# EFFECT OF SEED TREATMENT WITH ORGANIC AND INORGANIC SUBSTANCES ON GERMINATION AND FOLIAGE YIELD OF CORIANDER IN RABI SEASON UNDER CHHATTISGARH PLAINS

**M. Sc. (Ag.) THESIS**

**by**

**MOHIT JAIN**

**DEPARTMENT OF HORTICULTURE**
**COLLEGE OF AGRICULTURE**
**INDIRA GANDHI KRISHI VISHWAVIDYALAYA**
**RAIPUR (C.G.)**

**2013**

# EFFECT OF SEED TREATMENT WITH ORGANIC AND INORGANIC SUBSTANCES ON GERMINATION AND FOLIAGE YIELD OF CORIANDER IN RABI SEASON UNDER CHHATTISGARH PLAINS

***Thesis***

Submitted to the

**Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.)**

**by**

**MOHIT JAIN**

IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

**Master of Science**

**In**

**Agriculture**
**(Horticulture)**

**Roll No. 15333** **ID No. 110107033**

**JULY, 2013**

## CERTIFICATE - I

This is to certify that the thesis entitled **"EFFECT OF SEED TREATMENT WITH ORGANIC AND INORGANIC SUBSTANCES ON GERMINATION AND FOLIAGE YIELD OF CORIANDER IN RABI SEASON UNDER CHHATTISGARH PLAINS"** submitted in partial fulfillment of the requirements for the degree of **"Master of Science in Agriculture"** of the Indira Gandhi Krishi Vishwavidyalaya, Raipur, is a record of the bonafide research work carried out by **MOHIT JAIN** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.

No part of the thesis has been submitted for any other degree or diploma (certificate awarded etc.) or has been published / published part has been fully acknowledged. All the assistance and help received during the course of the investigations have been duly acknowledged by him.

Date: 21/07/13

**Chairman**
Advisory Committee

**THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE**

| | | |
|---|---|---|
| **Chairman** | **Dr. Jitendra Singh** | |
| **Member** | **Dr. Gaurav Sharma** | |
| **Member** | **Dr. G.K. Shrivastava** | |
| **Member** | **Dr. R. R. Saxena** | |

**CERTIFICATE - II**

This is to certify that the thesis entitled **"EFFECT OF SEED TREATMENT WITH ORGANIC AND INORGANIC SUBSTANCES ON GERMINATION AND FOLIAGE YIELD OF CORIANDER IN RABI SEASON UNDER CHHATTISGARH PLAINS"** submitted by **MOHIT JAIN** to the Indira Gandhi Krishi Vishwavidyalaya, Raipur in partial fulfillment of the requirements for the degree of **M.Sc. (Ag.)** in the **Department of Horticulture** has been approved by the external examiner and Student's Advisory Committee after oral examination.

**Date:** 27/8/13

**EXTERNAL EXAMINER**

**Major Advisor**

**Head of the Department / Section**

**Dean / Dean Faculty**

**Director of Instructions**

## *ACKNOWLEDGEMENT*

*"Education plays vital role in personal and social development and teacher plays a fundamental role in imparting education. Teachers have crucial role in shaping young people not only to face the future with confidence but also to build up it with aim and responsibility. There is no substitute for teacher pupil relationship". I take this golden opportunity to express my heartful humble and deepest sense of gratitude to those who helped me to complete my research possible. These words are small acknowledgement but never fully recompensed for their great help and co-operation.*

*I start in the name of God-who has bestowed upon me all the physical and mental attributes that I posses and skill to cut through and heal a fellow human.*

*It is my privilege to study and conduct my research under* ***Dr. Jitendra Singh*** *Principle Scientist/ Professor, Department of Horticulture, College of Agriculture, Raipur (C.G.), Chairman of my advisory committee, who provided me the research insight, illuminating and meticulous guidance, calm endurance, continuous and unfailing encouragement, scholarly suggestions, unique supervision, constructive criticisms, sympathetic attitude, plausible appreciation and sustained support during the entire course of investigation and preparation of manuscript. I am highly indebted to him for him invaluable painstaking efforts taken towards my study while devoting her precious time. I owe a profound debt to him for providing me him intellectual resources, reading materials and other all necessary facilities during my study period. Him scientific approach and generosity without any reservation greatly helped me to work under him supervision, knowledge and enthusiastic interest, which he provided me throughout my post graduation and research investigation despite him busy schedule of work.*

*I emphatically and gratefully acknowledge extend my loyal and venerable thanks to members of my Advisory Committee, Dr. Gourav Sharma, Assistant Professor, Department of Horticulture, Dr. (Major) G.K. Shriwastava, Professor, Department of Agronomy and NCC officer and Dr. R.R. Saxena, Professor, Department of Agril. Statistics and Social Sciences, Language for providing proper guidance, critical comments, valuable suggestions and deligent support lead to timely completion of this work.*

*I wish to record my grateful thanks to Dr. S.K. Patil, Hon'ble Vice Chancellor, Dr. D.A. Sarnaik, Director Research Services, Dr. Sadanand patel Director of Instructions, Dr. J.S. Urkurkar, Director Extension Services, Dr. S.S. Shaw, Dean Student Welfare and Dr. O. P. Kashyap, Dean, College of Agriculture, IGKV, Raipur for providing necessary facilities, technical and administrative supports for conductance of my research work.*

*I am highly obligated to all teaching staff members of Department of Horticulture, Dr. S.N. Dikshit, Dr. H.G. Sharma, Dr. Neeraj Shukla, Dr. Jitendra Triwedi, Dr. Dhananjay Sharma, Dr. Amit Dikshit, Dr. Satish Verma, Dr. Vijay kumar, Dr. G.D. Sahu, Dr. G.L. Sharma, Dr. T. Tirkey for their co-operation, valuable suggestions and encouragement during the course of study. The staff members of Horticulture Department deserve special thanks for their help and co-operation.*

*Sincere thanks are also due to Dr. (Major) G.K. Shrivastava, Professor (Agronomy) and NCC officer for his tireless efforts and dedication shown during the formatting of thesis.*

*Diction is not enough to express my heartful gratitude to my beloved father Shri Pushpendra Jain and mother Smt. Padma Jain, who bore the weight of sacrifice with patience, whose selfless love, filial affection; obstinate sacrifices and blessing made my path easier. Their blessings have always been the most vital source of inspiration and motivation in my life. My most cordial thanks go to my younger sister Dipika Jain who motivated me constantly and molded me into the present position.*

*There are many friends and well wishers who helped me in various ways towards the present study and they deserve my sincere thanks. Among them my special thanks to Ankita, Chetna and Bhavesh.*

*Last but not least, I would like to convey my cordial thanks to all the teachers and well wishers from my schooling days onwards who have directly and indirectly helped me to reach up to this level in my life.*

*Above all my humble and wholehearted prostration before Almighty and Omnipresent "God" for sprinkling his unprecedented favored upon me to reach the acme of success and always with me for improving the confidence and determination in my whole life. How can I express my thanks to "God" because there is no any word to express it? So, my lord, please realize and accept my feelings.*

**MOHIT JAIN**

Department of Horticulture,
College of Agriculture,
I.G.K.V., Raipur (C.G.)
Date:

**C O N T E N T S**

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF PLATES

## LIST OF APPENDICES

## LIST OF ABBREVIATIONS

| Abbreviations | Full form | Abbreviations | Full form |
|---|---|---|---|
| % | Per cent | kmph | Kilometre per hour |
| @ | At the rate | MH | Maleic hydrazide |
| B:C | Benefit cost ratio | IAA | Indol acetic acid |
| cm | Centimeter | NS | Non significant |
| DAS | Days after sowing | q | Quintal |
| DAT | Days after transplanting | $^{0}C$ | Degree Celsius |
| *et al.* | And co-worker/ and others | Rs | Rupees |
| Fig. | Figure | SEm$\pm$ | Standard error of mean |
| g | Gram | spp. | Species |
| GA | Gibbrelic acid | No. | Number |
| GA3 | Gibbreline | $m^{-2}$ | Per meter square |
| ha | Hectare | t | Tonnes |
| $ha^{-1}$ | Per hectare | *viz.* | For example |
| hrs | hours | mm | Millimetre |
| i.e. | That is | g $kg^{-1}$ | Gram per kilogram |
| K | Potassium | ml | Millilitre |
| kg | Kilogram | NAA | Nepthalic acetic acid |
| $kg^{-1}$ | Per kilogram | v | Volume |
| $lit^{-1}$ | Per litre | Kg/ $m^2$ | Kilogram per metre square |
| m | Metre | ml/ kg | Millilitre per Kilogram |
| mg | Milligram | g $l^{-1}$ | Gram per litre |
| N | Nitrogen | t $ha^{-1}$ | Tonne per hectare |
| P | Phosphorus | | |

# *INTRODUCTION*

# CHAPTER-I

# INTRODUCTION

Coriander generally known as "Dhania" (*Coriandrum sativum*) belongs to family Apiaceae. Coriander is one of the important spices in our day-to-day life. Its leaves are popular for garnishing of variety of Indian dishes. The leaves have a strong odour while its fruits have a warm and spicy aroma. It is widely cultivated in Rajasthan, Gujarat, Madhya Pradesh, Tamil Nadu, U.P., etc. It is mainly used as a condiment for its medicinal properties as well as spice for culinary purposes. It is an annual herb and a native of Southern Europe and the Middle East. Green coriander (also called cilantro or Chinese, Mexican or Japanese parsley) has been called the most commonly used flavoring agent in the world due to its usage across the Middle East into all of southern Asia as well as in most parts of Latin America (Perseglove et al., 1981 and Singh and Singh, 1996).

Coriander is an important spice crop having a prime position in flavorings food. Coriander is the most widely used favoring herb in the world, its fresh leaves are used in salads, soups, vegetables etc. due to its aromatic flavor. The fresh green stem, leaves and fruits of coriander have a pleasant aromatic smell. The entire plant, when young, is used in preparing chutneys and sauces and the leaves are used for flavoring curries and soups. The seeds are extensively employed as condiment with or without roasting in the preparation of curry powders, pickling spices, sausages and seasonings. They are used for flavoring pastry, cookies, buns, cakes and tobacco products (Shankaracharya and Natrajan 1971). Coriander seeds are generally used after mild roasting.There are two types of coriander viz large seeded (fruited) and small seeded. Large seeded coriander (seed diameter three to five mm)

is grown as a spring crop in northern temperate climates, or as a winter crop in areas with a Mediterranean climate. This has an essential oil content of 0.5 to one per cent. Small seeded coriander is produced mainly in more moderate temperature zones. Hundred grams of coriander seed contains nearly 6.3% moisture, 1.3% protein, 0.3% volatile oil, 19.6% fat, 31.5% crude fibre, 24% carbohydrates, 5.3% mineral matter, 0.26 mg vitamin B1, 0.23 mg vitamin B2, 3.2 mg niacin and12 mg vitamin C (Gupta et al., 1977). Volatile oils such as linalool are responsible for the aroma of coriander. The essential oil of coriander should contain 60-70 per cent linalool. Immature seedlings of small seeded coriander (cilantro) are harvested as a spicy addition to salads or for flavoring of meats, soups and stews.The oil is one of the oldest spice extract known, as it is mentioned for flavoring gin and liquors, soft drink, pickle, sausages, cigarette and cosmetics (Shankaracharya and Natrajan 1971).

The global production of coriander seed is estimated to be around 6 lac tonnes. The major global producers are India, Morocco, Canada, Romania, Russia and Ukraine. The other producers are Iran, Turkey, Israel, Egypt, China, US, Argentina and Mexico. The global trade in coriander is estimated to be around 0.85 - 1 lac tonnes year$^{-1}$. While, India, Turkey, Egypt, Romania, Morocco, Iran and China are the major exporters Middle East, South-east Asia, USA, UK and Germany are the major importers.India is the biggest producer, consumer and exporter of coriander in the world (John, 1994). Area, production and productivity of coriander in India are 5.30 lac ha 4.82 lac million tonnes and 0.9 million tonnes ha$^{-1}$ respectively (Anonymous, 2011).Rajasthan (54%) and Madhya Pradesh (17%) are the two largest producing states in the country contributing over two-thirds to the

country's total production. In Chhattisgarh coriander covers an area of 4090 ha and production of coriander is about 1010 tonne (Anonymous, 2011).

The crop is generally grown as rainfed crop, either pure or mixed with other crops in mid land situation. It can be grown on a fairly wide range of soils, but is best adapted to well drained loam and sandy loam soils. It is also cultivated in sandy loam soils of northern India and in red sandy loams of Chhattisgarh (Bala Shanmugam et al., 1988). In certain areas, it is grown as irrigated crop (Sharma and Bhati, 1984). The time of sowing varies in different localities but in Chhattisgarh, it is often cultivated in winter (rabi) as pure crop from October to January.Coriander for seed cultivation is grown as a rabi crop with sowing undertaken during October - November and new crop arrivals seen in February - March. Coriander germinates very slowly, and may take as long as 21 days to emerge. It does not compete well with weeds, especially perennial weeds, and should be planted on clean land. Plants can suffer flower blast if very hot, dry conditions occur at bloom. Crops can be severely affected by blossom blight.

