

Impacts of Paracetamol on the growth of *Cicer arietinum* (Gram)

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Abstract

Plants have to face a lot of stress like heat, cold, acidic and alkaline conditions as well as presence of unusual chemicals due to pollution. Plants responses in different ways to resist the impact of these stresses by morphological, biochemical, physiological and other methods to adapt themselves for survival but if the level of stress becomes very high then plants cannot resist completely and shows changes in rate of their growth and development pattern. Present research work concludes the results and their interpretations obtained after the observations regarding the length of shoot and roots and the number of leaves of *Cicer arietinum* (Gram) growing under the stress of pharmaceutical agent paracetamol. The work shows that in general as the concentrations of paracetamol increases, the height and the growth of the gram plants decreases.

Key Words: Paracetamol, Pharmaceutical effluent, Pollution, Plant stress

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Introduction

Environment is defined as the total conditions surrounding an organism or group of organism that includes combination of external physical conditions and influences the effect of growth, development and survival of organisms [1]. It's every components builds our surroundings and affect our capability to live on earth, the air, the water, the plants and animals around us. Formation of H_2SO_4 in the environment reduces the pH of the environment and nearby soils; this increases mobility of metals present there [2].

According to pharmaceuticals such as Diclofenac and Ibuprofen caused yellowing and dehydration of shoots of the plants of *Phragmites australis*, *Hordeum vulgare* (barley) and *Lupinus luteolus* but Acetaminophen has no effect [3]. reported Flumequine, a drug affects the photosynthetic pigment and growth of the plants of *Lemna minor* (aquatic plant) [4,5]. It is not sure whether the pharmaceuticals has negative impacts on the plants, the plants maybe damaged either directly by the pharmaceutical themselves or indirectly by affecting the microbial activities which helps the plants for its development [6].

Paracetamol under experimental concentrations had no toxic effect on the germination of seeds [7]. This is because the seed coat present inside the seed that constitutes barrier between embryo and its immediate stimuli generated from outside [8]. Paracetamol induced changes in mung bean germination and growth biomarkers to found the most suited concentration of paracetamol that will be tested whether it alters the physiology of plants or not. At low micromolar concentrations the Nonsteroidal Anti-inflammatory drugs salicylic acid, has been seen to increase flowering in Duckweed (*Lemna gibba*) [9].

Material and methods:

Area of study

A study was conducted at Rajiv Gandhi South Campus (Banaras Hindu University), Barkachha which is located in the central Vindhyan plateau region in Mirzapur district of Uttar Pradesh, India. The campus is about 65km away from the main campus of Banaras Hindu University, Varanasi and has an area of 2663 acre. It lies between 25.049805 North latitude and 82.59617 East longitudes at altitude of 146 m above sea level.

Selection of plant

Plant selected for the experiment is gram (*Cicer arietinum*), this plant selected because it is very common pulse grown in most of region of study area, having high nutritional value and also India is considered as the topmost chickpea producing country in the world (FAO, 2005). It is the third mostly widely used pulses in the world and are grown in many warm-temperate and subtropical regions.

Common name- chickpea, gram (*channa*), Family –leguminasae, Species-*Cicer*, Genus-*arietinum*

Preparation of soil

Soil from garden of the campus beside Farmers' Hostel was dug with spade. Pebbles were removed and the soil was sieved with 2 mm sieve. The soil was prepared by mixing 50% garden soil, 40% compost and 10% sand thoroughly. Compost is added to increase the nutritional value, productivity and humus content of the soil. Sand is added because soil present in these regions has property of compactness, when it receives water it gets compacted and less porous. Twenty two pots were selected; five pots for five different graded concentration of four different pollutants and two for the control (in case anyone gets damaged). Each pot was filled by 1.5 kg of soil and made ready for sowing of seeds of gram.

Purchasing, Soaking and Sowing of seeds

Gram seeds were purchased from Belhera market (Barkachha, Mirzapur) from where farmers bought the seed. These seeds are pre-soaked overnight in tap water for selection of the viable ones. Viable seeds were selected and sowed in pot at equal distance and depth and each pot contained five seeds.

Selection of pollutants

Solution of Paracetamol tablets were taken as pharmaceutical waste to see their effects on selected plant.

