

An Agro-Homoeopathic Evaluation Of Antagonistic Activity Of *Secale Cornutum* Against Phytopathogenic Fungus '*Claviceps Purpurea*' On Wheat Crop

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DOI: 10.47750/pnr.2023.14.03.11

Abstract

India is an agriculture-based country, agro-homoeopathy is one of the newest approaches in homoeopathic and agricultural research. Agriculture is a significant source of income in India, and it bears a significant economic burden in order to provide a livelihood. The ergot is one of the common diseases seen in cereal crop caused by fungus *Claviceps purpurea*. Soil was prepared with 2.5kg Loam soil + 500g Coco peat + 500g Cow dunk + 500g NPK + 500g Urea and Potash + 500g DAP and distributed across the seven plastic trays, each measuring 30cm × 15cm × 18cm (L × W × D). Thirty wheat seeds of LOK-1 variety were planted in three rows, four centimetres apart from one another, with a total of ten seeds in each row. After inoculation of the fungal pathogen *Claviceps purpurea* on the kernel of wheat crop, the treatment was started with homoeopathic medicine *Secale cornutum* with its various potencies (Q, 30C, 200C and 1M). The control group were treated with Crapton fungicide. The ethyl alcohol was used as negative control in this study. The treatment was given twice a day for 14 days. After 14 days of treatment, there were no any antifungal activity observed on wheat crop trays treated with *Secale cornutum* (Q, 30C, 200C, 1M), and ethyl alcohol. Accordingly, *Secale cornutum*, does not revealed antifungal activity on pathogenesis of *Claviceps purpurea* consequently. Further studies are needed to identify homoeopathic medicines that have antifungal effects on *Claviceps purpurea* in wheat crop pathology.

Keywords: *Claviceps purpurea*, *Secale cornutum*, Agro-homoeopathy, Wheat; crop; Homeopathy.

1. INTRODUCTION

Dutch homoeopath and pioneer of agro-homoeopathy, VD Kaviraj, popularized it with his magnum opus 'Homoeopathy for Farm and Garden'. Following his outstanding writing on agro-homoeopathy, the topic was the subject of scientific research. Agro-homoeopathy is a chemical-less and non-toxic approach to crop cultivation. Agro-homoeopathy can strengthen plants in all possible ways to make them resistant to diseases and pests. Agro-homoeopathy is the specialized field of homoeopathic practice that deals with the treatment of plants. From seed germination to crop production, homoeopathic medicines can be applied in agriculture for a variety of purposes.

India is an agriculture-based country, agro homoeopathy is one of the newest approaches in homoeopathic and agriculture research [1]. Agriculture is a significant source of income in India, and it bears a significant economic burden in order to provide a livelihood [2]. Infection by microorganisms such as fungi, bacteria, or other lower-class organisms is a major issue for obtaining a high-quality crop, and it will have an impact on both the quality and quantity of production [3]. The world's population will increase from the present level of about 7.25 billion to 15 billion by the year 2050. Providing food for such many people will be a formidable task. So, there would always be a compulsion to increase agricultural production although cultivable land would be decreasing due to its requirement for non-agricultural uses such as expanding

urbanization, and rail and road network, etc. According to recent estimates, agricultural production would need to be increased by 70% (100% in developing countries) by 2050 to cope up with the increasing world population and the scenario for India is also the same. [4]

Since its taming about 10,000 years ago, wheat has played an important role in global nutrition security. Wheat currently supplies one-fifth of the world's population's dietary calories and protein. [5] The primary crops cultivated and consumed in India are wheat, rye, rice, jowar, and maize, which are infected by many microorganisms and *Claviceps purpurea* is one of them [6]. It infects plant seeds, and the eating of infected seeds by humans or other higher animals causes the disease ergotism [7]. However, there is no specific fungicide or chemical agent available to combat *Claviceps purpurea* infection. Use of homoeopathic medicine to control and prevent various disease of plant caused by microorganism is not only be cost-effective but it also reduces the chances of chemical toxification produce from overuse of agro-chemicals (i.e., fertilizer, fungicide, insecticide) and promote the concept of organic farming as most of homoeopathic medicine are prepared from natural sources. *Secale cornutum* is a homoeopathic medicine prepared from *Claviceps purpurea* fungus infected rye plants [8]. Homoeopathy is a science originated on the principle of *Similia Similibus Curentur* (Latin) [9] and by application of this principal authors have done the present research to determine an agro-homoeopathic evaluation of antagonistic activity of *Secale cornutum* (SC) against phytopathogenic fungus *Claviceps purpurea* on wheat crop.

