Mulch Film

PlaNet
AGRO INDUSTRIES

Contents

- Mulch films today
- Future of mulch films
- Conclusions

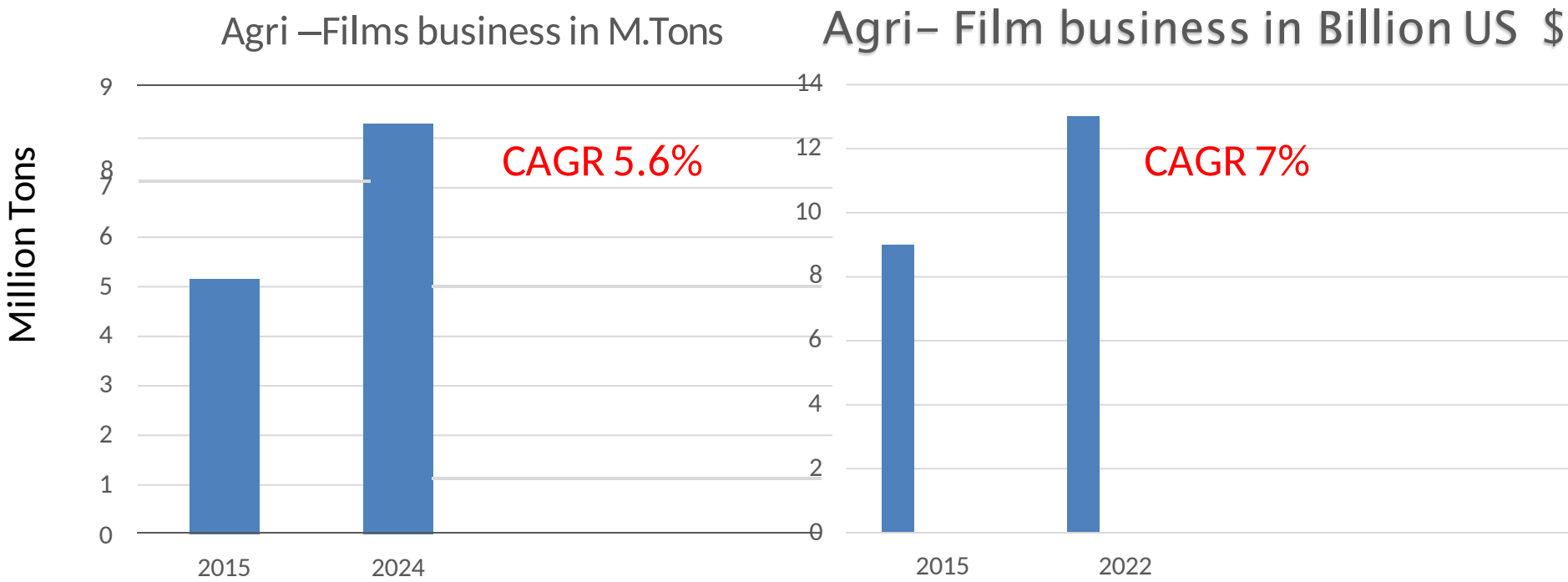
PlaNet AGRO INDUSTRIES

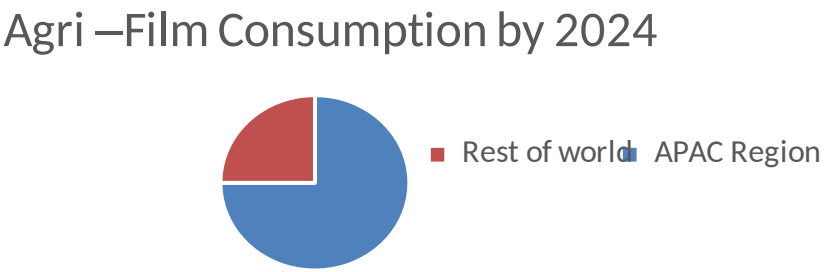
Global Agri Film Overview

- World Population is currently at 7.5 billion
- Expected to reach 9 billion by 2050.
- Food production need to grow to keep pace
- Plasticulture offers a solution

