tree
D_2: VAM @ 10 g/tree
D_3: Bio NPK Consortium @ 10 ml/tree + VAM @ 10 g/tree
D_4: No biofertilizers
Factor B. Spraying of bioinoculants (S)
S_1: Seaweed extract @ 0.2 %
S_2: Novel organic liquid nutrient @ 2 %
S_3: Jeevamrut @ 10 %
S_4: No bioinoculants

Anubhav Bio NPK Consortium contains strains of *Azotobacter chroococcum* (ABA-1), *Azospirillum lipoferum* (ASA-1), *Bacillus coagulans* and two *Bacillus spp*. was collected from the Department of Agricultural Microbiology, Anand Agricultural University, Anand. Sardar Vesicular Arbuscular Mycorrhiza (VAM) was collected from Gujarat State Fertilizers and Chemicals Limited, Vadodara.

Drenching with biofertilizers (D_1 and D_2) were given in the ring 1.5 m apart from the tree trunk by soil drenching by incorporation with well decomposed FYM after the week of half nitrogen given before pea stage *i.e.*, 1st week of March. For D_3 [Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree)], First Bio NPK Consortium was given and after that immediately VAM was applied. Bioinoculant, seaweed extract was collected from Fisheries Research Station, Port Okha- Junagadh Agricultural University. Novel organic liquid fertilizer was collected from soil and water management research unit, Navsari Agricultural University, Navsari. Jeevamrut was prepared by procedures given by Palekar (2006). Spraying of bioinoculants was applied to the trees as a preharvest spray in two frequencies in the month of 2nd week of April and 1st week of May as per treatments on trees by foot sprayer.

2.1 Yield parameters observation

The five mature fruits per treatment were randomly selected and fruit weight and fruit diameter were observed. The number of fruits were counted treatment wise at harvest and expressed as number of fruits per tree. Fruit yield per hectare was calculated with number of trees per hectare by multiplying the average yield of trees and expressed in tonne.

2.2 Leaf nutrient analysis

Leaf nutrient status was recorded at initial and after harvesting of crop. At initial and after harvest of the crop, the mature leaves were collected and dried it and these samples were analyzed for N, P and K content by Kjeldahl's digestion, Vanadomolybdo phosphoric acid yellow colour method and flame photometric methods of analysis (Jackson, 1973), respectively. Soil samples were collected before and after conducting experiment for microbial count. Rhizospheric microorganisms were isolated from each sample by serial dilution and spread plate method.

2.3 Statistical analysis

Data for individual years were analyzed and in order to study the average effect of different treatments over the years, the pooled analysis was also carried out as suggested by Gomez and Gomez (1976).

3. RESULTS AND DISCUSSION

3.1 Influence of biofertilizers on yield parameters of mango

The drenching of biofertilizers significantly influenced the yield parameters of mango (Table 1). The yield parameters in terms of maximum fruit weight (353, 337 and 345 g), fruit diameter (8.33, 8.11 and 8.22 cm),

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number of fruits per tree (212, 198 and 205) and fruit yield (13.7, 13.0 and 13.4 t/ha) were noted with drenching of Bio NPK Consortium 10 ml/tree + VAM 10 g/tree during the year 2019-20, 2020-21 and in pooled data, respectively. This increase in yield parameters was association of biofertilizers (Bio NPK Consortium + VAM) may supply optimum plant nutrients and growth hormones at desired amount during entire period of fruit growth, ultimately increases higher rate of photosynthesis resulted in more accumulation of dry matter responsible for more fruit weight and diameter of mango fruit. Maximum number of fruits per tree might be due to supply of all the nutrients in adequate right from starting of the experiment to the harvesting of the crop, which induced more retention of fruits by supply of photosynthates at critical requirement stage and that resulted into the higher number of fruits per tree and increased fruit yield. These observations are in agreement with the Madhavi *et al*. (2008) in mango, Ram *et al*. (2012) and Sutariya *et al*. (2018) in phalsa, Thakkar (2015) in guava, Patel *et al*. (2017) and Baviskar *et al*. (2011) in sapota and Nurbhanej *et al*. (2016) in acid lime.

