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A STUDY OF THE TIMING OF GERMINATION, FLOWERING AND FRUITING: PHENOLOGY

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Abstract: The study of periodic events in biological life cycles and how they are influenced by seasonal and inter-annual changes in climate, as well as habitat factors, is known as phenology (such as altitude). What is the effect of air temperature on plants, especially on their flowering and fruiting. It will be studied. Phenology is a scientific discipline that is responsible for studying the effect of the environment on the life cycles, specific recurrent phenomena of plants and animals. All this is due to the production of substances called hormones. In addition to hormones, vitamins are also made in plants, which are equally necessary and beneficial for animals and humans. Plants also have mobility. They travel in the direction of light. Phenology study the dates by which the different stages of plant development begin. In this way, they are recorded in chronological order and observations are made to analyze interactions with other living beings.

Keywords: Plants, Phenology, Temperature, Environment, Animals and Humans etc.

1.1 Introduction

The term phenology was introduced by the Belgian botanist Charles Morren in 1849. The environmental factors involved may be seasonal or annual in nature and climate-related climate change, such as land uplift. The biological cycle of living beings can be influenced by genotype and various climatic factors. At present it is possible to have information about the climate, biology and food factors of different crops.

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In addition, statistics on the natural cycle and the period of production of plants are in a fairly accessible database. However, it is possible that sometimes these information are not related to each other, nor are they related to the effect on plant morphology. For example, in the case of butterfly larvae, the time they become larvae is close to the time the chicks of some species of birds need their food to grow. Well, that time must be at the same time so that the chicks can grow. If the phenology of the larva is modified, the chicks will not get food.

Observations are made throughout the year and recorded to be a reliable memory of the life cycle of the organisms studied. Quantitative data related to plant development is also studied. It refers to comparing the increase in size with that experienced by the plant in question, its weight, volume, performance in photosynthesis and chemical composition. Under plant physiology, it is studied how each function takes place in the body of plants. The protoplasm is of colloidal nature and it is scattered in water. According to physical laws, water or salt enters through the cell walls of the articular cells of the root hair follicles from the soil and enters the vascular tubule, moving from the flow of the concentrate. There was no consensus among scientists on how this water etc. would climb upwards from here, but now it is believed that they reach the higher part of the stem from the root through the capillary tube in a capillary manner.

The water of the plant body comes into contact with the atmosphere through the pores of the leaves. Here also the water particles get released into the air, if the concentration of water in the air is less. Just as the water of a wet cloth evaporates into the air, so it is also a physical act. Now the question arises that from where do plants get the energy for every work and how is the energy converted from one type to another. In short, it can be said that due to light falling on the foliage, the foliage captures the energy of light and forms glucose and oxygen by carbon dioxide and water. These are the sources of energy.

Nitrogen cycle is also carried out by plants in nature. The sum of light is of great importance in the growth of plants. Plants increase in size and weight through light and new tissues and shapes or branches are formed. Plants that do not get light turn yellow. Such plants are called etiolated. The time of light, the photo period, depends on the leaf formation, fall, and flower formation of the plant. This is called photoperiodism. The amount of light required in a 24-hour cycle so that plants can flower is called the critical photoperiod. Some plants are long photophilous, some are

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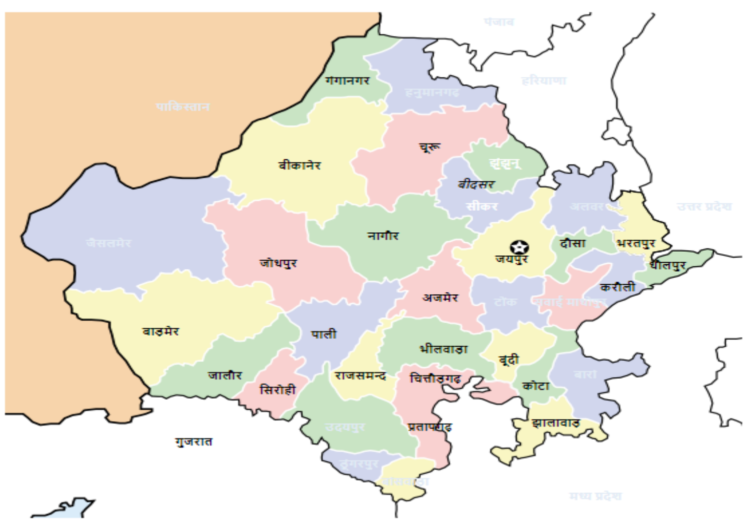
short-lived and some are indifferent. With this information, we can stop the formation of flowers in a plant which does not want flowers, and where flowers are desired, flowers can be planted at an untimely time.