2. MATERIAL

2.1. Collection of the fungus culture

Claviceps purpurea [NCIM no. 1046 CMI 44613 (1972)] was collected from National Collection of Industrial Microorganism (NCIM), of CSIR-National Chemical Laboratory (NCL) Pune-411008, Maharashtra, India.

2.2. Procuring of the Homoeopathic medicine

The Homoeopathic medicinal product *Secale cornutum* in various potencies (Q, 30CH, 200CH, 1M) were procured from a GMP certified homoeopathic manufacturing unit, vide; Dr. Willmar Schwabe India Pvt. Ltd., Noida-201304, Uttar Pradesh, India.

2.3. Active control

Active Chemical Control Crapton Fungicide (N-Trichloromethylthio-cyclohexene-1, 2- dicarboximide fungicide) was procured from Naik Krishi Udyog & Co, Swargate, Pune- 411002, Maharashtra, India.

2.4. Procuring of wheat crop seed

Wheat Seed- LOK-1 was procured from Sri Sadhguru Seeds, Market yard, Pune, Maharashtra, India.

2.5. Procuring of soil and fertilizer

Loam Soil and Fertilizer (coco peat, cow dunk NPK, urea, potash, and DAP) was procured from Pawan Nursery. Pune-411046, Maharashtra, India.

3. METHODS

3.1. Preparation of soil

Soil was prepared with 2.5kg Loam soil + 500g Coco peat + 500g Cow dunk + 500g NPK + 500g Urea and Potash + 500g DAP.

3.2. Seed Bed Preparation

The whole soil mixture was evenly distributed across the seven plastic trays, each measuring 30cm × 15cm × 18cm (L × W × D).

3.3. Seed Plantation

Thirty wheat seeds of LOK-1 variety, which were visually high quality, were planted in three rows, four centimetres apart from one another, with a total of ten seeds in each row. The seeds were then thoroughly covered by soil to a depth of one centimetre.

3.4. Inoculation of Phytopathogen *Claviceps purpurea*

50 ml of 1OD (Optimum Density) was prepared from the mother culture and set the optimum density in one under 600nm *uv*. Then the preparation was mixed with 500 ml of distilled water and sprayed to all seven trays over the well grown wheat kernel.

3.5. Sets of wheat crop

For the purpose to evaluate the phytopathogenic antifungal activity of *Secale cornutum* (SC) against the *Claviceps purpurea* on wheat crop, the wheat crops were planted into seven trays. Trays were labelled as A, B, C, D, E, F, and G, each of which included 30 wheat crops. SC Q was applied to tray A, SC 30CH to tray B, SC 200CH to tray C, SC 1M to tray D, Crapton (fungicide) / N-Trichloromethylthio-cyclohexene-1, 2-dicarboximide fungicide to tray E, Ethyl alcohol to tray F, and no any treatment was applied to tray G.

3.6 Preparation of dose and treatment

The Homoeopathic medicinal product SC 10 drops of each potency i.e., Q, 30CH, 200CH, 1M was mixed with 500 ml of distilled water. For Crampton fungicide as indicated on the package, 5 ml was mixed with 1000 ml of distilled water. Ethyl alcohol was applied at a concentration of 50% (w/w). Treatment was given twice a day for 14 days.

4. RESULT

4.1 Agro-homoeopathic evaluation

After inoculation of the fungal pathogen *Claviceps purpurea* on the kernel of wheat crop, the very first sign of infection was seen after fifteen days of inoculation as honeydew glume appears on the edge of the kernel. SC - Q, 30CH, 200CH, and 1M, Crampton (fungicide), and Ethyl alcohol were applied in their corresponding trays to begin the treatment. After receiving the dose twice daily for 14 days, a qualitative and quantitative evaluation was conducted. The following observations were observed after 14 days:



Fig. 1 & 2: Kernel of wheat crop with fungus, before treatment.

