

THE EFFECT OF HEAVY METAL ON SEED GERMINATION AND PLANT
GROWTH

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ABSTRACT

Heavy metals pollution had become one of the biggest issue happening in this world and is getting worse each day which could bring adverse effects toward organisms such as plants. Cadmium released to environment through anthropogenic activities such as metal extraction & combustion of fossil fuels whereas nickel is released into the air by power plants and trash incinerators. Plants uptake heavy metals such as cadmium and nickel that are present in the environment which affect their growth or eventually die. This study was carried out to determine the effect of heavy metals namely Cadmium (Cd) and Nickel (Ni) on the seed germination and growth of *Extreme Yield Red Chili*. Firstly, the seeds were grown in Petri dishes containing different concentrations ranging from 0 to 300 mg/L of both cadmium (Cd) and nickel (Ni) solution for 14 days. Negative control is prepared by just adding deionized water. All treatments were prepared in 4 replicates. The length of shoots and roots for each treatment were observed and measured at day 7 and day 14. As shown in the results, 0.1 mg/L and 0.5 mg/L for Ni concentration did not had massive effect on the growth as both of them had a longer roots and shoots formation which is 1.86 cm and 1.37 cm at day 14. Cd shown the similar results which 0.1 mg/L and 0.5 mg/L had the longest length of roots and shoots which is 3.6 cm and 2.7 cm at day 14. The germination percentage was also calculated at day 7 and day 14 and the results showed that Ni had a 100% of seed germination when the concentration was at 1, 50 and 150 mg/L while Cd concentration at 1 mg/L. In conclusion, Ni and Cd were not able to affect the seed germination but could affect the growth of shoots and roots.

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LIST OF ABBREVIATIONS

Cd	Cadmium
Ni	Nickel
%	Percentages
cm	centimeter
mg/L	Milligram Per Litres
mL	Millilitres
mM	Millimolar

CHAPTER 1

INTRODUCTION

Heavy metal pollution is a very serious and growing problem associated with the industrial areas (Ram, 2013). Heavy metals are naturally occurring elements in the ecosystem that exhibit metallic properties, which have a high atomic weight and a relatively high density of at least 5 times greater than water. Heavy metals are not biodegradable and would stay in the soil for long period of times. Examples of heavy metals include chromium (Cr), thallium (Tl), lead (Pb), zinc (Zn), copper (Cu), mercury (Hg), and cadmium (Cd). Some of the heavy metal such as lead, mercury, arsenic and cadmium appear to be essential to the body at very low concentrations, but it can be toxic when it is in high concentration (Navari-Izzo & Rascio, 2010).

Cd and Ni production have a majority increased throughout the years worldwide (Statista, 2018). Cd can affect human health through many ways which include respiratory system and kidney failure (Wu et al., 2016). On the other hands, Ni can caused skin disease, cardiovascular disease and lung disease (Ahmad & Asraf, 2011). Chili had been selected as a study subject as this food had been consumed daily worldwide especially in China (Shi, Riley, Taylor & Page, 2017).

Extreme Yield Red Chili is widely use as spices in daily food throughout Malaysia (Ong, Subramaniam and Tan, 2015). Its economic importance is shown from its wide use throughout Malaysia. It due to the nutritional values and is economic importance. Chopan & Littenberg (2017) suggested that eating chili do brings benefits to human health like reducing chances of getting cardiovascular disease, diabetes and liver disease. Seed germination is the process of budding of seeds which developing into new plants. Factors which affect the seed germination includes temperature, aeration, water availability, seed maturation, seed dormancy and seed vitality (Woods, 2015). In addition to these factors, seed germination can also affected by heavy metal (Sethy & Ghosh, 2013). Growth of plantlets which includes its shoots and roots can be affected by several factors which include the light intensity (Yokawa, Fasano,

Kagenishi & Baluška, 2014), nutrients availability (Sharma, Modgil & Thakur, 2007) and heavy metals (Abou Auda, Abu Zinada & Ali, 2011).

The main objective of this study was to find out the effect of cadmium and nickel on seed germination and growth of *Capsicum annuum*.

CHAPTER 2

LITERATURE REVIEW

2.1 POLLUTION

Pollution is the introduction of contaminants or harmful pollutants into the environment. A pollutant is a harmful substance that can pollutes the air, water or land. It has a harmful effect on the natural world and on the activities of living beings (Peter, n.d.). During the last 10 years, pollution level has become more serious all over the world (Roux & Sahut, 1997).

There are many types of pollutants produced either due to natural causes or human activities which include volcanic eruption, earthquakes, flood and even natural decay over dead bodies of both plant and animal. During floods, soil is eroded, plants are uprooted and animals are killed and washed away by water while their bodies are decomposed and able to pollute the water. In addition to these natural causes of pollution, pollution can also be caused by technologies advancements made by man. Factories and exhaust fumes from cars contribute to about 75% of all toxin into the earth. Many factories are dumping their toxic waste into the lakes, rivers, and oceans. Factories also burn a lot of fossils fuels for gasoline, and other daily products. The growing population worldwide leads to more infrastructure being built which causes more damage to the earth (Valeriia, Olga, Begunova, 2017).

Pollution has been a known concern and is getting worse over time. It poses a major threats to the environment and all living. The pollution index of Asian cities in 2017 and 2018 is shown in Table 2.1 and Table 2.2 (Numbeo, 2018). As shown in Table 2.1 and Table 2.2, most of the Asian cities are facing the pollution problem and it is getting worse over time. Pollution index of 90 and above is considered unhealthy and it could lead to respiratory problems and other health effects. An international non-profit organization from New York dedicated to pollution problems which known as The Blacksmith Institute, stated that of the among the world top ten worst places to live

in, four of them were in Asia, out of which two are situated in China and the other two in India (Biswas & Tortajada, 2017).

Table 2.1. The pollution index 2017 (Numbeo, 2017).

Rank	City	Pollution Index	Exp Pollution Index
1	Accra, Ghana	103.20	188.13
2	Ghaziabad, India	97.60	177.38
3	Tetovo, Macedonia	97.46	178.30
4	Faridabad, India	97.41	176.72
5	Kathmandu, Nepal	96.57	175.53
6	Cairo, Egypt	96.18	174.83
7	Kabul, Afghanistan	95.94	174.19
8	Karachi, Pakistan	95.70	172.83
9	Ulaanbaatar, Mongolia	95.53	177.52
10	Kanpur, India	94.61	172.75

Table 2.2. The pollution index 2018 (Numbeo, 2018).

Rank	City	Pollution Index	Exp Pollution Index
1	Kabul, Afghanistan	97.79	177.84
2	Ghaziabad, India	97.67	177.55
3	Tetovo, Macedonia	97.57	178.53
4	Faridabad, India	95.89	173.69
5	Kathmandu, Nepal	95.78	173.90
6	Cairo, Egypt	94.74	171.73
7	Kanpur, India	94.69	172.56
8	Ho Chi Minh City, Vietnam	94.60	171.67
9	Karachi, Pakistan	94.51	170.36
10	Dhaka, Bangladesh	94.15	169.60