3.2 Influence of bioinoculants on yield parameters of mango

The spraying with bioinoculants significantly influenced on the yield parameters of mango cv. Mallika (Table 1). Maximum fruit weight was recorded (336 g) in pooled data, maximum fruit diameter (8.00, 7.82 and 7.90 cm), number of fruits per tree (205, 192 and 199) and fruit yield (13.3, 12.5 and 12.9 t/ha) during both the years and pooled mean, respectively with spraying of Novel organic liquid nutrient 2 %. Novel organic liquid nutrient provides higher carbohydrate accumulation in plant at early stage of growth as a resulted in better nutrient supply, which reflect on fruit size and there by increased the fruit diameter and fruit weight (Patel *et al*., 2018). Novel organic liquid nutrient contains a good amount of essential nutrients and growth boosters and these constituents are known to have positive effect on fruiting parameters of the crops (Rathod *et al*., 2017). Similar type of results was also reported by Anon. (2012) in mango, Anon. (2011 and 2014) in banana.

3.3 Interaction effect of biofertilizers and bioinoculants on yield parameters of mango

Interaction effect of biofertilizers and bioinoculants on yield of mango (Fig. 1) showed significant result. Maximum fruit yield (14.9 t/ha) in pooled result was observed with combined application *i.e*., drenching with biofertilizers like Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree) and spraying with bioinoculants *viz.*, Novel organic liquid nutrient (2 %). Combine effect of drenching with biofertilizers (Bio NPK Consortium + VAM) at critical stage *viz*., pea stage and spraying with bioinoculant (Novel organic liquid nutrient) that provides essential macro nutrient (N, P and K) in adequate quantity, VAM may increases uptake of phosphorus and other micronutrients (Zn, Cu, Mn, Fe) as well as spraying with Novel organic liquid nutrient act as a growth stimulant which have regulatory role in more fruit retention upto harvest period ultimately increases fruit yield. This finding is supported by Yadav *et al*. (2011) in mango, Rathod *et al*. (2017) in pomegranate, Ram *et al*. (2012) and Sutariya *et al*. (2018) in phalsa and Musmade *et al*. (2010) in acid lime.

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Treatments	Fruit weight (g)			Fruit diameter (cm)			Number of fruits per tree			Fruit yield (t/ha)		
	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean
Biofertilizers as drenching (D)												
D_1	345	327	336	8.00	7.81	7.90	206	191	198	13.1	12.3	12.7
D_2	332	316	324	7.63	7.43	7.53	196	184	190	12.3	11.5	11.9
D_3	353	337	345	8.33	8.11	8.22	212	198	205	13.7	13.0	13.4
D_4	295	279	287	6.48	6.23	6.36	169	160	165	10.4	9.80	10.1
S.Em.±	9.10	8.23	6.13	0.210	0.173	0.136	4.61	5.83	3.72	0.215	0.276	0.175
CD at 5 %	26.2	23.7	17.3	0.606	0.500	0.385	13.9	16.8	10.5	0.620	0.795	0.494
Bioinoculants as spraying (S)												
S_1	337	320	329	7.79	7.55	7.67	200	187	193	12.7	11.9	12.3
S_2	344	327	336	8.00	7.82	7.90	205	192	199	13.3	12.5	12.9
S_3	333	317	325	7.66	7.48	7.57	198	184	191	12.4	11.7	12.1
S_4	311	296	303	6.98	6.75	6.86	181	169	175	11.2	10.5	10.8
S.Em.±	9.10	8.23	6.13	0.210	0.173	0.136	4.61	5.83	4.61	0.215	0.276	0.175
CD at 5 %	NS	NS	17.3	0.606	0.500	0.385	13.2	16.8	10.5	0.620	0.795	0.494
Interaction (D x S)												
S.Em.±	18.2	16.5	12.3	0.421	0.347	0.272	9.21	11.7	7.43	0.430	0.552	0.350
CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.988

Table 1. Influence of biofertilizers and bioinoculants on yield parameters of mango