PlaNet AGRO INDUSTRIES

Global Agri Film Overview



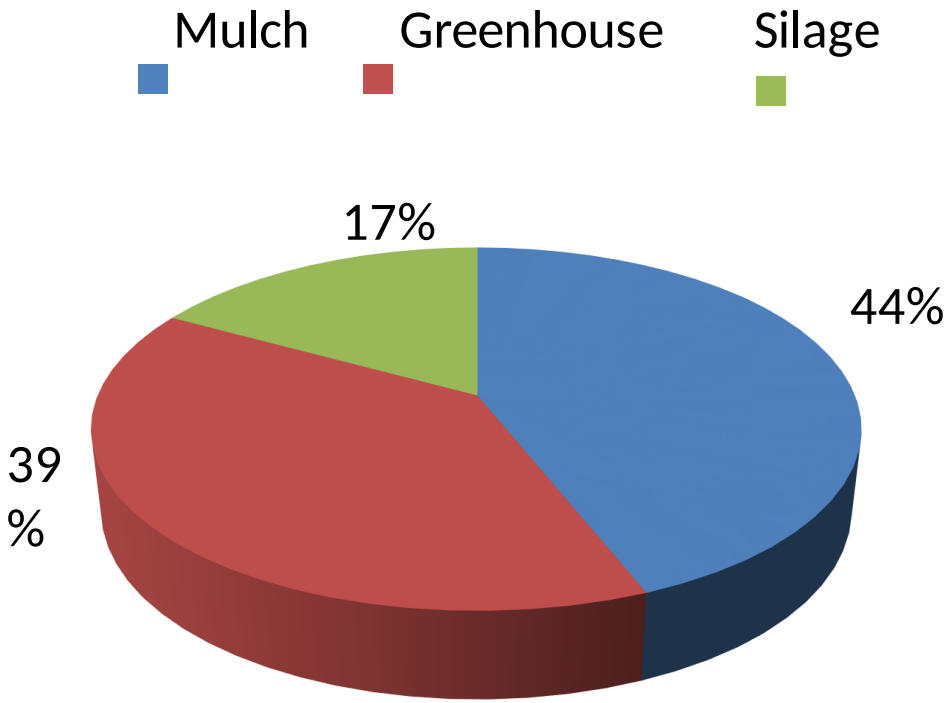


PlaNet AGRO INDUSTRIES

Mulch Film Overview

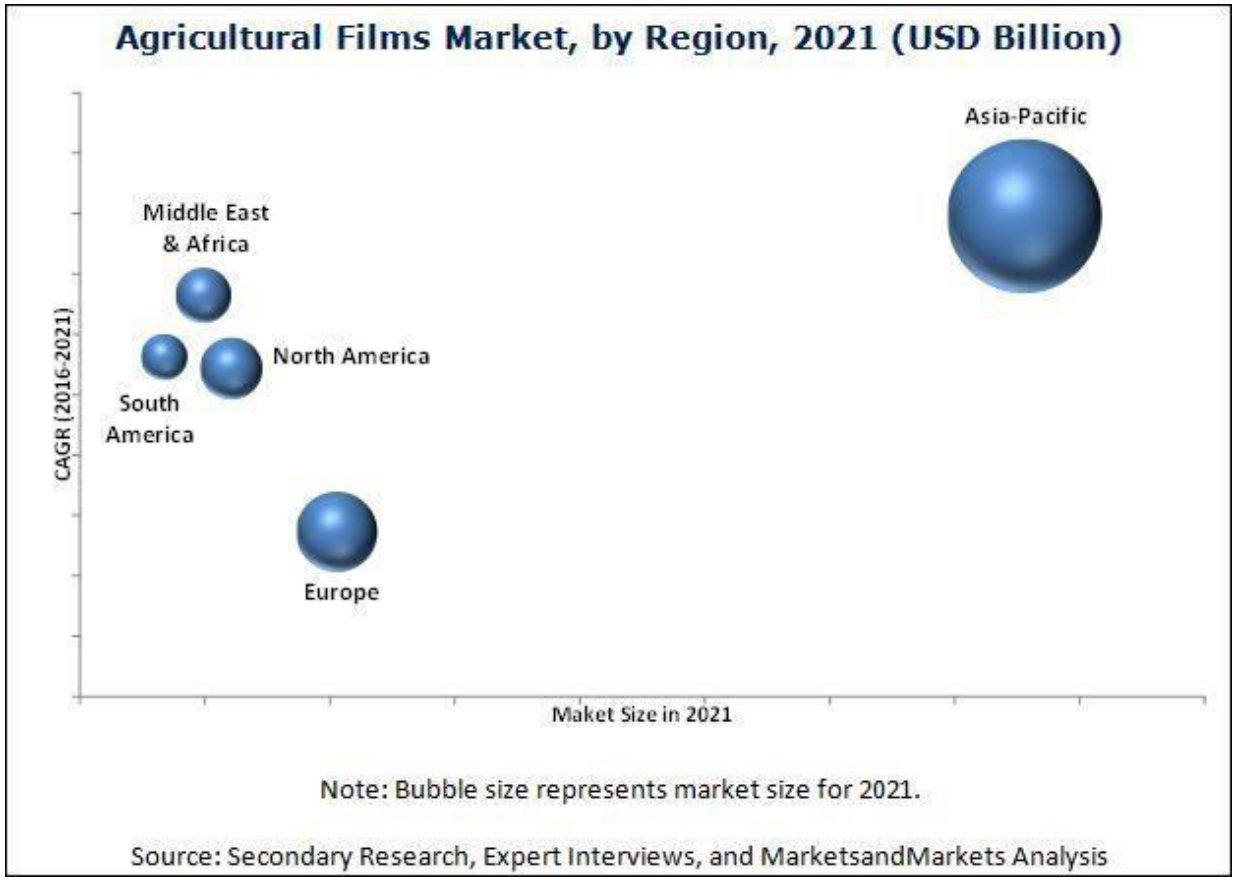
- Cultivation under mulch film offers 20-40% higher yields

- Worldwide $2.9 bn of Mulch films were consumed in 2015 and expected to reach $4.2 bn by 2021 at CAGR of 6.5%.



PlaNet AGRO INDUSTRIES

Mulch Film Overview



- Environmental concerns is shifting focus to eco-friendly films.
- Biodegradable mulch film currently account for < 3% .

PlaNet AGRO INDUSTRIES

What is Mulch ?

