1

Our Time Together

- Precision Agriculture – an overview and understanding
- Impact of Drones – Now and tomorrow
- Autonomous equipment and robotics – made for Ag
- Indoor Agriculture

2

Hands Free Hectare - Video

3

Taurus Insurance Consulting

3

Precision Ag, Defined

4

Precision agriculture (PA), satellite farming or site specific crop management (SSCM) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops.

The goal of precision agriculture research is to define a decision support system (DSS) for whole farm management with the goal of optimizing returns on inputs while preserving resources.

Wikipedia.org

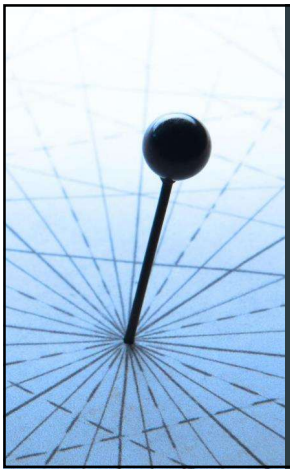
4

Technologies In Use Include

5

- GPS guidance & autosteer
- Sprayer section controls
- Row control on planters & seeders
- Yield monitoring
- Remote & in field sensing
- VRA – variable rate applications
- Telematics
- Robotics

5



GPS Guidance & Autosteer

6

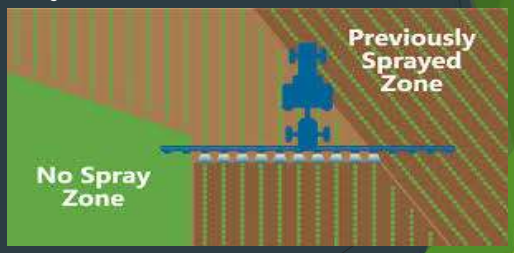
- Two primary types as:
  - Navigation aids
  - Auto guidance

6

Sprayer Section Control

7

Section Control turns machine or implement sections ON and OFF automatically to reduce overlap and improve input management



7

Row Control, Planters & Seeders

8

Similar to sprayer control – Except used for planting & seeding

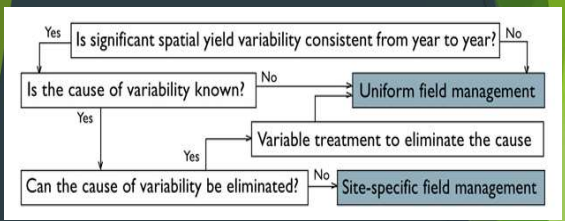
Used due to cost of seed, fertilizer & chemicals per acre

- 2022 – corn @ $370.00 per acre
- 2022 – soybeans @ $233.00 per acre
- 2022 – wheat @ $27.50 to $30.00 per acre (seed only)

8

Yield Monitoring & Mapping

9



9

10

Yield Monitoring and Mapping

- Sensors mounted on the combine measuring yield as the crop is harvested.
- Coupled with a GPS logging location, data can be mapped.
- Identifies in-field variations in yield.
- Allows fine tuning of next year's seeding and fertilizer applications.
- Overall yield monitor accuracy is improving with use and research, while in-field accuracy is improved with calibration.

Yield monitors are attached to conveyors or combines to measure grain yield and moisture content.

Taurus Insurance Consulting

10

11

Remote & In Field Sensing

- Remote sensing – process of detecting & monitoring the physical characteristics of an area by measuring its reflected & emitted radiation from a distance
- In field may use measurements regarding field moisture, temperature, soil oxygen & CO2, air flow (orchards), frost temperatures and the like

11

12

Telematics

Technology that captures data from farm equipment operating in a field and transfers the data to the Internet in real time.

Telematic products allow navigation, prescription application, location and other data to be transferred easily to and from farm machinery.

