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(54) Titre : FILM POLYMERE  
(54) Title: POLYMERIC FILM

(57) **Abrégé/Abstract:**

The present disclosure provides a film for enhancing the growth of plants in the Cannabaceae family, the film being capable of blocking solar spectrum in the range 440-550 nm. The present disclosure also provides a single- or multi- layer plastic greenhouse film for enhancing cannabis plant growth, where the single- or multi-layer plastic greenhouse film (a) has at least one blue light blocking layer for blocking solar spectrum in the range of 440-500 nm; (b) has a high transmittance for red light in the solar spectrum in the range of 600-750 nm.

## **ABSTRACT**

The present disclosure provides a film for enhancing the growth of plants in the Cannabaceae family, the film being capable of blocking solar spectrum in the range 440-550 nm. The present disclosure also provides a single- or multi-layer plastic greenhouse film for enhancing cannabis plant growth, where the single- or multi-layer plastic greenhouse film (a) has at least one blue light blocking layer for blocking solar spectrum in the range of 440-500 nm; (b) has a high transmittance for red light in the solar spectrum in the range of 600-750 nm.

## POLYMERIC FILM

The present invention relates to a polymeric film for modifying solar light and particularly, although not exclusively, to greenhouse and greenhouse-like structures  
5 which includes covering materials that protect plants from external climate conditions and diseases, create optimal growth microenvironments, and offer a flexible solution for sustainable and efficient year-round cultivation.

Glass and polycarbonate were traditionally utilised for such materials, but with  
10 advances in technology many types of flexible plastic materials, including copolymers such as polyethylene, poly (ethylene-vinyl acetate) and polycarbonate, have become popular.

Produced with co-extrusion technology, flexible plastic films can be tailored specifically  
15 to the unique light and temperature requirements of many field-grown plants including flowers, fruits and vegetables. At the same time, plastic films can help to reduce water consumption by reducing evaporation.

Most greenhouse polyethylene plastic films contain ultraviolet (UV) light-protection  
20 components added to prolong the life of the material and maintain high levels of transmission of photosynthetically active radiation (PAR). The commonly used UV protection chemicals include UV absorber or blocker and light stabiliser.

Some aspects and embodiments of the present invention relate generally to a  
25 polymeric film and method for enhancing growth of plants in the Cannabaceae family

of plant, for example through blending a blue light blocker or absorber in the film structure to partially block natural sunlight with wavelengths range from 440 nm to 500 nm.

5 *Cannabis* is a genus of flowering plants in the Cannabaceae family. Some embodiments relate to improvements in or relating to the growth of *Cannabis* plants (for example *C. sativa*, *C. indica* and *C. ruderalis*).

10 Some embodiments relate to a polymeric greenhouse film for enhancing cannabis plant crop yield and speed up growth of cannabis plants.

