

Studies on the Influence of Fertilizers and Bioinoculants on the Growth Parameters of Guava (*Psidium Guajava* L.) cv. L-49

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Abstract

The experiment was conducted influence of fertilizers and bioinoculants on growth characteristics of guava cv. L-49 at Fruit Research Station Imaliya, Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh, during 2022-23 and 2023-24 on twelve-year-old guava trees planted at 3.0 m x 3.0 m spacing. The experiment was carried out in factorial RBD with three replications. The data revealed that different levels of nutrients and bioinoculants alone and in combinations significantly influenced the growth parameter. The maximum increase in plant height (12.16% & (12.46%), canopy spread E-W (14.15% & (14.45%), canopy spread N-S (14.33% & (14.72%) and stem girth (11.19% & (10.07%) were recorded in N₂(100%RDF), during both years of experimentation respectively. With respect of bioinoculants, the maximum plant height (11.48% & (11.71%), canopy spread E-W (13.24% & (13.61%), canopy spread N-S (14.05% & (14.44%) and stem girth (9.72% & (8.85%) were observed in B₅(Bactobooster 200 ml), during both years respectively. Among the treatment combinations, T₁₀ (100% RDF + bactobooster200ml) was found superior with respect of the maximum increase in plant height (12.86% & (13.09%), in canopy spread E-W (15.77% & (16.11%), canopy spread N-S (16.16% & (16.66%) and in stem girth (12.54% & (11.01%) during both the years of experimentation respectively followed by T₁₅ (75% RDF + bactobooster200ml) and minimum was recorded in control (T₁).

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Keywords: Guava, fertilizers, bioinoculants, growth parameters

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Introduction:

Guava (*Psidium guajava* L.) belonging to the Myrtaceae family is a tropical fruit tree and is widely grown in many parts of the world for its delicious fruits and numerous health benefits. Among various cultivars, Guava Cv. L-49 is known for its high yield potential and quality fruit production. However, to achieve maximum yield and quality, appropriate nutrient management is crucial. Fertilizers and bioinoculants play significant roles in improving soil fertility and promoting plant growth. The application of nitrogen, phosphorus, potash, manures, and bio-fertilizer to synthesize amino acids acts as a precursor of polyamine and secondary messengers in growth characters. Synthesis of this amino acid is also influenced by phytohormones which are formed in plants due to the application of chemical and biofertilizers as reported by Goswami et al. (2012), Surage et al. (2017) and Dwivedi et al. (2018) in guava. The significant increase in plant height, canopy spread and trunk girth might be due to the active and rapid multiplication of bacteria especially in the rhizosphere creating favourable conditions for

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nitrogen fixation and phosphorus solubilization at a higher rate through nitrogen supply by nitrogenous fertilizers and supply of other nutrients, bacterial secretion, hormone production and supply of antibacterial and antifungal compounds, which were favourable for growth and ultimately increased yield.

Material and methods:

The experiment was carried out on twelve years old guava orchard with planting distance 3 (m) x 3 (m) at Fruit Research Station Imaliya, Department of Horticulture, Jawaharlal Nehru Agriculture University, Jabalpur, Jabalpur, Madhya Pradesh during the year 2022-23 and 2023-24 during mrig bahar of Guava. The experimental site was situated at 23.100 North latitude, 79.500 East longitudes and at an altitude of 411.76 meters above the mean sea level. The site is typically semi-arid with little rainfall during the rainy season. The Experiment was conducted in Factorial Randomized Block Design with three replications. The experiment consists of two factors, factor A - Doses of Nutrients (04), Control(N₁), 100%RDF(N₂), 75%RDF(N₃),50%RDF(N₄) and Factor B - Levels of Bioinoculants (05) No Bioinoculant/control(B₁), Biofertilisol 100ml Plant⁻¹(B₂), Bactobooster 100ml Plant⁻¹ (B₃), Biofertilisol 200ml Plant⁻¹ (B₄), Bactobooster 200ml(B₅) having 20 different treatment combinations. The plant height of guava was measured using measuring tape from the base to the apex of the trees. The stem girth of guava was recorded using Vernier Callipers. Plant Canopy spread (E-W and N-S) were measured with the help of measuring tape. Soil physicochemical parameters including soil pH, electrical conductivity (dSm⁻¹), organic carbon (%) and available NPK (kg ha⁻¹) were recorded at the initiation of the experiment. Soil pH was determined by using glass electrode pH meter (Jackson, 1973), electrical conductivity of soil by using standard precision conductivity bridge (Jackson, 1973), organic carbon content by Walkley and Black (1934) wet digestion method, available Nitrogen (kg/ha) by using alkaline Potassium Permanganate method (Subbiah and Asija, 1956), available soil Phosphorus (kg/ha) by Olsen et al., (1954), available potassium content (kg ha⁻¹) by Flame Photometer (Metson, 1956). The data obtained during the experiment were subjected to statistical analysis using Fisher's analysis of variance technique.

