

THE IMPACT OF EXCESSIVE USE OF PESTICIDES ON THE TRIGONELLA FOENUM GRAECUM L. AND ITS OVERALL IMPACT ON SOIL PROPERTIES

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Abstract

In this research, the impact of overuse of pesticides will be discussed in the cultivation of fenugreek. The effect of these pesticides on the quality of soils is also evaluated. The importance of control of pesticides is important at a particular rate. The effect of excessive use of pesticides to reduce enzyme activity is evaluated. Due to the low rate of enzyme activity, the conversion from nitrate to nitrogen-based components can be reduced. It can lower the nitrogen content within the soil and can increase the pollution rate.

Keywords - Pesticides, fenugreek, plant height, enzyme activity, agriculture, medicinal field, etc.

Introduction

Trigonellafoenum-graecum L. that is also known as fenugreek is important to be cultivated due to its medicinal properties of this plant. Most importantly in ayurvedic medicine, this plant is very effective in the treatment of diabetes. Lots of benefits are present within the fenugreek plant that is including controlling blood sugar levels, increment milk production within breastfeeding mothers, and boosting testosterone. With this, the control of appetite, reduced level of inflammation, and reduction in the cholesterol levels with the help of this fenugreek plant. Different concentrations of pesticides can be harmful to the growth of fenugreek and they can also damage the chemical properties of soil. Due to the use of pesticides, the control of the pest but in case of excessive use cytotoxic effects and oxidative stress can be induced within the seedlings of Trigonella. In this case, the mitotic index can be appreciably reduced. The chromosomal abnormalities can be induced within the "root meristematic cell".

Review of Literature

According to longdom.org, 2015, the function of the enzyme, Nitrate reductase, abbreviated as NR can be inhibited due to the excessive use of pesticides. This enzyme is effective for the assimilation of exogenous nitrate is one kind of predominant form of nitrogen molecules. This enzyme is also available within the green plants that grow in the soil. This enzyme is one kind of monomer and is composed of about 100KiloDalton polypeptide, FAD, molybdenum, and Hemeion. Due to the presence of the enzyme, the clean-up process within the environment can also be possible. For this, the nitrogen content within the soil can be increased. With this, due to the excessive use of pesticides the fertility of the soils can also be affected. The rate of degradation properties within soils can also be affected. Some of the beneficial organisms can be present within the soils that are declined due to overuse of pesticides that can affect the fertility factor of the soil. Due to the overuse of pesticides several chemical properties of the soil can be affected. This can be the enzymatic activity, content of organic matter within soils, salinity of the soil, base saturation level, pH of the soil, nitrogen and phosphorus content, and capacity of cation exchange is also affected. Some of the pesticides that are used by the farmers can be mentioned are Chlorpyrifos with Cypermethrin, Omite, Karathane, and Confidor. Nitrate can be considered a significant hazardous pollutant and for this by the activity of Nitrate reductase, the reduction of the pollutant can be possible by the degradation of nitrate [10]. Due to this, the maintenance of the water quality within the cultivated area can also be possible. In this article, it is also reported that by the use of pesticides the enzyme activity within the plant can also be hampered.

