CLAIMS

1. An apparatus comprising:

a processor;

a memory coupled to the processor; and

computer-readable instructions stored on the memory which, when run on the processor, cause the apparatus to:

receive data captured from a first geo position of a plant in a crop plantation, the data indicating:

the first geo position;

at least one environmental variable at the first geo position from: temperature, humidity, rainfall, soil condition and dewpoint; and

an indication of a plant disease, of a first plant at the first geo position;

predict, using a machine-learning, ML, model, a likelihood of the disease being present in a second plant at a second geo position different to the first geo position in a predetermined timeframe, based on:

the received data;

a first historical record of the first geo position indicating one or more of: previous plant disease, treatment of previous plant disease, and historical environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint;

a first environmental variable indicating the local environment at the first geo position;

a second historical record of a second geo position indicating one or more of: previous plant disease, treatment of previous plant disease, and historical environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint; and

a second environmental variable indicating the local environment of the second geo position; and

provide a disease indicator of the likelihood of the disease being present in the second plant to a treatment unit, the disease indicator to cause treatment of the second plant at the second geo location by the treatment unit according to the predicted likelihood of disease, to reduce the likelihood of the disease occurring at the second plant.

2. The apparatus of claim 1, wherein the computer-readable instructions, when run on the processor, cause the apparatus to:

use the trained ML model to predict a likely severity of the disease predicted to be present at the second plant; and

provide a severity indication of the predicted likely severity of the disease being present to the treatment unit, the severity indication to cause treatment of the second crop at the second geo location according to the determined likely severity of the disease.

3. The apparatus of any preceding claim, wherein the indication of the plant disease is obtained from an artificial intelligence, AI, model, wherein:

the AI model is trained using experimental control data indicating, for each control plant of a plurality of control plants, an image of the control plant, one or more plant diseases or plant disease absence of the control plant, and a plurality of environmental parameters of the control plant, and

the trained AI model receives, as input, a captured image of the first plant, and determines, as output, based on the training data, the indication of the plant disease for the plant in the captured image.

4. The apparatus of any preceding claim, wherein training the ML model is performed according to:

an initial training phase comprising:

receiving a series of training data entries each indicating, for a training plant:

at least one environmental parameter from: temperature, humidity, rainfall, soil condition and dewpoint;

an indication of a training plant disease; and

a training historical record indicating one or more of: previous training plant disease, treatment of previous training plant disease, and historical training plant environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint; and

determining relationships between the training data entries to allow for prediction of the likelihood of the plant disease for another plant; and,

optionally, according to a feedback training phase comprising:

receiving a further data entry indicating, for the first plant:

the first geo position;

the at least one environmental variable at the first geo position from: temperature, humidity, rainfall, soil condition and dewpoint;

the indication of a plant disease; and

a first historical record of the first geo position indicating one or more of: previous first plant disease, treatment of previous first plant disease, and historical first plant environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint; and

determining relationships between the training data entries and the further data entry to allow for prediction of the likelihood of the plant disease for another plant.

5. The apparatus of claim 4, wherein training the ML model comprises:

comparing the prediction of the likelihood of the plant disease obtained in the initial training phase of the ML model with the experimental control data indicating one or more plant diseases or plant disease absence of a control plant, to determine a lag time between the effect of changing a parameter of the set of environmental parameters and a resultant effect on the plant disease; and

providing the determined lag time as input to the ML model for the compared prediction and experimental control data to train the ML model to determine a relationship between a change in an environmental parameter and determined lag time.

6. The apparatus of any preceding claim, wherein the ML model is configured to use Bayesian probability analysis to predict the likelihood of the disease being present in the second plant in the predetermined timeframe.

7. The apparatus of any preceding claim, wherein the disease indicator indicates:

the second geo location of the second plant; and

one or more treatment parameters from: the disease type, the treatment substance type, the plant type, a volume of treatment substance to apply, a concentration of treatment substance to apply, a plant location to treat on the second plant; and a treatment schedule indicating when to treat the second plant.

8. The apparatus of any preceding claim, wherein:

the first plant in the crop plantation has an associated unique identifier; and the computer-readable instructions stored on the memory, when run on the processor, cause the apparatus to:

retrieve the first historical record and the first environmental variable from a database of historical records and a database of environmental variables using the unique identifier; and

store the at least one environmental variable and the indication of a plant disease of the first plant at the first geo position with the unique identifier for subsequent use as training data to train the ML model.

