The Pharma Innovation Journal 2023; 12(12): 3517-3522

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(12): 3517-3522

www.thepharmajournal.com
Received: 18-10-2023
Accepted: 22-11-2023

HA Shekhada
PhD Scholar, Department of Plant Pathology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Hemant Sharma
Associate Professor, Department of Plant Protection, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

RL Joshi
PhD Scholar, Department of Plant Pathology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

PR Patel
Associate Professor and Head, Department of Plant Protection, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
HA Shekhada
PhD Scholar, Department of Plant Pathology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Effect of fungal metabolites of *Alternaria alternata* on seed germination and seedling vigour index of coriander

HA Shekhada, Hemant Sharma, RL Joshi and PR Patel

Abstract
A study was conducted at the Department of Plant Pathology, N. M. College of Agriculture, NAU, Navsari during 2021-22 to find out the effect of fungal metabolites of *Alternaria alternata* on seed germination and seedling vigour index of coriander. Fungal metabolites become more toxic as they age and concentration increases. In both 7 days after seed germination and 14 days after seed germination, 50-day-old fungal metabolites were highly toxic and caused a maximum reduction in seed germination, seedling growth (radicle and plumule length) and vigour index over control. At cent percent fungal metabolites concentrations, the highest reduction in germination percent, seedling growth (radicals and plumules) and vigour index is observed.

Keywords: *Alternaria alternata*, fungal metabolites, seed germination and seedling vigour index

Introduction
Spices play an important role not only as condiments but in the Indian agricultural economy owing to medicinal, industrial and processing points of view. In India, spices are considered the highest quality in the world and are known as "Home of Spices". The coriander plant (*Coriandrum sativum* L.) belongs to the Apiaceae family (2n=22). It is also known by various names like Dhania (Hindi), Dhane, Dhania (Bengali) and Kothmiri, Konphir, Libdhane (Gujarati). Coriander plants usually grow to a height of 20 inches. Leaves are irregularly shaped, widely lobed, and slender. In coriander, the flowers are carried in small umbels in a racemose inflorescence. (Singh and Bhandari, 2015) [10]. The seed clusters are very symmetrical and fall as soon as they are ripe. In appearance, the fruit is a brown to yellow globular dry schizocarp with a diameter of 3-5 mm and containing a pair of single seeds, which stop having an un pleasant scent on drying and become more fragrant as they age. Alternaria species are omnipresent in the environment and produce specific mycotoxins like alternariols [alternariol (AOH), alternariol monomethyl ether (AME), and altenuene (ALT)], tentoxin (TEN), and tenuazonic acid (TeA) (Ostry, 2008) [1]. It has been reported that the production of different toxins by necrotrophic fungus *A. alternata* is required for its pathogenesis (Chung, 2012) [3] and after successful infection the host plants induces cell membrane damage (disrupting cell wall proteins), production of ROS molecules and increased H_2O_2 accumulation followed by cell death.
Moreover, the pathogen's toxicity may inhibit seed germination or negatively affect seedling growth, resulting in considerable yield losses. Therefore, effect of fungal metabolites of *Alternaria alternata* on seed germination and seedling vigour index of coriander was investigated.

Materials and Methods
Preparation of fungal metabolites
The pathogen *A. alternata* was isolated aseptically from diseased leaves of coriander from the field and multiplied on potato dextrose agar (PDA) for further studies. Small bit (5 mm diameter) from seven days old culture of pathogen inoculum was inoculated in 250 ml Erlenmeyer flasks having 50 ml of potato dextrose broth (PDB) and incubated at 25±1 °C in BOD incubator. Fungal mycelium was separated by passing fungal culture through muslin cloth and then through sterilized Whatman No. 1 filter paper. The fungal metabolites were further sterilized by passing through millipore filter of 0.22 µm size and heated at 100 °C for 2 minutes to inactivate enzymes.

Autoclaved flasks containing PDB without pathogen were kept as control (Watpade and Mehta, 2013) [12].