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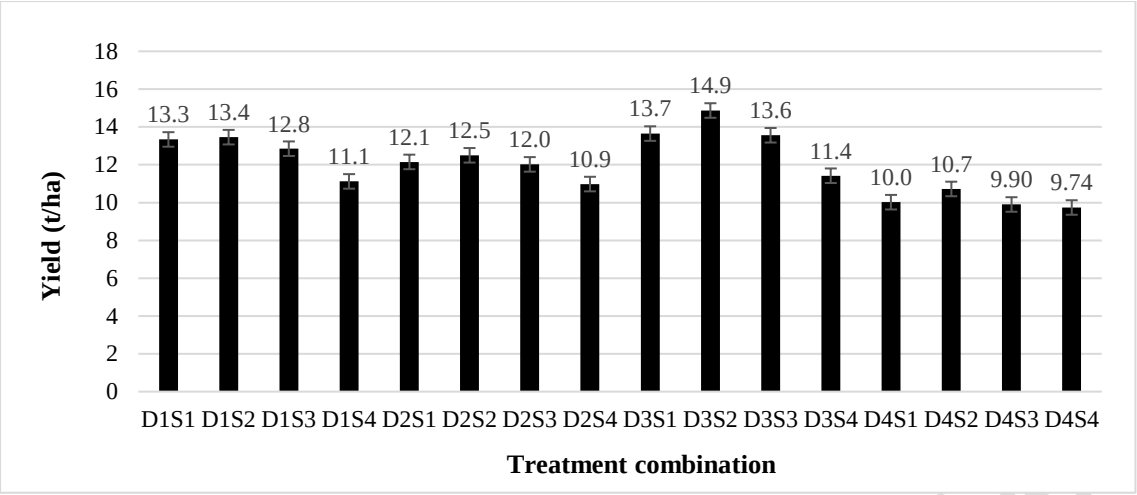

Fig. 1. Interaction effect of biofertilizers and bioinoculants on yield (t/ha) of mango (pooled result).

3.4 Influence of biofertilizers on nutrient status of mango leaf

Drenching of biofertilizers on nitrogen, phosphorus and potassium content in mango leaf (Table 2) showed significant result for individual year as well as pooled mean.

3.4.1 Nitrogen content of leaf (%)

Maximum nitrogen content (1.34, 1.48 and 1.41 %) in leaf was also noted in D_3 (Bio NPK Consortium 10 ml/tree + VAM 10 g/tree) during year 2019-20, 2020-21 and pooled mean, respectively. Increase in nitrogen status observed was partially attributed to the stimulating influence of biofertilizers, which in turn, increases nutrient-absorption rate and translocation in the tree system and ability of VAM fungi in supplying the host plants with nutrient requirements. It could also be due to increased dry-matter production, and nitrogen-fixation or nitrogen assimilation by *Azotobacter* and *Azospirillium* (Singh *et al*., 2004). These results are in agreement with Sharma *et al*. (2013) in guava, Ennab (2016) in lemon, Kour *et al*. (2019) in aonla and Dutta and Kundu (2012) in mango.

3.4.2 Phosphorus content of leaf (%)

Maximum phosphorus content (0.345, 0.370 and 0.358 %) in leaf was also noted in D_3 (Bio NPK Consortium 10 ml/tree + VAM 10 g/tree) during both the years and pooled mean, respectively. This was perhaps due to production of enzyme complexes by the biofertilizers applied, which may have solubilized the unavailable form of phosphorus and made it available to the plant (Singh *et al*., 2003). VAM fungi improve plant growth in the low phosphate soils by exploiting large areas of soil and actively transporting the phosphate up to the plants. Similar findings were reported by Sharma *et al*. (2011) in guava, Ennab (2016) in lemon, Kour *et al*. (2019) in aonla and Jain *et al*. (2012) in mandarin.

3.4.3 Potassium content of leaf (%)

Similarly, maximum potassium content (0.824, 0.879 and 0.852 %) in leaf was noted in D_3 (Bio NPK Consortium 10 ml/tree + VAM 10 g/tree) during both the years and pooled mean, respectively. This increase in potassium content in leaf of mango was probably due to the use of biofertilizers which may have contributed to improving soil physical-properties. Which results in better rooting, and therefore, better uptake of potassium from native sources. Increase in potassium content of leaves in the present study is also in conformity with findings of Ahmad *et al*. (2004) in mango, Sharaf *et al*. (2011) in Washington navel orange and El-Sheikh (2014) in lemon trees.

