

Sustainable management of Root Knot Nematodes in Pomegranate: Impact of Bio control Agents on Yield and Grower Profitability (Sciforum-164436)

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Background

Pomegranate is a perennial crop which is a good host to root knot nematodes and can harbour high nematode populations causing heavy yield losses and when predisposes secondary infection of soil borne pathogens, death of plants occur. Present study investigated the biocontrol potential of *Purpureocillium lilacinum*, *Pochonia chlamydosporia*, and *Bacillus subtilis* at different doses to manage *Meloidogyne incognita* infestations in pomegranate at two locations, Haryana and Rajasthan for three consecutive years.

Table 1: Details regarding the specific locations chosen for the experimental purpose

Location	Village/ location	GPS co-ordinates	temperature (C)	annual rainfall (mm)	relative humidity (%)	soil type	Elevation (meters)
1.	Morkhedi, Rohtak district, Haryana	28.85° N, 76.80° E	7-40	592	66	Sandy loamy	221.85
2.	Budiwad, Balotra District, Rajasthan	25.69° N, 72.21° E	2-48	307.7	80	desert soils	106 metres

Table 2. Experimental treatments, application details, and dosages for biocontrol-based management of *Meloidogyne incognita* in pomegranate orchards

Treatment No.	Dosage	Name of bioagents	Formulation Type	FYM mixed	source	CFU	Strain name
T1	30 ml	<i>Pochonia chlamydosporia</i>	Oil dispersion formulation	5 kg/plant	TNAU, Department of Nematology	1×10 ⁸	TNAU-Pc001
T2	10 ml	<i>Bacillus subtilis</i>	Liquid (carrier Omni protectant glycerol)	5 kg/plant	TNAU, Department of Plant pathology	1×10 ⁸	Bbv57
T3	60 ml	<i>Pochonia chlamydosporia</i>	Oil dispersion formulation	5 kg/plant	TNAU, Department of Nematology	1×10 ⁸	TNAU-Pc001
T4	20 ml	<i>Bacillus subtilis</i>	Liquid (carrier Omni protectant glycerol)	5 kg/plant	TNAU, Department of Plant pathology	1×10 ⁸	Bbv57
T5	15 g	<i>Purpureocillium lilacinum</i>	Talc	5 kg/plant	TNAU, Department of Nematology	1×10 ⁸	TNAUPL-001
T6	30 g	<i>Purpureocillium lilacinum</i>	Talc	5 kg/plant	TNAU, Department of Nematology	1×10 ⁸	
T7	500 g/plant	Neem cake	Cake	5 kg/plant	Local	-	-
T8	5 Kg/plant	FYM	Well decomposed	-	Local	-	-
T9	-	Control	-	-	-	-	-

Results:

Table 3: Comparative efficacy of treatments on the nematode soil population in two locations (2021-24)

Treatments	Rohtak (Location 1)				Balotra (Location 2)			
	2021 INP	2022	2023	2024	2021 INP	2022	2023	2024
T1	365.2 ^a	252.8 ^b	205.0 ^b	181.4 ^b	842.4 ^{bc}	696.6 ^{de}	384.2 ^{de}	167.0 ^c
T2	356.4 ^a	243.6 ^b	191.8 ^b	174.6 ^b	818.2 ^{bc}	697.4 ^{de}	371.6 ^{ef}	162.0 ^c
T3	359 ^a	245.0 ^b	188.4 ^b	176.4 ^b	788.4 ^{bc}	685.6 ^e	358.4 ^{fg}	156.6 ^c
T4	334.8 ^a	223.4 ^b	188.8 ^b	173.2 ^b	773.6 ^c	681.2 ^e	355.0 ^g	154.4 ^c
T5	379.6 ^a	275.6 ^b	189.8 ^b	176.4 ^b	881.2 ^{ab}	755.4 ^c	395.4 ^{cd}	178.6 ^c
T6	362.2 ^a	256.0 ^b	187.0 ^b	190.8 ^b	939.0 ^a	722.0 ^d	386.8 ^{de}	177.8 ^c
T7	371 ^a	335.0 ^{ab}	186.2 ^b	194.2 ^b	948.4 ^a	852.8 ^b	418.2 ^b	373.8 ^b
T8	365.6 ^a	268.2 ^b	168.6 ^b	180.2 ^b	940.6 ^a	770.8 ^c	406.6 ^{bc}	215.0 ^c
T9	493.8 ^a	508.2 ^a	830.0 ^a	900.0 ^a	961.8 ^a	971.0 ^a	1002.6 ^a	1165.8 ^a