Germination represents a dynamic period in the life cycle of plants as a seed makes the transition from a metabolically quiescent to an active and growing entity. Seed germination is one of the basic aspects of eco-physiological studies, because functionally a seed is device for reproduction, perpetuation and multiplication of a particular species so as to ensure its continuation.Seed germination represents the termination of a developmental phase and the commencement of a growth phase. Germination is a separate developmental phase in life cycle of the higher plants. This phase is preceded by embryogenesis and seed development which is followed by seedling growth and development. Thus, a seed has a

specific programme for germination consisting differential gene activation, distinct from programmes for embryogenesis and for seedling development. The germination percentage of coriander is less due to structural property of the seed itself, so it is necessary to treat the seeds to increase the germination.Many organic and inorganic substances are used for seed treatment in coriander. Some of the organic substances are *Calotropis* spp, *Azadirachta* spp, *Prosopis* spp.cow urine, *Pseudomonas florescence* and inorganic substances are SAAF.

The process of breaking, scratching, mechanically altering or softening the seed coats to make permeable to water and gases in known as scarification. Mechanical scarification is generally done by pounding seeds in a large sized mortar with pestle. Scarified seeds make injury to the seeds and induces susceptible to pathogenic organisms hence, scarification is done at the time of sowing or a few days before sowing in coriander. As germination involves hydration or imbibitions as the first step, soaking seeds helps in carrying out the initial steps of germination. The most common soaking material is water and cow-dung extract is also found to improve germination.

Allelopathic effects of *Calotropis* on different agricultural crops have not been well studied. Extracts of different plant parts viz. root, stem, leaf and stem of *Calatropis* affect germination and seedling vigor of many agricultural crops have been reported (Oudhia and Tripathi 1997, 1999; Oudhia et al., 1997, 1998a, b). However, the germination at higher concentrations of leaf extract of *Calotropis procera*, decreases germination percentage and also delays it (Zahrani and Robai, 2007). Neem tree has superb pharmaceutical and pesticide controlling qualities and is also eco-friendly. The azadirachton compound in neem has been recognized as an effective insecticide that is biologically selective, not harming the useful

pest- predators but keeping almost 250 harmful ones at bay. Scientists recommend coating urea with neem cake to kill nitrifying bacteria. Neem also contains salanin, a chemical substance that is a potent pest controller and is said to be far more effective than the chemically produced diethyl-toluamide that is a part of most of the lethal synthetically produced pesticides. Now a day's leaf extract of neem is used for seed treatment of various crops as it has selective insecticidal property. *Prosopis* of Fabaceae family also known as, mesquite (*Prosopis juliflora*) is reported to be both invasive and allelopathic. It is found to inhibit germination or growth of many plant species growing inits vicinity, through the release of allelopathic substances into the environment (Humaid and Warrag, 1998 and Pandit et al., 1995). The genus pseudomonas is one of the most diverse Gram negative bacterial genera, isolated from sources ranging from plants to soils and water. *Pseudomonas* is characterized by their ability to grow in simple media at the expense of a great variety of simple organic compounds, without needing organic growth factors. Because of the infectious nature of these bacteria, they can actually be used to combat other agricultural pathogens. Since the 1980s, certain types of Pseudomonas bacteria, such as *Pseudomonas fluorescens*, have been applied directly to soils and seeds in order to prevent the growth of crop pathogens. This practice of deterring one type of pathogen with another is generally referred to as biocontrol. Another member of the Pseudomonas genus which has biocontrol properties is *Pseudomonas chlororaphis*, which itself produces an antibiotic which is active against certain fungi that attack plants.

As per Ayurvedic literatures cow urine (gomutra) is useful in curing controlling number of diseases. Cow urine also contains antioxidant and it has antimicrobial properties (Jarald et al., 2008). Due to these properties it can be used for seed treatment.

At present vary meager work has been done on seed treatment of coriander with organic and inorganic substances especially under agro-climatic conditions of Chhattisgarh plains so keeping the above points in view the present investigation entitled **"Effect of seed treatment with organic and inorganic substances on germination and foliage yield of coriander in rabi season of Chhattisgarh plains"** was undertaken during rabi season of 2012-13 at Horticulture Research cum Instructional farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur with the following objectives:

1. To study the effect of various seed treatments on germination of coriander.
2. To study the effect of seed treatment on foliage yield of coriander.
3. To find out economical seed treatment method for coriander.

# *REVIEW OF LITERATURE*

# CHAPTER-II

# REVIEW OF LITERATURE

Seed treatment with organic and inorganic substances has a potential use in horticulture. Though several workers have reported the influence of seed treatment of coriander, the information on the use of organic and inorganic substances for seed treatment of coriander is very scanty. Therefore, the available information on the use of organic and inorganic substances for seed treatment in coriander and other crops have been reviewed and described under following heads:-

## 2.1 Effect of seed treatment on germination and growth parameters

Vasyuta *et al.* (1978) reported that of the various seed treatments tried, 18 h at 10 deg + 6 h at 30 deg without any previous seed treatment gave 81-92% germination compared with 6-35% in the control where the seeds were heat-treated and then held at 18-22 degree .

Mandal *et al.* (1987) studied that the highest germination in *Coriandrum sativum* (80%) and *F. vulgare* (82%) was obtained with seeds soaked for 6 and 8 h, respectively, and aged naturally; the corresponding germination in the controls was 15 and 20%.

Badgujar and Warhal (1988) observed that soaking seeds of C*oriandrum sativum* in warm water, 10 p.p.m. IAA, 20 p.p.m. NAA or 50 p.p.m. GA increased germination percentage and leaf yield. Wrapping treated seeds in polyethylene film or in gunny bag cloth for 24 h before sowing further enhanced germination percentage and leaf yield.

Banafar (1994) conducted the experiment for enhancement in germination and emergence of coriander [*Coriandrum sativum*] seeds. At 28 DAS, maximum field

emergence was recorded in water-soaked seeds (71.33 %), followed by 100 p.p.m. GA3 and NAA-treated seeds and dry seeds showed 55.13% emergence. MH slightly increased emergence up to 14 days, but gave similar results to dry seeds at 28 DAS. Scarification with acid at 5 or 10% also initially enhanced emergence but had no benefit on the overall percentage at 28 DAS. A higher acid concentration reduced emergence considerably.

Vasugi and Thangaraj (1998a) studied that the effect of seed treatment with plant extracts and *Azospirillum* on field emergence and seedling vigour was studied in *Coriandrum sativum* in Tamil Nadu, India. A combined seed treatment with plant extracts (2.0% leaf extract of *Prosopis* + *Calotropis*) and *Azospirillum* led to significantly earlier and increased field emergence and increased seedling vigour compared with untreated seeds.

Vasugi and Thangaraj (1998b) reported that coriander seeds were soaked for 16 h at 25 $^{0}$C in 1 or 2% aqueous extracts of mature leaves of *Acacia sp.*, *Albizzia amara*, *Calotropis gigantica*, *Prosopis juliflora* or *Pongamia glabra* and all their combinations. The combination of 2% *Calotropis gigantica* and 2% *Prosopis juliflora* gave the highest percentage germination (86%) and vigour index (1978) as compared with the untreated control (66% and 1509, respectively).

Badgujar and Warhal (1998) found that soaking the seeds of *Coriandrum sativum* in warm water, 10 p.p.m. IAA, 20 p.p.m. NAA or 50 p.p.m. GA increased germination percentage and leaf yield. Wrapping treated seeds in polyethylene film or in gunny bag cloth for 24 h before sowing further enhanced germination percentage and leaf yield.

Gandhikumar and Raguchander (2001) revealed that seed germination was significantly lower when seeds were treated with either fungal preparation over the untreated

control. Fungal preparations reduced the shoot and root lengths significantly over the control. Among the two treatments, seed treatment with toxin more strongly inhibited seed germination as well as seedling growth than with spore suspension.

Haroun and Shehri (2001) studied the morphological and cytogenetic effects of *Calotropis procera* extract on *Vicia faba L.* The control plants being normal while treated ones are significantly affected. Four concentrations (5, 15, 30, and 60%) of this extract were applied for 3 duration time. For treated seeds, low doses caused increase in mitotic indix (MI) and exhibit stimulatory effect on percentage of germination and plant height. On the other hand high concentratiosn gave rise to substantial reduction in MI, percentage of germination and plant height and all were found dose and time dependent. In contrast, all parameters tested for treated roots were found negatively affected with no exception and found more harmful and effective compared to seed treatment experiment.

Subramanian and Vijayakumar(2001) revealed that application of 100% N with seed treatment and soil application of *Azospirillum* recorded the highest germination percentage of 95.78. The same treatment recorded the highest vigour index, plant height at 80 days after sowing and dry matter production. The highest level of N (1.22%), P (0.11%) and K (1.46%) in the plant tissue was also noticed in 100% N combined with *Azospirillum* seed and soil application. Among the different combinations, 100% N combined with seed treatment and soil application of *Azospirillum* recorded the highest grain yield and oleoresin content.

Pradeep *et al.* (2003) recorded that the essential oils, especially clove oil, stimulated seedling growth (seedling emergence, number of leaves, leaf size, root-shoot length, vigour

and biomass) and reduced the incidence of seedling diseases. Cardamom oil resulted in enhanced germination and emergence in Italian millet and coriander.

Saravanapriya and Sivakumar (2005) conducted field experiment for the management of *Meloidogyne incognita* infecting tomato with five botanicals, viz. leaves of *Calotropis gigantea* (Linn.), *Tagetes erecta* Linn. And *Azadirachta indica* A. Juss. ; seeds of *Citrullus lanatus* ( Thunb). Matsumura & Nakai and *Areca catechu* Linn. Results showed statistically significant increase in both seed germination as well as seedling establishment in all the treatments when compared with control. Seed treatment with dry powder of *Calotropis gigantea* leaves gave the highest germination (98.0%) and high percentage of established seedlings (99.6%). Root dip treatment with leaf extract of *Calotropis gigantea* resulted in significant reduction of the soil nematode population at 45 DAT and at harvest (87.3% and 90.0%, respectively) and lowest gall index (1.7) with increase in fruit yield, 23.9%.

Alves *et al.* (2005) observed that seed germination percentage and germination index increased with increasing manure levels in the absence of mineral fertilizers, reaching 90% and 5.0, respectively, at the highest manure rate. In the presence of mineral fertilizer, these values were 82% and 4.5, respectively, with manure at 8 $kg/m^2$.

Zahrani and Robai (2007) studied the effect of dry leaf water extraction (5, 10, 20, 40 and 60%) of *Calotropis procera* Decne. plants on the germination of Barley (*Hordeum vulgare* L.), Wheat (*Triticum aestivum* L.), and Cucumber (*Cucumis satirus*) L., Fenugreek (*Trigonella foenum graecum* L.) and Alssana (*Senna occidentalis* L. Link) was investigated. The results showed that the germination delayed at the higher concentrations, and the final

germination percentage was decreased by increasing leaf extract concentration. The most affected seeds of the tested plants were *Senna occidentalis* seeds, which were inhibited at the last two treatments (40 and 60%). Generally, the radicle and Plumule growth was sensitive to different levels of leaf extraction whereas, the radicle length was decreased by increasing the extract concentration; it died at the higher concentrations (40 and 60%) for Alssana seeds. Plumule emergence and growth stimulated by the lower concentration (5%) for Alssana Cucumber and Fenugreek more than control treatment, and then the plumule length decreased with increasing the concentration in leaf extracted of *Calotropis procera* plants.

Ghasemi *et al.* (2011) studied that the effect of different concentrations (0, 5, 10, 20, 40 and 60%) of dry leaf water extraction of *Calotropis procera* on the germination of cucumber (*Cucumis sativus*), tomato (*Lycopersicon esculenthum*), and eggplant (*Solanum melongena*). The results showed that leaf extract of milkweed reduced germination percentage in studied plants. In treatment of 60%, germination percentages of seeds of cucumber, tomato and eggplant were 17.77, 84.44 and 93.33, respectively, while seed germination of these plants in control treatment (distilled water) were 100, 97.77 and 100 %, respectively. Therefore, the greatest and the least inhibitory effects of leaf extract on percentage of seed germination were belonged to cucumber and eggplant, respectively.
Effect of different levels of leaf extraction on seed germination of cucumber, tomato and eggplant. In all plants, the highest reduction in plumule length observed in treatment of 60%.

Hamid *et al.* (2012) observed that the dual culture studies of four biocontrol agents in pea revealed that *Trichoderma harzianum* exhibited highest inhibition percentage of 78.60 followed by *Trichoderma viride* (75.72%), *Gliocladium virens* (69.52%)

and *Pseudomonas fluorescence* (68.37%). *Pseudomonas fluorescence* was the only biocontrol agent which showed zone of inhibition in dual culture. Seed treatment with biocontrol agents revealed the highest germination percentage in pots treated with *Trichoderma harzianum* and carbendazim (90% each) followed by *Trichoderma viride* (86%), *Pseudomonas fluorescence* (83%) and *Gliocladium virens* (82%) while it was 61 per cent in control. *Trichoderma harzianum* treated seeds took least 7.26 days to germinate followed by *Trichoderma viride* (7.32 days), carbendazim (7.34 days), *Pseudomonas fluorescence* (7.37 days) and *Gliocladium virens* (7.53 days) as against 7.88 in control. Disease incidence and severity was lowest in the pots treated with carbendazim (14.64 and 4.98%) followed by *Trichoderma harzianum* (21.30 and 10.94%), *Trichoderma viride* (25.30 and 12.02%), *Pseudomonas fluorescence* (29.28 and 14.98%) and *Gliocladium virens* (38.64 and 17.58%) whereas in control it was 54.64 and 32.02%, respectively.