4.1.1 Qualitative evaluation: (Visual observation of ergot on wheat crop)

Table 1: Qualitative evaluation of wheat crop before and after treatment.

Sr. No.	Tray	Drug	Observation before treatment	Observation after treatment	Remark of observation
1	Tray A	<i>Secale cornutum Q</i>	Honeydew appears	Ergot formed	No antifungal activity
2	Tray B	<i>Secale cornutum 30CH</i>	Honeydew appears	Ergot formed	No antifungal activity
3	Tray C	<i>Secale cornutum 200CH</i>	Honeydew appears	Ergot formed	No antifungal activity
4	Tray D	<i>Secale cornutum 1M</i>	Honeydew appears	Ergot formed	No antifungal activity
5	Tray E	Crapton	Honeydew appears	No ergot / honeydew seen	Antifungal activity seen
6	Tray F	Ethyl alcohol	Honeydew appears	Ergot formed	No antifungal activity
7	Tray G	No drug / chemical	Honeydew appears	Ergot formed	No antifungal activity



Fig. 3 & 4: Kernel of wheat crop, after treatment (ergot formed).

4.1.2 Quantitative evaluation

Sr. No.	Tray	Drug	Percentage of infection before treatment	Percentage of infection after treatment
1	Tray A	<i>Secale cornutum Q</i>	23.4% / tray	29.7% / tray
2	Tray B	<i>Secale cornutum 30CH</i>	18.6% / tray	33.0% / tray
3	Tray C	<i>Secale cornutum 200CH</i>	18.6% / tray	33.3% / tray
4	Tray D	<i>Secale cornutum 1M</i>	22.8% / tray	31.2% / tray
5	Tray E	Crapton	22.5% / tray	11.7% / tray
6	Tray F	Ethyl alcohol	18.0% / tray	33.3% / tray
7	Tray G	No drug/ chemical	19.2% / tray	36.0% / tray

Table 2: Quantitative evaluations of percentage of infection before and after treatment.

4.1.3 Statistical analysis

All the data was recorded and mean with the standard deviation (SD) was calculated accordingly. Further one-way analysis of variance (ANOVA) followed by multiple comparisons test was applied to compare between the control and target groups. The impression of standard deviation with mean value was greater (0.25) than the standard value (0.05). So, authors accepted the null hypothesis that *Secale cornutum* Q, 30CH, 200CH and 1M not shown antifungal activity on *Claviceps purpure* on wheat crop.

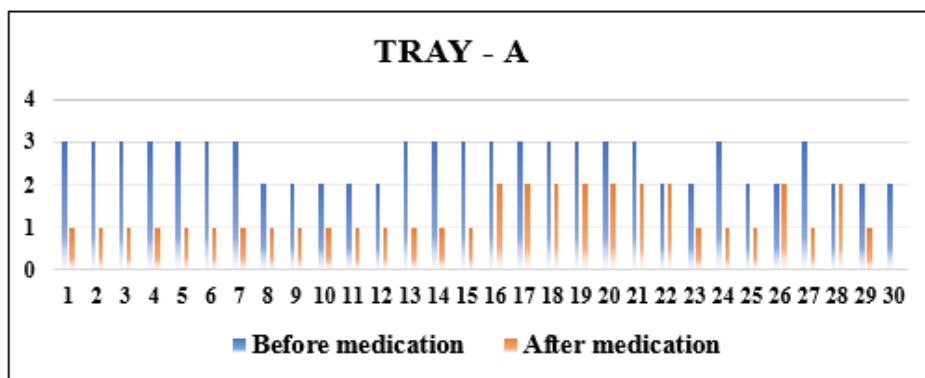


Fig. 5: Data comparison chart of *Secale cornutum* Q with control groups: before and after medication.

