International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 1166-1170

Received: 16-09-2019
Accepted: 18-10-2019

Satendra Kumar Sharma
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

DS Tomar
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

MK Nayak
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

Corresponding Author:
Satendra Kumar Sharma
JNKVV, College of Agriculture, Tikamgarh, Madhya Pradesh, India

Screening of fungicides, essential oil and plant extract against early blight of potato caused by *Alternaria solani*

Satendra Kumar Sharma, DS Tomar and MK Nayak

Abstract
Potato (*Solanum tuberosum* L.) is known as a king of vegetable crop of Madhya Pradesh as well as India. The experiment was conducted at JNKVV, College of Agriculture, Tikamgarh. During Ravi season 2018-19 to control of early blight of potato caused by Alternaria solani (Ellis and Martin) Jones and Grout. Seven different treatments were evaluated *in vitro* and *in vivo* condition. However, *in vitro* result revealed that the minimum radial growth (20 mm) was observed in Mancozeb 75% WP at 0.25 per cent concentration followed by Eucalyptus oil (21.0 mm), Onion extract (22.03 mm), Carbendazim 12% + Mancozeb 63%WP (30.53 mm), Garlic extract (38.07 mm) and in Neem oil (60.0 mm). *In vivo* results indicated that Mancozeb 75% WP @ (0.25%) was found most effective and recorded lowest disease intensity (21.73%) with significantly increased in yield over control (73.62%) followed by Eucalyptus oil @ (5%), disease intensity (22.97%) and yield (68.86%), Onion extract @ (5%), disease intensity (24.77%) and yield (47.52%), Carbendazim 12%+ Mancozeb 63%WP @ (0.15%), disease intensity (25.07%,) and yield (39.31%), Garlic extract @ (5%), disease intensity (26.67%) and yield (15.4%) and Neem oil @ (5%), disease intensity (27.70%) and yield (2.38%) insignificantly. Overall results revealed that Mancozeb is highly effective against *Alternaria solani in vitro* and *in vivo* condition.

Keywords: Management, *Alternaria solani*, potato, Mancozeb, Carbendazim + Mancozeb, eucalyptus oil, Neem oil, onion extract, garlic extract

Introduction
Potato (*Solanum tuberosum* L.) is known as a king of vegetable crop of Madhya Pradesh as well as India. It is consumed as a popular source of carbohydrate, and can be used both for table consumption as well as in many processed products. More than 75 per cent of the dry matter is starch but it also contains protein, fibers and small amount of fatty acids (Prokop and Albert, 2008) [15]. It is also rich in minerals such as potassium, phosphorus, magnesium and vitamins like B1, B3 and B6 (Camire *et al.*, 2009) [7].

India is the second largest producer of Potato after China, with area 2.16 million ha, production 46.55 million tonnes and productivity 21.50 tonnes/ha in 2016-17 (Anonymous, 2017 a) [1]. In northern Madhya Pradesh, potato is one of the major cash crops. Tikamgarh is a major potato growing districts of Bundelkhand region, which account for 0.003 million hectares area and 0.037 million tonnes of production with average productivity 14.5 tonnes ha^{-1} (Anonymous, 2017 b) [3].

Early blight is the most common, wide spread and destructive disease of Potato in India, and may cause up to 40 to 49 per cent loss in yield (Gupta and Thind, 2006 and Bhattacharya and Raj, 1977) [12, 5].

Material and Method
The experiment was conducted at Department of Plant Pathology, JNKVV, College of Agriculture, Tikamgarh during Rabi 2018-19. To determine the efficacy of different treatments like Mancozeb 75% WP @ 0.25%, Carbendizim 12% + Mancozeb 63% WP @ 0.15%, Eucalyptus oil, @ 5% Neem oil @ 5%, onion extract @ 5% and garlic extract @ 5% against early blight disease of potato under the lab and field conditions.

In vitro evaluation of fungicides, plant extracts and essential oil against *A. solani*
In vitro evaluation of fungicides, Essential oil and plant extract against *Alternaria solani* (Ellis and Martin) Jones and Grout was carried out through poisoned food technique, respectively

(Ganie *et al.*, 2013 a) [10]. The efficacy of fungicides, essential oil and plant extract were assayed in inhibiting the mycelial growth of *A. solani*. The fungus was grown on PDA medium for seven days prior to setting up the experiment.

