International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2020; 8(1): 2332-2336

Received: 22-11-2019
Accepted: 24-12-2019

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Effect of Indian traditional homa (Agnihotra) in the management of *Alternaria solani* of potato crop and *Alternaria solani* and *Xanthomonas compestris* pv. *vesicatoria* of tomato under controlled environmental conditions in polyhouse

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DOI: https://doi.org/10.22271/chemi.2020.v8.i1ai.8616

Abstract
Crop cultivation in controlled environment is significantly increasing all over the world due to erratic climatic conditions and climate change. Under controlled environment, the plant pathogens particularly from seed borne infections, develop very quickly infecting the crop and causes substantial losses. Control of these pathogens and diseases with pesticide application in controlled environment has its own limitations due to persistance of pesticidal residues over a long period owing to its non depletion in the controlled environment. Traditional homa treatment as non-chemical treatment was used to manage the fungal pathogen *Alternaria solani* in tomato and potato crop and bacterial pathogen *Xanthomonas campestris* pv. *vesicatoria* in tomato crop under controlled polyhouse condition. It was observed that homa therapy effectively reduced the incidence of early blight disease of potato and tomato and bacterial blight disease of tomato in polyhouse and it also reduced the environmental pathogenic microflora around 70 per cent. Thus homa therapy can be used as an alternate solution for chemical pesticides in protected cultivation and also be used in integrated pest management.

Keywords: Homa therapy, *Alternaria solani*, *Xanthomonas campestris* pv. *vesicatoria*, aero sampling

Introduction
Management of plant pathogens and diseases play important role in the crop production and food quality. Various plant protection methods like use of chemical pesticides, biological agents and other conventional methods has its own limitations in open field cultivations and under controlled environmental conditions [1-4]. Crop cultivation in controlled environment is significantly increasing all over the world due to erratic climatic conditions and climate change [5]. Under controlled environment, the plant pathogens particularly from seed borne infections, develop very quickly infecting the crop and causes substantial losses. Control of these pathogens and diseases with pesticide application in controlled environment has its own limitations due to persistence of pesticidal residues over a long period owing to its non depletion in the controlled environment. Therefore other options in plant disease control has to be explored.

Ancient Indians used the homa (agnihotra) to purify the environment and keep the surrounding free from toxic elements and noxious pest and diseases. Homa therapy is nothing but the technical term from vedic science of bioenergy denoting the process of removing the toxic conditions of the atmosphere through the agency of fire [6]. In last few decades scientist have reported the efficacy of Agnihotra and ash thus generated against microbes [7-9]. Koch (2004), says that the central idea of Homa therapy is “you heal the atmosphere and the healed atmosphere heals you.” The same concept has been studied in the present investigation under controlled polyhouse condition to control the plant pathogens and diseases with reference to *Alternaria solani* as fungal pathogen and *Xanthomonas campestris* pv. *vesicatoria* as bacterial pathogen.

Material and Method

Collection and isolation of pathogen

To obtain the fungal and bacterial cultures of *Alternaria solani* and *Xanthomonas campestris* pv. *vesicatoria* the leaves samples of potato and tomato exhibiting typical leaf spot symptoms of *Alternaria spp.* (concentric rings on leaf) and *Xanthomonas campestris* pv. *vesicatoria* (water soaked lesions on leaf) were collected respectively. The fungal pathogen *Alternaria solani* and the bacterial pathogen Xanthomonas *campestris* pv. *vesicatoria* was isolated on Potato Dextrose Agar (PDA) and Nutrient Agar Sucrose (NAS) media respectively by employing routine isolation techniques of fungal and bacterial plant pathogens. The pure culture of these pathogens were maintained and used for the inoculation and disease development studies during the homa therapy experiment.

Homa therapy material

To perform the homa (agnihotra), homa material was collected from the local market and it is presented in Table 1. The material used for homa was mainly either from tree source (mango sticks, black sesame seeds and agnihotra samagri) or from cow (dried cow dung, cow urine and cow ghee).