Traditionally mulch denoted any organic covering over the cultivated land ie dead leaves , wood shavings , grass or paper etc

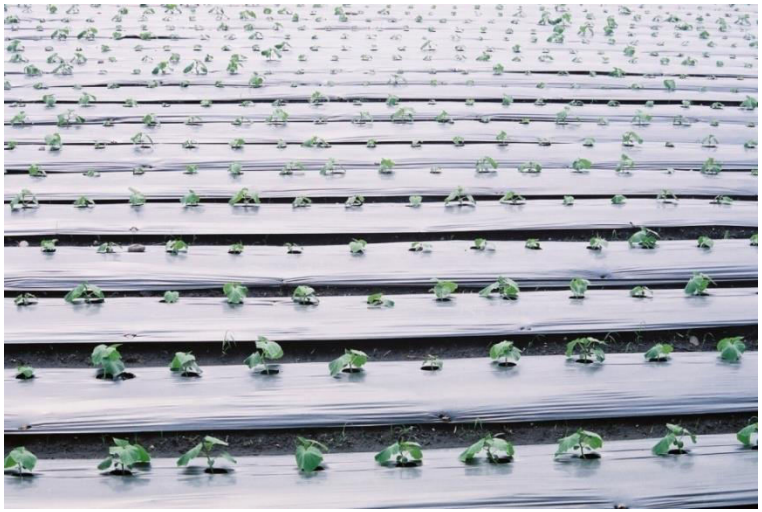
Mulch = German word " molsch" meaning soft, beginning to decay

PlaNet AGRO INDUSTRIES

What is Mulch Film ?

The Modern plastic mulch film is a more recent development

- Manufactured from LLDPE
- Thickness from 7 µ to 75 µ
- Is designed for a outdoor lifetime of 3 months to 1 year.
- Should withstand aggressive pesticides
- Prevent weed growth
- Provide moisture barrier.
- Prevent soil erosion
- Prevent fertilizer loss.
- Mechanically strong to withstand laying and wind stress.
- Easy to remove after harvesting.



PlaNet AGRO INDUSTRIES

What is Mulch Film ?

The Modern plastic mulch film are normally used for the following crops/ vegetables

- ✓ Strawberries.
- ✓ Groundnuts
- ✓ Cotton
- ✓ Tomatoes
- ✓ Brinjals
- ✓ Apple orchards
- ✓ Water melons
- ✓ Eggplant
- ✓ Rice /wheat
- ✓ Cucumbers
- ✓ Chilis

PlaNet AGRO INDUSTRIES

Functions of Mulch Film

- Reflection of UV radiation
- Insect & Pest Management
- Moisture retention
- Prevent weed growth
- Retain fumigants in soil
- Prevent soil erosion
- Prevent loss of soil nutrients.
- Maintain soil thermal balance
- Reflection of PAR onto underside of foilage.

PlaNet AGRO INDUSTRIES

How mulch film meets these functionalities

- Reflection of UV radiation -25- 50% UV reflection

- Reflection of PAR -25- 65% PAR reflection
- Insect management -Yes – Alphids borne
- Moisture retention - virus 20- 30% less
- Prevent weed growth - water loss
- Retain fumigants in soil - 90 -100%
- Prevent soil erosion - Yes
- Prevent loss of soil nutrients - Yes
- Maintain soil thermal balance - Yes 3- 5°C ↑ soil Temp at night

PlaNet AGRO INDUSTRIES

Reflection of UV & PAR*

Silver Mulch

Silver mulch reflects appx 50 % UV radiation and PAR

White Mulch

White Mulch reflects 10-40 % UV radiation and 50 - 90 % PAR

Silver + White + Black Mulch

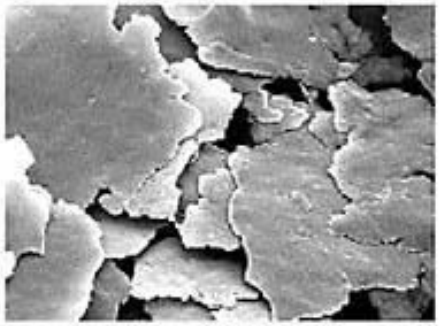
Silver + White mulch reflect 70 % UV Radiation and 90 % PAR

