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Pranamya Jain
IV BHMS, Alva's Homoeopathic Medical College, Mijar, Moodbidri, Karnataka, India

Maria Dhivya
Assistant Professor and Research Coordinator, Department of Homoeopathic Pharmacy, Alva's Homoeopathic Medical College, Mijar, Moodbidri, Karnataka, India

Praveen Raj P
HOD and Professor, Department of Organon Of Medicine and Homoeopathic Philosophy, Alva's Homoeopathic Medical College, Mijar, Moodbidri, Karnataka, India

Corresponding Author:
Maria Dhivya
Assistant Professor and Research Coordinator, Department of Homoeopathic Pharmacy, Alva's Homoeopathic Medical College, Mijar, Moodbidri, Karnataka, India

An evidence based study on germination, growth and yield of *Cucumis Sativus* using homoeopathic biochemic medicines calcarea phosphoricum 3X, calcarea sulphurica 3X and Silicea 3X

Pranamya Jain, Maria Dhivya and Praveen Raj P

Abstract
Presently there is an increase in the use of chemicals for cultivation of plants. This has affected the general health of the consumers. The aim of this current study is to assess the germination, growth and yield of *Cucumis sativus* using homoeopathic Biochemic medicines Calcarea phosphoricum 3X, Calcarea sulphurica 3X and Silicea 3X.
Total of 40 samples were used, dividing them into 4 groups of 10 each randomly. The intervention Placebo, Calcarea phosphoricum 3X, Calcarea sulphurica 3X and Silicea 3X were administered to the corresponding groups. The results were recorded, tabulated and statistically analyzed.
The study has shown statistically significant difference among 4 groups. Overall study shows that Calcarea phosphoricum 3X has shown significant effect on germination, growth and yield of *Cucumis sativus*.

Keywords: Calcarea phosphoricum 3X, Calcarea sulphurica 3X, *Cucumis sativus*, placebo and silicea 3X

1. Introduction
There is an increase in use of chemicals for the cultivation of plants [1] which has affected the general health of the consumers. Extensive use of synthetic nitrogen fertilizers [2] in agriculture causes environmental hazards [3, 4]. Usage of Homoeopathy in agriculture is an emerging field of research with beneficial outcomes [5]. The homoeopathic medicines can be used not only as fertilizers but also as an insecticidal agent [6, 7]. Sunflower and mug green seeds showed 100% germination with *Arnica montana* and *Thuja occidentalis* [8]. Silica supplementation has been reported to promote nitrogen fixation [9]. Silicea terra aids in the germination of seeds, stimulates flower growth [10]. These homoeopathic medicines effects growth and development of plants [11]. *Cucumis sativus* is been extensively used all over the world. Approximately 50-70 days are required to grow *Cucumis sativus* [12]. It is proved that Homoeopathic combinations are beneficial in the germination of *Cucumis sativus* [13]. The main components required in the soil for the growth of *Cucumis sativus* are Nitrogen, Calcium and Phosphorous [14]. So, the biochemic homoeopathic medicines Calcarea phosphoricum 3X, Calcarea sulphurica 3X and Silicea 3X is been selected to assess the effect of medicines on germination, growth and yield of *Cucumis sativus* [15].

2. Materials and Methods
Cucumis sativus seeds were procured from the authenticated reliable dealers with batch number EM/19/31 of ECL Agrotech Ltd. Biochemic homoeopathic medicines Calcarea phosphoricum 3X, Calcarea sulphurica 3X and Silicea 3X were procured from Sharda Boiron Laboratories Ltd. With batch number HT181777, HT161337, HT161238 respectively. Seeds were sown in 4 groups, group A, group B, group C and group D which were administered with unmedicated tablets (control), Calcarea phosphoricum 3X, Calcarea sulphurica 3X and Silicea 3X respectively. Each group had 10 plants. The tablets were administered through irrigation method. Daily care like sunlight, water, air was made available equally to all the groups. No fertilizers were used. Germination was determined by the number of seeds germinated. After 25 days growth was determined by measuring length of plant. Yield was determined by amount of cucumber yielded. Results were statistically analysed by one-way ANOVA and post-hoc Tukey HSD test.

3. Result and Discussions

3.1: Observation

Table 1: Germination

Control	Calcarea phosphoricum 3X	Calcarea sulphurica 3X	Silicea 3X
7/10	10/10	10/10	9/10

Table 2: Growth and Yield

Plants	Control		Calcarea phosphoricum 3x		Calcarea sulphurica 3x		Silicea 3x	
	Length [cm]	Yield [gm]	Length [cm]	Yield [gm]	Length [cm]	Yield [gm]	Length [cm]	Yield [gm]
I	300	754	304	1050	405	894	309	1010
II	152	724	170	2158	320	1432	190	998
III	302	800	350	2326	256	1548	268	1116
IV	120	520	334	3430	309	1534	294	882
V	149	758	458	1820	255	1512	305	972
VI	319	1108	379	1936	401	1236	233	1282
VII	284	1300	502	2334	390	1584	250	748
VIII			668	1940	205	1236	350	1676
IX			358	1136	311	782	316	706
X			480	752	150	820		

3.2 Statistical Analysis

One-way ANOVA test was conducted which showed a significant difference among the groups (Mean=280.625, SD=141.6825, f ratio value is=6.64065, p value=0.0011). Further Post hoc Tukey HSD study suggested a significant difference in the germination, growth and yield between the control group and groups treated which homoeopathic medicines.

Table 3: Growth

Treatments pair	Bonferroni and Holm TT-statistic	Bonferroni p-value	Bonferroni inferfence	Holm p-value	Holm inferfence
A vs B	4.3580	0.0003142	** $p<0.01$	0.0003142	** p<0.01
A vs C	2.4814	0.0536794	Insignificant	0.0357863	* p<0.05
A vs D	1.5459	0.3926273	Insignificant	0.1308758	Insignificant

Table 4: Yield

Treatments Pair	Bonferroni and Holm TT-statistic	Bonferroni p-value	Bonferroni inferfence	Holm p-value	Holm Inferfence
A vs B	5.4976	9.7885e-06	** $p<0.01$	9.788506	** $p<0.01$
A vs C	2.8148	0.0235959	* $p<0.05$	0.0157306	* $p<0.05$
A vs D	1.4580	0.4605092	insignificant	0.1535031	Insignificant

In regards to germination, *Calcarea phosphoricum* 3X and *Calcarea sulphurica* 3X has shown 100% germination.
Considering the growth and yield, Calcarea phosphoricum 3X has shown a very significant result in comparison to all other groups whereas Calcarea sulphurica 3X has shown the significant outcome than control group.

4. Conclusion

Calcarea phosphoricum 3X is effective in the germination, growth and yield of *Cucumis sativus.* It is been proved that in case of *Trigonella foenum,* Silicea can be used to initiate germination and Calcarea phosphoricum can be used in the later part of germination [16]. From this it can be inferred that medicine that effect different plants are different and Calcarea phosphoricum 3X is found to be effective in *Cucumis sativus* for germination, growth and yield. Based on this study, further studies can be made on large scale farming.

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