Table of Contents

| Sl. No. | Conte | ent | Page no. | |
|------------|--------|--|-------------|--|
| | Abbr | eviations | v-viii | |
| | List o | of Figures | ix-xiv | |
| | List o | of Tables | xv-xvi | |
| 1 | Intro | 1-8 | | |
| 2 | Revie | Review of Literature | | |
| | 2.1 | Background | 9-11 | |
| | 2.2 | Mode of synthesis of NPs | 11-13 | |
| | 2.3 | Applications of NPs in agriculture | 14-16 | |
| | | 2.3.1 Nanofertilizers | 14 | |
| | | 2.3.2 Macronutrient nanofertilizers | 14 | |
| | | 2.3.3 Micronutrient nanofertilizer | 15 | |
| | | 2.3.4 Nanoparticulate fertilizer | 15 | |
| | | 2.3.5 Nanopesticides | 15-16 | |
| | 2.4 | 2.4 Role of NPs in seed germination | | |
| | 2.5 | Mode of uptake of NPs in plants and their accumulation | 21-24 | |
| | 2.6 | Effect of NPs on plant hormones | 24-25 | |
| | 2.7 | Effect of NPs on plant physiological indices | 25-26 | |
| | 2.8 | Effect of NPs on crop quality | 26-27 | |
| | 2.9 | Phytotoxic effect of NPs | 27-28 | |

_

-{ i }

| | 2.10 | Factors affecting phytotoxicity by NPs | |
|---|---|---|-------|
| | | 2.10.1 Effects of different growth media on NPs phytotoxicity | 28-29 |
| | | 2.10.2 Effects of different growth stages on NPs phytotoxicity | 29 |
| | | 2.10.3 Effect of different coating material on NPs phytotoxicity | 29-30 |
| | 2.11 | Impact of NPs on the environment and their regulatory aspects Potential risks on human health due to accumulation of NPs through food chain Environmental fate of NPs Migration characteristics of NPs | |
| | 2.12 | | |
| | 2.13 | | |
| | 2.14 | | |
| | 2.15 | Future scope and possibilities in nano-farming | |
| 3 | 8 Materials and methods | | 35-46 |
| | 3.1 | Chemicals and consumables | 35 |
| | 3.2 | Sample collection | 35 |
| | 3.3 Isolation and screening of biosurfactant-producing microorganisms | | 35-37 |
| | 3.4 | Hemolysis assay of the biosurfactant producing isolate | 37 |
| | 3.5 | Drop collapse test | 38 |
| | 3.6 | Determination of the emulsification index of the cell-free extract | 38 |
| | 3.7 | Identification of the best isolate | 38-39 |
| | | 3.7.1 Microscopic identification | 38 |

| | 3.7.2 | Molecular identification | 39 |
|------|------------------|---|-------|
| 3.8 | Extract | ion and characterization of crude biosurfactant | 39-40 |
| | 3.8.1 | Extraction of crude biosurfactant | 39 |
| | 3.8.2 | Biochemical characterization of the crude biosurfactant | 40 |
| | 3.8.3 | FTIR analysis of the crude biosurfactant | 40 |
| | 3.8.4 | SEM analysis of the crude biosurfactant | 40 |
| 3.9 | Synthes | sis of Ag and ZnO NPs | 40-41 |
| 3.10 | Charact | terization of the NPs | 41 |
| 3.11 | Metal I assay | NPs mediated seed germination and plant growth | 41-43 |
| | 3.11.1 | Nanopriming of seeds | 41 |
| | 3.11.2 | Seed water uptake assay | 42 |
| | 3.11.3 | Assessment of germination percentage and the length of the germinated seedlings | 42 |
| | 3.11.4 | Alpha-amylase activity assay | 42-43 |
| | 3.11.5 | Total soluble sugar content | 43 |
| 3.12 | Toxicit | y assay of the NPs | 43-44 |
| | 3.12.1 | Cytotoxicity assay of the NPs | 43 |
| | 3.12.2 | Environmental toxicity assay of NPs | 44 |
| 3.13 | Antimi | crobial activity of Ag NPs and ZnO NPs | 44-45 |
| 3.14 | Statistic | cal analysis | 46 |
| | | | |

| 4 | Resu | lts | | 47-94 |
|--|-------|-----------------------------|---|---------|
| | 4.1 | | Isolation and screening of biosurfactant producing microorganisms | |
| | 4.2 | Identifi | cation of the best isolate | 48 |
| | | 4.2.1 | Based on cell morphology | 48 |
| | | 4.2.2 | Molecular identification of the best isolate | 48 |
| | 4.3 | Extract | ion and characterization of crude biosurfactant | 48-49 |
| | 4.4 | Synthes | sis of Ag and ZnO NPs | 49 |
| | 4.5 | Characterization of the NPs | | 49-50 |
| | 4.6 | Metal N assay | Metal NPs mediated seed germination and plant growth assay | |
| | | 4.6.1 | Seed water uptake assay | 50-52 |
| | | 4.6.2 | Germination percentage and length of the germinated seedlings | 52-54 |
| | | 4.6.3 | Alpha-amylase activity assay | 54-56 |
| | | 4.6.4 | Total soluble sugar content | 56-57 |
| | 4.7 | Cytotoz | xicity effect of the synthesized NPs | 58 |
| | 4.8 | Enviror as indic | nmental toxicity assessment by taking earthworms cator | 58 |
| | 4.9 | | crobial activity of Ag NPs and ZnO NPs against athogens | 58-59 |
| 5 | Discu | ission | | 95-102 |
| 6 | Conc | lusion | | 103-104 |
| References Appendices List of Publications | | | 105-146 | |
| | | | 147-150 | |
| | | | 151-152 | |
| List of Conferences | | | 153-154 | |
