PATENT CLAIMS

1. A plant cultivation lighting device, ~~characterised in that,~~ wherein said lighting device ~~(100)~~ comprises a plurality of quantum dots ~~(110, 120, 130, 140, 150, 160)~~ of different size producing light for plant cultivation.

2. A light device as claimed in claim 1, ~~characterized in that,~~ wherein said lighting device comprises a plurality of multiple quantum well structures for light emitting diode and at least one quantum well structure comprise quantum dot structures on a barrier layer.

3. A lighting device as claimed in claim 1, ~~characterised in that,~~ wherein the size distribution of said plurality of quantum ~~(110, 120, 130, 140, 150, 160)~~ dots is arranged to produce an aggregate emission spectrum similar to photosynthetically active radiation (PAR) spectrum except that the emission spectrum omits or provides a very low intensity in the green yellow (500-600) nm and comprises a high intensity spectral feature in the far red 700-800 nm band.

4. A lighting device as claimed in claim 1, ~~characterised in that,~~ wherein the size of at least one said quantum dot is chosen to emit photons in a band or in various bands with preset relative intensities in the photon spectrum with a certain photomorphogenetic effect in plants.

5. A lighting device as claimed in claim 4, ~~characterised in that,~~ wherein the said photomorphogenetic variable effected is any of the following biological parameters: weight, leaf number, root mass, stem height, chemical composition (such as vitamin, mineral, and/or nutrient content and/or concentration) of the plant at different time points or at harvesting maturity.

6. A lighting device as claimed in claim 1, ~~characterised in that,~~ wherein at least one of said quantum dots ~~(110, 120, 130, 140, 150, 160)~~ is made of any of the following alloys: GaN, InGaN, AlGaN, GaAs, cadmium selenide, cadmium sulphide, indium arsenide, indium phosphide and/or cadmium selenide sulphide or any combination of these.

7. A lighting device as claimed in claim 1, **~~characterised in that,~~** wherein the said size distribution of quantum dots ~~(110, 120, 130, 140, 150, 160)~~ comprises quantum dots of different sizes within the range of 1 nm – 20 nm.

8. A lighting device as claimed in claim 1, **~~characterised in that,~~** wherein at least one said quantum dot ~~(110, 120, 130, 140, 150, 160)~~ is produced by MOCVD process.

9. A lighting device as claimed in claim 1, **~~characterised in that,~~** wherein at least one said quantum dot ~~(110, 120, 130, 140, 150, 160)~~ is produced by colloidal synthesis process.

10. A lighting device as claimed in claim 1, **~~characterised in that,~~** wherein the size of at least one quantum dot ~~(110, 120, 130, 140, 150, 160)~~ is arranged so that it emits in the far red 700-800 nm band.

11. A lighting method for plant cultivation, **~~characterised in that,~~** wherein light is produced by a plurality of quantum dots ~~(110, 120, 130, 140, 150, 160)~~ of different size and said light illuminates at least one plant ~~(310, 311)~~.

12. A lighting method as claimed in claim 11, **~~characterised in that,~~** wherein the size distribution of said plurality of quantum dots ~~(110, 120, 130, 140, 150, 160)~~ produces an aggregate emission spectrum similar to photosynthetically active radiation (PAR) spectrum except that the emission spectrum omits or provides a very low intensity in the green yellow (500-600) nm and comprises a high intensity spectral feature in the far red 700-800 nm band.

13. A lighting method as claimed in claim 11, **~~characterised in that,~~** wherein the size of at least one said quantum dot ~~(110, 120, 130, 140, 150, 160)~~ is selected so that photon emission in a band or in various bands with preset relative intensities in the photon spectrum with a certain photomorphogenetic effect in plants results.

14. A lighting method as claimed in claim 11, **~~characterised in that,~~** wherein the said photomorphogenetic variable effected is any of the following biological parameters: weight, leaf number, root mass, stem height, chemical composition

(such as vitamin, mineral, and/or nutrient content and/or concentration) of the plant at different time points or at harvesting maturity.

15. A lighting method as claimed in claim 11, ~~**characterised in that,**~~ wherein at least one of said quantum dots ~~(110, 120, 130, 140, 150, 160)~~ is made of any of the following alloys: GaN, InGaN, AlGaN, GaAs cadmium selenide, cadmium sulphide, indium arsenide, indium phosphide and/or cadmium selenide sulphide or any combination of these.

16. A lighting method as claimed in claim 11, ~~**characterised in that,**~~ wherein the said size distribution of quantum dots ~~(110, 120, 130, 140, 150, 160)~~ comprises quantum dots of different sizes within the range of 2 nm - 200 nm.

17. A lighting method as claimed in claim 11, ~~**characterised in that,**~~ wherein at least one said quantum dot ~~(110, 120, 130, 140, 150, 160)~~ is produced by colloidal synthesis.

18. A lighting method as claimed in claim 11, ~~**characterised in that,**~~ wherein the size of at least one quantum dot ~~(110, 120, 130, 140, 150, 160)~~ is arranged so that the said quantum dot emits in the far red 700-800 nm band.

19. A light emitting component of a horticultural light, comprising;

- a light emitting quantum dot semiconductor chip; and
- a light wavelength up-conversion quantum dot which is deposited in direct proximity of the quantum dot chip;

said component being capable of emitting two characteristic light emission peaks, and 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.

20. The light emitting component of claim 19, wherein the light wavelength up-conversion quantum dot is deposited directly on the surface of the quantum dot chip or spaced out with other optical material.

21. The light emitting component of any of claims 19 or 20, wherein the light emitting quantum dot semiconductor chip has a peak emission within the range of 440 to 500 nm.

22. The light emitting component of any of claims 19 to 21, wherein the wavelength up-conversion quantum dot is arranged to convert part of the light emission energy emitted by the quantum dot semiconductor chip to the high wavelength of 600 to 700 nm.

23. The light emitting component of any of claims 19 to 22, wherein the two characteristics light emission peaks are at 440 nm–500 nm and 600–700 nm, respectively.

24. The light emitting component of any of claims 19 to 23, wherein the two characteristics light emission peaks omit spectral characteristics one at least 50 nm full width at half maximum and another maximum of 50 nm full width at half maximum and both at different wavelength ranges.

25. Use of the lighting device ~~or fixture~~ of claim 1 in providing light for at least one plant with the said at least one plant in ambient light or in a dark cavity with said lighting device ~~or fixture~~ as the sole source of light.

26. Use of the light emitting component of claim 19 in providing light for at least one plant with the said at least one plant in ambient light or in a dark cavity with said lighting device ~~or fixture~~ as the sole source of light.

27. A method for enhancing plant growth wherein at least one lighting device ~~or fixture~~ of claim 1 emits light to at least one plant with the said at least one plant in ambient light or in a dark cavity with said lighting device ~~or fixture~~ as the sole source of light.

28. A method for enhancing plant growth wherein at least one light emitting component of claim 19 emits light to at least one plant with the said at least one plant in ambient light or in a dark cavity with said lighting device ~~or fixture~~ as the sole source of light.

29. A light emitting device ~~, fixture and~~/or component as claimed in any of the claims 1 and/or 19 wherein said light emitting device~~, fixture and~~/or component is surrounded by a shading cavity which may optionally be closed with a lid.