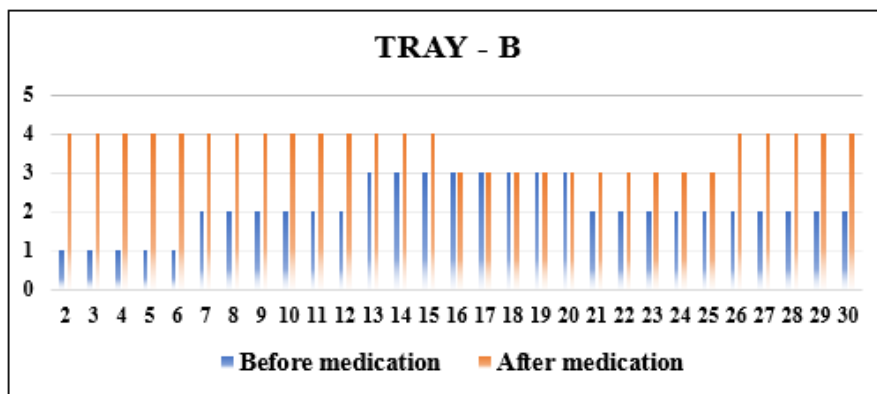


Fig. 6: Data comparison chart of *Secale cornutum* 30CH with control groups: before and after medication.

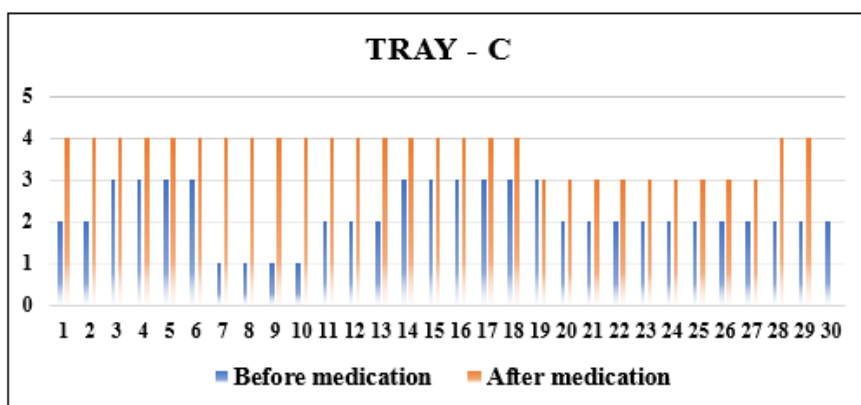


Fig. 7: Data comparison chart of *Secale cornutum* 200CH with control groups: before and after medication.

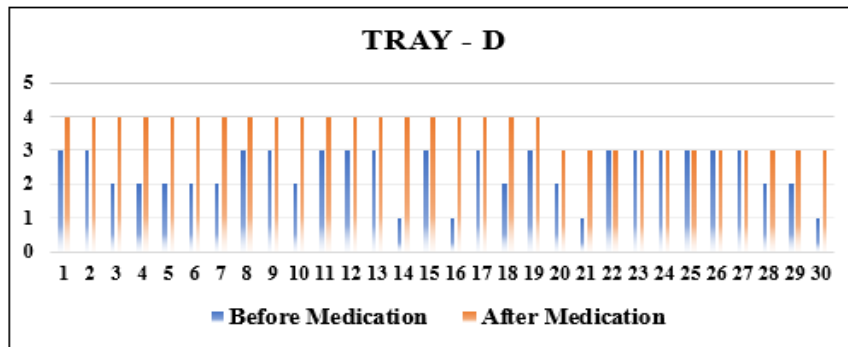


Fig. 8: Data comparison chart of *Secale cornutum IM* with control groups: before and after medication.

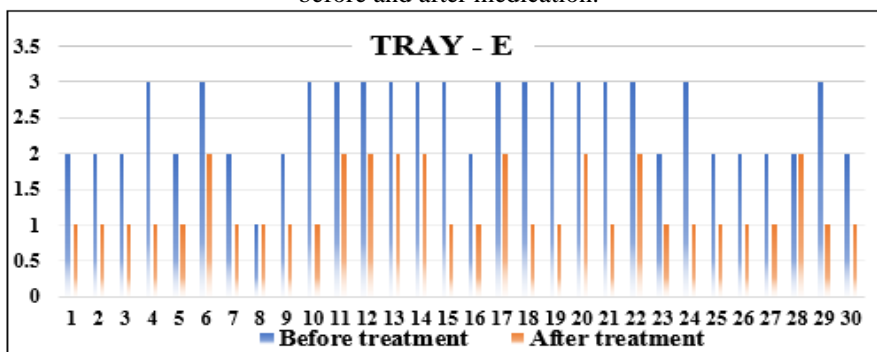


Fig. 9: Data comparison chart of Crapton with control groups: before and after medication.

