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EFFECT OF GROWTH HORMONES ON SEED GERMINATION OF SOME MEDICINAL PLANTS OF GENUS *TERMINALIA*

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Abstract: Seed germination is controlled by a number of mechanisms and is necessary for the growth and development of the embryo, resulting in the production of a new plant. Under unfavorable conditions seeds may become dormant (secondary dormancy) to maintain their germination ability. However, when the conditions are favorable seeds can germinate. There are a number of factors controlling seed germination and dormancy, including plant hormones, which are produced by plant. Three growth hormones i.e. IAA (Indol Acetic Acid), Gibberellins and 2, 4-D with different concentrations i.e. 10, 20 and 30 ppm were afforded to study their effects on the germination of seeds of four medicinally important plants. i. e. *Terminalia cuneata* Roth., *Terminalia bellerica* Roxb., *Terminalia chebula* Retz. and *Terminalia catappa* Linn.

Keywords: Growth hormones, seed germination, *Terminalia*

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INTRODUCTION

Among the most important functions of plant hormones is controlling and coordinating cell division, growth and differentiation (Hooley, 1994). Plant hormones can affect different plant activities including seed dormancy and germination (Graeberet al., 2012). Plant hormones including abscisic acid (ABA), ethylene, gibberellins, auxin (IAA) and cytokinins are biochemical substances controlling many physiological and bio-chemical processes in the plant. These interesting products are produced by plants and also by soil microbes (Finkelstein, 2004; Jimenez, 2005; Santner et al., 2009). There are hormone receptors with high affinity in the plant, responding to the hormones. Eukaryotes and prokaryotes can utilize similar molecules, which act as hormone receptors (Urao et al., 2000; Hwang and Sheen, 2001; Mount and Chang, 2002; Santner et al., 2009).Before a seed can germinate a set of stages must be completed including the availability of food stores in the seed. Such food stores include starch, protein, lipid and nutrients, which become avail-able to the seed embryo through the activity of specific enzymes and pathways (Miransari and Smith, 2009). Seed development includes the formation of the embryo body by cell division and differentiation, resulting in the formation of embryonic organs (Goldberg et al., 1994; Meinke, 1995). This period covers the maturation of seed, including the formation of organs and nutrient storage, as well as changes in the embryo size and weight, followed by the acquisition of desiccation tolerance and dormancy (Finkelstein, 2004; de Castro and Hilhorst, 2006).

The plant world comprises a rich store house of biochemical that could be trapped for the welfare of mankind. India is a rich source of plant wealth, which is due to its varied geographical and climatic conditions. India contains a great wealth of biological diversity in its forests. Among ancient civilization India has been known to be rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants which are largely collected as raw materials for manufacture of drugs and perfumery products. The knowledge about the use of medicinal plants has been acquired through centuries and such plants are still valued even today. Establishment of herbal forms in well selected localities will exercise scientific control over the cultivation of medicinal herbs (Kirtikar and Basu, 1988). It is necessary to study medicinal plants scientifically by their anatomical, physiological, biochemical, taxonomical, genetical and molecular aspect. Plants have always played a major role in the treatment of human traumas and diseases worldwide (Principe*et. al.,* 1991). They have been used as sources of modern drugs, either by providing pure compounds, starting materials for partial synthesis of useful compounds or models for synthesis of drugs (Hansel, 1972). According to the World Health Organization (WHO) as much as 80 % of world's population depends on traditional medicine for their primary health care needs (Azaizeh *et al.* 2003).All human beings required a number of complex organic /inorganic compounds in diet to

meet the need for their activities. The important constituents of diet are carbohydrates, fats, proteins, vitamins, minerals and water (Indrayan *et al.,* 2005). According to(New Wall *et al*.,1996), every constituent plays an important role and deficiency of any one constituent may lead to abnormal developments in the body. Plants are the rich source of all the elements essential for human beings.

MATERIALS AND METHODS –

Three growth hormones i.e. IAA (Indol Acetic Acid), Gibberellins and 2, 4-D with different concentrations i.e. 10, 20 and 30 ppm were afforded to study their effects on the germination of seeds of four medicinally important plants. i. e. *Terminalia cuneata* Roth, *Terminalia bellerica* Roxb*. Terminalia chebula* Retz .and *Terminalia catappa* Linn*.*