Preparation of the stock solution

Organized by Pharmacy (AY.) Course, Faculty of Ayurveda, Institute of Medical Sciences & Medical Laboratory Technology Course, Ddu, Kaushal Kendra, Rajiv Gandhi South Campus, Barkachha, Mirzapur
Banaras Hindu University

Paracetamol solution: 100 ml of tap water was measured and poured in five different beakers and all the beakers were labeled. Amount of 109.2 mg, 218.4 mg, 327.6 mg, 436.8 mg and 546 mg Paracetamol tablets were crush into powder and added in subsequent beaker and mixed well by using glass rod. Paracetamol tablets were bought from the medical store and weight of the tablets is 710 mg per tablet. Each tablet contains 325 mg of Paracetamol, 100 mg of Aceclofenac and 285 mg of other additives. Amount of Paracetamol used in 100 ml of water is 50 mg, 100 mg, 150 mg, 200 mg and 250 mg respectively. Since, 325 mg of Paracetamol is present in 710 mg of tablet:

$$\begin{aligned}
 325 \text{ mg} &= 710 \text{ mg} \\
 1 \text{ mg} &= 710/325 \\
 50 \text{ mg} &= (710 \times 50)/325 = 109.2 \text{ mg} \\
 100 \text{ mg} &= 109.2 \times 2 = 218.4 \text{ mg} \\
 150 \text{ mg} &= 109.2 \times 3 = 327.6 \text{ mg} \\
 200 \text{ mg} &= 109.2 \times 4 = 436.8 \text{ mg} \\
 250 \text{ mg} &= 109.2 \times 5 = 546 \text{ mg}
 \end{aligned}$$

Treatment of plants

Five pots were selected for each pollutant and two for the control. All the pots were marked. After sowing the seed the pots were irrigated with the different solution prepared with different graded concentration and the control with only 100 ml of tap water on every alternative day.

Collection of data

The work was conducted in the months of January and February for about 46 days. After the germination of the following parameters were noted daily:

(i) Length of Shoot- the length of shoot were measured daily using centimeter scale, the measurement was done from the bottom of the plant to the tip of the plant. The length of shoot of each plant in every pot was noted down and the average length of each pot of plants was taken.

(ii) No. of leaves- number of leaves were counted every day and the average number of leaves of plant in each pot was noted. The leaves were counted from fifteen day since; the leaves were noticeable and countable at this time.

(iii) Length of root- after 46 days when the growth of the plant terminated and death of some plants were observed, the soil was loosen by pouring little amount of water. The roots were uprooted carefully and the length was measured using centimeter scale and average length of each pot was noted.

(iv) Moisture content- after the uprooting of the plants the fresh weight of the plant in gram was noted using weighing machine and average weight of each pot was calculated. The plant was cut into shoot and roots using scissor and was weighed separately and average weight of each pot was calculated. Shoots and roots were wrapped in brown paper and kept in oven for 24 hours at 70°C. After 24 hours dry weight of shoots and roots of each pot was calculated separately (dry weight of the sample).

$$\% \text{ Moisture (on wet basis)} = (Mw \times 100)/Fw$$

$$\text{Where, } Mw = Fw - Dw$$

$$Mw = \text{Moisture Content}$$

$$Fw = \text{Fresh Weight}$$

$$Dw = \text{Dry Weight}$$

Results and discussion:

1. Impact on height of the plants

The growth of the gram plant was observed in all the pots irrigated with pharmaceutical waste (paracetamol). First germination of seeds was seen on fifth day in control but last germination in 250 mg concentration which was on eighth day. As the concentration increases there was decrease in plant height but the growth is directly correlated to the no. of days. The data in the graph (fig. 1) shows that very small amount concentration of Paracetamol has no effect on the growth of the plant and there is healthy growth of plants like in control. But at higher concentration there was decrease in growth rate. At 250 mg and 200 mg concentration of Paracetamol the height of the plant is minimum (10.1 and 10.3 cm) but at 50 mg the height

was 11.5 cm. At the end of the experiment the average height plants in control, 50, 100, 150, 200 and 250 mg concentrations were 12.7, 11.5, 11.4, 11, 10.3 and 10.1 cm respectively. This concludes very small concentrations of pharmaceutical waste (paracetamol) have no negative effect but high concentrations decreases the growth and growth rate of gram plants.

