

White discoloration on leaves and flower-like outgrowth on stem: A new species or hormonal disequilibrium?

Wenfa Ng

Novena, Singapore, Email: ngwenfa771@hotmail.com

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Conflicts of interest

The author declares no conflicts of interest.

Author's contribution

The author made the casual observation of white patches on leaves and outgrowth on stem of a species of plant, and would like to report to the plant biologists community of this new species or, more worryingly, first signs of a plant disease. As the matter is urgent, this manuscript is written as a rapid communication, where it may be updated in future for both language and content. The author conceived the idea and wrote the manuscript.

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Abstract

Strange patterns of white discoloration on leaves as well as unusual outgrowth that resembles arrested generation of new branches on stem were observed on a plant in Singapore. The white discoloration patterns were random in size and shape but radiated from the veins of the leaf, with a higher concentration in the center and no discoloration in the outer regions. Possible explanations for the coloration pattern on the leaves include: (i) a new species, and more serious (ii) a plant disease of a hormonal nature or mediated by microbe pathogenesis or both. Observations of the plant stem revealed that the length of the stem is of regular segments, with each section punctuated by a ring-like structure. However, an evident flower-like (or, from a different perspective, rose-like) outgrowth in the middle of one section suggested that it is a sprout point for the development of a new branch. But the development was halted in unexplained ways, leaving behind an arrested ring. Though the above may be part of normal development, it could also be signs that the plant is under significant environment stress such as high temperature or manifesting the effects of uptake of toxins, which impacts on equilibrium of hormones in the plant. Most puzzling, the outgrowth that likely will form the basis of a new branch appeared in a lower segment of the stem without branches – which pointed tantalizingly to a hormonal disequilibrium cause. Collectively, the plant mentioned above was likely to be in distress in two scenarios. Specifically, (i) as a new plant species with a different leaf coloration pattern (white round patches on green background) but suffering from a hormonal disease manifesting as outgrowth in the stem, or (ii) a leaf discoloration pattern due to microbe infestation of the xylem in the leaf that led to reduced chlorophyll production in areas of microbe growth together with a systemic hormonal disequilibrium that result, through unknown mechanisms, in flower-like outgrowth in areas of stems not associated with sprouting of branches. Written as a rapid communication to inform the scientific community of a possible new plant species or an early indication of a plant disease likely to be hormonal disequilibrium that impacts on development of a mature plant, interested researchers may explore further the initial observations reported in this short note.

Keywords: hormones; plant pathogenesis; fungus disease; hormone imbalance; endocrine compounds; hormone receptors; bacteria colonization; hormone mimics; reactive oxygen and reactive nitrogen species; epigenetics;

Subject areas: biochemistry; soil science; microbiology; cell biology; molecular biology; ecology;

Plants come in all shapes, colors, patterns, sizes, stem and leaf structures, and colors our world; however, once in a while, there will be the odd one out that catches the eye. While most are pleasing to the eye, there are occasions when a strange plant is an outlandish new species or a plant showing the first symptoms of disease, either due to plant pathogens such as bacteria, fungus or virus, or a hormone imbalance within the plant tissue. Using a 5 megapixel smartphone camera in daylight conditions, I captured, in two photographs, interesting (but also worryingly) features of a plant I observed near Inland Revenue Authority Singapore building in Singapore. With a distinct white discoloration pattern on leaf that does not follow specific sizes and shapes, the plant may be a new species (Figure 1). But closer observations revealed a regularly segmented stem where each segment is punctuated with a ring structure (Figure 2). More importantly, and most worryingly, there are flower-like (one looked like a rose) outgrowth in the middle of a few segments that suggested that there might be microbe pathogen on the plant (very unlikely), or more tellingly, a hormonal disequilibrium in the plant due to uptake of toxins from soil. Pictures of the plant are as shown below with further explanations.



