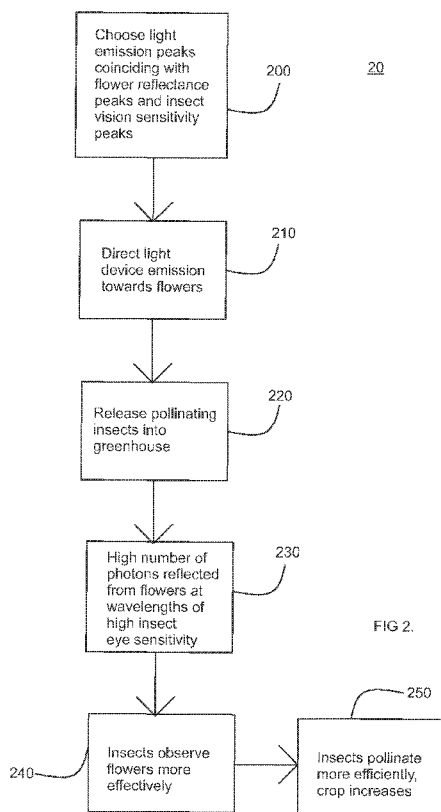




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[Continued on next page]

(54) **Title:** METHOD AND MEANS FOR IMPROVING PLANT PRODUCTIVITY THROUGH ENHANCING INSECT POLLINATION SUCCESS IN PLANT CULTIVATION



(57) **Abstract:** The invention relates to the cultivation of insect (840) pollinated plants (710, 711) in a greenhouse (700, 701 and 802) environment. In more particular, the invention relates to a lighting device and a method of illumination designed to enhance insect pollination in plants, such as the tomato. The best mode of the invention is considered to be the use of a LED (101, 102, 103 and 104) lighting device having emission peaks (401, 402, 403, 410 and 510) matching the photosynthetic relative absorption peaks of green plants, and the relative reflectance peaks of flowers of plants being cultivated and the relative sensitivity peaks of the insect's vision being used in the pollination. The inventive lighting device and method reduces insect mortality and increases pollination efficiency, photosynthetic growth and thereby increases the productivity of plant cultivation.



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AMENDED CLAIMS

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1. A horticultural light device, **characterised in that**, said light device is arranged to
5 emit at least one spectral peak (401, 402, and 403) at a wavelength that coincides
with increased reflectivity of flowers of pollinating plants (710, 711), said light
device is arranged to emit at least one spectral peak (401, 402, and 403) at a
wavelength that coincides with increased photoreception sensitivity of insect (840)
vision.
- 10 2. A light device as claimed in claim 1, **characterised in that**, the said increased
reflectivity and/or sensitivity is understood to exceed the 90%-, 80%-, 70%-, 60%-,
, 50%-, 40%- or 30%- level of maximum of said reflectivity and/or sensitivity in
the UV (300-400 nm) to far red (700-800 nm) band.
- 15 3. A light device as claimed in claim 1, **characterised in that**, said light device is
arranged into a greenhouse (700, 701, and 802) that is arranged to cultivate insect
pollinated plants (710, 711).
- 20 4. A light device as claimed in claim 1, **characterised in that**, said light device is
arranged with at least one LED (101, 102, 103 and 104) and/or quantum dot (110,
120, 130, 140, 150 and 160).
- 25 5. A light device as claimed in claim 1, **characterised in that**, at least one spectral
peak is arranged to occur at any of the following wavelengths: 348 nm, 424 nm,
435 nm, 533 nm, 538 nm with an error range of ± 10 nm and/or the lighting device
is arranged to emit a broad and flat spectral peak resulting in a broad UV
continuum component.
- 30 6. A light device as claimed in claim 1, **characterised in that**, the light device is a
horticultural lighting fixture comprising at least one Light Emitting Diode (LED)
(101, 102, 103 and 104) having

- a) first spectral characteristics including a peak in the wavelength range from 600 to 700 nm and arranged to exhibit a full width at half maximum of at least 50 nm or more,
- b) second spectral characteristics with a maximum of 50 nm full width at half maximum and arranged to exhibit a peak wavelength in the range from 440 to 500 nm (410, 510 and 610).

