Original Research Article

AN EXPERIMENTAL STUDY TO EVALUATE THE ACTION OFZINCUMPHOSPHORICUMOFVARIOUSPOTENCIESAGAINSTBORONINDUCEDTOXICITYINSOLANUMLYCOPERSICUMTHROUGHHYDROPHONICSYSTEM.

ABSTRACT: Agro homeopathy is a boon nowadays, whereas homeopathy is acting like fertilizer, insecticide and adds more nutritional value. It is helping the public with organic veggies. This study is regarding boron toxicity in solanumLycopersicum, where with hydroponic system boron toxicity is induced and treated with ZincumPhosphoricum of different potencies. After the study, a few strengths of ZincumPhosphoricum showed a drastic influence on the total yield of the plant. So, the result showed maximum significance between and within the samples.

Keywords: Agrohomoeopathy, Boron toxicity, Hydrophonic and ZincumPhosphoricum

INTRODUCTIONAgro-Homoeopathy is a specialized area in the field of Homoeopathy that mainly deals with the treatment of gardens and agricultural practices [1]. The use of Homoeopathic remedies for plants started with the pioneering works of Kolisko on wheat germination, [2] Agro-homoeopathy is an efficient way of eradicating abiotic stress in crops due to various factors. It is cost-effective and an alternative to chemical fertilizers thus helping to increase the yield and farmer's income [3]. Homoeopathy strengthens the energy and vitality of plants. Even prevents the damage caused by abiotic stress and will promote a dynamic balance within the plant and of plants with soil, water, and environment [4].

Borontoxicity

Boron is a plant micronutrient, i.e., it is necessary for normal growth and development in amounts as small as 1 μ/g-1 mg/g. In India, more specifically in Andhra Pradesh, concentrations of Boron in soil and irrigation waters are harmful to boron-sensitive plants [5]. When Boron levels in soil is between 10 to 20 mg/kg -1 B level produce boron toxicity in plants [6]. Other plants which are affected by boron toxicity are maize, carrot, and Alfalfa [7].Boron (B) toxicity, an important agricultural problem that limits crop productivity in different regions of the world, can occur in B-rich soils or in soils exposed to B-rich irrigation waters, fertilizers, sewage sludge, or fly ash [8]. Boron toxicity can affect tomato (SolanumLycopersicum), which is one of the most widely grown vegetables worldwide, with more than 3 million hectares under cultivation. The typical symptoms shown by plants exposed to an excess of B are reduced vigor, retarded development, leaf burn (chlorotic and necrotic patches in older leaves), and decreased number, size, and weight of fruits [9].

SOLANUMLYCOPERSICUM

The SolanumLycopersicum is an important crop plant cultivated all over the world, and its production and consumption continue to increase. This popular vegetable is known as a major source of important nutrients including lycopene, B-carotene, flavonoids, and vitamin C as well as hydroxycinnamic acid derivatives. Since the discovery of lycopene that has anti-oxidative and anti-cancer properties, interest in tomatoes has grown rapidly [10].

ZincumPhosphoricum

The ZincumPhosphoricum is one of the remedies in Homoeopathic MateriaMedica. It is considered to be the major remedy for sensitivity and marked weakness [12]. Homeopathically ZincumPhosphoricum is used in humans for conditions like chorea, spinal headache, weak memory, bleeding gums, constipation, palpitations of the heart, and anxiety. Symptoms of ZincumPhosphoricum in relation to Agro Homoeopathy are weak vitality, sensitivity to the external environment, and enriched nutritional status. Alleviatestressespeciallydifferentabioticstress.