Table 1: List of ingredients used for homa therapy / agnihotra

S. No.	Ingredients	Qty.	S. No.	Ingredients	Qty.
1	Pot for Agnikunda	1	11	Navgraha sticks	
2	Soil to fill Agnikunda	1 pot	i.	Ark stick for Sun	1
3	Agnihotra samagri	1 pack	ii.	Palash stick for Moon	1
4	Mango tree wood	1/2 kg	iii.	Peepal stick for Jupiter	1
5	Black sesame seeds	100 gm	iv.	Khadir stick for Mars	1
6	Cooked rice	100 gm	v.	Apamarga stick for Mercury	1
7	Brown rice or whole rise	100 gm	vi.	Audambar stick for Venus	1
8	Dried Cow dung	100 gm	vii.	Shabhi stick for Saturn	1
9	Cow urine	200 ml	viii.	Durva stick for Rahu	1
10	Cow ghee	200 gm	ix.	Kusha stick for Ketu	1

Aero sampling by passive method

To study the effect of homa on air microflora of controlled polyhouse condition aero sampling was done two times, first before homa therapy and then after homa therapy in polyhouse. It was done by using two method. One by using parafilm wax coated on glass slides and other by using settle petri plates.

i) Aero sampling using parafilm wax on glass slides

Glass slides were taken in polyhouse and then sterilized using direct heat by spirit lamp. These glass slides were then covered with a thin layer of melted parafilm wax and allowed to solidify. The glass slides covered with wax were placed at different heights *i.e.* ½, 1, 1 ½, 2, 2 ½ and 3 ft for 24 hrs in polyhouse, two sets of slides were kept at each level. After 24 hrs of exposure the slides were imprinted on PDA plates and the fungus and bacteria were allowed to grow. Number of colonies grown on the media were recorded after three days.

ii) Aero samplng using petri plates

In this method petri plates of PDA were prepared. 5 petri plates of PDA media with opened lids were placed 1 m away from wall and at 1 m height for 1 hr in polyhouse. After 1 hr the petri plate's lids were closed and incubated at 28° C $\pm$ 2 temperature for 3 days to observe the fungal and bacterial growth respectively. Observations were recorded as colony forming units in petri plates.

Effect of homa therapy on disease initiation and development

The five potato seedling having 4 to 5 leaves per plant were kept in polyhouse and inoculated with pathogen by spraying the spore suspension of *Alternaria solani* on the leaf surfaces. Similarly, five tomato seedlings of the same age having 4 to 5 leaves per plant were inoculated with *Alternaria solani* spore suspension on the leaf surfaces and other five tomato seedlings were inoculated with *Xanthomonas campestris* pv. *vesicatoria* pathogen. And these inoculated plants were used to study the effect of homa therapy.

As per the procedure of agnikunda preparation the soil was spread on the floor and on that the earthen pot half filled with soil was kept. Here the earthen pot was considered as agnikunda. In this agnikunda dried cow dung cake, cow urine and seven to eight wooden sticks of mango tree were kept. The dried wooden sticks of nine different trees *viz.* ark, palash, peepal, khadir, apamarga, audambar, shabhi, durva and kusha dipped in cow ghee were then placed above the mango wooden sticks. Ghee was added on cow dung cake and the wooden sticks, and then fire was set on. The cooked rice was added in the burning agnihotra. The routine mantras used in the homa therapy i.e Gayatri mantra (*Om Bhur Bhuvah Svaha, Tat Savitur Varenyam, Bhargo Devasya Dhimahi, Dhiyo Yo Nah Prachodayat. Svaha*) and Agni mantra (*Om Mahajwalay Vidmahe Agni Madhyay Dhimahi, Tanno Agnih Prachodayat. Svaha*) were enchanted twenty one times, at the end of each mantra, ghee and samidha was offered after the word svaha. This homa was kept till the fire extinguished itself and then the ash was spread in the pots of tomato and potato seedling which were earlier inoculated with the *Alternaria solani* and *Xanthomonas campestris* pv. *vesicatoria* pathogens. The homa was performed in the early morning and it took 1 hr for the entire procedure. Homa therapy/agnihotra was done at seven days interval and for 4 times. The potato and tomato plants inoculated with test pathogen maintained in another polyhouse in which homa was not performed were treated as a control. The plants thus exposed to the homa therapy were observed for initiation of disease. The development of the symptoms were recorded after 10 days of inoculation.

