AgriSun Solutions pty ltd

REFLECTIVE ORCHARD GROUND FILM

The Science of Orchard Light Management

EXECUTIVE SUMMARY

Light is one of the fundamental environmental factors affecting fruit production.

Within an orchard canopy, however, light is not distributed evenly.

Leaves, branches, fruit, tree architecture, row orientation and protective netting can reduce the amount of direct and diffuse radiation reaching lower and interior portions of the canopy.

Reflective orchard ground covers are designed to alter this light environment.

Instead of allowing a portion of incoming solar radiation reaching the orchard floor to be absorbed by soil, vegetation or conventional orchard surfaces, a reflective material can redirect part of that radiation upward.

Published horticultural research has demonstrated that reflective ground covers can increase reflected or intercepted light within orchard canopies and, under particular experimental conditions, influence fruit skin coloration. The magnitude of the response depends on factors including reflective material, positioning, crop, cultivar, orchard architecture and environmental conditions.

This does **not** mean that reflective ground film universally increases fruit colour, °Brix, fruit size, yield or pack-out.

Nor does research conducted using one reflective material automatically establish the performance of another.

The purpose of this White Paper is therefore to explain:

- The physical principle behind reflective orchard ground covers
- Why orchard light distribution matters
- What published research has demonstrated
- How material and placement affect reflected light
- What research exists across different crops and production systems
- What remains uncertain
- Why local South African validation remains important
- How AgriSun approaches responsible technical claims

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1. THE ORCHARD LIGHT ENVIRONMENT

Fruit trees operate within a complex three-dimensional light environment.

Incoming solar radiation interacts with:

- Leaves
- Branches
- Fruit
- Canopy density
- Tree height
- Training system
- Row orientation
- Adjacent rows
- Orchard floor
- Protective netting
- Weather and cloud cover

The upper and outer canopy generally has greater exposure to incoming radiation than deeply shaded or lower canopy positions.

Consequently, two fruit on the same tree can experience substantially different light environments.

This is important because light exposure is associated with a range of physiological processes, including photosynthesis and, in coloured cultivars, pathways involved in pigment development.

Reflective orchard ground covers attempt to modify one part of this system:

the fate of radiation reaching the orchard floor.

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2. WHAT REFLECTIVE GROUND COVER ACTUALLY DOES

Reflective ground cover does not create sunlight.

It redirects a portion of available incoming radiation.

Without reflective ground cover, radiation reaching the orchard floor may be:

- Absorbed
- Reflected
- Scattered
- Intercepted by vegetation
- Converted partly into heat

Installing a highly reflective surface changes the optical properties of that orchard-floor area.

A greater portion of incident radiation may then be reflected upward.

Some of that reflected radiation may reach:

- Lower fruit
- Inner-canopy fruit
- Lower leaf surfaces
- Shaded portions of fruit
- Other canopy positions

Whether that reflected radiation is actually intercepted by fruit or foliage depends on orchard geometry and film placement.

This distinction is fundamental.

MATERIAL REFLECTIVITY IS NOT THE SAME AS CANOPY LIGHT DELIVERY.

A laboratory reflectivity measurement describes a physical property of a material under specified test conditions.

It does not tell a grower exactly how much additional useful light will reach a particular fruit in a commercial orchard.

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3. EVIDENCE THAT PLACEMENT AND ORCHARD ARCHITECTURE MATTER

Recent Cornell field research compared reflective ground-cover materials and deployment configurations in apple orchards.

The studies evaluated Mylar and Extenday with several cultivars, including EverCrisp, Honeycrisp, NY1 and NY2.

The researchers reported that reflective ground cover could increase light interception, but the response depended on material and deployment configuration.

This has an important commercial implication.

Simply stating that a film has a high laboratory reflectivity does not establish how effectively that film will redirect radiation into a particular orchard canopy.

The useful light environment depends on the complete system:

Material + Position + Coverage + Canopy + Training System + Solar Conditions

For this reason, AgriSun treats film positioning as an important part of orchard application rather than an incidental installation detail.

