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Application of botanicals for effective management of *Alternaria* blight of Pigeon pea

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Abstract

Pigeon pea (*Cajanus Cajan* L. Millsp.) is an important pulse crop of India and grown in *Kharif* seasons. *Alternaria* blight caused by *Alternaria tenuissima* is one of the most important disease of pre-rabi Pigeon pea. An inexpensive and environment friendly management regimen is required to minimize loss due to *A. tenuissima*. The inhibitory effect of 17 botanicals were evaluated both *in vitro* and *in vivo* at 10 and 15 per cent concentration of plant extracts against *A. tenuissima*. The results showed that the effectiveness of extracts was directly proportional to their concentration. Among all plant extracts were neem showed maximum inhibition against *A. tenuissima* at 15% concentration after 7 days of incubation *in vitro* followed by Eucalyptus and Garlic. However, percent disease control in between Neem and Eucalyptus; Garlic and Mehandi; Ginger and Tulsi; Kaner and Onion; Lantana and Sadabahar; Bael and Bhang; Parthenium and Marigold were at par to each other.

Keywords: Pigeon pea, botanicals, percent disease control, *Alternaria tenuissima*

Introduction

The yield of Pigeon pea (699kg/ha) is much lower than potential yield of 2000 to 2500 kg/ha with improved varieties. The poor yield of Pigeon pea is mainly due to biotic stress like diseases and insect pests.

The crop is infected by 210 pathogens (83 fungi, 4 bacteria, 19 viruses and mycoplasma and 104 nematodes) reported from 58 countries. The maximum number has been reported from India with 98 pathogens (Nene *et al.*, 1996) but only few of them like wilt, sterility mosaic, phytophthora blight and *Alternaria* blight are major and destructive diseases.

Alternaria blight caused by *Alternaria tenuissima* is one of the most widespread and destructive foliar diseases of Rabi Pigeon pea. The disease was first described by Pavgi and Singh in 1971 followed by Kannaiyan and Nene in 1977-1980 crop season on September planted Pigeon pea cultivar (Bahar and Basant) in northern Indian states of Uttar Pradesh and Bihar (Mehta and Sinha, 1982; Narula, 1983 and Venkateswarlu *et al.*, 1981). The fungus causing leaf spot of Pigeon pea observed by Kannaiyan and Nene in year 1997 at ICRISAT, Hyderabad. The disease appeared in epiphytic form on September planted Pigeon pea during February, 1980 in Muzzaffarpur district of Bihar and also in 1981 in Varanasi and other areas of eastern Uttar Pradesh. (Kannaiyan and Nene, 1977).

The incidence varied from 18.0% to 37.5% in different locations of Central Uttar Pradesh. (Kushwaha *et al.*, 2010). Hence, for minimizing the losses caused by *Alternaria* blight need inexpensive and environmentally safe management practices.

It was, therefore considered desirable to disease management through botanicals with the following objectives:

1. Efficacy of botanical against *A.tenuissima in vitro* and
2. Efficacy of botanical against *A.tenuissima in vivo*.

2. Materials and Methods

The present studies were carried out in the laboratory and glass house of the Department of Plant Pathology, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.). The details of materials used, experimental procedures followed and techniques adopted are given as under:

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2.1 Management of Alternaria blight disease of Pigeon pea

2.1.1 Efficacy of plant extract against *Alternaria tenuissima* in vitro

In order to find out the efficacy of seventeen plant extract viz., Neem, Mehandi, Eucalyptus, Tulsi, Sadabahar, Ashoka,

Madar, Marigold, Bael, Parthenium grass, Bhang, Lantana, Clerodendron, Kaner, bulb of Garlic, Onion and Ginger were used against *Alternaria tenuissima* at 10 and 15% concentration in vitro. Detailed description of plants and their parts used are given in Table 1.

Table 1: List of plant with common name, English name, botanical name, family and their part used

S. No.	Common name	English name	Botanical name	Family	Part used
1.	Neem	Neem	<i>Azadirachta indica</i>	Meliaceae	Leaves
2.	Mehandi	Heena	<i>Lawsonia alba</i>	Lythraceae	Leaves
3.	Sefeda	Eucalyptus	<i>Eucalyptus globules</i>	Myrtaceae	Leaves
4.	Tulsi	Basil	<i>Ocimum sanctum</i>	Labiataceae	Leaves
5.	Sadabahar	Sadabahar	<i>Vinca rosea</i>	Apocynaceae	Leaves
6.	Ashok	Ashok	<i>Polyanthia longifolia</i>	Annonaceae	Leaves
7.	Madar	Madar	<i>Calotropis procera</i>	Asclepiadaceae	Leaves
8.	Genda	Marigold	<i>Tagetes erecta</i>	Compositae	Leaves
9.	Bael	Stone fruit	<i>Agele marmelos</i>	Rutaceae	Leaves
10.	Congress grass	Parthenium	<i>Parthenium hysterophorus</i>	Compositae	Leaves
11.	Bhang	Bhang	<i>Cannabis sativa</i>	Connabinaceae	Leaves
12.	Adarakh	Ginger	<i>Zingiber officinale</i>	Zingiberaceae	Rhizome
13.	Lantana	Lantana	<i>Lantana camara</i>	Verbenaceae	Leaves
14.	Clerodendron	Clerodendron	<i>Clerodendron inerme</i>	Verbenaceae	Leaves
15.	Kaner	Kaner	<i>Nerium indicum</i>	Apocynaceae	Leaves
16.	Lahsun	Garlic	<i>Allium sativum</i>	Lilliaceae	Bulb
17.	Pyaz	Onion	<i>Allium cepa</i>	Lilliaceae	Bulb

Fresh leaves, bulb and rhizome were collected and washed thoroughly in clean water. Hundred gram of each washed plant material was grinded in Pestle and Mortar by adding equal amount (100 ml) of sterilized water (1: 1 w/v) and heated at 80°C for 10 minutes in hot water bath. The materials were filtered through double layered muslin cloth followed by filtering through sterilized Whatman No. 1 filter paper and treated as standard plant extract (100%). The 10.0 and 15.0 per cent concentration were made by adding in requisite amount of sterilized PDA medium.

To study the inhibitory effect of seventeen botanicals viz., Neem, Mehandi, Eucalyptus, Tulsi, Sadabahar, Ashoka, Madar, Marigold, Bael, Parthenium grass, Bhang, Lantana, Clerodendron, Kaner, bulb of Garlic, Onion and Ginger on mycelial growth of *Alternaria tenuissima*, 10.0 and 15.0 per cent concentration were used by applying poison food techniques under in vitro condition. Ten and fifteen ml plant extract of stock solution were added to the 90.0 ml and 85 ml of sterilized melted PDA medium. The flasks were thoroughly taken to get uniform mix of the extract under aseptic condition before pouring it into the Petri plates.