Figure 1: White discoloration patterns on leaf, random in size and shape, but which radiates from the center of the leaf with no white patches in the outer regions of the leaf. Red arrow indicates the radiation pattern from the leaf's center. Blue arrow, on the other hand, shows a section of the leaf with brown discoloration, possibly indicating another unknown etiology likely to be plant pathogenesis, microbial or not.

Distinct white discoloration patterns on leaf of plant (Figure 1) may be indicative of a new plant species or a microbe infestation of the leaf. I did not touch the leaf, but visual observation suggested that the discoloration pattern may be an imprint in the leaf rather than the growth of plant pathogens such as bacteria or fungus in and on the leaf itself. Multiple explanations and hypotheses could account for the white discoloration pattern; for example, (i) a loss of chlorophyll through unknown plant cell biology mechanisms or disease, or equally plausible, the need to reduce the production of photosynthesis induced reactive oxygen and reactive nitrogen species (ROS and RON) through reducing chlorophyll production or deposition or both, (ii) secretion of a new pigment at the protein, genetics and epigenetics level, the latter due to adaptation of the leaf to high thermal stress or solar radiation, (iii) bleaching of the chlorophyll due to intense solar radiation that, due to peculiar leaf structure, concentrates at specific spots on or within the leaf, and (iv) an unknown plant disease. The third point may be important from the structural biology perspective, as the photosynthetic center of chlorophyll in this plant, is likely to be more fragile and sensitive to parts of the wavelength spectrum of solar insolation present in the tropics, and thus, represents an interesting variant for more detailed study if the above hypothesis holds true.