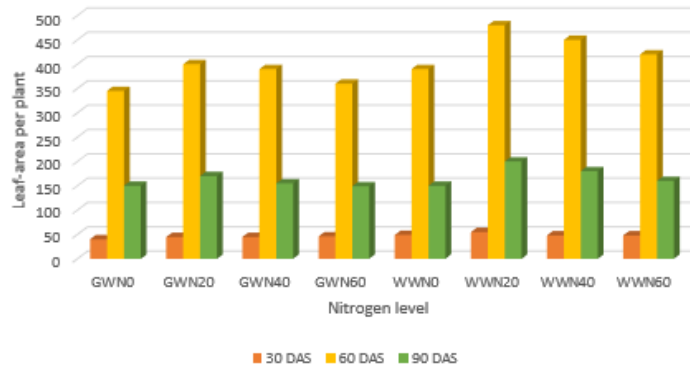
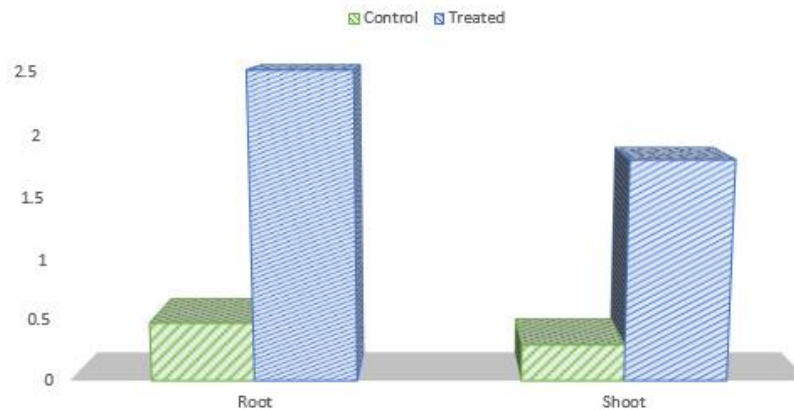


Figure 1: Effect of nitrogen level within fenugreek growth

(Source: Self-created)

According to Yaldiz, and Camlica, 2021, at the time of the growth, the plant can be subjected to different types of abiotic and biotic stress. Within the biotic stress insecticides, pesticides, pathogens, and herbicides can be mentioned. Presence of the high temperature, heavy metals, and radiation can be included in the abiotic stress. Due to the presence of these stresses the rate of the crop production of fenugreek can be hampered. With this, the chemical constituents can be altered within the plant. Different types of altered gene regulation can be present in the root meristematic region of the plant. Different growth stages of the plant can be affected. The morphological properties of the plant can be the branch numbers of the plant and the height of the plant can be affected due to the excessive use of pesticides and with this, the fertility rate of the soils can also be affected. The vigor index of fenugreek seedlings can be negatively affected by oxidative stress [1]. With this, the level of regulators within cell cycles that are "CDK1", "CDK2" and "Cyclin B1" can be decreased. In case of the presence of heavy metals within the plants, the generation of the reactive oxygen species can take place that can affect the process of photosynthesis.