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4. APPLES — ONE OF THE STRONGEST RESEARCH BASES

Apples are among the better-studied fruit crops for reflective orchard-floor treatments.

Research has investigated reflective materials in cultivars including Fuji and Gala, as well as newer studies involving Honeycrisp and other cultivars.

A frequently cited Fuji study by Ju and colleagues compared several orchard-floor reflective materials.

The treatments included:

- Crinkled aluminium foil bonded to cloth
- Aluminium-metallised polypropylene film
- Polypropylene film

The foil and metallised treatments increased light intensity within the canopy under the study conditions.

The researchers also observed increased anthocyanin concentration, reduced chlorophyll concentration in the peel and improved percentage red coloration in Fuji fruit.

Importantly, the polypropylene treatment did not produce the same significant increase in canopy light.

This demonstrates an important principle:

NOT ALL GROUND-COVER MATERIALS PRODUCE THE SAME OPTICAL RESPONSE.

The Fuji study therefore supports the biological and physical principle behind reflective orchard-floor management.

It does not mean every reflective product will produce the same response.

5. WHY RED FRUIT COLOUR IS FREQUENTLY STUDIED

Anthocyanins are responsible for much of the red pigmentation seen in the peel of many apple cultivars.

Fruit colour development is influenced by several factors, including:

- Cultivar genetics
- Fruit maturity
- Light exposure
- Temperature
- Canopy position
- Orchard management

Reflective ground-cover research has therefore frequently focused on increasing light exposure to fruit that would otherwise receive relatively little radiation.

This is why red and bi-coloured cultivars feature prominently in reflective-ground-cover research.

The objective is not simply to create “more light.”

It is to alter the spatial distribution of available light within the orchard.

6. REFLECTIVE GROUND COVER UNDER HAIL NETTING

Protective netting introduces another layer into orchard light management.

Hail and shade nets can modify:

- Incoming radiation
- Light quality
- Wind
- Temperature
- Orchard microclimate

Research in Germany investigated reflective materials beneath hail nets in apple orchards.

One study involving Jonagold examined reflective white ground cover beneath black and white hail nets.

The reflective ground cover improved fruit coloration, particularly in more shaded fruit positions. Fruit size, firmness, starch breakdown and sugar content were reported as mostly unaffected by the hail-net and reflective-ground-cover treatments in that experiment.

Another German study in Gala Mondial evaluated several reflective ground-cover materials beneath black hail net and reported improved orchard light utilisation and fruit coloration.

These studies demonstrate that reflective ground cover can remain relevant where incoming light has already been modified by protective netting.

They do **not** demonstrate that reflective ground cover replaces protective netting.

The technologies perform different functions.

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7. REFLECTIVE FILM DOES NOT REPLACE SHADE OR HAIL NETTING

This distinction is important for AgriSun.

Protective netting may be installed to manage:

- Hail
- Excessive radiation
- Sunburn risk
- Wind
- Other production risks

Reflective ground cover is an orchard-floor light-management technology.

It cannot provide the physical hail protection of a hail net.

Nor should it automatically be considered a substitute for a shade-net system designed to reduce incoming radiation.

Where both technologies are used, the relevant question becomes:

How much incoming radiation passes through the net, and how is part of that available radiation redistributed within the canopy?

That interaction should be assessed for the specific net, cultivar and orchard system.

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8. CITRUS — A DIFFERENT RESEARCH QUESTION

Citrus illustrates why research findings must be interpreted according to the actual mechanism being investigated.

Research on the precocious Clemenpons Clementine mandarin used reflective white plastic mulch to investigate soil temperature and rind colour development.

The mulch increased reflected light and reduced daily maximum soil temperature and temperature range.

The largest differences were established during approximately 70–30 days before harvest.

Under the conditions of the experiment, colour break occurred earlier in treated trees.

However:

70 – 30 DAYS IS NOT A UNIVERSAL REFLECTIVE-FILM INSTALLATION RECOMMENDATION.

It describes the period during which important treatment differences were observed in that particular Clemenpons study.