Hydroponic

The term Hydroponics was derived from the Greek word hydro' which means water and ponos' which means labor. It is a method of growing plants using mineral nutrient solutions, without soil [13]. The science of hydroponics began with experiments to determine the elementary composition of plants. These experiments have been dated as early as 1600 A.D. The hanging gardens of Babylon and the floating gardens of the Mexican Aztecs are both examples of early hydroponic gardening. Historians have found Egyptian hieroglyphics depicting the cultivation of plants in water that can be dated as far back as several thousand years, Before Christ [14]. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, or mineral wool. Hydroponics is the technique of growing plants in soil-less conditions with their roots immersed in nutrient solution [15]. In India, Hydroponics was introduced in the year 1946 by an English scientist, W. J. ShaltoDuglas and he established a laboratory in the Kalimpong area, West Bengal. He has also written a book on Hydroponics, named Hydroponics the Bengal System.

Hydroponicbenefits

- Elimination of soil-borne pests, fungi, and diseases
- Elimination of troublesome weeds and stray seedlings which eliminates the need for herbicides and reduces labor
- Reduction of health risks and labor costs associated with pest management and soil care.
- Reduced turnaround time between planting as no soil preparation is and we can control nutrient values in solution.

IMPORTANCEOFSTUDY

Through this study we can able to solve the following issues which are threatening the mankind like the effects of chemical fertilizers on soil. The prolonged use of chemical fertilizers causes the pollution of groundwater sources. Chemical fertilizers that are highly soluble get absorbed by the ground more rapidly than they are absorbed by plants. Plants only absorb a given level of nutrition and the rest of them remain in the soil. That is not only hazardous to groundwater sources but also to the health of the soil where these chemicals react with clay to create hard layers of soil known as hardpan.

STUDY NEED

The study conducted on Boron Content in Shallow Ground Water of Andhra Pradesh and the Telangana States found that high boron concentrations are recorded [16] and plants which are growing in these areas mainly boron-sensitive plants like tomatoes are more prone to boron toxicity and fruits produced by this plants may cause boron toxicity for humans According to WHO (World Health Organization), it is expected that the amount of boron taken is 0.44 µg/day via air, 0.2-0.6 mg/ day via drinking water and 1.2 mg/day via diet[17]. Clinical symptoms Observed from boron toxicity have been reported within the dose range of 100 to 55,500 mg depending on age/body weight. Inter-individual variability appears to be high. Clinical effects include irritability, seizures, and gastrointestinal disturbances [18]. Studies were done to observe that boron can have an impact on brain functions and the cognitive performance of humans [19]. The study conducted on the alleviation of Boron toxicity in tomato plants with zinc and phosphorus proved that both zinc and phosphorus are effective in alleviating boron toxic symptoms [20]. The ZincumPhosphoricum (Zn_3P_2) is one of the remedies in Homoeopathic MateriaMedica. It is considered to be the major remedy for sensitivity and marked weakness [12] thus nanoparticles in ZincumPhosphoricum containing zinc and phosphorus may alleviate the toxic effects of boron in irrigation water and soil.

AIMSANDOBJECTIVES

- To assess the efficacy of the medicine ZincumPhosphoricum 6c, 12c, 30c, in Boron induced toxicity in solanumLycopersicum (tomato plant)
- To establish the improvement in plant parameters and reduce the toxic effects on the plant

- To find out the potency this has significant action to alleviate toxic effects of boron
- To evaluate the yielding and resistance capacity of SolanumLycopersicum to boron toxicity

Scope / accompanying merits of the research

- To prove the action of ZINCUM PHOSPHORICUM on boron toxicity in plants to enhance yield as well as to contribute to food safety by replacing chemical fertilizer and Agrohomoeopathy

METHODOLOGY

Study setting - The study was conducted in MNR Homoeopathic medical college premises withgood sunlightand ventilation.

Sample size - Total sample size is 25 plants. Each group contains 5 plants toanalyze theparameters.

Comment [Y1]: Sample size is not quite enough

Selectioncriteria

- Inclusioncriteria: Healthyplantswaschosenwhiletransplantinginto hydroponics
- Exclusioncriteria: Unhealthy,diseasedandstuntedplants.

Medicine used

- ZincumPhosphoricum 6CH, 12CH, 30CH Procured from ShardaBoiron Laboratories Ltd (SBL). It is a Homoeopathic pharmaceutical company's authentic homoeopathic pharmaceutical outlet with Batch Number SH035228, SH035233, and SH035268 respectively.