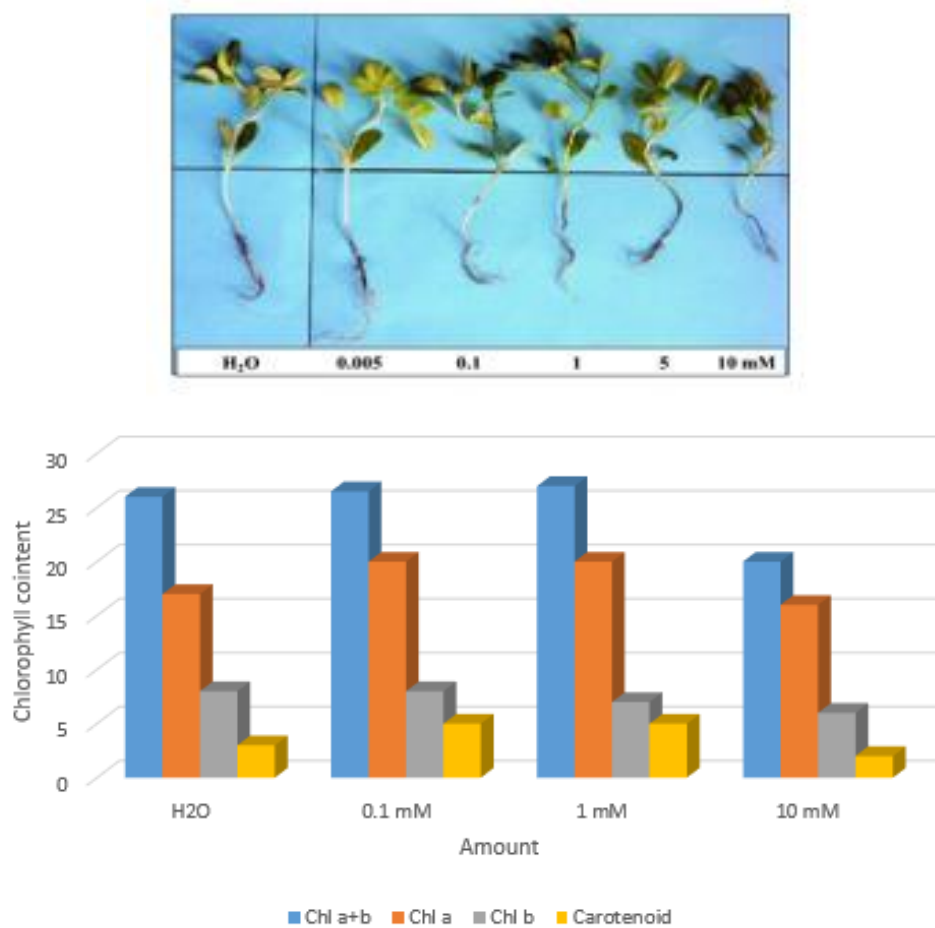


Figure 2: Morphological effect of fenugreek with excessive pesticides

(Source: Self-created)

According to Sharma *et al.* 2019, within modern agriculture, now Pesticides are used extensively. This can be stated as an effective economical way the increment the yield quantity and quality. Within the growing population throughout the world food security can be ensured due to the use of pesticides. The use of pesticides within the specific estimation is effective for crop production. But in case of excessive use due to the presence of persistent nature and bio magnification properties, serious consequences can be introduced. Due to its persistence, indirect and direct pollution within the air and water can take place that can affect the overall ecosystem [2]. Due to this, different types of severe health hazards can be incorporated into the people. Due to pesticides, the normal function of the reproductive and endocrine systems of living organisms can be affected.

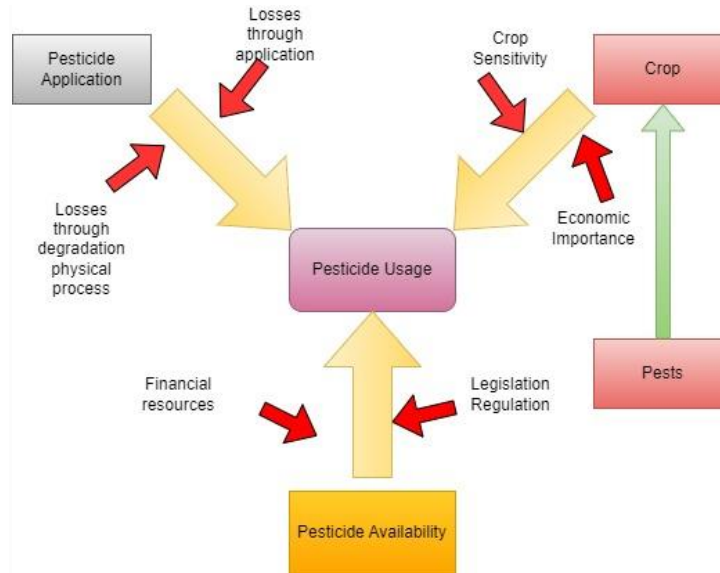


Figure 3: Pesticides usage and its impact

(Source: Self-created in Draw.io)

Materials and Methodology

As per research, the analysis of the effect of pesticides can be identified in some experimental way. In case of the identification of the change in the enzyme activity, the in-vivo assay can be performed. For this assay, the required materials can be nitrate, propanol, and phosphate buffer within the solution, sulfanilamide, and N-(1-naphthyl)-ethylene diamine hydrochloride. The cut plant tissue was taken for the treatment of the solution. Due to the use of propanol, the permeability within the plant can be increased [3]. The leaf segments of fenugreek can be anaerobic and the photosynthetic activity can be reduced. The methods for this experiment can be presented below. Within various effects of the use of pesticides on the chemical properties of the soil the affected enzymatic activity and nitrogen content of the soils are mainly focused.

