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INTRODUCTION

Recently increases the demands of the fresh vegetables in day to day life of human being because the vegetable plants and human being have unique relationship since time immemorial and they played vital role in the human life. People should consume several hundred grams of plant-based diet a day since it is a good source of nutrients and dietary fiber. A plant-based diet – focusing mainly on vegetables, fruits and whole grains – has become one of the most important guidelines for lowering the risk of human diseases. Therefore, need to improve the nutritive value of the final products of vegetables plant. The important contributions of the nineteenth Century, experimental plant physiology to agriculture was discovery that soil fertility and crop yields could be increased by adding several nutrients to the soil. Even though crop plants require micronutrients in very minute quantities, their deficiencies may affect fundamental physiological and biochemical processes, leading to drastic reductions in yield. Hence, some common fertilizers are used to increase the crop production. One of the most important and common fertilizers in them is urea. It is also called as the king of fertilizers since it has the ability to supply plants with adequate nitrogen and it can adapt to all types of soils.

AIM OF THE PROJECT

To study the effect of different concentrations of urea on the rate of germination, elongation of hypocotyl and the length of root.

HYPOTHESIS

Fertilizers like urea increase the growth rate of plants, both epigeal and hypogeal. However there is a limit to nutrient intake and excess use of fertilizers can have negative effects on plant growth.

GERMINATION OF SEEDS

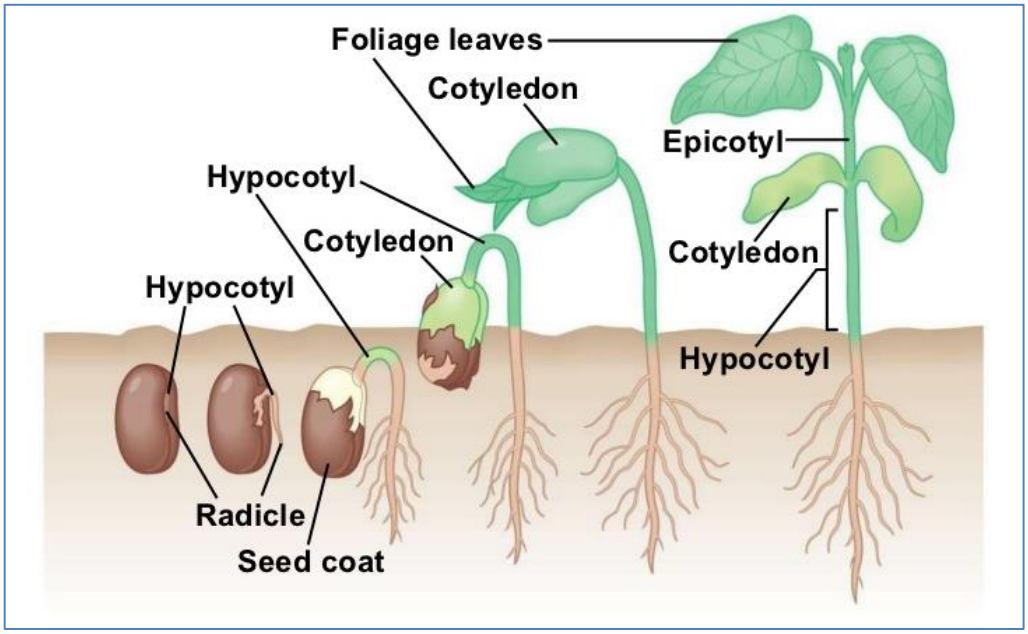

Figure 1. Seed Germination stages

Germination is the beginning of growth of a seed. The seed must have the right level of warmth and moisture to begin to germinate. First, the seed leaves absorb moisture which allows the food reserves to become available to the new plant. It can then produce a root so that it can find its own water, followed by a shoot which develops from the plumule, which will allow it to absorb light. The plant needs both water and light to grow.

Different structures seen during the formation of seedlings from the seed after the germination of seed.