The PDA medium was prepared and melted. The required concentration of fungicidal suspension was added to the molten medium. Twenty ml of poisoned medium was poured in each sterilized Petri plates. Suitable check was maintained without addition of fungicide. Mycelial disc of 5 mm was taken from the periphery of seven days old culture and placed in the center of Petri plates and incubated at 27 ±1 ˚C for seven days. The diameter of the colony was measured in two directions and average was recorded. Three replications were maintained for each treatment and CRD was followed. Data obtained were subjected for statistical analysis. For evaluation of plant extracts, Onion and Garlic were selected for the study. Fresh bulbs were collected from local market, Tikamgarh and confirmed their taxonomical identification. These samples were washed thoroughly with tap water and surface sterilized with 0.1 per cent sodium hypochlorite and repeatedly washed with distilled water. Hundred grams of bulbs materials was taken and cut into small pieces, 100 ml water was added and the bulbs materials were crushed using a grinder. The stock solution of all the bulbs extracts was collected by filtering with muslin cloth. 5 per cent of bulb extracts were prepared by adding 5 ml of stock solution to 95 ml of PDA medium, respectively. The PDA medium with plant extracts was sterilized in autoclave. The sterilized amended medium was poured into petri plates, for each treatment three replications were maintained, these plates were inoculated with 5 mm disc of seven days old culture of *A. solani.* Suitable control plates were maintained where in culture discs were inoculated into the center of potato dextrose agar plates without plant extracts.

The essential oils were purchased from market and prepared required (5%) solution by dissolving 5 ml oil in 100 ml PDA before use. Certain volumes of each essential oil were added to melted PDA medium and carefully mixed by gentle swirling to ensure the equal oil concentration before pouring into 90 mm diameter Petri dishes. After agar was solidified, a 5 mm disk from the edge of an actively growing colony of *Alternaria solani* was placed in the center of each Petri dish. A separate PDA plates free of essential oils was used as control treatment. All Petri dishes were incubated at 25±1 °C. Each treatment was replicated three times.

Radial growth of the fungus was measured after seven days of inoculation and the per cent inhibition of growth of the test fungus was calculated by using the formula of Vincent (1947)

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

Where,
I = Per cent inhibition
C = Radial growth in control
T = Radial growth in treatment

In vivo* evaluation of fungicides, Essential oil and Plant extract against *A. solani

Field experiment was conducted to evaluate the efficacy of different treatments. The susceptible variety Kufri chandramukhi was planted on 3rd November 2018 with plot size: 3 × 3 m^2, spacing: 45 × 15 cm, all the treatment replicated thrice. The first spray was given just after the first appearance of early blight symptoms *i.e.* 35 days after planting. Second spray was applied at an interval of 12 days after the first spray. The disease intensity was recorded 15 days after the second spray by using 0 - 5 scale (Pandey and Pandey, 2002) [16].

Result and Discussion

In vitro* evaluation of fungicides, Essential oil and Plant extract against *A. solani

The data are presented in the Table 1, indicated that there was a significant difference among the fungicides, essential oil and plant extract in inhibiting the growth of *A. solani*. The result revealed that mean radial growth recorded was least in the Mancozeb 75% WP (20.5 mm) with maximum (72.08%) inhibition of mycelial growth. It was followed by Eucalyptus oil (21.0 mm) inhibition of mycelial growth (71.49%), Onion extract (22.0 mm) inhibition of mycelial growth (70.09%), Carbendazim 12% + Mancozeb 63% WP (30.53 mm) inhibition of mycelial growth (58.55%), Garlic extract (38.0 mm) inhibition of mycelial growth (48.33%), and Neem oil mycelium growth (60.0 mm) and inhibition of mycelium growth (18.54%). Ganie *et al.* (2013 b) [11] recorded that non-systemic fungi toxicants mancozeb 75 WP, irrespective of concentration was most effective *in vitro* against *A. solani* followed by propineb 70 WP.

