SUMMARY

[0004a] In one aspect, the present disclosure refers to a granular composition for agricultural use comprising:

a plurality of granulates having a biodegradable coating applied over the granulates,

wherein the granulates comprise a material selected from the group consisting of seeds, fertilizers, and pesticides,

wherein the biodegradable coating comprises from ~~about~~ 5 to ~~about~~ 75 weight percent polylactic acid and from ~~about~~ 25 to ~~about~~ 95 weight percent polyhydroxyalkanoates, and

wherein the biodegradable coating comprises a continuous phase of polylactic acid having globules of the polyhydroxyalkanoates homogeneously dispersed therein, wherein the globules have an average size of from ~~about~~ 2 nm to ~~about~~ 10 micron, and

wherein the biodegradable coating is annealed at 150-170 °C or exposed to solvent vapors after application.

[0004b] In another aspect, the present disclosure refers to a method for making a coated granular composition disclosed herein, comprising the steps of:

mixing polylactic acid and a polyhydroxyalkanoate, optionally in the presence of a solvent, at a temperature from ~~about~~ 25 °C to ~~about~~ 180 °C to provide a coating mixture;

applying the coating mixture over outer surfaces of a plurality of granulates; and

solidifying the coating mixture to create a biodegradable coating over the outer surfaces of the plurality of granulates,

wherein the granulates comprise a material selected from the group consisting of seeds, fertilizers, and pesticides, and

wherein the biodegradable coating comprises a continuous phase of polylactic acid having globules of the polyhydroxyalkanoates homogeneously dispersed therein, wherein the globules have an average size of from ~~about~~ 2 nm to ~~about~~ 10 micron~~.~~, and

~~**[0004c]** In yet another aspect, the present disclosure refers to a method for controlled release of a granular material, comprising the steps of:~~

wherein the biodegradable coating is annealed after application at 150-170 °C or the biodegradable coating is exposed to solvent vapors after coating.

[0004c] In yet another aspect, the present disclosure refers to a method for controlled release of a granular material, comprising the steps of:

providing a granular composition ~~comprising a plurality of granulates having a biodegradable coating applied over the granulates, wherein the granulates comprise a material selected from the group consisting of seeds, fertilizers, and pesticides, and wherein the biodegradable coating comprises from about 10 to about 30 weight percent polylactic acid and from about 70 to about 90 weight percent polyhydroxyalkanoates~~as disclosed herein;

dispersing the granular composition over a plot of soil;

dissolving at least the polyhydroxyalkanoates in the biodegradable coating by exposing the plot of soil, and the granular composition dispersed therein, to moisture,

wherein dissolution of the polyhydroxyalkanoates forms a plurality of channels in the biodegradable coating through which the granulate material may be released into the soil.

[0005] The above and other needs are met by a granular composition for agricultural use in accordance with the current disclosure. According to one example, this granular composition is made up of a plurality of granulates having a biodegradable coating applied over the granulates. These granulates, in turn, are made up of a material selected from the group consisting of seeds, fertilizers, and pesticides. The biodegradable coating is made up of from about 5 to about 75 weight percent polylactic acid and from about 25 to about 95 weight percent polyhydroxyalkanoates.

[0006] In certain examples, the granulates of the composition are preferably made up of seeds. In other examples, the granulates of the composition are preferably made up of fertilizer, more preferably a urea-based fertilizer.

[0007] As noted, the biodegradable coating includes both polylactic acid (PLA) and a polyhydroxyalkanoate (PHA). In certain examples, the biodegradable coating preferably includes polylactic acid having a weight average molecular weight from about 10,000 to about 250,000 Daltons. Also, in certain examples, the biodegradable coating preferably includes polyhydroxyalkanoates having a weight average molecular weight from about 50,000 to about 2.5 million Daltons.

WHAT IS CLAIMED IS

Claim 1. A granular composition for agricultural use comprising:

a plurality of granulates having a biodegradable coating applied over the granulates,

wherein the granulates comprise a material selected from the group consisting of seeds, fertilizers, and pesticides,

wherein the biodegradable coating comprises from ~~about~~ 5 to ~~about~~ 75 weight percent polylactic acid and from ~~about~~ 25 to ~~about~~ 95 weight percent polyhydroxyalkanoates, and

wherein the biodegradable coating comprises a continuous phase of polylactic acid having globules of the polyhydroxyalkanoates homogeneously dispersed therein, wherein the globules have an average size of from ~~about~~ 2 nm to ~~about~~ 10 micron, and

wherein the biodegradable coating is annealed at 150-170 °C or exposed to solvent vapors after application.