Image 1:ZincumPhosphoricum 6CH, 12CH, 30CH

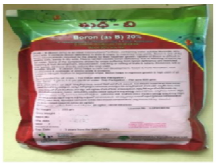


Image 2:Di sodium octaborate tetra

Image 3:Hydroponics water soluble nutrient solution

Method usedformedicineapplication:

Direct administration of medicine was applied to the Hydroponic system. The Non-hybrid SolanumLycopersicum seeds are collected from an authorized agricultural institution i.e. Professor JayashankarTelangana State Agricultural University Rajendranagar, Hyderabad Telangana, India -500 030.

Image 4: Tomato seeds

MATERIALSANDNEED

COCONUT COIR: Otherwise known by trade names like ultra-peat, cocopeat, and coco Tek. Coco coir represents a major step forward in organic soil-free growing mediums. It combines the water retention of perlite; however, it is a completely organic medium made from shredded coconut husks.

Image 5: Coco peat

LECA: stands for lightweight expanded clay aggregate are made of expanded clay pellets that hold water by virtue of their porosity and surface area. These mediums are pH neutral and reusable, making them ideal for Hydroponics systems.

Image 6: clay aggregate

NET POTS: allows water to flow freely past the roots of the plants they contain, facilitating the

uptake of nutrients. As the plants grow, the roots extend out easily into the water
TUBS: High-density polyethylene plastic tubs are used for making hydroponic setups that are suitable for hydroponic operations.

Image 7:High-density polyethylene plastic tubs

AIR PUMP: submersible water pump was used for oxygenate hydroponics systemDEEPWATER CULTURE: (DWC)
A method of plant production by means of suspending the plant roots in a solution of nutrientrich, oxygenated water, this method uses a rectangular tank less than one foot deep filled with anutrient-richsolution with plants floating inStyrofoamboards on top[28]

OTHERCONDITIONSREQUIRED

TEMPERATURE:
Tomatoes need 3 to 4 months of warm, clear, fairly dry weather to produce best. Tomatoes needconsistentnight temperatures between n 65°Fand85°Fto set fruit[29]

SUNLIGHT:
Tomatoesrequireaminimumof 8hours ofcontinuoussunlight eachday.[30]

HYDROPHONICSETUP:
Continuous Equal amount of water changed once in a week for each group in the Deep-waterculture of hydroponics. Air pump is used for all groups for from the day of transplantation toharvest.

PH:
Theideal pHmaintainedis 6.0to 6.5.

TDS:
Totaldissolvedsolvents of hydroponicssolutionaremaintainedinbetween1500to 2000TDS.

METHODS:
FiveseparatetubsHydroponicssystemswillbecreatedwhereeachrepresentsagroupandeachgroupcontains five plants.
GroupA: -Plain without anyaddition ofextraboron
Group B: - Induced Boron toxicity (10 to 20 ppm) through irrigation in Hydroponics method andadditionof Placebo in liquid from[16].
Group C: - Induced Boron toxicity (10 to 20 ppm) through irrigation in Hydroponics method andadditionof Zincum phosphoricum-6CH
Group D: - Induced Boron toxicity (10 to 20 ppm) through irrigation in Hydroponics method andadditionof ZincumPhosphoricum-12CH
GroupE: -InducedBoron toxicity(10to20ppm)throughirrigationinHydroponicsmethodandadditionof Zincum phosphoricum-30CH
Sunlightwaterandnutrients willbeequallysupplied forallthegroups.

- **PROCEDURE**
- Procured seeds are sowed in a seed tray on 07/03/2022, 50 seeds are sowed and on day 5th (12/03/2022) the germination started in 36 seeds. On day 14th i.e., 21/03/2022 the height of the plant is 6cm and the number of leaves is 4-5 for each plant.
- Transplantation of healthy plants is done on the 17th day (24/03/2022) to hydroponics tubs into 5 groups A, B, C, D, and E.

