Claims

1. A plant injection system comprising:

an injection tool configured to penetrate a plant and distribute a liquid formulation to the plant, the injection tool includes:

a base having an inlet port;

a penetrating distribution body extending along a longitudinal body axis and having a body profile, the penetrating distribution body includes:

a penetrating element;

at least one distribution reservoir within the body profile; and

one or more distribution ports in communication with the inlet port and the at least one distribution reservoir, the one or more distribution ports are spaced from the penetrating element; and

wherein the injection tool includes penetrating and distribution configurations:

in the penetrating configuration the penetrating element is configured to penetrate the plant along the longitudinal body axis; and

in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation transversely relative to the longitudinal body axis within the at least one distribution reservoir proximate to the plant.

2. The plant injection system of claim 1, wherein the one or more distribution ports are laterally spaced from the longitudinal body axis.

3. The plant injection system of claim 1, wherein the penetration element includes a penetration profile, and the one or more distribution ports are within the penetration profile and proximal relative to the penetration profile.

4. The plant injection system of claim 3, wherein the one or more distribution ports are recessed within the penetration profile.

5. The plant injection system of claim 1, wherein in the penetrating configuration the penetrating element interrupts engagement of the one or more distribution ports with the plant.

~~6. The plant injection system of claim 1, wherein the one or more distribution ports are recessed from an exterior of the body profile.~~

~~7. The plant injection system of claim 6, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation toward the exterior of the body profile.~~

~~8. The plant injection system of claim 1, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation remotely relative to the penetrating element.~~

~~9. The plant injection system of claim 1, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation at a proximal location along the penetrating distribution body relative to the penetrating element.~~

~~10. The plant injection system of claim 1, wherein in the distribution configuration the penetrating distribution body having the at least one distribution reservoir is configured to retain the liquid formulation along a plant tissue of the plant.~~

~~11. The plant injection system of claim 1 comprising a retained configuration wherein the penetrating distribution body is retained in an ongoing state in the plant with an anchor element.~~

~~12. The plant injection system of claim 1, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation to the plant in an ongoing state.~~

~~13. The plant injection system of claim 12, wherein the ongoing state includes a plurality of distributions of the liquid formulation from the one or more distribution ports over one or more hours.~~

~~14. The plant injection system of claim 13, wherein the plurality of distributions includes a continuous distribution of the liquid formulation.~~

15. The plant injection system of claim 1, wherein the penetrating element includes one or more of a cutting element, a wedge profile or a spike profile.

16. A method for distribution of a liquid formulation to a plant, the method comprising:

penetrating a plant with an injection tool having a penetrating distribution body extending along a longitudinal body axis, penetrating includes:

piercing the plant with a penetrating element of the penetrating distribution body;

isolating one or more distribution ports from the plant with the penetrating distribution body; and

distributing the liquid formulation to the penetrated plant, distributing the liquid formulation includes:

transmitting the liquid formulation from an inlet port of the injection tool to the one or more distribution ports;

delivering the liquid formulation from the one or more distribution ports to at least one distribution reservoir in communication with the penetrated plant, the at least one distribution reservoir within a body profile of the penetrating distribution body.

17. The method of claim 16, wherein isolating the one or more distribution ports from the plant includes isolating the one or more distribution ports from the plant with a penetration profile of the penetration element.

18. The method of claim 16, wherein the one or more distribution ports are within the body profile of the penetrating distribution body; and

isolating the one or more distribution ports from the plant includes isolating the one or more distribution ports with the body profile.

19. The method of claim 16, wherein the one or more distribution ports are within a body profile of the penetrating distribution body; and

penetrating the plant with the injection tool includes interrupting the engagement of the one or more distribution ports with the plant.

20. The method of claim 16, wherein the penetrating element includes a cutting element; and

piercing the plant with the penetrating element includes cutting the plant with the cutting element.