Kanaga *et al.* (2012) studied the effect of aqueous extracts of Neem (*Melia azadirachta*) on germination percentage of test plants. Neem aqueous extract slightly inhibited seed germination of cow pea (90, 70 and 60%) over control, whereas very little or no significant effect on germination of horse gram. Root and Shoot elongation of test plants seedlings was more adversely affected than seed germination due to the allelochemicals. *Melia azadirachta* aqueous extracts significantly inhibited the root and shoot elongation of test plants. Root elongation of horse gram was reduced about 3.7 cm by Neem extracts respectively. Root elongation of cow pea was more adversely affected about 3.4 cm than horse gram due to the allelochemicals. The aqueous extracts exhibited highest inhibition of shoot elongation (3.2cm) in cow pea. About 3.6 cm reduction in horse gram by Neem

aqueous extract was recorded. Shoot elongation in cow pea was more adversely affected by the aqueous extracts as compared to horse gram seedlings.

## 2.2 Effect of seed treatment on yield attributes and yield

Taylor *et al.* (1975) reported that when the pathogen (*Pseudomonas spp.*) from decayed coriander seed heads was spray inoculated on coriander plants at the flowering or immature seed stage the resulting heads showed dark discoloured streaks on the green seed or were blackened and bore shrunken seeds.

Taylor and Dudley (1980) reported that a *Pseudomonas spp*. which on serological and biochemical characters falls in P. Group IA (similar to *Pseudomonas syringae*, infected the inflorescences and caused seed decay of coriander.

Maheswari and Sundarababu (2001) studied the effect of Calotropis leaf extract at 5,10,15 per cent concentration on root penetration and at 10 and 15 per cent as soil and foliar application on population suppression of root knot nematode was studied under glass house condition. Maximum inhibition of penetration was observed on the first day itself at 15 per cent (0.6% penetration). When the leaf extract was applied as soil and foliar treatment at 10 and 15 per cent concentration, maximum shoot and root weight with more pods were observed in soil application at 15 per cent concentration followed by 10 per cent. Nematode population was minimum at 15 per cent soil application (88.5% and 72% reduction over control) followed by 10 per cent (87.1 and 79.3%) in root and soil application at 15 per cent.

Capecka *et al*. (2003) studied the effect of presowing conditioning and fungicide application on seedling vigour and seed yield in coriander. Matri-conditioning with Micro Cel-E (seed:carrier:water ratio of 2:1:4) and osmo-conditioning in PEG 6000 solution (280

g/kg) under lighted conditions at 15 $^{0}$C for 7 and 6 days, respectively, significantly increased seed and seedling vigour compared with the untreated control.

Bardin *et al.* (2004) observed that coating sugar beet seeds with *Pseudomonas fluorescens 708* and flax or pea straws increased the efficiency of the bacterial strain for the control of Pythium damping-off.

Marwat and Azim Khan (2006) conducted experiment in NWFP Agricultural University Peshawar (Pakistan). Grinded leaves of *Prosopis juliflora, Eucalyptus camaldulensis* and *Acacia nilotica* were soaked in tap water for 5 hr at room temperature. Results showed that germination percentage and plant height of both species were significantly affected by different concentrations. Prosopis showed stimulatory effect on germination of both the species. In wheat, maximum germination and plant height of 52.50 % and 32.22 cm, respectively was recorded in Prosopis treated pots as against 15 and 31.50 cm in control however in Eucalyptus @ 150 g $l^{-1}$ also 15% germination of wheat was recorded. Similarly, for wild oats, maximum germination percentage and plant height of 47.5 % and 51.9 cm was recorded in Prosopis treated pots. Low concentration of Prosopis proved stimulatory as compared to higher concentrations.

Siddiqui *et al.* (2009) conducted experiment on *Prosposis julifl*ora aqueous leaf extract, prepared by 25 g and 50 g powder of dry leaf dissolved in 500 ml of double distilled water, tested for their allelopathic effects on seed germination and radicle length of *Triticum aestivum* var-Lok. Allelopathic effect of leaf extract of different concentrations (25 g/500 ml (C1) and 50 g/500ml (C2) of *Prosopsis juliflora* and its possible allelopathic effect tested in a laboratory experiment (Bundelkhand University, Jhansi). The experiment was conducted

in sterilizes Petri dish with a 24 h, 48 h, 72 h, 96 h and 120 h time interval for seed germination and 24 h, 48 h and 72 h for radicle length on an average of 25° C. Aqueous effect caused pronounced inhibitory effect on seed germination and root length of receptor plant. Seed germination and root length results indicated that the inhibitory effect was proportion to the concentration of the extract. Inhibitory effect was much pronounced radicle length rather than germination. Hence, it could be concluded that the mesquite leaf aqueous extract contain water-soluble allelochemicals. This could inhibit the seed germination and reduce radicle length of wheat. It is suggested that wheat should not be planted close to *Prosopsis juliflora* due to adverse effects on its growth.

Usha *et al.* (2009) showed strong antifungal activity of a concoction brewed from *Datura stramonium, Calotropis gigantea, Azadirachta indica* (neem) and cow manure ($T_1$) followed by methanol-water (70/30 v/v) extracts of *Datura stramonium, Calotropis gigantea* and *Azadirachta indica* ($T_2$) against *Fusarium mangiferae*. Optimal control of floral malformation was found in trees sprayed with $T_1$ followed by $T_2$ at bud break stage and again at fruit set stage when compared with the control. All the malformed buds or panicles completely dried two days after foliar spray with $T_1$ or $T_2$.

Singh *et al.* (2010) conducted the field experiment at Raigarh, Chhattisgarh and observed the effect of rhizobacteria on disease suppression, growth promotion and yield of coriander and fennel. The application of these two rhizobacteria FK-14 (*Pseudomonas putida*) and FL–18 (*Macrobacterium paraxidum*) as seed and soil application was found to be significantly superior to their exclusive application and that of other agents like *Trichoderma*.

Salam and Kato-Noguchi (2010) investigated the allelopathic potential of aqueous methanol extract of neem leaves on seed germination and seedling growth of different plants *viz.* cress (*Lepidum sativum* L.), lettuce (*Lactuca sativa* L.), alfalfa (*Medicago sativa* L.), wild buckwheat (*Eriogonum compositum* Douglas ex Benth.), sand fescue (*Festuca myuros* L.), timothy (*Phleum pratense* L.), barnyardgrass (*Echinochloa crus-galli* [L.] Beauv and *Echinochloa colonum* [L.] Link.). Germination, root and shoot growth of all test plant species were inhibited at concentrations greater than 0.001 g dry weight equivalent extract/ml except timothy and *E. colonum*. Inhibitory activity was dependent on the extract concentrations and the higher extract concentration had the stronger inhibitory activity. The effectiveness of the extract was much higher on the root growth than the shoot growth of test plants. Comparing in the extract concentrations required for 50% inhibition, germination of sand fesucue was the most sensitive and root and shoot growth of cress was the most sensitive to the extract.

Refshauge *et al.* (2010) used an Australian isolate of *Pseudomonas syringae* pv. c*oriandricola* (*Psc*) to study aspects of dispersal of the pathogen and infection of coriander and reported that of the 50 inoculated plants, 47 died (94%). Plants in the control treatment did not develop any disease symptoms. The total plant biomass of *Psc*-inoculated plants was lower compared to the control plants. ANOVA demonstrated that total dry weight, shoot and root dry weights and the root-to-shoot ratios were significantly reduced at the 4th and 5th weeks after inoculation. No significant difference was detected between plants inoculated with the wild-type and the rif mutant strains of *Psc*.

Raghavendra *et al.* (2010) revealed that pooled alkaloid extract (PAE) isolated from fractionation of methanol extract of leaves of *Prosopis juliflora* and treatment sorghum seeds were treated with this extract treatment of seeds significantly reduced percent incidence of moulds and mould induced biodeterioration up to 180 days storage along with significant increase in seed germination and seedling vigor up to 90 days. Carbohydrate, protein, lipid and dry matter losses were also not observed in the treated seeds while significant loss of all the parameters was observed in untreated control seeds. The result of the present study is highly encouraging in developing herbal remedy for seed borne fungal diseases and biodeterioration of grains during storage.

Sangeetha and Muthukumar (2011) reported that seed treatment of chilly with liquid formulations of *Pseudomonas fluorescence* (1.0% AS) @ 10 ml/kg and 15 ml/kg of seed was found to be most effective in reducing the pre and post emergence damping off both in pot culture and field study. The treatments also increased the plant growth and vigour index of chilli seedlings.

Rakib and Mustafa (2012) revealed that the treatment of cucumber seeds and soil with *Pseudomonas fluorescence* suspension induced significant reduction in virus accumulation in the plants as proved by absorbance values of ELISA-reactions. Minimum absorbance values of ELISA reactions at 405 nm were found to be 0.160 and 0.298 for seed and soil treatments, respectively when compared with 1.190 for samples from CMV-inoculated plants (control). The inhibition activity of *Pseudomonas fluorescens* against CMV (cucumber mosaic virus) continued to be significant up to 20 days of virus inoculation with absorbance values of ELISA-reactions (0.460 and 0.930) for seed and

soil treatment, respectively. The results indicate that *Pseudomonas fluorescenc*e's able to induce systemic resistance against CMV in the plants.

Getachew *et al.* (2012) studied the allelopathic effects of the invasive *Prosopis juliflora* on seed germination and seedling growth of *Acacia nilotica* (L.) Willd. ex Del., *Acacia tortilis* (Forssk.) Hayne, *Cenchrus ciliaris* L. and *Enteropogon rupestris* (J.A. Schmidt) A. Chev. *P. juliflora* was recorded in all habitat types in highest density and observed affecting the plant diversity there in. Its growth characteristics and dense thicket formation restrict light to the ground flora and hence diminishes plant diversity. Leaf, bark and root aqueous extract of *P. juliflora* at 0, 0.5, 0.8, 1, 2 and 6% were prepared and their effect studied on germination percentage and seedling growth of the study plant species. Germination of *Acacia nilotica* and *Acacia tortilis* was not affected by all aqueous extracts of different organ parts of *Prosopis juliflora* while leaf and root extracts at higher concentrations inhibited germination of *Cenchrus ciliaris* and *Enteropogon rupestris*. Shoot and root growth of the study species were inhibited by leaf and root at higher concentrations. Seed germination of all species except *Acacia nilotica* was inhibited by soil amended with decaying plant parts and under canopy soil.

# *MATERIALS AND METHODS*

# CHAPTER –III

# MATERIALS AND METHOD

The experiment entitled "**Effect of seed treatment with organic and inorganic substances on germination and foliage yield of coriander (*Coriandrum sativum* L.) in rabi season of Chhattisgarh plains**" was conducted during the winter season of 2012-13. The details of the materials used and methods followed are given below.

## 3.1 Location of experiment site

Field experiment was carried out during Rabi season of 2012-13 in the Horticulture Research cum Instructional Farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.).

## 3.2 Geographical situation

Raipur is situated in the central eastern part of Chhattisgarh and lies at $21^0$ $16^{'}$ N latitude and $81^0$ $26^{'}$ E longitude with an altitude of 289.59 m above the mean sea level.

