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ONION BULB GROWING DUE TO PRESENCE OF APICAL MERISTEM - A REVIEW STUDY

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***Abstract*:** A tissue is a group of cells which are similar for structure and origin and perform similar function.In this study we are going to deal about the meristematic tissue of green gram and onion bulb. The study was conducted in our school laboratory. The growth of green gram and onion bulb's meristematic tissue was observed and it was interrupted in the tabular column. The changes in the meristematic cell of green gram was observed. Cutting the root tip of the onion bulb stops the meristematic cell. Due to the presence of the meristematic tissue in green gram and onion bulb it is applied in the medical field for the treatment of some diseases.

***Key words*:** Meristematic tissue, apical meristem, intercalary meristem, lateral meristem, Growth of onion roots experiment

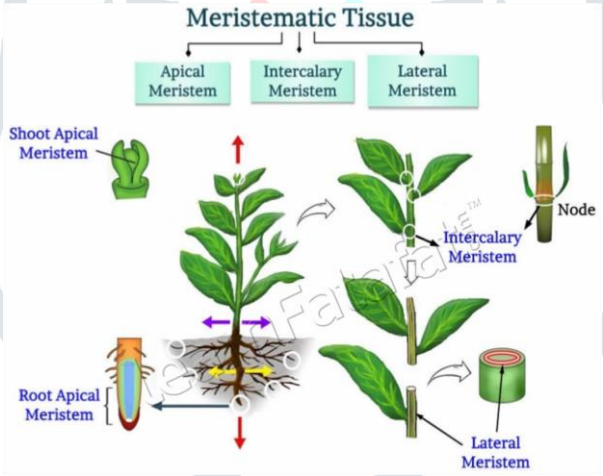
Introduction:

Meristematic tissues are the tissues in which the cells divide continuously and help in increasing the length and girth of the plant. According to their position in the plant, meristems are of three types: 1) **Apical Meristems**, 2) **Lateral Meristems,** These are responsible for the growth of cambium and hence increases the girth of the plant. 3) **Intercalary Meristems.**
(https://byjus.com/question-answer/what-are-meristematic-tissues-explain-with-the-help-of-suitable-diagram-give-their-classification-on/)
Apical meristem is present on root and shot tips of the plant and increases the height of the plant. This tissue divides and results in growth of stem and roots of the plant. Intercalary meristem is present on leaf base and nodes.It increases the length of the plant.Lateral meristem is responsible for increase in circumference,These are found beneath the bark and in vascular bundles of dicot roots and stems. i.e. Girth of the stem or root of the plant.
(https://edurev.in/studytube/Meristematic-Tissue-in-Plants-Class-9/97efeae8-80d2-4b32-a6fa-c6d926eb47a1_t#:~:text=Observation%20of%20Onion%20bulb%20experiment,the%20root%20tips%20were%20removed2)
Meristematic tissue converts to permanent tissue through a process called differentiation. The process of taking up a permanent shape, size and specific function is called differentiation. One of the parameters aggravating root loss is contagion. When the rotten bulbs are not quickly detected, their decomposition generates a liquid. (especially before the first six months when the bulbs always contain a "high" rate of water) which humidifies the healthy bulbs resulting in the same way their deterioration. Therefore, to reduce the influence of contagion, it is desirable to reduce the intervals between sorting. Tissues are groups of cells that perform the same functions. Thus, tissues are classified in two types: plant tissue and animal tissue. Plant tissue is classified into meristematic tissue, simple, permanent tissue and complex permanent tissue.Growth in plants occurs in specific regions. These regions are apical, lateral and intercalary.
(https://edurev.in/studytube/Meristematic-Tissue-in-Plants-Class-9/97efeae8-80d2-4b32-a6fa-c6d926eb47a1_t#:~:text=Observation%20of%20Onion%20bulb%20experiment,the%20root%20tips%20were%20removed).
These regions contain fast-dividing cell groups called meristematic tissues. When we cut the onion root tip, the apical meristem tissues are cut off. The apical meristem is the main dividing tissue in the root and shoot which

increases the length. As a result, the growth of roots is stopped in these roots. Meristematic Tissues in Plants tissues are groups of cells that perform the same functions. Thus, tissues are classified in two types: plant tissue, animal tissue. Plant tissue is classified into meristematic tissue, simple permanent tissue and complex permanent tissue. The group of similar or dissimilar cells that work together to perform a specific function and also have the same origin are called tissues. On the basis of capacity to divide, there are two types of plant tissues. They are Meristematic tissues and Permanent tissues.