Twenty ml medium was poured into each Petri plate. Seventeen treatments having four replications were maintained. Control treatment was maintained by pouring PDA medium without plant extract. Five mm discs of 7 days old culture of *Alternaria tenuissima* were cut with sterilized cork borer and placed in the centre of plant extract amended Petri plates. The Petri plate having PDA alone were inoculated in the same manner. These Petri plates were incubated in incubator at 28 ± 1 °C. The observations were recorded on radial growth at 4 days and 7 days of incubation in plant extracts amended Petri plate as well as in control. Per cent growth inhibition was calculated by using formula:

$$I = \frac{C - T}{C} \times 100$$

Where,

- I = Per cent inhibition of fungal growth
C = Radial growth of control
T = Radial growth of treated petridishes

2.1.2 Efficacy of plant extracts against *Alternaria blight* in vivo

The effective concentration of plant extracts found effective in vitro was further tested in vivo. The experiment was conducted in CRD with 18 treatments including control maintaining 4 replications. Healthy seeds of *Alternaria blight* susceptible variety Bahar were sown in 72 pots at rate of 15 seeds per pots. The plants were artificially inoculated by spraying inoculum (15-20 conidia/microscopic field). Control plants were left without spraying inoculum. After 4 days of inoculation plant extracts (15 per cent concentration) sprayed on the plants to determine the effect of plant extract in vivo. Fifteen ml of each plant extracts were added to the 85 ml of water (15%) and sprayed on the plants after 4 days of inoculation by using atomizer. 2 sprays of plant extracts were sprayed at 4 days interval.

First appearance of disease, disease incidence and per cent disease control were observed at weekly interval after spraying of botanicals. Percent disease incidence (PDI) and percent disease control (PDC) were calculated by using following formula.

$$PDI = \frac{\sum \text{All numerical rating}}{\text{Max. Grade} \times \text{No. of leaves examined}} \times 100$$

$$PDC = \frac{C - T}{C} \times 100$$

Where,

- C = Per cent disease incidence of control pots
T = Per cent disease incidence in treated pots

2.1.3 Statistical analysis

The data were analysed statistically to draw the conclusion. Statistically analyses of laboratory and pot experiments were done by the method of Completely Randomized Block Design (CRD) prescribed by Goon *et al.*, (1931). The significance of treatments differences was tested by variance ratio test of 5 per cent level of probability.

The observation of per cent inhibition of mycelial growth, disease incidence and disease control were transferred into "Arc Sign Transformation" used for statistical analysis. Formula used for such transformed was:

$$\text{Arc Sign Transformation} = \text{Sin}^{-1} \sqrt{P/100}$$

3. Results

3.1.1 Efficacy of botanicals against *A. tenuissima* on radial growth *in vitro*

Seventeen plant extracts (Table 1) used in present studies were evaluated under *in vitro* against *A. tenuissima* by poison food technique at 10.0 and 15.0 per cent concentration at 4 day and 7 days of incubation.

3.1.2 At 4 days of incubation

A perusal of data presented in table 2 & Fig.1 revealed that minimum radial growth was obtained in Neem (16.39mm) followed by Eucalyptus (18.63mm). Garlic (19.17mm), Mehandi (24.57mm), Ginger (26.94mm), Tulsi (27.10mm), Madar (28.08mm), Kaner (29.64mm), Onion (30.78mm), Lantana (31.96mm), Sadabahar (32.75mm), Ashok (34.23mm), Bael (36.18mm), Bhang (36.93mm),

Clerodendron (37.53mm), Parthenium (38.07mm) and Marigold (38.61mm). The maximum radial growth of *A. tenuissima* was 41.20 mm recorded in check. The radial growth significantly differed in different treatments with each other except Ginger, Mehandi, and Madar which were at par to each other. Similarly there was no significant difference observed in radial growth of Parthenium and Clerodendron at 10 per cent concentration (Fig. 2).

In fifteen per cent concentration of plant extracts, the minimum mycelial growth of *A. tenuissima* was recorded in Neem (13.37mm) followed by Eucalyptus (15.93mm). Garlic (16.69mm), Mehandi (18.94mm), Ginger (19.98mm), Tulsi (21.87mm), Madar(24.03mm), Kaner (24.24mm), Onion (25.92mm), Lantana (27.29mm), Sadabahar (30.13mm), Ashok (31.05mm), Bael (32.34mm), Bhang (32.67mm), Clerodendron (34.02mm), Parthenium (34.83mm) and Marigold (36.18mm). There was no significant difference in radial growth in between Madar and Kaner; Sadabahar and Ashok; Bhang and Clerodendron and Parthenium and Marigold as compared to untreated Check (41.20). The maximum radial growth observed in check (41.20mm) (Table 2), Fig2 (a), 2(b).

Table 2: Effect of different concentration of plant extract against *A. tenuissima* on mycelia growth *in vitro* at 4 days

Plant extract	Mycelial growth (mm)	
	Concentration (%)	
	10.00	15.00
Neem	16.39	13.37
Eucalyptus	18.63	15.93
Garlic	19.17	16.69
Mehandi	24.57	18.49
Ginger	26.94	19.98
Tulsi	27.10	21.87
Madar	28.08	24.03
Kaner	29.64	24.24
Onion	30.78	25.92
Lantana	31.96	27.29
Sadabahar	32.75	30.13
Ashok	34.23	31.05
Bael	36.18	32.34
Bhang	36.93	32.67
Clerodendron	37.53	34.02
Parthenium	38.07	34.83
Marigold	38.61	36.18
Check	41.20	41.20
CD at 5%	3.46	3.44

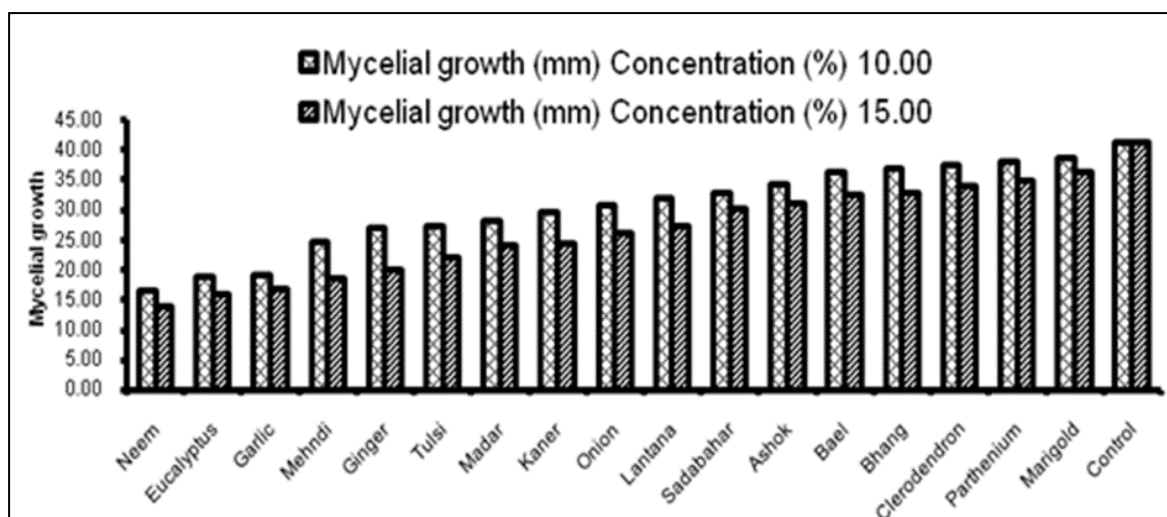


Fig 1: Effect of 10% & 15% Concentration of plant extract against *A.tenuissima* on mycelia growth *in vitro* at 4 days.