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Table 1: Physico-chemical properties of experimental soil

Particulars	Values	
	2022-23	2023-24
Soil pH	7.53	7.45
Electrical conductivity (dSm ⁻¹)	0.321	0.287
Organic carbon (g kg ⁻¹)	5.15	5.0
Available nitrogen (kg ha ⁻¹)	263.42	234.96
Available phosphorus (kg ha ⁻¹)	14.95	12.70
Available potassium (kg ha ⁻¹)	321.57	271.19

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Results and Discussion:

Plant Height: Data on plant height as influenced by nutrients and bioinoculants and their combinations are presented in Table 2. The data revealed that plant height was considerably increased during both consecutive years of experimentation. Among different levels of nutrients, the maximum increase in plant height (12.16%) & (12.46%) were found in N₂ (100% RDF). Regarding bioinoculants, the maximum increase in plant height (11.48%) & (11.71%) was recorded in B₅ (Bactobooster 200ml). Among the treatment combinations, T₁₀ (100% RDF + bactobooster200ml) was found superior with respect to the maximum increase in plant height (12.86%) & (13.09%), followed by T₁₅ (75% RDF + bactobooster200ml) with increase in plant height (12.81%) & (12.89%). The minimum increases in plant height (9.14%) & (9.34%) was recorded in control (T₁). Similar results were reported by Jugnake et al. 2017 in sweet orange, Patil and Shinde, 2013 in banana, Rani et al. 2021 in guava. The increase in vegetative characteristics of the plant may be attributed to the increased availability of nutrients such as N, P and K in plants leading to increased formation of plant metabolites that might have helped to build up the plant tissue (Claypol, 1938). In mango, the application of Azotobacter along with Phosphorus Solubilizing Bacteria (PSB) and Vermicompost at the concentration of 50g, 50g, 3kg respectively can increase the plant growth parameters particularly girth of the rootstock, height of the plant of the mango tree (Poonia et. al 2018). The inoculation of three biofertilizers viz; Azospirillum, Pseudomonas fluorescence and Vesicular Arbuscular Mycorrhiza (VAM) in the potting mixture of grafted Alphonso mango enhance the height of the plant (Shankarappa et al. 2018).

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Table 2 Influence of levels of nutrients and bioinoculants on Plant height (cm) of guava cv. L-49

Treatments	Influence of levels of nutrients and bioinoculants on Plant height (cm)					
	Initial height 2022-23	Height at harvest stage 2022-23	Increase in height (%) 2022-23	Initial height 2023-24	Height at harvest stage 2023-24	Increase in height (%) 2023-24
Factor A (Level of nutrients)						
N1	4.08	4.48	10.00	4.13	4.56	10.34
N2	3.86	4.32	12.16	3.91	4.39	12.46
N3	4.03	4.49	11.59	4.11	4.58	11.80
N4	3.73	4.10	10.10	3.78	4.16	10.30
SEm±	0.13	0.13	0.47	0.13	0.13	0.41
CD (5%)	NS	NS	1.35	NS	NS	1.18
Factor B (Bioinoculants)						
B1	3.96	4.36	10.23	4.00	4.42	10.66
B2	3.83	4.24	10.94	3.91	4.34	11.16
B3	4.05	4.50	11.10	4.10	4.56	11.31
B4	4.03	4.47	11.07	4.08	4.54	11.29
B5	3.77	4.19	11.48	3.81	4.25	11.71
SEm±	0.15	0.15	0.53	0.15	0.15	0.46
CD (5%)	NS	NS	NS	NS	NS	NS
Interaction (A x B)						
N1B1	4.52	4.93	9.14	4.55	4.98	9.34
N1B2	3.86	4.22	9.45	3.89	4.27	9.70

