



# EFFECT OF DIFFERENT CONCENTRATIONS OF GIBBERELIC ACID (GA) ON SEED GERMINATION AND VIGOUR OF BLACK GRAM

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## ABSTRACT

India is the largest producer and consumer of pulses globally, accounting for over 25% global production. Black gram is the most widely cultivated pulse crop in India, ranking among the top three pulses in terms of production. Pulse production faces a series of constraints due to physiological limitation such as lower germination percentage, and source limitation crop, as well as the C3 photosynthetic apparatus etc. To overcome this limitation, the application of plant growth regulators can be adopted. Plant growth regulators, such as GA<sub>3</sub>, can enhance growth and development of crop which leads to increase the crop yield. This study aims to investigate the effects of GA<sub>3</sub> on black gram germination and seed vigour to improve productivity.

**Key words:** Pulses, Constraints, Gibberellic Acid, Germination and Productivity.

## INTRODUCTION

Pulses are a vital source of nutrition for millions of people worldwide. Pulses are popularly known as the poor man's meat. It is the chief source of protein in the human diet. It is also rich in vitamin complex, carbohydrates, minerals, dietary fibres etc. And also pulses cultivation improves soil fertility by nitrogen fixation. Black gram (*Vigna mungo* L.) ranks third among pulse crops in India (Deol *et. al*, 2018) which belongs to the Leguminosae family. It is highly nutritious. Black gram, being a legume, enriches the soil nitrogen content and has a relatively short life span (90-120 days). Black gram seeds contain a higher amount of protein (23-26%) and are rich in minerals and vitamins. Its production decreased due to physiological constraints such as lower germination percentage, source limitation, C3 photosynthetic apparatus, etc. Plant growth regulators play a crucial role in managing plant growth and improving the physiology of plants (Baliah *et. al*, 2018). To overcome this limitation, plant growth regulators can be adopted. Plant growth regulators like GA (Gibberellic acid) play a vital role in various growth processes such as seed germination and development (Mander, L.N.,1992). They are known to stimulate rapid growth in stems and roots, include mitosis in leaves, regulate flowering times, and even promote organ elongation (Yamaguchi, 2008). It also enhances crop productivity. So, this study aims to investigate the effect of different concentrations of GA on black gram germination and seed vigour to improve crop productivity.

## MATERIALS AND METHODS

The laboratory study was conducted at the Krishna College of Agriculture and Technology, Usilampatti, Madurai District. Black gram (VBN 11) seeds were treated with different concentrations of GA solution (Control, 10, 20, and 30 ppm) to determine the germination percentage, root length, shoot length, and seed vigour.

**SEED:** Black gram

**VARIETY:** Vamban 11

**GA CONCENTRATION:** Control, 10ppm, 20ppm, 30ppm

**REPLICATION:** Three

**DATE OF SOAKING:** 14<sup>th</sup> July 2025

### PARAMETERS TO BE OBSERVED:

#### GERMINATION PERCENTAGE

The emergence of a 2mm radicle was set as the criteria for germination. The number of germinated seeds in each petriplates was counted on alternate days from day 3 to day 7 to determine germination percentage.

$$\text{Germination percentage} = \frac{\text{Total no of germinated seeds}}{\text{Total seeds placed for germination}} \times 100$$

#### SHOOT AND ROOT LENGTH

Shoot and root length were taken on alternate days from day 3 to day 7.

#### SEED VIGOUR

Seed vigour = Germination percentage × Seedling length.

### PREPARATION OF GA CONCENTRATE SOLUTION:

1. Dissolve 30mg of GA in 2ml of ethanol.
2. Add 298ml of distilled water will give 30ppm of 300ml (Solution A).
3. For control, direct distilled water is used.

For ppm solutions, use  $N_1 V_1 = N_2 V_2$ .

$$V_1 = 10 \times 100 / 100$$

$$V_1 = 10 \text{ml}$$

4. For 10ppm, take 10ml from solution A and final volume make up to 100ml using distilled water.
5. For 20ppm, take 20ml from solution A and final volume make up to 100ml using distilled water.
6. For 30ppm, take 30ml from solution A and final volume make up to 100ml using distilled water.