The leaf sample was placed within the proper tubes. During the in-vivo process, 10 ml of the assay solution was added to each of the tubes and all of the tubes were covered. The maintenance of specific pH is important. For this, the 5% propanol, 30 mM of potassium nitrate (KNO_3) and 100 mM of phosphate buffer were added to the tube, and then the tubes were placed within the water bath for 5 minutes. After that, the tubes were cooled at room temperature. All of the tubes were marked properly and placed within the shaker for 30 minutes. After lifting from the shaker the tubes were placed within the water bath for 5 minutes and then cooled at room temperature [4]. For the detection of the nitrate assay after the use of pesticides, 1 ml solution of 1% sulfanilamide in HCL was added. Within HCL 1ml of 0.02% "N-(1-naphthyl)-ethylene diamine hydrochloride" was also added. All of the solutions were mixed properly and then it was incubated at room temperature in dark conditions for 15 minutes. After that, the OD (Optical Density) value was taken for the measurements of enzyme activity. The fertility factor

Results and discussion

The identification of the enzyme activity can be possible within the total plants and the different parts of the plants. Within this result part, the enzyme activity in different concentrations at the different parts like the leaf, root, and stems of the plant can be identified with the help of graphical representation [5]. This enzyme activity can be identified by the measurement of the amount of nitrogen dioxide from nitrate per unit of time.

The enzyme activity at $200\mu\text{l}/100\text{ml}$ at different parts of plants can be presented below.

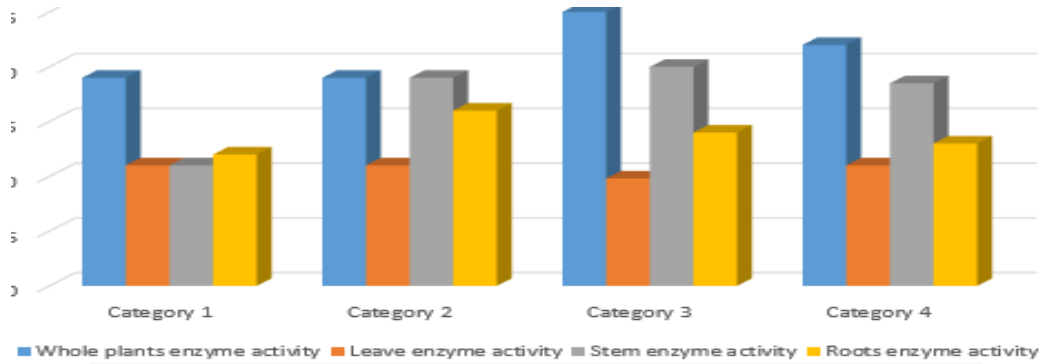


Figure 4: Effect of pesticides on Nitrate reductase activity in Fenugreek

(Source: Self-created)

The enzyme activity at 25µl/100ml and 50µl/100ml can be presented below.

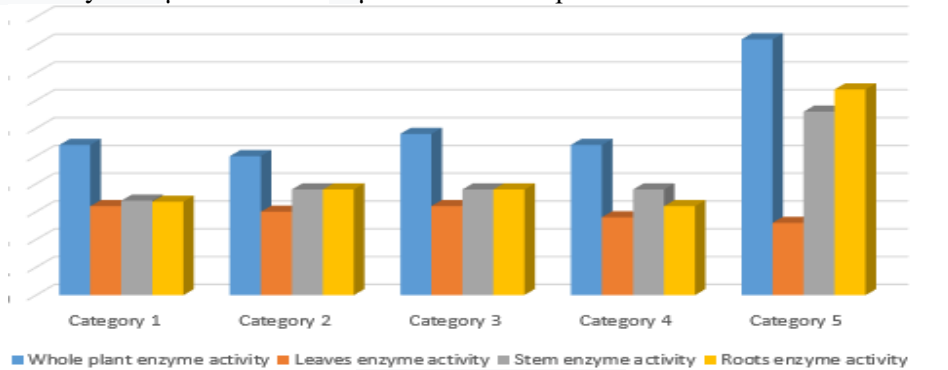


Figure 5: Enzyme activity at 25µl/100ml

(Source: Self-created)