Great for future management of the farm operation as well as for safe operation of farm equipment

12

Robotics

13

Robots being used and developed for specific agricultural purposes

- Weeding
- Planting
- Harvesting
- Soil analysis
- Environmental monitoring

13

Robotics on the Farm

14

14

HOW AND WHY IT HAS GROWN

15

- Been around for 25+ years, thank you, John Deere, and the U.S. Air Force
- Enabled by:
  - Crop yield monitors on GPS-equipped combines
  - Variable rate technology (VRT) such as seeders and sprayers
  - An array of real-time vehicle mountable sensors that measure everything from chlorophyll levels to plant water status
  - Multi- and hyperspectral aerial and satellite images from which products such as NDVI maps can be produced

15

Why It Is Growing

- The United Nations predicts
- By 2050 – world population will exceed 9.7 billion
- Current world population approximately 8.1 billion
- It is expected that the world will have about 50% less cultivable land than now exists

Taurus Insurance Consulting

16

Why It Is Growing

- Aging population of farmers in the US
- Farming is not attractive to most people
- Migrant labor is not nearly as plentiful as in the past
- Immigration challenges
- H2A difficulties
- Competitive labor pools
- It provides an opportunity to solve many of these issues

Taurus Insurance Consulting

17

Additional Considerations

- It reduces stressors on the farmer
- It allows for better environmental protections
- Maximization of profits within current time restraints
  - Less labor needed
  - More accurate application of inputs
- Overall better opportunities for the farm operator

Taurus Insurance Consulting

18

Does This Challenge Current ISO Farm Insurance Coverage Forms

- Farm Property - two primary coverage forms to consider
- FP 00 13 04 16 – Farm Personal Property Coverage Form
- FP 00 30 04 16 – Mobile Agricultural Machinery & Equipment Coverage Form
- Farm Liability - regardless of whether we use the CGL or the FL coverage forms - this equipment will meet the current definitions of "mobile equipment"

Laurus Insurance Consulting

19

FP 00 13, Farm Property, Farm Personal Property Coverage Form

- Property can be either scheduled or blanketed
- Regardless - coverage is essentially provided for in the same manner
- Always subject to the selected Causes of Loss as shown in the FP 10 60, Cause of Loss form
- Causes of Loss to be selected include:
  - Basic
  - Broad
  - Special

Laurus Insurance Consulting

20

FP 00 30, Mobile Agricultural Machinery & Equipment Coverage Form

- Coverage can be provided on a per item limit or via a single applicable coverage limit (blanket)
- Not all farm equipment is eligible for coverage using this form
  - Cotton pickers
  - Harvester thresher combines
- Coverage is provided on an "open perils" basis

Laurus Insurance Consulting

21

22

What is a Drone

23

An unmanned aerial vehicle - an aircraft without a human pilot on board

AKA:

- UAV – unmanned aerial vehicle
- UAS – unmanned aircraft system

23

Types

24

24

Predicted Growth

- According to www.grandviewresearch.com
- Global commercial drone market was estimated at $18.89 billion in 2022
- Expected compound annual growth rate of 13.9% from 2023 to 2030
- Growth is due to expected increasing enterprise application of drones across multiple industry verticals

Taurus Insurance Consulting

25

Market Share By 2023 Segments

- Hardware = 16%
- Software = 4%
- Services = 80%
- MOST drone growth is expected in the commercial market - not on the consumer side
  - Drone Industry Reports (Dronell) 2023 market report

Taurus Insurance Consulting

26

Agricultural Growth

- According to www.grandviewresearch.com
- US agricultural drone market estimated at $347.9 million in 2022
- Expected to grow at a CAGR of 22.8% from 2023 to 2030
- Global market valued at $4.17b in 2022 according to Fortune Business Insights

Taurus Insurance Consulting

27

What The FAA Says

- Drone use over crops that are for the personal consumption of the user is "personal" use
- Drone use over crops that are for commercial purposes (ie, your farmer) is considered to be "commercial use"
- This determination and distinction is extremely important as liability coverages for personal use are often considered to be hobby craft - otherwise it would be excluded from coverage

Taurus Insurance Consulting

28

It's All About FAA Rule 107

- Operational limits
- Remote pilot in command certification
- Remote pilot in command responsibilities
- Aircraft requirements
- Visual line of sight operations
- Daytime operations
  - One half hour before sunrise - one half hour after sunset
- One pilot - one drone
- Remote identification requirements
- How it does or doesn't apply to hobby aircraft
- All that and more