1. **COTYLEDONS-** It is the embryonic leaf in seed-bearing plants, one or more of which are the first leaves to appear from a germinating seed.
2. **HYPOCOTYL** – The part of shoot below cotyledons is called hypocotyls.
3. **EPICOTYL-** The part of shoot above cotyledons is called epicotyls.
4. **RADICLE-** The radicle is the first part of a seedling (a growing plant embryo) to emerge from the seed during the process of germination.

Sometimes, the seed leaves, or cotyledons, remain below the surface of the soil, as in germination of a Pea, below. This is called **Hypogeal Germination**.

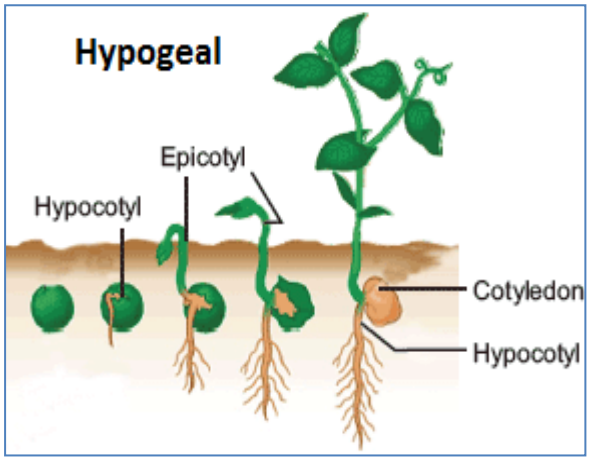

Figure 2. Epigeal Germination

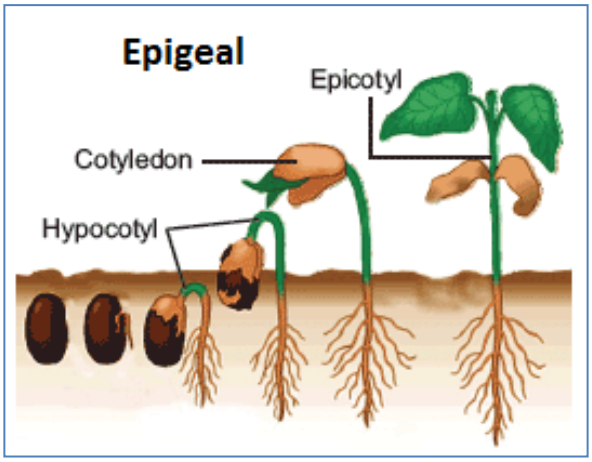

Figure 3. Hypogeal Germination

In some species, the seed leaves remain on the new shoot and are brought above the ground, as in germination of the Ash tree, below. This is called **Epigeal Germination**.

Factors Affecting Seed Germination

Some of the major factors necessary for seed germination in plants are as follows:

External Factors:

1. Water

Germination cannot occur unless and until the seed is provided with an external supply of water.

Water is absorbed by a dry seed through the micro Pyle and the seed coat. Water performs a number of functions during the germination of seeds.

(a) It softens seed coat and makes it permeable. Increased permeability allows better gaseous exchange.
(b) Water activates the protoplasm of the seed cells.
(c) Insoluble food materials get solubilised in the presence of water which then diffuses from the storage region to the embryo axis.
(d) Several enzymes which are essential for growth and germination develop only in the presence of water.

2. Oxygen

Aeration of the soil is absolutely necessary for the germination of the seed because oxygen is necessary for the aerobic respiration by which the seeds get the requisite energy for the growth of the embryo.

3. Temperature

Seeds normally germinate within a wide temperature range. However, freshly harvested seeds of several plants germinate only within a narrow temperature range which widens only when after-ripening has taken place.

4. Light

Plants differ as to the effect of light on their germination. Seeds of many plants are light indifferent or nonphotoblastic, i.e., they are not influenced in the germination by the presence or absence of light. Most of our important crop plants belong to this category. The seeds which are affected by light are described as photoblastic.

Sensitivity to light is a specific character. The photoblastic seeds are of two types, positively photoblastic or light sensitive and negatively photoblastic or light hard. The positively photoblastic seeds require light for germination, e.g., lettuce, tobacco, many grasses and several epiphytes. The negatively photoblastic seeds cannot germinate in the presence of light e.g., Tomato, Onion, Lily, etc.