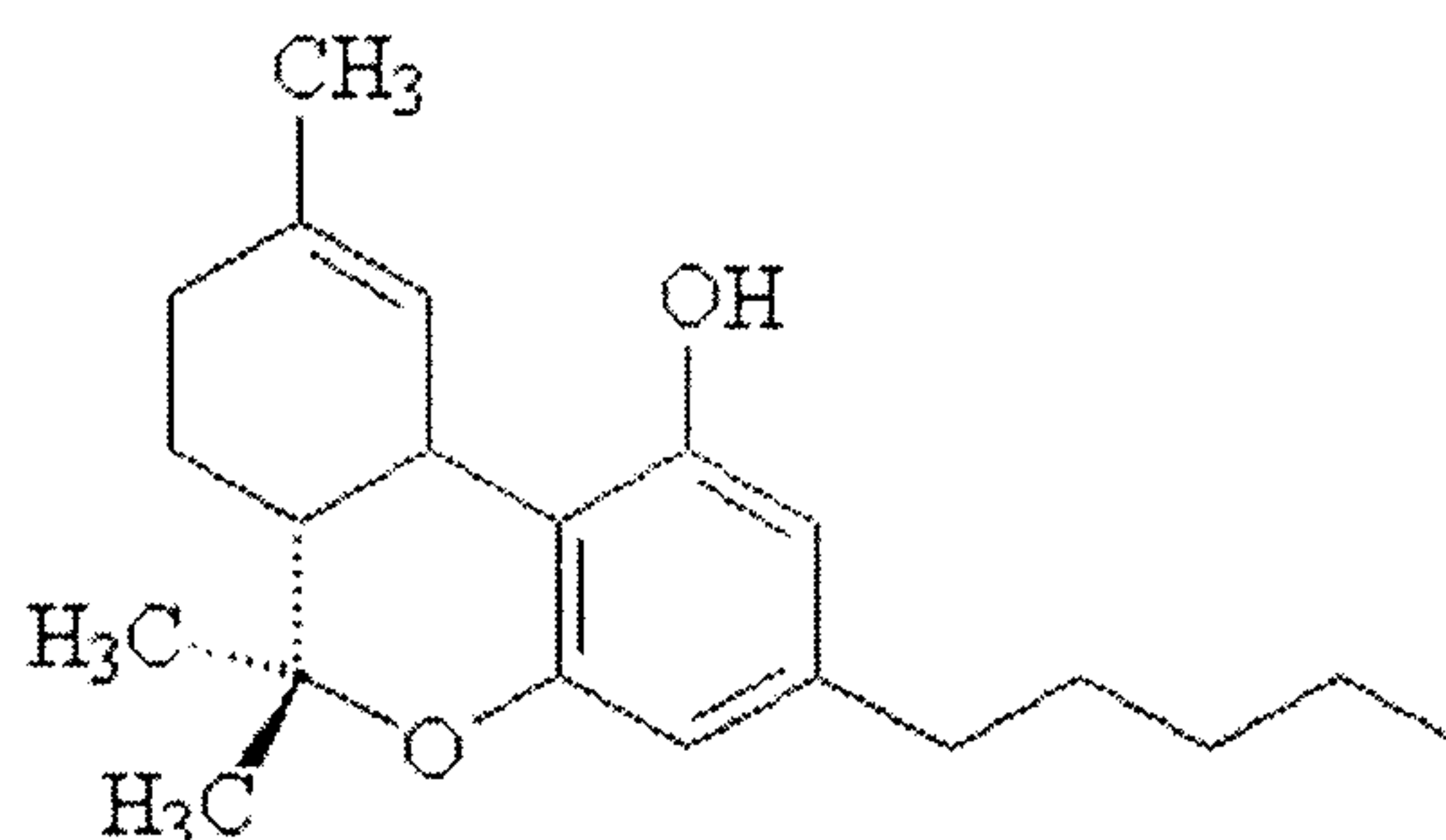
The film may promote cannabis plant growth in terms of, for example, accelerating the growth period (e.g. faster flowering period), promoting bigger and more dense flowers, or producing higher tetrahydrocannabinol (THC) concentration.

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The key elements of some polymeric greenhouse films comprise a blue light blocker or absorber which is capable of reducing the intensity of natural sunlight in the blue light range from 440 nm to 500 nm, UV light protection components which protect said greenhouse films from UV degradation, a polymeric film base structure comprising polyethylene and/or EVA, and fillers comprising light diffuser and processing aids. The blue light blocker or absorber blended in said polymeric film, being capable of blocking light with wavelength ranges from 440 nm to 500 nm, provides a unique light source for growing cannabis.

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Some aspects and embodiments are configured to enhance growth of Cannabis plants with the aim of producing more cannabinoids, for example THC, per plant or per weight. THC is the principal psychoactive constituent of Cannabis.



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The present invention provides a polymer film for modifying solar light, the film being capable of at least partially blocking the solar spectrum up to and/or within a wavelength and/or wavelength band in the 440-500 nm blue range.

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The present invention provides a greenhouse film that is capable of at least partially blocking the solar spectrum up to a wavelength in the 440-500 nm blue range.

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The present invention also provides a greenhouse film that is capable of at least partly blocking the region of the solar spectrum around and/or up to a wavelength in the range 440-500 nm.

The present invention also provides a polyethylene-based multilayer greenhouse film that is capable of blocking the 440-500 nm blue region of the solar spectrum.

The present invention also provides a blue light-blocking film for enhancing cannabis plant growth which absorbs blue light around and/or up to approximately: 440 nm, 450 nm, 460 nm, 470 nm, 480 nm, 490 nm, and 500 nm.

- 5 The present invention also provides a greenhouse film having an orange colour that is capable of at least partly blocking the region of the solar spectrum around and/or up to a wavelength in the range 440-500 nm.