Study Area

The shape of Rajasthan is almost kite shape. The state is located between 23 3 to 30 12 latitude and 69 30 to 78 17 longitude. It is bounded by Pakistan, Punjab and Haryana in the north, Madhya Pradesh and Gujarat in the south, Uttar Pradesh and Madhya Pradesh in the east and Pakistan in the west.

The 480 km long Aravalli mountain range going from Sirohi to Alwar divides the state into two parts from the natural point of view. The eastern part of Rajasthan has been fertile from the very beginning. The average rainfall in this part is 50 cm. 90 cm from Till then. After the formation of Rajasthan, big dams and power houses have been built on Chambal and Mahi rivers, which have provided irrigation and electricity facilities to Rajasthan. Medium-range dams have also been built on other rivers, which irrigate thousands of hectares. Large deposits of copper, zinc, mica, emerald, ghee stone and other minerals are found in this part.



A mixture of species belonging to the rain forest is found in the study area (Villagraen et al. 1986). There are three vegetation zones along the elevation gradient that have been studied: (1) Low

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altitude forests (<400 m) are severely disturbed during the present century for use for pastures, crop fields and firewood production.

Method

Flowering and fruiting

During two years from December 2019 to November 2021 8, we studied the phenology of flowering and fruiting. The overlap of flowering or fruiting periods between species pairs was estimated using the similarity index of Colwell and Futuyama (1971), for each pair, if the large-fruited species had a longer maturity period, it was assigned a positive was assigned. signal, whereas species with larger fruits had shorter maturation periods, a negative sign was assigned to pairs. We assessed, in both cases, the statistical significance of the comparisons by a binomial test (Zar 1984). These analyzes were performed only with fleshy-fruited species, therefore excluding Tapulia stipularis.

Germination

Seedling timing was monitored in the laboratory and in the field. The seeds of Myrtaceae were collected during the period of highest fruit production for each species. To evaluate the effect of adult longevity we performed two analyses: (1) we divided Myrtaceae into forest interior species (possibly long-lived) and forest edge and clearing species (possibly short-lived); and (2) we divided the taxa into two life forms, trees (long-lived) and shrubs (short-lived). To determine the relationship between the germination and fruiting seasons, the Myrtaceae were divided into one group of species that primarily fruit during the dry summer season, and another group primarily in the wet season (Smith-Ramerez and Armesto 1994) flourished.

1.2 Biological activities

All the chemical and physical changes that occur in the plant cell and all types of exchange between the plant or plant cell and the environment come under biological action.

Following are the biological activities:-

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Chemical Changes: Chemical changes include photosynthesis, digestion, respiration, synthesis of proteins, fats and hormones.

Physical Change: Under physical change, different types of gases are carbon dioxide, oxygen, and osmosis, transpiration, sorption, absorption of minerals and water etc.

Both chemical and physical changes occur in cell growth and development. In photosynthesis and respiration, oxygen and carbon dioxide are exchanged between the atmosphere and the cell. Similarly, in transpiration and water absorption, water molecules are exchanged between the atmosphere and the plant cell.

Plant growth and development can be completely controlled by:-

The discovery of photoperiod has led many plants to increase or decrease their desired luminescence and low heat treatment induces precocious flowering and cold species to flourish in normal environments. Research in plant physiology can increase the photosynthesis capacity of plants by reducing certain actions such as photorespiration.

In plant activity with tissue culture techniques, scientists have prepared such plants in a short time which cannot normally be obtained by reproduction and they are being used on a wide scale.

Various plant hormones like auxin, gibberellin, etc.