## 3.3 Climatic condition

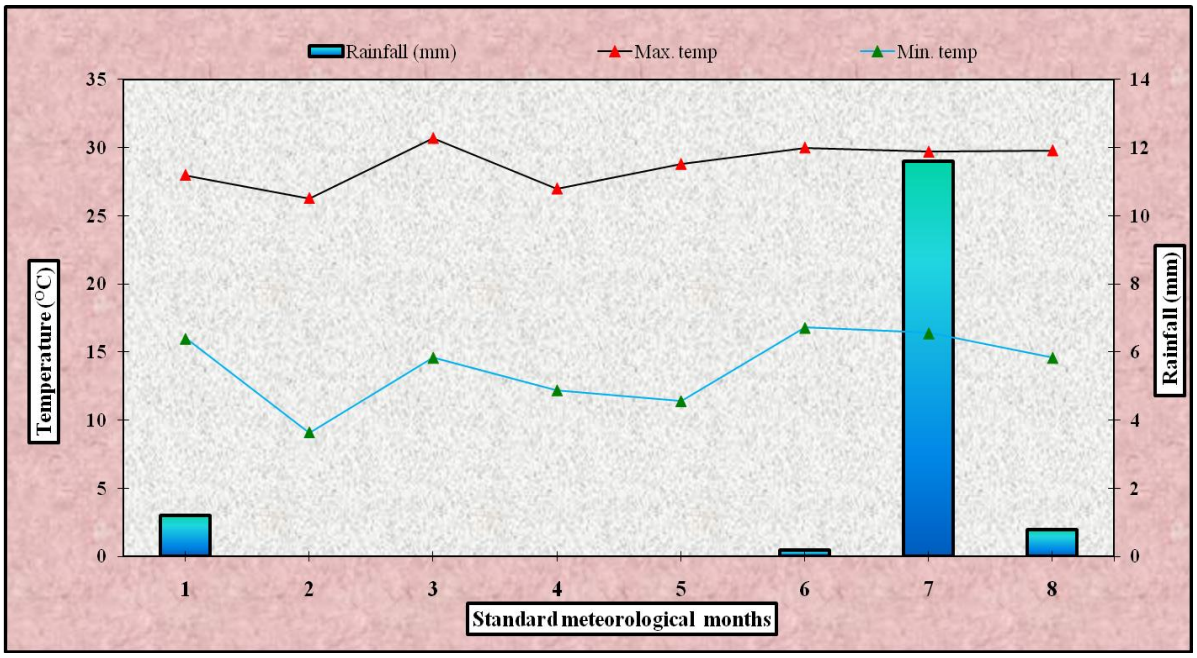
The climate of Raipur region is sub-humid to semi arid. The source of rainfall is South-western monsoon. The average annual rainfall is 1326 mm (based on 80 years mean), of which mostly it is concentrated during the period from June to September and very little during October to February. May is the hottest and December is the coolest month of the year. The pattern of rainfall particularly during June to September months has great variations from year to year. The weekly maximum temperature raises upto $46^oC$ during summer and minimum temperature drop down as low as $6^oC$ during winter season. The

relative humidity is high from June to October and wind velocity is high from May to August with its peak in June-July months.

### 3.4 Weather condition during crop growth period

The weather data recorded during the course of investigation are presented in Appendix-1 and depicted through Fig. 3.1 and 3.2. The coriander crop received about 13.80 mm of rainfall during its growth period. The maximum temperature during the crop growth period varied between 30.70 $^0$C in the third week of January to 26.30 $^0$C in the second week of January, whereas the minimum temperature varied between 9.10 $^0$C in the second week of January to 16.80 $^0$C in the second week of February. The average maximum temperature for different months varied from 29.58 $^0$C to 28 $^0$C, while monthly average minimum temperature ranged between 12.98 $^0$C to 14.80 $^0$C.

The monthly relative humidity throughout the crop season varied between 81.0 to 87.0 per cent at morning and 24.0 to 57.0 per cent in evening hours. The open pan evaporation mean values ranged from 2.4 to 4.3 mm/day, whereas, the bright sunshine varied from 3.3 to 9.9 hours/day. The monthly wind velocity ranged between 1.1 to 2.5 kmph.




**3.1: Weekly meteorological observations during crop period (3 January to 23 February 2013)**

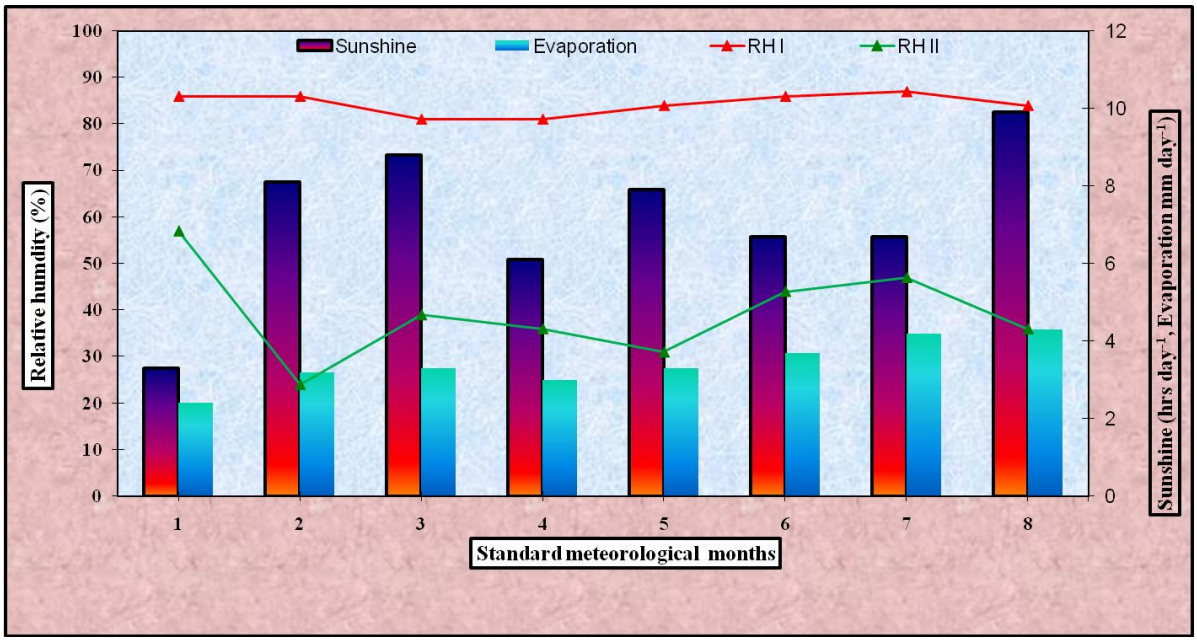



**Fig 3.2: Weekly meteorological observations during crop period (3 January to 23 February 2013)**

### 3.5 Physico-chemical properties of soil

In order to determine the mechanical and chemical composition of experimental plot, soil samples were collected randomly from the experimental site upto 20 cm depth with the help of soil auger. A composite sample was drawn from mixed representative samples by dividing repeatedly till the amount of representative samples remain about 250 g and then it was used for analysis. The detailed physico-chemical properties of the soil are presented in Table 3.1.

**Table 3.1: Physico-chemical analysis of the experimental soil**

| Properties | Analysis Values | Group/ Class | Method used |
|---|---|---|---|
| **A. Mechanical composition** | | | |
| Sand (%) | 22.65 | Silt loam | International Pipette method (Black and Evans, 1965) |
| Silt (%) | 57.70 | | |
| Clay (%) | 19.68 | | |
| **B. Chemical properties** | | | |
| 1. Available N (kg $ha^{-1}$) | 177.05 | Medium | Alkaline permanganate method (Subbiah and Asija, 1956) |
| 2. Available $P_2O_5$ (kg $ha^{-1}$) | 14.53 | Low | Olsen's method (Olsen *et al.*, 1954) |
| 3. Available $K_2O$ (kg $ha^{-1}$) | 379.92 | High | Flame photometric method (Hanway and Heiddle, 1952) |
| 4. Soil reaction ( 1: 2.5 soil : water) | 6.52 | Neutral | Glass electrode pH meter (Piper, 1967) |
| 5. EC ($dsm^{-1}$ 25$^{o}$C) | 0.19 | Neutral | Solubridge method (Black and Evans, 1965) |

## 3.6 Experimental details and design

### 3.6.1 Experimental details

Crop : Coriander (*Coriandrum sativum*)

Variety : Selection- 51

No. of Replications : Three

No. of Treatments : Fifteen

No. of Experimental plots : Fourty five

Experimental Design : Randomized Block Design (RBD)

### 3.6.2 Experimental design

The experiment was laid out in randomized complete block design with three replications. Each replication consists of 15 treatments. The treatments in each block were allotted randomly as illustrated in Fig. 3.3. Plants were spaced 10 cm apart in rows of 15 cm and the net plot size was 2.10 m X 2.00 m The recommended dose of fertilizer (RDF) added at the rate of 60:40:40 kg N:$P_2O_5$:$K_2O$ per hectare. Similar cultural practices were adopted to raise healthy crop in all the experimental plots.

### 3.6.3 Treatment Details:

**Seed treatment**

$T_1$: Control

$T_2$: Soaking seeds in plain water for 12 hrs

$T_3$: Soaking seeds in 25% cow urine solution for 12 hrs

$T_{4:}$ Soaking seeds in 50% cow urine solution for 12 hrs

$T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs

$T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs

$T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs

T8: Soaking seeds in SAAF solution (2g/lit water) for 12 hrs

T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed)

T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed)

T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed)

T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed)

T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *P. fluresence* (10g/kg seed)

T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *P. fluresence* (10g/kg seed)

T15: Soaking seeds in SAAF solution (2g/lit water) for 12 hrs + *P. fluresence* (10g/kg seed)

## 3.7 Experimental material

### 3.7.1 Organic and inorganic substances used

1. Plain water
2. Cow urine
3. *Pseudomonas fluorescence*
4. SAAF
5. *Calotropis sp*.
6. *Prosopsis sp*.
7. *Azadirachta sp.*

Cow urine was obtained from the dairy of college of agriculture, Indira Gandhi Krishi Vishwavidyalaya (IGKV) Raipur. *Pseudomonas fluorescence* culture was obtained from the Department of Agricultural Microbiology, Indira Gandhi Krishi Vishwavidyalaya (IGKV) Raipur. SAAF was obtained from AICRP of tuber crop store of Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya (IGKV) Raipur. *Calotropis sp*., *Prosopsis sp*. and *Azadirachta sp.* were taken from the Horticulture Research cum Instructional farm, Department of Horticulture, college of agriculture, Indira Gandhi Krishi Vishwavidyalaya (IGKV) Raipur, for use in the experiment.

### 3.7.2 Seed treatment

Two seed lots for each treating material was taken and soaked in water for 12 hrs or with other leaf extracts, cow urine and SAAF solution and after soaking the seed, one lot of

seed was sown directly in the prepared field and another lot was sown after treating it with the culture of *Pseudomonas fluorescence.*

### 3.8 Cultural practices

The details regarding the various cultural practices carried out during the course of this investigation are furnished as under:

#### 3.8.1 Preparation of field and experimental plot

Ploughing was done with MB plough followed by harrowing to break the clods. Previous crop debris and weeds were removed. Plots of 2.1 m X 2.0 m were prepared and applied with well decomposed FYM at the rate of 12 tonnes $ha^{-1}$. The FYM was incorporated 15 days before sowing and were mixed well with the soil. Allocation of treatments to each plot was done randomly.

#### 3.8.2 Sowing

Seeds were split into two halves before sowing. They were sown in rows in well prepared beds and covered gently with fine soil. Immediately after sowing, the beds were irrigated and thereafter light irrigation was provided at an interval of two days for two weeks. The seeds germinated in about 10 – 12 days after sowing. The plants were thinned to the required spacing 30 DAS.

#### 3.8.3 Fertilizer application

Fertilizer dosage recommended for coriander is 60:40:40 kg/ha (N: $P_2O_5$:$K_2O$). Nitrogen, phosphorus and potassium were applied in the forms of urea, single super phosphate and murate of potash, respectively. Whole amount of phosphorus and potash and

half of the nitrogen were applied as basal at the time of sowing, whereas, half amount of nitrogen was given in split at 30 DAS. Soon after fertilization light irrigation was given.

### 3.8.4 Weeding and irrigation

The experimental plots were irrigated twice a week until the crop came to full bloom and once a week there after depending on the moisture status of the soil. Weeds were removed manually as and when they emerged.

### 3.8.5 Harvesting

When foliage became lush green in colour and before flowering, plants were uprooted from the ground. After uprooting plants were kept in shade to prevent the wilting of leaves.

### 3.8.6 Details of cultural schedule

The details of the cultural operations adopted in the experimental plot from preparatory tillage to harvesting are given in Table 3.2.

**Table 3.2: Cultural schedule of experiment**

| S.No. | Cultural operation | Implement / method used | Date |
|---|---|---|---|
| 1 | Ploughing and harrowing | Tractor drawn cultivator and disc harrow | 01-01-2013 |
| 2 | Soil sampling | Soil auger | 01-01-2013 |
| 3 | Planking | Tractor drawn planker | 02-01-2013 |
| 4 | Layout preparation | Manual | 02-01-2013 |
| 5 | Seed treatment (for 12 hrs) | Manual | 02-01-2013 |
| 7 | Fertilizer application and sowing | | 03-01-2013 |
| 9 | Weed management | Hand weeding | 04-02-2013 |
| 11 | Harvesting | Manual | 22-02-2013 |

## 3.9 Observations

Twenty plants from each plot were tagged randomly for recording the observations.

### 3.9.1 Growth parameters

#### 3.9.1.1 Days taken for first emergence

Observations for first emergence of seeds were recorded from each plot.

#### 3.9.1.2 Days taken for fifty per cent emergence

Observation for fifty per cent emergence of seeds was recorded from each plot.

#### 3.9.1.3 Days taken for hundred per cent emergence

Observation for hundred per cent emergence of seeds was recorded from each plot.

#### 3.9.1.4 Germination percentage

The germination was tested on a paper medium (roll towel) in a germination chamber maintained at $20^{o}$ C with continuous light (Anon. 1985). Hundred seeds were sown for each treatment. The number of normal seedlings emerged after twelve days of sowing.

#### 3.9.1.5 Plant height (cm)

At harvest, twenty plants were selected randomly from each plot and were labeled for recording observations. Plant height was measured from the ground level to the growing tip of the main branch at harvest. Observations recorded from twenty plants (from each plot) were used to calculate the average height (cm).