The study used reflective white plastic mulch and investigated the relationship between root-zone temperature and rind colour development.

It did not establish a universal programme for:

- Nadorcott
- Tango
- Nova
- Navel oranges
- Valencia
- Midknight
- Delta
- Eureka lemons
- Lisbon lemons

These require cultivar- and production-system-specific evaluation.

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9. WHY RESULTS CANNOT SIMPLY BE TRANSFERRED BETWEEN CULTIVARS

A common mistake in agricultural marketing is to take a result obtained in one cultivar and present it as evidence for an entire crop.

AgriSun deliberately avoids this approach.

A treatment demonstrated in Fuji does not automatically establish the response in Golden Delicious.

A result in Clemenpons does not automatically establish the response in Nadorcott.

A result in one peach cultivar does not establish the ideal timing for every nectarine.

Cultivars differ in:

- Skin pigmentation
- Maturity timing
- Canopy characteristics
- Temperature response
- Fruit exposure
- Commercial quality requirements
- Susceptibility to physiological disorders

Therefore:

CROP EVIDENCE IS NOT ALWAYS CULTIVAR EVIDENCE.

Where cultivar-specific evidence is unavailable, AgriSun identifies the application as requiring further validation rather than manufacturing a recommendation.

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10. REFLECTIVITY: WHAT THE NUMBER MEANS

Reflectivity is an important physical property of reflective orchard material.

However, a reflectivity percentage should be interpreted correctly.

A laboratory reflectivity value relates to the amount of incident radiation reflected by a material under specified measurement conditions.

It does **not** mean that the same percentage of solar radiation reaches the fruit.

Once the material is deployed in an orchard, the amount and direction of useful reflected radiation can be influenced by:

- Solar angle
- Film orientation
- Wrinkling
- Dust
- Soil contamination
- Water
- Vegetation
- Canopy architecture
- Row orientation
- Film width
- Film position
- Netting
- Cloud conditions

Consequently:

HIGH MATERIAL REFLECTIVITY IS A MATERIAL PROPERTY — NOT A GUARANTEE OF FRUIT RESPONSE.

This is why AgriSun separates its **Technical Data Sheet** from its **crop application research**.

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11. CLEANLINESS AND REFLECTIVE PERFORMANCE

A reflective surface must remain sufficiently exposed to incoming radiation to perform its optical function.

In commercial orchards, the surface may become affected by:

- Dust
- Mud

- Organic debris
- Leaves
- Standing water
- Weed growth
- Traffic

The practical importance of contamination will depend on its severity and the material involved.

Growers should therefore inspect reflective film during use and keep the reflective surface reasonably exposed.

AgriSun does not assign a universal percentage loss of performance to soiling unless supported by product-specific measurement.

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12. FRUIT SURFACE TEMPERATURE AND SUNBURN

Light management and heat management are related, but they are not identical.

Apple sunburn research has demonstrated that fruit-surface temperature and solar exposure are important factors in the development of solar injury.

Reflective ground cover changes the orchard radiation environment.

This means it should not automatically be assumed either to:

prevent sunburn

or

cause sunburn.

The response depends on the orchard system, fruit exposure, radiation, temperature, cultivar and treatment.

In orchards with a known sunburn risk, fruit-surface temperature and fruit condition should form part of a controlled evaluation.

This is particularly important for AgriSun's planned South African work involving Golden Delicious.

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13. GOLDEN DELICIOUS — WHY AGRISUN IS CAUTIOUS

Golden Delicious illustrates the importance of matching reflective-film application to the actual production objective.

In red cultivars, the objective may be enhanced red or blush colour development.

Golden Delicious presents a different commercial problem.

Growers may need to balance:

- Maturity
- Soluble solids
- External peel appearance
- Fruit exposure
- Temperature
- Sunburn risk

AgriSun therefore does not currently position Golden Delicious as a standard red-colour reflective-film application.

Instead, Golden Delicious has been identified as a priority for controlled South African research.

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14. WHAT ABOUT °BRIX?