- All the requirements like water and sunlight were provided equally to all groups
- All the essential nutrients for the plants in hydroponics are supplemented once a week ie 1 ml of stock A and 1 ml of stock B in the early stages of plants and in the fruiting stage 2 ml of each stock solution for one liter of water GREEN LOOP HYDROPHONIC NUTRIENTS ARE USED and this continued till the harvest time.
- The boron is induced i.e Di sodium octaboratetetrahydrate Boron 20% w/w min. 15 mg for one liter of water till the flowering stages of plants once in 3 weeks induced to all the groups except group A (control for boron toxicity)
- Then ZincumPhosphoricum of various potencies i.e., 6ch 12ch 30 CH according to groups is administrated i.e. 10 drops in 10 liters of water into the hydroponics tubs once in three days. All the groups except group B. (control for zincumphosphoricum)
- No other fertilizers are used in this process
- The TDS (total dissolved solvents) temperature and pH are monitored regularly.
- Plants after vegetative growth started flowering on 35 - 39th days i.e. (11/04/2022- 15/04/2022) except Group B which showed toxic effects in all the plants, marginal necrosis, and chlorosis with a premature drop of leaves with young shoot tip cessation failure to flower with corky lesions along the stems and petioles and plants become wither. In other groups i.e. A, C, D, E the fruit formation started on 48- 53 Days (24/04/2022 - 29/04/2022) from this period up to day 64 (10/05/2022) yield is collected and the following parameters of different groups are analyzed.

Followingarethe**parameters**usedtorecordandanalyze.

1. Heightof theplant
2. Weightof theFruit
3. No.ofFruits
4. Dryweightofplant
5. Totalyieldof theplan

IndividualParameterswithdifferentpotenciesareanalyzedbyANOVATEST

OBSERVATIONANDRESULTS:

Day 1

Day6

Day14

Day17

Day34

Day39

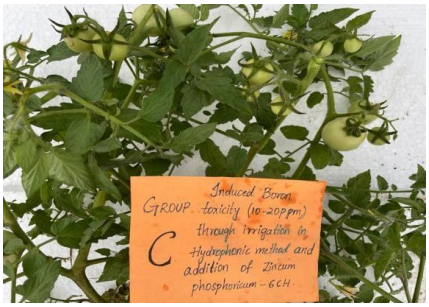
Day35

Group B with BoronToxicsymptoms

Marginal Chlorosis andnecrosis

GroupA (plain)

GroupB(BoronToxicity+Placebo)



GroupC (BoronToxicity +6CH)

Group D (BoronToxicity + 12CH)

Image 8: Study observations showing toxic symptoms

Nameofthe Group	HeightofthePlant(cm)
A	92.5
B	0.00
C	114.18
D	142.34
E	96.26

GroupE (BoronToxicity+30CH)

Table.No-1:Height ofthePlant

Fig.No-1:HeightofthePlant

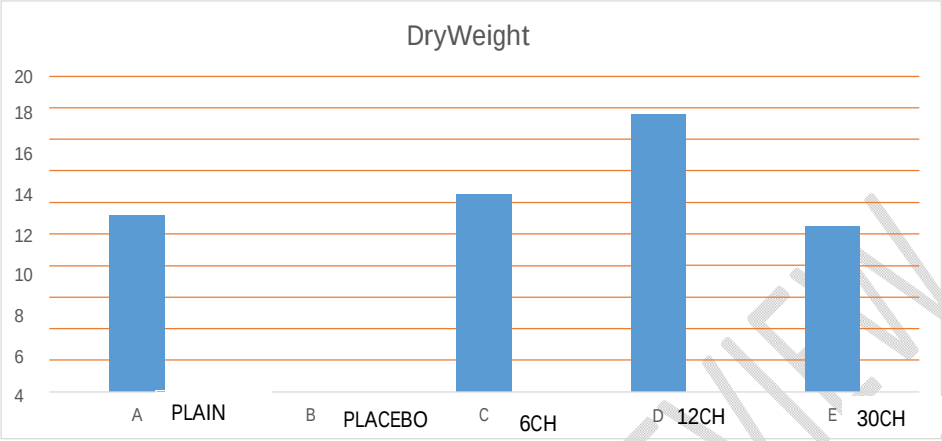
From the graph above, it is understood that there is a significant difference between control i.e.,(A &B) group as compared to groups C, D, E and group D i.e., 12 CH showing significantincreasein height (142.34cm)as compared to anothergroups.