#### 3.9.1.6 Number of plants plot$^{-1}$

Number of plants was counted from each plot.

#### 3.9.1.7 Plant population $ha^{-1}$

Number of plants were counted from each plot and converted into the plant population per hectare.

### 3.9.2 Yield attribute and yield

#### 3.9.2.1 Plant weight (g)

At harvest, the tagged plants were uprooted and weighted.

#### 3.9.2.2 Dry weight of 100 g fresh foliage (g)

100 g fresh foliage was taken from each plot and air dried for 72 hours. Foliage were put in separate paper bags and dried in hot air oven at $60^0$C till constant weights were recorded.

#### 3.9.2.3 Foliage yield $plot^{-1}$ (kg)

Foliage yield $plot^{-1}$ was recorded by uprooting the plants and weighing it by electronic balance.

#### 3.9.2.4 Foliage yield Green (q $ha^{-1}$)

Foliage yield from each plot was noted down, then calculated in quintal hectare $^{-1}$ with appropriate multiplication factor.

#### 3.9.2.5 Foliage yield Dry (q $ha^{-1}$)

Foliage yield from each plot was noted down, then calculated in quintal hectare $^{-1}$ with appropriate multiplication factor.

## 3.10 Economics

The economics of coriander crop production pertaining to each of the treatment has been worked out in terms of cost of cultivation. Gross return (Rs. $ha^{-1}$) was obtained by

converting the harvest into monetary terms at the prevailing market rate during the course of studies for every treatment. Net return (Rs. $ha^{-1}$) was obtained by deducting cost of cultivation from gross return. The benefit: cost ratio was calculated with the help of following formula:

Net return = Gross return – Cost of cultivation

(Rs $ha^{-1}$) (Rs $ha^{-1}$) (Rs $ha^{-1}$)

$$\text{Benefit: cost ratio} = \frac{\text{Net return (Rs ha}^{-1}\text{)}}{\text{Total cost of cultivation (Rs ha}^{-1}\text{)}}$$

### 3.11 Statistical analysis

The data obtained on various parameters were tabulated and subjected to statistical analysis. The design used was Random Block Design the influence of treatment was tested with 'F' test, wherever 'F' test shown their significance, the levels of treatment were compared by critical difference at 5% level of probability (Gomez and Gomez, 1984). The skeleton of analysis of variance and formula used for various estimations are given below:

**Table 3.3: The skeleton of the analysis of variance**

| **Source of Variation** | **DF** | **SS** | **MSS** | **F Cal** | **F Tab (5%)** |
|---|---|---|---|---|---|
| Replication (r) | (r-1) | RSS | RMS | RMS/EMS | - |
| Treatment (t) | (t-1) | TrSS | TrMS | TrMS/EMS | - |
| Error | (r-1) (t-1) | ESS | EMS | | |
| Total | rt-1 | TSS | | | |

The following formula was used for standard error, critical difference and coefficient of variance estimations.

(a) S.Em± = $\sqrt{\frac{EMS}{r}}$

(b) C.D. = S.Em x $\sqrt{2}$ x $t_{error}$ d.f.at 5%

(c) C.V. (%) = $\frac{\sqrt{EMS}}{GM}$ x 100

Where,

| | | | | | |
|---|---|---|---|---|---|
| r | = | Number of replication | M.S.S. | = | Mean sum of square |
| t | = | Number of treatment | S.Em± | = | Standard error of mean |
| D.F. | = | Degree of freedom | EMS | = | Error mean squares |
| S.S. | = | Sum of square | C.D. | = | Critical difference |

# *RESULT S AND DISCUSSION*

# CHAPTER-IV

# RESULTS AND DISCUSSION

Present investigation entitled **"Effect of seed treatment with organic and inorganic substances on germination and foliage yield of coriander in Rabi season under Chhattisgarh plains"** was carried out at Horticulture Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *Rabi* season of 2012-13. The data recorded on various aspects of crop growth, yield attributing characters, productivity and economic parameters are analyzed and the results and discussion are briefly described in chapter with figures, facts, cause and effect relationship along with established scientific views of different research workers.

## 4.1 Growth studies of coriander

### 4.1.1 Days taken for first emergence

The data pertaining to days taken for first emergence are presented in Table 4.1. Days taken for first emergence of coriander were significantly influenced by different treatments. Significantly minimum days taken for first emergence was recorded under the treatment soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ (9.00). The maximum days taken for first emergence were recorded under the treatment Control $T_1$ (12.67) and soaking seeds in 2% leaf extract of *Prosopis sp*. for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{13}$ (12.67).

**Table 4.1: Days taken for first emergence of coriander as affected by seed treatment**

| Treatment | 1ST Emergence (Days) |
|---|---|
| $T_1$: Control | 12.67 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 12.00 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 10.67 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 11.33 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 9.33 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs | 10.67 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 10.67 |
| T8: Soaking seeds in SAASF solution (2g/lit. water) for 12 hrs | 11.67 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed) | 11.00 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 10.00 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 12.00 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed) | 9.00 |
| T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 12.67 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 9.67 |
| T15: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 10.33 |
| **SEm ±** | **1.20** |
| **CD (P=0.05)** | **3.46** |

### 4.1.2 Days taken for fifty percent emergence

The data pertaining to days taken for fifty percent emergence are presented in Table 4.2. Days taken for fifty percent emergence of coriander were significantly influenced by different treatments. Minimum days taken for fifty percent emergence was recorded under the treatment soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ (14.00); however it was found comparable with treatment soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs ($T_5$) (13.33). The maximum days taken for fifty percent emergence were recorded under the treatment Control $T_1$ (17.00) and soaking seeds in 50% cow urine for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{11}$ (14.00).

**Table 4.2: Days taken for fifty per cent emergence of coriander as affected by seed treatment**

| Treatment | 50% Emergence (Days) |
|---|---|
| $T_1$: Control | 17.00 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 16.33 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 14.33 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 15.67 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 13.33 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs | 14.33 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 15.33 |
| T8: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs | 14.67 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed) | 14.67 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 16.67 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 14.00 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed) | 14.00 |
| T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 13.00 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 15.33 |
| T15: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 16.33 |
| **SEm ±** | **1.20** |
| **CD (P=0.05)** | **3.47** |

### 4.1.3 Days taken for hundred percent emergence

The data pertaining to days taken for hundred percent emergences are presented in Table 4.3. Days taken for hundred percent emergence of coriander were significantly influenced by different treatments. Significantly minimum days taken for hundred percent emergence were noted under the treatment soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ (15.33). The maximum days taken for hundred percent emergence were recorded under the treatment Control $T_1$ (18.67), soaking seeds in 50% cow urine for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{11}$ (18.00) and soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{13}$ (18.33).

**Table 4.3: Days taken for hundred per cent emergence of coriander as affected by seed treatment**

| Treatment | 100% Emergence (Days) |
|---|---|
| $T_1$: Control | 18.67 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 17.33 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 16.00 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 17.33 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 15.67 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs | 16.67 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 17.00 |
| T8: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs | 16.33 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed) | 17.67 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 18.33 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 18.00 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed) | 15.33 |
| T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 18.33 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 17.00 |
| T15: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 16.33 |
| **SEm ±** | **1.24** |
| **CD (P=0.05)** | **3.59** |

### 4.1.4 Germination percentage

The data related to Germination percentage are presented in Table 4.4. The maximum germination percentage (78.53) was registered under soaking seeds in 2% leaf extract of *Calotropis sp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ as compared to other treatments, however it was found at par with soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (75.71), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ (76.60), soaking seeds in 2% leaf extract of *Prosopsis spp*. for 12 hrs $T_6$ (74.15), soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{10}$ (76.13), soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{14}$ (70.65) and soaking seeds in SAAF solution (2g $lit^{-1}$ water) for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{15}$ (71.33). Minimum Germination percentage was registered under Control $T_1$ (57.62).

Similar findings have also been reported by Vasugi and Thangaraj (1998a). Vasugi and Thangaraj (1998b) found the combination of 2% *Calotropis gigantica* and 2% *Prosopis juliflora* gave the highest vigour index (1978) as compared with the untreated control (66% and 1509, respectively).

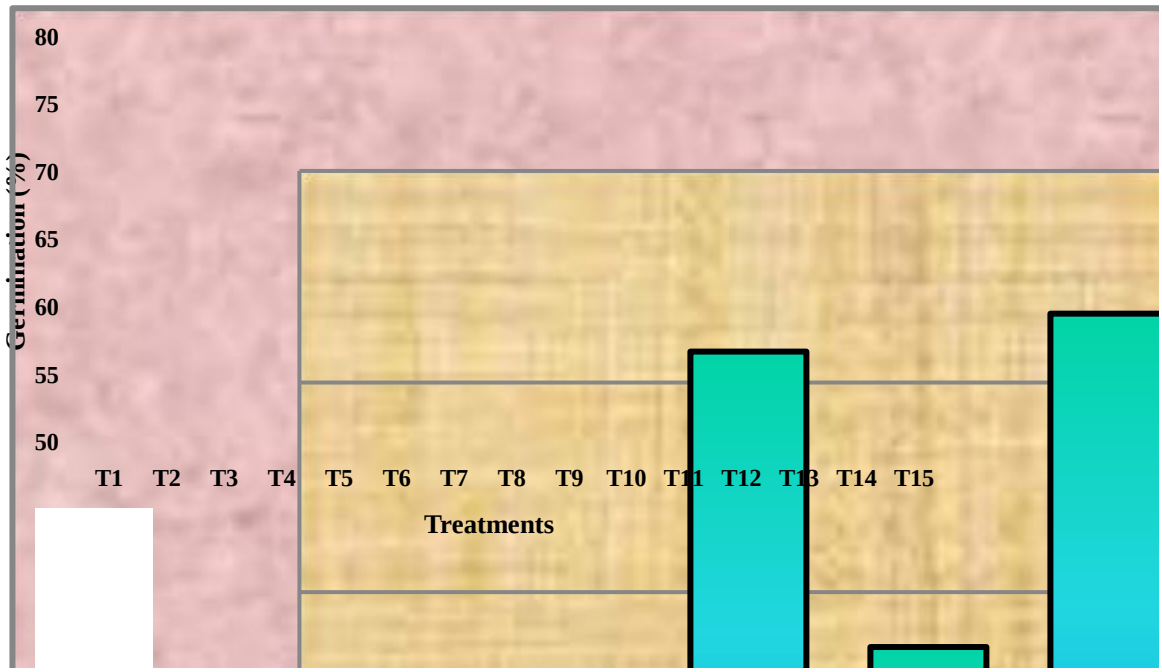



**Fig 4.1: Germination percentage of coriander as affected by seed treatment**

### 4.1.5 Plant height (cm)

Plant height of coriander was observed at harvest stage and data pertaining to plant height are presented in Table 4.5. Plant height of coriander was significantly influenced by different treatments. Taller plants (31.78 cm) were observed in treatment Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ as compared to other treatments, however it was found comparable to Soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (28.2 cm), soaking seeds in 2% leaf extract of *Prosopis sp*. for 12 hrs $T_6$ (27.92 cm), soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{10}$ (29.01 cm) and soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ (30.41 cm). The minimum plant height was registered under Control $T_1$ (23.51 cm).

The taller plants under the treatment 2% leaf extract of *Calotropis sp*. for 12 hrs $T_5$ were due to the minimum concentration of effect of leaf extract. Similar results have been found by Zahrani and Robai (2007). Minimum plant height of control plot was registered due to poor root growth of emerged seedlings.

**Table 4.5: Plant height of coriander as affected by seed treatment**

| Treatment | Plant height (cm) |
|---|---|
| $T_1$: Control | 23.51 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 25.71 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 28.20 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 25.42 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 31.78 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs | 27.92 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 26.13 |
| T8: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs | 26.33 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed) | 24.42 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 29.01 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 27.18 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed) | 30.41 |
| T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 25.28 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 25.49 |
| T15: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 25.32 |
| **SEm ±** | **1.58** |
| **CD (P=0.05)** | **4.56** |

### 4.1.6 Number of plants plot$^{-1}$

The data pertaining to number of plant plot$^{-1}$ are presented in Table 4.9. The maximum number of plant plot$^{-1}$ (1095) was registered under Soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{12}$ as compared to other treatments, however it was found comparable with Soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (1082.67), Soaking seeds in 50% cow urine solution for 12 hrs $T_4$ (982.67), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ (1087.67), soaking seeds in 2% leaf extract of *Prosopsis spp*. for 12 hrs $T_6$ (1060.33), soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs $T_7$ (951), soaking seeds in SAFF solution (2g lit$^{-1}$. water) for 12 hrs $T_8$ (992), soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{10}$ (1088.67), soaking seeds in 50% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{11}$ (991.67), soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{14}$ (1010.33) and Soaking seeds in SAAF solution (2g lit$^{-1}$. water) for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{15}$ (1020). The minimum number of plant plot$^{-1}$ was recorded under Control $T_1$ (824).