Soluble solids are commercially important in many fruit crops.

However, reflective ground cover should not be marketed as a universal method of increasing °Brix.

Some reflective-ground-cover studies have measured soluble solids or sugar-related parameters without finding a significant treatment effect.

For example, the Jonagold hail-net study reported that sugar content, along with several other maturity and quality parameters, was mostly unaffected by the reflective ground-cover treatment.

Therefore:

AGRISUN DOES NOT GUARANTEE AN INCREASE IN ° BRIX.

Where °Brix is commercially relevant, it should be measured as an outcome rather than assumed as a benefit.

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15. WHAT ABOUT YIELD?

The same principle applies to yield.

Reflective ground covers are primarily being considered by AgriSun as a **light-management technology**.

AgriSun does not claim that reflective film universally increases:

- Yield
- Fruit number
- Fruit weight
- Fruit size

unless an appropriate study or local trial supports the claim for the specific application being discussed.

Yield should be measured where relevant.

It should not be assumed.

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16. WHAT ABOUT FRUIT SIZE?

Fruit size is influenced by numerous biological and management factors.

A change in orchard light distribution does not automatically mean fruit will become larger.

Some reflective-ground-cover studies have reported little or no effect on fruit size or related maturity variables.

For this reason:

AGRISUN DOES NOT GUARANTEE AN INCREASE IN FRUIT SIZE.

Where fruit size is commercially important, treated and untreated areas should be compared.

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17. WHY COMMERCIAL PACK-OUT MATTERS

A physiological response is not necessarily a commercial benefit.

A treatment could theoretically:

- Improve colour
- Leave °Brix unchanged
- Leave fruit size unchanged
- Produce no difference in defects

and still provide commercial value if more fruit reaches a higher colour grade.

Conversely, a measurable biological response may have no meaningful effect on marketability.

This is why AgriSun places particular emphasis on:

COMMERCIAL PACK-OUT.

Where practical, trials should record:

- Grade
- Pack-out
- Rejected fruit
- Reasons for downgrade
- Percentage of marketable fruit

The relevant question is not simply:

Did something change?

It is also:

DID THE CHANGE MATTER COMMERCIALLY?

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18. MATERIALS USED IN PUBLISHED RESEARCH

The term “reflective ground cover” describes a category of treatments rather than one identical product.

Published studies have used materials including:

- Aluminium foil bonded to cloth
- Metallised polypropylene
- Reflective woven ground covers
- White reflective plastic
- Aluminium-coated materials
- Reflective paper
- Other reflective orchard-floor surfaces

For example, the Fuji study compared foil film, aluminium-metallised polypropylene and polypropylene film.

The German hail-net research investigated several different reflective materials.

The Clemenpons study used reflective white plastic mulch.

This matters enormously.

RESEARCH ON A REFLECTIVE MATERIAL SUPPORTS THE PRINCIPLE BEING STUDIED — IT DOES NOT AUTOMATICALLY VALIDATE EVERY OTHER REFLECTIVE PRODUCT.

AgriSun therefore identifies the material used when discussing published research wherever possible.

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19. THE AGRISUN PRODUCT

AgriSun Reflective Orchard Film is a reflective orchard-ground-cover product intended to redirect a portion of available solar radiation upward from orchard-floor level.

Its verified physical product properties belong in the separate:

AGRISUN TECHNICAL DATA SHEET

The White Paper should not use laboratory product specifications as substitutes for horticultural field evidence.

Likewise, field research conducted using another reflective material should not be presented as a product-specific AgriSun performance test.

This separation protects the scientific integrity of the technical programme.

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20. INSTALLATION IS PART OF THE SYSTEM

The performance of reflective ground cover cannot be separated completely from its deployment.

Relevant factors include:

- Position relative to the canopy
- Film width
- Ground coverage
- Row orientation
- Canopy architecture
- Reflective surface condition
- Anchoring
- Irrigation layout
- Orchard traffic
- Wind

Detailed practical instructions belong in the separate:

AGRISUN INSTALLATION & APPLICATION GUIDE

The White Paper establishes the scientific reason installation matters.