Table 1: Effect of fungicides, essential oils and botanicals on radial growth of *A. solani* after 7 days of inoculation

S. No	Treatment	Application Dose (%)	Mycelium (mm.)	% Inhibition over Control
1	Neem oil	5	60.00*	18.54
2	Eucalyptus oil	5	21.00	71.49
3	Garlic extract	5	38.07	48.33
4	Onion extract	5	22.03	70.09
5	Carbendazim 12%WP+ Mancozeb 63%WP	0.15	30.53	58.55
6	Mancozeb 75%WP	0.25	20.56	72.08
7	Untreated control		73.66	-
SEm ±			1.32	
CD at 5%			3.86	
CV %			6.00	

*Mean of three replications

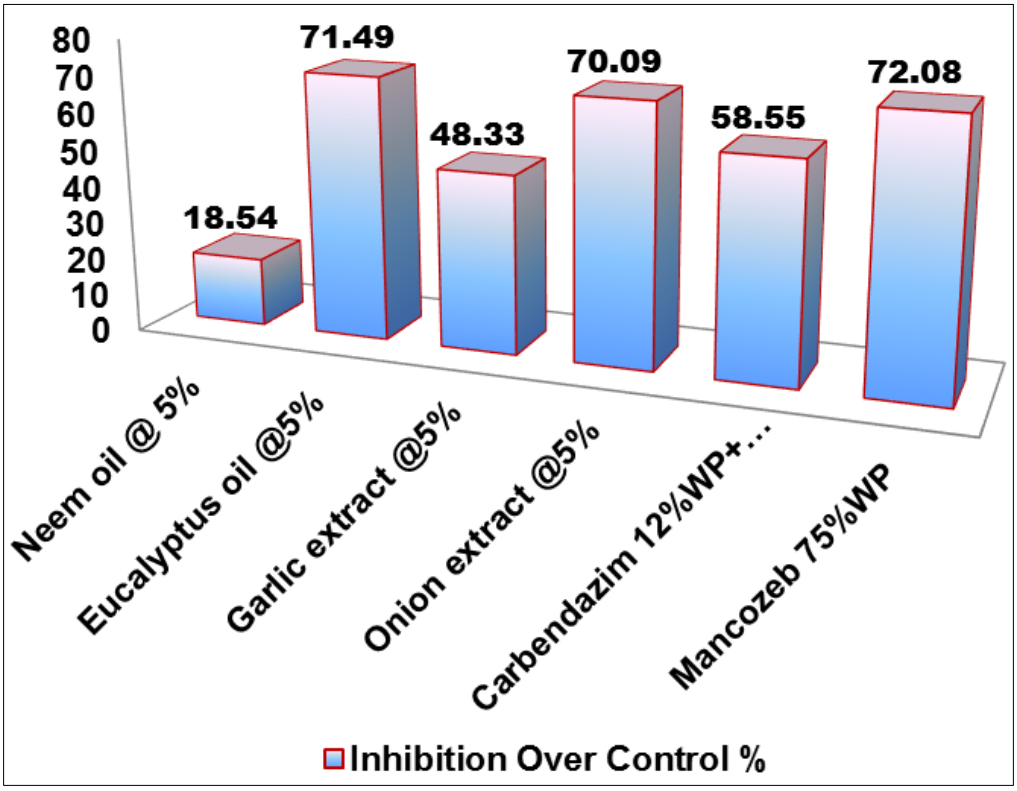

Fig 1: Inhibition of growth of *A. solani in vitro* as influenced by fungicides, essential oil and Plant extract.

In vivo* evaluation of fungicides, Essential oil and Plant extract against *A. solani

The perusal of data in Table 2 revealed that all the treatments under study were significantly effective in controlling the intensity of early blight over control. Mancozeb 75% WP showed significantly minimum per cent disease intensity (21.73%) with maximum disease control (20.19%) and maximum increase in potato yield (73.62%) followed by Eucalyptus oil (22.97% disease intensity and 68.86% increase in potato yield), Onion extract (24.77% disease intensity and 47.52% increase in potato yield), Carbendazim 12%WP + Mancozeb 63%WP (25.07% disease intensity and 39.31% increase in potato yield) Garlic extract (26.67% disease intensity and 15.4% increase in potato yield) and Neem oil (27.70% disease intensity and 2.38% increase in potato yield) respectively.