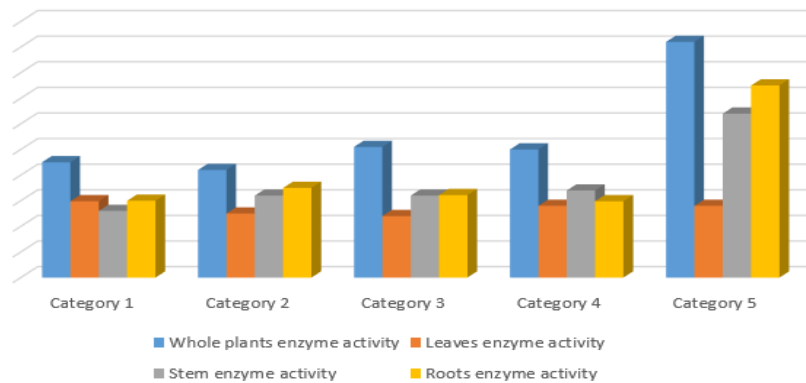


Figure 6: Enzyme activity at 50µl/100ml

(Source: Self-created)

In this investigation, it can be stated that by the use of pesticides like Karathane, Confidor, and Omite the inhibition of nitrate reductase activity is identified [6]. Within the control pot that is not subjected to the pesticides, the enzyme activity was 0.460 units and by the use of Confidor pesticides, the enzyme activity is reduced to 0.192 units. From this investigation, it can also be stated that the leaf area of the plant is more affected than the effect of stem and root area. Due to the changes in the enzymatic activity of the soil the rate of salinity within the soil can also be affected. For this, the growth of fenugreek and another crop in the soils can also be affected. The base saturation level within the soil can also be high which can affect the nitrogen cycle and create an overall environmental impact.

Some of the pesticides can be contained with heavy metals. Due to this the effect of heavy metals can also be present in the growth rate of the plants [7]. The germination of the seed of fenugreek can be affected

and this can be calculated by the total numbers of the germinated seeds divided by the total numbers of planted seeds * 100%. By the estimation of the concentration of heavy metals such as cadmium, the accumulation of cadmium within the different parts of the plants can be identified.

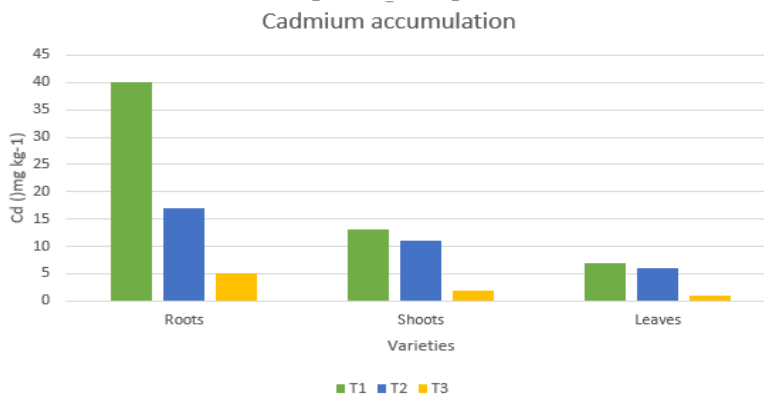


Figure 7: Cadmium accumulation in different parts of fenugreek

(Source: Self-created)

Conclusion and Future scope

From the overall analysis, it can be concluded that the use of pesticides is important to control the pest that can affect plant growth. But in case of excessive use, severe effects on plant growth as well as the ecosystem can be possible. The rate of health damage to the people can also be possible. Due to its excessive use, the fertility rate of soil can be reduced due to the low level of enzyme activity. In the future scope, the use of fenugreek plants within the medicinal field can be possible and for this, a detailed analysis of different factors of plant with enzyme activity can be done. In the future, the analysis and study for the improvements of the crop yield can be possible.

