LIST OF FIGURES	PAGES
Figure 1.1: Microbial biological control agent (MBCA) in Action.	4
Figure 1.2: Mode of Actions of Antibiotics in Bacteria	9
Figure 1.3: Mechanism of action of PGPR.	12
Figure 1.4: Structural overview of ethylene biosynthesis.	22
Figure 1.5: Structural overview of ACC conjugation and deamination.	24
Figure 1.6: Typical structures of Mycorrhiza	26
Figure 1.7: Developmental stages of arbuscular mycorrhizae.	27
Figure 1.8: Nutrient uptake pathways.	28
Figure 2.1: Map showing soil Sample collection sites from Gujarat region	41
Figure 2.2A: Actinomycetes isolation from different soil sample	46
Figure 2.2B: Colony morphology of different actinomycetes isolates on	46
Actinomycetes isolation agar medium showing different pigment and colour	
Figure 2.3. PCR amplification of 16s rDNA of actinomycetes strains	47
Figure 2.4: Molecular phylogenetic analysis by maximum likelihood method.	48
Figure 2.5: Colony characterization of actinomycete isolates: Variation in	50
Streptomyces isolates aerial hyphae and spores colour and texture on ISP-1. A: S-	
107 Strain; B: S-280 Strain; C: S-9 Strain	
Figure 2.6: Colony characterization of actinomycete isolates: Variation in	50
Streptomyces isolates aerial hyphae and spores colour and texture on ISP-2. A: S-	
107 Strain; B: S-280 Strain; C: S-9 Strain	
Figure 2.7: Colony characterization of actinomycete isolates: Variation in	50
Streptomyces isolates aerial hyphae and spores colour and texture on ISP-3. A: S-	
107 Strain; B: S-280 Strain; C: S-9 Strain	
Figure 2.8: Colony characterization of actinomycete isolates: Variation in	51
Streptomyces isolates aerial hyphae and spores colour and texture on ISP-4. A: S-	
107 Strain; B: S-280 Strain; C: S-9 Strain	
Figure 2.9: Colony characterization of actinomycete isolates: Variation in	51
Streptomyces isolates aerial hyphae and spores colour and texture on ISP-5. A: S-	
107 Strain; B: S-280 Strain; C: S-9 Strain	

Figure 2.10: Colony characterization of actinomycete isolates: Variation in	51
Streptomyces isolates aerial hyphae and spores colour and texture on ISP-6. A: S-	
107 Strain; B: S-280 Strain; C: S-9 Strain	
Figure 2.11: Colony characterization of actinomycete isolates: Variation in	52
Streptomyces isolates aerial hyphae and spores colour and texture on ISP-7. A: S-	
107 Strain; B: S-280 Strain; C: S-9 Strain	
Figure 2.12: Gram staining of rhizospheric actinomycetes isolates. A: S-280; B: S	52
9; C: S-107	
Figure 2.13: ACC deaminase production by <i>Streptomyces</i> spp. S-9	54
Figure 3.1: Scanning electron microscopy of strain S-9 grown on ISP 3 for	64
4 weeks at 28 °C	
Figure 3.2: Scanning electron micrographs (SEM) of pathogen-bacterial	65
interaction during antagonism assay against F. udum in dual culture.	
Figure 3.3: Bioactive fraction of S-9 ethyl acetate against Fusarium udum	66
Figure 3.4: LC-MS Chromatogram of S-9-Ethyl Acetate Extract (A) ESI+; (B)	67
ESI-	
Figure 3.5: Mass fragmentation of S-9 ethyl acetate extract at 15.44 retention time	68
in ES+	
Figure 3.6: Mass fragmentation of S-9 ethyl acetate extract at 25.08 retention time	69
in ES+	
Figure 3.7: Mass fragmentation of S-9 ethyl acetate extract at 13.94 retention time	69
in ES-	
Figure 3.8: Mass fragmentation of S-9 ethyl acetate extract at 15.45 retention time	70
in ES-	
Figure 3.9: Molecular Structure of 2-(4-Chloro-3,5-dimethyl-1H-pyrazol-1-yl)-N-	70
(3,5-difluoro-4-iodophenyl) acetamide	
Figure 3.10: Molecular Structure of (2S,5S,8S,11S)-2,5,8-Tribenzyl-3,6,9-	71
trimethyl-11-(2-naphthylmethyl)-4,7,10,13-tetraoxo-3,6,9,12-tetraazatetradecan-1-	
amide	
Figure 3.11: Molecular Structure of (5E)-3-[(4-bromophenyl)methyl]-5-[[4-[(2,4-	71
dichlorophenyl)methoxy]-3,5-diiodophenyl]methylidene]imidazolidine-2,4-dione	