Claim 2. The granular composition of Claim 1, wherein the granulates comprise seeds.

Claim 3. The granular composition of Claim 1, wherein the granulates comprise fertilizer.

Claim 4. The granular composition of Claim 1, wherein the granulates comprise pesticide.

Claim 5. The granular composition of Claim 1, wherein the biodegradable coating comprises polylactic acid having a weight average molecular weight from ~~about~~ 10,000 to ~~about~~ 250,000 Daltons.

Claim 6. The granular composition of Claim 1, wherein the biodegradable coating comprises polyhydroxyalkanoates having a weight average molecular weight from ~~about~~ 50,000 to ~~about~~ 2.5 million Daltons.

Claim 7. The granular composition of Claim 1, wherein the granulates have an average particle size, before coating, from ~~about~~ 1 to ~~about~~ 25 mm.

Claim 8. The granular composition of Claim 1, wherein the biodegradable coating comprises from ~~about~~ 10 to ~~about~~ 50 weight percent polylactic acid and from ~~about~~ 50 to ~~about~~ 90 weight percent polyhydroxyalkanoates.

Claim 9. The granular composition of Claim 1, wherein the polyhydroxyalkanoates comprise from ~~about~~ 70 to ~~about~~ 99 mole percent monomer residues of 3-hydroxybutyrate and from ~~about~~ 1 to ~~about~~ 30 mole percent monomer residues of 3-hydroxyhexanoate.

Claim 10. The granular composition of Claim 1, wherein the polyhydroxyalkanoates comprise three or more different types of hydroxyalkanoate monomer residues, each having from 5 to 22 carbon atoms.

Claim 11. A method for making a coated granular composition according to any of Claims 1-10, comprising the steps of:

mixing polylactic acid and a polyhydroxyalkanoate, optionally in the presence of a solvent, at a temperature from ~~about~~ 25 °C to ~~about~~ 180 °C to provide a coating mixture;

applying the coating mixture over outer surfaces of a plurality of granulates; and

solidifying the coating mixture to create a biodegradable coating over the outer surfaces of the plurality of granulates,

wherein the granulates comprise a material selected from the group consisting of seeds, fertilizers, and pesticides, and

wherein the biodegradable coating comprises a continuous phase of polylactic acid having globules of the polyhydroxyalkanoates homogeneously dispersed therein, wherein the globules have an average size of from ~~about~~ 2 nm to ~~about~~ 10 micron, and~~.~~

~~Claim 12. The method of Claim 11,~~ wherein the biodegradable coating is annealed ~~briefly~~ after application at 150-170 °C ~~for a few seconds~~ or the biodegradable coating is exposed to solvent vapors after coating.

Claim ~~13~~12. A method for controlled release of a granular material, comprising the steps of:

providing a granular composition according to any of Claims 1-10~~comprising a plurality of granulates having a biodegradable coating applied over the granulates, wherein the granulates comprise a material selected from the group consisting of seeds, fertilizers, and pesticides, and wherein the biodegradable coating comprises from about 10 to about 30 weight percent polylactic acid and from about 70 to about 90 weight percent polyhydroxyalkanoates~~;

dispersing the granular composition over a plot of soil;

dissolving at least the polyhydroxyalkanoates in the biodegradable coating by exposing the plot of soil, and the granular composition dispersed therein, to moisture,

wherein dissolution of the polyhydroxyalkanoates forms a plurality of channels in the biodegradable coating through which the granulate material may be released into the soil.

Claim 13~~14~~. The method of Claim 12~~13~~, wherein the biodegradable coating comprises from ~~about~~ 10 to ~~about~~ 30 weight percent polylactic acid and from ~~about~~ 70 to ~~about~~ 90 weight percent polyhydroxyalkanoates.

Claim 14~~15~~. The method of Claim 12~~13~~, wherein the polyhydroxyalkanoates comprise from ~~about~~ 70 to ~~about~~ 99 mole percent monomer residues of 3-hydroxybutyrate and from ~~about~~ 1 to ~~about~~ 30 mole percent monomer residues of 3-hydroxyhexanoate.

~~Claim 16. The method of Claim 13, wherein the biodegradable coating comprises a continuous phase of polylactic acid having globules of the polyhydroxyalkanoates stably dispersed therein, wherein the globules have an average size of from about 2 nm to about 10 micron.~~

Claim 15~~17~~. The method of Claim 12~~13~~, wherein at least ~~about~~ 50 percent of the polyhydroxyalkanoates in the biodegradable coating are dissolved after ~~about~~ 21 days exposure to moisture in the plot of soil.