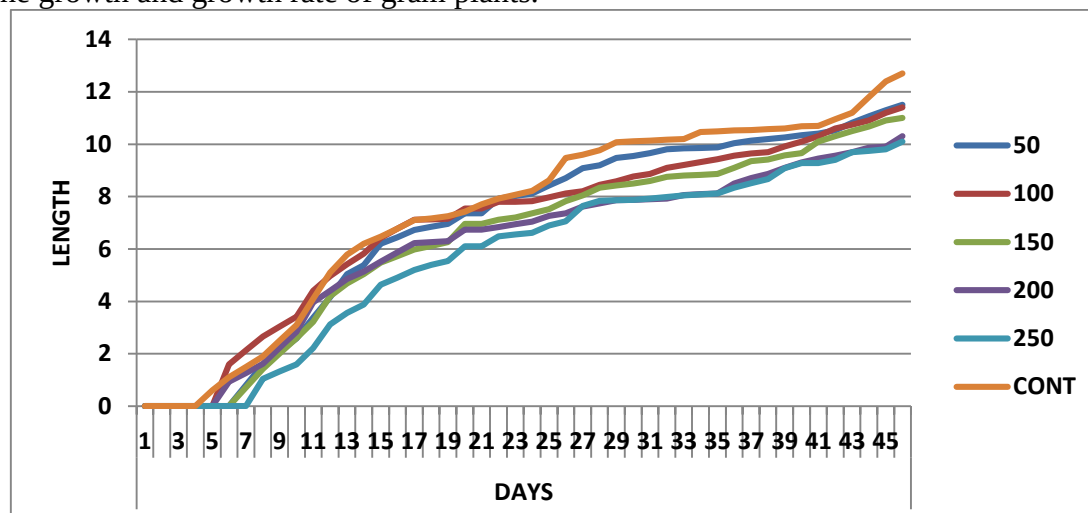


Figure 1: Impact on the height of the plants

2. Impact on no. of leaves of plant

The data in graph (fig. 2) show that the maximum average no. of leaves in gram plants was observed in control (40.2) and minimum (20.2) at 250 mg concentration of paracetamol (paracetamol). Very small concentration has little or no effect on the no. of leaves of gram plant. The graph show direct correlation of no. of leaves to the days, but has less in comparison to control. At 150 mg and 200 mg concentration not much variation in average no. of leaves can be observed in the plant. At the last day the average no. of leaves in control, 50, 100, 150, 200 and 250 mg are 40.2, 29, 25.5, 22, 22.2 and 20.2 respectively. This concludes that at lower concentration paracetamol has almost no impact but higher concentration decreases the growth rate of leaves of gram plants.

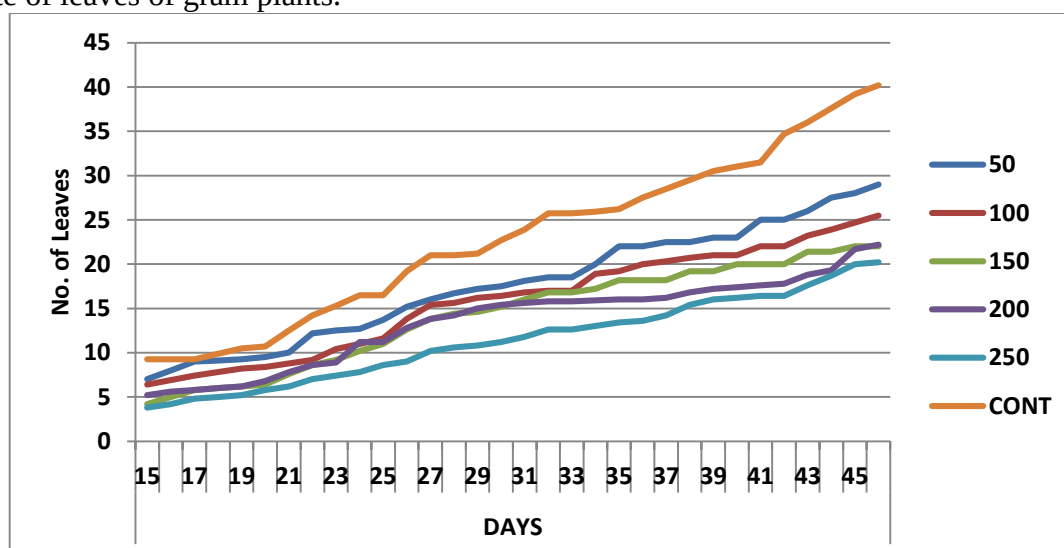


Figure 2: Impact on no. of leaves of plant

3. Impacts on root length of the gram plants

Measuring the average root length, control has the longest length (8.5 cm), while plant irrigated with pharmaceutical at 4 ml concentration has the smallest (3.3 cm). In pharmaceutical irrigated plants, plants with lower concentration has longer root than higher concentration (Table 1).

4. Impacts on the fresh weight of shoot of the plants

In control the fresh weight of shoot of plants was 1.14 gm having the maximum weight but in case of pharmaceutical irrigated plant, as its concentration increases its weight decreases (Table 1).

5. Impacts on the fresh weight of root of the plants

Control has the maximum root weight (0.45g) while in pharmaceutical root weight decreases with increase in concentrations (Table 1).

6. Impacts on the moisture percent of root the plants

Control has the moisture percent of 46.67%, plants irrigated with paracetamol at 0.1 ml concentration has maximum root moisture percent (65%). In pharmaceutical irrigated plants, at lower concentrations roots of the plants has more moisture than at higher concentrations (Table 1).

7. Impacts on the fresh weight of the plants

Plants in control have the maximum weight (1.62 g), Plants with paracetamol have more weight at lower concentrations than at higher concentrations (Table 1).

8. Impacts on the percent moisture content of the plants

The plants in control have moisture percent of 67.95% and the plants irrigated with paracetamol at 0.1 ml concentrations have maximum percent moisture (Table 1).