Meristematic tissues

Meristematic tissues are the specialised regions in the plant where the active cell division takes place and the growth is restricted to this region. The tissues present in the meristem are called meristematic tissues. These tissues are a group of immature and similar cells. They are also undifferentiated cells which remain in the state of continuous division. Meristems are classified on the basis of their position in the plant body, origin and development and their function. Additionally, all cells within meristematic tissue are living, while other plant tissue can be made of both living and dead cells. Meristematic cells have thin cell walls, small or no vacuoles, which are stored organelles, and large prominent nucleus. This compares to the thick walls and small nucleus of programmed cells, which also have one or more large vacuoles. Also, meristematic cells contain a significant volume of dense liquid, while specialised cells have only a small quantity of thick liquid. Meristems are classified by their location in the plant as apical (located at root and shoot tips), lateral (in the vascular and cork cambia), and intercalary (at internodes, or stem regions between the places at which leaves attach, and leaf bases, especially of certain monocotyledons - e.g., grasses).Meristems form a new form from other cells in injured tissues and are responsible for wound healing. Unlike most animals, plants continue to grow throughout their entire life span because of the unlimited division of meristematic regions. Meristematic tissue is responsible for the growth of plants. Meristematic tissue has the ability to divide and redivide to provide growth plants [2]. Generally, growth of plants occurs from specific regions like root and shoot, nodes, girth of stem, leaf base etc.



[2].

Meristematic tissue growth in (a) Green Gram and (b) Onion bulb

a. Materials Required: Green beans, Distilled water, Aceto-orcein stain, Tissue paper (or) Filter paper
b. Materials Required: Two Beakers or jar (jar 1 & jar 2), water, two Onion

a. Aim: To prepare microscope slides of zone of cell division, zone of cell differentiation.
b. **Aim:** To observe the different stages of mitosis in onion root tip. To study and demonstrate mitosis by preparing to mount onion root cells.

Meristematic tissue growth Procedure:

(a) Green gram: Soak the green grams overnight as shown in the figure:1.Cut the end of the root about 10mm. Soak the end of the roots in a mixed solution of 25% acetic acid and 75% of the ethanol for 30 seconds, Using a knife, obtain a longitudinal section of a root cutting, Wash the cutting by using distilled water. Then, place the cutting in a drop of distilled water on the glass slide and close it with the cover slip. Stain the sample by using aceto-orcein stain within 30 sec to 1 minute. Remove the bubble form in the slide and clean it from excessive

stain, Observe the slide. Start with low magnification and followed by higher magnification which is the Meristematic Tissue.


Fig:1


Fig:2


Fig:3

Fig:4

Meristematic tissue growth Procedure:

(b) Onion bulb: Meristematic tissue can divide and re-divide up to an extent, after this they lose the ability to divide, thereby, converting into permanent tissue. Growth in plants with meristematic tissue can be easily demonstrated experimentally with the help of onion bulbs. Take two jars (jar 1 & jar 2) filled with water, Take two onion bulbs (with roots protruding from them) and place one in each jar. Pour water into the jars until the jars are nearly full. Place the two onions with their roots immersed in the water into each of the jars as shown in the picture. Measure the length of the roots on day 1, 2 and 3. After a few days we observe that both the roots have grown to a certain length. On day 4, take onion bulb out of the jar 2 and cut the tip of the root by about 1 cm. Place it again in the jar and observe the growth of roots in both jar 1 and jar 2 for another 5 days. Mark the jar of the root- trimmed onion bulb [7]. Observe the growth of roots in both the bulbs for a few days. Measure the length of roots on days 1, 2, and 3.

Observe changes occurring in onion bulbs after 2 days. Cut the root tips of the onion bulb in a second jar and observe it after 3 days. After a few days we observe that both the roots have grown to a certain length. Onion bulb out of the jar 2 and cut the tip of the root by about 1 cm. Place it again in the jar and observe the growth of roots in both jar 1 and jar 2 for another 5 days. Mark the jar of the root- trimmed onion bulb.