N1B3	4.11	4.50	9.48	4.18	4.60	10.13
N1B4	3.71	4.06	9.76	3.75	4.11	10.04
N1B5	4.26	4.68	9.90	4.32	4.74	9.96
N2B1	3.69	4.11	11.40	3.72	4.16	11.83
N2B2	3.93	4.37	11.52	4.10	4.56	11.52
N2B3	3.92	4.37	11.81	3.98	4.44	11.83
N2B4	3.89	4.38	12.60	3.95	4.46	12.91
N2B5	3.76	4.24	12.86	3.82	4.32	13.09
N3B1	3.75	4.13	10.52	3.81	4.20	10.63
N3B2	4.10	4.58	11.75	4.15	4.65	12.09
N3B3	3.87	4.33	11.91	3.92	4.40	12.27
N3B4	4.18	4.67	11.82	4.22	4.73	12.22
N3B5	3.80	4.27	12.81	3.85	4.34	12.89
N4B1	3.87	4.26	10.08	3.92	4.32	10.14
N4B2	4.33	4.76	10.28	4.35	4.80	10.66
N4B3	3.86	4.27	10.61	3.89	4.32	11.13
N4B4	3.48	3.84	10.71	3.52	3.91	11.01
N4B5	3.65	4.04	10.88	3.73	4.15	11.15
SEm±	0.30	0.29	1.06	0.29	0.29	0.92
CD (5%)	NS	NS	NS	NS	NS	NS

Canopy Spread (East-West): Data recorded on canopy spread E-W as influenced by nutrients and bioinoculants and their combinations are presented in Table 3. The data revealed that canopy spread E-W was significantly increased during both years of experimentation. Among different levels of nutrients, the maximum increase in canopy spread E-W (14.15%) & (14.45%) was found in N₂(100%RDF). With respect to bioinoculants, the maximum increase in canopy spread E-W (13.24%) & (13.61%) was found in B₅(Bactobooster 200ml) respectively during both years. Among the treatment combinations, T₁₀ (100% RDF + bactobooster200ml) was found superior with respect to the maximum increases in canopy spread E-W (15.77%) & (16.11%) followed by T₁₅ (75% RDF + bactobooster200ml) with increase in canopy spread E-W (14.89%) & (15.21%). The minimum increase in canopy spread E-W (9.76%) & (10.08%) was recorded in control (T₁). Biofertilizers produce growth-promoting substances viz., auxin, gibberellins and cytokinins, which contribute toward the vigorous growth of the plant (Azcon and Barea, 1975).

Table 3 Influence of levels of nutrients and bioinoculants on Canopy Spread (E-W) of guava cv. L-49

Treatments	Influence of levels of nutrients and bioinoculants on Canopy Spread (E-W)					
	Initial Canopy Spread (E-W) 2022-23	Canopy Spread (E-W) at harvest stage 2022-23	Increase in Canopy Spread (E-W) (%) 2022-23	Initial Canopy Spread (E-W) 2023-24	Canopy Spread (E-W) at harvest stage 2023-24	Increase in Canopy Spread (E-W) (%) 2023-24
Factor A (Level of nutrients)						

