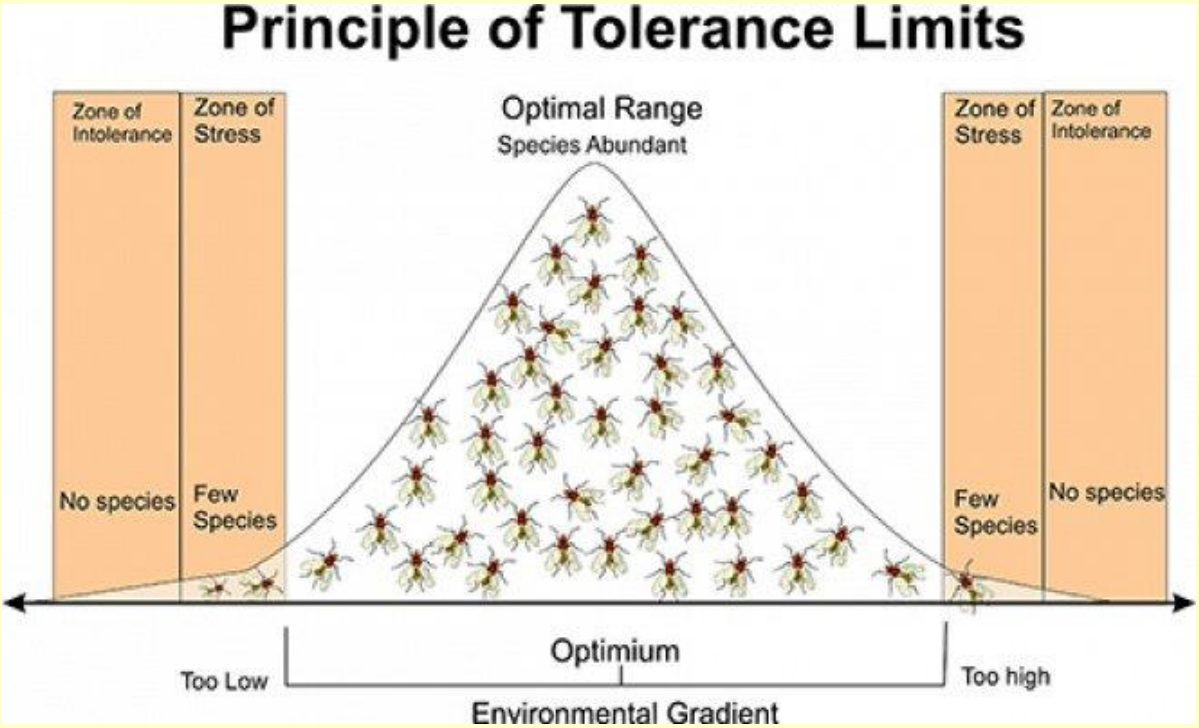
Why is a plant shade – tolerant?

In order to better understand the behaviour and needs of plants grown in either sun or shade, it is helpful to familiarise oneself with some basic botanical principals of photosynthesis and plant nutrition. I have chosen to include this summary as a prelude to the review of shade-tolerant plants because these are ones which have had to adapt their prime food-making mechanism (photosynthesis) to reduced levels of sunlight which is the energy provider of this process. A plant, in common with other living beings, exists to reproduce itself and without food it will eventually die so the explanation given under photosynthesis and plant nutrition really does encompass elements of life and death. Shade comes in a variety of guises all of which imply that the power of the sun to initiate photosynthesis is limited either permanently or for varying portions of the day. As primeval forests developed, under-storey plants evolved to cope with optimizing the utilisation of lower light intensities and even developed growth mechanisms and responses which minimize the energy required to grow which lowers demands on food produced by photosynthesis. Shade can be accompanied by a lack of water in the soil and the gardener knows that some plants have even adapted to be able to survive this additional stress on food production. In fact, adapting to shade has been so successful in some cases that exposure of the plant to too much sun can cause stress to the extent that one does sometimes see the terminology of “shade-loving” as opposed to “sun-loving” plants; “Sciophytes” as opposed to “Heliophytes” if you like jargon. Let us start with optimizing food production by photosynthesis which is a phenomenon taking place on the upper surface of a leaf. Maximizing leaf surface area, wasting minimal energy by growing leaves thicker than they need be while maximising chlorophyll per unit surface area are almost immediate stratagems which come to mind after this introduction and this is indeed a feature of many sciophytes. There are less obvious modifications of leaf structure which optimize light usage for photosynthesis such as enhanced levels of red pigments in the lower leaf which reflect incident light so that it gets double usage and leaf cells develop in a manner which tends to focus light on chlorophyll receptors. There are also different forms of chlorophyll which have different peak-absorption maxima and these have been found to vary as a function of incident light. In short, the leaves of shade tolerant plants tend to be larger and thinner than those of heliophytes. Turning to energy conservation, producing flowers and seed and new foliage consume large amounts of food = energy. Where possible, shade plants will flower and produce seed when light levels are highest and species in deciduous woodlands will