~~21. The method of claim 16, wherein the penetrating element includes a wedge profile; and~~

~~piercing the plant with the penetrating element includes cutting the plant with the wedge profile.~~

~~22. The method of claim 16, wherein the penetrating distribution body includes a body profile, and the one or more distribution ports are recessed from the body profile; and~~

~~delivering the liquid formulation from the one or more distribution ports includes transversely delivering the liquid formulation relative to a longitudinal body axis of the penetrating distribution body.~~

~~23. The method of claim 16 comprising retaining the liquid formulation along a plant tissue of the plant.~~

~~24. The method of claim 16, wherein the one or more distribution ports are remote from the penetrating element; and~~

~~delivering the liquid formulation from the one or more distribution ports includes delivering the liquid formulation remotely relative to the penetration element.~~

~~25. The method of claim 24, wherein delivering the liquid formulation remotely includes delivery the liquid formulation at a proximal location along the penetrating distribution body relative to the penetrating element.~~

~~26. The method of claim 16 comprising retaining the penetrating distribution body in the plant with an anchor element.~~

~~27. The method of claim 16, wherein delivering the liquid formulation from the one or more distribution ports includes ongoing delivery of the liquid formulation.~~

~~28. The method of claim 27, wherein ongoing delivery of the liquid formulation includes ongoing delivery of the liquid formulation over one or more hours.~~

~~29. The method of claim 27, wherein ongoing delivery of the liquid formulation includes a plurality of distributions.~~

30. The method of claim 16, wherein delivering the liquid formulation includes passive delivering of the liquid formulation.

31. The method of claim 30, wherein passive delivering of the liquid formulation includes delivering of the liquid formulation based on a hydrostatic pressure of the liquid formulation.

32. A plant injection system comprising:

an injection tool configured to penetrate a plant and distribute a liquid formulation to the plant, the injection tool includes:

a base having an inlet port;

a penetrating distribution body extending along a longitudinal body axis, the penetrating distribution body includes:

a penetrating element; and

one or more distribution ports in communication with the inlet port, the one or more distribution ports are spaced from the penetrating element; and

wherein the injection tool includes penetrating and distribution configurations:

in the penetrating configuration the penetrating element is configured to penetrate the plant along the longitudinal body axis; and

in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation to the plant transversely relative to the longitudinal body axis.

33. The plant injection system of claim 32, wherein the one or more distribution ports are laterally spaced from the longitudinal body axis.

34. The plant injection system of claim 32, wherein the penetration element includes a penetration profile, and the one or more distribution ports are within the penetration profile and proximal relative to the penetration profile.

35. The plant injection system of claim 34, wherein the one or more distribution ports are recessed within the penetration profile.

~~36. The plant injection system of claim 32, wherein in the penetrating configuration the penetrating element interrupts engagement of the one or more distribution ports with the plant.~~

~~37. The plant injection system of claim 32, wherein the penetrating distribution body includes a body profile, and the one or more distribution ports are recessed from an exterior of the body profile.~~

~~38. The plant injection system of claim 37, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation toward the exterior of the body profile.~~

~~39. The plant injection system of claim 32, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation remotely relative to the penetrating element.~~

~~40. The plant injection system of claim 32, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation at a proximal location along the penetrating distribution body relative to the penetrating element.~~

~~41. The plant injection system of claim 32, wherein the penetrating distribution includes a body profile and at least one distribution reservoir within the body profile; and~~

~~in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation into the least one distribution reservoir.~~

~~42. The plant injection system of claim 41, wherein in the distribution configuration the penetrating distribution body having the at least one distribution reservoir is configured to retain the liquid formulation along a plant tissue of the plant.~~

~~43. The plant injection system of claim 32 comprising a retained configuration wherein the penetrating distribution body is retained in an ongoing state in the plant with an anchor element.~~

~~44. The plant injection system of claim 32, wherein in the distribution configuration the one or more distribution ports are configured to distribute the liquid formulation to the plant in an ongoing state.~~

45. The plant injection system of claim 44, wherein the ongoing state includes a plurality of distributions of the liquid formulation from the one or more distribution ports over one or more hours.

46. The plant injection system of claim 44, wherein the plurality of distributions includes a continuous distribution of the liquid formulation.

47. The plant injection system of claim 32, wherein the penetrating element includes one or more of a cutting element, a wedge profile or a spike profile.

48. A plant injection system comprising:

an injection tool configured to penetrate a plant and distribute a liquid formulation to the plant, the injection tool includes:

a base having an inlet port configured to receive the liquid formulation;

a penetrating distribution body extending from the base along a longitudinal body axis, the penetrating distribution body having a body profile, the penetrating distribution body includes:

a penetrating element proximate a distal portion of the penetrating distribution body;

a distribution element along the penetrating distribution body, the distribution element includes one or more distribution ports; and

wherein the one or more distribution ports open laterally along the penetrating distribution body relative to the longitudinal body axis.

49. The plant injection system of claim 48, wherein the body profile includes a shaft profile having one or more cutting elements along the penetrating element.

50. The plant injection system of claim 48, wherein the body profile includes a wedge profile tapering toward the distal portion.