Figure 3.12: Molecular Structure of $3,3'-\{4-[(3\beta,5\alpha)-8-Methylcholestan-3-yl]-1,1-$	72
butanediyl}bis(5-chloro-6-hydroxybenzoic acid)	
Figure 3.13: ¹ H NMR Spectra of purified bioactive principle isolated from	73
Streptomyces sp. S-9	
Figure 3.14: IR Spectral	74
Figure 4.1: Biomass in gm/L for selection of basal medium	83
Figure 4.2: Effect of salt formulation on Mycelial biomass	84
Figure 4.3: Biomass (gm/L) in different carbon sources	85
Figure 4.4: Antifungal activity on medium containing different carbon source	85
Figure 4.5: Antifungal activity % in different carbon sources	86
Figure 4.6: Biomass (gm/L) in different nitrogen sources	86
Figure 4.7: Antifungal activity on medium containing different nitrogen source	87
Figure 4.8: Antifungal activity % in different nitrogen sources	87
Figure 4.9: Antifungal activity shown by 13 experimental trials	88-90
Figure 4.10: Fit summary analysis of the quadratic model	91
Figure 4.11: ANOVA of quadratic model and significance test	92
Figure 4.12: Residual diagnostic plot of quadratic model. Observed verses	93
predicted response plot	
Figure 4.13: 3D Response surface plot showing interactive effects of variables on	94
antifungal activity by Streptomyces sp. S-9	
Figure 4.14: Summary of criteria set for optimization run	94
Figure 4.15: Antifungal activity shown on different media	94
Figure 5.1: Methods of application of biocontrol agents.	101
Figure 5.2: Effect of different treatments on the germination and growth of <i>C</i> .	111
cajan(BDN-2) seeds at germination level in Petri plates.	
Figure 5.3: The Effect of Seed Bacterization on shoot length (A) and root length	112
(B) of <i>C. cajan</i> .	
Figure 5.4: Talc-kaoline Streptomyces formulation	112
Figure 5.5: Effect of Talc-kaolin-Streptomyces formulation on the root length	113
Figure 5.6: Effect of Talc-kaolin-Streptomyces formulation on the shoot fresh	114
weight	

Figure 5.7: Effect of inoculation with different treatment growth on Pigeon pea	115
180 days after inoculation (DAI)	
Figure 5.8: Effect of Application of BCA formulations on Plant Biomass of	116
Cajanus cajan in 2019-2020 Dwarkapura	
Figure 5.9: Effect of Application of BCA formulations on Plant height (cm) of	116
Cajanus cajan in 2019-2020 Dwarkapura	
Figure 5.10: Effect of Application of BCA formulations on number of pods/plant	117
of <i>Cajanus cajan</i> in 2019-2020 Dwarkapura	
Figure 5.11: Effect of Application of BCA formulations on pod yield (kg/h) of	117
Cajanus cajan in 2019-2020 Dwarkapura	
Figure 5.12: Effect of Application of BCA formulations on 100-seed mass (g) of	118
Cajanus cajan in 2019-2020 Dwarkapura	
Figure 5.13: Symptom of Fusarium wilt in the stem of <i>Cajanus cajan</i> plant	118
Figure 5.14: Incidence of Fusarium wilt on pods of <i>Cajanus cajan</i> plant	119
Figure 5.15: Symbiotic structures of <i>R. irregularis</i> colonization of Pigeon pea	120
roots	
Figure 5.16: Effect of <i>Fusarium udum</i> inoculation on ethylene biosynthesis in	121
Pigeon pea plants.	
Figure 5.17: Proline accumulation in Pigeon pea plant	122
Figure 5.18: MDA content in wilted Pigeon pea leaves	122
Figure 5.19: H ₂ O ₂ accumulation in wilted Pigeon pea leaves	122
Figure 5.20: Representative photograph of <i>in vivo</i> DAB staining for visualization	123
of H ₂ O ₂ formed in Pigeon pea leaf at the end of the experiment.	
Figure 5.21: Defense enzyme activities in Pigeon pea leaves.	124
Figure 5.22: Physicochemical properties 2018-2019 Model Farm-cultivated	125
Cajanus cajan Plant roots	
Figure 5.23: Physicochemical properties 2019-2020 Model Farm-cultivated	125
Cajanus cajan Plant roots	
Figure 5.24: Physicochemical properties 2019-2020 Dwarkapura-cultivated	126
Cajanus cajan Plant leaves	
Figure 5.25: Physicochemical properties 2019-2020 Dwarkapura-cultivated	126
Cajanus cajan Plant Roots	

Figure 6.1: Phylogenetic analysis proclaimed that S-9 belonged to the genus	140
Streptomyces and species pseudogriseolus.	
Figure 6.2: PubMLST ST Number	141
Figure 6.3:Dot plot showed the similarity index of S-9 species.	142
Figure 6.4:Genomic map of <i>Streptomyces</i> sp. S-9 as a reference sequence blasted	143
with circular genome	
Figure 6.5: Distribution of the genes of S-9 under various subsystem features of	144
RAST.	
Figure 6.6: Distribution of Gene-related COG categories	145
Figure 6.7: QC of isolated RNA samples on 1% denatured agarose gel	147
Figure 6.8: Total RNA quality Check	148
Figure 6.9: qRT-PCR gel image	149
Figure 6.10: Network shows the interaction between ABD1 gene and other genes	151
Figure 6.11: Co expression Venn diagram	152
Figure 6.12: DEGs count in Control vs Fusarium infected plant	154
Figure 6.13: Volcano plot for DEGs between <i>Fusarium</i> -infected and healthy <i>C</i> .	155
cajan Plants.	
Figure 6.14: Hierarchical Clustering Heatmap	156
Figure 6.15: GO Enrichment Histogram	157
Figure 6.16: GO Enrichment Scatter Plot	158
Figure 6.17: KEGG Enrichment Histogram	158
Figure 6.18: KEGG Enrichment Scatter Plot	159
Figure 6.19: : Differential expression gene using KEGG	160