Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(2): 538-540
Received: 07-01-2019
Accepted: 12-02-2019

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Efficacy of different phytoextracts against *Erysiphe cichoracearum* dc causing powdery mildew of okra

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Abstract
Okra (*Abelmoschus esculentus* (L.) Moench.) is one of the most important vegetable crops grown in India. Powdery mildew caused by *Erysiphe cichoracearum* DC is one of the major constraints in the production of okra. In order to find out the efficacy of various phyto extract against *Erysiphe cichoracearum* experiment was carried out under *in vitro* condition. The relative efficacy of nine different phytoextracts were tested in different concentrations and different time of interval 24, 48 and 72 hours, respectively. Out of nine phytoextracts tested, six phytoextracts showed more than 50% inhibition at all concentrations on different time interval. Neem leaf extract and garlic cloves extracts found best in spore germination inhibition at all the concentrations on different time interval. The significantly highest spore germination inhibition (82.23%) was recorded at 10 per cent concentration of neem followed by 10 per cent concentration of garlic (80.09%) on 72 hrs after the treatment.

Keywords: Erysiphe cichoracearum, *in vitro*, powdery mildew, phyto extracts and okra

Introduction
Okra (*Abelmoschus esculentus* (L.) Moench) locally known as *Bhindi* belongs to family *Malvaceae* is one of the important vegetable crops grown in India. In India, major okra growing states are West Bengal, Gujarat, Orissa, Bihar, Jharkhand, Madhya Pradesh and Andhra Pradesh (Anon., 2015) [2]. The okra plant is affected by a number of diseases caused by fungi, nematodes, virus and phytoplasma. Fungal diseases like wilt (*Fusarium oxysporum* f. sp. *vasinfectum)*, root rot (*Fusarium solani* (Mart) Sacc.), damping off (*Pythium* spp.), fruit rot (*Pythium aphanidermatum* and *Phytophthora palmivora*), Phyllosticta leaf spot (*Phyllosticta hibiscini* Ell and Ev.), Alternaria leaf spots (*Alternaria hibiscinum*), powdery mildew (*Erysiphe cichoracearum* DC.) (Arden and Alan, 1986; Rangaswami and Mahadevan, 2004) [4, 10]. Among these, powdery mildew of okra caused by *Erysiphe cichoracearum* is an important disease and it cause huge losses in okra growing region of Gujarat state. It is a routine practice for farmers to spray fungicides onward from one month crop age to maturity, particularly for powdery mildew control. Fungicidal applications are also mandatory for powdery mildew management after its initiation. The pesticides residues present in seed are main concern for human health at national and international level. It is also affect export of okra fruit. To overcome these problems, we have to find out the some eco-friendly alternative of fungicides for the control of disease. Hence looking to importance of this disease and need of present era, efficacy of various phytoextracts was tested in laboratory condition against powdery mildew pathogens.

Materials and Methods
Locally available plant species were tested for their efficacy against *Erysiphe cichoracearum*. Fresh leaves, cloves or rhizomes of respective plant species as shown in Table - 1 were first washed with tap water and then with sterilized water. Each sample was then homogenized in sterilized distilled water at the rate of 1 ml/g of tissues (1:1 V/W) with a pestle and mortar and filtered through fine muslin cloth. The filtrate was centrifuged at 5000 rpm for 20 minutes and the supernatant was filtered with sterilized sintered funnel (pore size 1-2 microns), which formed the standard plant extract solution (100%). The clarified extracts were stored in refrigerator at 4° C till used (Ansari, 1995). To prevent bacterial contamination, a pinch of streptocycline was added to each stalk solution. The spore suspension was also prepared in sterilized distilled water separately. Double strength than required concentration was obtained for all phytoextracts by dilution technique in sterilized distilled water. With micropipette appropriate required quantity of each phytoextracts was incorporated into autoclaved water agar medium before solidification and then immediately one drop of each phytoextracts

Suspension and one drop of spore suspension was placed on a cavity slide, so that the tested concentration were obtained. These slides were kept in Petri plates lined with moist blotting paper with sporting the glass rods and incubated at room temperature (23° ± 1° C). Thereafter, observations were recorded at an interval of 24, 48 and 72 hours. Inoculated cavity slide containing water agar medium with spore suspension, without agrochemicals served as control. The conidium having germ tube length of more than its width was considered as germinated conidium. Effect of toxicity on conidia and on their germination was observed with the help of compound microscope (Pipliwal, 2013) [9].

Per cent inhibition of spore germination in each treatment was calculated using following formula (Bliss, 1934).

$$I = \frac{C - T}{C} \text{ x } 100$$

Where,

I = Per cent inhibition

C = Number of germinated spore in control

T = Number of germinated spore in treatment

Results and Discussion

Effect of phytoextracts on spore germination inhibition

Effect of nine different phytoextracts on the cumulative spore germination inhibition of test fungus was evaluated for given concentrations and observation recorded after the period of 24, 48 and 72 hours of treatment by slide spore germination technique. With increasing the concentration of phyto extract, spore germination inhibition was found to be increased. The data regarding spore germination in Table 1. Out of nine phytoextracts tested, six phytoextracts showed more than 50 % inhibition at all concentrations on different time interval except jatropha which showed 51.19 and 53.37 per cent spore germination inhibition at 10 and 15 per cent concentration after 72 hours. Neem leaf extract and garlic cloves extracts found best in spore germination inhibition at all the concentrations on different time interval. Due to antifungal properties of neem leaf extract, it was act as an excellent source for spore germination inhibition of *E. cochoracearum.* Phyto extract of neem leaf extract 10 per cent provided the maximum cumulative spore germination inhibition of 80.72, 81.63 and 82.23 per cent at 24, 48 and 72 hours, which is at par with phyto extract of neem leaf extract at 5 per cent for spore germination inhibition of 77.76, 79.83 and 80.76 per cent at 24, 48 and 72 hours, respectively and closely followed by garlic 15 per cent with spore germination inhibition of 77.71, 78.12 and 80.09 per cent at 24, 48 and 72 hours, respectively. The phytoextracts of lantana, jatropha and ardusi found poor in spore germination inhibition at all concentrations.