51. The plant injection system of claim 48, wherein the penetrating distribution body includes an anchor element configured to retain the injection tool within a penetrated plant.

~~52. The plant injection system of claim 51, wherein the anchor element includes one or more of threading, flutes, cleats, or a wedge profile.~~

~~53. The plant injection system of claim 48, wherein the penetrating distribution body includes an inlet passage extending from the inlet port to the one or more distribution ports.~~

~~54. The plant injection system of claim 48, wherein the one or more distribution ports are recessed from an exterior of the body profile.~~

~~55. The plant injection system of claim 48, wherein the one or more distribution ports include a plurality of distribution ports.~~

~~56. The plant injection system of claim 48, wherein the one or more distribution ports extend away from the longitudinal body axis.~~

~~57. The plant injection system of claim 48, wherein the one or more distribution ports extend toward the base and extend away from the distal portion of the penetrating distribution body.~~

~~58. The plant injection system of claim 48, wherein the injection tool includes a distribution configuration having the one or more distribution ports configured to distribute the liquid formulation to the plant transversely relative to the longitudinal body axis.~~

~~59. The plant injection system of claim 48, wherein the body profile includes at least one distribution reservoir, and the one or more distribution ports open into the at least one distribution reservoir.~~

~~60. The plant injection system of claim 59, wherein the at least one distribution reservoir is spaced from a leading edge of the penetrating element.~~

~~61. The plant injection system of claim 59, wherein the at least one distribution reservoir is recessed from an exterior of the body profile.~~

~~62. The plant injection system of claim 48 comprising:~~

~~a delivery device in communication with the injection tool, the delivery device includes:~~

a container configured to store the liquid formulation; and

an attachment interface in communication with the container, the attachment interface is configured for coupling with the inlet port of the injection tool.

63. The plant injection system of claim 62, wherein the delivery device includes a dosing device interposed between the container and the attachment interface, the dosing device is configured to deliver a specified quantity of the liquid formulation to the injection tool for lateral distribution from the one or more distribution ports.

64. A plant injection system comprising:

an injection tool configured to penetrate a plant and distribute a liquid formulation to the plant, the injection tool includes:

a base having an inlet port configured to receive the liquid formulation;

a penetrating distribution body extending from the base along a longitudinal body axis, the penetrating distribution body having a body profile, the penetrating distribution body includes:

a penetrating element proximate a distal portion of the penetrating distribution body;

an anchor element along the penetrating distribution body, the anchor element is configured to retain the injection tool within the penetrated plant;

a distribution element along the penetrating distribution body, the distribution element includes one or more distribution ports; and

wherein the one or more distribution ports are in communication with the inlet port, and the one or more distribution ports are laterally spaced from the longitudinal body axis.

65. The plant injection system of claim 64, wherein the body profile includes a shaft profile, and the penetrating element includes one or more cutting elements.

66. The plant injection system of claim 64, wherein the body profile includes a wedge profile tapering toward the distal portion.

67. The plant injection system of claim 64, wherein the anchor element includes one or more of threading, flutes, cleats or a wedge profile.

~~68. The plant injection system of claim 64, wherein the penetrating distribution body includes an inlet passage extending from the inlet port to the one or more distribution ports.~~

~~69. The plant injection system of claim 64, wherein the one or more distribution ports are recessed from an exterior of the body profile.~~

~~70. The plant injection system of claim 64, wherein the one or more distribution ports are remotely located relative to the penetrating element.~~

~~71. The plant injection system of claim 64, wherein the one or more distribution ports extend away from the longitudinal body axis.~~

~~72. The plant injection system of claim 64, wherein the one or more distribution ports extend toward the base and extend away from the distal portion of the penetrating distribution body.~~

~~73. The plant injection system of claim 64, wherein the injection tool includes a distribution configuration having the one or more distribution ports configured to distribute the liquid formulation to the plant transversely relative to the longitudinal body axis.~~

~~74. The plant injection system of claim 64, wherein the body profile includes at least one distribution reservoir, and the one or more distribution ports open into the at least one distribution reservoir.~~

~~75. The plant injection system of claim 74, wherein the penetrating distribution body surrounds the at least one distribution reservoir.~~

~~76. The plant injection system of claim 74, wherein the penetrating distribution body includes one or more scalloped surfaces, and the at least one distribution reservoir extends along the one or more scalloped surfaces.~~

~~77. The plant injection system of claim 74, wherein the penetrating distribution body includes one or more cavities, and the at least one distribution reservoir is within the one or more cavities.~~

78. The plant injection system of claim 74, wherein the at least one distribution reservoir is spaced from a leading edge of the penetrating element.