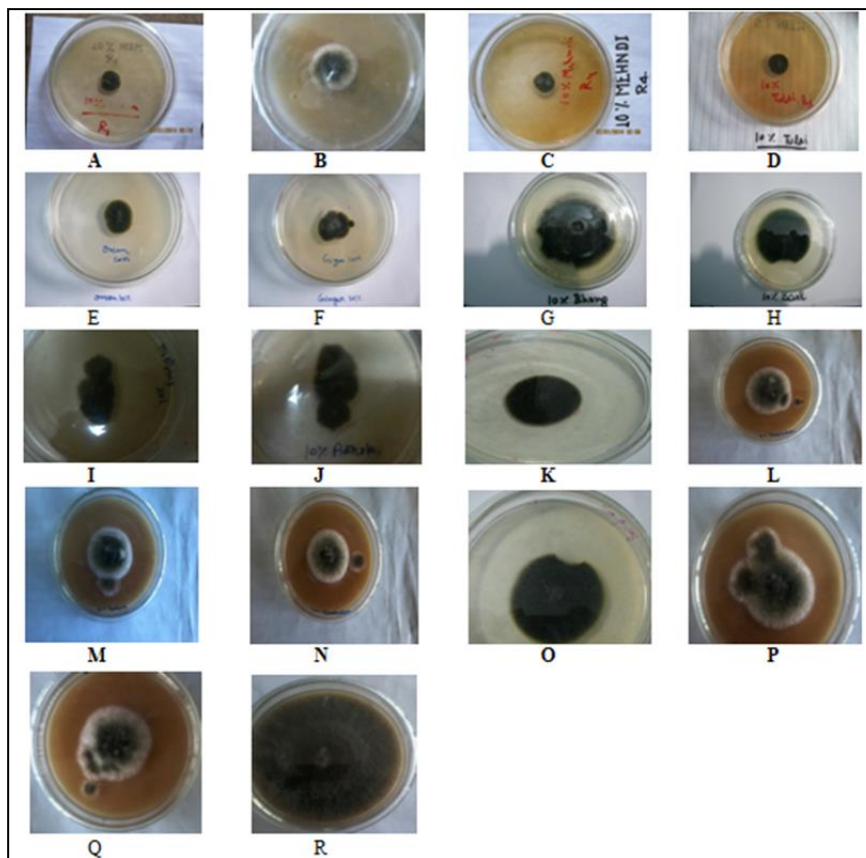


Fig 2(a): Effect of 10% Concentration of plant extract against *A.tenuissima* on mycelia growth *in vitro* at 4 days. Neem (A), Garlic (B), Mehndi (C), Tulsi (D), Onion (E), Ginger (F), Bhang (G), Bael (H), Marigold (I), Ashok (J), Eucalyptus (K), Sadabahar (L), Lantana (M), Clerodendron (N), Kaner (O), Madar (P), Parthenium (Q), Check (R).

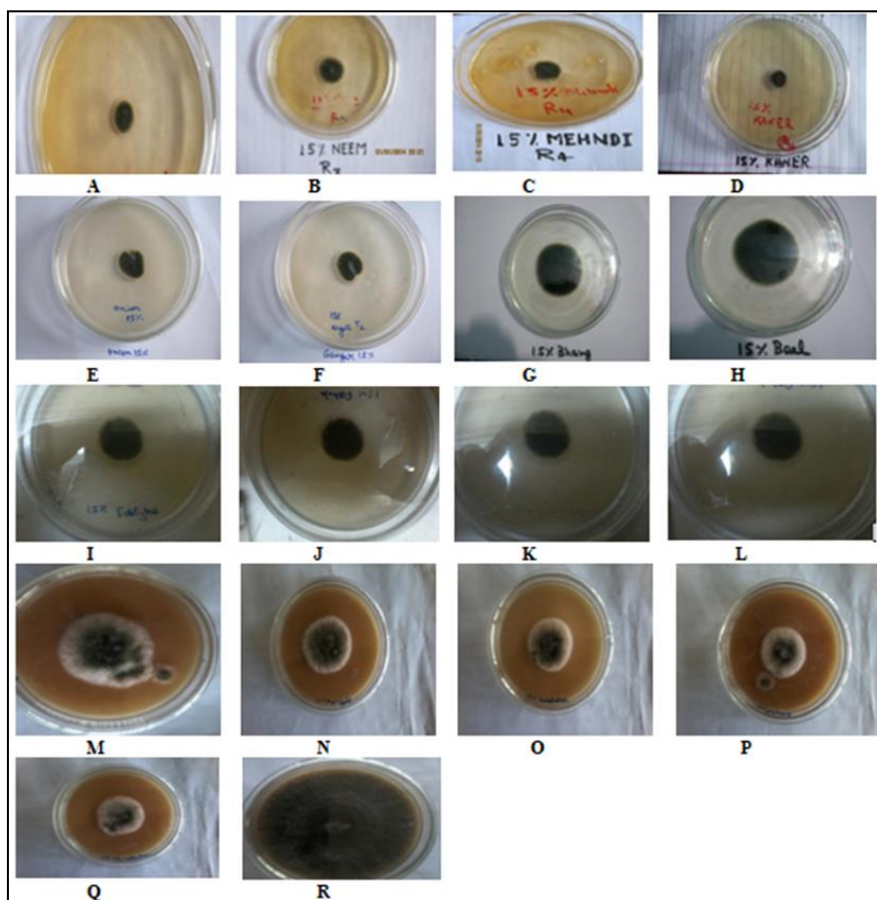


Fig 2(b): Effect of 15% concentration of plant extract against *A. tenuissima* on mycelia growth *in vitro* at 4 days. Garlic (A), Neem (B), Mehndi (C), Kaner (D), Onion (E), Ginger (F), Bhang (G), Bael (H), Eucalyptus (I), Ashok (J), Tulsi (K), Madar (L), Parthenium (M), Marigold (N), Sadabahar (O), Lantana (P), Clerodendron (Q), Check (R)