10 The present invention also provides a greenhouse film having an orange colour that is capable of at least partially blocking the solar spectrum up to a wavelength in the range 440-500 nm.

15 The present invention also provides a polyethylene-based multilayer greenhouse film having an orange colour that is capable of blocking the 440-500 nm region of the solar spectrum.

20 The present invention also provides a blue light-blocking film which absorbs the blue light in the solar radiation around and/or up to approximately: 440 nm, 450 nm, 460 nm, 470 nm, 480 nm, 490 nm, or 500 nm.

In some aspects and embodiments the film blocks all blue light wavelengths up to and including 440 nm, 450 nm, 460 nm, 470 nm, 480 nm, 490 nm, or 500 nm.

25 The present invention may provide a multilayer polymer film for modifying solar blue light.

In some embodiments the film blocks all blue wavelengths up to and including 440 nm, 450 nm, 460 nm, 470 nm, 480 nm, 490 nm, or 500 nm. In other embodiments a specific band of blue wavelengths is blocked.

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In some embodiments additives are provided so that the film is configured to absorb the blue light (440-500 nm) of the spectrum.

10 The present invention also provides a polyethylene based multilayer greenhouse film that is capable of blocking the 440-500 nm region of the solar spectrum.

In some aspects and embodiments the present invention provides a polyethylene based multilayer greenhouse film that is capable of blocking at least the 440-500 nm region of the solar spectrum by 20-100%.

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The film may be a monolayer or a multi-layer.

In some embodiments the film has multilayer structure. The light modifier or blocker will be added to at least one layer.

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In some embodiments the film is still a functional greenhouse film. Adding a blue light modifier will reduce the PAR light transmittance (which is a critical property for greenhouse film). In some embodiments the film has an overall light transmittance greater than 60%.

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In some embodiments the film has an overall 600-750 nm red light transmittance larger than 80%.

In some embodiments the film will also pass certain physical standards as a greenhouse film, including tear resistance, puncture resistance, elongation, etc.

In some aspects and embodiments UV absorbers are provided and in addition one or more pigments are provided.

10 Different aspects and embodiments can be used together or separately.

Examples

Example 1

Typical structure of a 7-layer blue light blocking film for enhancing cannabis growth:

<b>Layer #</b>	<b>Layer %</b>	<b>Main Ingredients</b>
1 inner	19	polyethylene blend; UV light inhibitor
2	22	polyethylene blend; blue light blocking additive; UV light inhibitor
3	8.5	polyethylene blend; UV light inhibitor

4	3	polyethylene blend; UV light inhibitor
5	8.5	polyethylene blend; UV light inhibitor
6	20	polyethylene blend; blue light blocking additive; UV light inhibitor
7 outer	19	polyethylene blend; UV light inhibitor

Example 2

Typical structure of a diffused 7-layer blue light blocking film for enhancing cannabis growth:

<b>Layer #</b>	<b>Layer %</b>	<b>Main Ingredients</b>
1 inner	20	polyethylene blend; UV light inhibitor; light diffuser
2	20	polyethylene blend; blue light blocking additive; UV light inhibitor
3	8	polyethylene blend; UV light inhibitor; light diffuser
4	4	polyethylene blend; UV light inhibitor

5	8	polyethylene blend; UV light inhibitor; light diffuser
6	20	polyethylene blend; blue light blocking additive; UV light inhibitor
7 outer	20	polyethylene blend; UV light inhibitor; light diffuser

### Example 3

A 150 um thick 7-layer polyethylene-based orange greenhouse film having two layers containing blue light blocker is used to grow cannabis plants. The overall PAR light transmission of the film is 70%. The overall 440-500 nm blue light transmission is 50%. The overall 600-750nm red light transmission of the film is 95%. Cannabis plants are grown at a controlled temperature ranging from 23 to 30 degree Celsius. The greenhouse has 12-hour per day sunlight following a 12-hour per day total black out. Cannabis plants grown using this film reach maturity much faster than control plants and produce more THC per plant or per weight.

### Example 4

A 152.4 um thick 5-layer polyethylene-based orange greenhouse film having three layers containing blue light blocker is used to grow cannabis plants. The overall PAR light transmission of the film is 68%. The overall 440-500 nm blue light transmission is 40%. The overall 600-750nm red light transmission of the film is 90%. The greenhouse film has a light diffusion rate of 65%. Cannabis plants are grown at a controlled temperature ranging from 25 to 28 degree Celsius. The greenhouse has 14-hour per

day sunlight following a 10-hour per day total black out. Cannabis plants grown using this film reach maturity much faster than control plants and produce more THC per plant or per weight.