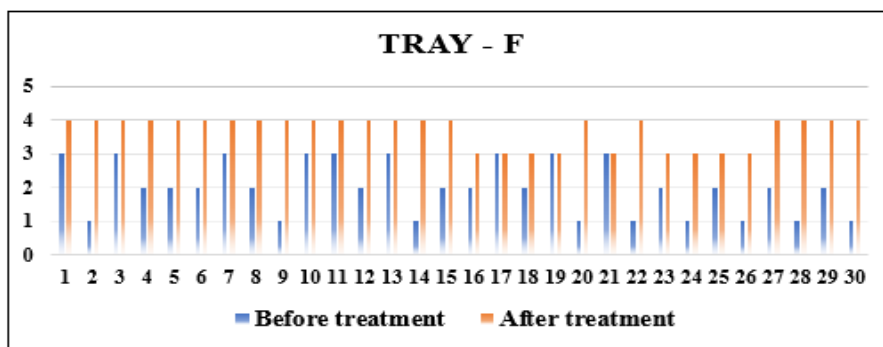


Fig. 10: Data comparison chart of Ethyl alcohol with control groups: before and after medication.

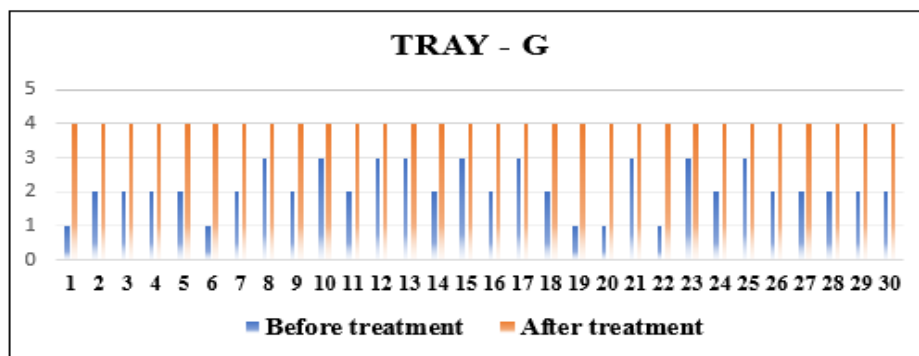


Fig. 11: Data comparison chart of tray having no drug/chemical with control groups: before and after medication.

Sr. No.	Tray	Drug	SD before treatment	SD after treatment
1	Tray A	<i>Secale cornutum Q</i>	78	99
2	Tray B	<i>Secale cornutum 30CH</i>	62	110
3	Tray C	<i>Secale cornutum 200CH</i>	62	111
4	Tray D	<i>Secale cornutum 1M</i>	76	104
5	Tray E	Crapton	75	39
6	Tray F	Ethyl alcohol	60	111
7	Tray G	No drug/ chemical	64	120

Table 3: Standard Deviation before and after the result.

Sr. No.	Tray	Drug	Mean value before treatment	Mean value after treatment
1	Tray A	<i>Secale cornutum Q</i>	2.6	3.3
2	Tray B	<i>Secale cornutum 30CH</i>	2.06	3.6
3	Tray C	<i>Secale cornutum 200CH</i>	2.06	3.7
4	Tray D	<i>Secale cornutum 1M</i>	2.5	3.4
5	Tray E	Crapton	2.5	1.3
6	Tray F	Ethyl alcohol	2.0	3.7
7	Tray G	No drug/ chemical	2.1	4.0

Table 4: Mean value of result before and after treatment.