5. Other factors

Many orchids and other plants exhibit seed germination only when an appropriate fungus partner is available. Seeds of some parasitic plants will similarly grow only in the vicinity of their host roots because the latter excrete certain growth hormones. Seeds of some aquatic plants germinate only at low or acidic pH.

Internal Factors:

1. Vitality

The ability of a seed to germinate when provided with optimum condition is described as vitality of the seeds. It is dependent upon its stored food, size, health, etc.

2. Longevity or viability

With the passage of time a seed looses it power to germinate. Thus each seed has longevity or a period within which it can show renewal of growth or germination. Most of the crop plants lose their viability within 2-5 years.

Legumes ordinarily retain their viability for longer periods. A number of seeds have been recorded to remain viable even after 100 years,

(e.g., Trifolium, Astragalus, Mimosa species). Many species remain viable only for one season, e.g., Birch, Elm, tea.

3. Dormancy

It is due to the internal conditions of the seed. It is, therefore, also described as the inhibition of the germination due to the internal conditions in an otherwise viable seed. These internal restrictions must be offset before germination can occur in dormant seeds.

Urea And Its Effects On Plants

Urea is an inexpensive form of nitrogen fertilizer with an NPK (nitrogen-phosphorus-potassium) ratio of 46-0-0. Although urea is naturally produced in humans and animals, synthetic urea is manufactured with anhydrous ammonia. Although urea often offers gardeners the most nitrogen for the lowest price on the market, special steps must be taken when applying urea to the soil to prevent the loss of nitrogen through a chemical reaction.

How to Use Urea

Figure 4. Urae Granules

When urea is placed on the surface of the soil, a chemical reaction takes place that changes the urea to ammonium bicarbonate. The ammonium will convert into a gas, which is then lost if not protected. This means that urea should be mixed in with the soil for maximum effectiveness. This may be done either by broadcasting the urea then plowing it into the soil immediately or by injecting the urea into the soil. This may also be done by broadcasting urea then irrigating heavily to push dissolved urea into the soil.

Advantages of urea

In general, urea will provide the most nitrogen at the lowest cost. It is easy to store and does not pose as a fire risk for long-term storage. Urea may be mixed with other fertilizers or may be applied on its own. For plants that love acidic soils, urea is one of the top fertilizers for acidifying soils. For gardeners who grow crops like corn, strawberries, blueberries and other heavy nitrogen feeders, urea will supply immediate and powerful applications of nitrogen.

Negative Effects of Chemical Fertilizers

The biggest issue facing the use of chemical fertilizers is groundwater contamination. Nitrogen fertilizers break down into nitrates and travel easily through the soil. Because it is water-soluble and can remain in groundwater for decades, the addition of more nitrogen over the years has an accumulative effect.

At the University of Wisconsin, Madison, they discovered the effects of chemical fertilizers are compounded when mixed with a single pesticide. They discovered altered immune, endocrine and nervous system functions in mice, as well as influence on children's and fetus's developing neurological, endocrine and immune systems. These influences "portend change in ability to learn and in patterns of aggression."

One popular fertilizer, urea, produces ammonia emanation, contributes to acid rain, groundwater contamination and ozone depletion due to release of nitrous oxide by denitrification process. With its increased use and projections of future use, this problem may increase several fold in the coming decades.

Groundwater contamination has been linked to gastric cancer, goitre, birth malformations, and hypertension[3]; testicular cancer[4] and stomach cancer.

Excessive air- and water-borne nitrogen from fertilizers may cause respiratory ailments, cardiac disease, and several cancers, as well as can "inhibit crop growth, increase allergenic pollen production, and potentially affect the dynamics of several vector-borne diseases, including West Nile virus, malaria, and cholera."

Perhaps one of the scariest effects of chemical fertilizers is something called methemoglobinemia. In infants it is alternatively known as Blue Baby Syndrome. The risk most often occurs when infants are

given formula reconstituted with nitrate contaminated water. The condition causes a decrease in oxygen in the blood and results in a blue-grey skin color, causes lethargy and/or irritability and can lead to coma or death.