79. The plant injection system of claim 74, wherein the at least one distribution reservoir is recessed from an exterior of the body profile.

80. A method for distribution of a liquid formulation to a plant, the method comprising:

penetrating a plant with an injection tool having a penetrating distribution body extending along a longitudinal body axis, penetrating includes:

piercing the plant with a penetrating element of the penetrating distribution body, wherein the penetrating element is moved along the longitudinal body axis;

distributing the liquid formulation to the penetrated plant, distributing the liquid formulation includes:

transmitting the liquid formulation from an inlet port of the injection tool to one or more distribution ports of the penetrating distribution body;

delivering the liquid formulation from the one or more distribution ports transversely relative to the longitudinal body axis.

81. The method of claim 80, wherein penetrating the plant with the injection tool includes isolating the one or more distribution ports from the plant with a penetration profile of the penetration element.

82. The method of claim 80, wherein the one or more distribution ports are within a body profile of the penetrating distribution body; and

penetrating the plant with the injection tool includes isolating the one or more distribution ports from the plant with the body profile.

83. The method of claim 80, wherein the one or more distribution ports are within a body profile of the penetrating distribution body; and

penetrating the plant with the injection tool includes interrupting the engagement of the one or more distribution ports with the plant.

84. The method of claim 80, wherein the penetrating element includes a cutting element; and

~~piercing the plant with the penetrating element includes cutting the plant with the cutting element.~~

~~85. The method of claim 80, wherein the penetrating element includes a wedge profile; and~~

~~piercing the plant with the penetrating element includes cutting the plant with the wedge profile.~~

~~86. The method of claim 80, wherein the penetrating distribution body includes a body profile, and the one or more distribution ports are recessed from the body profile; and~~

~~delivering the liquid formulation from the one or more distribution ports transversely includes delivering the liquid formulation into the body profile.~~

~~87. The method of claim 86, wherein the penetrating distribution body includes at least one distribution reservoir; and~~

~~delivering the liquid formulation from the one or more distribution ports transversely includes delivering the liquid formulation into the at least one distribution reservoir.~~

~~88. The method of claim 80 comprising retaining the liquid formulation along a plant tissue of the plant.~~

~~89. The method of claim 80, wherein the one or more distribution ports are remote from the penetrating element; and~~

~~delivering the liquid formulation from the one or more distribution ports includes delivering the liquid formulation remotely relative to the penetration element.~~

~~90. The method of claim 89, wherein delivering the liquid formulation remotely includes delivery the liquid formulation at a proximal location along the penetrating distribution body relative to the penetrating element.~~

~~91. The method of claim 80 comprising retaining the penetrating distribution body in the plant with an anchor element.~~

~~92. The method of claim 80, wherein delivering the liquid formulation from the one or more distribution ports includes ongoing delivery of the liquid formulation.~~

93. The method of claim 92, wherein ongoing delivery of the liquid formulation includes ongoing delivery of the liquid formulation over one or more hours.

94. The method of claim 92, wherein ongoing delivery of the liquid formulation includes a plurality of distributions.

95. The method of claim 80, wherein delivering the liquid formulation includes passive delivering of the liquid formulation.

96. The method of claim 95, wherein passive delivering of the liquid formulation includes delivering of the liquid formulation based on a hydrostatic pressure of the liquid formulation.

97. A plant injection system comprising:

an injection tool configured to penetrate a plant and distribute a liquid formulation to the plant, the injection tool includes:

a base having an inlet port;

a penetrating distribution body extending from the base along a longitudinal body axis, the penetrating distribution body having a body profile, the penetrating distribution body includes:

a penetrating element proximate a distal portion of the penetrating distribution body;

a distribution element along the penetrating distribution body, the distribution element includes one or more distribution ports directed laterally relative to the longitudinal body axis, the one or more distribution ports in communication with the inlet port; and

a delivery device in communication with the injection tool, the delivery device includes:

a container configured to store the liquid formulation; and

an attachment interface in communication with the container, the attachment interface is configured for coupling with the inlet port.