Results

Aero sampling by using parafilm wax on glass slides

It was noticed that, there were more number of colonies (ranging from 68.0 to 102.0) in the petri plates of aero sampling, which was done before homa, than the colonies (ranging from 22.5 to 27.5) observed in the aero sampling done after homa. The average per cent reduction in the number of colonies in aero sampling due to the effect of homa

environment was 70.27 per cent (Table 2). A variety of microbial colonies were observed on the petri plates, which included *Alternaria sp., Aspergillus sp., Penicillium sp., Trichoderma sp., Curvularia sp., Drecheslera sp., Pyricularia sp. Rhisopus sp., Neurospora sp.,* some bacterial species and few actinomycetes species.

Table 2: Aero sampling by using parafilm wax on glass slides

S. No	Treatments	Number of Colonies before Home			Number of Colonies after Homa			Per cent decrease in colony (%)
		RI	RII	Avg.	RI	RII	Avg.	
1.	T1: 1/2 ft height	111	93	102.0	26	29	27.5	73.04
2.	T2: 1 ft height	99	81	90.0	22	27	24.5	72.78
3.	T3: 1 1/2 ft height	84	77	80.5	24	26	25.0	68.94
4.	T4: 2 ft height	83	88	85.5	28	24	26.0	69.59
5	T5: 2 1/2 ft height	79	83	81.0	23	25	24.0	70.37
6	T6: 3 ft height	64	72	68.0	22	23	22.5	66.91

Aero samplng using petri plates

Here the average number of colonies noted on the aero sampling petri plates before homa were 121.8 and after homa were 32.2, which included a variety of microbial colonies viz., *Alternaria sp., Aspergillus sp., Penicillium sp., Trichoderma sp., Curvularia sp., Drecheslera sp., Pyricularia sp. Rhisopus sp., Neurospora sp.,* some bacterial species and few actinomycetes species. Here the per cent decrease in number of colonies on petri plate due to homa environmental effect was 73.56 per cent. Thus in both the sampling treatment the reduction in microbial colony was in the range of 70 to 73 per cent. Thus it was observed that the inoculum load present in the polyhouse was reduced by homa therapy treatment.

Effect of homa therapy on disease initiation and development

The disease development in control plants (the plants which were not exposed to homa therapy treatment) started just 3 to 4 days after inoculum spread, while there was no disease development in test plants (the plants which were exposed to homa therapy treatment) for first 2 - 3 weeks. The final recording was done 10 days after the last homa therapy. The PDI of homa treated plants of potato against *Alternaria solani* was 2.67 per cent while that of untreated control was 31.67 per cent. Also, the PDI of homa treated tomato against *Alternaria solani* and *Xanthomonas campestris* pv. *vesicatoria* were 3.67 and 2.33 per cent respectively, as compared to that of control plants 26.67 and 25.00 per cent. From this it was observed that the homa therapy was effective against the disease development. The plants were healthy, lustrous with dark green broad leaves. Thus the homa therapy treatment enhanced the plant vigour and increase in plant height over the control plant (Table 3).

Table 3: Plant height and vigour

S. No.	Test pathogens	Plant height (cm)	Plant vigour (1 - 10 scale)
1	*Potato plants tested for *Alternaria solani*	64.6	9.8
2	Potato control Plant	42.5	6.0
3	*Tomato plants tested for *Alternaria solani*	48.2	9.2
4	Toato control plant	88.6	6.0
5	*Tomato plants tested for *Xanthomonas campestris* pv. *vesicatoria*	50.6	9.6
6	Tomato control plant	37.4	5.0

*Average of five plants

Discussion

To fulfil the demand of increased agricultural production and to meet the present and future needs of growing population, the farmer's community has to use enormous amount of fertilizers and pesticides. Continuous use of these synthetic agrochemicals leads to adverse effects like resistance breakdown in pest, residual effect of pesticide which is harmful for human beings and environment, soil fertility, loss of beneficial microflora and macrofuana (earthworms) in soil and contaminated water sources due to leaching [1-4, 10]. These are some of the reasons why several communities started thinking in terms of organic farming and biological pest control [11-13]. Due to erratic environmental conditions and climate change the polyhouse cultivation is emerging as a way of agriculture cultivation [5]. We must try and rely upon natural means to undo the effects of polluted conditions in atmosphere, soil, water and on all life forms. We can find a number of references in our Vedas and the other ancient literature. How the seed is treated, when the seed is to be planted, how to nourish the crops, how and when to harvest, is all contained in the Vedas, specifically in the sub-branch known as Vruksha Ayurveda (Ayurveda for the plant kingdom) which is now presented in the modern context as naturopathy. Homa therapy is one such natural therapy which deals with the healing power of nature, since it believes that all healing powers are within the nature. It is a very old science, with homa therapy we can grow crops without using chemicals and pesticides. We can get maximum yield out of minimum agricultural inputs. We can keep the soil fertile, the water pure, and the atmosphere nutritious.