Nameofthe Group	DryWeight (gms)
A	11.18
B	0.00
C	12.54
D	17.6
E	10.44

Table.No-2:DryWeightofthePlant

Comment [Y2]: Where is the lettering?

Fig.No-2:Dryweightof thePlant



Fromthegraphabove,itisunderstoodthatthereisasignificantdifference betweencontroli.e.,(A &B) group as compared to groups C, D, E and group D i.e., 12 CH showing significantincreasein dry weight(17.6 gms) ascompared to other groups.

Nameofthe Group	No.ofFruits
A	54
B	0.0
C	43
D	62
E	47

Table.No-3:No.ofFruits

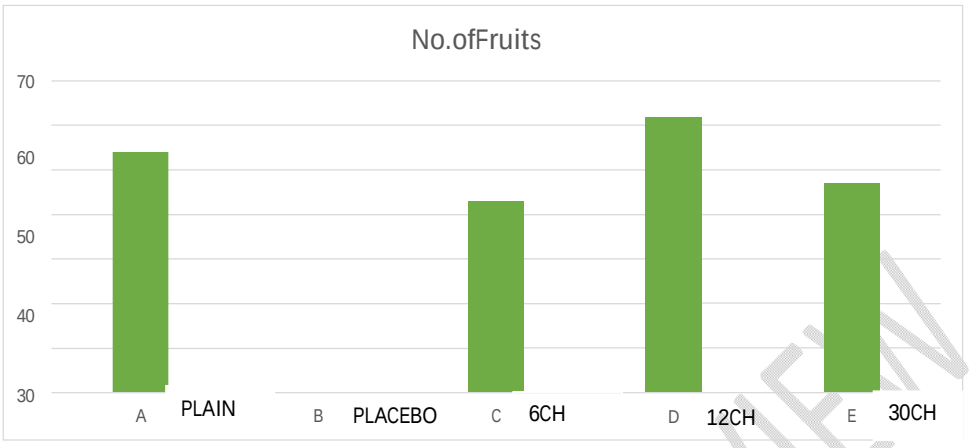


Fig.no-3:No.of Fruits

Fromthegraphabove,itisunderstoodthatthereisasignificantdifference betweencontroli.e.,(A &B) group as compared to groups C, D, E and group D i.e., 12 CH showing significantincreaseinas number of fruits (62)comparedtoanothergroups.

Nameofthe Group	Weightof theFruit (in grams)
A	43.2
B	0.0
C	39.7
D	60.8
E	42.3

Table.No-4:WeightoflargestFruit

Comment [Y3]: Where is the SE?