3.1.3 At 7 days of incubation

The minimum radial growth of *A. tenuissima* was recorded in Neem (34.78mm) followed by Eucalyptus (37.74mm), Garlic (42.18mm), Mehendi (44.32mm), Ginger (45.29mm), Tulsi (49.54mm), Madar (51.43mm), Kaner (54.76mm), Onion (63.27mm), Lantana (66.16mm), Sadabahar (68.08mm), Ashok (72.52mm), Bael (73.96mm), Bhang (74.74mm), Clerodendron (79.55mm), Parthenium (82.51mm) and Marigold (83.25mm). The maximum radial growth of fungus was recorded in Check was (90.00mm). There was no significant differences in radial growth in between Eucalyptus and Garlic; Mehendi and Ginger; Ginger and Madar; Lantana and Sadabahar; Bhang and Clerodendron and Clerodendron and Parthenium. Similarly radial growth among Madar, Kaner and Onion were at par to each other at 10 % concentration

(Table 6 & Fig. 9). In fifteen per cent concentration of plant extracts, growth was minimum in Neem (29.33mm) followed by Eucalyptus (29.97mm), Garlic (33.23mm), Mehendi (35.30mm), Ginger (38.18mm), Tulsi (48.62mm), Madar (51.73mm), Kaner (53.13mm), Onion (60.50mm), Lantana (63.27mm), Sadabahar (67.56mm), Ashok (70.76mm), Bael (71.26mm), Bhang (72.52mm), Clerodendron (74.44mm), Parthenium (77.62mm) and Marigold (78.59mm). The radial growth in Check was (90.00mm). The radial growth significantly differed in different treatment with each other except Mehendi and Ginger; Madar and Kaner; Kaner and Onion; Onion and Lantana and Clerodendron and Parthenium which were at par to each other (Table 3, Fig.4(a), 4(b)& Fig 3).

Table 3: Effect of different concentration of plant extract against *A. tenuissima* on mycelia growth *in vitro* at 7 days

Plant extract	Mycelial growth (mm)	
	Concentration (%)	
	10.00	15.00
Neem	34.78	29.33
Eucalyptus	37.74	29.97
Garlic	42.18	33.23
Mehendi	44.32	35.30
Ginger	45.29	38.18
Tulsi	49.58	48.62
Madar	51.43	51.73
Kaner	54.76	53.13
Onion	63.27	60.50
Lantana	66.16	63.27
Sadabahar	68.08	67.56
Ashok	72.52	70.76
Bael	73.96	71.76
Bhang	74.74	72.52
Clerodendron	79.55	74.44
Parthenium	82.51	77.62
Marigold	83.25	78.59
Check	90.00	90.00
CD at 5%	7.44	7.59

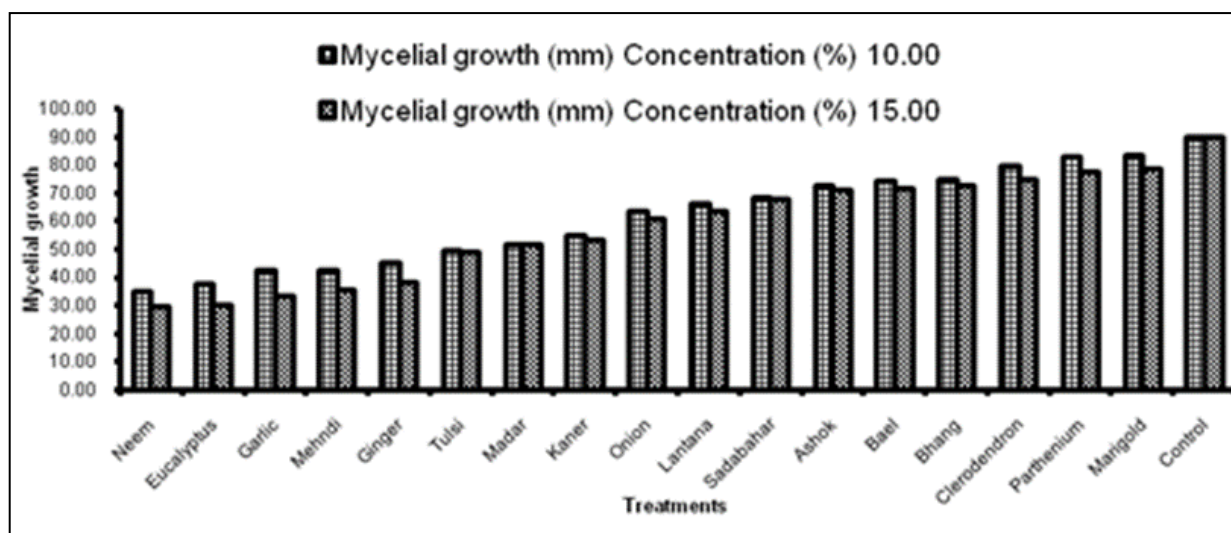


Fig 3: Effect of 10% & 15% Concentration of plant extract against *A. tenuissima* on mycelia growth *in vitro* at 7 days.

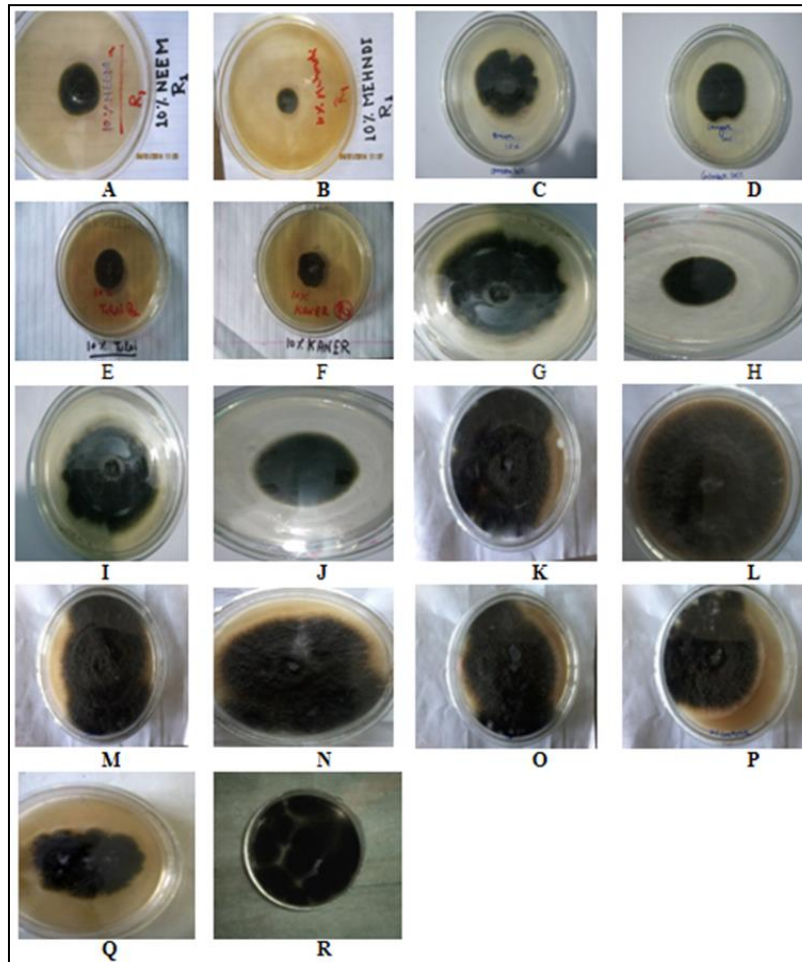


Fig 4(a): Effect of 10% concentration of plant extract against *A.tenuissima* on mycelia growth *in vitro* at 7 days. Neem (A), Mehndi (B), Onion (C), Ginger (D), Tulsi (E), Kaner (F), Ashok (G), Eucalyptus (H), Madar (I), Garlic (J), Bael (K), Marigold (L), Bhang (M), Parthenium (N), Clerodendron (O), Lantana (P), Sadabahar (Q), Check (R)