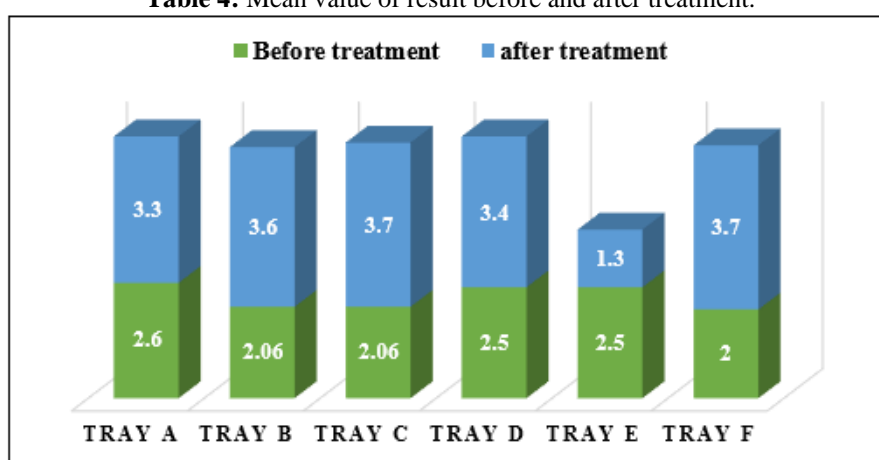


Fig. 12: Columnar presentation of rate of infection before and after medication.

5. DISCUSSION

Wheat is consumed and cultivated as a second succession crop in India and Asiatic countries and as a primary crop in Europe and America. [10-12] Among the infection of wheat ergot is the common one which is caused by fungus *Claviceps purpure*. [13, 14] There is no specific fungicide to fight this pathogen. *Secale cornutum*, a homoeopathic plant nosode prepared from *Claviceps purpure* infected rye, but there are no specific studies on the efficacy of SC on pathogen infection of wheat crops. [8, 15] The controlled interventional study was performed with aim to establish an *in vitro* and on field agro-homoeopathic evaluation of antagonistic activity of SC against phytopathogenic fungus *Claviceps purpurea* on wheat crop. The study showed that the application of Crapton (fungicide) improved wheat crop in Tray - E, in the intervening time observed a drop in mean value from 2.5 to 1.3 per Tray. However, it has been noted that the mean value in the wheat crop trays treated with different SC tincture and potencies, such as Q, 30CH, 200CH, and 1M, increased to 3.3, 3.6, 3.7, and 3.4, respectively. The mean values observed for alcohol-treated tray and tray without any treatment were, respectively, 3.7 and 4.0. In addition, overall antagonistic activity was earlier in the control group than the experimental groups. Perception of standard deviation about the mean value is greater (0.25) than the standard value (0.05). Therefore, the null hypothesis has been accepted that *Secale cornutum* at different potencies (Q, 30CH, 200CH, and 1M) does not have antifungal activity on wheat crop.

6. CONCLUSION

Claviceps purpure infection in wheat crops not only reduces crop productivity and quality, but also leads to ergotism in higher animals that consume the infected crops. Inhibition and /or control of the infection using of homoeopathic medicine was the prime objective as we compiled data on antifungal activity of various potency Q, 30CH, 200CH, and 1M of *Secale cornutum* on wheat crop of LOK-1 variety. Further studies are needed to identify homoeopathic medicines having antifungal effect on *Claviceps purpure* on wheat crop pathology.

Implication

Homoeopathy can offer a reasonable strategy to combat contagious contaminations in crops. This road should be explored with more ponders on bigger capacity and tests for conclusive confirmation that will offer assistance progress on homoeopathic science and offer arrangements to concerns related to developing crops in tainted parts.

Conflict Of Interest

The authors declare no conflict of interest in the entire study.

ACKNOWLEDGMENT

The work was completed as part of the STSH project under the auspices of the Central Council for Research in Homoeopathy, New Delhi, under Ministry of AYUSH, Government of India for which the authors are grateful. We would like to convey our sincere appreciation and debt of gratitude to Prof. (Dr.) Avinash R. Mhetre, I/C Principal at the BV (DTU)-HMC, Pune. Further we are thankful to Prof. (Dr.) Anita S. Patil, Dean (Faculty of Homoeopathy) and PG-Coordinator at the BV (DTU)-HMC, Pune for individual invaluable encouragement and support in study.

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