Table 1: Impacts of graded concentrations of Paracetamol on different parameters of plant

Concen- tration	Root length (cm)	Fresh weight of the plants (Gram)	Fresh weight of shoot (Gram)	Fresh weight of root (Gram)	Fresh weight of shoot (Gram)	Percent moisture content of the plants (%)	Moisture percent of root (%)	Moisture percent of shoot (%)
CONTROL	8.5	1.62	1.14	0.45	1.14	67.9	46.67	75.44
50	7	0.25	0.19	0.06	0.19	32	33.33	31.6
100	6.5	0.76	0.4	0.36	0.4	35.53	33.55	40
150	5.5	1.27	0.88	0.39	0.88	66.92	51.28	73.8
200	4.5	1.29	0.78	0.31	0.78	69.77	29.03	82.65
250	3.3	1.59	1.09	0.5	1.09	66.04	54	71.5

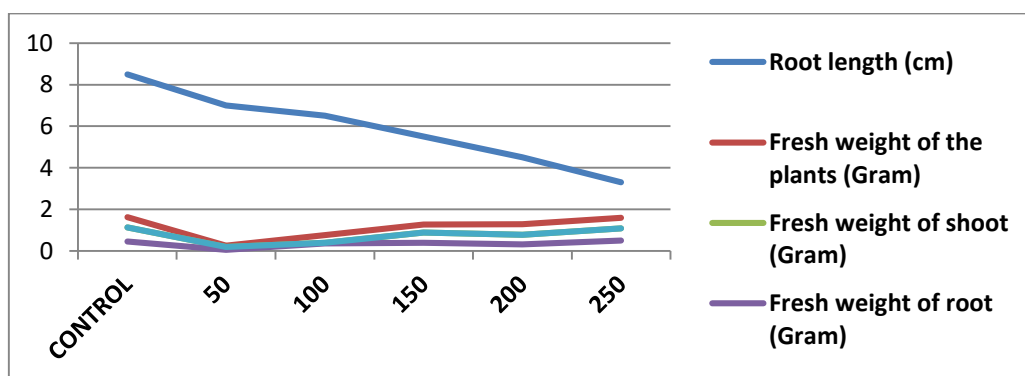


Figure 3: Impact on Root length, fresh weight of plant, shoot and root of plant

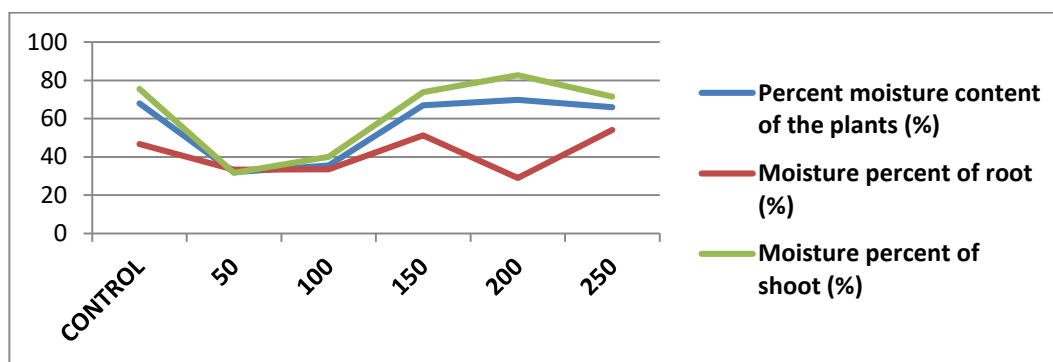


Figure 4: Impact on percent moisture of plant, shoot and root

Conclusion

In this study gram plants grown are irrigated with different concentrations of paracetamol. Average plants height and no. of leaves are observed for certain period of time. Average length of root, average weight of plants, shoot and root has been observed along with percent moisture contents of plants, shoot and root were calculated on last day at the end of the experiment. Results are compared to the plants in unpolluted control plants. In general as the concentrations of paracetamol increases, the height and the no. of leaves of the plants decreases. Reductions in no. of leaves of the plants decrease the canopy of the plants and lead to decrease in photosynthesis, thus decline in productivity and economy. The root length of the gram plants decreases with increase in the concentrations of paracetamol (at higher concentration there was no germination of seeds). In general the healthy plants have more weight than the degraded plants. As the concentrations of the paracetamol increases the weight of the plants, shoot and root decreases. The percent moisture content of the plants, shoot and root decreases with increase in the concentrations of paracetamol. Reduction in percent moisture of shoot decreases the primary productivity and the biomass production. Decrease in moisture percent of root decreases the biomass of the plants and the transportation of the nutrients from root to plants. This study is conducted to evaluate the impacts of paracetamol on the growth and physiological characteristics of plants.

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