RESULTS AND DISCUSSION -

***Terminalia cuneata* Roth. -**For every treatment, ten seeds were set for germination of *Terminalia cuneata* Roth*.* In IAA, 2 seeds were germinated at 10 ppm in 4 days, while the percentage of seed germination was found 20 % (SGP^{4}_{20}). At 20 ppm 3 seeds were germinated in 4 days, while the percentage of seed germination was 30 % (SGP^{4}_{30}) and at 30 ppm, 5 seeds were germinated in 6 days and the percentages of seed germination was 50 % (SGP^{6}_{50}). While Gibberellic acid in 10 ppm 3 seeds were germinated and it takes 6 days for germination and the percentage of seed germination was 30% (SGP^{6}_{30}). 4 seeds were germinated at 20 ppm and 30 ppm respectively and the percentage of seed germination was 40 % (SGP^{7}_{40}) at each ppm in 7days.In 2, 4-D, out of 10 seeds, 2 seeds was germinated in 8 days at 10 ppm concentration, where percentage of seed germination was 20 % (SGP^{8}_{20}). At 20 ppm only one seed was get germinated in seven days, where percentage of seed germination was 10 % (SGP^{7}_{10}). At 30 ppm, observation was recorded that, in 11 days not a single seed was germinated, so the percentage of seed germination was zero percent was recorded i.e. the growth was inhibited. In IAA (30ppm) treated seedlings induced in enlargement in shoot and leave, while in Gibberellic acid treated seedlings induce in only stem elongation. In 2, 4-D 10, 20 and 30 ppm the seeds were germinate, but root and shoot were not developed. In 2, 4-D treatment in seedlings cell formation and elongation takes place but cell differentiation was not proceeds (Table No.1).

***Terminalia bellerica* Roxb.-**The seeds of *Terminalia bellerica* when treated with IAA, 3 seeds were germinated at 10 ppm. Concentration in 7 days. Same results were observed with 20 ppm. Concentration also i.e. in 7 days, 3 seeds was germinated. The percentage of seed germination in both concentrations i.e. 10 and 20 ppm were found 30% (SGP^{6}_{30}). 4 seeds are germinated in 6 days at 30 ppm concentration when treated with IAA. The percentage of 6 seed germination was 40% (SGP^{6}_{40}). In Gibberllic Acid only 2 seeds were germinated, and it takes 6 days for

germination at 10 ppm concentration of G.A. and the percentage of seed germination was noted 40 % (SGP^{6}_{40}). In 20 ppm concentration, 3 seeds get germinated in 8 days, the percentage of seed germination at this concentration was noted 30% (SGP^{6}_{30}), while 4 seeds were germinated in 7 days in 30 ppm concentration of G.A., the percentage of seed germination was 40% (SGP^{6}_{40}). In 2, 4-D at 10 ppm concentration, 2 seeds were germinated out of 10 in 7 days, the percentage of seeds germination was 20 % (SPG^{6}_{20}). While in 20 ppm concentration, 3 seeds were germinated in 6 days and the percentage of seed germination was 30 % (SPG^{6}_{30}), at 30 ppm concentration of 2, 4-D, seed germination was totally inhibited, in 11 days not a single seed was germinated out of 10 seeds. In seedling of *Terminalia bellerica* Roxb. Which was treated with IAA, there were elongation in root was takes place in 7 days, in 10 and 20 ppm. Concentration, while in G.A. at 10, 20 and 30 ppm concentration seeds were germinated, shoot and root were well developed in 2, 4-D treated seeds, germination takes place but root and shoot formation not differentiated (Table No.1).

***Terminalia chebula* Retz.-** The seeds of *Terminalia chebula* Retz. When treated with IAA in 10 ppm concentration only one seed was get germinated in 6 days i.e. 10 % (SPG^{6}_{10}). In 20 ppm concentration out of 10 seeds, only 3 seeds were germinated in 8 days, i.e. 30 % of seed germination took place (SPG^{6}_{30}). In 30 ppm concentration 3 seeds were germinated in 9 days, i.e. again 30% of seed germination took place (SPG^{6}_{30}). When seeds of *Terminalia chebula* Retz. Were treated with Gibberelliic acid. The percentage of seed germination was found 20 %, 30 % and 30 % at 10 ppm, 20 ppm, and 30 ppm concentrations respectively. Two seeds were germinated in 7 days at 10 ppm concentration (SPG^{6}_{20}) and three seeds were germinated in 6 days at 20 ppm concentration. (SPG^{6}_{30}), where as in 30 ppm concentration, percentage of seed germination was 30 % i.e. three seeds were germinated in 8 days. (SPG^{8}_{30}). The seeds of Terminalia *chebula* Retz., when treated with 2, 4-D growth hormone at different ppm concentration i.e. at 10 ppm, 20 ppm and 30 ppm concentrations, it was found 20 % and 10 % seed germination treated with 10 ppm concentration and 20 ppm concentration respectively, 2 seeds get germinated in 7 days (SPG^{7}_{0}) and only one seed was geminated in 7 days i.e. (SPG^{7}_{10}).), whereas in 30 ppm concentration the percentage of seed germination was found to be zero percent and no one seed was get germinated in 11 days, therefore (SPG^{11}_{0}). When seeds of *Terminalia chebula* Retz. Were treated with distil water and served as control, the percentage of seed germination was 30 %, that 3 seeds were germinated in 9 days (SPG^{9}_{30}). In the treatment of 10 ppm concentration of IAA, this seedling showed enlargement in shoot and root as compare to 20 and 30 ppm concentration, where as in 10 ppm concentration of GA the seedling produced leaf lamina, as compared to 20 and 30 ppm concentration. In 2, 4-D treatment, the leaf lamina was observed, and it was found reduced in all concentrations compare to control (Table No.1).