It would not be wrong to say that the success of Green Revolution in agriculture has been possible only due to the knowledge of plant physiology and new discoveries.

1.3 Phenological mismatch

A hummingbird approaches and pollinates a flower in this illustration. This contact will be lost if the flower blooms too early in the season or if the hummingbird migration is delayed.

Most species, both plants and animals, interact with one another within ecosystems and habitats, a process known as biotic interactions. Plant-plant, animal-animal, predator-prey, and plant-animal interactions can all be critical to the success and survival of populations and thus species.

Warmer temperatures than in previous patterns cause changes in the life cycle of many species, such as evolution, migration, or some other process/behavior at different times of the season. Phenological mismatch occurs when interacting species alter the timing of regularly repeated phases in their life cycle at different rates, resulting in a mismatch in interaction timing and thus

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negatively affecting interactions. Mismatches can occur in a variety of biological interactions, including those between species at the same trophic level (intratrophic interactions), those between different trophic levels (intertrophic interactions), and those between species at different trophic levels (i.e. plant–animal). through and through (IntraguildInteraction). A phenological mismatch occurs when a plant species blooms its flowers earlier than in previous years but the pollinators that feed and pollinate this flower do not arrive or grow earlier. Plant populations suffer as a result because there are no pollinators to aid their reproductive success. Another example involves plant-species interactions, in which the presence of one species aids in the pollination of another by attracting pollinators. However, if these plant species evolve at incongruent times, this interaction will be harmed, and the plant species that rely on the other will suffer.

Phenological mismatch results in the loss of many biological interactions, which threatens to have a negative impact on ecosystem functions or cause them to disappear entirely. In future generations, phenological mismatch will affect the food web, reproductive success, resource availability, population and community dynamics, and thus the evolutionary process and overall biodiversity of its species and ecosystems.

1.4 Phenological stages of plants

Early stages

This stage begins when the seed is in the germination stage. During this stage the plant receives the name of the seedling and all energy is directed towards the absorption and growth of new tissues of photosynthetic character.

Vegetative stage

During this period the plant needs more energy to meet the growing needs of leaves and branches. The end of the stage is marked by the flowering of the plant.

Reproductive stage

It starts with fructification. One of the main features of this stage is vegetative detachment. This is because the fruits begin to absorb the bulk of the nutrients received by the plant.

Identification of steps

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Extended scale BBCH is a coding system used to identify phenological stages. This applies to any type of plant, both monocotyledons and dicots.

One of its basic principles is that the general scale is basic to all species. Furthermore, the code used is common to the same phenological stage. It is important that in order to complete the description, recognizable external features are taken.

1.5 Actual Studies in Phenology

Plankton and climate

In 2009, a probe was conducted in the North Sea, located between the coasts of Norway and Denmark. It was based on phenological changes in plankton in that natural habitat.

Currently, echinoderm larvae appear in plankton 42 days earlier than 50 years ago. The same happens with the larvae of fish syrup.

The research established that there is a close relationship between a 1°C increase in temperature in that area, with a revision of the date in which the larval stages of these species appear.

Changes in the timing of plankton abundance can have an impact at higher trophic levels. If zooplankton populations could not adapt to the new characteristics of plankton, their survival could be compromised.

The impact of climate change on plankton affects the future of marine bio-ecosystems. In addition, it has a significant impact on the environment at the regional and global level.

Physiology of sunflower crops

A group of researchers conducted a study on sunflower cultivation in 2015. They concluded that a good planting process is the key to high yields in the crops of this plant.

The physiology and agronomy of the sunflower crop were analyzed in this study. This provided a basis for the management of their crops and their improvement at the genetic level.

The time between germination and germination should be short. This will allow plants of similar size to be obtained, thus reducing competition between species. In addition, the use of environmental resources will be maximized.

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Soil temperature affects the duration of phenological stages. In addition, the difference between each planting date affects those stages. In addition to these factors, moisture and soil management have a significant impact on the germination process.

The researchers argue that there are several agronomic aspects that must be considered. The first is the date and time in which sowing is done, the characteristics of the plants are also considered. In addition, the space between each row of planting should be taken into account. In this way, it will improve the efficiency in the production of sunflower crops.