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3.5 Influence of bioinoculants on nutrient status of mango leaf

Maximum nitrogen content (1.27, 1.39 and 1.33 %), phosphorus content (0.319, 0.340 and 0.330 %) and potassium content (0.784, 0.844 and 0.814 %) in leaf was noted in S_2 (Novel organic liquid nutrient 2 %) in both the years and pooled mean, respectively (Table 2). Spraying with Novel organic liquid nutrient significantly increased nitrogen, phosphorus and potassium content of leaf, which could be attributed to the rapid absorption of these elements by the plant surface and their translocation in the leaf. Similar finding was obtained by Sathyanarayana *et al*. (2018) in gladiolus.

Treatments	Nitrogen content (%)			Phosphorus content (%)			Potassium content (%)		
	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean
Initial content (%)	**0.960**			**0.140**			**0.590**		
Biofertilizers as drenching (D)									
D_1	1.26	1.39	1.32	0.321	0.340	0.331	0.787	0.848	0.817
D_2	1.18	1.30	1.24	0.285	0.310	0.298	0.743	0.804	0.773
D_3	1.34	1.48	1.41	0.345	0.370	0.358	0.824	0.879	0.852
D_4	0.925	1.03	0.975	0.188	0.208	0.198	0.622	0.683	0.652
S.Em.±	0.010	0.009	0.007	0.003	0.002	0.002	0.007	0.006	0.005
CD at 5 %	0.028	0.026	0.019	0.008	0.007	0.005	0.020	0.018	0.013
Bioinoculants as spraying (S)									
S_1	1.21	1.33	1.27	0.302	0.324	0.313	0.765	0.821	0.793
S_2	1.27	1.39	1.33	0.319	0.340	0.330	0.784	0.844	0.814

Table 2. Influence of biofertilizers and bioinoculants on nutrient status (N, P and K) of mango leaf

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S_3	1.19	1.32	1.26	0.289	0.313	0.301	0.752	0.810	0.781
S_4	1.03	1.15	1.09	0.231	0.251	0.241	0.675	0.738	0.706
S.Em.±	0.010	0.009	0.007	0.003	0.002	0.002	0.007	0.006	0.005
CD at 5 %	0.028	0.026	0.019	0.008	0.007	0.005	0.020	0.018	0.013
Interaction (D x S)	**2019-20**	**2020-21**	**Pooled Mean**		**2019-20**	**2020-21**		**Pooled Mean**	
S.Em.±	0.019	0.018	0.013	0.006	0.005	0.004	0.014	0.013	0.009
CD at 5 %	0.056	0.051	0.037	0.016	0.014	0.010	NS	NS	0.026
Code	**Nitrogen content (%)**				**Phosphorus content (%)**				
D_1S_1	1.30	1.44	1.37		0.342		0.362	0.352	

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3.6 Interaction effect of biofertilizers and bioinoculants on nutrient status of mango leaf

Maximum nitrogen content (1.45, 1.60 and 1.53 %) and phosphorus content (0.391, 0.412 and 0.402 %) was recorded with D_3S_2 *i.e.,* Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree) with Novel organic liquid nutrient (2 %) in the years 2019-20, 2020-21 and pooled mean, respectively (Table 3). Whereas, maximum potassium content (0.91 %) in leaf was also recorded with D_3S_2 *i.e.,* Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree) with Novel organic liquid nutrient (2 %) in pooled mean (Table 4).

The combined application of bio-fertilizers (Bio NPK Consortium + VAM) and bioinoculant (Novel organic liquid fertilizer) significantly increased nitrogen, phosphorus and potassium content in leaf as bio-fertilizers increases nutrient-absorption rate and translocation in the tree system by increases nitrogen-fixation and bioinoculant which could be attributed to the rapid absorption of these elements by the plant surface and their translocation in the leaf. These results are in agreement with Sharma *et al*. (2013) in guava and Sathyanarayana *et al*. (2018) in gladiolus.