(a) Observation of meristematic tissue in Green gram:

Fig: 5 (https://www.youtube.com/@ezonesensei7392)

(b) Observation of onion bulb experiment:

This experiment suggests that plant growth appears from a specific region. At first jar roots were uncut, hence, the growth of root tips did not stop. However, in the second jar root steps were cut i.e., Apical Meristem from the root tips were removed. As a result, the growth of the roots of the onion bulb in the second jar stopped. There will be a difference in the length of the roots. The root-trimmed onion's root (in jar 2) is shorter in length than the un-trimmed one (in jar 1). Tips of the plant roots contain apical meristematic tissue and are responsible for the elongation or length of the roots. As the tip of the onion roots in jar 2 is cut, apical meristematic tissue is removed from it. There will not be any observable growth in the roots of the onion in jar 2. So the length of the roots of the onion in jar 2 is lesser than the length of the roots of the onion in jar1. The roots won't grow after their tips are removed.

We observe that roots in both the bulbs for a few days grow almost similarly but when we cut the tips of roots in jar B, there is no growth seen in the roots in jar B. Onion root-tip cells have a cell cycle of approximately 24-hour duration, i.e., they divide once in 24 hours, and this division usually takes place about two hours after sunrise. Therefore, roots grown on water should be cut only at that time to score the maximum number of dividing cells. (https://byjus.com/question-answer/what-are-meristematic-tissues-explain-with-the-help-of-suitable-diagram give-their-classification-on/),(https://www.geeksforgeeks.org/meristematic-tissues-definition-features-types-role/)

Growth in plants occurs in specific regions. These regions are apical, lateral and intercalary. These regions contain fast-dividing cell groups called meristematic tissues. When we cut the onion root tip, the apical meristem tissues are cut off. The apical meristem is the main dividing tissue in the root and shoot which increases the length. As a result, the growth of roots is stopped in these roots [7].

Experiment:

(https://www.youtube.com/@ezonesensei7392)

Table 1: Growth of Onion Bulb on Different Days:

Length	Day 1	Day 2	Day 3	Day 4	Day 5
Jar 1	2 cm	2.5 cm	3 cm	3.5 cm	4.5 cm
Jar 2	2 cm	2.5 cm	3 cm	nil	nil

[7]

Table 2: Methods of preparation of onion bulbs in different experimental groups.

Bulb preparation		Onion no.	
		A	B
Reduce stem damage	Pricking with needle	+	+
	brushing	I	I
	Cone like out of reduced stem	+	+
	Cutting thick slice from reduced stem	+	+
Upper part damage	External scales removal	-	-

There will be a difference in the length of the roots. The root-trimmed onion's root (in jar 2) is shorter in length than the un-trimmed one (in jar 1). Tips of the plant roots contain apical meristematic tissue and are responsible for the elongation or length of the roots. As the tip of the onion roots in jar 2 is cut, apical meristematic tissue is removed from it. There will not be any observable growth in the roots of the onion in jar 2. So the length of the roots of the onion in jar 2 is lesser than the length of the roots of the onion in jar1. The roots won't grow after their tips are removed. Tips of the plant were much more slowly than the inorganic one sodium selenate (IV). The results obtained indicate much lower toxicity of Selol than sodium selenate (IV), which supports the necessity of further investigations of this compound as a potential safe anticancer drug [Joanna Slusarczyka *et al.*, 2015].

Onion waste in the form of peel, skin, top and bottom parts and outer layers are discarded as waste, despite their bioactive components confirmed through various studies. Substantial research has validated that onion peels are a concentrated source of bioactives and thus confer many therapeutic benefits. The biochemical compounds, especially phytochemicals viz. total flavonoids, total polyphenols, quercetin and its derivatives present in onion peel make its application feasible in the biomedical and pharmaceutical fields. These reboots contain apical meristematic tissue, and are responsible for the elongation or length of the roots. As the tip of the onion roots in jar 2 is cut, apical meristematic tissue is removed from it. So there will not be any growth in the roots of the onion in jar 2 after the tips are cut.

(a) Green gram: Meristematic tissue growth Explanation: Green gram seeds can be used to demonstrate meristematic tissue which when soaked in a petri-dish stuffed with wet cotton and left for 3-4 days would sprout out. These sprouted seeds have roots developing whose root tips have meristematic tissue.

(b) Onion bulb: Meristematic tissue growth Explanation: The roots of the onion in jar 1 would be longer whereas the growth of roots of onion in jar 2 stop after the root tips of the onion bulb in jar 2 have been cut. When the root tips are cut, the apical meristem responsible for the increase in length gets removed. The growth of plants occurs only in certain specific regions. In the above picture, the roots of onion bulb grow fast at the tip due to presence of dividing cells of meristematic tissues located only at these points, new cells produced by meristem are initially like those of the cells of meristem itself, but as they grow and mature, their characteristics slowly change and they become differentiated as components of other tissues. Apical meristem is present at the growing tips of stems and roots and increases the length of the stem and the root as in table [7].