* PAR = Photosynthetically active radiation - 400 -700nm

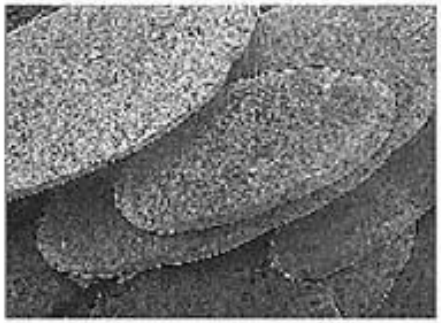
PlaNet AGRO INDUSTRIES

Reflection of UV Radiation – The science behind it

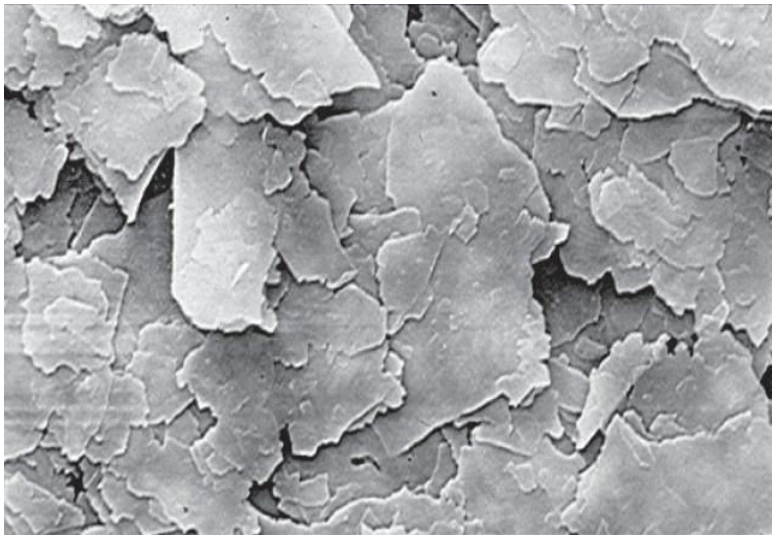
Silver Mulch Film



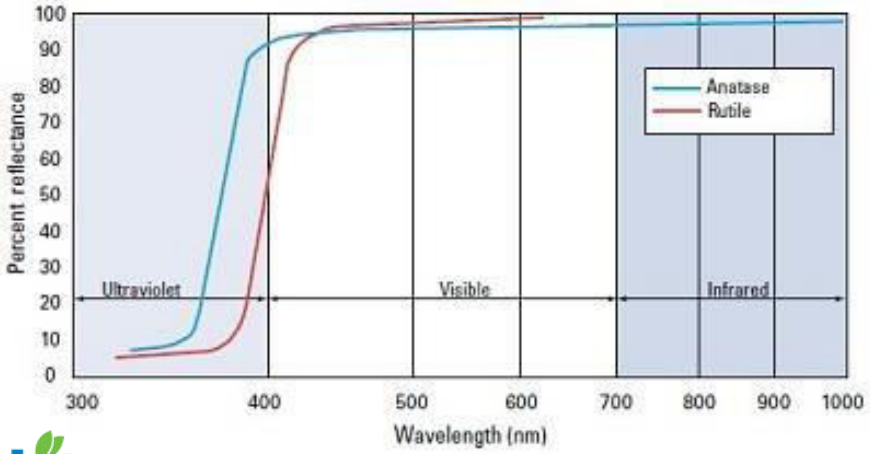
Cornflake-Like Aluminum Pigment



Silver-Dollar-Like Aluminum Pigment



White Mulch Film



PlaNet AGRO INDUSTRIES

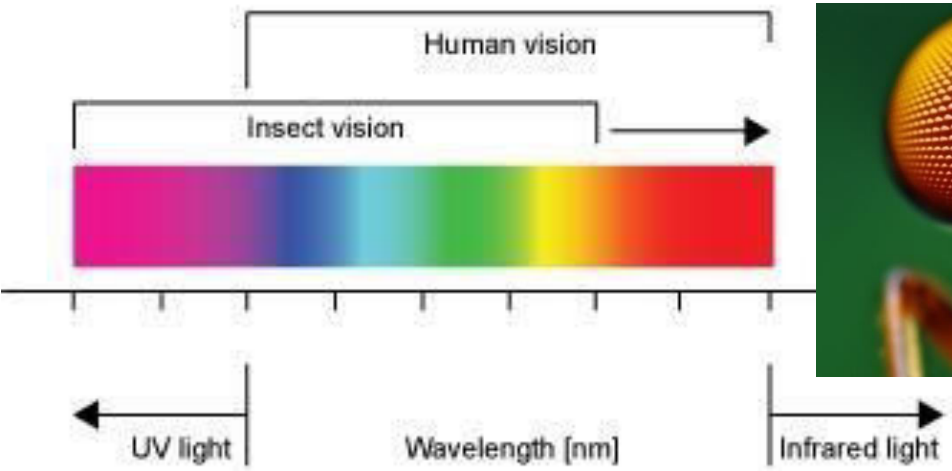
Pest & Disease Management

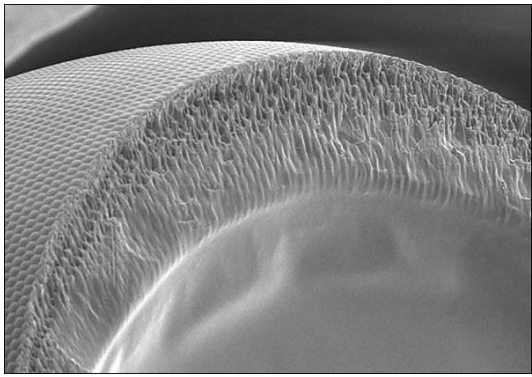
Plant virus are borne by vectors like aphids & white flies