Taurus Insurance Consulting

29

Drones Costs for Ag

30

Fixed Wing - $10,000 to $25,000 ++

Trimble, Sentera, AgEagle, AgDrone, PrecisionHawk

Multi Rotor - $2,000 to $30,000 ++

AgBot, senseFly, Sentera, AGCO, DJI Smarter, PrecisionHawk, InDago AG

30

Farm/Ag Uses

- Soil and field analysis
- Planting
- Crop monitoring
- Irrigation observations and measurements
- Health assessments
- Crop spraying - Subject to FAA Rule 137

Taurus Insurance Consulting

31

Rule 137

According to the Part 137, aircraft operations that do any of the following are considered agricultural:

1. Dispensing any substance by air that acts as a pesticide, plant regulator, or defoliant (a blanket phrase for these substances is an economic poison).
2. Dispensing any substance by air meant for plant nourishment, soil treatment, propagation of plant life, or pest control.
3. Doing any kind of dispensing by air that directly affects agriculture, horticulture, or forest preservation.

32

Dispensing Chemicals and Agricultural Products (Part 137) with UAS

Under Part 137, the following aircraft operations are considered agricultural by nature:

- Dispensing any economic poison as defined in Section 137.3
- Dispensing any other substance intended for plant nourishment, soil treatment, propagation of plant life, or pest control.
- Engaging in dispensing activities directly affecting agriculture, horticulture, or forest preservation.

Note: The FAA considers chemicals used as disinfectants for viruses to fall in the category of economic poisons as defined in Section 137.3.

33

Rule 137 Exemptions – The Process

How to petition for an exemption ?

Apply for an Agricultural Aircraft Operator Certificate (AAOC)

1. Preapplication Phase
2. Formal Application Phase
3. Document Compliance Phase
4. Demonstration and Inspection Phase
5. Certification Phase

CONGRATULATIONS – You Made It !

34

How Else Do They Work In Agriculture

35

Uses NDVI technology

NDVI – normalized difference vegetation index

A numerical indicator that uses the visible and near-infrared bands of the electromagnetic spectrum and is adopted to analyze remote sensing measurements and assess whether the target being observed contains live green vegetation or not.

35

NDVI - Explained

36

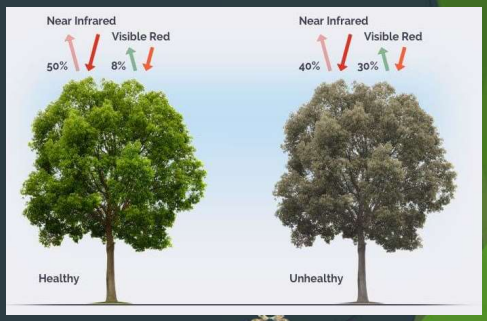
NDVI is a measure of the state of plant health based on how the plant reflects light at certain frequencies (some waves are absorbed and others are reflected).

Chlorophyll, a health indicator, strongly absorbs visible light, and the cellular structure of the leaves strongly reflect near-infrared light. When the plant becomes dehydrated, sick, afflicted with disease, etc., the spongy layer deteriorates, and the plant absorbs more of the near-infrared light, rather than reflecting it

36

NDVI - Explained

37



37

NDVI - The Formula

38

NDVI is calculated in accordance with the formula:

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

NIR - reflection in the near-infrared spectrum
RED - reflection in the red range of the spectrum