9. A device network for agricultural crop treatment, the device network comprising:

a disease recognition apparatus comprising:

a processor;

a memory coupled to the processor; and

computer-readable instructions stored on the memory which, when run on the processor, cause the apparatus to:

receive, as training input, control data from a control plant in experimental control conditions, the control data indicating an image of the control plant, a disease

of the control plant in an environment having a set of environmental parameters, and data representing the set of environmental parameters;

establish, from the received training input, a knowledge library of plant diseases according to plant appearance and environmental parameters;

subsequently receive, as use input, a captured image of a crop plantation plant;

determine, based on the received captured image and the knowledge library, a disease of the crop plantation plant; and

provide, as output, an indication of the crop plantation plant disease in the captured image,

the disease recognition apparatus configured to provide the indication of the crop plantation plant disease;

the apparatus of any of claims 1 to 8 configured to provide the disease indicator of the likelihood of the disease being present in the second plant to a treatment unit; and

the treatment unit configured to receive the disease indicator.

10. The device network of claim 9, further comprising a field device configured to:

capture and transmit the geo position and the at least one environmental parameter at the geo position data in the crop plantation to the apparatus of any of claims 1 to 8; and

capture and transmit, as use input, the captured image of the crop plantation plant to the disease recognition apparatus .

11. The device network of any preceding claim, wherein the treatment unit comprises a drone configured to:

receive the disease indicator comprising a geo location of the second plant and a treatment to apply to the second plant;

travel to the second plant at the geo location; and

apply the treatment indicated in the disease indicator to the plant.

12. The device network of claim 9 or claim 10, the device network further comprising:

a storage server in communicative connection with the apparatus of any of claims 1 to 8, and a disease recognition apparatus comprising:

a disease recognition apparatus comprising:

a processor;

a memory coupled to the processor; and

computer-readable instructions stored on the memory which, when run on the processor, cause the apparatus to:

receive, as training input, control data from a control plant in experimental control conditions, the control data indicating an image of the control plant, a disease of the control plant in an environment having a set of environmental parameters, and data representing the set of environmental parameters;

establish, from the received training input, a knowledge library of plant diseases according to plant appearance and environmental parameters;

subsequently receive, as use input, a captured image of a crop plantation plant;

determine, based on the received captured image and the knowledge library, a disease of the crop plantation plant; and

provide, as output, an indication of the crop plantation plant disease in the captured image, the storage server configured to store one or more of:

the transmitted captured data from the geo position in the crop plantation; and

training data used to train the AI model.

13. A computer-implemented method comprising:

receiving data captured from a first geo position of a plant in a crop plantation, the data indicating:

the first geo position;

at least one environmental variable at the first geo position from: temperature, humidity, rainfall, soil condition and dewpoint; and

an indication of a plant disease, of a first plant at the first geo position;

predicting, using a machine-learning, ML, model, a likelihood of the disease being present in a second plant at a second geo position different to the first geo position in a predetermined timeframe, based on:

the received data;

a first historical record of the first geo position indicating one or more of: previous plant disease, treatment of previous plant disease, and historical environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint;

a first environmental variable indicating the local environment at the first geo position,

a second historical record of a second geo position indicating one or more of: previous plant disease, treatment of previous plant disease, and historical environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint; and

a second environmental variable indicating the local environment of the second geo position; and

providing a disease indicator of the likelihood of the disease being present in the second plant to a treatment unit, the disease indicator to cause treatment of the second plant at the second geo location by the treatment unit according to the predicted likelihood of disease, to reduce the likelihood of the disease occurring at the second plant.

14. A non-transitory computer-readable storage medium having executable instructions stored thereon which, when executed by a processor, cause the processor to:

receive data captured from a first geo position of a plant in a crop plantation, the data indicating:

the first geo position;

at least one environmental variable at the first geo position from: temperature, humidity, rainfall, soil condition and dewpoint

an indication of a plant disease, of a first plant at the first geo position;

predict, using a machine-learning, ML, model a likelihood of the disease being present in a second plant at a second geo position different to the first geo position in a predetermined timeframe, based on:

the received data;

a first historical record of the first geo position indicating one or more of: previous plant disease, treatment of previous plant disease, and historical environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint;

a first environmental variable indicating the local environment at the first geo position,

a second historical record of a second geo position indicating one or more of: previous plant disease, treatment of previous plant disease, and

historical environmental variable values from: temperature, humidity, rainfall, soil condition and dewpoint; and

a second environmental variable indicating the local environment of the second geo position; and

provide a disease indicator of the likelihood of the disease being present in the second plant to a treatment unit, the disease indicator to cause treatment of the second plant at the second geo location by the treatment unit according to the predicted likelihood of disease, to reduce the likelihood of the disease occurring at the second plant.