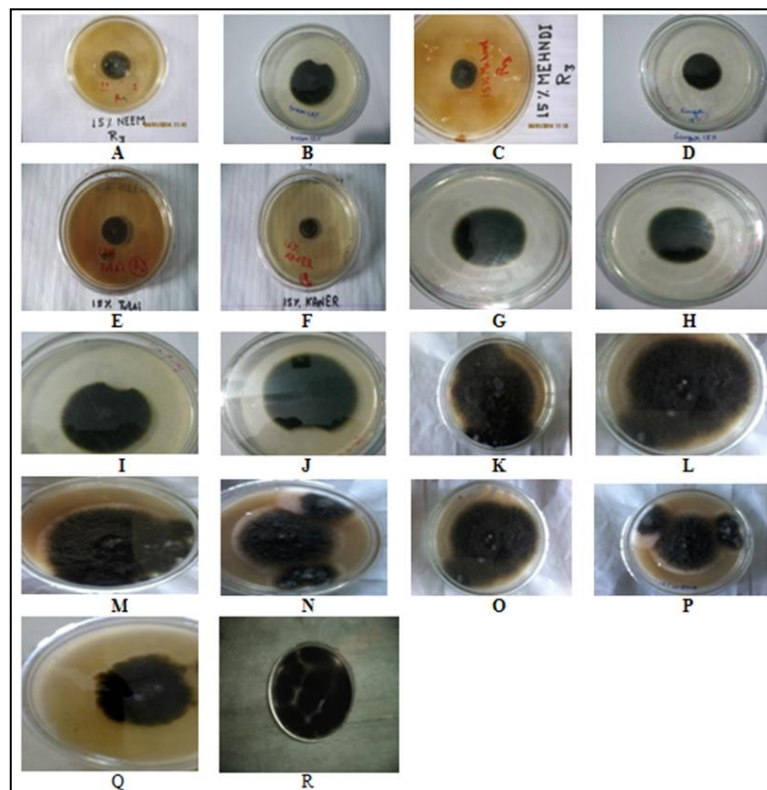


Fig 4(b): Effect of 15% Concentration of plant extract against *A.tenuissima* on mycelia growth *in vitro* at 7 days. Neem (A), Onion (B), Mehndi (C), Ginger (D), Tulsi (E), Kaner (F), Garlic (G), Eucalyptus (H), Madar (I), Sadabahar (J), Parthenium (K), Marigold (L), Bael (M), Bhang (N), Clerodendron (O), Lantana (P), Ashok (Q), Check (R)

Thus, results clearly indicated that plant extracts reduced the radial growth of *A.tenuissima* and the effectiveness of extracts increased with the increase of their concentration.

3.1.4 Efficacy of plant extracts against *A.tenuissima* on per cent inhibition *in vitro*

3.1.5 At 4 days of incubation

The maximum mycelial growth inhibition was recorded in Neem (60.22%) followed by Eucalyptus (54.79%), Garlic (53.47%), Mehandi (40.36%), Ginger (34.61%),Tulsi (34.22%).Madar(31.84%), Kaner (28.05%), Onion (25.30%), Lantana (22.42%), Sadabahar (20.52%), Ashok (16.91%), Bael (12.81%), Bhang (10.36%), Clerodendron (8.90%), Parthenium (7.59%mm) and Marigold (6.28%) after 4 days of incubation in 10% concentration.

The percent inhibition among the Mehandi, Ginger and Madar and Madar, Kaner and Onion were at par to each other. Similarly there was no significant difference in radial growth in Clerodendron and Parthenium.

In 15 per cent concentration maximum inhibition in radial growth of *A.tenuissima* was recorded in Neem (66.57%) followed by Eucalyptus (61.33%), Garlic (59.49%), Mehandi (55.12%), Ginger (51.58%),Tulsi (46.91%).Madar(41.67%), Kaner (41.16%), Onion (37.08%), Lantana (33.76%), Sadabahar (26.86%), Ashok (24.63%mm), Bael (21.74%mm), Bhang (20.74%), Clerodendron (17.42%), Parthenium (15.46%) and Marigold (12.18%) after 4 days of incubation. (Table 7& Fig 10). The per cent inhibition in between Neem and Mehandi; Madar and Kaner and Sadabahar and Ashok

were significantly to each other. However, per cent inhibition in rest of the treatments was differed significantly. (Table 4, Fig.5)

Table 4: Effect of different concentration of plant extract against *A.tenuissima* on per cent inhibition *in vitro* after 4 days

Plant extract	Percent inhibition	
	Concentration (%)	
	10.00	15.00
Neem	60.22 (50.45)	66.57 (54.77)
Eucalyptus	54.79 (47.75)	61.33 (51.51)
Garlic	53.47 (47.01)	59.49 (50.48)
Mehndi	40.36 (39.36)	55.12 (47.95)
Ginger	34.61 (36.01)	51.58 (45.91)
Tulsi	34.22 (35.73)	46.91 (43.23)
Madar	31.84 (34.35)	41.67 (40.20)
Kaner	28.05 (31.96)	41.16 (39.89)
Onion	25.30 (30.19)	37.08 (37.49)
Lantana	22.42 (28.25)	33.76 (35.49)
Sadabahar	20.52 (26.93)	26.86 (31.18)
Ashok	16.91 (24.25)	24.63 (29.75)
Bael	12.81 (20.95)	21.74 (27.74)
Bhang	10.36 (18.75)	20.74 (27.08)
Clerodendron	8.90 (17.33)	17.42 (24.67)
Parthenium	7.59 (15.99)	15.46 (23.12)
Marigold	6.28 (14.48)	12.18 (20.40)
Check	0.00 (0.00)	0.00 (0.00)
CD at 5%	3.70	3.92