Table 2: *In vivo* evaluation of fungicides, Essential Oils and Botanicals on radial growth of *A. solani.*

S. No.	Treatment	Dose (%)	PDI	PDC	Yield (q ha^{-1})	% IOC
1.	Neem oil	5	27.70* (31.72)**	9.10	111.8	2.38
2.	Eucalyptus oil	5	22.97 (28.59)	17.86	184.4	68.86
3.	Garlic extract	5	26.67 (31.01)	10.71	125.9	15.4
4.	Onion extract	5	24.77 (29.83)	14.30	161.1	47.52
5.	Carbendazim 12%WP+ Mancozeb 63%WP	0.15	25.07 (30.04)	12.66	152.2	39.31
6.	Mancozeb 75%WP	0.25	21.73 (27.78)	20.19	189.6	73.62
7.	Untreated control		32.73 (34.81)		109.2	-
SEm±			1.63		1.29	-
CD at 5%			5.04		3.98	-
CV %			10.91		16.77	-

* Mean of three replications
**Figures in parentheses indicate angular transformed values
PDI: Per cent Disease Intensity
PDC: Per cent Disease Control
% IOC: Per cent Increase in yield Over Control

Conclusion

All the treatments under study were significantly effective in inhibiting mycelia growth as well as in controlling the disease intensity of early blight over control. Overall results revealed that Mancozeb is highly effective against *Alternaria solani in vitro* and *in vivo* condition.

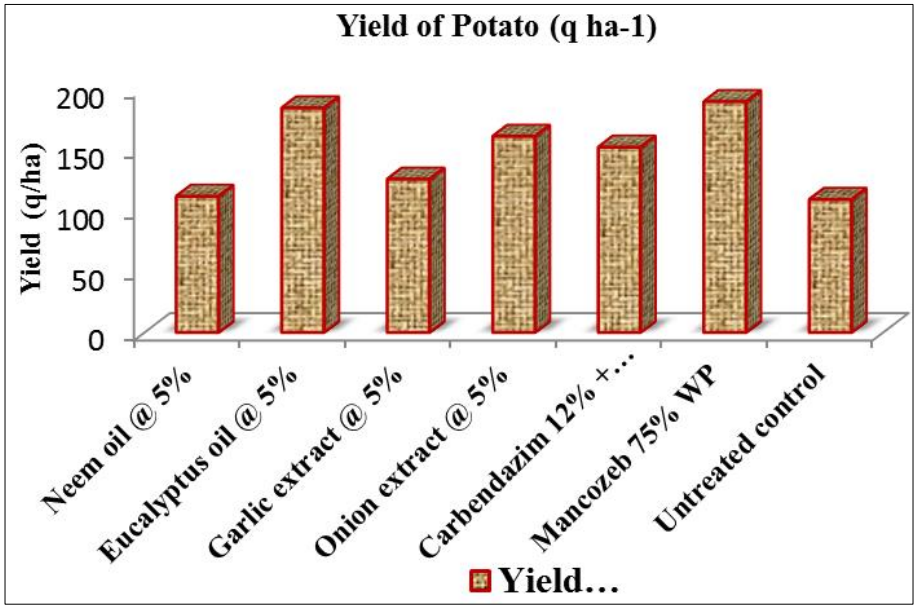

Fig 2: Yield q ha^{-1} of potato as influenced by fungicides, Essemtial oil and Botanicals applied to control the disease in the field.