Effect of various ages of fungal metabolites on seed germination and seedling vigour index of coriander

Prepared different days old fungal metabolites *viz.*, 10, 20, 30, 40 and 50 days according to 3.2.2. Seeds of coriander cv GC-3 were surface sterilized with sodium hypochlorite (0.1%) and 25 seeds were placed in sterilized three blotter paper containing Petri plates, each watered with 10 ml of fungal metabolites except control and incubated in BOD chamber at 25±1 °C and 80 percent relative humidity. Percent seed germination, radicle and plumule lengths recorded after 7 days and 14 days respectively, after incubation. The experimental design was completely randomized design (CRD) with four repetitions.

Effect of various concentrations of fungal metabolites on seed germination and seedling vigour index of coriander

Fungal metabolites and sterilized water were used to make 0, 20, 40, 60, 80 and 100 percent of fungal metabolites solution. Seeds of coriander cv GC-3 were surface sterilized with sodium hypochlorite (0.1%) and 25 seeds were placed in sterilized three blotter paper containing Petri plates, each watered with 10 ml of fungal metabolites except 0 percent and incubated in BOD chamber at 25±1 °C and 80 percent relative humidity. Percent seed germination, radicle and plumule lengths recorded after 7 days and 14 days respectively, after incubation. The experimental design was completely randomized design (CRD) with four repetitions.

Observations

Germination (%)

The number of seedlings emerged were counted seven days after incubation and the means was expressed in percentage. Percent germination was calculated as below.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds incubated}} \times 100$$

Radicle and plumule length

The length was measured after fourteen days of incubation.

Radicle length

Radicle length was measured from the collar region to tip of the primary root and the mean value was expressed in millimeters (mm).

Plumule length

Plumule length was measured from the collar region to the top and the mean value was expressed in millimeters (mm).

Seedling vigour index

Seedling vigour was also calculated by following formula of Abdul-Baki and Anderson (1970) [1].

Seeding Vigour Index = Germination (%) x (Radicle length + Plumule length)

Results and Discussion

Effect of various ages of fungal metabolites on seed germination and seedling vigour index of coriander

The effect of various ages fungal metabolites of pathogen inhibited the seed germination and seedling growth (radicle and plumule length) and vigour index. It is clear positive relationship between toxicity of fungal metabolites increases with increase in age. The results showed that in coriander variety GC-3 fungal metabolites of 50 days old was highly toxic and caused maximum reduction of seed germination, seedling growth (radicle and plumule length) and vigour index over control in both 7 days and 14 days after seed germination, respectively (Table 1 and Photo 1). Fifty days old fungal metabolites showed minimum germination (%) and vigour index with 30 percent and 1094.63 seven days after seed germination, respectively. While the maximum germination (%) and vigour index observed in control with 83 percent and 7174.31 seven days after seed germination, respectively.

Seedling growth (radicle and plumule length) also decrease with increase in age. The minimum plumule and radicle length was found at 50 days old fungal metabolites with 20.43 mm and 16.06 mm seven days after seed germination, respectively. However, maximum plumule and radicle length was found in control with 45.43 mm and 41.01 mm seven days after seed germination, respectively. Similarly, 50 days old fungal metabolites showed minimum germination (%) and vigour index with 38 percent and 1660.13 fourteen days after seed germination, respectively. While the maximum germination (%) and vigour index found in control with 87 percent and 8231.29 fourteen days after seed germination, respectively. The minimum plumule and radicle length was found at 50 days old fungal metabolites with 23.23 mm and 20.46 mm fourteen days after seed germination, respectively. However maximum plumule and radicle length was found in control with 49.21 mm and 45.40 mm fourteen days after seed germination, respectively.

The results of present investigation corroborated with the result obtained by Bhajbhuje (2020) [2] that increase in percent seed germination, seedling emergence and green biomass without any abnormalities over control were recorded with seven days old metabolites treated seeds while same parameters were declined with longer duration containing metabolites of *A. alternata*. Wagh and Mangaonkar (2012) [11] prepared the culture filtrate of post-harvest sapota fungi to study their effect on germination. They observed all the fungal filtrates showed decrease in percentage of seed germination with increase in filtrate age. Sharma *et al.* (2020) [7] revealed that the toxicity of culture filtrate increases with increased age of culture filtrate. They noticed that 60 days old culture filtrate was highly toxic and least germination and seedling vigour were observed in such culture filtrate.