PlaNet AGRO INDUSTRIES

Keeping Alpids at bay – The science behind it

- Insect have compound eyes which can see UV and visible radiations



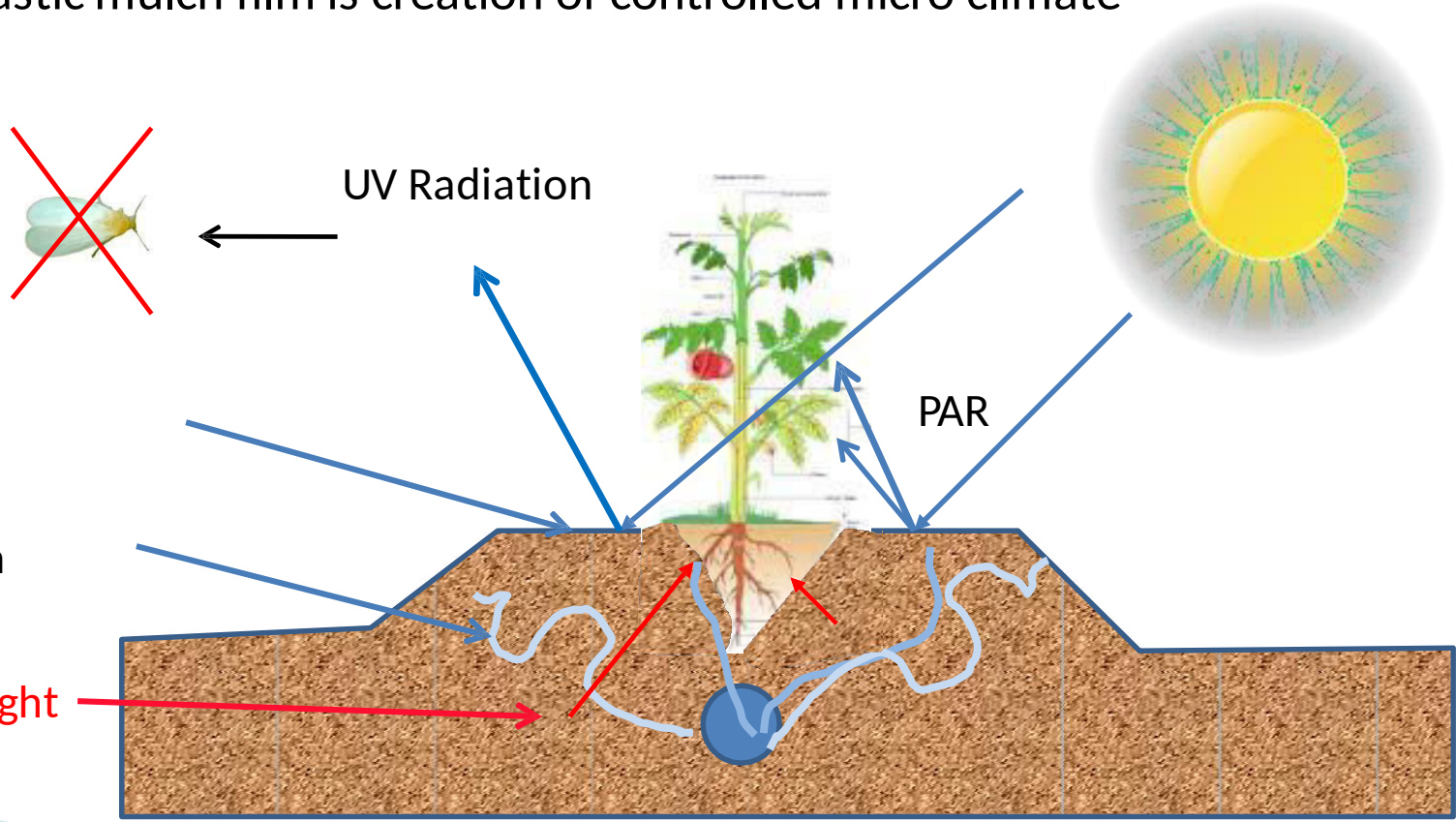


- Reflective mulch film by high reflection of UV radiation cause disorientation and navigation issues in insects like alpids, thrips thus deflecting them from homing on plants

