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Role of Coloured Shade Netting in Horticulture

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Abstract

Globally climate change is the challenging issue, which is mainly caused due to unsustainable use of fossil fuels, forest degradation for industrialization and rapid urbanization with an over population. It also threatens the livelihood of the growing population. To sustain with the changing climate, adaptation of new technologies plays an important role in bringing tremendous change in improvement of production per unit area. Protected cultivation is one of the promising fields having wide scope in fetching higher yield per unit area. Protected cultivation is crops grown under controlled environment such as temperature, humidity, light, and others, which is regulated as per the crop's growth need. Based on the crop requirement the environment can be controlled fully, partially or modified to protect the crop from adverse weather. It also protects the crop from rain, wind, high temperature thereby improves the quality and yield of the crop.

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Introduction

During the last decade, due to increased air temperature and intensity of solar radiation caused by climate change, an increasing area of crops is being grown under shade nets of various types. Higher plants respond to light quantity, quality, direction, and periodicity. Plants react to changes that occur in the spectrum of electromagnetic radiation to which they are exposed, through alterations in morphology and physiological functions that results in adaptation to different environmental conditions. Such alterations are mediated by specialized pigments, known as phytochromes, which have absorption peaks in the red and blue/ ultraviolet regions of the spectrum (Pattnaik and Mohanty, 2021). These photoreceptors are able to detect variations in light composition and induce photo morphogenetic responses, either *in vivo* or *in vitro* that influence growth and development, morphology, leaf and stem anatomy, photosynthetic efficiency and chemical composition.

Color nets represent a new agro-technological concept, which aims at combining the physical protection, together with differential filtration of the solar radiation (Shahak *et al.,* 2004). They are based on the incorporation of various chromatic additives, light dispersive and reflective elements into the netting materials during manufacturing (Figure 1). It is either applied by itself over net-house constructions, or combined with greenhouse technologies. Netting is frequently used to protect agricultural crops from excessive solar radiation (shade-nets), improving the thermal climate, sheltering from wind and hail storms and exclusion of bird and insect-transmitted virus diseases. The shading of crops results in number of changes on both local microclimate

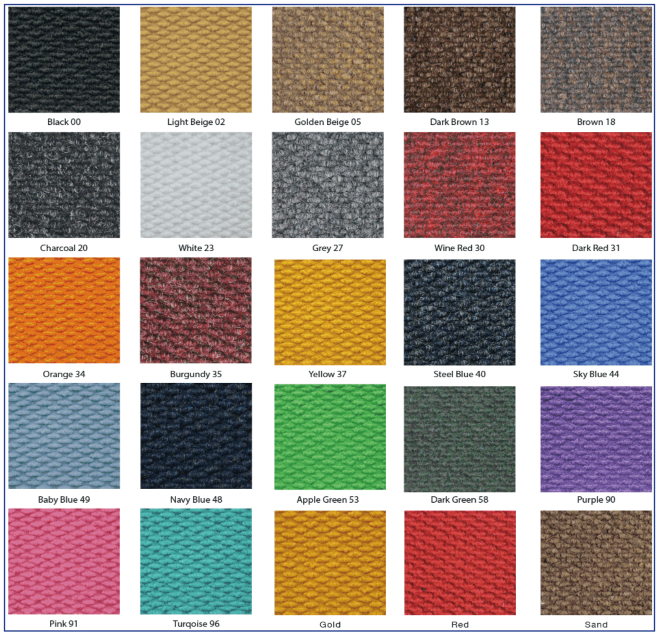

Figure 1: Different coloured shade net available in the market

and crop activity (Kittas *et al.,* 2009). These changes on local microclimate modify CO_2 assimilation and consequently crop growth and development. Under shade nets, the air temperature was comparatively lower than that of the ambient air, depending on the shading intensity. Shade netting not only decreases light quantity but also alters light quality to a varying extent and might also change other environmental conditions. The target responses are those determining the commercial value of each crop, including yield, product quality and rate of maturation.