Effect of various concentrations of fungal metabolites on seed germination and seedling vigour index of coriander

The effect of various concentrations of fungal metabolites of pathogen inhibited the seed germination and seedling growth (radicle and plumule length) and vigour index. The results showed that coriander variety GC-3 exhibited highest reduction of germination percent, seedling growth (radicle and plumule length) and vigour index at 100 percent concentration over control (Table 2 and Photo 3). Fungal metabolites with 100 percent concentration showed minimum germination (%) and vigour index with 43 percent and 1906.51 seven days after seed germination, respectively.

While the maximum germination (%) and vigour index found in control with 82 percent and 7135.03 seven days after seed germination, respectively.

Seedling growth (radicle and plumule length) also decrease with increase in concentration. The least plumule and radicle length was found at 100 percent concentration of fungal metabolites with 24.50 mm and 19.84 mm seven days after seed germination, respectively. However maximum plumule and radicle length was found in control with 45.75 mm and 41.26 mm seven days after seed germination, respectively. Similarly, 100 percent concentration of fungal metabolites showed minimum germination (%) and vigour index with 48 percent and 2572.80 fourteen days after seed germination, respectively. While the maximum germination (%) and vigour index found control with 88 percent and 8243.40 fourteen days after seed germination, respectively. The minimum plumule and radicle length was found at 100 percent concentrations of fungal metabolites with 29.50 mm and 24.10 mm fourteen days after seed germination, respectively. However maximum plumule and radicle length was found in control with 48.89 mm and 44.79 mm fourteen days after seed germination, respectively.

The similar trend of result was also reported by Sharma *et al.*, (2020) [7] showed that the toxic metabolites produced by *A. alternata* can cause diseases and the intensity of the leaf spot was found to be influenced by high metabolite concentrations (culture filtrate of *A. alternata*). In 100 percent culture filtrates, the highest disease rate was observed followed by 50 percent, 25 percent and 10 percent concentrations. Similar observations on seed germination, radicle and plumule length on *Cajanus cajan* by (Kamal and Verma, 1977) [4], Bitter gourd and *Foeniculum vulgare* (Singh *et al.*, 1991) [9], *Vigna mungo* (Reddy and Subbayya, 1985) [6] and *Pennisetum typhoides* by (Mathur and Sinha, 1978) [5] were reported earlier.

Table 1: Effect of various ages of fungal metabolites on seed germination and seedling vigour index of coriander

7 days after seed germination					14 days after seed germination			
Ages of fungal metabolites	**Germination (%)**	**Plumule length (mm)**	**Radicle length (mm)**	**Vigour index**	**Germination (%)**	**Plumule length (mm)**	**Radicle length (mm)**	**Vigour index**
10 days	57.45* (71)	41.93	36.64	5577.94	62.05 (78)	46.48	40.40	6776.25
20 days	51.36 (61)	36.73	31.33	4151.05	54.95 (67)	40.74	35.15	5084.46
30 days	45.57 (51)	31.41	26.84	2970.75	50.78 (60)	34.58	30.51	3905.25
40 days	39.22 (40)	25.80	21.36	1886.50	44.43 (49)	29.05	25.86	2690.71
50 days	33.15 (30)	20.43	16.06	1094.63	38.05 (38)	23.23	20.46	1660.13
Control	65.68 (83)	45.43	41.01	7174.31	68.90 (87)	49.21	45.40	8231.29
S.Em. ±	1.02	0.44	0.55	-	0.75	0.63	0.48	-
CD (P=0.05%)	3.04	1.31	1.62	-	2.24	1.87	1.42	-
CV %	4.19	2.62	3.78	-	2.83	3.39	2.91	-
*Figures outside the parentheses are arcsine transformation values where in parentheses are original values								

Table 2: Effect of various concentrations of fungal metabolites on seed germination and seedling vigour index of coriander