***Terminalia catappa* Linn. -**When the seeds of *Terminalia catappa* Linn. treatedwith10 ppm concentration of IAA, three 3 seeds get germinated in 9 days, i.e. 30 % of seed germination was found (SPG^{9}_{30}), whereas there was 50 % of seed germination was found in both 20 ppm and 30 ppm concentrations. In both concentrations, 5 seeds germinated in 8 and 7 days ($SPG^{8}_{50,}$ SPG^{7}_{50}) respectively. In gibberllic acid at 10 ppm concentration 4 seeds germinated in 7 days i.e. 40 % of seed germination took place (SPG^{7}_{40}), whereas it was found 50 % of seed germination and 5 seeds were germinated out of 10 at 20 ppm concentration in 6 days (SPG^{6}_{50}) and in 30 ppm concentration in 6 days, 6 seeds were germinated, the percentage of germination was 60 % (SPG^{6}_{60}).When seeds were treated with 2, 4-D at 10 ppm concentration, two seeds were germinated in 8 days, and 20 % of seed germination took place. (SPG^{8}_{20}), where as in 20 and 30 ppm concentrations in both 3 seeds were germinated in 6 days and the percentage of seed germination, was 30% in both concentrations (SPG^{6}_{30}). When seed germination was studies in distil water, as control, percentage of seed germination was found 40 % in seedling of *Terminalia catappa* Linn. Treated with IAA Showed elongation in roots, in 10 and 20 ppm concentration, while in G. A., in 10 and 20 ppm concentration seeds were germinated and in 30 ppm concentration shoot and root formation took place. In 10 ppm concentration seedling showed large leaf lamina and stem elongation more, compare to 20 ppm concentration. In 2, 4-D treatment, seeds were germinated, but root and shoot formation not differentiated well. (Table No.1)

CONCLUSION –

Seed germination and dormancy are important processes affecting crop production. These processes are influenced by a range of factors, including plant hormones. Plant hormones produced by both plants and soil bacteria, can significantly affect seed germination. The collection of plant hormones, including IAA, 2-4-D and gibberellins, can positively or adversely affect seed germination, while interacting with each other. Different concentration of hormones of IAA and Gibberellin enhance the seed germination of some plants of genus *Terminalia*, comparatively than 2-4- D and distilled water. Future research could beneficially focus on how the combination of appropriate agricultural strategies and biological methods, such as use of Plant hormones, can provide a proper medium for the germination and growth of seeds under a range of conditions. More details have yet to be indicated related to hormonal signaling during seed germination and seed biology. For example, how it is possible to regulate seed germination at dormancy and how the speed of seed germination may increase by adjusting seed behavior under different conditions.

Table No.1: Effect of hormones on seed germination of*1) Terminalia cuneata*Roth.2) *Terminalia bellerica* Roxb.3) *Terminalia chebula* Retz. *And 4) Terminalia catappa* Linn.

Sr. No.	Growth hormones	Ppm.	Total seeds put for germination				Days for germination				Total seeds germinated				Percentage of seed Germination%			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Auxin (IAA)	10	10	10	10	10	04	07	06	09	02	03	01	03	20	30	10	30
		20	10	10	10	10	04	07	08	08	03	03	03	05	30	30	30	50
		30	10	10	10	10	06	06	09	07	05	04	03	05	50	40	30	50
2	Gibberellic Acid	10	10	10	10	10	06	06	07	07	03	02	02	04	30	20	20	40
		20	10	10	10	10	07	06	06	06	04	03	03	05	40	30	30	50
		30	10	10	10	10	07	07	06	06	04	04	03	06	40	40	30	60
3	2,4-D	10	10	10	10	10	08	04	05	08	02	02	02	02	20	20	20	20
		20	10	10	10	10	07	06	06	06	01	03	01	03	10	30	10	30
		30	10	10	10	10	09	06	09	06	00	00	00	03	00	00	00	30
4	Control with Distil Water	--	10	10	10	10	08	08	08	08	03	03	03	04	30	30	30	40

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