PlaNet AGRO INDUSTRIES

Retaining Moisture

Function of a plastic mulch film is creation of controlled micro climate



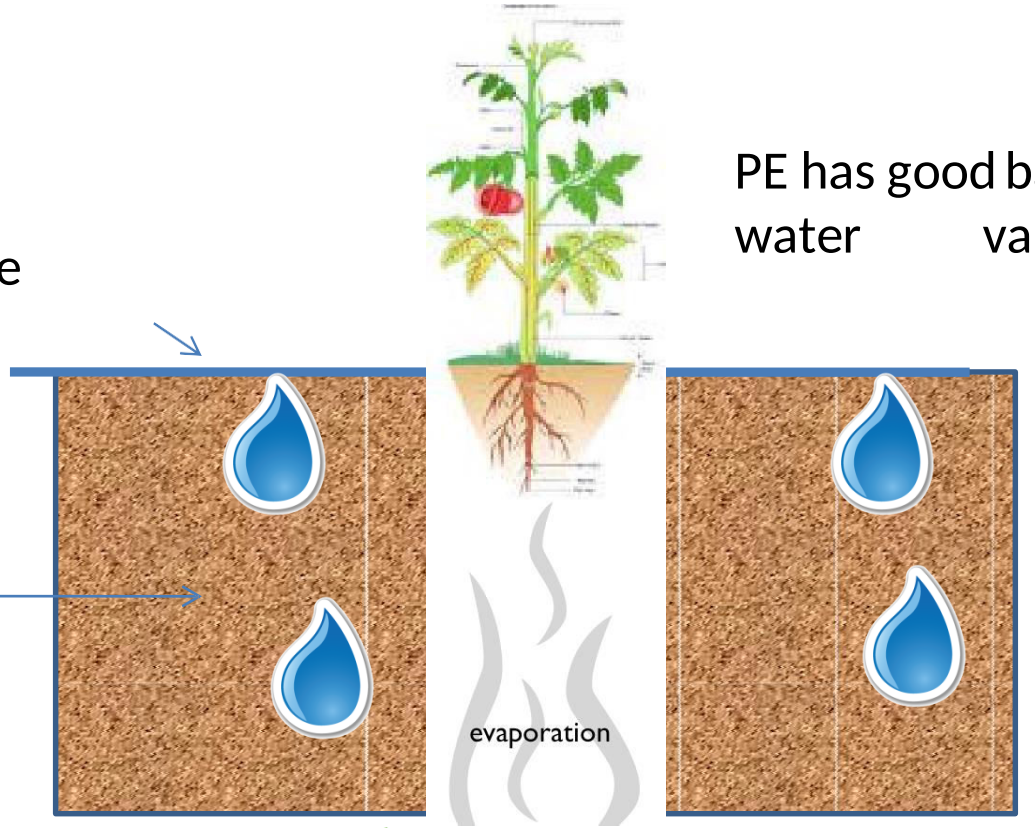
PlaNet AGRO INDUSTRIES

Retaining Moisture – The science behind it

Polyethylene has a excellent barrier to water vapor

Mulch Film – Polyethylene

PE has good barrier to water vapor



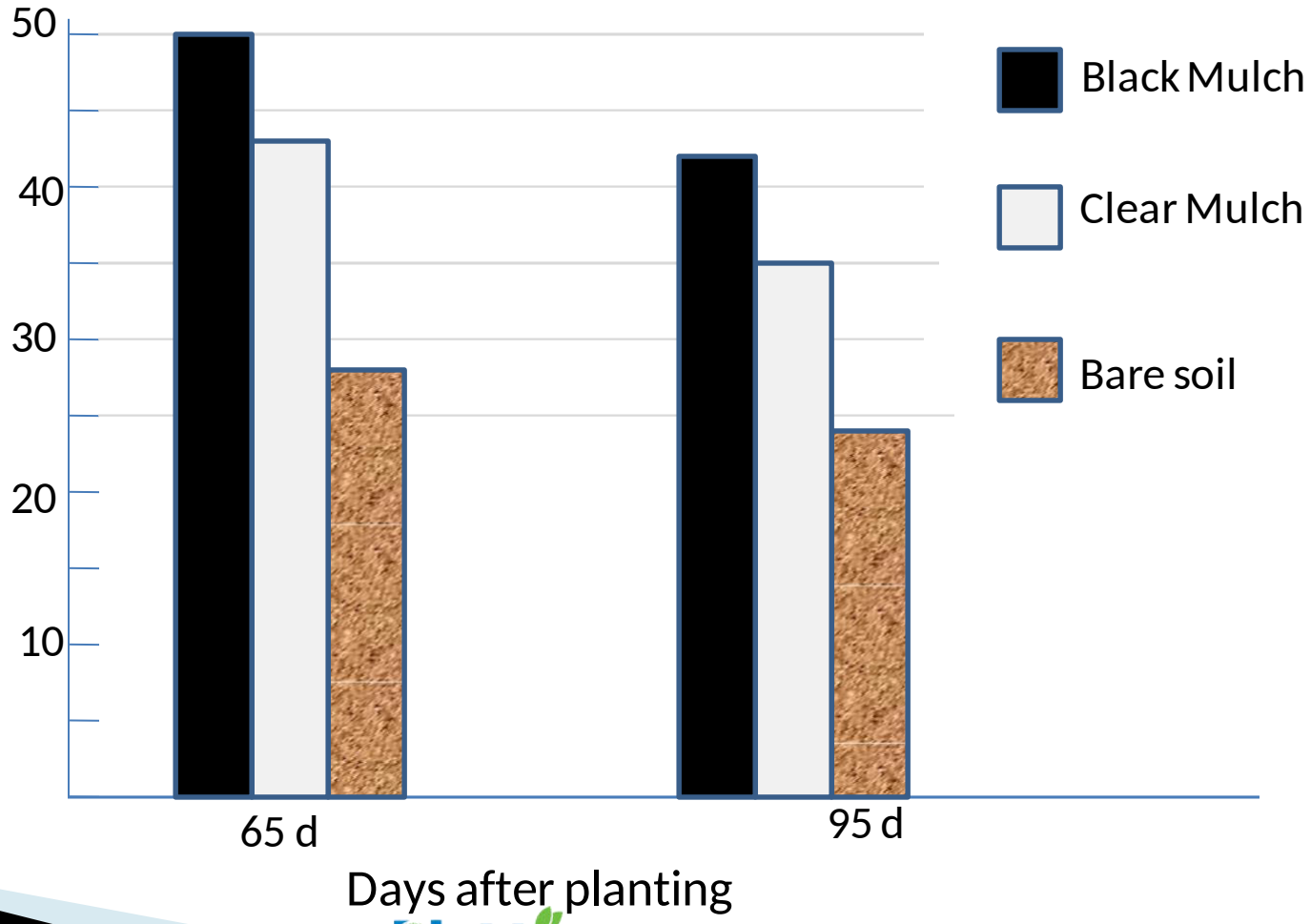
PlaNet AGRO INDUSTRIES

Retaining Moisture – The science behind it

LLDPE has a excellent barrier to water vapor - 10 g **/m2/24h** WVTR*

* 38C , 25 µ

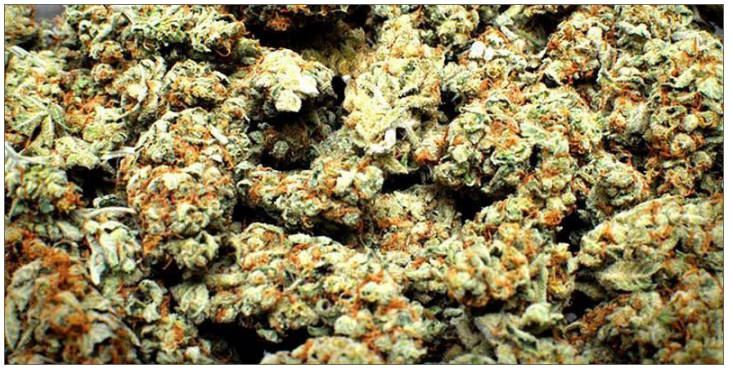
Volumetric water content% in soil



PlaNet AGRO INDUSTRIES

Preventing Weed growth

- Weeds are unwanted plant which consumes water and nutrients from the soil .
- Weeds require sunlight for growth .
- Black mulch films severely restrict the passage of sunlight.
  - 25 microns black film can c visible light transmission