7 days after seed germination					14 days after seed germination			
Concentrations of fungal metabolites	**Germination (%)**	**Plumule length (mm)**	**Radicle length (mm)**	**Vigour index**	**Germination (%)**	**Plumule length (mm)**	**Radicle length (mm)**	**Vigour index**
0%	64.93* (82)	45.75	41.26	7135.03	68.86 (88)	48.89	44.79	8243.40
20%	62.05 (78)	43.40	37.84	6336.53	64.93 (82)	45.54	40.26	7035.6
40%	55.57 (68)	39.85	32.93	4948.70	60.05 (75)	42.00	36.03	5851.88
60%	51.95 (62)	35.89	30.09	4090.45	56.20 (69)	40.00	32.13	4976.63
80%	46.72 (53)	31.81	25.01	3011.73	49.03 (57)	36.03	28.00	3649.43
100%	40.97 (43)	24.50	19.84	1906.51	43.85 (48)	29.50	24.10	2572.80
S.Em. ±	0.94	0.66	0.75	-	1.16	0.62	0.79	-
CD (P=0.05%)	2.79	1.95	2.22	-	3.44	1.84	2.35	-
CV %	3.50	3.57	4.79	-	4.04	3.07	4.63	-
*Figures outside the parentheses are arcsine transformation values where in parentheses are original values								