N1	3.48	3.87	11.72	3.54	3.95	12.14
N2	3.39	3.85	14.15	3.46	3.93	14.45
N3	3.62	4.07	12.75	3.69	4.16	13.03
N4	3.58	4.00	12.14	3.63	4.08	12.54
SEm±	0.17	0.17	0.65	0.18	0.18	0.65
CD (5%)	0.49	0.50	NS	0.50	0.50	NS
Factor B (Bioinoculants)						
B1	3.89	4.34	11.79	3.95	4.42	12.08
B2	3.59	4.00	12.35	3.65	4.08	12.68
B3	3.45	3.88	12.84	3.51	3.95	13.23
B4	3.34	3.78	13.23	3.38	3.83	13.60
B5	3.32	3.75	13.24	3.40	3.86	13.61
SEm±	0.19	0.19	0.73	0.20	0.20	0.72
CD (5%)	0.55	0.55	NS	0.56	0.56	NS
Interaction (A x B)						
N1B1	4.08	4.46	9.76	4.15	4.54	10.08
N1B2	4.25	4.72	11.17	4.32	4.81	11.46
N1B3	3.67	4.09	11.57	3.71	4.15	11.98
N1B4	3.35	3.74	11.71	3.41	3.82	12.30
N1B5	3.42	3.81	12.00	3.46	3.87	12.45
N2B1	3.22	3.64	13.46	3.28	3.74	13.96
N2B2	3.45	3.91	13.51	3.52	4.00	13.82
N2B3	2.90	3.30	13.78	2.96	3.37	14.20
N2B4	3.15	3.61	14.76	3.22	3.70	15.07
N2B5	3.05	3.50	15.77	3.11	3.58	16.11
N3B1	3.65	4.09	12.14	3.71	4.16	12.41
N3B2	3.58	4.03	12.71	3.65	4.11	12.95
N3B3	3.38	3.81	13.63	3.45	3.90	13.91
N3B4	3.25	3.70	14.10	3.32	3.79	14.41
N3B5	3.22	3.65	14.89	3.28	3.74	15.21
N4B1	3.68	4.09	11.12	3.72	4.15	11.53
N4B2	3.65	4.06	11.33	3.71	4.14	11.68
N4B3	3.75	4.17	11.71	3.81	4.25	12.09
N4B4	4.10	4.58	11.81	4.16	4.66	12.03
N4B5	3.57	4.01	12.84	3.63	4.09	13.16
SEm±	0.39	0.39	1.46	0.39	0.39	1.45
CD (5%)	1.10	1.11	NS	1.12	1.12	NS

Canopy Spread (North-South): Data regarding canopy spread N-S as influenced by nutrients and bioinoculants and their combinations are presented in Table 4. The data revealed that canopy spread N-S was considerably increased during two consecutive years of experimentation. Among different levels of nutrients, the maximum increases in canopy spread N-S (14.33%) & (14.72%) was found in N₂(100% RDF). With respect to bioinoculants, increase in canopy spread N-S (14.05%) & (14.44%) was recorded in B₅(Bactobooster 200ml). Among the treatment combinations, T₁₀ (100% RDF + bactobooster200ml)) was found superior with respect to the increase in canopy spread N-S (16.16%) & (16.66%), followed by T₁₅ (75% RDF + bactobooster200ml) with increase in canopy spread N-S (16.07%) & (16.38%). The

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minimum increase in canopy spread N-S (9.16%) & (9.55%) was recorded in control (T₁). Similar findings by Chandra et al. (2016), Godage et al. (2013) in guava.

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Table 4 Influence of levels of nutrients and bioinoculants on Canopy Spread (N-S) of guava cv. L-49