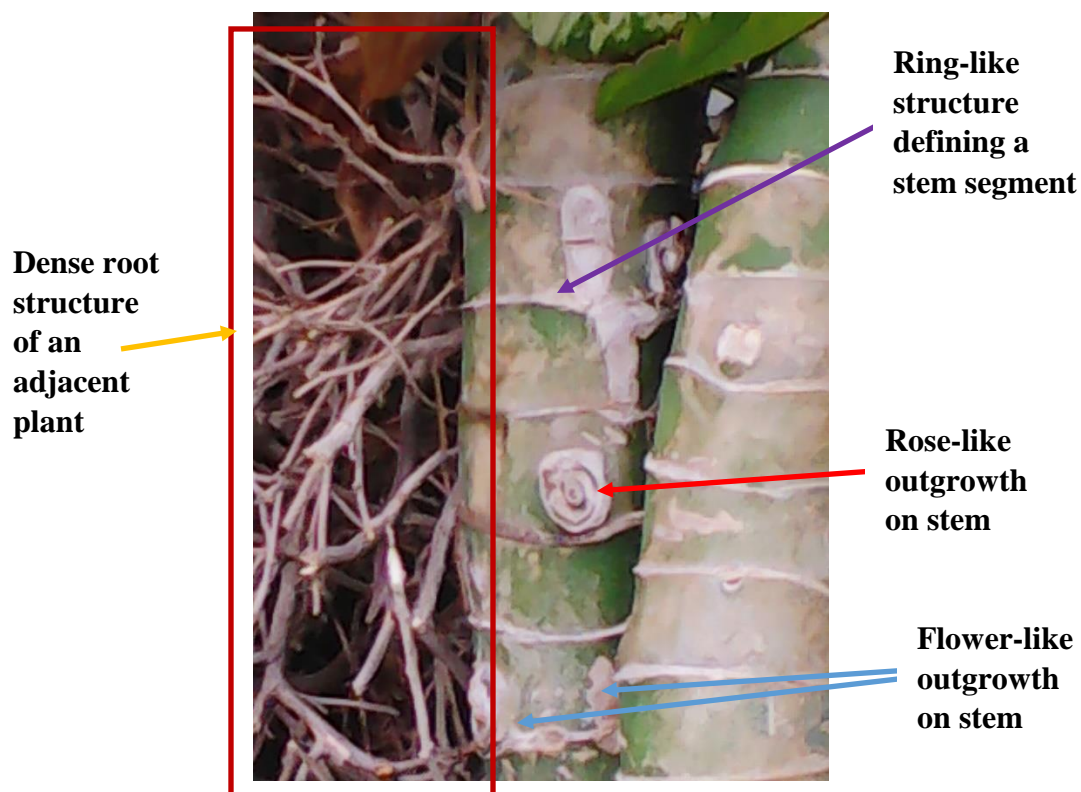


Figure 2: Rose-like outgrowth in the middle of a stem segment defined by a ring-like structure. While microbe infestation might have triggered the observed outgrowth, it was far more likely that the observed growth sprout, for what is probably a new branch, was a manifestation of plant hormonal imbalance, possibly due to uptake of soil toxins. On the other hand, the possibility that the outgrowth was a collection of dead cells or waste materials generated from an overly active plant immune system removing a large collection of plant and microbe cells due to a systemic

infection cannot be ruled out. Two flower-like outgrowths were also observed in a lower segment of the plant (blue arrows); thus, indicating that more than one growth sprout could be found in one stem segment. Outgrowth for the generation of a new branch is not uncommon on stem, but what is most peculiar in this plant is the formation of a growth structure exhibiting characteristics of halted growth in a stem segment far away from the main branching segment at the top of the plant.

Branches typically sprout out from the side of a stem at specific sites, and are generally at the same height from the ground. Moreover, the growth sprout did not show signs of arrested growth. However, evident signs of halted growth were observed in the same plant with white discoloration pattern on the leaves. Specifically, flower-like outgrowths were observed in the middle of stem segments, which in turn are demarcated by ring-like structures (Figure 2). One of the flower-like outgrowth appears rose-like, and maybe part of the growth structure that should result in a branch. More than one growth sprout could be seen on one stem segment. Such growth structures could usually be associated with plant disease caused by microbes such as fungus or bacteria. The chances, however, of the observations being due to plant microbe pathogenesis are small. What appears to be more plausible may be severe imbalances in plant hormones that resulted from infection by microbes or toxins taken up by the plant's roots. If hormonal causes are the etiologies of the observations, growth hormones' effect on the sprouting of new branches at places far away from the usual branch sprout points must be investigated. In a related hypothesis, infection of the plant by microbes might have resulted in an influx of hormones necessary to protect the plant, but which inevitably led to a growth spurt at stem segments not usually designated to sprout branches from a development perspective. The reasons underlying such a growth sprout might not be completely due to growth, but rather, an outgrowth of tissue that collected massive amount of dead plant and microbe cells killed by the plant immune system. Finally, the case for plant neoplasm or new growth resembling a cancer cannot be ruled out. What is confirmed is that the flower-like structures are arrested growth structures; thus, it could be an observation endpoint of a hormonal imbalance where an initial imbalance resulted in a growth sprout, but which was subsequently halted by the plant immune cells.

Collectively, observation of peculiar discoloration patterns on leaves and usual locations of branch growth sprout may have pointed to a new plant species, or they could also be a manifestation of diseases of microbe or hormonal origin. White discoloration pattern on the leaf system pointed to a change in pigment or a loss of chlorophyll, the latter is most likely the cause, but which is the underlying cause? Microbes is usually the chief assailant in mind, but what is equally likely could also be an adaptation of the plant to heat and high insolation stress such that less chlorophyll is produced to reduce the effect of photosynthesis induced reactive oxygen and nitrogen species on plant's health. Also, a variant of more fragile photosynthetic center might also lead to more rapid and readily degradation of chlorophyll, leading to discoloration. Further down the plant, peculiar rose-like outgrowth was seen on a stem segment defined by a ring-like structure. Clearly a result of arrested growth, the likely causes are manifold with hormonal imbalance likely to be principal. But given that hormonal imbalances itself could be due to bacteria or fungus pathogenesis resulting

in an overly strong immune response from the plant, or a natural transient disequilibrium that resembles human cancer, experiment studies need to delve deep into the underpinning biochemistry and molecular biology of plant's reaction to heat and insolation stress and uptake of toxins from the environment.