1.6 Crop Phenology and Phenological Overview

In cultivation, phenology is also analyzed. It serves to improve the yield of the crop, as it is known the best time to fertilize, water more or less, or less so that it can fully grow and develop. In addition, it is necessary to prevent pests and diseases. There are times of year when insect pests are most active and reproduce more quickly. Knowing this, when it is time for most activity for the pests, prevention techniques can be started. The same is true of diseases. In winter, given more unfavorable conditions and rain, there is more humidity. Excess moisture generally gives rise to diseases in crops. A basic understanding of meteorology is essential for improving crop yields. To know about temperature, prevailing winds, types of clouds, etc. It can be of great help in the care of crops. It is important to have reliable phenological data, not only in agriculture, but its derived industry. For example, you should know the average date at which many crops bloom, fruit, and mature. These figures are essential for proper agricultural and industrial planning. Advances or delays in their expression can be predicted if the effects of environmental conditions on each stage of crop development are also known. Phenological observations, carried out over a long period of time, allow to draw conclusions in the field of scientific research. Also, it is very useful in agriculture and industry. It favors the knowledge of the possible dates of the different stages of development, the duration of the different sub-periods, the time frame and the frequency of occurrence of biological events.

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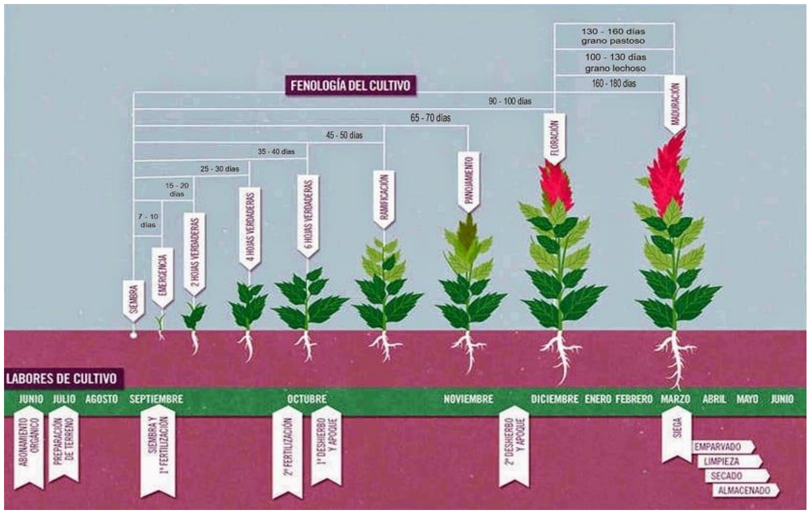

Source: https://www.meteorologiaenred.com/hi/fenologia.html

Bell Phenology

We are going to name the stages of grape phenology to give an example of its usefulness.

- winter bud
- crying bell
- swollen yolk
- green tips
- First leaves appear (pine leaves)
- leaf extension
- first bunch
- Racemes further apart (they are inflorescences)
- Flower buds (fully developed clusters)
- Falling of discolored stamens (this is called curling)
- Cluster closure (increased fruit size)
- Beginning of Verison (Loss of Chlorophyll)
- maturity
- Fall leaves

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At each stage of the vine you can know the operation and development of its parts. Knowing them is important to avoid certain pests and diseases and to optimize their fertilization and irrigation. It requires different care at each time of year.

1.7 Significance and Applications

The analysis of phenological observations is very important. This is because they can tell farmers when to fumigate their plantings or help them establish an appropriate time to plant.

In addition, any change in the phenological stages of plants will affect the trophic chain, given that vegetables are the nutritional basis of herbivorous animals.

These records also acquire relevance in the medical field, as they serve to evaluate the season of flowering herbs, whose pollen causes the disease known as feverfew.

1.8 Result and Discussion

Table 1.1: Correlation of S. Senegal Phenological Events with Climatic Factors.