therefore tend to flower and set seed early in the year before tree leaves form; the ivies – Hedera – are the exceptions to this rule and flower near to winter once deciduous leaves have fallen. Leaf production in sciophytes tends to be slower than that in heliophytes and damaged leaves tend not to be replaced. In some cases, the plants even develop damage prevention mechanisms such as being distasteful to major predators. Before anybody else says it, I do agree that it would be great if somebody told Hostas about this! Finally and in more general terms, a plant growing in developing shade thrown by a shrub or tree or adjacent to brighter light will tend to grow towards the light. This mechanism is not present in true sciophytes where distortion of cells could expend energy. For readers wanting to search further into the phenomena described here but who don't want to be blinded by science, there is a lovely publication by Lorraine Middleton which I can recommend. After itemising the various mechanisms and modifications by which plants adjust to life in the shade, the temptation is great to try and predict which plants will potentially thrive under such conditions and, similarly, which are candidates for sun. Experienced gardeners will already have been thinking that, in practise, plant selection is far more complicated than ticking one or more characteristics off a list and the reality is that there are numerous interacting properties in a plant's physiology which have evolved over millennia to equip it for life in a particular set of conditions. Moreover, the tolerance of a plant to departures from it's ideal planting conditions can be – and often is – considerable. For example, many people intuitively think of hosta and ferns as classic subjects for the shade garden. While that is correct, many of these will also thrive in sunny conditions. This line of thought understandably prompts one to speculate on what is the point of going to the trouble of spending time trying to understand the mechanisms going on within plants if "exceptions to rules" are so widespread? My response to this is that having an understanding of the mechanisms going on within a plant often helps when some sort of trouble shooting is called for and we can stay with hosta to illustrate what I'm talking about. Something with large, green leaves will most likely be able to cope with deeper shade than, say, one with yellow leaves where photosynthesis (needing green chlorophyll) is less efficient; in fact, when placed in too deep a shade, the yellow colouration could even disappear as the plant is forced to up the concentration of chlorophyll. Turning to another shade classic, the rhododendron family which includes azaleas. The larger leaved varieties and hybrids of species such as Ponticum and Catawbiense will cope with deeper shade far better than, say, Yakushimanum; many azalea and tiny-leaved rhododendrons actually thrive best in fairly sunny conditions and will even not flower if shade is too intense/prolonged. In short, understanding something of plant physiology doesn't substitute for experience and it certainly shouldn't stop the adventurous gardener from experimenting. Plants often display a

surprising tolerance to conditions which can differ quite radically from those in which the native species occur and this is neatly formalised under “The Principle of Tolerance Limits” from which the following diagram is taken:



It will be appreciated that this general principle can be applied to a variety of aspects of planting besides shade/sun tolerance such as winter hardiness. In conclusion, nothing of what I’ve said here offers a short cut to success and a successful choice of plants for shaded positions still starts with literature searches, Internet and visits to nurseries and gardens!

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