38

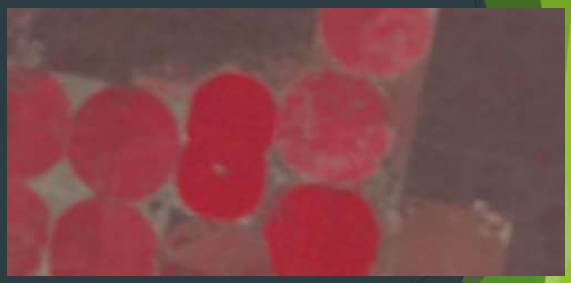
In True Color

39

39

Colored Infrared

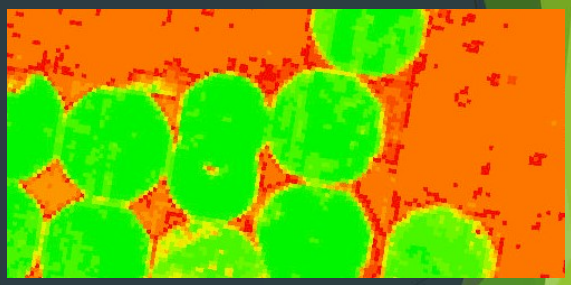
40



40

Formulated Color

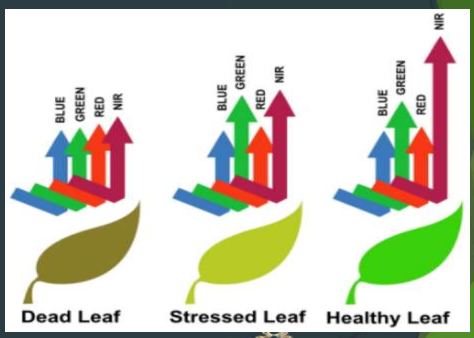
41



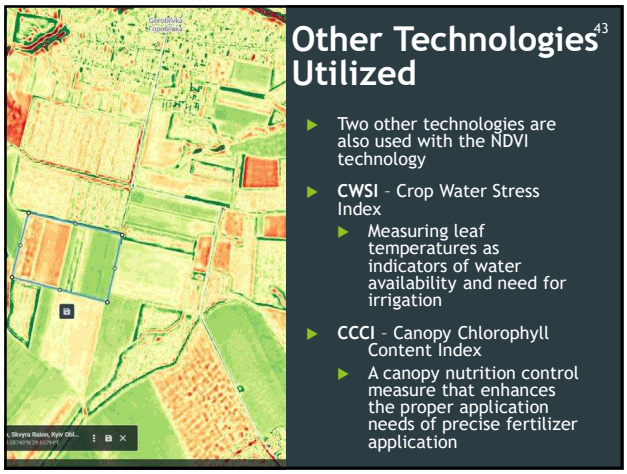
41

One Last Look

42



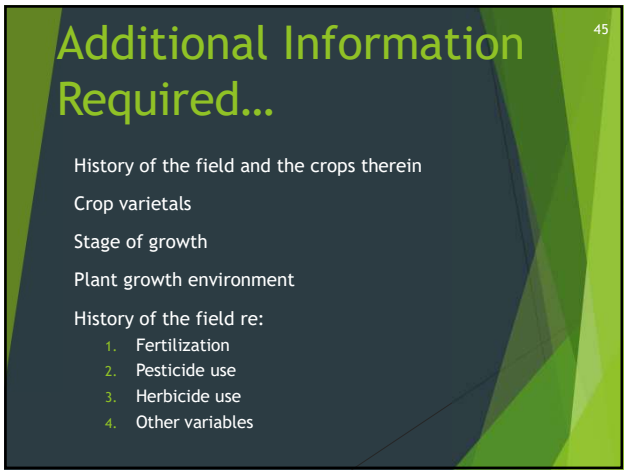
42


Other Technologies Utilized
43
Two other technologies are also used with the NDVI technology
CWSI – Crop Water Stress Index
Measuring leaf temperatures as indicators of water availability and need for irrigation
CCCI – Canopy Chlorophyll Content Index
A canopy nutrition control measure that enhances the proper application needs of precise fertilizer application

43


What Else Do We Know – It's Another Tool
44
Variability = instant recognition of issues
Quicker information = quicker decisions
The farm as a food/crop factory
Ground truthing (an agronomist in the field) is still needed
Boots on the ground are the next step
What else is needed ?