Nitrogen groundwater contamination also contributes to marine "dead zones". The increase in the water-soluble nitrates creates an influx of plant-life, which eats up oxygen and starves out fish and crustaceans. This has an impact not only on the aquatic ecosystem, but on local societies who depend on food sourced from those areas.

APPARATUS REQUIRED

- ✓ Bean seeds
- ✓ Five petri dishes
- ✓ Beaker
- ✓ Cotton
- ✓ Measuring cylinder
- ✓ Weighing balance
- ✓ Urea as the fertilizer

PROCEDURE

1. Around 10 bean seeds were soaked in water for a day.
2. Five Petri dishes A, B, C, D and E were taken and moist cotton was kept in them.
3. Different concentrations i.e. 0.5%, 1.5%, 2.5% and 3% solutions of urea were made by dissolving 0.5 gm, 1.5 gm, 2.5gm, 3gm, of urea in 100ml of water respectively.
4. Two castor beans were put in each Petri dish. 0.5%, 1.5%, 2.5% and 3% of prepared urea solution was put in 4 Petri dishes A, B, C, D respectively. No urea was put in E as it is the control.

OBSERVATION

S. No	Features	Days	Control	Fertilizers (Urea)			
				0.5%	1.5%	2.5%	3%
1	Length of hypocotyl (in cm)	1	1	1.5	2.0	1.4	0.8
2		2	1.5	2.5	2.8	2	1.5
3		3	2.2	3.8	4.0	2.5	1.8
4		4	2.6	4.6	5.0	2.8	2.0
1	Length of root(in cm)	1	2.2	2.8	2.6	2.3	2.1
2		2	3.4	4.0	3.6	3.0	2.8
3		3	5.0	5.3	4.8	4.0	3.7
4		4	7.0	6.8	5.8	5.2	4.7

Figure 5. Control Plant

Figure 6 Plant B with low urea concentration

Figure 7. Plant D with high urea concentration

INFERENCE

In the first day of observation the length of hypocotyl of the control was around 1 cm and showed normal growth on successive days. On the other hand in the plant where only 0.5% urea was used grew faster than the control.

The plant having a slightly high concentration of urea i.e. 1.5% grew even faster and better, producing impressive results. The length of its hypocotyl reached around 3 cm on the fourth day. This accounts to four times the normal growth rate of the hypocotyl of the control.

Surprisingly the plant with 2.5% of urea content was not able to grow as fast as the one with 1.5% urea. This contradicts the assumption that high concentration of urea implies high growth rate. This in other words means that there is always a capacity to nitrogen intake in plants.

The last plant with 3.0% urea showed negative growth results to our surprise. It had stunted growth of hypocotyl, even less than the control. Although the hypocotyl grew quickly in case of the plants with high urea concentration their leaves were very late to grow properly. The leaves of the control grew properly. This observation depicts the negative effects of excess urea on plant growth.

The scenario was a bit different when the root of the plants was accounted for.

The plant with 0.5% urea accounted for 2.8cm of root length on the first day of observation, only 0.6cm more than that of the control.

In the plant where 1.5% of the urea was used, showed a better root growth than control and the one with only 5% urea.

But the plant with 2.5% urea and 3.0% urea showed less growth than the first two.

The last plant with 3.0% urea showed lesser root growth even in comparison with the control.

Hence our hypothesis that there is always a capacity for nitrogen intake holds true and high nitrogen intake affects the plants too in many ways. Most importantly it was noticed from observations that in the plants where urea was used, the difference in root lengths in successive days more compared to that of control. In other words the length of root in successive days increased.

CONCLUSION

Fertilizers like urea when used in the required concentrations increase the growth rate and are very useful as far as productivity is concerned. However, when they are used in excess, may harm the plants in many ways. Additionally they can have harmful effects to the environment as well. Most of the chemical fertilizers are discharged to natural water reservoirs and pollute the water. This can prove fatal on drinking. Also the qualities of foods are affected due to chemical fertilizers. Hence organic farming should be encouraged for a better yield as well to ensure our healthy lifestyle and environment.