### PREPARATION OF PETRI PLATES:

1. Take conical flasks and add different concentrations of GA solutions and mark them.
2. Black gram (VBN 11) seeds are taken in 12 petriplates, mark them control (T1R1, T1R2, T1R3), 10PPM (T2R1, T2R2, T2R3), 20PPM (T3R1, T3R2, T3R3), 30PPM (T4R1, T4R2, T4R3).
3. Now spread the blotting paper gently, and wet the blotting paper using distilled water.
4. Take 10 black gram seeds and place them at equal spacing in all the petri plates accordingly.
5. Add the GA concentration to the Petri plates on alternate days.

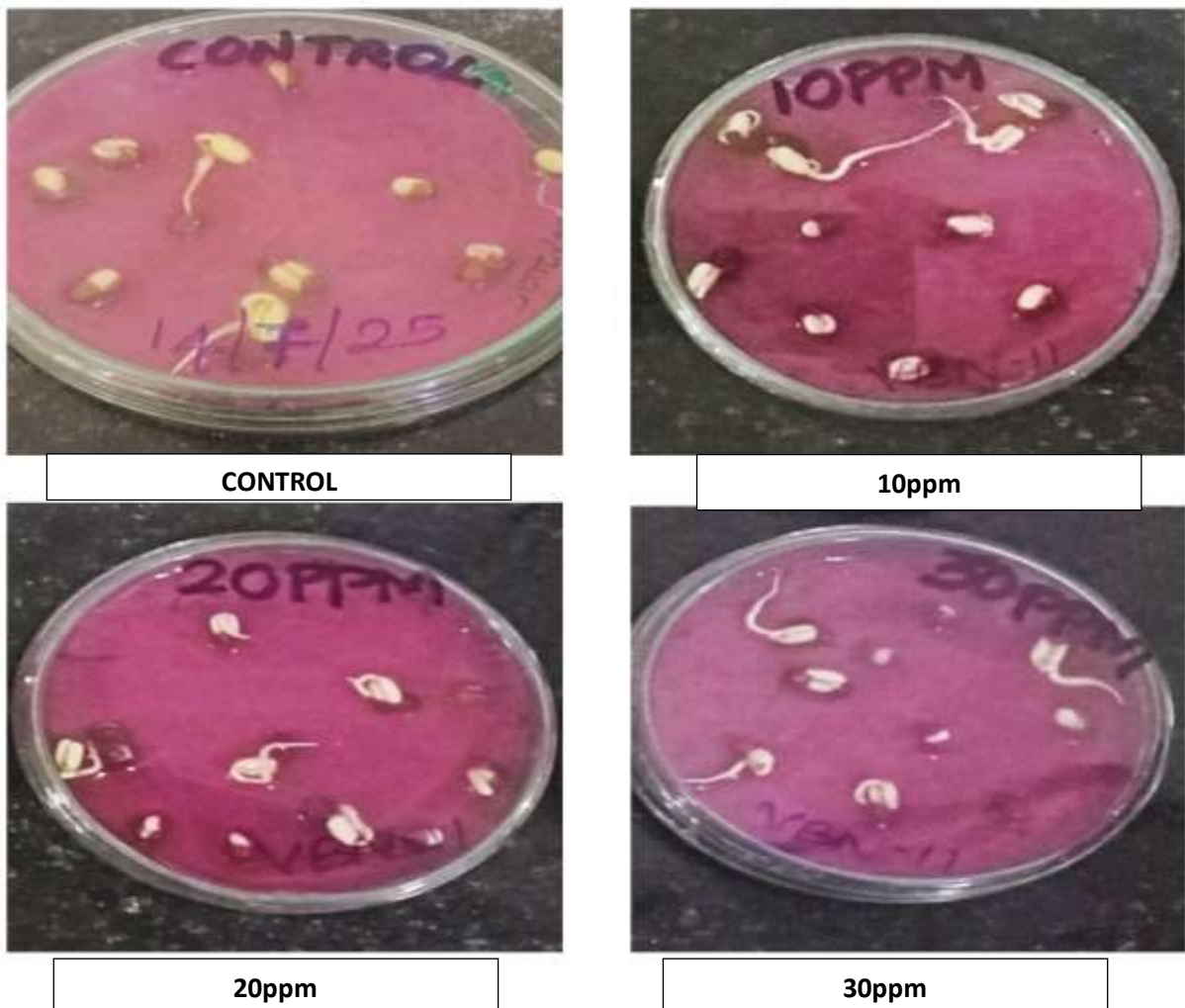
## OBSERVATIONS RECORDED

### DAY 3

The following observations were taken on the 3<sup>rd</sup> day of soaking.

