

|                                                                                                               |            |
|---------------------------------------------------------------------------------------------------------------|------------|
| 6. Interaction effect of N levels and bacterial inoculation .....                                             | 98         |
| 7. Interaction effects of cropping system, nitrogen fertilizer levels and bacterial inoculation .....         | 102        |
| <b>II. Maize.....</b>                                                                                         | <b>107</b> |
| <b>A. Azospirilla count in maize root rhizosphere and growth characters of maize.....</b>                     | <b>107</b> |
| 1. Effect of cropping system .....                                                                            | 107        |
| 2. Effect of nitrogen fertilizer levels .....                                                                 | 111        |
| 3. Effect of Azospirilla inoculation .....                                                                    | 116        |
| 4. Effect of interaction of nitrogen fertilizer levels and cropping system .....                              | 120        |
| 5. Effect of interaction of cropping system and inoculating maize with azospirilla .....                      | 123        |
| 6. The interaction effect of nitrogen fertilizer levels and inoculation with Azospirilla .....                | 127        |
| 7. The interaction effect of intercropping, nitrogen fertilizer levels and inoculation with Azospirilla ..... | 130        |
| <b>B. Yield and yield components of maize.....</b>                                                            | <b>135</b> |
| 1. Effect of cropping system .....                                                                            | 135        |
| 2. Effect of nitrogen fertilizer levels .....                                                                 | 138        |
| 3. Effect of bacterial inoculation .....                                                                      | 142        |
| 4. Effect of interaction of cropping system with nitrogen fertilizer levels .....                             | 146        |
| 5. Interaction effect of intercropping with bacterial inoculation of Azospirillum .....                       | 148        |
| 6. Effect of interaction of nitrogen fertilizer levels and bacterial inoculation with Azospirilla .....       | 150        |
| 7. Effect of intercropping, nitrogen fertilizer levels and bacterial inoculation with Azospirillum .....      | 154        |
| <b>III. Competitive relationships .....</b>                                                                   | <b>160</b> |
| 1. Land Equivalent Ratio (L. E. R.).....                                                                      | 160        |
| 2. Relative Crowding Coefficient (R. C. C.).....                                                              | 163        |
| 3. Aggressivity (A).....                                                                                      | 164        |
| 4. Competitive Ratio (C R.).....                                                                              | 164        |
| 5. Area Time Equivalent Ratio (ATER) .....                                                                    | 165        |
| <b>IV. Cereal Units (CUs) .....</b>                                                                           | <b>165</b> |
| <b>5. SUMMARY .....</b>                                                                                       | <b>169</b> |
| <b>6. REFERENCES .....</b>                                                                                    | <b>189</b> |
| <b>7. ARABIC SUMMARY .....</b>                                                                                | <b>189</b> |

# CONTENTS

|                                                                                                                                                      |             |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>1. INTRODUCTION .....</b>                                                                                                                         | <b>Page</b> |
| <b>2. REVIEW OF LITERATURE .....</b>                                                                                                                 | <b>1</b>    |
| <b>2.1. Soybean .....</b>                                                                                                                            | <b>3</b>    |
| 2.1.1. Effect of bacterial inoculation with rhizobia and nitrogen fertilizer levels on soybean nodulation .....                                      | 3           |
| 2.1.2. Effect of bacterial inoculation with rhizobia on growth, yield and yield components of soybean plants .....                                   | 6           |
| 2.1.3. Interaction effect of nitrogen fertilizer levels and inoculation with rhizobia on growth, yield and yield components of soybean .....         | 8           |
| <b>2.2. Maize .....</b>                                                                                                                              | <b>11</b>   |
| 2.2.1. Effect of nitrogen fertilizer and biofertilizers by non symbiotic fixer bacteria on growth characters of maize plants .....                   | 11          |
| 2.2.2. Effect of nitrogen fertilizer and biofertilizers on yield and yield components of maize plants .....                                          | 16          |
| 2.2.3. Interaction effect of nitrogen fertilizer levels and inoculation with azospirilla on growth, yield and yield components of maize plants ..... | 25          |
| <b>2.3. Competitive relationships of maize-soybean intercrop .....</b>                                                                               | <b>36</b>   |
| <b>2.4. Effect of number of bacteria in plant rhizosphere .....</b>                                                                                  | <b>40</b>   |
| <b>2.5. Physiological aspects and mode of action of inoculants of N-fixer bacteria .....</b>                                                         | <b>42</b>   |
| <b>3. MATERIALS AND METHODS .....</b>                                                                                                                | <b>47</b>   |
| <b>4. RESULTS AND DISCUSSION .....</b>                                                                                                               | <b>60</b>   |
| <b>I. Soybean .....</b>                                                                                                                              | <b>60</b>   |
| <b>A. Number of nodules/plant and growth characters of soybean..</b>                                                                                 | <b>60</b>   |
| 1. Effect of cropping system .....                                                                                                                   | 60          |
| 2. Effect of nitrogen fertilizer levels .....                                                                                                        | 63          |
| 3. Effect of bacterial inoculation .....                                                                                                             | 67          |
| 4. Interaction effect of cropping system with nitrogen fertilizer levels .....                                                                       | 70          |
| 5. Interaction effect of cropping system and bacterial inoculation ...                                                                               | 74          |
| 6. Interaction effect of N levels and bacterial inoculation .....                                                                                    | 76          |
| 7. Interaction effects of cropping system, nitrogen fertilizer levels and bacterial inoculation .....                                                | 80          |
| <b>B. Yield and yield components of soybean .....</b>                                                                                                | <b>84</b>   |
| 1. Effect of cropping system .....                                                                                                                   | 84          |
| 2. Effect of nitrogen fertilizer levels .....                                                                                                        | 87          |
| 3. Effect of bacterial inoculation .....                                                                                                             | 91          |
| 4. Interaction effect of cropping system and nitrogen fertilizer levels .....                                                                        | 94          |
| 5. Interaction effect of cropping system and bacterial inoculation ...                                                                               | 96          |