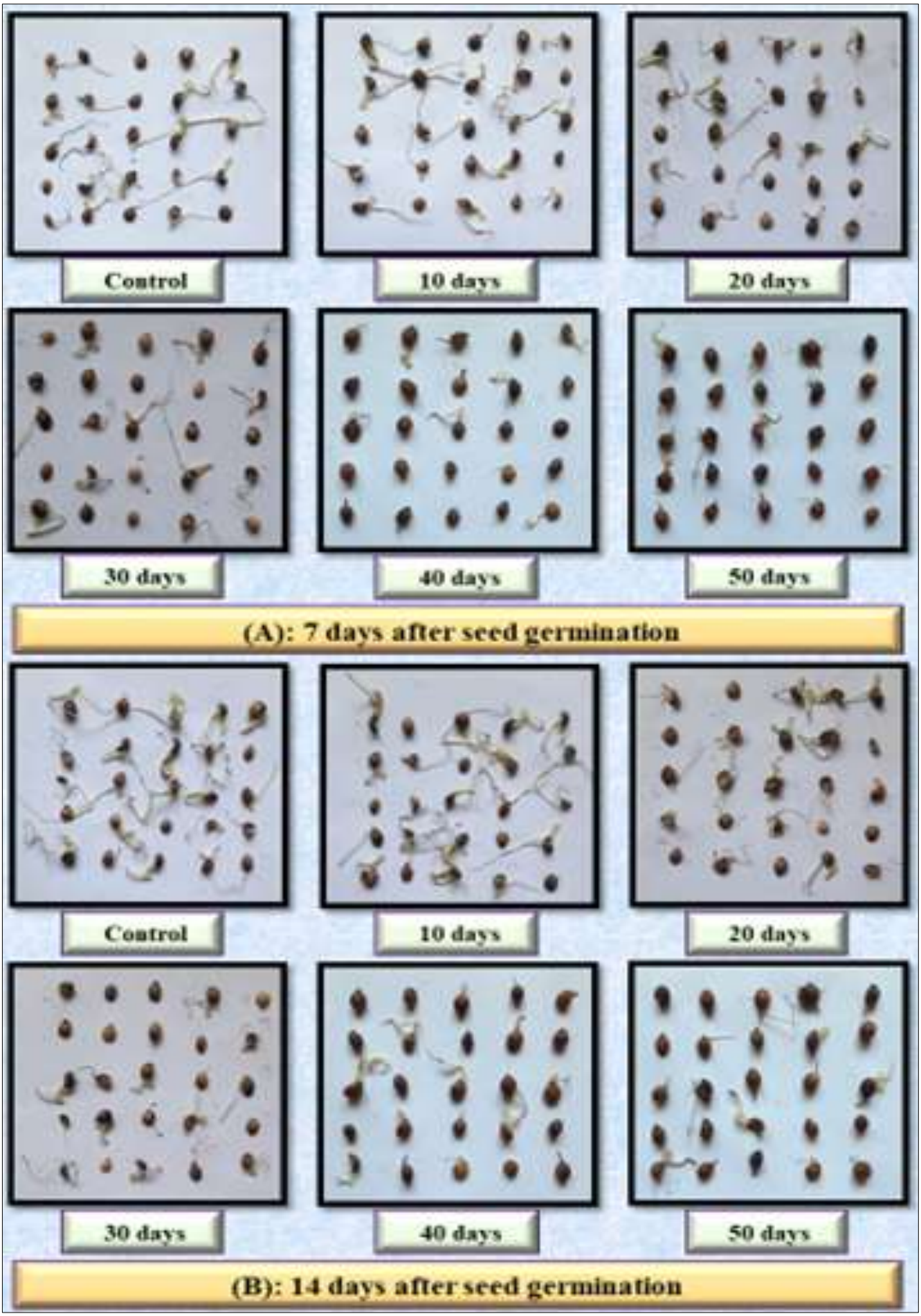

Photo 1: Effect of various ages fungal metabolites on seed germination and seedling vigour index of coriander