## 5 Example Trial Results

The flowering period was much quicker than observed with a standard clear polyethylene film used for comparison. The flowering period was 6.5 to 7.5 weeks compared to 8 to 9 weeks with standard film (about 18-20% shorter). The flowers are much harder and more dense; one could say they appeared to be more "finished". Also  
10 there is visibly much more trichome and resin production.

The present inventions can be embodied in other specific apparatus and/or methods. The described embodiments are to be considered in all respects as illustrative and not restrictive. In particular, the scope of the invention is indicated by the appended claims  
15 rather than by the description and figures herein. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

## CLAIMS

1. A film for enhancing the growth of plants in the Cannabaceae family, the film being capable of blocking solar spectrum in the range 440-550 nm.
2. A single- or multi-layer plastic greenhouse film for enhancing cannabis plant growth, characterized in that (a) it has at least one blue light blocking layer for blocking solar spectrum in the range of 440-500 nm; (b) it has a high transmittance for red light in the solar spectrum in the range of 600-750 nm.
3. The film of claim 1 or claim 2, wherein said blue light blocking layer is capable of at least partly blocking the region of the solar spectrum around and/or up to a wavelength in the range 440-500 nm.
4. The film of any preceding claim, wherein said blue light blocking layer is capable of at least partially blocking the solar spectrum up to a wavelength in the range 440-500 nm.
5. The film of any preceding claim, wherein said blue light blocking layer is capable of blocking the intensity of 440-500 nm region of the solar spectrum by 20-40%.
6. The film of any preceding claim, wherein said blue light blocking layer is capable of blocking the intensity of 440-500 nm region of the solar spectrum by 40-60%.
7. The film of any preceding claim, wherein said blue light blocking layer is capable of blocking the intensity of 440-500 nm region of the solar spectrum by 60-100%.

8. The film of any preceding claim, wherein said blue light blocking layer is capable of blocking the intensity of 440-500 nm region of the solar spectrum by 80-100%.
9. The film of any preceding claim, wherein said blue light blocking layer absorbs the blue light in the solar radiation around and/or up to approximately: 440 nm, 450 nm, 460 nm, 470 nm, 480 nm, 490 nm, or 500 nm.
10. The film of any preceding claim, wherein said blue light blocking layer blocks all blue light wavelengths up to and including 440 nm, 450 nm, 460 nm, 470 nm, 480 nm, 490 nm, or 500 nm.
11. The film of any preceding claim, wherein said film has a transmittance of 75%-100% for red light in the solar spectrum.
12. The film of any preceding claim, wherein said film has an overall transmittance for red light in the solar spectrum at 60-80%.
13. The film of any preceding claim, wherein said film has an overall transmittance for red light in the solar spectrum larger than 80%.
14. A film as claimed in any preceding claim, in which the film is formed using blow extrusion technology.
15. A film as claimed in any preceding claim, in which the film is formed using cast extrusion technology.
16. A film as claimed in any preceding claim, in which the or at least one of the layers of the film comprises: polyethylene, poly ethylene-vinyl acetate, polypropylene, or polyamide.

17. A film as claimed in any preceding claim, comprising one or more UV absorber additives and one or more pigment additives.
18. A film as claimed in any preceding claim, further comprising an anti-fogging agent.
19. A film as claimed in any preceding claim, further comprising an infrared blocker.
20. A film as claimed in any preceding claim, comprising one or more UV absorber additives and one or more orange pigment additives.
21. A film as claimed in any preceding claim, comprising one or more UV absorber additives and one or more yellow pigment additives.
22. A film as claimed in any preceding claim, in which the film comprises an additive for modifying the transmitted light spectrum.
23. A film as claimed in any preceding claim, in which the film comprises an additive for blocking the transmitted light spectrum.
24. A polyethylene-based greenhouse film which promotes or enhances the growth of cannabis plants compared to standard, clear polyethylene film.
25. A film as claimed in claim 24, in which growth is promoted or enhanced in terms of one or more of: accelerating the growth period, faster flowering time, promoting bigger and denser flowers, or producing higher THC concentration.
26. A greenhouse comprising film as claimed in any preceding claim.