

Supplementary Material

Article title: Acclimatization and foraging of native Brazilian stingless bees in arenas with covering materials with different spectral properties

Journal: Neotropical Entomology

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Evaluation of the optical characteristics of materials used to cover green houses in Brazil: The optical characteristics of nineteen plastic films and a 4 mm transparent glass, which are commonly employed for greenhouse coverings by various manufacturers (for detailed material information, refer to Table S1), were analyzed at the Optics Laboratory of Embrapa Instrumentação in São Carlos, SP. This evaluation involved measuring transmittance across the entire visible and ultraviolet (UV) spectrum, as well as investigating the behavior of polarized light.

Transmittance is the amount of light at a specific wavelength that passes through the material without being absorbed, is quantified on a scale ranging from 0% to 100%. Polarized light is achieved by passing natural light through a polarizing material, resulting in a resultant light electromagnetic wave with only one direction of oscillation. Certain materials, such as polymers, can polarize light. Polarization is detected by using a reference polarizer and varying the angle with the test material.

To perform these analyses, the UV-VISIBLE SPECTROPHOTOMETER equipment, model UV-1601PC from SHIMADZU, was utilized. This equipment offers an average reading response and a precision of 1 nm. Prior to assessment, the film samples were thoroughly cleaned using flowing water and subsequently dried to remove any potential contaminants. For the purpose of transmittance analysis, the samples were subjected to varying temperatures: approximately $\sim 35^{\circ}\text{C}$ (representing sunlight conditions), $\sim 0^{\circ}\text{C}$ (cold conditions), and room temperature $\sim 25^{\circ}\text{C}$. Three samples were tested at each temperature, with disposable gloves and tweezers employed during sample handling to prevent contamination from hand grease.

Table S1 presents the percentage ranges of transmittance for wavelengths within the ultraviolet and photosynthetic light spectrum, along with polarization data for the diverse materials. While the glass plate and plastic films, on the whole, did not display polarizing characteristics, they did manifest variations in light transmittance across distinct wavelengths. No changes in transmittance were observed based on the material's temperature. Specifically, the glass plate exhibited a behavior akin to a "high-pass filter," signifying its strong light transmission for wavelengths surpassing 370 nm. Conversely, below this threshold, it progressively blocked light, eventually reaching a complete blockage at 250 nm."

Table S1. Commercial information and optical characteristics (transmittance in the range of ultraviolet light and visible light, polarized light) of different materials used to cover a greenhouse in Brazil.

Sample supplier company	Manufacturer company	Country of origin	Material name or code according to the supplier company's website	Thickness in microns (μm) or millimeter (mm)	Light transmittance in the ultraviolet wavelength (320-400nm) (%)	Light transmittance in the ultraviolet wavelength (365nm) (%)	Light transmittance in the wavelengths of the photosynthesis range (400-700 nm) (%)	Polarized light
AgriEstufa	Not informed	Japan	F-clean Difusor	100 μm	35,78-37,40	37,37	38,80-42,47	highly polarized
AgriEstufa	Not informed	Japan	F-clean Transparent	100 μm	57,54-71,36	59,42	71,36-85,56	has little polarization
AgriEstufa	Eletroplastic	Brazil	Extra long life Transparent	150 μm	57, 41-59,42	66,321	63,0-75,75	has little polarization
AgriEstufa	Eletroplastic	Brazil	Difusor	150 μm	0,00-1,40	0,04	1,40-15,81	does not polarize
AgriEstufa	Not informed	Japan	0.15 HF - transparent	Not informed	19,30-44,68	36,17	44,68-63,11	has little polarization
AgriEstufa	Not informed	Japan	0.15 HK - Light diffuser	Not informed	26,06-65,89	54,05	65,89-80,81	does not polarize
AgroLord/AgroFlex Brasil	AgroLord/AgroFlex Brasil	Brazil	Ultra Transparent	75 μm	54,57- 60,52	56,47	60,52-75,65	does not polarize
AgroLord/AgroFlex Brasil	AgroLord/AgroFlex Brasil	Brasil	Ultra Transparent	150 μm	42,58-48,95	44,43	56,71-72,31	does not polarize
Ginegar/ Polysack	Ginegar	Israel	Nectarine C' 927	120 μm	12,32-26,50	23,16	26,50-42,77	does not polarize
Ginegar/ Polysack	Ginegar	Israel	Nectarine C' 927	150 μm	10,45-24,33	21,19	24,33-40,08	does not polarize
Nortene	Nortene	Brazil	Transparent FES	150 μm	47,61-58,11	53,33	58,11-72,39	does not polarize
Nortene	Nortene	Brazil	Maxilux	150 μm	2,87-24,57	14,53	24,57-48,76	does not polarize
Nortene	Nortene	Brazil	TermoFilm	150 μm	5,52-11,62	8,92	11,62-27,10	does not polarize

Table S1: continued

Material code	Sample supplier company	Manufacturer company	Country of origin	Material name or code according to the supplier company's website	Thickness in microns (µm) or millimeter (mm)	Light transmittance in the ultraviolet wavelength (320-400nm) (%)	Light transmittance in the ultraviolet wavelength (365nm) (%)	Light transmittance in the wavelengths of the photosynthesis range (400-700 nm) (%)	Polarized light
18	Nortene	Nortene	Brazil	Difusor	150 µm	11,83-17,04	14,97	17,04-30,29	does not polarize
7	RuralTop	Ginegar	Israel	Suncover Leitoso 60% ou 80%?	120 µm	3,50-4,16	2,98	4,16-8,08	polarizes
8	RuralTop	Ginegar	Israel	Suncover AV Blue	150 µm	0,02-2,63	0,07	2,63-11,71	has little polarization
9	RuralTop	Ginegar	Israel	Suncover Difusor AV 75%	150 µm	0,07-4,58	0,14	4,58-16,11	polarizes
10	RuralTop	Ginegar	Israel	Suncover Difusor	150 µm	1,81-12,63	2,73	16,83-27,05	polarizes
22	Vidraçaria São Paulo/DF	Not informed	Brazil	Transparent glass	4 mm	22,22-89,95	87,82	89,95-88,43	does not polarize