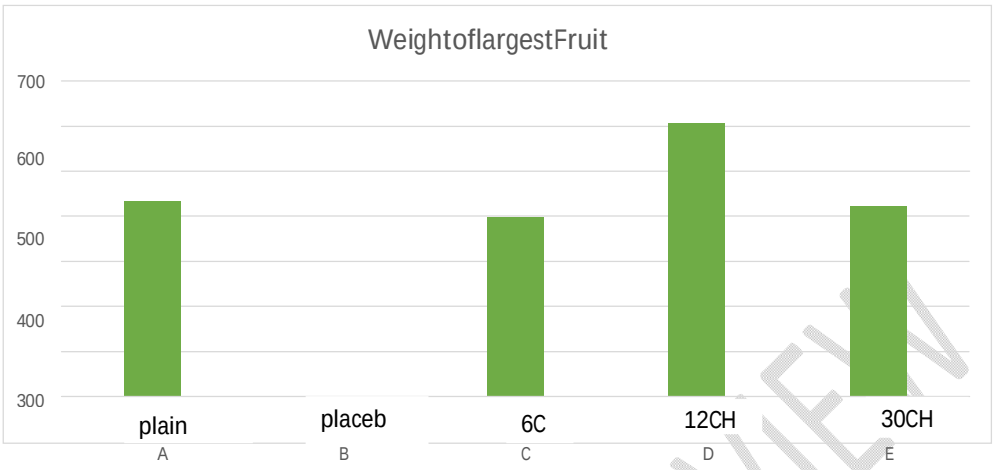


Fig.No-4:WeightoflargestFruit

Fromthegraphabove,itisunderstoodthatthereisasignificantdifference betweencontroli.e.,(A &B) group as compared to groups C, D, E and group D i.e., 12 CH showing significantincreasein weight offruit(60.8 grams) ascomparedto other groups.

Nameofthe Group	Totalyield (inkgs)
A	2.16
B	0.0
C	1.985
D	3.4
E	2.12

Table.No-5:TotalYield

Comment [Y4]: Where is the SE?

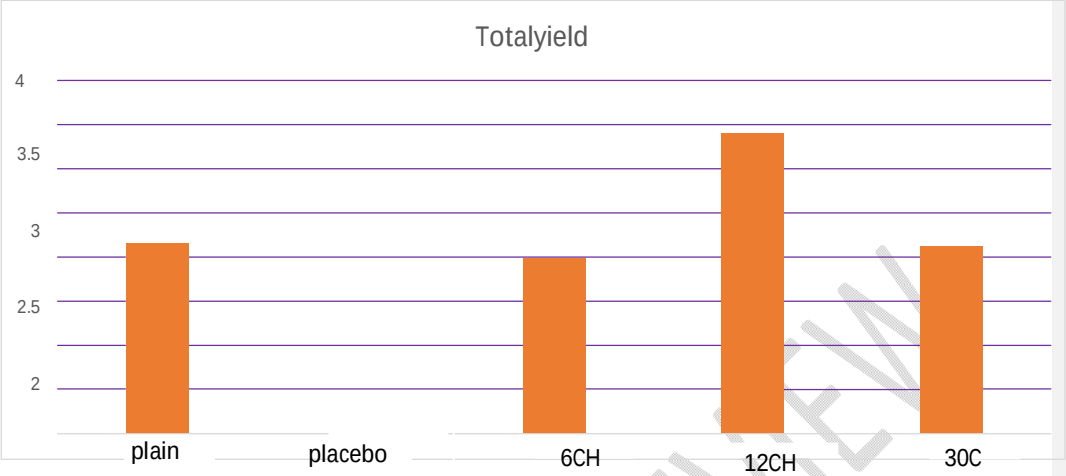


Fig.no-5:TotalYield

A

Fromthegraphabove,itisunderstoodthatthereisasignificantdifference betweencontroli.e.,(A &B) group as compared to groups C, D, E and group D i.e. 12 CH showing significantincreasein yield (3.4 kgs) as compared to other groups.

Name ofthe Group	Height ofthePlant	DryWeight	No.ofFruits	WeightoftheFruit	Totalyield
A	92.5	11.18	54	43.2	2.16
B	0	0	0	0	0
C	114.18	12.54	43	39.7	1.985
D	142.34	17.6	62	60.8	3.4
E	96.26	10.44	47	42.3	2.12