#### **1.GERMINATION PERCENTAGE**

$$\text{Germination Percentage} = \frac{\text{NO.OF SEEDS GERMINATED}}{\text{TOTAL NO. OF SEEDS SOWN}} \times 100$$

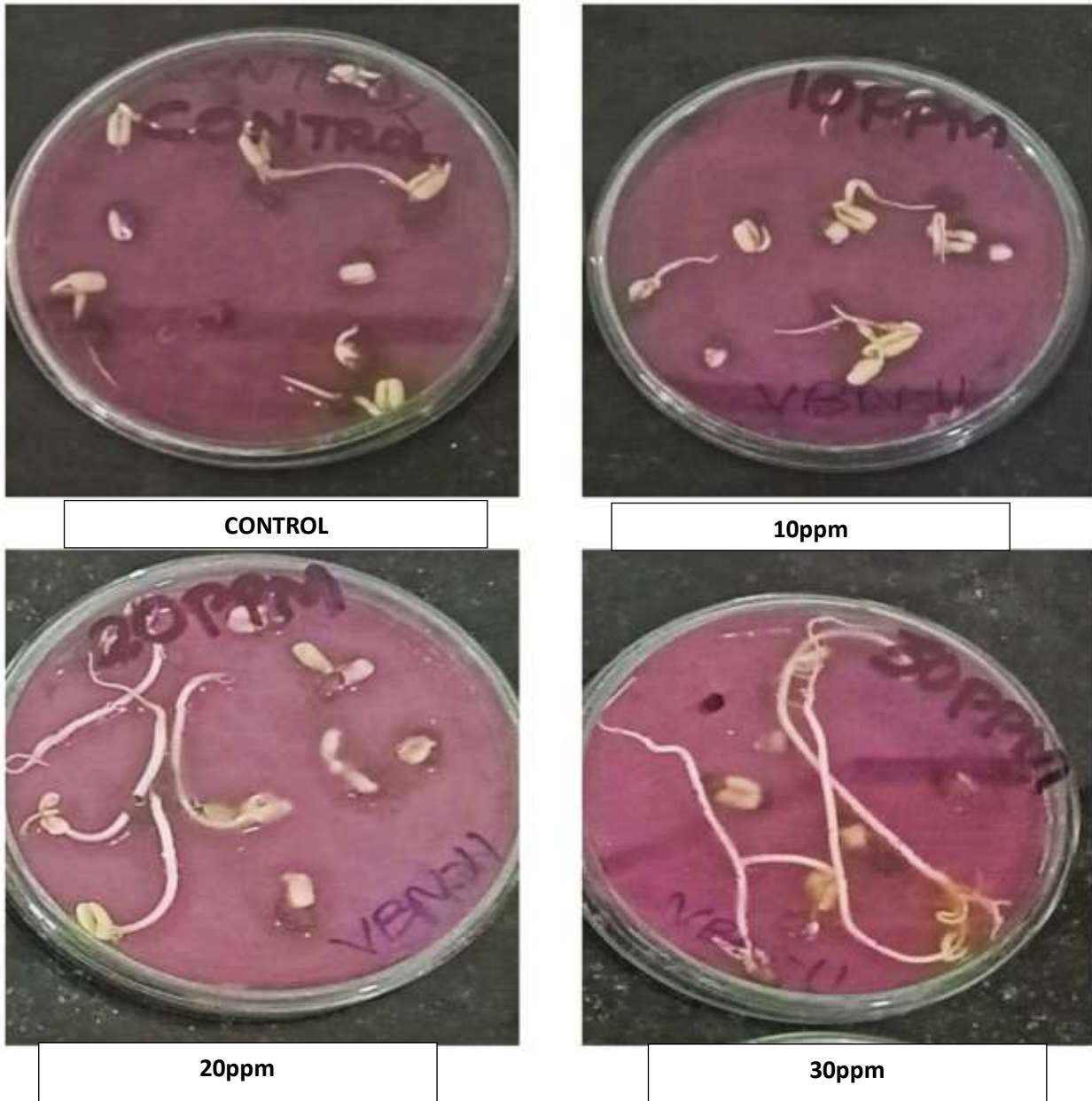


**Fig.1 Germination on 3<sup>rd</sup> day**

## DAY 5

Second observation taken on the 5<sup>th</sup> day. The following parameters were observed,

- Germination Percentage
- Shoot length & Root length
- Seed viability index.