**Table 4.6: No. of plants plot$^{-1}$ of coriander as affected by seed treatment**

| Treatment | No. of plants plot$^{-1}$ |
|---|---|
| $T_1$: Control | 824 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 907.33 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 1082.67 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 982.67 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 1087.67 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs | 1060.33 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 951 |
| T8: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs | 992 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed) | 928.33 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 1088.67 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 991.67 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed) | 1095 |
| T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 925.67 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 1010.33 |
| T15: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 1020 |
| **SEm ±** | **54.44** |
| **CD (P=0.05)** | **157.70** |

### 4.1.7 Plant population ha$^{-1}$

Plant population ha$^{-1}$ of coriander was recorded at harvest and data are presented in Table 4.10. The maximum plant population ha$^{-1}$ of coriander was recorded under Soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{12}$ (2607143) as compared to other treatments, however it was found comparable with Soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (2577778), soaking seeds in 50% cow urine solution for 12 hrs $T_4$ (2339683), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ (2589683), soaking seeds in 2% leaf extract of *Prosopis sp*. for 12 hrs $T_6$ (2524603), soaking seed in SAAF solution (2g lit$^{-1}$ water) for 12 hrs $T_8$ (2361905), soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{10}$ (2592063), soaking seeds in 50% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{11}$ (2361111), soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{14}$ (2405556) and soaking seeds in SAAF solution (2g lit$^{-1}$ water) for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{15}$ (2428571). The minimum number of plant ha$^{-1}$ was recorded under Control $T_1$ (1961905).


**Fig 4.2: Plant population of coriander as affected by seed treatment**

**Table 4.7: Plant population ha$^{-1}$ of coriander as affected by seed treatment**

| Treatment | Plant population ha$^{-1}$ |
|---|---|
| $T_1$: Control | 1961905 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 2160317 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 2577778 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 2339683 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs | 2589683 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopis spp*. for 12 hrs | 2524603 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs | 2264286 |
| T8: Soaking seeds in SAAF solution (2g lit$^{-1}$water) for 12 hrs | 23619057 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 2210317 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 2592063 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 2361111 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 2607143 |
| T13: Soaking seeds in 2% leaf extract of *Prosopis spp*. for 12 hrs + *Pseudomonas fluorescence* (10g kg$^{-1}$seed) | 2203958 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluorescence* (10g kg$^{-1}$seed) | 2405556 |
| T15: Soaking seeds in SAAF solution (2g lit$^{-1}$ water) for 12 hrs + *Pseudomonas fluorescence* (10g kg$^{-1}$seed) | 2428571 |
| **SEm ±** | **100451.68** |
| **CD (P=0.05)** | **290996.98** |

## 4.2 Yield attributes and yield

### 4.2.1 Weight plant$^{-1}$ (g)

Weight plant$^{-1}$ of coriander was observed at harvest stage and data pertaining to plant height are presented in Table 4.6. Significant variation in weight plant$^{-1}$ was observed due to different treatments. The maximum weight plant$^{-1}$ (9.99 g) of coriander was recorded under the treatment Soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{12}$ as compared to other treatments, however it was found statistically at par with treatments soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs $T_5$ (8.86 g) and soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{10}$ (8.54 g). The minimum weight plant$^{-1}$ was recorded under control $T_1$ (6.35 g).

Similar observation has been reported that plant weight of tomato and eggplant was found to be higher with higher concentration of leaf extracts of *Tricoderma peruviana* and *Calotropis procera* and with longer dip duration (Tiyagi et al., 2009**).**

**Table 4.8: Weight plant$^{-1}$ of coriander as affected by seed treatment**

| Treatment | Weight plant$^{-1}$ (g) |
|---|---|
| $T_1$: Control | 6.35 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 6.42 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 8.40 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 7.14 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 8.86 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs | 7.47 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 7.53 |
| T8: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs | 7.80 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed) | 7.62 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 8.54 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 7.17 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed) | 9.99 |
| T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 6.82 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 7.72 |
| T15: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 8 |
| **SEm ±** | **0.51** |
| **CD (P=0.05)** | **1.47** |

### 4.2.2 Dry weight of foliage (g)

Dry weight of coriander was recorded at harvest and data are presented in Table 4.7. The maximum dry weight of coriander (15.78 g) was recorded under soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{10}$ as compared to other treatments, however it was found comparable with soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (13.93 g), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ (14.44 g), soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs $T_7$ (14.97 g), soaking seed in plain water for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_9$ (11.51 g), soaking seeds in 50% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{11}$ (13.92 g), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) ($T_{12}$) (14.08 g), soaking seeds in 2% leaf extract of *Prosopsis spp*. for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{13}$ (13.92 g), soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{14}$ (15.31 g) and soaking seeds in SAAF solution (2g $lit^{-1}$ water) for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{15}$ (14.21 g). Minimum weight of coriander was recorded under Control $T_1$ (10.43 g).

**Table 4.9: Dry weight of coriander foliage as affected by seed treatment**

| Treatment | Dry weight of foliage (g) |
|---|---|
| $T_1$: Control | 10.43 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 11.17 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 13.93 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 12.95 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 14.44 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs | 12.13 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 14.97 |
| T8: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs | 12.44 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluresence* (10g/kg seed) | 11.51 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 15.78 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 13.92 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluresence* (10g/kg seed) | 14.08 |
| T13: Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 13.92 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 15.31 |
| T15: Soaking seeds in SAAF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 14.21 |
| **SEm ±** | **0.77** |
| **CD (P=0.05)** | **2.24** |

### 4.2.3 Foliage Yield plot$^{-1}$ (kg)

The data related to foliage yield plot$^{-1}$ are presented in Table 4.11. The maximum foliage yield plot$^{-1}$ (7.75 kg) was observed under soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + treatment with *Pseudomonas florescence* (10g kg$^{-1}$ seed) $T_{12}$ as compared to other treatments, however it was found at par with soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (6.61 kg), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ (7.57 kg), soaking seeds in 2% leaf extract of *Prosopsis spp*. for 12 hrs $T_6$ (6.04 kg) and soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) $T_{10}$ (6.86 kg). Minimum foliage yield plot$^{-1}$ was recorded under control $T_1$ (4.0 kg).

**Table 4.10: Foliage yield plot$^{-1}$of coriander as affected by seed treatment**

| Treatment | Yield plot$^{-1}$ (kg) |
|---|---|
| $T_1$: Control | 4.0 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 4.32 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 6.61 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 5.28 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs | 7.57 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopsis spp*. for 12 hrs | 6.04 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs | 5.23 |
| T8: Soaking seeds in SAAF solution (2g lit$^{-1}$ water) for 12 hrs | 5.69 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 4.90 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 6.86 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 5.91 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g kg$^{-1}$seed) | 7.75 |
| T13: Soaking seeds in 2% leaf extract of *Prosopis spp*. for 12 hrs + *Pseudomonas fluorescence* (10g kg$^{-1}$ seed) | 4.82 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + *Pseudomonas fluorescence* (10g kg$^{-1}$seed) | 5.84 |
| T15: Soaking seeds in SAAF solution (2g lit.$^{-1}$ water) for 12 hrs + *Pseudomonas fluresence* (10g kg$^{-1}$seed) | 5.92 |
| **SEm ±** | **0.62** |
| **CD (P=0.05)** | **1.79** |

### 4.2.4 Foliage Yield Green (q $ha^{-1}$)

Foliage yield green $ha^{-1}$ of coriander was recorded at harvest and data are presented in Table 4.12. The maximum foliage yield green $ha^{-1}$ of coriander was recorded under soaking seeds in 2% leaf extract of *Calotropis sp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ (184.44 q $ha^{-1}$) as compared to other treatments, however it was found at par with soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (156.03 q $ha^{-1}$), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ (180.32 q $ha^{-1}$), soaking seeds in 2% leaf extract of *Prosopsis spp*. for 12 hrs $T_6$ (142.46 q $ha^{-1}$), soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{10}$ (163.25 q $ha^{-1}$) and soaking seeds in SAAF solution (2g $lit^{-1}$ water) for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{15}$ (143.62 q $ha^{-1}$). The minimum foliage yield green $ha^{-1}$ of coriander was recorded under Minimum yield $plot^{-1}$ was recorded under control $T_1$ (95.16 q $ha^{-1}$).

Similar findings are reported that the botanical extracts have a positive effect on yield. Comparison of the date yield indicated that, *Calotropis spp.* treatments showed an average increase in yield over the control of 20%, respectively (Khalid et al., 2011**).**

**Table 4.11: Foliage yield green of coriander as affected by seed treatment**

| Treatment | Foliage yield green (q $ha^{-1}$) |
|---|---|
| $T_1$: Control | 95.16 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 102.94 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 156.03 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 125.79 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs | 180.32 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopis spp*. for 12 hrs | 142.46 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs | 124.87 |
| T8: Soaking seeds in SAAF solution (2g $lit^{-1}$water) for 12 hrs | 135.55 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 116.75 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 163.25 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 140.64 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 184.44 |
| T13: Soaking seeds in 2% leaf extract of *Prosopis spp*. for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$seed) | 114.76 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$seed) | 138.97 |
| T15: Soaking seeds in SAAF solution (2g $lit^{-1}$water) for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$seed) | 143.62 |
| **SEm ±** | **14.50** |
| **CD (P=0.05)** | **41.99** |

### 4.2.5 Foliage Yield Dry (q $ha^{-1}$)

The data related to foliage yield dry $ha^{-1}$ are presented in Table 4.8. The maximum foliage yield dry $ha^{-1}$ (25.97 q $ha^{-1}$) was registered under soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ as compared to other treatments, however it was found at par with Soaking seeds in 25% cow urine solution for 12 hrs $T_3$ (21.71 q $ha^{-1}$), soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs $T_5$ (25.88 q $ha^{-1}$), soaking seeds in 25% cow urine for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{10}$ (25.69 q $ha^{-1}$) and soaking seeds in *Azadirachta spp.* for 12 hrs + treatment with *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{14}$ (21.38 q $ha^{-1}$). Minimum foliage yield dry $ha^{-1}$ was registered under Control $T_1$ (13.56 q $ha^{-1}$).

**Table 4.12: Foliage yield dry of coriander as affected by seed treatment**

| Treatment | Foliage yield dry (q $ha^{-1}$) |
|---|---|
| $T_1$: Control | 13.56 |
| $T_2$: Soaking seeds in plain water for 12 hrs | 15.67 |
| $T_3$: Soaking seeds in 25% cow urine solution for 12 hrs | 21.71 |
| $T_4$: Soaking seeds in 50% cow urine solution for 12 hrs | 16.11 |
| $T_5$: Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs | 25.88 |
| $T_6$: Soaking seeds in 2% leaf extract of *Prosopis spp*. for 12 hrs | 17.26 |
| $T_7$: Soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs | 18.72 |
| T8: Soaking seeds in SAAF solution (2g $lit^{-1}$water) for 12 hrs | 14.44 |
| T9: Soaking seed in plain water for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 13.69 |
| T10: Soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 25.69 |
| T11: Soaking seeds in 50% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 19.82 |
| T12: Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$seed) | 25.97 |
| T13: Soaking seeds in 2% leaf extract of *Prosopis spp*. for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) | 16.04 |
| T14: Soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$seed) | 21.38 |
| T15: Soaking seeds in SAAF solution (2g $lit^{-1}$water) for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$seed) | 20.15 |
| **SEm ±** | **1.82** |
| **CD (P=0.05)** | **5.27** |

## 4.3 Economics

The data on cost of cultivation, gross return, net return and benefit cost ratio from coriander as affected by seed treatment are presented in Table 4.13. The maximum cost of cultivation was recorded under treatment soaking seeds in 50% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_{11}$ and minimum was recorded under the treatment Control $T_1$ and soaking seeds in plain water for 12 hrs $T_2$. The highest gross return was obtained under treatment soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_{12}$ followed by soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs $T_5$ and soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_{10}$. The lowest values were recorded under control $T_1$ followed by soaking seeds in plain water for 12 hrs $T_2$ and soaking seeds in 2% leaf extract of *Prosopsis spp.* for 12 hrs + *Pseudomonas fluorescence* (10g $kg^{-1}$ seed) $T_{13}$. The highest net return were obtained under treatment soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_{12}$. It was followed by soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs $T_5$, soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_{10}$ and soaking seeds in 25% cow urine solution for 12 hrs ($T_3$). The highest benefit cost ratio was recorded under soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{12}$) and it was followed by soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs $T_5$ and soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_{10}$. The lowest benefit cost ratio was recorded under untreated control $T_1$.