Meristematic tissue growth Conclusion:

(a) Green gram: Through fold scope, it is possible to study the microstructure Changes, i.e. meristematic cell development in both the shoot and the roots occurring during germination. Tissues are 1. Apical Meristem, 2. Lateral Meristem and 3. Axillary Meristem (or intercalary meristem) [6].

(b) Onion bulb: From this activity, we can conclude that the growth of plants occurs in certain regions, which have meristematic tissues that are responsible for the growth. A study was conducted under storage conditions to examine root growth pattern of three onion bulb sizes (small, medium and large) of cultivar as influenced by different durations of field curing (1, 2, 3, 4 & 5 days) and root burning vs non- burning treatments. Bulbs cured for different durations produced roots in a few days of storage whereas different bulbs sizes showed 25% of root growth. It was observed that burning of roots of bulbs prior to storage resulted in decrease in root growth. On the other hand, bulbs of storage showed higher percentage of fresh root growth such as maximum percentage of root growth was found after 5 days of field curing and the root growth decreased linearly with the decrease in field curing time. About 60% of bulbs showed root growth in three different sizes. Burning roots resulted in less root

growth than non- burnt bulbs after 5 days of storage. This native method has emerged as a low- cost, non-hazardous one, which can be recommended at local community level.

https://edurev.in/studytube/Meristematic-Tissue-in-Plants-Class-9/97efeae8-80d2-4b32-a6fa-c6d926eb47a1_t#:~:text=Observation%20of%20Onion%20bulb%20experiment,the%20root%20tips%20were%20removed).

APPLICATION:

A number of medicinal plant extracts are being used against various diseases in different systems of medicine such as Ayurveda, Unani, and Siddha, but only a few of them have been scientifically explored. The objective of the present study was to explore the dose-dependent *in vitro* anticancer effects of the extracts of *Pandanus odoratissimus* whose scientific documentation as an anticancer agent is lacking despite being used traditionally. The dried parts of roots and leaves were extracted with methanol (MEPO) and water (AEPO). The extracts were then subjected to *in vitro* cytotoxic and antimitotic screening by brine shrimp lethality assay and onion root tip method, respectively. Further, the behaviour of the extracts on calu-6 (non-small cell lung cancer cell lines), PBMC (peripheral blood mononuclear cells) and WI (lung fibroblast cell lines) was studied using 3- (4, 5-dimethylthiazol-2-yl) -2,5 -diphenyltetrazolium (MTT) assay followed by flow cytometric analysis on calu -6 cell lines. AEPO showed significant cytotoxic and antimitotic activities. It showed 100% lethality of brine shrimps at 80 µg/ml and an LC50 of 33.33 µg/ml, which was eightfold higher than that of synthetic standard podophyllotoxin (4.16 µg/ml). AEPO at 10 mg/ml concentration showed significant antimitotic activity by showing a 3% mitotic index. which was more than that of standard cyclophosphamide with 4% mitotic index in comparison to control. There was a significant reduction in cell proliferation of calu-6 cells, ranging from 56 to 35%, after 24-48 h of treatment with 200 µg/ml ($P < 0.001$) of AEPO, while AEPO remained unaffected on PBMC and WI-38 cell lines. Cell cycle analysis revealed that AEPO at 50 µg/ml and 100 µg/ml significantly increased the number of cells in sub G0-G1 phase, indicating the cells entering into apoptotic phase. These results suggest that aqueous extract of *P. odoratissimus* possesses better anticancer activity. The plant has the potential to be used in anticancer therapy, and this study scientifically validated the folklore use of this plant (Gunti GowthamRaj *et al.*, 2014).

Artemisinin-based combination therapy is used to treat uncomplicated malaria disease in most endemic countries. Although most antimalarial drugs are effective in killing the parasite, there is a concern of induced toxicity to the cell. Here, the cytogenotoxicity of dihydroartemisinin-piperaquine phosphate (DHAP), a coformulation for artemisinin-based combination therapy, was evaluated using the Allium *cepa* model. The toxicity on the mitotic index varies with the duration of exposure and dose tested. Chromosome aberrations observed include chromosome fragments, chromosome bridges, binucleated cells, and micronucleated cells. This study showed that DHAP can depress mitosis and induce chromosome abnormalities. Their accumulation in cells may be inhibitory to cell division and growth. This calls for caution in the administration of artemisinin combination therapy for the treatment of malaria ailment. Wide spacing of dosage is therefore suggested in order to avoid the risk of genetic damage (J. I.Raji *et al.*, 2018). Onion peel extract and its constituent quercetin is known to be an effective infertility treatment due to its action on sperm motility (Tharaka Darshana Wijerathne *et al.*, 2019).