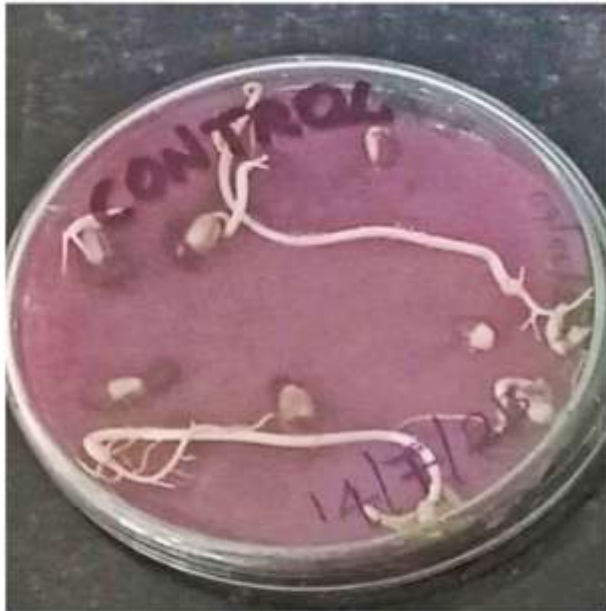


**Fig.2 Root and Shoot growth on the 5<sup>th</sup> day**

## DAY 7

Third observation taken on the 7<sup>th</sup> day and below mentioned parameters were observed,

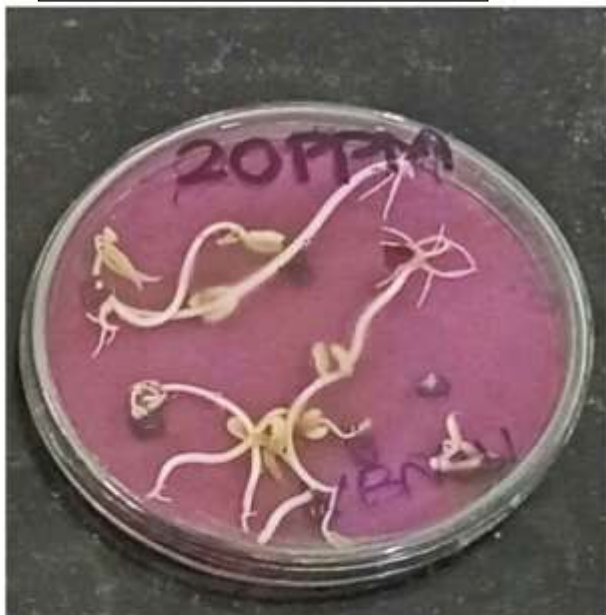
- Germination Percentage
- Shoot length & Root length
- Seed viability index.



