List of Tables

Table 3.1 Sampling locations in Lahaul valley and Spiti valley in the Indian trans-Himalayas 27
Table 3.2 Primers for amplification and sequencing 32
Table 3.3 PCR conditions for atpD gene 33
Table 3.4 PCR conditions for recA gene 33
Table 3.5 PCR conditions for nodC gene 34
Table 3.6 PCR conditions for nifH gene 34
Table 3.7 Regression equations for authentic organic acid standards 39
Table 3.8 Regression equations for authentic indole derivatives standards 41
Table 3.9 Monthly meteorological data of Palampur for pea cropping season for 2009-10 47
Table 4.1 Chemical properties of soils collected from Lahaul valley and Spiti valley of the Indian trans-Himalayas 55
Table 4.2 ERIC patterns generated by pea root-nodulating bacteria 59
Table 4.3 Blastn results of 16S rRNA gene sequences of Rhizobium leguminosarum sv. viciae 63
Table 4.4 Blastn results of atpD and recA genes sequences of Rhizobium leguminosarum sv. viciae 64
Table 4.5 Blastn results of nodC and nifH genes sequences of Rhizobium leguminosarum sv. viciae 67
Table 4.6 Loading values of first two components of principal component analysis based on carbon source utilization of Rhizobium leguminosarum sv. viciae from Lahaul and Spiti valleys in the Indian trans-Himalayas 72
Table 4.7 Loading values of first two components of principal component analysis based on fatty acid methyl ester analysis of Rhizobium leguminosarum sv. viciae from Lahaul and Spiti valleys in the Indian trans-Himalayas 74
Table 4.8 Screening of Rhizobium leguminosarum sv. viciae for plant growth-promoting activities 76-78
Table 4.9 Effect of Rhizobium leguminosarum sv. viciae on nodulation and nitrogen fixation in Pisum sativum var. Palam Priya grown in sterilized vermiculite after 30 days of inoculation in environment controlled room 80
Table 4.10 Influence of Rhizobium leguminosarum sv. viciae on Pisum sativum var. Palam Priya growth in sterilized vermiculite after 30 days of inoculation in environment controlled room 81
Table 4.11  Production of indole derivatives by *Rhizobium leguminosarum* sv. *viciae* in tryptophan supplemented yeast mannitol broth after incubation at 28±0.1 °C for 48 h

Table 4.12  ACC-deaminase activity of *Rhizobium leguminosarum* sv. *viciae* after incubation at 28±0.1 °C for 24 in DF salts minimal medium

Table 4.13  Siderophore production by *Rhizobium leguminosarum* sv. *viciae* after incubation at 28±0.1 °C for 7 days in succinate broth

Table 4.14  Solubilization of tricalcium phosphate by *Rhizobium leguminosarum* sv. *viciae* in National Botanical Research Institute’s Phosphate broth after incubation at 28±0.1 °C for 7 days

Table 4.15  Organic acid production by *Rhizobium leguminosarum* sv. *viciae* during tricalcium phosphate solubilization in National Botanical Research Institute’s Phosphate broth after incubation at 28±0.1 °C for 7 days

Table 4.16  Effect of *Rhizobium leguminosarum* sv. *viciae* on growth of *Pisum sativum* var. Palam Priya after 110 days of sowing in microplots

Table 4.17  ARDRA banding patterns generated by phosphate-solubilizing rhizobacteria isolated from Lahaul valley and Spiti valley in the Indian trans-Himalayas

Table 4.18  First two type strains showing maximum 16S rRNA gene sequence identity to representative isolates of phosphate-solubilizing rhizobacteria from Lahaul and Spiti valleys in the Indian trans-Himalayas

Table 4.19  Distribution of rRNA types of phosphate-solubilizing rhizobacteria associated with cultivated pea in Lahaul and Spiti valleys of the Indian trans-Himalayas

Table 4.20  Loading values of first three components of principal component analysis based on carbon source utilization of phosphate-solubilizing rhizobacteria associated with cultivated pea in Lahaul and Spiti valleys in the Indian trans-Himalayas

Table 4.21  Loading values of first two components of principal component analysis based on whole-cell fatty acid profiles of phosphate-solubilizing rhizobacteria associated with cultivated pea in Lahaul and Spiti valleys in the Indian trans-Himalayas

Table 4.22  Screening of phosphate-solubilizing rhizobacteria for plant growth-promoting activities

Table 4.23  Solubilization of tricalcium phosphate by phosphate-solubilizing rhizobacteria in National Botanical Research Institute’s Phosphate broth after incubation at 28±0.1 °C for 5 days

Table 4.24  Organic acid production by phosphate-solubilizing rhizobacteria during tricalcium phosphate solubilization in National Botanical Research Institute’s Phosphate broth after incubation at 28±0.1 °C for 5 days

Table 4.25  Production of indole derivatives by phosphate-solubilizing
rhizobacteria in nutrient broth supplemented tryptophan after incubation at 28±0.1 °C for 48 h

Table 4.26  ACC-deaminase activity of phosphate-solubilizing rhizobacteria in DF minimal medium after incubation at 28±0.1 °C for 24 h  

Table 4.27  Siderophore production by phosphate-solubilizing rhizobacteria in succinate broth after incubation at 28±0.1 °C for 5 days  

Table 4.28  Antagonistic activity of phosphate-solubilizing rhizobacteria against fungal pathogens on yeast malt extract agar in dual plate assay after incubation at 28±0.1 °C for 7 days  

Table 4.29  Influence of phosphate-solubilizing rhizobacteria on growth of *Pisum sativum* var. Palam Priya under controlled environment after 30 days of sowing  

Table 4.30  Influence of phosphate-solubilizing rhizobacteria on growth of *Zea mays* var. Girija under controlled environment after 30 days of sowing  

Table 4.31  Effect of phosphate-solubilizing rhizobacteria on growth of *Pisum sativum* var. Palam Priya in microplots  

Table 4.32  Effect of phosphate-solubilizing rhizobacteria and *Rhizobium leguminosarum* sv. *viciae* isolates singly and in combination on nodulation and plant growth of *Pisum sativum* var. Palam Priya after 45 days of sowing at CSIR-IHBT Chandpur Experimental Farms, Palampur  

Table 4.33  Effect of phosphate-solubilizing rhizobacteria and *Rhizobium leguminosarum* sv. *viciae* isolates singly and in combination on nutrient content and yield of *Pisum sativum* var. Palam Priya after 110 days of sowing at CSIR-IHBT Chandpur Experimental Farms, Palampur