44


Additional Information Required…
45
History of the field and the crops therein
Crop varietals
Stage of growth
Plant growth environment
History of the field re:
1. Fertilization
2. Pesticide use
3. Herbicide use
4. Other variables

45


46
PROS AND CONS
Analysis
Monitoring
Spraying
Irrigation
Health assessment
Ease of deployment
Flight time and flight range
Initial cost of purchase
Federal laws and regulations
Interference with airspace
Connectivity
Weather dependence
Knowledge and skill
Laurus Insurance Consulting

46


Insurance Considerations
Laurus Insurance Consulting

47


48
Farm Property Coverage Forms
FP 00 12 – Farm Property – Farm Dwellings, Appurtenant Structures and Household Personal Property
Coverage C – Household Personal Property
Excluded as aircraft & aircraft parts
Property Not Covered, exclusion 2.b.
Unless considered as model or hobby aircraft
NOT the case when used in the Farm Operations as they are considered in commercial use

48

Farm Property Coverage Forms

49

- FP 00 13 – Farm Property – Farm Personal Property Coverage Form
- Scheduled & Unscheduled Farm PP
- No coverage provided as "aircraft" (drones) do not meet the criteria of the definition of "Farm Personal Property"

49

Farm Liability Coverage Form – FL 00 20

50

2. Exclusions e. Aircraft, Motor Vehicle, Motorized Bicycle or Tricycle

No coverage for BI or PD

Arising out of the ownership, maintenance use or entrustment to others of any aircraft

Giving rise to vicarious liability, whether or not imposed by law, for the actions of a child or minor involving any aircraft

50

Farm Liability Exclusions (cont.)

51

- Same exclusion also applies even if the claims against any "insured" alleging negligence or wrongdoing in the supervision, hiring, employment, training or monitoring of others by that "insured"

51

Exceptions to the Exclusion

52

"Bodily Injury" to a "residence employee" caused by an aircraft, provided the "bodily injury" occurs while the "residence employee" is not engaged in the operation or maintenance of such aircraft.

52

Farm Liability Coverage Form – FL 00 20

53

2. Exclusions d. Release Or Discharge From Aircraft

BI or PD caused by or resulting from any substance released or discharged from an aircraft

Does not apply to hobby or model aircraft

53

FL 04 44 – Coverage For Physical Injury To Crops And Animals Due To Certain Crop Dusting Operations Performed By Licensed Independent Contractor By Aircraft (Limited Crop Dusting Coverage)

Provides excess coverage after the independent contractor's liability pays

Provides for physical injury to crops or animals only

Application must be consistent with normal agricultural practice

Not in violation of any law

$25,000 aggregate limit, can be increased

54

FL 01 63 04 16, Amendatory Endorsement

- Does provide limited coverage for chemical drift losses
- Applies to ground application only
- Unendorsed limit is only $25,000
- Many insurers will increase to $1,000,000
- The limit is also an annual aggregate
- Physical injury to crops or animals of others – NO BI
- This is considered by many ISO carriers as a mandatory amendatory endorsement

55

Some Insurers

56

- Have independently filed forms for drones
- Often apply to their use in mapping and/or crop observational purposes only
- Size of drone (weight) and other limitations (normally based upon the use of the drone) may also apply
- Read The Stinking Policy (RTSP)

56

Autonomous and Robotics

57

What Is Stimulating The Growth Of These

- Speed of work
- Work in multiple environments
- Temperature is not a problem
- Repetitive tasks do not bore the bot
- Accuracy of work
- Labor cost management

Laurus Insurance Consulting

58

Where Are We Seeing Them TODAY

- Weeding
- Planting
- Spraying
- Harvesting
- Other

Laurus Insurance Consulting

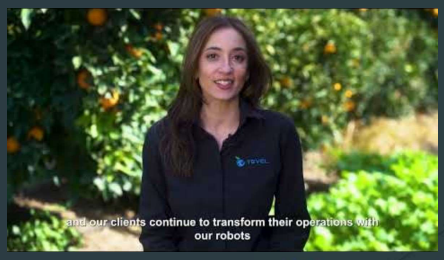
59

Weeding

Laurus Insurance Consulting

60

Fruit Picking



61

Roadblocks to More & Faster Implementation

- Costs of machinery and the economies of scale needed for great adoption
- Acceptance by the end user - the farmer
- Still some bugs to be worked out…but those are being rapidly attacked and minimized