98. The plant injection system of claim 97, wherein the delivery device includes a dosing device interposed between the container and the attachment interface, the dosing device is

~~configured to deliver a specified quantity of the liquid formulation to the injection tool for lateral distribution from the one or more distribution ports.~~

~~99. The plant injection system of claim 97, wherein the one or more distribution ports are recessed from an exterior surface of the body profile.~~

~~100. The plant injection system of claim 97, wherein the body profile includes at least one distribution reservoir, and the one or more distribution ports open into the at least one distribution reservoir.~~

~~101. The plant injection system of claim 100, wherein the at least one distribution reservoir is spaced from a leading edge of the penetrating element.~~

~~102. The plant injection system of claim 100, wherein the at least one distribution reservoir is recessed from an exterior surface of the body profile.~~1. An injection tool, comprising:

a base including an inlet port; and

a penetrating distribution body having a distal end away from the base and a proximal end near the base, wherein the penetrating distribution body includes:

a cutting edge at the distal end of the penetrating distribution body,

a penetrating element that extends from the cutting edge to the proximal end of the penetrating distribution body,

wherein the cutting edge and the penetrating element form a wedge type body profile extending along a longitudinal axis of the injection tool,

opposing faces that extend from the base and meet at the cutting edge,

a distribution element that includes:

a main channel that runs longitudinally through the center of the penetrating distribution body;

distribution ports; and

two distribution reservoirs, one on each side of the main channel, wherein each distribution reservoir is an opening that extends through both opposing faces of the penetrating distribution body.

2. The injection tool of claim 1, wherein the two distribution reservoirs are configured to retain a liquid formulation in residence proximate to adjacent plant tissues.

3. The injection tool of claim 1, wherein the penetrating element increases in thickness from the distal end of the penetration distribution body toward the proximal end of the penetration distribution body and the base.

4. The injection tool of claim 1, wherein the inlet port has a ribbed outer structure.

5. The injection tool of claim 1, wherein a transition between the base and the penetrating distribution body forms an abutting face that extends away from the longitudinal axis of the injection tool.

6. A plant injection system, comprising:

an injection tool of claim 1; and

a delivery device connected to the injection tool, wherein the delivery device includes a container configured to store a liquid formulation.

7. The plant injection system of claim 6, further comprising: an attachment interface connected to the container, wherein the attachment interface is configured for coupling with the inlet port of the injection tool.

8. The plant injection system of claim 7, wherein the delivery device further includes a dosing device interposed between the container and the attachment interface, wherein the dosing device is configured to deliver a specified quantity of the liquid formulation to the injection tool for lateral distribution from one or more distribution ports.

9. A method of distributing a liquid formulation to a plant, comprising:

penetrating the plant with an injection tool of claim 1; and

distributing the liquid formulation through the injection tool to the plant.

10. The method of claim 9, wherein penetrating the plant comprises:

piercing the plant with the cutting edge, wherein the penetrating element is moved along the longitudinal axis of the injection tool.

11. The method of claim 9, wherein distributing the liquid formulation to the plant comprises:

transmitting the liquid formulation from the inlet port of the injection tool to the distribution ports of the penetrating distribution body; and

delivering the liquid formulation from the distribution ports transversely relative to the longitudinal axis into the two distribution reservoirs.

12. The method of claim 9, further comprising:

retaining the liquid formulation along a plant tissue of the plant.

13. The method of claim 9, wherein the liquid formulation is distributed over one or more hours.

14. The method of claim 9, wherein the liquid formulation is continuously distributed.

15. The injection tool of claim 1, wherein the distribution ports are oriented at an angle between around 100 degrees to around 180 degrees relative to a penetrating movement direction.

16. The injection tool of claim 15, wherein the distribution ports are oriented at an angle of about 125 degrees relative to the penetrating movement direction.

17. The injection tool of claim 1, wherein each distribution port is recessed within a wall of one of the two distribution reservoirs.

18. The injection tool of claim 1, wherein the penetrating distribution body has a lance tip shape.

19. The injection tool of claim 5, wherein the abutting face is flat.

20. The injection tool of claim 5, wherein the abutting face has a corresponding shape to a portion of the plant where the tool is intended for insertion.

21. The injection tool of claim 1, wherein the distribution ports are configured to receive a liquid formulation from the main channel and direct the liquid formulation in a transverse direction relative to the longitudinal axis into the two distribution reservoirs.

22. The injection tool of claim 1, wherein the penetrating distribution body increases in width from cutting edge toward the proximal end of the penetrating distribution body and the base.

23. The injection tool of claim 1, wherein the injection tool is configured to direct a liquid formulation from the inlet port to the main channel of the distribution element, through the main channel to the distribution ports, and through the distribution ports into the two distribution reservoirs.

24. The injection tool of claim 23, wherein the injection tool is configured to deliver at least a portion of the liquid formulation from the distribution ports into the two distribution reservoirs in a transverse direction relative to the longitudinal axis of the injection tool.