Environmental variables	Leaf initiation		Peak leaf fall		Peak flowering		Peak fruiting	
	Coeff.	*P* value	Coeff.	*P* value	Coeff.	*P* value	Coeff.	*P* value
Maximum daily temperatures (°C)	0.226	0.106	0.414	0.001**	0.140	0.076	0.212	0.044*
Monthly total precipitation (mm)	0.358	0.031*	−0.618	0.001**	0.347	0.021*	0.492	0.001**
Mean relative humidity (%)	0.116	0.091	−0.172	0.082	0.121	0.218	0.018	0.912
Mean soil moisture content (m^3/m^3)	0.488	0.001**	−0.322	0.001**	0.278	0.037*	0.398	0.001**

*Significant at $P < 0.05$; **significant at $P < 0.01$.

Table 1.2: Synchronous Index for Phenological Events of S. Senegal within the Lake Baringo Woodland Ecosystem.

Population	Synchrony index		
	Leafing	Flowering	Fruiting
Tangulbei	0.78	0.85	0.74
Kampi Ya Samaki	0.81	0.74	0.88
Kimalel	0.91	0.80	0.79
Lake Bogoria	0.85	0.78	0.82
Overall	*0.87*	*0.75*	*0.85*

The values are means of the two annual cycles.

Leafing phenology

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Precipitation is one of the most likely environmental changes that regulate tree growth and flowering periodicity in most tropical forests, according to phenological studies [2]. It is also widely assumed that rainfall events followed by periods of drought or prolonged drought typically initiate plant growth in predominantly dry forest ecosystems like the Lake Baringo woodland [26]. According to the findings of this study, S. senegal sheds the majority of its leaves during the dry season, when soil moisture content is very low and atmospheric temperature is high. During the rainy season, the species sheds and regrows its leaves as a defence mechanism against drought or dry conditions [12]. When it rains, the tree produces leaf buds, which initiate leaf phenophase. This phenomenon has been observed in a number of dry forest species [25]. In general, the arrival of rain improves soil moisture, prompting the tree to begin growing. Once the season's first new leaves have expanded, leaf buds and young leaves continue to grow until the entire crown is covered in leaves. There is no distinct transition from old to new leaves during this time. Depending on the length of the rainy season, this could take 16 to 18 weeks. Full leaf cover occurs in the middle of the rainy season and is associated with increased water availability in terms of both rainfall amount and soil water content (Table 1.1). This type of leaf development is more closely linked to changing water availability conditions than flower or fruit production [6]. For almost the entire rainy season, a high percentage of mature leaves are retained. Leaf formation and duration were found to be synchronous within and between the four populations (Table 1.2). This could be due to the population's environmental conditions having similar dynamics. During the current study, it was discovered that most environmental variables occur at the same time, causing species phenophases in the four populations to occur almost simultaneously. The occurrence of leaves did not vary between years. However, some minor variations in duration were discovered, which can be explained by variations in environmental condition duration. The leafless period in 2014, for example, was one week longer than in 2015; however, the sequence of events was the same. Khanduri reported similar findings for Lagerstroemia speciosa [2].

Flower phenology

Senegalia Senegal sprouted during the blustery season that was like numerous other Acacia species inside the forest and other exotic species concentrated so far [26]. During the current review, S. In

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Senegal blooming is accounted for to start half a month after the beginning of downpours, when over 65% of the crown is covered with new leaves. The pinnacle blooming was really felt in the pinnacle blustery months demonstrating the significance of precipitation in S. Senegal during the blooming season. Most examinations have shown that, for species that bloom during the blustery season, the beginning of weighty rains typically fills in as a sign that triggers blossoming ([26] and references in that). For sure, during the current review, the pinnacle blossoming month was decidedly associated with the pinnacle blustery months and soil dampness content. Comparative outcomes were accounted for S. Senegal by Tandon et al. [27] In India it shows that this species likes to bloom during the blustery season. It has likewise been accounted for that S. Senegal might answer by giving blossoms even with unseasonal downpours in certain spots [11]. Fundamentally, most tree species found in dry timberland environments normally utilize less good blustery seasons for leaf improvement and gathering of adequate photosynthesis and proliferation before soil dampness decreases in ensuing dry seasons. starts [26].