Table.No-6:Variationwithdifferentpotencies

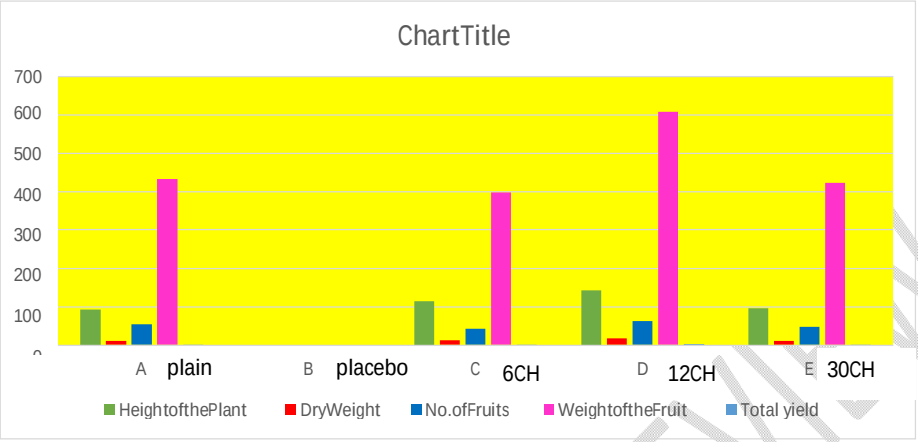


Fig.No-6:Variationwithdifferentpotencies

STATISTICALANALYSIS

Table 7 : Data statistics results

Sourceof Variation	SumofSquares(SS)	(df)	Meansquare	F-Ratio
Between samples	SSC=480725.6	4	120181.4	MSC÷MSE =11.17
WithinSamples	SSE=215168.378	20	10,758.41	

Thistable shows that thecollectedvalue of Fis 11.17 whichis morethan thetablevalueof 2.87at5% level with degreeof freedom v1=4 and v2=20. Hence this analysis report supports research hypothesis of difference in means. So, SolanumLycopersicum output is having difference between different potencies and study is muchsignificant.

DISCUSSION

In the study, boron toxicity is induced and treated homeopathically with different potencies in hydroponics methods. In regard to the height of the plant, zincumphosphoricum 12CH and 6CH acted well than compared to control groups in the largest weight of single fruit in a group the 12 CH showed a significant increase in weight as compared to the control group and in the number of fruits from each group the 12 CH and 6ch showed a significant increase in number as compared to control groups, the group B i.e. induced boron toxicity with placebo, plants died in between the study by showing symptoms marginal necrosis and chlorosis with a premature drop of leaves with young shoot tip cessation failure to flower with corky lesions along the stems and petioles and plants become wither. Total yield including other parameters like the height of the plant, dry weight, the total number of fruits, and weight of fruits of SolanumLycopersicum is having a good result with 12CH when compared with the control group.

Therefore, Zincumphosphoricum 12 CH alleviates boron toxicity in solanumlycopersicum and reduces toxic effects caused by boron, and influences the growth and yield of plant.

CONCLUSION

The aim is to avoid fertilizers which may affect the health of the human beings. So, to develop organic farming, homeopathy is playing a key role in healthy cultivating practices. Concluding the above-discussed points, we derive the conclusion stating, ZincumPhosphoricum 12CH had significantly influenced the growth and yield thereby contributing to the rise in economic output. Further studies are required on large scale to validate and confirm the current findings. F ratio i.e ratio between the sample mean and within the sample mean was very much significant. In addition to the yield, nutritive value can also be analyzed to have a detailed overview of the same.

SUMMARY

SolanumLycopersicum is one of commonest crops grown in India. Therefore, increasing the yield without harming the soil with chemicals is important. Telangana and Andhra Pradesh soil are more prone to boron toxicity. Considering the fact that,SolanumLycopersicum requires Zinc and Phosphorous to fight boron toxicity. Hence Zinc-photos were selected for the study, "to investigate and compare the efficacy of Zincumphosphoricum in different potencies by inducing boron toxicity and analyzing the quantitative yield of SolanumLycopersicum". For thestudy, 25 plants were taken and divided in 5 groups including control, ZincumPhos 6CH, 12CH and 30Ch was administered directly in hydroponics three days once. No fertilizers or any chemicals were added. Following are the parameters were recorded height of plant, weight of the fruit, number of Fruits, dry weight of the plant and total yield. Data was then statistically analysed by Anova test. Conclusion derived was Zincum phos-12CH has significantly influenced the growth and yield.

LIMITATIONSOFSTUDY

Due to the limited sample size, the conclusions made through this study are only suggestive andfurtherresearchastobedoneinlargerfarmsfor moreaccurateresultsofalleviating BoronToxicity

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