**Table 4.13 Economics of coriander as affected by seed treatment**

| | Treatment | Cost of cultivation (Rs ha$^{-1}$) | | | Gross return (Rs ha$^{-1}$) | Net return (Rs ha$^{-1}$) | Benefit :Cost ratio |
|---|---|---|---|---|---|---|---|
| | | Fixed cost | Treatment cost(Rs ha$^{-1}$) | Total cost | | | |
| $T_1$ | Control | 27014 | - | 27014 | 95160 | 68146 | 2.52 |
| $T_2$ | Soaking seeds in plain water for 12 hrs | 27014 | - | 27014 | 102940 | 75926 | 2.81 |
| $T_3$ | Soaking seeds in 25% cow urine solution for 12 hrs | 27014 | 250 | 27264 | 156033 | 128769 | 4.72 |
| $T_4$ | Soaking seeds in 50% cow urine solution for 12 hrs | 27014 | 500 | 27514 | 125790 | 98276 | 3.57 |
| $T_5$ | Soaking seeds in 2% leaf extract of Calotropis sp. for 12 hrs | 27014 | 20 | 27034 | 180317 | 153283 | 5.67 |
| $T_6$ | Soaking seeds in 2% leaf extract of Prosopsis sp. for 12 hrs | 27014 | 30 | 27044 | 142460 | 115416 | 4.26 |
| $T_7$ | Soaking seeds in 2% leaf extract of Azadirachta sp. for 12 hrs | 27014 | 30 | 27044 | 124870 | 97826 | 3.61 |
| $T_8$ | Soaking seeds in SAFF solution (2g/lit. water) for 12 hrs | 27014 | 25 | 27039 | 135553 | 108514 | 4.01 |
| $T_9$ | Soaking seed in plain water for 12 hrs + P. fluresence (10g/kg seed) | 27014 | 43 | 27057 | 116747 | 89690 | 3.31 |
| $T_{10}$ | Soaking seeds in 25% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 27014 | 293 | 27307 | 163250 | 135943 | 4.97 |
| $T_{11}$ | Soaking seeds in 50% cow urine for 12 hrs + *P. fluresence* (10g/kg seed) | 27014 | 543 | 27557 | 140637 | 113080 | 4.10 |
| $T_{12}$ | Soaking seeds in 2% leaf extract of Calotropis sp. for 12 hrs + *P. fluresence* (10g/kg seed) | 27014 | 63 | 27077 | 184443 | 157366 | 5.81 |
| $T_{13}$ | Soaking seeds in 2% leaf extract of Prosopsis sp. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 27014 | 73 | 27087 | 114760 | 87673 | 3.23 |
| $T_{14}$ | Soaking seeds in 2% leaf extract of Azadirachta sp. for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 27014 | 73 | 27087 | 138967 | 111880 | 4.13 |
| $T_{15}$ | Soaking seeds in SAFF solution (2g/lit. water) for 12 hrs + *Pseudomonas fluresence* (10g/kg seed) | 27014 | 68 | 27082 | 143620 | 116538 | 4.30 |

**Marketable price:** Foliage = Rs 1000 q$^{-1}$

# *SUMMARY, CONCLUSION AND SUGGESTIONS FOR FUTURE RESEARCH WORK*

# CHAPTER – V

# SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH WORK

The present investigation entitled **"Effect of seed treatment with organic and inorganic substances on germination and foliage yield of coriander in rabi season under chhattisgarh plains"** was carried out during *rabi* season of 2012-13 at Horticulture Instructional Cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, with the objective to find out suitable organic or inorganic seed treatment material for seed treatment and growing coriander under the agro-climatic condition of Chhattisgarh plain.

The soil of the experimental field was medium texture with low, medium and high in N, P and K, respectively. The climate of the region is sub humid to semi arid. The experiment composed of T1-Control, $T_2$-Soaking seeds in plain water for 12 hrs, $T_3$-Soaking seeds in 25% cow urine solution for 12 hrs, $T_4$.Soaking seeds in 50% cow urine solution for 12 hrs, $T_5$-Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs, $T_6$-Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs, $T_7$-Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs, T8-Soaking seeds in SAAF solution (2g $lit^{-1}$ water) for 12 hrs, T9-Soaking seed in plain water for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed), T10-Soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed), T11-Soaking seeds in 50% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed), T12-Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed), T13-Soaking seeds in 2% leaf extract of *Prosopsis sp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed), T14-Soaking

seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed), T15-Soaking seeds in SAAF solution (2g/lit water) for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed). Experiment was laid out in Randomized Block Design with three replications. Coriander variety selection-51 was shown on 03-01-2013 at a spacing of 15 cm x 5 cm. with a seed rate of 25 kg $ha^{-1}$. The crop was harvested on 23-02-2013. Days taken for first emergence, fifty per cent emergence, hundred per cent emergence, germination percentage, plant height, weight $plant^{-1}$, number of plant $plot^{-1}$ and $ha^{-1}$, dry weight, Foliage yield $plot^{-1}$, foliage yield green $ha^{-1}$, foliage yield dry $ha^{-1}$, and economics at harvest and statistically analyzed.

**The results are highlighted below:**

1. Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed), followed by 2% leaf extract of *Calotropis spp*. for 12 hrs were found effective in days taken for first emergence, fifty per cent emergence and hundred per cent emergence as rapid germination of coriander takes place under these treatments.
2. Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) and 2% leaf extract of *Calotropis spp*. for 12 hrs were found effective in enhancing plant height, weight $plant^{-1}$ of coriander.
3. The higher number of plants $plot^{-1}$ and plant population $ha^{-1}$ were registered under the treatment Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) and it was statistically similar with soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) followed by 2% leaf extract of *Calotropis spp*.

4. Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) was found effective in enhancing foliage yield $plot^{-1}$, fresh weight and dry weight $ha^{-1}$ and was followed by the treatment soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs. $ha^{-1}$.
5. Dry weight was recorded maximum under soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) and was followed by soaking seeds in 2% leaf extract of *Azadirachta spp.* for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed).
6. Soaking seeds in 2% leaf extract of *Calotropis spp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) was found effective in enhancing germination percentage and was followed by the treatment soaking seed 2% leaf extract of *Calotropis spp.* for 12 hrs $T_5$ and 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) $T_{10.}$
7. Soaking seeds in 2% leaf extract of *Calotropis spp.* for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) gave the maximum gross return, net return and benefit: cost ratio. Seed treatment of 2% leaf extract of *Calotropis spp.* for 12 hrs also gave the maximum gross return, net return and benefit: cost ratio.

## Conclusion:

The present study has been conducted for one season, hence definite conclusion could not be drawn. However, on the basis of results obtained, it can be concluded that Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) have registered higher growth, yield attributes, yield and economics of *Rabi* coriander under *Vertisols* condition of Chhattisgarh plain as compared to other treatments. The next

best performing treatments were 2% leaf extract of *Calotropis sp*. for 12 hrs and 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed).

## Suggestions for future research work:

- The same experiment can be repeated for one or more years to get some concrete findings. It can also be tested under different combinations.
- Detailed investigation regarding enhanced germination through cow dung in different concentrations need to be evaluated in combination with different organic and inorganic substances.
- Studies should be conducted for allelopathic effect as well as on residual effect of newer leaf extracts in coriander.
- Detail study is needed to identify the best seed treatment under kharif and rabi coriander in different agro-climatic zones of Chhattisgarh.

# *ABSTRACT*

# "EFFECT OF SEED TREATMENT WITH ORGANIC AND INORGANIC SUBSTANCES ON GERMINATION AND FOLIAGE YIELD OF CORIANDER IN RABI SEASON UNDER CHHATTISGARH PLAINS"

By

**MOHIT JAIN**

## ABSTRACT

The present investigation entitled **"Effect of seed treatment with organic and inorganic substances on germination and foliage yield of coriander in rabi season under Chhattisgarh plains"** was carried out during *rabi* season of 2012-13 at the Horticulture Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The soil of experimental field was clayey in texture, low in nitrogen, medium in phosphorus and high in potassium contents with neutral pH. The experiment was laid in randomized block design having the combination of fifteen treatments and three replications. The coriander variety selection-51 was grown as test crop.

The result of the experiment indicated that rapid emergence of coriander was taken under Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{12}$). The growth characters like plant height, weight $plant^{-1}$ and fresh weight was maximum under Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{12}$) and show at par result with 2% leaf extract of *Calotropis sp*. ($T_5$) Dry weight $ha^{-1}$ was maximum under Soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{10}$) and was followed by Soaking seeds in 2% leaf extract of *Azadirachta sp.* for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{14}$).

Among the yield and yield attributes number of plants $plot^{-1}$, plant population $ha^{-1}$ and foliage yield $plot^{-1}$ were maximum under 2% leaf extract of *Calotropis sp*. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{12}$) and the next best treatment was Soaking seeds in 2% leaf extract of *Calotropis sp*. for 12 hrs. $ha^{-1}$ ($T_5$).

The economic returns in terms of net return and B:C ratio were maximum under Soaking seeds in 2% leaf extract of Calotropis sp. for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{12}$). It was followed by Soaking seeds in 2% leaf extract of *Calotropis sp.* for 12 hrs ($T_5$), Soaking seeds in 25% cow urine for 12 hrs + *P. fluorescence* (10g $kg^{-1}$ seed) ($T_{10}$) and Soaking seeds in 25% cow urine solution for 12 hrs ($T_3$).

Department of Horticulture
College of Agriculture, IGKV, Raipur (C.G.)

**Dr. Jitendra Singh**
(Major Advisor)

# *REFERENCES*

# REFERENCES

Alves, E.U., Oliveira, A.P.De., Bruno, R.de.L.A., Sader, R. and Alves, A.U. 2005. Yield and physiological quality of coriander seeds cultivated with manure and mineral fertilizer. Revista-*Brasileira-de-Sementes* **27**(1): 132-137.

Anonymous, 1985. International rules for seed testing. Seed Sci., and Technology **13**:307-355.

Anonymous, 2011. Annual Report of National Horticulture Mission. Area and production district wise. Government of Chhattisgarh, Raipur.

Anonymous, 2011. Indian Horticulture Database 2010.National Horticulture Board, Ministry of Agriculture, Government of India, Gurgaon, India.

Badgujar, C.D. and Warhal, K.N. 1998. Effects of seed soaking and wrapping on growth and yield of vegetable coriander.*Journal of the Maharashtra Agricultural Universities* **13**(3): 344-365.

Balashanmugam, P.V., Shah Ahmad, and Cheziyan, N. 1988. Studies on relay inter cropping in Turmeric. *South Indian Hort.* **36**(4): 207-208.

Banafar, R.N.S. 1994. Influence of hormones and chemicals on the germination of coriander seed (*Coriandrum sativum L.*). *Gujarat Agricultural University Research Journal* **20**(1): 111-113.

Bardin, S.D.,Huang, H.C. and Moyer, J.R. 2004. Control of Pythium damping-off of sugar beet by seed treatment with crop straw powders and a biocontrol agent.*Biological-Control* **29**(3): 453-460.

Black, C. A. 1965. Method of soil analysis. *Amar. Agron. Inc. Madeson*, Wisconsin, USA. pp. 131-137.

Black, C.A. and Evans, D.D. 1965. Methods of soil analysis. *American Soc. Agron.* Madison,Wisconsin, USA.

Capecka, E., Dabrowska, B., Suchorska, T.K., Szalacha, E. and Wiewiora, B. 2003. Influence of presowing conditioning and fungicide application on the seed and seedling vigour and yield of coriander (*Coriandrum sativum L.*) seeds. *Acta-Horticultura* (598): 265-270.

Farooqi, A. A., Sreeramu, B. S. and Srinivasappa, K. N. 2005. Cultivation of spice crops 128-140.

Sangeetha, G. and Muthukumar, A. 2011. Efficacy of liquid formulation of *Pseudomonas fluorescens* for the management of chilli damping off. *Indian Journal of Plant Protection* **39**(1).

Gandhikumar, N. and Raguchander, T. 2001. Effect of spore suspension and partially purified toxin of Fusariumoxysporumf.sp.corianderii on seed germination and seedling vigour of coriander. *Annals-of-Plant-Protection-Sciences* **9**(1): 142-144.

Getachew, S., Demissew, S. and Woldemariam, T. 2012. Allelopathic effects of the invasive *Prosopis juliflora* on selected native plant species in Middle Awash, Southern Afar Rift of Ethiopia. *Management of Biological Invasions* **3**(2): 105–114.

Ghasemi, S., Ghasemi, M., Moradi, N. and Shamili, A. M., 2011.Effect of *Calotropis procera* leaf extract on seed germination of some plants. *Journal of Ornamental and Horticultural Plants* **2**(1): 27-32.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedure for Agricultural Research. John Wiley and Sons Publication 2nd edition.

Gupta, G.K., Dhar, K.L. and Atal, C.K. 1977. Chemical constitution of *Coriandrum sativum* Linn. Seeds. *Indian Perfumer* **21**:86-90.

Hamid, A., Bhat, N. Ah., Sofi, T. A., Bhat, K. A. and Asif, M. 2012. Management of root rot of pea (*Pisum sativum* L.) through bioagents. *African Journal of Microbiology Research* **6**(44): 7156-7161.

Hanwy, J.J. and Heiddle, H. 1952. Bulletin Iowa State College of Agri. **57**:1.

Haroun, S. A. and Shehri, A. M. 2001. Cytogenetic effects of *Calotropis procera* extract on *Vicia faba* L. *Cytologia* **66**(4): 373-378.

Humaid, A.I. & Warrag, M.O.A. 1998. Allelopathic effects of mesquite (Prosopis juliflora) foliage on seed germination and seedling growth of bermuda grass (Cynodon dactylon). *Journal of Arid Environment* **38**(2): 237–243.

Jarald, E., Edwin, S., Tiwari, V., Garg, R. and Toppo, E. 2008. Antioxidant and antimicrobial activities of cow urine. *Global Journal of Pharmacology* **2**(2): 20-22.