Aero sampling

Aero sampling was done with a view to study the inoculum load in the polyhouse. It was done two times, first before homa therapy and then after homa therapy. Similar kind of work was carried out where the petri dishes with blood agar medium were exposed to the atmosphere at constant temperature before and after Agnihotra and they found significant reduction in number of colonies of air borne microbial growth after the procedure of Agnihotra [9]. So far there are not many references on studies of aero sampling to report the effect of homa therapy on inoculum load present in environment before and after the therapy. This is the first report of effect of homa enviornment on the inoculum load in polyhouse. In this aero sampling experiment it was observed that homa therapy reduced the inoculum load of

environmental microflora by 70 to 73 per cent in polyhouse and thus may help to minimize the disease pathogen and disease incidence.

Effect of homa therapy on disease initiation and development

Homa therapy effectively reduced the incidence of early blight disease of potato and tomato and bacterial blight disease of tomato in polyhouse conditions. Similar kinds of results were observed by others [14-17] who found that plants treated with agnihotra exibited resistant against the disease development. Plants showed resistant to various diseases tested *viz.* powdery mildew in rose, fusarium wilt in carnation, leaf spot and *Fusarium* in gerbera, leaf spot of cabbage and late blight in potato when subjected to organic farming along with agnihotra [14]. Decrease in the incidence of rust and insect attackwas noticed due to different homa treatments in Soyabean crop [15]. Studies revealed that homa farming heals the atmosphere by lowering the incidence of black rot, black spot leaf, head borer, number of diamond black moth larvae in cabbage [16]. Decrease in incidence of powdery mildew and *Alternaria* leaf spot, fruit borer and *Spodoptera litura* larvae per plant were observed due to homa treatment in okra [17]. Soil has been polluted by various toxic compounds and homa therapy has the power to rejuvenate the soil by maintaining a healthy micro flora and fuauna [18]. Studies have also demonstrated that homa organic treatments enhanced crop productivity and quality [19-20]. Application of homa treatment, smoke and ash makes the soil rich in terms of soil micro flora and macro and micronutrient i.e. increase in organic carbon, availability of N, P and K and Cu, Zn, Mn and Fe nutrients [21]. Apart from disease and pest resistance, increase in plant vigour has been observed in the plants subjected to homa/ agnihotra [14-17, 21, 22]. An experiment was conducted, in which the plants were treated with organic farming along with agnihotra and the results obtained showed increase in plant vigour, plant height, number of flowers, flower diameter, stalk length and longer shelf life [14]. Enhancement in morphological characters of soyabean variety JS-335, like plant height, increase in number of branches, leaves, pods, nodules etc. was observed when the plants were subjected to homa organic farming [15, 21-22]. Increase in quality parameters like TSS, ascorbic acid, phenol, nitrogen, crude protein, sulphur, potassium, phosphorous and micro nutrients like Cu, Zn, Mn and Fe due to different homa treatments was noticed [16]. Significant increase in quality parameters were reported in okra like ascorbic acid, phenols, nitrogen, phosphorous, micronutrients Cu, Zn, Mn and Fe [17].

Conclusions

Homa therapy effectively reduced the incidence of early blight disease of potato and tomato and bacterial blight disease of tomato in controlled environmental conditions of polyhouse. Home therapy was also found effective to reduce the inoculum load of environmental pathogenic microflora. Homa therapy has potential and can be used as an alternate solution for chemical pesticides in protected cultivation and integrated pest management as these are eco-friendly, has no side effect on environment, increase the disease resistance and enhance the plant growth.

Abbreviations

Qty.: Quantity; PDA: Potato Dextrose Agar; NAS: Nutrient Agar Sucrose; PDI: Plant Disease Intensity

Acknowledgement

The authors are grateful to the Department of Plant Pathology and Agricultural Microbiology, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India for the facilities provided for conducting the study. The first author would like to thank Dr. Mohindersingh Kadian, International Potato Center (CIP), SWCA, New Delhi for permitting to do in-service PhD.

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