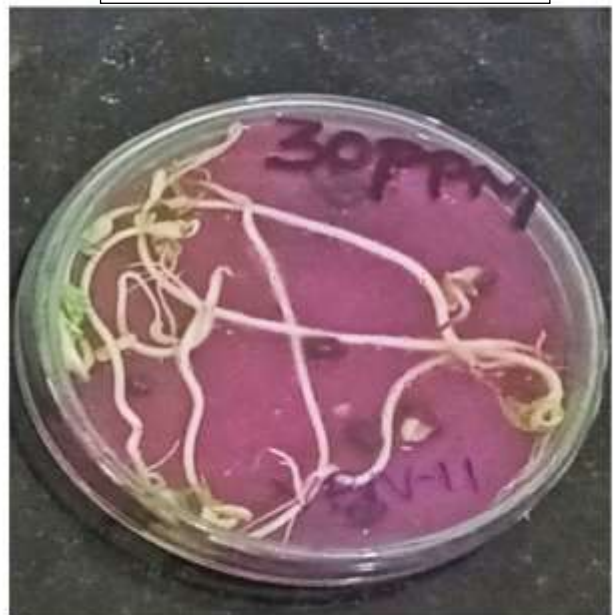
CONTROL



10ppm



20ppm

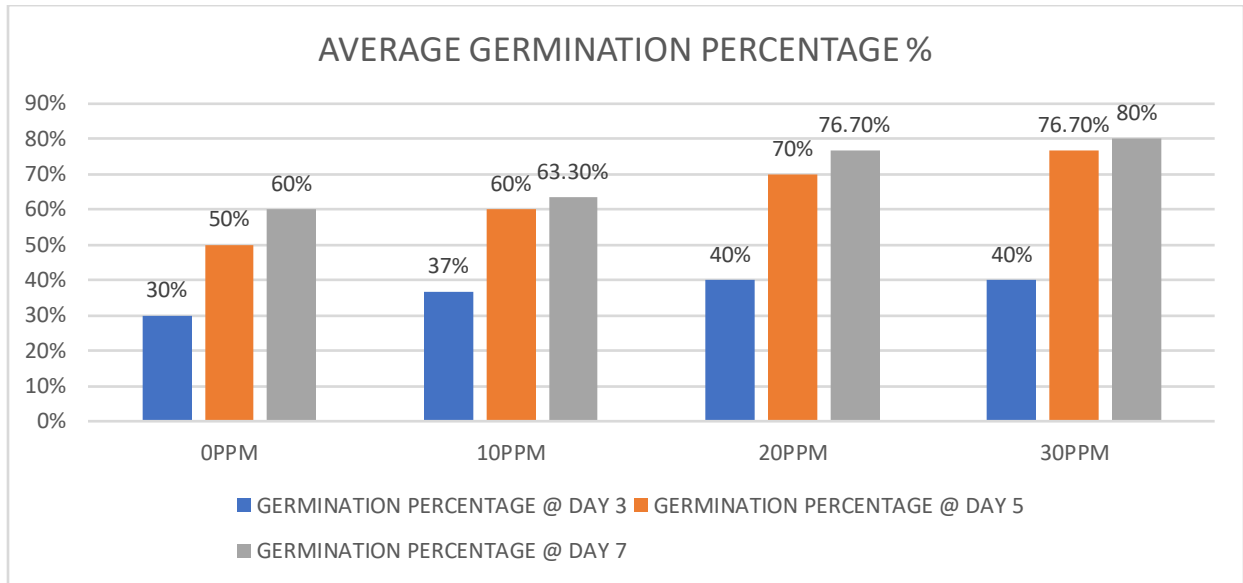


30ppm

Fig.3 Root and Shoot growth at 7<sup>th</sup> day

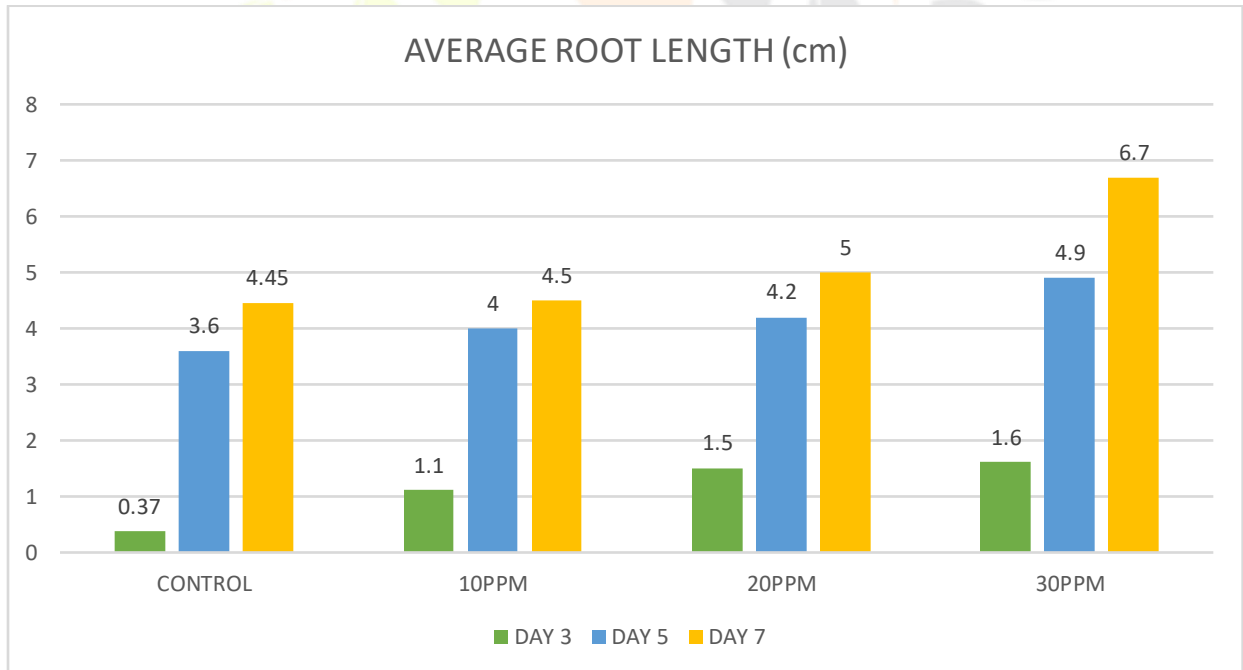