The finding of present investigation was in favor of work done by *Anon.*, 1996. They observed that neem based botanical and neem leaf extract found better for the control of powdery mildew of mustard. Similarly, Maurya *et al*. (2004) [8] have reported more than 80 per cent spore germination inhibition of *E. pisi* causing pea powdery mildew with neem and motha. While, working with *Uncinula nectar* causing powdery mildew of grapevine, Dhaliwal *et al*. (2002) [2] observed the complete inhibition of conidial germination with phyto extract of garlic (*Allium sativum*). The effectiveness of neem product against *Sphaerotheca pannosa* (powdery mildew of rose) and *Phyllactinia corylea* (powdery mildew of mulberry) and *Erysiphe cichoracearum* (powdery mildew of sunflower) has been reported by Ravikumar (1998) [11], Vidyasagar and Rajasab (2001) [12] and Dinesh, *et al*. (2011) [7].

Conclusion

In vitro evaluation of phyto extract revealed that neem leaf extract have certain antifungal properties. Due to this properties, maximum spore germination inhibition was recorded in the treatment of neem leaf extract 10 per cent with of 80.72, 81.63 and 82.23 per cent spore germination inhibition after 24, 48 and 72 hours, respectively followed by 5 per cent concentration of same with 79.83 and 80.76 per cent at 48 and 72 hours, respectively. Garlic cloves extracts also found better with 77.71, 78.12 and 80.09 per cent spore germination inhibition at 15 per cent concentration after 24, 48 and 72 hours of treatment application, respectively.

Table 1: Effect of phyto extract on spore germination inhibition of *E. cichoracearum in vitro*

S. No.	Phytoextracts	Concen-tration (%)	Per cent spore germination inhibition after*		
			24 hr	48 Hr	72 hr
1	*Allium sativum* L. (Garlic)	5	56.64** (69.76)*	57.98 (71.88)	58.59 (72.83)
		10	58.80 (73.15)	59.36 (74.01)	60.14 (75.20)
		15	61.83 (77.71)	62.13 (78.12)	64.00 (80.09)
2	*Zingiber officinale* Rosc. (Ginger)	5	47.35 (54.09)	49.16 (57.22)	50.96 (60.31)
		10	49.59 (57.97)	50.51 (59.54)	51.87 (61.87)
		15	51.60 (61.40)	52.01 (62.11)	54.16 (65.70)
3	*Ocimum sanctum* L. (Tulsi)	5	44.24 (48.68)	45.02 (50.03)	46.80 (53.13)
		10	45.56 (50.97)	46.30 (52.27)	48.91 (56.78)
		15	46.91 (53.32)	47.96 (55.16)	49.09 (57.11)
4	*Lantana camara* L. (Lantana)	5	36.01 (34.62)	37.70 (37.42)	41.88 (44.58)
		10	37.00 (36.22)	38.71 (39.11)	43.32 (47.08)
		15	38.65 (39.01)	40.70 (42.52)	44.81 (49.66)
5	*Jetropha curcas* L. (Jatropha)	5	39.45 (40.40)	40.74 (42.60)	44.59 (49.29)
		10	40.71 (42.54)	41.62 (44.12)	45.68 (51.19)
		15	42.92 (46.38)	43.48 (47.34)	46.94 (53.37)
6	*Adhatoda vasica* Ness. (Ardusi)	5	33.49 (30.51)	35.54 (33.83)	38.28 (38.41)
		10	35.08 (33.06)	36.36 (35.20)	39.73 (40.87)
		15	38.10 (38.08)	39.03 (39.67)	40.97 (43.00)
7	*Allium cepa* L. (Onion)	5	52.00 (62.09)	52.46 (62.87)	53.47 (64.56)
		10	52.98 (63.75)	53.75 (65.03)	55.45 (67.82)
		15	54.76 (66.70)	56.08 (68.85)	57.38 (70.93)
8	*Azadirachta indica* A. Juss. (Neem)	2	60.49 (75.73)	60.92 (76.37)	62.61 (78.79)

		5	61.87 (77.76)	63.33 (79.83)	63.51 (80.76)
		10	63.96 (80.72)	64.63 (81.63)	65.07 (82.23)
9	*Curcuma longa* L. (Turmeric)	2	54.96 (67.03)	55.89 (68.54)	57.32 (70.85)
		5	56.89 (70.15)	57.47 (71.07)	58.39 (77.52)
		10	59.66 (74.47)	60.29 (75.43)	61.55 (77.29)
S.Em. ±			0.89	0.81	0.87
C.D. at 5%			2.51	2.31	2.46
C.V.%			3.13	2.82	2.88

*Data given in parentheses are retransformed values

**Data were transformed (Arcsine) prior to analysis

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