John, T.D. 1994. Coriander development in Andhra Pradesh. *Spice India* **7**(1-2): 4-5.

Kanaga, A., Muniyammal, P. and Manonmani, R., 2012. Suppressive effects of aqueous extracts of neem (*MeliaAzadirachta*L.) on some initial growth parameters of cow pea and horse gram. *Journal of Applied Pharmaceutical Science* **2**(05): 185-187.

Khalid, O. A., Eldoush1, M., Taha1, A. K., Elsir, T., Idris, I. M., Omar, A. A., Sidahmed, F. E., Musa, A. and Hatim, G. M. 2012. Application of plant based extracts for the

control the green pit scale insect (*Asterolicanium phoenicis* Rao.) with yield enhancement on date palm. *Emir. J. Food Agric* **23**(5): 404-412.

Khan, B. M. and Khan, M. A. 2006. Allelopathic proclivities of tree leaf extracts on seed germination and growth of wheat and wild oats. *Pak J. Weed Sci. Res.* **12**(4): 265-269.

Maheswari, U. and Sundarababu, R. 2001. Management of root-knot nematode, meloidogyne incognita infecting cowpea by calotropis leaf extract. *Indian Journal of Nematology* 31(2).

Mandal, A.K., Hore, A. and Gupta, D.K.D. 1987. Preservation of coriander (*Coriandrum sativum* L.) and fennel (*Foeniculum vulgare* L.) seeds by soaking. Drying treatment for the maintenance of vigour and viability. *Indian-Agriculturist* **31**(1): 29-32.

Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium carbonate. *United State Department of Agriculture Circ. No.* **939**: 1-9.

Oudhia, P. and Tripthi, R.S. 1997. Allelopathic effects of *Ageratum conyzoides* and *Calotropis gigantea* on germination and seedling vigour of rice. *Agric, Sci. Digest* **21**(1): 69-70.

Oudhia, P., S.S. Kolhe, and R.S Tripathi, 1998a. International congress on allelopathy in ecological agriculture and forestry, UAS, dharwad, 151.

Oudhia, P., S.S. Kolhe, and R.S. Tripathi, 1998b. Extended summaries. *First International Agronomy Congress on Agronomy, Environment and Food Security for 21st Century,* 23-27.

Oudhia, P., S.S. Kolhe, and R.S. Tripathi. 1997. Legume Res. 20(2):133-136.

Pandit, B.R., Mahesh, K.R. & Kotiwar, O.S. 1995. Effect of Prosopis juliflora (Sw) DC. extracts on root and shoot growth of bajra seedlings. *Geobios* **22**: 145–148.

Perseglove, J.W., Brown, E.G., Green, G.L. and Robins, S.R.J., 1981. Spices Long man. *Inc. Newyork* **2**: 736-788.

Piper, C.S. 1967. Soil and plant analysis. Bombayl New Delhi, Asia publishing house. pp.30-38.

Pradeep, A.G., Lokesh, S. and Rai, V.R. 2003. Efficacy of some essential oils on seed mycoflora and seedling quality of some crop species saved by farmers. *Advances-in-Plant-Sciences.* **16**(1): 53-58.

Raghavendra, M. P., Satish, S. and Raveesha, K. A. 2010. Alkaloid extract of *Prosopis juliflora* on sorghum seed mould. *Journal of Biopesticides* **3**(1): 333-342.

Rakib, A. A. and Mustafa, A. A. 2012. Protection of melon plants against cucumber mosaic virus infection using *Pseudomonas fluorescens* biofertilizer. *African Journal of Biotechnology* **11**(100): 16579-16585.

Refshauge, S. J., Nayudu, M., Vranjic, J. and Bock, C. H. 2010. Infection and dispersal processes of *Pseudomonas syringae*pv. *coriandricola*on coriander. *Phytopathol Mediterr* **49**: 42–50.

Salam, M.A. and Kato-Noguchi, H. 2010. Evaluation of allelopathic potential of neem (*Azadirachtaindica.* A. Juss) against seed germination and seedling growth of

different test plant species. *International Journal of Sustainable Agriculture* **2**(2): 20-25.

Saravanapriya, B. and Sivakumar, M. 2005. Management of root knot nematode meloidogyne incognita on tomato with botanicals. *Indian Journal of Natural Products and Resources* **4**(3): 158-161.

Shankaracharya, N.B. and Natarajan, C.P. 1971. Coriander-chemistry, technology and uses. *Indian Spices* **8**(2)**:** 4-13**.**

Sharma, R.K. and Bhati, D.S. 1984. Performance of coriander varieties under irrigated condition. *Indian Cocoa, Arecanut and Spices J.* **2**: 96-98.

Siddiqui,S., Bhardwaj, S., Saeed, S. and Meghvanshi, M. K. 2009. Allelopathic effect of different concentration of water extract of *Prosopsis Juliflora* leaf on seed germination and radicle length of wheat (*Triticum aestivum* Var-Lok-1). *American Eurasian Journal of Scientific Research* **4**(2): 81-84.

Singh, A.K., Banwasi, R. and Jangre, A. 2010. Effect of rhizobacteria on wilt suppression, growth promotion and yield of coriander and fennel. *Journal of Biological Control* **24**(3): 276-278.

Singh, A.K., Banwasi, R. and Jangre, A. 2010. Effect of rhizobacteria on wilt suppression, growth promotion and yield of coriander and fennel.*Journal of Biological Control*.**24**(3): 276-278.

Singh, V.B. and Singh, K. 1996. Spices, *New Age Int., (p) Ltd.*100-112.

Subbiah, B.V. and Asija, G.L. 1956. A rapid method for estimation of nitrogen in soil. Curr. Sci. **26**: 259-260.

Subramanian, S. and Vijayakumar, M. 2001. Effect of various levels of nitrogen and Azospirillum on growth and yield of CO 3 coriander (*Coriandrum sativum* L.). *South Indian Horticulture* **49**(Special): 191-194.

Taylor, J.D. and Dudley, C.L. 1980. Bacterial disease of coriander. *Plant Pathology* **29**(3): 117-121.

Taylor, J.D., Dudley, C.L. and Gray, L. 1975. Bacterial disease of coriander. *25th Annual Report for National Vegetable Research Station* 115-117.

Tiyagi, S.A., Mahmood, I. and Rizvi, R. 2009. Application of some Latex-bearing Plants for the Management of Phytonematodes Infecting Tomato and Eggplant. *Thai Journal of Agricultural Science* **42**(4): 183-189.

Usha, K., Singh, B., Praseetha, P., Deepa, N., Agarwal, D. K., Agarwal, R. and Nagaraja, A. 2009. Antifungal activity of *Datura stramonium, Calotropis gigantea* and *Azadirachta indica* against *Fusarium mangiferae* and Floral Malformation in Mango. *European Journal of Plant Pathology* **124**(4): 637-657.

Vasugi, C. and Thangaraj, T. 1998a. Effect of pre-sowing seed treatments on field emergence and seedling vigour in coriander (*Coriandrum sativum L.*). *Advances in Plant Sciences* **11**(1): 303-304.

Vasugi, C. and Thangaraj, T. 1998b. Effect of seed hardening with botanicals on germination and seedling vigour in coriander (*Coriandrum sativum L.*). *South Indian Horticulture* **46**(3/6): 167-170.

Vasyuta, G.G., Inskaya, L.R. and Timasheva, L.A. 1978. Characteristics of germination of freshly harvested coriander seeds. *Trudy-VNII-Efiromaslich-Kul'-tur*. **11**: 41-44.

Zahrani, H. S. and Robai, S. A., 2007. Allelopathic effect of *Calotropis procera* leaves extract on seed germination of some plants. *JKAU Sci.* **19:** 115-126.

# *APPENDICES*

**Appendix-I : Weekly meteorological data during crop growth period (from 06 July, 2010 to October 27, 2010)**

| Week No. | Month & year | Date | Temp (°C) | | Rainfall (mm) | Relative humidity (%) | | Vapour pressure | | Wind velocity (kmph) | Evaporation (mm) | Sunshine (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max | Min | | I | II | I | II | | | |
| 1 | January, 2013 | 31-06 | 28 | 16 | 1.2 | 86 | 57 | 12.4 | 15 | 1.5 | 2.4 | 3.3 |
| 2 | | 07-13 | 26.3 | 9.1 | 0 | 86 | 24 | 8 | 6.3 | 1.3 | 3.2 | 8.1 |
| 3 | | 14-20 | 30.7 | 14.6 | 0 | 81 | 39 | 10.8 | 11.6 | 1.2 | 3.3 | 8.8 |
| 4 | | 21-27 | 27 | 12.2 | 0 | 81 | 36 | 9.3 | 8.9 | 1.1 | 3 | 6.1 |
| **Average** | | | **28** | **12.98** | **1.2*** | **83.5** | **39** | **10.13** | **10.45** | **1.28** | **2.98** | **6.58** |
| 5 | February, 2013 | 28-03 | 28.8 | 11.4 | 0 | 84 | 31 | 9.1 | 8.7 | 1.1 | 3.3 | 7.9 |
| 6 | | 04-10 | 30 | 16.8 | 0.2 | 86 | 44 | 13 | 12.6 | 1.3 | 3.7 | 6.7 |
| 7 | | 17-23 | 29.7 | 16.4 | 11.60 | 87 | 47 | 13.2 | 13 | 2.5 | 4.2 | 6.7 |
| 8 | | 18-24 | 29.8 | 14.6 | 0.8 | 84 | 36 | 11.5 | 11 | 2.1 | 4.3 | 9.9 |
| **Average** | | | **29.58** | **14.8** | **12.6*** | **85.25** | **39.5** | **8.78** | **11.33** | **1.75** | **3.88** | **7.8** |
| | | | | | **13.8**** | | | | | | | |

* Total of the month ** Cumulative rainfall during the season

**Appendix-II: Calculation of fixed cost of cultivation (Rs ha$^{-1}$) of coriander**

| S. No. | Particulars | Coriander | | |
|---|---|---|---|---|
| | | **Input** | **Price (Rs)** | **Total cost (Rs ha$^{-1}$)** |
| **1.** | **Land preparation** | | | |
| | i Deep ploughing | 1 tractor (2 hrs) ha$^{-1}$ | 400 Rs hrs$^{-1}$ | 800.00 |
| | ii Harrowing | 1 tractor (2 hrs) ha$^{-1}$ | 400 Rs hrs$^{-1}$ | 800.00 |
| | iii Planking | 1 tractor (1 hrs) ha$^{-1}$ | 400 Rs hrs$^{-1}$ | 400.00 |
| **2.** | **Sowing** | | | |
| | i Seed | 25 kg ha$^{-1}$ | 80 Rs kg$^{-1}$ | 2000.00 |
| | ii Seed treatment | 2 man days | 150 Rs man days$^{-1}$ | 300.00 |
| | iii Sowing | 15 man days | 150 Rs man days$^{-1}$ | 2250.00 |
| **3.** | **Fertilizer** | | | |
| | i FYM | 8 tonne ha$^{-1}$ | 800 tonne$^{-1}$ | 6400.00 |
| | ii Urea | 130 kg ha$^{-1}$ | 5.63 Rs kg$^{-1}$ | 732.00 |
| | iii SSP | 222 kg ha$^{-1}$ | 6.53 Rs kg$^{-1}$ | 1450.00 |
| | iv MOP | 67 kg ha$^{-1}$ | 17.64 Rs kg$^{-1}$ | 1176.00 |
| | v Fertilizer application | 4 man days | 150 Rs man days$^{-1}$ | 600.00 |
| **4.** | **Cultural practices** | | | |
| | i Weeding | 8 man days | 150 Rs man days$^{-1}$ | 1200.00 |
| | ii Thinning | 8 man days | 150 Rs man days$^{-1}$ | 1200.00 |
| | iii Irrigation | 15 hrs ha$^{-1}$ | 200 Rs hrs$^{-1}$ | 3000.00 |
| | **Harvesting** | | | |
| | i Harvesting | 15 man days | 150 Rs man days$^{-1}$ | 2250.00 |
| | **A Common cost** | | | **24558.00** |
| | **B Miscellaneous** | 10 % of common cost | | **2456.00** |
| | **Grand Total (A+B)** | | | **27014.00** |

Rs = Rupees, ha$^{-1}$ = Hectare, hrs$^{-1}$= per hour, g = Gram, kg$^{-1}$ Per kilogram, % = Percent.

**Appendix-III: Analysis of variance table for coriander seed yield**

**ANOVA**

| Source of variation | DF | SS | MSS | F Cal | F Tab (5%) | Result | T (5%) |
|---|---|---|---|---|---|---|---|
| **Treatment** | 14 | 28058.22 | 2004.16 | 3.18 | 2.06 | Significant | **2.05** |
| **Replication** | 2 | 31.64 | 15.82 | 0.03 | 3.34 | Nonsignificant | |
| **Error** | 28 | 17652.54 | 630.45 | | | | |
| **Total** | 44 | 45742.40 | | | | | |

**Sem = 14.50 Sed = 20.50 CD (p=0.05) = 41.99 CV = 18.23**