Recommendation

From this research, it can be recommended that the use of pesticides is important to be used at a particular rate. This is important to be used at a particular time of the day like early morning comparable cold part of the day. In the production of medicine, fenugreek can be used due to the presence of lots of benefits. Taking fenugreek is also important in a regular diet for the maintenance of the quality of life [8]. It is recommended for the effect of fenugreek in controlling cardiovascular disease. The use of fenugreek can also be recommended for pneumonia, asthma, etc. Due to excessive use of pesticides the water solubility and the volatile properties of the soil which is another chemical property can be affected.

References

Journals

- [1]. Hatamleh, A.A., Danish, M., Al-Dosary, M.A., El-Zaidy, M. and Ali, S., 2022. Physiological and oxidative stress responses of *Solanum lycopersicum* (L.) when exposed to different chemical pesticides. *RSC advances*, 12(12), pp.7237-7252.
- [2]. Kidwai, M. and Dhull, S.B., 2021. Heavy Metals Induced Stress and Metabolic Responses in Fenugreek (*Trigonella foenum-graecum* L.) Plants. In *Fenugreek* (pp. 327-353). Springer, Singapore
- [3]. Koteb, N.I., 2019. Effect of Fenugreek on Carbohydrate and Lipid Metabolisms of Rats Treated With Cypermethr in Combined With High-Fat-Diet and Low Dose streptozotocin. *Annals of Agricultural Science, Moshtohor*, 57(2), pp.367-374.
- [4]. Sharma, A., Kumar, V., Shahzad, B., Tanveer, M., Sidhu, G.P.S., Handa, N., Kohli, S.K., Yadav, P., Bali, A.S., Parihar, R.D. and Dar, O.I., 2019. Worldwide pesticide usage and its impacts on ecosystem. *SN Applied Sciences*, 1(11), pp.1-16.

- [5]. Tanveer, M., Shaikh, I.A., Irfan, M., Noor, H. and Farooq, U., 2019 EFFECT OF WHEAT STRAW BIOCHAR ON THE GROWTH OF FENUGREEK (*TRIGONELLA FOENUM-GRAECUM L.*) IN CADMIUM SPIKED SOIL.
- [6]. TESFA, A., 2021. *DETERMINATION OF THE LEVELS OF SELECTED ESSENTIAL AND TOXIC METALS IN FENUGREEK SEEDS (TRIGONELLA FOENUM GRAECUM L.): THE CASE OF DERA WOREDA, SOUTH GONDAR ZONE, ETHIOPIA* (Doctoral dissertation).
- [7]. Tunçtürk, M., Tunçtürk, R., Oral, E. and Nohutçu, L., 2022. Effects Of Lead Doses On The Mineral Content And Antioxidant Capacity of Fenugreek (*TrigonellaFoenum-Graecum L.*). *JOURNAL OF ELEMENTOLOGY*, 27(2).
- [8]. Yaldiz, G. and Camlica, M., 2021. Impact of Various Environmental Stress Factors on Productivity, Quality, and Secondary Metabolites of Fenugreek (*Trigonellafoenum-graecum L.*). *Fenugreek*, pp.301-326.

Website

- [9]. longdom.org, 2015, Effect of Pesticide on Nitrate Reductase Activity in *TrigonellaFoenum* i.e., Fenugreek. Available at:<https://www.longdom.org/open-access/effect-of-pesticide-on-nitrate-reductase-activity-in-trigonella-foenum-iefenugreek-12798.html> [Accessed on: 31/05/2022]
- [10]. researchgate.net, 2019, Pesticide mediated oxidative stress induces genotoxicity and disrupts chromatin structure in fenugreek (*Trigonellafoenum-graecum L.*) seedlings Available at: https://www.researchgate.net/publication/331145804_Pesticide_mediated_oxidative_stress_induces_genotoxicity_and_disrupts_chromatin_structure_in_fenugreek_Trigonella_foenum_-_graecum_L_seedlings [Accessed on: 31/05/2022]