

## 6. SUMMARY

1. Studies were undertaken to estimate the microbial population in the rhizosphere soil of okra (*Abelmoschus esculentus*), bittergourd (*Momordica charantia*), and sunflower (*Helianthus annuus*) and from non-rhizosphere soil using soil-dilution-plate method. The actinomycete population was isolated, identified and the physiological and antagonistic properties studied. The root exudates of the crop plants were collected aseptically and the amino acids and sugars present identified.
2. Significant difference was observed between the quantity of the microbial population present in the rhizosphere soils of the three crop plants. Bacterial population was the highest in the rhizosphere as well as in the control soil. Bittergourd rhizosphere harboured the highest number of bacteria ( $951.4 \times 10^6$  cfu/g dry soil) while actinomycetes were more in the rhizosphere of sunflower ( $10.9 \times 10^6$  cfu/g dry soil) and fungi in the rhizosphere of okra ( $3.06 \times 10^6$  cfu/g dry soil). The R:S ratio was higher for bacteria than for actinomycetes or fungi.
3. Kuster's medium was used to isolate actinomycetes. Based on the morphological and cultural characteristics, all identical cultures except one were discarded from the total isolates. Thus finally 15 isolates from the rhizosphere of okra, 15 from bittergourd, 36 from sunflower and 18 from the garden soil were retained in pure cultures for further studies. These isolates were characterised, and identified based on Bergey's Manual of Determinative Bacteriology, 8th Edition and methods of characterisation and descriptions of Streptomyces provided by the collaborators of the International Streptomyces Project (ISP).
4. Majority of the isolates were coloured. Melanoid and other pigment producers were more in the rhizosphere soil of sunflower than in any other group.
5. Studies on spore chain morphology showed that generally *Rectiflexibiles* and *Retinaculiaperti* were the predominant types. More than seventy five percent of the

isolates were with smooth-surfaced spores. Warty, spiny and hairy spores were also present.

6. Significant difference was observed between the four groups of isolates in their ability to utilize various sugars, starch, gelatin and nitrate. In general, isolates from the rhizosphere soils were found to be physiologically more active than those from control soil in utilizing various nutrients.
7. Among the actinomycetes studied, nearly 80 per cent belonged to the *Streptomyces* and *Streptoverticillium* spp., and the remaining belonged to the genera *Nocardia*, *Micromonospora*, *Thermomonospora*, *Thermoactinomyces* and *Actinobifida*.
8. Approximately 44 per cent of the isolates were found to be antagonistic against the test fungi. Of the ten soil pathogenic fungi, *Sclerotium rolfsii* was inhibited by the largest number of antagonists, followed by *Rhizoctonia bataticola* and *Fusarium moniliforme*. However, in the case of *S. rolfsii*, only germination of the sclerotium was inhibited, while the mycelial growth from germinated sclerotium was not suppressed. *Pythium aphanidermatum* was inhibited by the least number of actinomycetes. More than 85 per cent of the antagonists belonged to *Streptomyces* spp. The highest percentage of antagonistic isolates were from the rhizosphere soil of sunflower.
9. Three antagonists viz. *Streptomyces vastus*, *S. luteo-griseus* and *S. endus* were tested against *Rhizoctonia solani*, *R. bataticola* and *F. oxysporum* in pot-culture experiments infesting sterile soil. When antagonist-treated seeds and seedlings were raised in pathogen-infested soil, more germination and seedling survival was observed indicating suppression of the pathogen, compared to the very low germination and survival of non-treated seeds and seedlings.
10. Chromatographic separation of amino acids in the root exudates showed the presence of nine amino acids in the root exudates of okra, eight in the bittergourd and five in the sunflower. Similarly, fructose in the root exudate of okra, glucose, arabinose and rhamnose in the bittergourd, and xylose, fructose, rhamnose and raffinose in the root exudate of sunflower were identified.