Protected cultivation may be defined as crops growing in controlled environment. The area under protected cultivation in India is around 30,000 ha with states like Maharashtra, Karnataka and Tamil Nadu leading the path from the front (Lenka, 2020). Shade nets are available in different shade percentages or shade factors (15%, 35%, 40%, 50%, 75% and 90%) (Figure 2). For example, in case of 50% shade, the net will cut 50% of the light intensity and allows 50% of the light intensity similarly the light intensity will differ for other shade percentages also. The yield efficiency of different crops varies with different shade percentages based on which the shade percentage has to be standardized. *E.g.*, tomato performs better in terms of yield and quality under 35 percentage shade factor. For many of the green leafy vegetables the shade factor ranges from 50-70 percent. Different Horticultural crops grown under different shade net are given in Table 1.

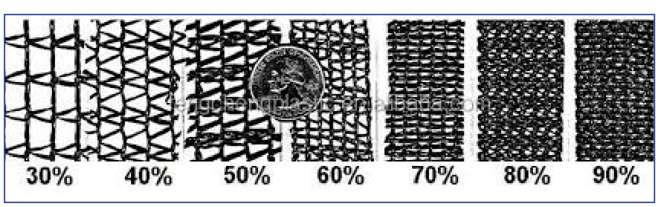

Figure 2: Intensity in shade factor

Table 1: Crops that can be grown under coloured shade net

Particulars	Crops grown under shade net
Flowers	Chrysanthemum, Carnation, Gerbera, Rose, Lilium, Orchid, Gladiolus, *etc*.
Vegetables	Tomato, coloured Capsicum (Yellow and Red Bell Peppers), Cucumber, Broccoli, Red Cabbage, Leafy vegetables, Radish, *etc.*
Fruits	Strawberry
Seedling and Nurseries	Vegetables, Flowers, Tissue Culture, clonal nursery for Forestry, Fruit Grafts (like Lemon, Citrus, Mango, Pomegranate, Guava, Litchi) *etc*.

(Source: Pattnaik and Mohanty, 2021)

Uses of Coloured Shade Nets

- Losses caused by biotic and abiotic factors can be reduced.
- Year round production is possible.
- Highly suitable for raising grafts and vegetable nursery.
- Cultivation of vegetables and ornamental crops during off-season will be highly remunerative.
- Increases the productivity of the crop per unit area.
- Aids for systematic monitoring of the crops during critical control points.

Effects of Microclimate

1. Radiation

Nettings, regardless of colour, reduce radiation-reaching crops underneath. Obviously, the higher the shade factor, the more radiation will be blocked. Besides affecting the amount of radiation, nettings can influence the radiation direction.

2. Photoselectivity

Colored shade nets were tested primarily because of their ability to manipulate the spectra of radiation reaching the crops below. They can be used to change red to far-red light ratios that are detected by phytochromes, the amounts of radiations available to activate the blue/ ultraviolet-A photoreceptors, blue light involved in phototropic responses mediated by phototropins, and radiation at other wavelengths that can influence plant growth and development.

3. Air Movement

Nettings also reduce wind speeds and wind run (Stamps, 2008), which can affect temperatures, relative humidity and gas concentrations resulting from reductions in air mixing. These changes can affect transpiration, photosynthesis, respiration, and other processes.

4. Temperature

Shade nets are often used over crops to reduce heat stress; however, in enclosed net (shade) houses, temperatures during the day are typically higher than outside and may be lower at night, at least during radiation freezes.

5. Relative Humidity

Relative humidity is often higher under netting than outside as a result of water vapour being transpired by the crop and reduced mixing with drier air outside the netted area, even when temperatures under the netting are higher than outside.

Conclusion

Changing the light intensity and radiation spectrum has a large impact on the total production system of horticultural crops. The microclimate inside the net house creates suitable environment to the plant to utilize the energy effectively produced by the crop which in turn results in high return in cost and benefits. Colored shade netting is a relatively new tool that can be used for a wide variety of purposes by horticulturists. However, the effects are varied and plant responses may differ even among cultivars of the same plant. Therefore, much additional research is needed to demonstrate and elucidate the effects of colored shade nets.

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