## GRAPHS

### 1. GERMINATION PERCENTAGE (%)



**Fig.4 Average Germination Percentage %**

### 2. ROOT LENGTH (cm)



**Fig.5 Average Root Length (cm)**

### 3. SHOOT LENGTH (cm)

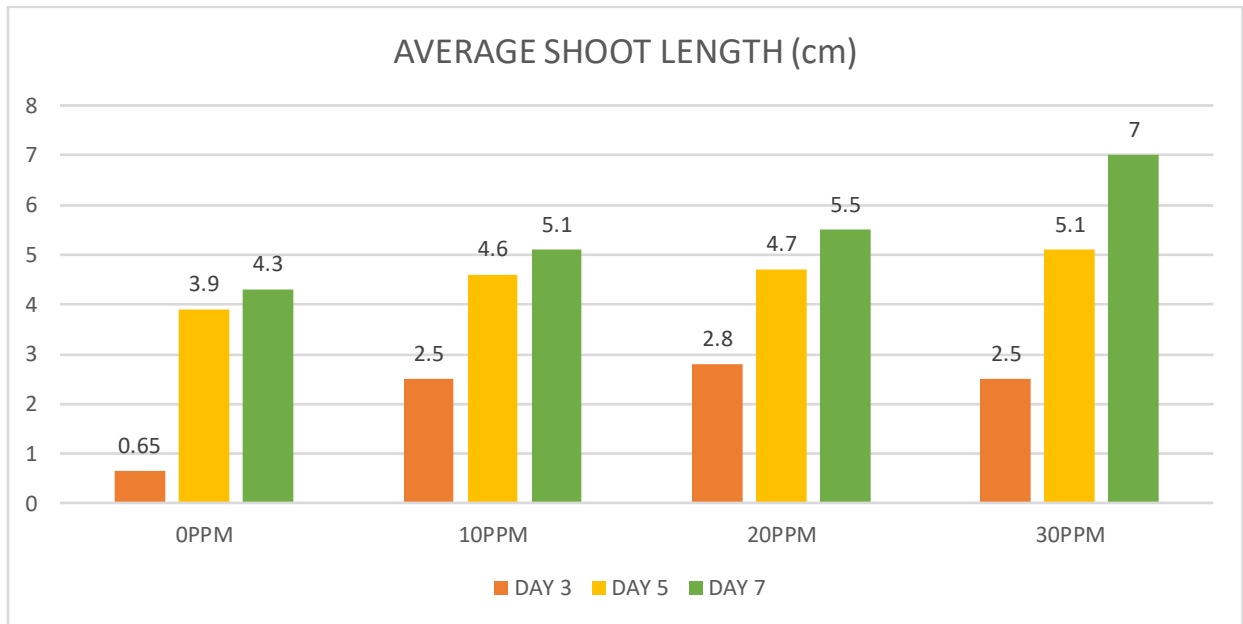


Fig.6 Average Shoot Length (cm)