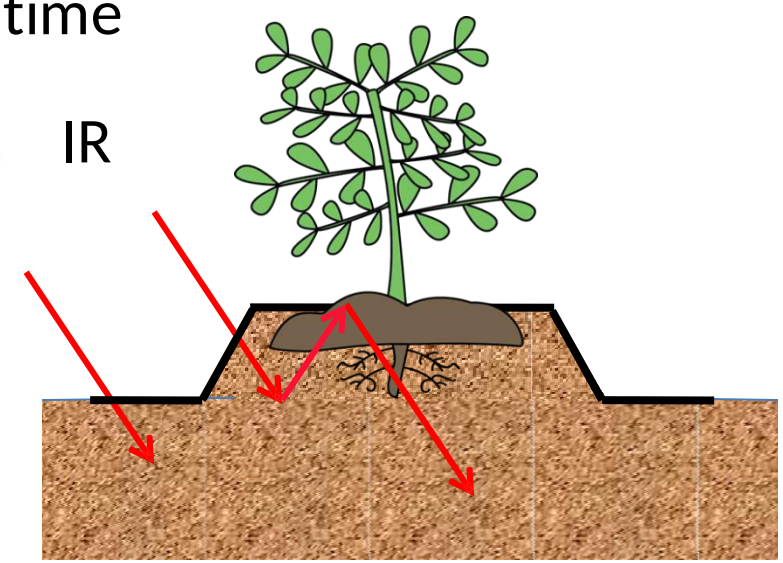
PlaNet AGRO INDUSTRIES

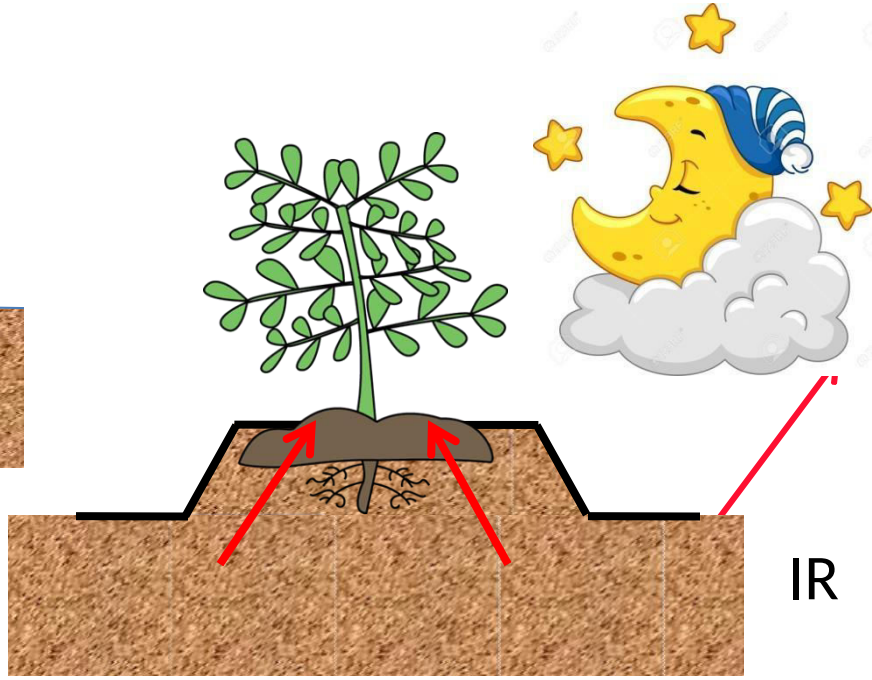
Maintain soil thermal balance

PE is an insulating material with K = 0.4W/m/°C

Day-time

IR



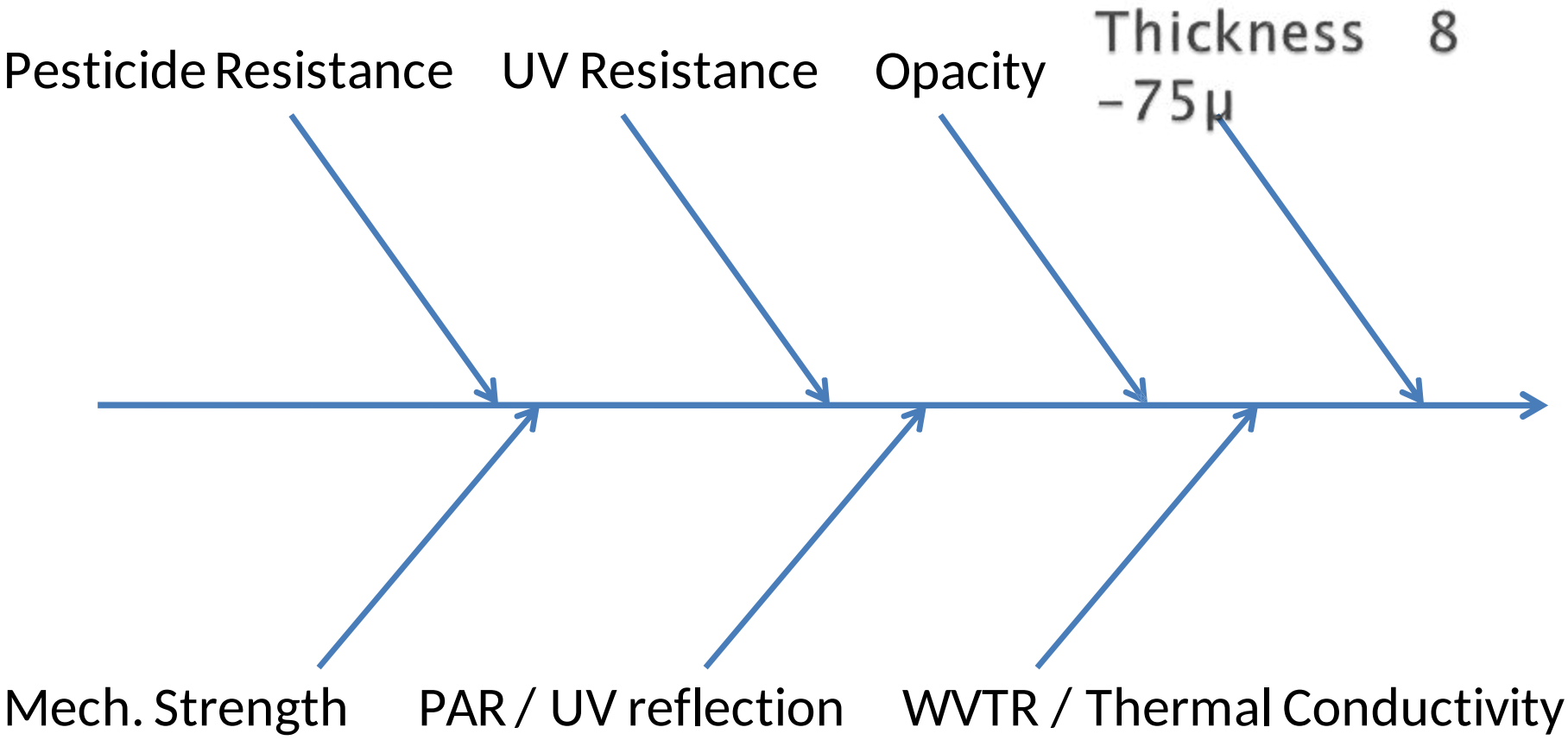


IR

Night-time

2-5°C higher soil temperature at night-time

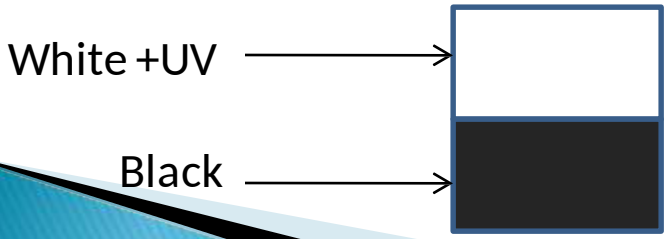
Design of Mulch Film

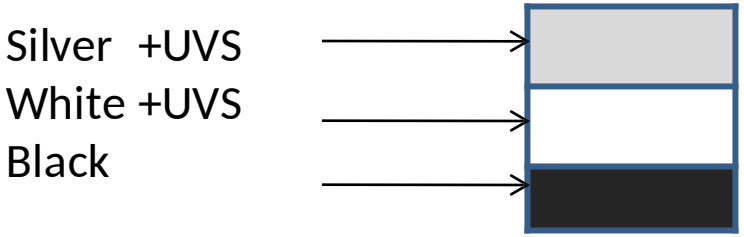


PlaNet AGRO INDUSTRIES

Design of Mulch Film

1. Moisture barrier - PE resin is cheap and has excellent WVTR properties
2. Mechanical strength - LLDPE resin + m-PE resin / bimodel PE / thickness / processing
3. Silver reflective - Silver MB in top layer (UV Radiation + PAR reflection)
4. Enhanced silver effect - White MB in middle layer (UV Radiation + PAR reflection)
5. High opacity - White reflecting / Black in inner layer (prevent weed growth)
6. 9 -12 months life - Use of m-PE resin, bi-model PE + UVS in outer /middle layers
7. Heat retention in night - PE resin is thermally insulating.





PlaNet AGRO INDUSTRIES

Design of Mulch Film

Design Specification of mulch film (BS / EN 13655:2002 / IS 15177:2002)

Film thickness

Crops	Groundnuts	Short Duration	Medium Duration
Thickness	7 µ	25µ	50µ

Black / Black/White Film

Characteristics	10µ< t < 25µ	25µ< t<50µ	>50 µ
Tensile Strength at Break	>20 MPa	>20MPa	> 16 MPa
Tensile Elongation at Break	> 300 %	>300 %	>250 %

Classification Based on artifical weathering duration for 50% strength retention

Class	Duration in hours in QUV
N	> 400
A	> 1700

PlaNet AGRO INDUSTRIES

Products for Mulch Film

- Silver Color Masterbatches