Not many examinations have inspected the likely practical meaning of an interrelationship among leaf and blooming/fruiting phenophages in tropical trees; However this peculiarity can be credited to the requirement for a significant measure of assets to keep up with multiplication [28]. Senegal The Senegal, hence, as different species with comparative phenological conduct, expects photosynthesis to keep up with it during the conceptive stage. As portrayed by Singh and Kushwaha [26], non-photosynthetic tissues for the creation and support of blossoms and the arrangement of nectar require impressive use of energy. This peculiarity consequently requires the accessibility of foliage for photosynthesis to support physiological exercises during blooming. Some measure of soil dampness will be expected during this interaction; Hence the blustery season is the best time for blooming of the species. Most extreme blooming month was not fundamentally associated with relative moistness; However, phenophase happened during high relative mugginess somewhere in the range of 48 and 62%. This finding affirms the outcomes announced by Stone et al. [29] that general dampness somewhere in the range of 50 and 60% is related with top dust accessibility. Such high relative dampness might be vital for S. senegal to upgrade dust move and treatment.

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The current review uncovered huge blossom synchrony among populaces and people inside populaces. The synchrony mirrors the pliancy of individual trees that can generally add to populace upkeep and network in forest. Synchronism can help species by giving the open door to dust move inside and between populaces hence guaranteeing high hereditary variety and forestalling separation. Such hereditary impacts have been accounted for species holding onto high hereditary variety with restricted populace separation [16]. Blooming occurrence was comparative concerning timing and extent of individual trees with blossoms inside the space of months in the two years. The two blustery seasons additionally didn't vary altogether in blossoming power. This could imply that reproductively mature trees bloom similarly when set off by natural prompts.

Fruiting phenology

The fruiting period of the species goes on for around 90 days in the two seasons and years. This happened during the pinnacle stormy season until the seeds were developed and prepared for dispersal and maybe germination. This season of fruiting during the blustery season takes into consideration natural product improvement and development as this stage requires a ton of photosynthesis [9]. As the downpours die down and the dry season draws near, practically all organic products are ready and prepared to age and try and grow. The presence of reasonable circumstances for organic product development and dispersal is firmly organized in tropical dry woods species because of the unmistakable differentiation of biotic and abiotic conditions between the dry and stormy seasons [30].

Senegalese seeds are spread basically by wind and are ungulates whose exercises are more conspicuous during the dry season. Consequently the planning of the time is vital for the development of the species [13]. In most dry timberland environments, solid breezes are normal during the dry season, giving open doors to dispersal of scattered seeds, as in S. Senegal [25]. Moreover, it is during this equivalent period that the S. Senegal unit is a significant wellspring of grub for animals and different herbivores who are additionally potential seed dispersers of the species [12]. In this review, a higher level of individual trees with mature cases (earthy colored units) was seen toward the finish of the stormy season, with a more prominent number of trees with dry cases happening during the dry season. Fruiting phenophases were likewise observed to

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be coordinated inside and between populaces through fruiting and blossoming occasions. In any case, the natural product endured longer in both the Kimmelale and Kampi or Samaki populaces than in the Tangulbi and Lake Bogoria populaces. These varieties can be achieved because of variety in soil qualities. The dirts found in the Kimalel and Kampi or Samaki populaces are loamy and hence ready to hold dampness for a more drawn out timeframe than the dirts of Lake Tangulbei and Bogoria which are basically sandy and rough [17]. Soil dampness might have kept the organic product green for quite a while.

Conclusion

Phenological patterns in the Myrtaceae of Chiloe seem to support the idea advanced by Allerton and Lack (1992), suggesting that factors other than strong selection due to competition or predation in the local environment are responsible for flowering patterns and possibly fruiting. can be. and seed germination in plant communities. Among these other factors are constraints due to seed size and phylogenetic inertia. Our results suggest that phylogenetic inertia maintains the synchrony of flowering periods between species, but this constraint does not affect fruiting patterns. The non-aggregated fruiting pattern of Myrtaceae would be best explained by constraints caused by differences in fruit morphology and ripening duration, which in turn have a strong phylogenetic component, and another with vertebrate seed dispersers during the year. by talking. The duration of seed germination in the field and dormancy in the laboratory is best explained by phylogenetic constraints associated with seed size.

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