Table 3. Interaction effect of biofertilizers and bioinoculants on N and P content (%) of mango leaf

D_1S_2	1.34	1.47	1.40	0.351	0.366	0.358
D_1S_3	1.28	1.44	1.36	0.334	0.356	0.345
D_1S_4	1.10	1.22	1.16	0.258	0.275	0.267
D_2S_1	1.21	1.33	1.27	0.309	0.328	0.318
D_2S_2	1.26	1.38	1.32	0.313	0.342	0.328
D_2S_3	1.20	1.32	1.26	0.287	0.311	0.299
D_2S_4	1.05	1.17	1.11	0.236	0.259	0.247
				Soil microorganism (cfu/g)		
D_3S_1	1.38	1.52	1.45	0.363	0.393	0.378
D_3S_2	1.45	1.60	1.53	0.391	0.412	0.402
D_3S_3	1.37	1.51	1.44	0.351	0.380	0.366
D_3S_4	1.15	1.28	1.21	0.276	0.295	0.286
D_4S_1	0.941	1.04	0.990	0.193	0.212	0.202
D_4S_2	1.01	1.12	1.06	0.220	0.240	0.230
D_4S_3	0.914	1.01	0.964	0.184	0.204	0.194
D_4S_4	0.840	0.930	0.885	0.154	0.174	0.164
S.Em.±	0.019	0.018	0.013	0.006	0.005	0.004
CD at 5 %	0.056	0.051	0.037	0.016	0.014	0.010

Table 4. Interaction effect of biofertilizers and bioinoculants on K content (%) of mango leaf

3.7 Influence of biofertilizers and bioinoculants on soil microorganism

Treatment D_3S_2 [Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree) with spraying of Novel organic liquid nutrient (2 %)] recorded maximum soil microorganism 6.6×10^9 and 7.9×10^9 cfu/g during 2019-20 and 2020-21, respectively in soil (Table 5).

The soil microorganism population varied with different treatments of biofertilizers and bioinoculants. Higher soil bacteria were observed from the soil treated with biofertilizers and bioinoculants. Biofertilizers and bioinoculants were increased the nitrogen fixing bacteria and biological activities, promotes mycorrhiza symbiosis that sequentially improved the beneficial microorganism. These results are supported by Dutta *et al*. (2010) in papaya, Dutta *et al*. (2016) in mango and Kour *et al*. (2019) in aonla.

Treatments	**Pooled mean**			
	S_1	**S_2**	**S_3**	**S_4**
D_1	0.846	0.853	0.835	0.737
D_2	0.793	0.806	0.779	0.715
D_3	0.875	0.904	0.865	0.762
D_4	0.658	0.693	0.647	0.611
S.Em.±	0.009			
CD at 5 %	0.026			

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Treatment combinations	2019-20	2020-21
Initial count = 4.2×10^7 cfu/g		
D_1S_1	6.2×10^9	7.4×10^9
D_1S_2	6.3×10^9	7.5×10^9
D_1S_3	6.1×10^9	7.1×10^9
D_1S_4	5.4×10^8	6.4×10^8
D_2S_1	5.7×10^9	6.9×10^9
D_2S_2	6.0×10^9	7.0×10^9
D_2S_3	5.6×10^8	6.7×10^8
D_2S_4	5.3×10^8	6.3×10^8
D_3S_1	6.4×10^9	7.7×10^9
D_3S_2	6.6×10^9	7.9×10^9
D_3S_3	6.3×10^9	7.6×10^9
D_3S_4	5.4×10^8	6.6×10^8
D_4S_1	4.5×10^8	6.0×10^8
D_4S_2	5.4×10^8	6.1×10^8
D_4S_3	4.4×10^8	5.9×10^8
D_4S_4	4.3×10^7	5.8×10^8

Table 5. Influence of biofertilizers and bioinoculants on soil microorganism of mango

4. CONCLUSION

From the two years of field study, it can be concluded that drenching of biofertilizers like Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree) at pea stage increased yield, nutrient status of leaf and soil microorganism.

Similarly, spraying of Novel organic liquid nutrient (2 %) per tree twice during 2nd week of April and 1st week of May enhanced yield, nutrient status of leaf and microbial count of mango.

Further, combined effect of biofertilizers like Bio NPK Consortium (10 ml/tree) + VAM (10 g/tree) at pea stage with spraying of Novel organic liquid nutrient (2 %) per tree twice during 2nd week of April and 1st week of May increased yield, nutrient status of leaf (N, P and K) as well as soil microorganism.

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