Figure 5 : Root Gall index (pooled) during year 2024 both the locations

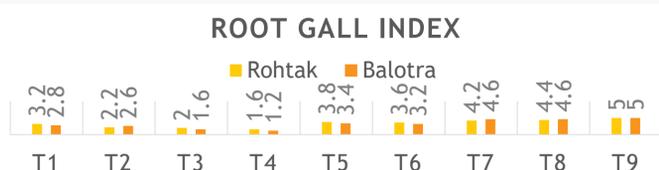


Table 4: Galls per plant during 2022-24 at both the locations

Treatments	Rohtak (Location 1)				Balotra (Location 2)			
	Yi	Y1	Y2	Y3	Yi	Y1	Y2	Y3
T1	298 ^{de}	221 ^{ef}	230 ^{cd}	178 ^{de}	167.4 ^a	131.6 ^{de}	109.8 ^{de}	83.0 ^{cd}
T2	28 ^{ef}	214 ^f	229 ^{cd}	174 ^{de}	168.2 ^a	128.2 ^{de}	105.8 ^{ef}	78.2 ^{de}
T3	270 ^f	207 ^f	212 ^{de}	163 ^e	163.4 ^a	126.6 ^{de}	103.6 ^{ef}	76.0 ^{de}
T4	225 ^g	208 ^f	173 ^e	99 ^f	161.0 ^a	124.4 ^e	100.4 ^f	72.4 ^e
T5	334 ^c	262 ^{cd}	250 ^{cd}	213 ^c	172.4 ^a	136.0 ^{cd}	114.8 ^{cd}	84.6 ^{cd}
T6	319 ^{cd}	240 ^{de}	254 ^{cd}	182 ^d	169.4 ^a	130.0 ^{de}	110.6 ^{cde}	83.4 ^{cd}
T7	330 ^c	284 ^c	275 ^c	220 ^c	166.4 ^a	156.2 ^b	138.6 ^b	138.4 ^b
T8	707 ^b	676 ^b	628 ^b	627 ^b	182.2 ^a	141.8 ^c	117.6 ^c	91.6 ^c
T9	1082 ^a	1121 ^a	1214 ^a	1274 ^a	167.8 ^a	192.2 ^a	197.8 ^a	204.4 ^a



Figure 1. Nematode galls in roots (5 grams) increased in the control plants

Figure 2. Reduction in number of nematode galls in roots (5 grams) in treated plants



Figure 3. Formation of new white fibrous roots devoid of galls after the treatments



Figure 4. Heavy infestation of root knot galls in the control plants

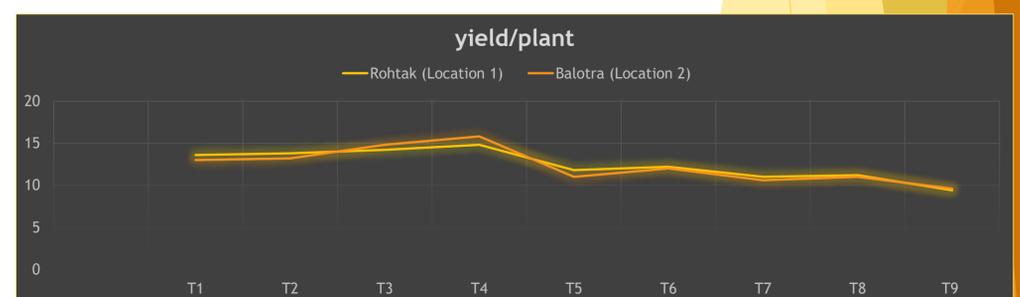
Table 10: Plant height at Rohtak, Haryana (Location 1)