Figure given in parenthesis are transformed value

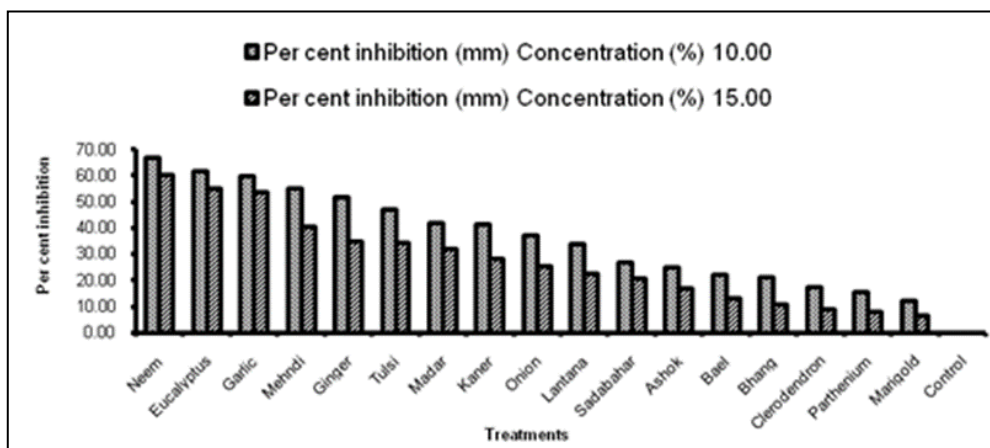


Fig 5: Effect of 10% & 15% Concentration of plant extract against *A.tenuissima* on percent inhibition *in vitro* at 4 days.

3.1.6 At 7 days of incubation

The mycelial growth inhibition was maximum in Neem (61.35%) followed by Eucalyptus (58.06%), Garlic (53.13%), Mehandi (50.75%), Ginger (49.68%), Tulsi (44.91%). Madar (42.86%), Kaner (39.15%), Onion (29.70%), Lantana (26.48%), Sadabahar (24.35%), Ashok (19.42%), Bael

(17.82%), Bhang (16.95%), Clerodendron (11.61%), Parthenium (8.32%) and Marigold (7.50%). at 10% concentration. The per cent inhibition in between, Eucalyptus and Garlic; Mehandi and Ginger; Madar and Kaner; Kaner and Onion; Lantana and Sadabahar and Bhang and Clerodendron were at par to each other (Table 5 & Fig. 6).

Table 5: Effect of different concentration of plant extract against *A.tenuissima* on per cent inhibition *in vitro* after 7 days

Plant extract	Per cent inhibition	
	Concentration (%)	
	10.00	15.00
Neem	61.35 (51.57)	67.41 (55.20)
Eucalyptus	58.06 (49.68)	66.70 (54.95)
Garlic	53.13 (46.80)	63.08 (52.60)
Mehndi	50.75 (45.43)	60.77 (51.23)
Ginger	49.68 (44.81)	57.66 (49.45)
Tulsi	44.91 (42.08)	45.98 (42.68)
Madar	42.86 (40.87)	42.52 (40.67)
Kaner	39.15 (38.73)	40.96 (39.76)

Onion	29.70 (33.02)	32.77 (34.92)
Lantana	26.48 (30.94)	29.70 (32.97)
Sadabahar	24.35 (29.54)	24.93 (29.87)
Ashok	19.42 (26.11)	21.37 (27.51)
Bael	17.82 (25.93)	20.82 (27.09)
Bhang	16.95 (24.31)	19.42 (26.14)
Clerodendron	11.61(19.89)	17.28 (24.55)
Parthenium	8.32 (16.75)	13.75 (21.76)
Marigold	7.50 (15.08)	12.68 (20.85)
Check	0.00 (0.00)	0.00 (0.00)
CD at 5%	4.12	4.49

Figure given in parenthesis are transformed value

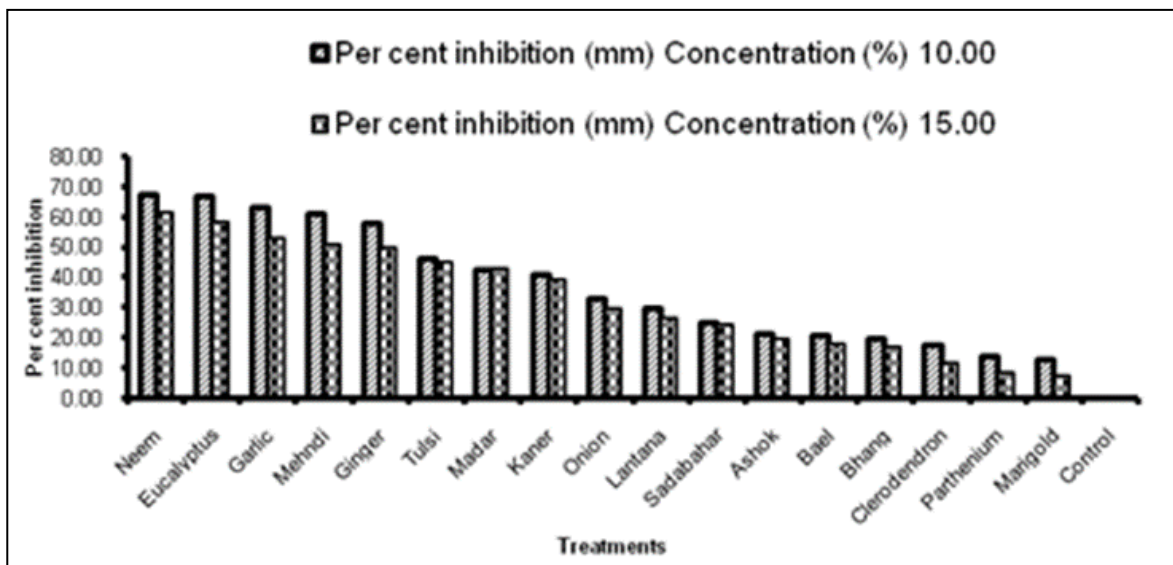


Fig 6: Effect of 10% & 15% Concentration of plant extract against *A.tenuissima* on percent inhibition *in vitro* at 7 days.

In 15 percent concentration maximum inhibition in radial growth of *A.tenuissima* was recorded in Neem (67.41mm) followed by Eucalyptus (66.70%), Garlic (63.08%), Mehandi (60.77%), Ginger (57.66%), Tulsi (45.98%).Madar(42.52%), Kaner (40.96%), Onion (32.77%), Lantana (29.70%), Sadabahar (34.93%), Ashok (21.37%), Bael (20.82%), Bhang (19.42%), Clerodendron (17.28%), Parthenium (13.75%) and Marigold (12.68%). The per cent inhibition in between Eucalyptus and Garlic; Madar and Kaner; Onion and Lantana; Sadabahar and Ashok and Clerodendron and Parthenium were at par to each other. However, per cent inhibition in rest of the treatments differed significantly to each other (Table 8). The per cent inhibition in radial growth was higher at 15 per cent concentration as compared to 10 percent concentration at 4 days and 7 days of incubation. Thus, it is very clear that the efficacy of plant extracts increased with an increased concentration and time of incubation.