Treatments	Influence of levels of nutrients and bioinoculants on Canopy Spread (N-S)					
	Initial Canopy Spread (N-S) 2022-23	Canopy Spread (N-S) at harvest stage 2022-23	Increase in Canopy Spread (N-S) (%) 2022-23	Initial Canopy Spread (N-S) 2023-24	Canopy Spread (N-S) at harvest stage 2023-24	Increase in Canopy Spread (N-S) (%) 2023-24
Factor A (Level of nutrients)						
N1	3.81	4.22	11.17	3.86	4.30	11.53
N2	3.27	3.72	14.33	3.33	3.80	14.72
N3	3.40	3.86	13.89	3.47	3.94	14.21
N4	3.67	4.07	11.36	3.72	4.14	11.76
SEm±	0.16	0.16	0.67	0.16	0.16	0.68
CD (5%)	0.46	NS	1.92	0.46	NS	1.95
Factor B (Bioinoculants)						
B1	4.00	4.45	11.53	4.06	4.52	11.89
B2	3.59	4.01	12.15	3.65	4.09	12.51
B3	3.50	3.91	12.62	3.56	3.99	12.97
B4	3.36	3.79	13.09	3.42	3.87	13.46
B5	3.23	3.68	14.05	3.29	3.75	14.44
SEm±	0.18	0.18	0.75	0.18	0.18	0.76
CD (5%)	0.51	0.51	2.15	0.52	0.52	2.18
Interaction (A x B)						
N1B1	4.18	4.56	9.16	4.22	4.62	9.55
N1B2	4.42	4.84	9.88	4.47	4.92	10.25
N1B3	3.98	4.37	9.89	4.06	4.47	10.16
N1B4	3.88	4.28	10.39	3.95	4.37	10.72
N1B5	3.63	4.04	11.33	3.69	4.12	11.70
N2B1	3.65	4.12	12.90	3.72	4.21	13.19
N2B2	3.35	3.80	13.55	3.42	3.89	13.94
N2B3	3.12	3.55	14.88	3.18	3.63	15.24
N2B4	2.87	3.31	15.74	2.93	3.39	16.07
N2B5	2.88	3.34	16.16	2.92	3.40	16.66
N3B1	3.88	4.32	11.63	3.93	4.39	12.10
N3B2	3.88	4.35	12.38	3.93	4.42	12.75
N3B3	2.92	3.33	14.76	2.97	3.40	15.22
N3B4	2.90	3.35	15.43	2.97	3.43	15.74
N3B5	2.82	3.25	16.07	2.89	3.34	16.38
N4B1	3.58	3.98	11.49	3.62	4.04	11.93
N4B2	3.68	4.10	11.49	3.72	4.16	11.94
N4B3	3.62	4.04	11.87	3.67	4.11	12.24
N4B4	3.48	3.91	12.37	3.54	3.98	12.71

N4B5	4.03	4.51	12.38	4.10	4.60	12.61
SEm±	0.36	0.36	1.50	0.36	0.36	1.52
CD (5%)	1.03	NS	4.30	1.04	NS	4.35

Stem Girth: Data regarding stem girth as influenced by nutrients and bioinoculants and their combinations are presented in Table 5. The data revealed that stem girth was considerably increased during both years of experimentation. Among different levels of nutrients, the maximum increase in stem girth (11.19%) & (10.07%) was recorded in N₂(100%RDF). With respect to bioinoculants the maximum increase in stem girth (9.72%) & (8.85%) was recorded in B₅ (Bactobooster 200ml), Among the treatment combinations, T₁₀ (100% RDF + bactobooster200ml) was found superior regarding the maximum increase in stem girth (12.54%) & (11.01%) followed by T₁₅ (75% RDF + bactobooster200ml) with increase in stem girth (11.93%) & (10.69%), whereas minimum increase in stem girth (6.68%) & (6.30%) was recorded in control (T₁).The biofertilizers help in fixing atmospheric nitrogen and also solubilization of phosphorus and potassium by producing organic acids through their metabolic process (Varma et al. 2011). Biofertilizers, particularly the inoculation of Biofertilisol and Bactobooster have a beneficial impact on the structural growth of guava trees. The enhancement in growth parameters might be due to a continuous supply of nutrients by the quick release of inorganic fertilizers (level of nutrients) in the initial stages and the slow release of organic fertilizers (Bioinoculants- Biofertilisol & Bactobooster) at later stages. Our results are in agreement with the findings of Ram et al. (2007), Naik and Babu (2007), Dutta et al. (2009) and Goswami et al. (2012) in guava Atom (2013).