### 4. SEED VIABILITY INDEX

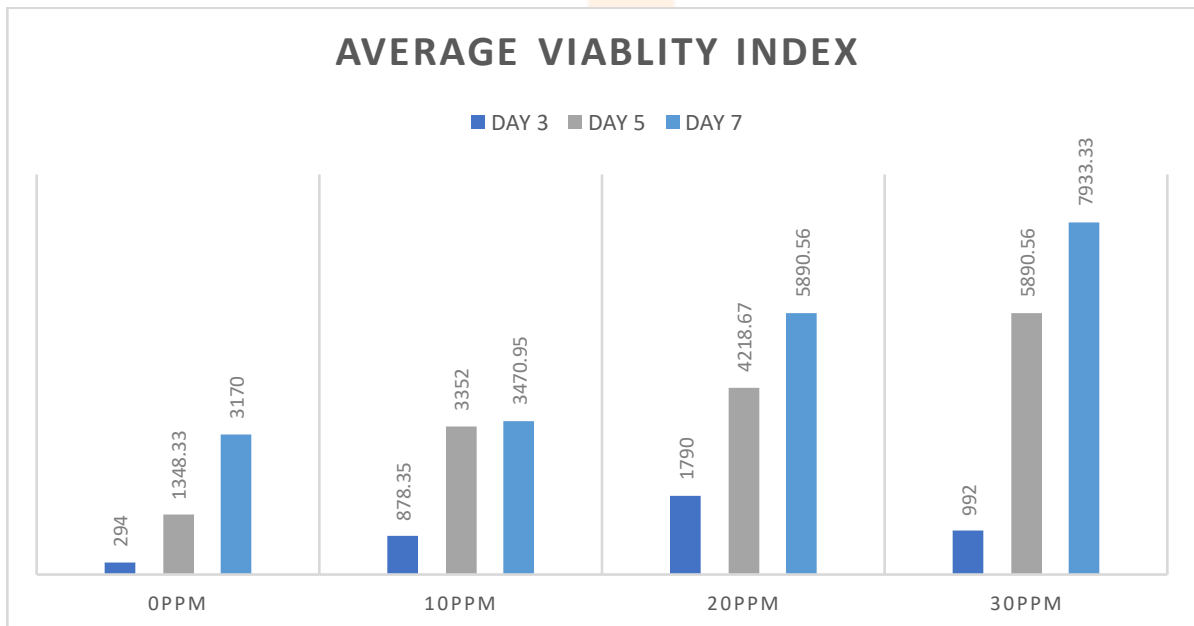


Fig.7 Average Viability Index

## RESULT AND DISCUSSION

The analysis of graphical data derived from the experiment demonstrates a clear positive correlation between the concentration of gibberellic acid (GA) and various parameters related to seed germination and seedling development. As the concentration of GA increased, there was a notable improvement in germination percentage, shoot length, root length, and overall seed vigour index (Chauhan *et. al*, 2019). This trend strongly supports the physiological role of GA in promoting seed germination and enhancing early plant growth.

Gibberellic acid is a plant growth regulator that plays a vital role in various developmental processes, particularly during seed germination. One of its primary mechanisms of action involves the induction of hydrolytic enzymes, especially  $\alpha$ -amylase, in the aleurone layer of cereal grains (Gupta *et. al*, 2013). Upon exposure to GA, the cells in the aleurone layer are stimulated to synthesize and secrete  $\alpha$ -amylase into the endosperm. This enzyme then catalyzes the breakdown of complex starch molecules stored in the endosperm into simpler sugars such as maltose and glucose (Unamba *et. al*, 2009). These sugars are essential energy sources and metabolic precursors that are readily absorbed by the developing embryo to support the rapid cell division and elongation required for seedling growth.

The enhanced availability of soluble sugars due to increased  $\alpha$ -amylase activity directly contributes to improved seed germination and vigour (Hota *et. al*, 2018). In seeds treated with GA, particularly at a concentration of “30 ppm”, the hydrolysis of starch appears to be more efficient, resulting in quicker and more uniform germination. The energy supplied through this process facilitates the emergence of the radicle (root) and the plumule (shoot), leading to increased shoot and root length as observed in the data.

Among the various concentrations tested, the 30 ppm GA treatment consistently recorded the highest values for all measured growth parameters. This indicates that 30 ppm may be the optimal concentration for maximizing the positive effects of GA on seed performance in this particular species or experimental context. While even higher concentrations might further stimulate growth, they may also lead to diminishing returns or potential physiological imbalances. Thus, determining an optimal GA concentration is crucial for practical agricultural applications.

## CONCLUSION

In this study, we concluded that the experimental findings support the hypothesis that gibberellic acid significantly enhances seed germination and early seedling growth through its effect on enzymatic activity and energy mobilization. The observed improvements in germination percentage, shoot and root length, and seed vigour index affirm the effectiveness of GA as a growth promoter. Specifically, the 30ppm concentration yielded the most favourable results, suggesting that this dosage could be recommended for improving seedling establishment and performance. These insights are valuable for both scientific understanding and practical applications.

## ACKNOWLEDGEMENT

There is no conflict of interest among the authors.

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