3.1.7 In vivo efficacy of plant extracts against Alternaria blight disease

Fifteen per cent concentration of plant extracts was found most effective *in vitro* and was further tested *in vivo* to find out the efficacy of the seventeen plant extracts. Data presented in table 6 indicated that all the plant extracts were more or less effective and exhibited reduction in disease incidence. The minimum disease incidence was found in

Neem(42.23%) followed by Eucalyptus (47.24%), Garlic (51.73%), Mehandi (56.43%), Ginger (60.36%), Tulsi (65.43%), Madar (67.37%), Kaner (69.73%), Onion (71.96%), Lantana (74.68%), Sadabahar (77.58%), Ashok (78.18%), Bael (82.68%), Bhang (83.24%), Clerodendron (85.44%), Parthenium (87.68%) and Marigold (89.33%) as compared to untreated plants (92.26%)..

The disease incidence in between Eucalyptus and Garlic; Mehandi and Ginger; Kaner and Onion; Lantana and Sadabahar; Bhang and Clerodendron and Pathenium and Marigold were at par to each other. (Fig.8)

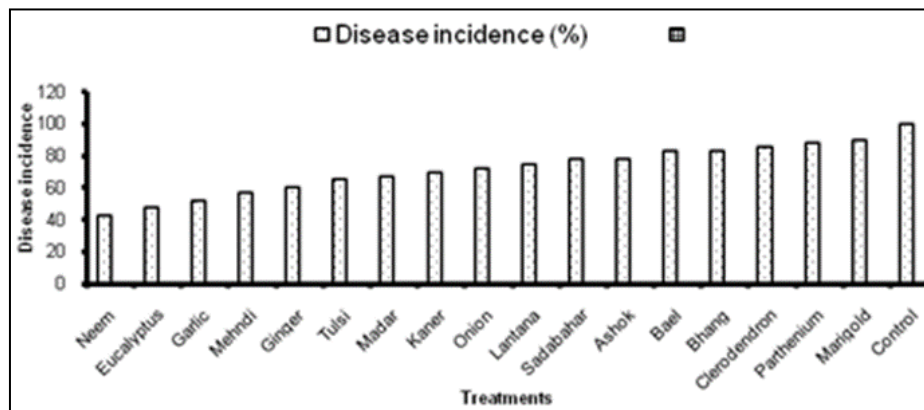


Fig 7: Efficacy of plant extracts against *Alternaria* blight of Pigeon pea *in vivo*

Table 6: Effect of plant extract on percent disease incidence against *Alternaria* blight *in vivo*.

Plant extract	Concentration (%)	Percent disease incidence
Neem	15	42.23 (40.53)
Eucalyptus	15	47.24 (43.41)
Garlic	15	51.73 (45.99)
Mehndi	15	56.43 (48.70)
Ginger	15	60.36 (50.98)
Tulsi	15	65.43 (54.11)
Madar	15	67.37 (55.27)
Kaner	15	69.73 (56.79)
Onion	15	71.96 (58.26)
Lantana	15	74.68 (59.80)
Sadabahar	15	77.58 (62.40)
Ashok	15	78.18 (62.25)
Bael	15	82.68 (65.48)
Bhang	15	83.24 (66.97)
Clerodendron	15	85.44 (68.49)
Parthenium	15	87.68 (71.06)
Marigold	15	89.33 (73.65)
Check	15	92.26 (90.00)
CD at 5%		10.31

Figure given in parenthesis are transformed value

**Fig 8:** Effect of plant extract on disease incidence against *A.tenuissima in vivo*

3.1.8 Effect on Per cent Disease Control

The highest per cent disease control of 57.77% was recorded in Neem followed by Eucalyptus (52.76%), Garlic (48.27%), Mehndi (43.57%), Ginger (39.64%), Tulsi (34.57%), Madar (32.63%), Kaner (30.27%), Onion (28.04%), Lantana (25.32%), Sadabahar (22.42%), Ashok (21.82%), Bael (17.32%), Bhang (16.76%), Clerodendron (14.56%), Parthenium (12.32%) and Marigold (10.67%) as compared to

untreated plants. The disease control in between Eucalyptus and Garlic; Mehndi and Ginger; Kaner and Onion; Lantana and Sadabahar; Bhang and Clerodendron and Parthenium and Marigold were at par to each other. Rest of the treatments significantly differed from each other with respect to percent disease control (Table 7 & Fig.9). Thus, disease control was highest in Neem and Eucalyptus and minimum in Marigold and Parthenium.

Table 7: Effect of plant extract on percent disease control against *Alternaria* blight *in vivo*

Plant extract	Concentration (%)	Percent disease control
Neem	15	57.77 (49.43)
Eucalyptus	15	52.76 (46.59)
Garlic	15	48.27 (43.94)
Mehndi	15	43.57 (41.30)
Ginger	15	39.64 (39.01)
Tulsi	15	34.57 (36.01)
Madar	15	32.63 (34.83)
Kaner	15	30.27 (33.38)
Onion	15	28.04 (31.94)
Lantana	15	25.32 (30.18)
Sadabahar	15	22.42 (28.22)
Ashok	15	21.82 (27.81)
Bael	15	17.32 (24.59)
Bhang	15	16.76 (14.56)
Clerodendron	15	14.56 (22.42)
Parthenium	15	12.32 (20.55)
Marigold	15	10.67 (19.04)
Check	15	0.00 (0.00)
CD at 5%		3.52

Figure given in parenthesis are transformed value

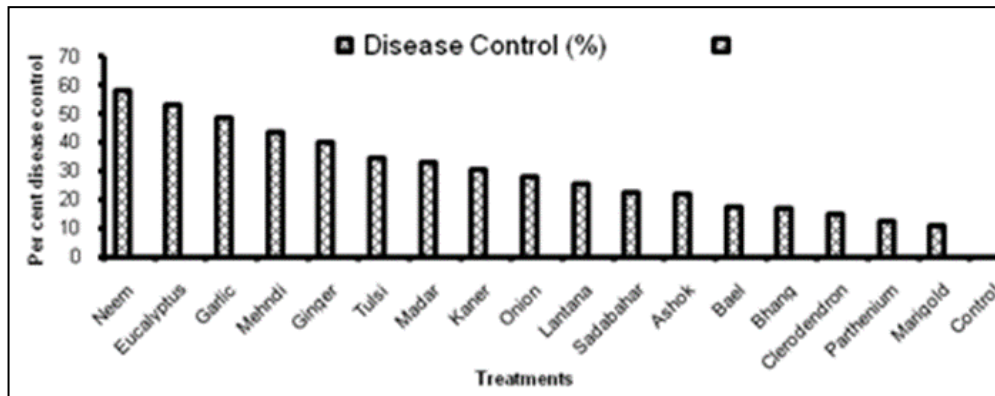


Fig 9: Effect of plant extract on percent disease control against *A.tenuissima* *in vivo*.

4. Discussion

Studies were carried out on the prevalence and severity of disease in central Uttar Pradesh and effect of temperature, relative humidity and rainfall on disease development. The incidence of disease varied from 18.0% to 37.5% at different locations. The temperature and humidity played the significant role in disease development while rainfall had no positive correlation with disease development. Blight symptoms on Pigeon pea were observed in alarming proportion during 2009-2011 crop seasons in Andhra Pradesh state in India. The disease incidence ranged between 20-80% irrespective of cultivars sown. (Sharma *et al.*, 2012).