- White Color Masterbatches Black
- Color Masterbatches
- Pesticide Resistant UV Masterbatches
- Antioxidants Masterbatches Oxo-
- degradable Masterbatches

.. All available from

PlaNet AGRO INDUSTRIES

Film defects

Mulch Film Failure - Forensics Analysis at Plastiblends

- Mechanical Failure → Use of RP

Film damage Optical Microscopy/SEM

- Weathering failure → Inadequate UV stabilization

ATR –FTIR spectroscopy / UV spectroscopy

- Pesticides use related failures → Pesticide interaction with HALS / film –identification elemental analysis for chlorine & sulphur

PlaNet AGRO INDUSTRIES

Future Trends

Wavelength selective mulch films

PlaNet AGRO INDUSTRIES

Trends

Degradable mulch films

- Mulch Plastic which is not removed can lead to soil pollution
- Estimates are 0.0015% of film per year on weight basis.
- Need to address this has lead to thicker and longer life films
- Use of Biodegradable films
  - Biodegradable mulch film usage is projected to grow from $ 35 Million in 2016 to $ 52 Million by 2021 at CAGR of 8%

PlaNet AGRO INDUSTRIES

Trends

- **Degradable mulch films**
  - PLA based
  - PHA based
  - Starch Based
  - PBSe
  - PBAT
- Standard Specification - ISO 17556 / Italian 11183:2006 / ASTM D 6400 / UNIEN 13432 / UNIEN 14995

PlaNet AGRO INDUSTRIES

Summary

- Mulch Film application demands good application knowledge.
- Mulch film needs to be engineered for the demanding requirements
- Stakes are high in case of premature film failure.
- Environmental concerns need to be addressed

PlaNet AGRO INDUSTRIES

PlaNet AGRO INDUSTRIES

Thank You

PlaNet AGRO INDUSTRIES