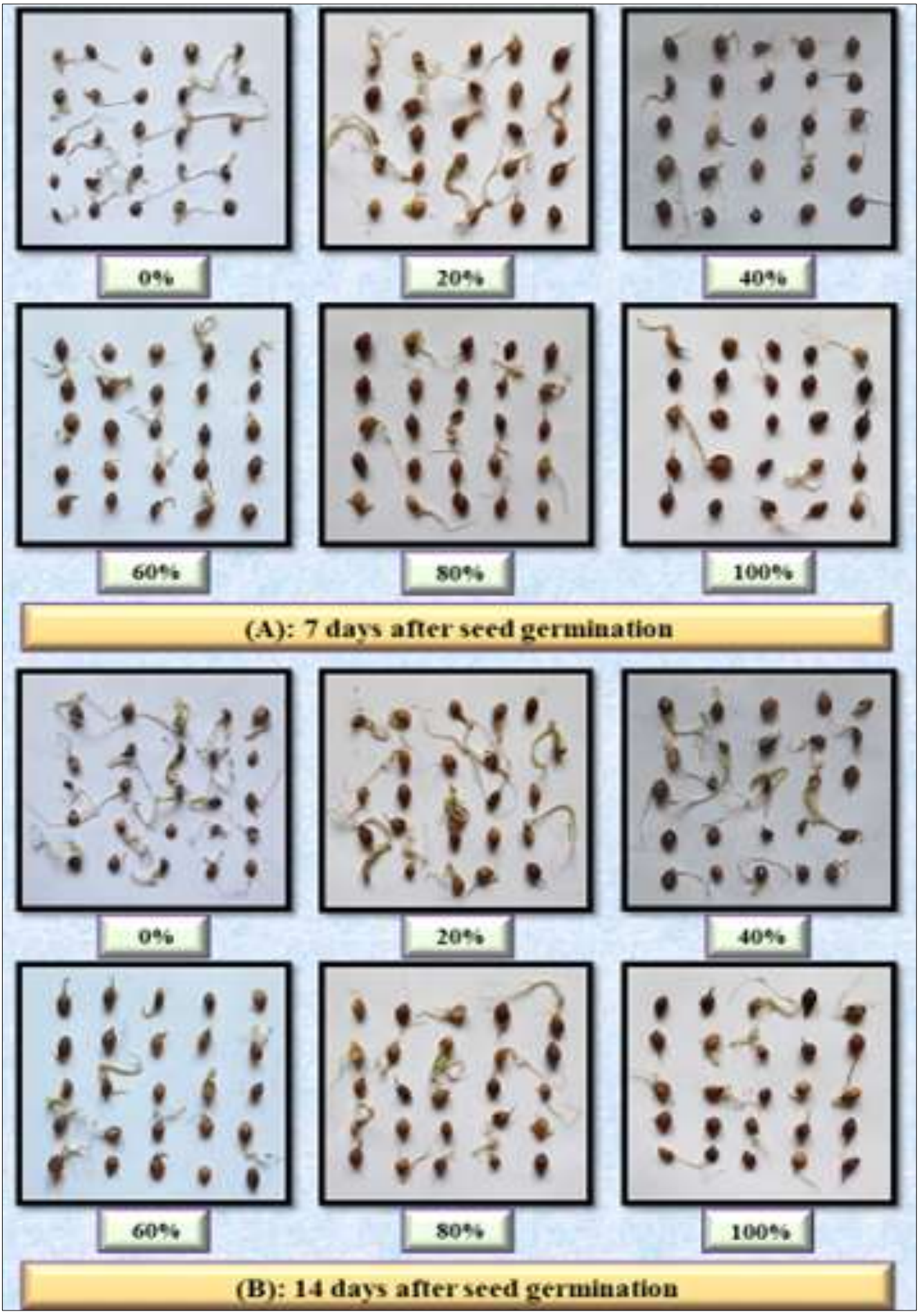

Photo 2: Effect of various concentrations of fungal metabolites on seed germination and seeding vigour index of coriander

Conclusions

Based on present investigations, it is concluded that fungal metabolites of *A. alternata* was prepared on potato dextrose broth medium to test effect of various ages and concentrations on seed germination and seedling growth (radicle and plumule length) and vigour index on variety of coriander GC-3. It is clear positive relationship between toxicity of fungal metabolites increases with increase in age and concentration. Fifty days old fungal metabolites were highly toxic and caused maximum reduction of seed germination, seedling growth (radicle and plumule length) and vigour index over control in both 7 days and 14 days after seed germination, respectively. While highest reduction of germination percent, seedling growth (radicle and plumule length) and vigour index at 100 percent fungal metabolites concentration over control.

Acknowledgement

I am very thankful to The Director of Research and Dean PG Studies, Navsari Agricultural University, Navsari for providing all the necessary facilities to conduct the research work.

References

1. Abdul Baki AA, Anderson JD. Viability and leaching of sugars from germinating barley. Crop Sci. 1970;10(1):31-34.
2. Bhajbhuje MN. Metabolite effect of Alternaria alternata (Fr.) Keissler on seedling emergence of Hordeum vulgare L. Int Res J Sci Engg. 2020;8(6):219-226.
3. Chung KR. Stress response and pathogenicity of the necrotrophic fungal pathogen Alternaria alternata. Scientifica; c2012. p. 1-17.
4. Kamal J, Verma AK. Seed borne mycoflora of arhar (T-21), effect of culture filtrates of some isolates on seed germination and fungicidal treatment. Indian J Mycol Pl Pathol. 1977;9:41-45.
5. Mathur SK, Sinha S. Effect of fungal metabolites on seed viability and seedling vigour of bajra. Seed Res. 1978;6:181-187.
6. Reddy MRS, Subbayya J. Effect of fungal metabolites on germination and seedling vigour of black gram (*Vigna mungo*), Seed Technol News. 1985;15:5.
7. Sharma J, Godika S, Goyal S, Yadav A, Kumari M. Effect of different ages of culture filtrate of Sclerotinia sclerotiorum on seed germination and seedling vigour of Indian mustard varieties. Int J Agri Sci Res. 2020;6(3):105-108.
8. Sharma RS, Saini KK, Sharma Y. Effect of toxic metabolites of Alternaria alternata in causing leaf spot infection on aloe vera. Int J Curr Microbiol Appl Sci. 2020;9(11):1-3.
9. Singh DS, Bhadraiah B, Rao P. Mycoflora and aflatoxin contamination in stored seeds of bitter gourd and Foeniculum vulgare. Indian J Microbial Ecol. 1991;1:133-138.
10. Singh KP, Bhandari RR. Vegetable crops production technology. Samikshya Publication, Kathmandu. 2015:103-107.
11. Wagh PM, Mangaonkar KV. Toxic potentialities of fungal metabolites on germination status of Mataki seeds (*Vigna aconitifolia* Jacq.). Elixir App Bio. 2012;53:11898-11899.
12. Watpade S, Mehta N. Biochemical characterization of rapeseed-mustard calli tolerant to Sclerotinia sclerotiorum culture filtrates. Plant Dis Res. 2013;28(1):1-4.
13. Ostry V. Alternaria mycotoxins: An overview of chemical characterization, producers, toxicity, analysis and occurrence in foodstuffs. World Mycotoxin Journal. 2008 May 1;1(2):175-88.