Keeping in view the importance of the crop and seriousness of the disease, it was thought worthwhile to investigate the disease with objectives as outlined in the introductory chapter and the results obtained are discussed in the light of available literature as follows:

5. Conclusion

Alternaria blight caused by *Alternaria tenuissima* is one of the most widespread and destructive foliar diseases of Pre-Rabi Pigeon pea. Use of synthetic fungicides has led to the emergence of several problems like environment pollution, residual effect in grain and killing of non target organism(s). Hence, for minimizing the losses caused by *Alternaria*, this disease needs inexpensive and environmentally safe management practices. Many plant extracts are known for their antifungal activity.

Different aspects of disease as well as pathogen were studied with disease management through use of plant extracts against *A. tenuissima*.

The salient finding of studies are summarized below:

- Seventeen plant extracts viz., Neem, Garlic, Tulsi, Ginger, Madar, Onion, Sadabahar, Ashok, Eucalyptus, Bhang, Mehandi, Lantana, Bael, Marigold, Parthenium, Clerodendron and Kaner were tested *in vitro* against *Alternaria tenuissima* following poison food technique. All the seventeen plant extract showed significant reduction in radial growth of *Alternaria tenuissima* at 10% and 15% concentration. The effectivity of extracts increased with an increase in concentration and time of incubation (4 days and 7 days).

In fifteen per cent concentration of plant extracts, minimum radial growth was recorded in Neem (29.33mm) and Eucalyptus (29.97mm) followed by Garlic (33.23mm), Mehandi (35.30mm), Ginger (38.18mm), Tulsi (48.62mm), Madar (51.73mm), Kaner (53.13mm), Onion (60.50mm), Lantana (63.27mm), Sadabahar (67.56mm), Ashok (70.76mm), Bael (71.26mm), Bhang (72.52mm), Clerodendron (74.44mm), Parthenium (77.62mm) and

Marigold (78.59mm). The radial growth in Check was (90.00mm). The radial growth significantly differed in different treatments with each other except Mehandi and Ginger; Madar and Kaner; Kaner and Onion; Onion and Lantana and Clerodendron and Parthenium which were at par to each other. Thus, results clearly indicated that plant extracts reduced the radial growth of *Alternaria tenuissima*.

- The radial growth of *A.tenuissima* and the effectiveness of extracts increased with the increase of their concentration.
- In fifteen percent concentration complete inhibition in radial growth of *A.tenuissima* were recorded in Neem (67.41%) and Eucalyptus (66.70%) followed by Garlic (63.08%), Mehandi (60.77%), Ginger (57.66%), Tulsi (45.98%), Madar (42.52%), Kaner (40.96%), Onion (32.77%), Lantana (29.70%), Sadabahar (24.63%), Ashok (21.37%), Bael (20.82%), Bhang (19.42%), Clerodendron (17.28%), Parthenium (13.75%) and Marigold (12.68%) after 7 days of incubation.

The similar trend was also observed in case of 10% concentration after 4 days of incubation. However, the radial growth was higher and percent inhibition was lower. Fifteen percent concentration of plant extracts was found most effective *in vitro* and was further tested *in vivo* to find out the efficacy of the seventeen plant extract.

- Disease incidence was lowest in Neem (42.23%) followed by Eucalyptus (47.24%), Garlic (51.73%), Mehandi (56.43%), Ginger (60.36%), Tulsi (65.43%), Madar (67.37%), Kaner (69.73%), Onion (71.96%), Lantana (74.68%), Sadabahar (77.58%), Ashok (78.18%), Bael (82.68%), Bhang (83.24%), Clerodendron (85.44%), Parthenium (87.68%) and Marigold (89.33%).

The disease incidence in between Neem and Eucalyptus; Garlic and Mehandi; Ginger and Tulsi; Kaner and Onion; Lantana and Sadabahar and Bael and Bhang and NDAenium and Marigold were at par to each other. Rest of the treatments significantly differed from each other. The disease incidence was not much affected by Parthenium and Marigold.

- The disease control was maximum in Neem (57.77%) followed by Eucalyptus (52.76%), Garlic (48.27%), Mehandi (43.57%), Ginger (39.64%), Tulsi (34.57%), Madar (32.63%), Kaner (30.27%), Onion (28.04%), Lantana (25.32%), Sadabahar (22.42%), Ashok (21.82%), Bael (17.32%), Bhang (16.76%), Clerodendron (14.56%), Parthenium (12.32%) and Marigold (10.67%). The lowest plant disease control was found in Parthenium and Marigold.

6. References

1. Anonymous. Annual Report on Pigeon pea. *All India CO-ordinated Research Project on Pigeon pea*, IIPR, Kanpur, 240.
2. Anonymous. Project Coordinated Report, 2012-13. *All India Co-ordinated Research Project on Pigeon pea*, IIPR, Kanpur, 16.
3. Goon AM, Gupta MK, Das Gupta B. *Fundamental of Statistics, Vol.2 published by Bhattacharjee for the world press Pvt. Ltd. 37 a College Street, Calicut-700073, 1931, 145.*
4. Kannaiyan J, Nene YL. Control of seed borne *Alternaria tenuissima* in Pigeon pea. *Tropical Grain Legume Bulletin No, 1977, 9.*
5. Kushwaha A, Nigam R, Srivastava A. Occurrence and severity of *Alternaria* blight of Pigeon pea in central U.P. *Int. Jr Pl. Prot.* 2010; 3(2):361.
6. Kushwaha A, Srivastava A, Nigam R, Srivastava N. Management of *Alternaria* blight of Pigeon pea crop through chemicals. *Int. Jr Pl. Prot.* 2010; 3(2):313-315.
7. Mehta PP, Sinha RKP. A new leaf spot disease of arhar from India. *Sci & cult.* 1982; 48(2):44.
8. Nene YL, Thapliyal PN. *Fungicides in plant disease control*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1993, 531-532.
9. Nene YL, Sheela VK, Sharma SB. A world list of chickpea and Pigeon pea pathogens. 5th edn. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics (Semi-formal Publication), Hyderabad, 1996.
10. Pavgi MS, Singh RA. Parasitic fungi from north India. *VII. Appl. Mycopath.* 1971; 43(2):117-125.
11. Sharma M, Ghosh R, Mangala UN, Saxena KB, Pande S. *Alternaria tenuissima* causing *Alternaria* blight on Pigeon pea [*Cajanus cajan* (L.) Mill sp.] In India. *Plant Disease.* 2012; 96(2):152-158.
12. Venkateswarlu S, Reddy AR, Singh ON, Chauhan VB. *Alternaria* blight: The most serious disease of post rainy season (Rabi) Pigeon pea. *Int. Pigeon pea Newsletter.* 1981; 1:28-29.