Table 5 Influence of levels of nutrients and bioinoculants on Stem girth (cm) of guava cv. L-49

Treatments	Influence of levels of nutrients and bioinoculants on Stem girth (cm)					
	Initial Stem girth (cm) 2022-23	Stem girth (cm) at harvest stage 2022-23	Increase in Stem girth (%) 2022-23	Initial Stem girth (cm) 2023-24	Stem girth (cm) at harvest stage 2023-24	Increase in Stem girth (%) 2023-24
Factor A (Level of nutrients)						
N1	31.44	33.72	7.47	33.69	36.00	6.97
N2	30.65	33.90	11.19	33.90	37.17	10.07
N3	34.20	37.48	10.23	37.47	40.77	9.19
N4	33.01	35.67	8.30	35.67	38.35	7.70
SEm±	2.06	2.06	0.61	1.95	1.94	0.47
CD (5%)	NS	5.89	1.75	NS	5.56	1.35
Factor B (Bioinoculants)						
B1	32.96	35.79	8.78	35.84	38.70	8.08
B2	32.57	35.29	9.13	35.29	38.04	8.30
B3	34.05	36.99	9.23	37.00	39.96	8.35
B4	31.05	34.01	9.63	33.97	36.96	8.82
B5	31.00	33.87	9.72	33.81	36.70	8.85

SEm±	2.30	2.30	0.68	2.18	2.17	0.53
CD (5%)	NS	6.58	NS	NS	6.22	NS
Interaction (A x B)						
N1B1	34.18	36.44	6.68	36.51	38.79	6.30
N1B2	33.54	35.87	7.10	35.81	38.17	6.63
N1B3	32.53	34.89	7.26	34.78	37.16	6.85
N1B4	34.00	36.54	7.62	36.54	39.11	7.14
N1B5	28.60	30.77	8.13	30.78	32.97	7.46
N2B1	34.33	37.62	9.70	37.51	40.82	8.90
N2B2	31.67	34.93	10.37	34.95	38.23	9.41
N2B3	30.00	33.09	11.22	33.09	36.19	10.15
N2B4	29.67	33.05	11.60	33.04	36.44	10.39
N2B5	29.67	32.90	12.54	32.85	36.10	11.01
N3B1	37.67	40.77	9.55	40.78	43.90	8.46
N3B2	32.33	35.52	9.91	35.57	38.78	9.05
N3B3	37.67	41.03	9.91	41.06	44.44	8.76
N3B4	32.60	35.97	10.38	35.96	39.34	9.44
N3B5	28.67	32.03	11.93	32.04	35.42	10.69
N4B1	36.33	39.04	7.97	39.07	41.80	7.34
N4B2	33.67	36.29	8.16	36.34	39.00	7.57
N4B3	28.33	30.61	8.20	30.59	32.90	7.61
N4B4	31.67	34.33	8.45	34.30	36.99	7.86
N4B5	29.40	32.14	9.30	32.11	34.87	8.59
SEm±	4.60	4.60	1.37	4.35	4.34	1.05
CD (5%)	NS	13.16	NS	NS	12.44	NS

Conclusion:

Based on the results proved that different levels of nutrients and bioinoculants alone and in combinations significantly influenced the growth parameter. The maximum increase in plant height (12.16%) & (12.46%), canopy spread E-W (14.15%) & (14.45%), canopy spread N-S (14.33%) & (14.72%) and stem girth (11.19%) & (10.07%) were recorded in N₂(100%RDF), during both years of experimentation respectively. With respect to bioinoculants, the maximum increase in plant height (11.48%) & (11.71%), canopy spread E-W (13.24%) & (13.61%), canopy spread N-S (14.05%) & (14.44%) and stem girth (9.72%) & (8.85%) were observed in B₅(Bactobooster 200 ml) during both years respectively. Among the treatment combinations, T₁₀ (100% RDF + bactobooster200ml) was found superior with respect to maximum increase in plant height (12.86%) & (13.09%), in canopy spread E-W (15.77%) & (16.11%), canopy spread N-S (16.16%) & (16.66%) and in stem girth (12.54%) & (11.01%) during both the years of experimentation respectively followed by T₁₅ (75% RDF + bactobooster200ml) and minimum was recorded in control (T₁).

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References:

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