62

Insurance Challenges

63

Who's Liable

- When the autonomous vehicle or the robot injures someone or damages something, WHO is LIABLE ???
- Owner
- "Operator"
- Manufacturer
- Others in the chain of supply

64

How Might The FL 00 20 Respond

65

- Coverage form provides BI, PD, PI, AI for "mobile equipment"
- Lengthy definition of "mobile equipment" - but the pertinent part reads:

16. "Mobile equipment" means the following, including any attached machinery or equipment:

65

Mobile Equipment - Defined

66

a. Bulldozers, forklifts and tractors designed for use principally off public roads;

Other farm machinery designed for use:

(1) Principally off public roads; and

(2) As implements for cultivating or harvesting

66

Indoor Farming, aka: Controlled Environment Agriculture

67

Growing Systems & Facility Types

68

Hydroponics
Plants are grown in water as opposed to soil.

Aeroponics
Plant roots are suspended in the air and misted with a nutrient solution.

Aquaponics
Plants are grown in water that has been used to cultivate aquatic organisms (typically, fish)

Soil-based
Plants are grown in soil.

Hybrid (Aquaponics, Hydroponics, Aeroponics)
Plants are grown in multiple systems in one facility.

Glass or poly Greenhouse
Transparent, enclosed structure made of glass or polycarbonate.

Indoor vertical farm
Fully enclosed and opaque room with a vertical growing system (hydroponic, aeroponic, and/or aquaponic). Artificial lights are used.

Low-tech plastic hoop house
Semi-circular, tunnel-shaped structure made of steel and polythene.

Container farm
Standardized, self-contained growing unit that employs vertical farming systems and artificial lighting.

Indoor DWC
Fully enclosed and opaque room with a non-vertical growing system where plants are grown in a deep-water culture system.

68

WHY More Interest In CEA

69

- Remember that UN Study ?
- Better environmental footprint
- Reduced usage of:
  - Water
  - Fertilizers
  - Herbicides
  - Pesticides

69

Advantages of CEAs/Verticals

70

- Twenty-four hour growth periods
- Temperature controlled environments
- Better distribution of goods
- Optimal growing conditions
- Fewer pests

Taurus Insurance Consulting

70

Challenges to CEA

- Energy costs
- Capital start-up costs
- Financial sustainability
- Pests
- Building related issues
- Labor

Taurus Insurance Consulting

71

What Are The Current Growth Leaders

72


LEAFY GREENS


MICRO GREENS


TOMATOES


FLOWERS


HERBS

Taurus Insurance Consulting
TheNationalAlliance.com

72

Why Those Five - Primary Reasons Include

- High revenue producing crops
- Shorter growth cycles
- Highly perishable
- It's costly to operate a CEA

Taurus Insurance Consulting

73

Other Crops Include

74

- Cannabis
- Cucumbers
- Mushrooms
- Sweet corn
- Shrimp
- Strawberries
- Peppers
- Onions
- Carrots
- Eggplant

74

Taurus Insurance Consulting
TheNationalAlliance.com

74

Where Are They Located

- EVERYWHERE there is a demand for those crops
- Large metropolitan areas
- Midwest cities
- All throughout the US

Taurus Insurance Consulting

75

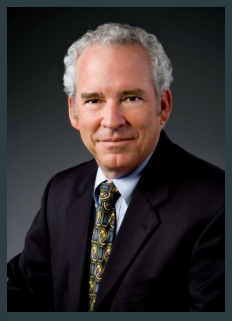
Insurance Considerations Include…

76

- Property
- Mechanical Breakdown
- Cyber
- Liability
- Business Auto
- Crime

76

Thank You



- Casey Roberts, ACSR, AFIS, CIC, CAIP, PLIC
- Principal
- Laurus Insurance Consulting
  - 328 Cupola Court
  - Lincoln, Ca. 95648
- (707) 477-0913
- casey@laurusinsuranceconsulting.com
- www.laurusinsuranceconsulting.com

77