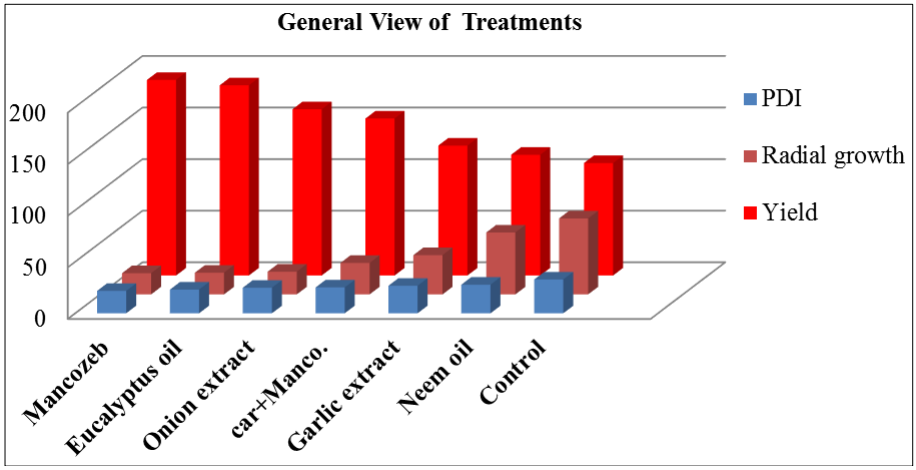

Fig 3: General view of treatments *in vivo* and *in vitro*

Reference

1. Anonymous. Horticultural Statistics at a Glance. Annual publication of Department of Agriculture Cooperation and Farmer Welfare, GOI, New Delhi, 2017a.
2. Anonymous. Annual Report. Krishi Vigyan Kendra, Tikamgarh, 2016-17.
3. Anonymous. January monthly potato report publication of Department of Agriculture Cooperation and Farmer Welfare, GOI, New Delhi. 2018, 2017b.
4. Agrios GN. Plant Pathology, 5th edition. Elsevier Academic Press, London, 2005, 454-455.
5. Bhattacharya SK, Raj S. Fungal diseases of potatoes: Diagnosis and control. India Fmr Dig. 1977; 10(9):15-18.
6. Butler EJ. Fungi and disease in plant. Thakur spink co. Culcutta, 1918, 111-116.
7. Camire ME, Kubow S, Donnelly DJ. Potatoes and human health. Critical Reviews in Food Science and Nutrition. 2009; 49(10):823-840.
8. Fontein DA, Aighewi B. Efficacy of fungicides on the progress of early blight (*Alternaria solani*) and yield of Potato in Cameroon. Tropiculture (Belgium). 1992; 10:15-19.
9. Fisher RA. The Design of Experiments. Printed and published in Great Britain by Oliver and Boyd Ltd, Edinburgh, 1935.
10. Ganie SA, Ghani MY, Qaisar Anjum, Qazi Nissar, Shabir UR, Dar WA. Bio efficacy of plant extracts and bio control agents against *Alternaria solani*. African J Microbiology Research. 2013a; 7(34):4397-4402.
11. Ganie SA, Pant VR, Ghani MY, Lone AH, Anjum Q, Razvi SM. *In vitro* evaluation of plant extracts against *Alternaria brassicae* Berk. Sacc. causing leaf spot of mustard and *Fusarium oxysporum f. sp. lycopersici* causing wilt of tomato. Scientific Research and Essays. 2013 b; 8(37):1808-1811.
12. Gupta SK, Thind TS. Diseases problem in vegetable production. Scientific Publisher, Jodhpur, Rajasthan, 2006; 649p.
13. Iglesias I, Rodriguez-Rajo FJ, Martinez J. Evaluation of the different Alternaria prediction models on a potato crop in A Limia (NW of Spain). Aerobiologia. 2007; 23:27-34.
14. Leiminger JH, Hausladen H. Early blight control in potato using disease-orientated threshold values. Plant Dis. 2012; 96:124-130.
15. Prokop S, Albert J. International Year of the Potato. Potatoes, nutrition and diet. [Online] Available from http://www.potato2008.org.
16. Pandey PK, Pandey KK. Field screening of different tomato germplasm lines again Septoria, Alterneria and

Bacterial disease complex seedling stage. Journal of Mycology and Plant Pathology. 2002; 32(2):233-235.
17. Vincent JM. Distribution of fungal hyphae in the presence of certain inhibitor. Nature. 1947; 159:239-241.
18. Wharton P, Kirk W. Early blight [Online]. Michigan State University: Michigan State University. 2013. Available: http://www.potatodiseases.org/earlyblight.html [Accessed 30/07/2014].