7. A light device as claimed in claim 1, **characterised in that**, at least a part or the whole of the emission at wavelengths of 500–600 nm is arranged to be minimized and/or omitted and/or to be reduced below the intensity in 400-500 nm band and below the intensity in 600-700 nm band.

8. A light device as claimed in claim 1, **characterised in that**, the emission spectrum (40, 50 and 60) is arranged to comprise far red radiation (700-800 nm).

9. A light device as claimed in claim 4, **characterised in that**, all or part of the emission at the wavelength band of 600–800 nm is arranged to be generated using a whole or partial wavelength up-conversion of the LED (101, 102, 103 and 104) chip radiation power.

10. A light device as claimed in claim 1, **characterised in that**, at least one said spectral peak is arranged to be turned on or off without influencing the emission of other spectral components in said lighting device.

11. A plant cultivation method, **characterised in that**, plants (710, 711) are illuminated with a light device emitting at least one spectral peak (401, 402 and 403) at a wavelength that coincides with increased reflectivity of flowers of said pollinating plants, said light device is arranged to emit at least one spectral peak (401, 402 and 403) at a wavelength that coincides with increased photoreception sensitivity of insect vision.

12. A plant cultivation method as claimed in claim 11, **characterised in that**, the said increased reflectivity and/or sensitivity is understood to exceed the 90%-, 80%-,

70%-, 60%-, 50%-, 40%- or 30%- level of maximum of said reflectivity and/or sensitivity in the UV (300-400 nm) to far red (700-800 nm) band.

13. A plant cultivation method as claimed in claim 11, **characterised in that**, said
5 light device is used in a greenhouse (700, 701 and 802) where insect pollinated plants (710, 711) are cultivated.
14. A plant cultivation method as claimed in claim 11, **characterised in that**, said
10 light device comprises at least one LED (101, 102, 103 and 104) and/or quantum dot (110, 120, 130, 140, 150 and 160).
15. A plant cultivation method as claimed in claim 11, **characterised in that**, at least
15 one spectral peak occurs at any of the following wavelengths: 348 nm, 424 nm, 435 nm, 533 nm, 538 nm with an error range of ± 10 nm and/or and/or the lighting device emits a broad and flat spectral peak resulting in a broad UV continuum component.
16. A plant cultivation method as claimed in claim 11, **characterised in that**, the light
20 device is a horticultural lighting fixture comprising at least one Light Emitting Diode (LED) (101, 102, 103 and 104) having
- c) first spectral characteristics including a peak in the wavelength range from 600 to 700 nm and exhibiting a full width at half maximum of at least 50 nm or more,
 - d) second spectral characteristics with a maximum of 50 nm full width at half
25 maximum and exhibiting a peak wavelength in the range from 440 to 500 nm (410, 510 and 610).
17. A plant cultivation method as claimed in claim 11, **characterised in that**, at least
30 a part or the whole of the emission at wavelengths of 500-600 nm is minimized and/or omitted and/or reduced below the intensity in 400-500 nm band and below the intensity in 600-700 nm band.

18. A plant cultivation method as claimed in claim 11, **characterised in that**, the emission spectrum (40, 50 and 60) comprises far red radiation (700-800 nm).
19. A plant cultivation method as claimed in claim 14, **characterised in that**, all or a
5 part of the emission at the wavelength band of 600-800 nm is generated using a whole or partial wavelength up-conversion of the LED (101, 102, 103 and 104) chip radiation power.
20. A plant cultivation method as claimed in claim 11, **characterised in that**, at least
10 one said spectral peak is arranged to be turned on or off without influencing the emission of other spectral components in said lighting device.

STATEMENT UNDER ARTICLE 19 PCT

Claim 2 is added to claim 1 from which it depends. Claim 13 is added to claim 12 from which it depends. Claims are renumbered. Subject matter has thus not been extended beyond the subject matter as filed.