A compar-ison of concentration of both compounds in Allium test cells showed that the organic form of selenium (Selol) penetrated them much more slowly than the inorganic one (sodium selenate (IV). The results obtained indicate much lower toxicity of Selol than sodium selenate (IV), which supports the necessity of further investigations of this compound as a potential safe anticancer drug (Joanna Slusarczyka *et al.*, 2015).

Onion waste in the form of peel, skin, top and bottom parts and outer layers are discarded as waste, despite their bioactive components confirmed through various studies. Substantial research has validated that onion peels are a concentrated source of bioactives and thus confer many therapeutic benefits. The biochemical compounds, especially phytochemicals viz. total flavonoids, total polyphenols, quercetin and its derivatives present in onion peel make its application feasible in the biomedical and pharmaceutical fields. The form of in vitro and in vivo studies that onion peel extracts can exhibit antimicrobial, neuroprotective properties and play protective roles against cancer (cervical, breast and liver cancer cells), hyperglycaemia, hypercholesterolemia, obesity and erectile dysfunction. This review can act as a database of information which can form the basis for further exhaustive research on utilisation of onion wastes. There is scope for conducting advanced research to understand thoroughly the mechanisms behind these protective roles, thus allowing the exploitation of onion waste and its extract as a promising agent in developing medicines and pharmaceuticals. Besides, colonic biotransformation of the

bioactive compounds in onion peel and their role as well as direct gut effects need to study and report as currently there are no studies (Manoj Kumar A *et al.*, 2022).

Plant secondary metabolites such as flavonoids demonstrate high degrees of antioxidant, anti-inflammatory, and anticancer activities. Among flavonoids, quercetin plays an important role in inflammation by downregulating the level of various cytokines. In this work, onion (Allium cepa) peel was successfully utilised for the synthesis of gold nano-bioconjugates acting as a natural therapeutic drug. In this process, crude onion peel extract was first divided into different fractionates, namely, ethyl acetate, butanol, methanol, and water, and they were subjected to various preliminary studies of antioxidant activities. The ethyl acetate fractionate shows high antioxidant activities in all the assays. The bioactive components were identified and found to contain a high amount of quercetin as confirmed by liquid chromatography with tandem mass spectrometry and high-performance liquid chromatography. Three gold nano-bioconjugates were prepared with different concentrations of the ethyl acetate fractionate. Various biochemical anti-inflammatory assays were carried out and compared with the active ethyl acetate fraction of the onion peel drug (OPD) (Kabyashree Phukan *et al.*, 2021).

The tests on storage and preparation of onion (*Allium cepa* L.) bulbs presented in this paper were performed in order to obtain the highest possible number of roots of similar length, which would be suitable for performing the Allium test. The results were subjected to a detailed statistical analysis and allowed the following procedure to be recommended: 1) Store the bulbs at room temperature rather than in a refrigerator for two weeks before starting the experiments. 2) Do not use the biggest bulbs (over 80-100 g); use medium and small bulbs with the largest possible diameter of the reduced stem. 3) Just before starting the culture, wash the bottom part of the bulb, cut out the central part of the reduced stem and cut off the upper part of the bulb. At least 70% of bulbs prepared this way are expected to be suitable for cytological tests [14].

A study was conducted under storage conditions to examine root growth pattern of three onion bulb sizes (small, medium and large) of cultivar Swat-I as influenced by different durations of field curing (0, 3, 6, 9, 12, and 15 days) and root burning vs non- burning treatments. Bulbs cured for different durations produced 17.75 to 30. 90% roots in 90 days of storage whereas different bulbs sizes showed 21.47 to 26.68% of root growth. It was also observed that burning of roots of bulbs prior to storage resulted in a decrease in root growth. On the other hand, bulbs after 105 days of storage showed higher percentage of fresh root growth such as maximum percentage of root growth was found after 15 days of field curing and the root growth decreased linearly with the decrease in field curing time. About 45. 40 to 60.36% of bulbs showed root growth in three different sizes. Burning roots resulted in less root growth than non- burnt bulbs after 105 days of storage. This native method has emerged as a low- cost, non-hazardous one, which can be recommended at local community level.

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