Rohtak	June 21	December 21	June 22	December 22	June 23	December 23	June 24
T1	60.346 ^a	89.440 ^b	118.276 ^{bc}	149.796 ^{cd}	196.684 ^{ab}	209.996 ^{bc}	250.400 ^c
T2	61.108 ^a	89.820 ^{ab}	120.822 ^{ab}	151.490 ^{bc}	198.350 ^a	209.368 ^{bc}	255.400 ^{bc}
T3	61.258 ^a	90.198 ^{ab}	121.132 ^{ab}	154.494 ^{ab}	197.532 ^{ab}	211.772 ^{ab}	264.490 ^b
T4	60.244 ^a	91.974 ^a	122.862 ^a	155.538 ^a	198.486 ^a	214.644 ^a	277.238 ^a
T5	61.732 ^a	85.170 ^c	118.338 ^{bc}	145.774 ^e	196.396 ^{ab}	214.484 ^a	231.800 ^d
T6	60.612 ^a	86.526 ^c	118.542 ^{bc}	147.726 ^{de}	196.106 ^{ab}	210.816 ^{bc}	234.400 ^d
T7	60.746 ^a	74.796 ^d	114.676 ^d	145.662 ^e	145.260 ^c	208.28 ^c	230.900 ^d
T8	61.654 ^a	86.556 ^c	116.508 ^{cd}	145.418 ^e	195.174 ^b	208.960 ^{bc}	230.000 ^d
T9	60.318 ^a	61.794 ^e	75.624 ^e	76.304 ^f	78.364 ^d	82.308 ^d	82.308 ^e

Table 11: Plant height at Balotra, Rajasthan (Location 2)

Rajasthan	June 21	December 21	June 22	December 22	June 23	December 23	June 24
T1	147.6 ^a	163.6 ^{bc}	185.0 ^{cd}	217.1 ^{bc}	245.8 ^b	287.8 ^{ab}	343.0 ^{ab}
T2	159.4 ^a	164.0 ^{bc}	188.6 ^{bc}	220.4 ^{abc}	251.6 ^a	291.7 ^{ab}	344.5 ^{ab}
T3	152.8 ^a	169.0 ^b	192.4 ^{ab}	223.2 ^{ab}	253.3 ^a	288.6 ^{ab}	347.8 ^{ab}
T4	155.6 ^a	176.4 ^a	195.3 ^a	225.3 ^a	255.0 ^a	294.9 ^a	352.0 ^a
T5	153.0 ^a	155.6 ^d	182.4 ^d	214.4 ^c	243.2 ^{bc}	277.1 ^c	351.0 ^a
T6	152.8 ^a	157.8 ^{cd}	185.2 ^{cd}	217.7 ^{bc}	244.6 ^{bc}	285.2 ^b	343.4 ^{ab}
T7	151.6 ^a	152.8 ^d	165.0 ^e	183.3 ^d	193.6 ^d	209.6 ^d	219.7 ^c
T8	148.6 ^a	153.8 ^d	185.4 ^{cd}	215.0 ^c	239.9 ^c	276.3 ^c	334.3 ^b
T9	148.8 ^a	151.6 ^d	161.6 ^e	177.2 ^d	183.8 ^e	190.1 ^e	197.0 ^d

Table 13: Effect of different treatments on fruit yield per plant at both the locations



- Both the fungal and bacterial biocontrol agents effectively reduced nematode galling and the overall nematode population in soil while concurrently boosting pomegranate fruit yield.
- Treatment with *B. subtilis* exhibited the lowest gall count (225-99), while remaining treatments also showed fewer galls, particularly in later years.
- Moreover, in Rajasthan, the number of galls per 5 grams of roots was lower than in Rohtak, with *B. subtilis* showing the lowest gall index, especially in the third year.

Conclusions:

- Over time, all the treatments showed progressive increase in plant height across time i.e. June 2021 to June 2024. *B. subtilis* at highest dose achieved maximum height at every point from December 2021 onwards.
- Also in both the locations plant width expanded greatly in plants, treated with *B. subtilis* exhibiting the significant difference from the control plants.
- Hence, continuous and long term application of bioagents reduced soil nematode populations and enhanced the fruit yield and farmers profitability.