The Installation Guide tells the grower what to do operationally.

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21. APPLICATION TIMING

There is no scientifically defensible universal statement such as:

“Install reflective film X days before harvest for all fruit.”

Published timing varies by:

- Crop
- Cultivar
- Study
- Treatment
- Material
- Research objective

Some cultivars have published timing experiments.

Others have evidence that reflective materials have been investigated but lack a sufficiently strong cultivar-specific timing programme.

Still others require local feasibility research.

AgriSun therefore presents application timing in the relevant crop guides rather than inventing one universal schedule.

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22. SOUTH AFRICAN VALIDATION

International science provides the foundation.

South African trials are needed to determine how that science translates into:

- Local cultivars
- Local solar radiation
- Local temperatures
- South African protective net systems
- Local orchard architectures
- South African harvest programmes
- Local grading requirements
- Export specifications

Priority areas identified by AgriSun include:

- Golden Delicious
- Fuji
- Cripps Pink / Pink Lady®
- Forelle
- Rosemarie
- Nectarines
- Nadorcott
- Tango
- Nova
- Navel oranges
- Valencia
- Midknight
- Delta
- Eureka
- Lisbon
- Mango cultivars
- Reflective film beneath South African shade and hail nets

These priorities are described separately in:

SOUTH AFRICAN RESEARCH PRIORITIES

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23. HOW AGRISUN INTENDS TO BUILD LOCAL EVIDENCE

A useful trial starts with a question rather than a desired answer.

Where appropriate, AgriSun trials should compare:

TREATED AREA

Reflective ground film.

with

CONTROL AREA

Comparable orchard area under conventional management without reflective ground film.

Measurements should be selected according to the question being investigated.

They may include:

- Reflected PAR
- Canopy light
- Fruit colour
- Fruit-surface temperature
- Sunburn
- °Brix
- Firmness
- Acidity
- Maturity
- Fruit size
- External defects
- Commercial grade
- Pack-out

Positive, negative, mixed and null results should all be recorded.

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24. COMMERCIAL TRIALS ARE NOT PEER-REVIEWED RESEARCH

Commercial field trials are extremely valuable.

They can identify:

- Promising applications
- Poor applications
- Practical installation issues
- Cultivar differences
- Possible timing programmes
- Commercial responses
- Future research questions

But a commercial comparison does not automatically constitute scientific proof.

Formal scientific research may require:

- Replication
- Randomisation
- Appropriate sample size
- Standardised measurements
- Statistical analysis
- Documented methodology

AgriSun should distinguish clearly between:

Published peer-reviewed evidence

Formal AgriSun research

and

Commercial field observations

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25. RESPONSIBLE CLAIMS

AgriSun's technical communication is based on a simple principle:

SAY WHAT THE EVIDENCE SUPPORTS.

AgriSun may explain that reflective orchard ground covers can alter orchard light distribution because this is supported by published research.

AgriSun may discuss a particular cultivar response where a study actually investigated that cultivar.

AgriSun should not turn that result into a universal claim.

Accordingly, AgriSun does not make universal guarantees that reflective orchard film will:

- Increase yield
- Increase °Brix
- Increase fruit size
- Prevent sunburn
- Improve every cultivar's colour
- Advance harvest
- Improve pack-out

These outcomes should be treated according to the evidence available for the particular crop, cultivar and production system.

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26. THE AGRISUN EVIDENCE FRAMEWORK

AgriSun separates information into four levels.

LEVEL 1 — PRODUCT SPECIFICATION

What is the physical product?

Source: AgriSun Technical Data Sheet.

LEVEL 2 — PUBLISHED SCIENCE

What has independent research demonstrated about reflective orchard-ground-cover technologies?

Source: Scientific Research Compendium and peer-reviewed literature.

LEVEL 3 — CROP APPLICATION GUIDANCE

What does the evidence suggest for a particular crop or cultivar?

Source: AgriSun crop-specific application guides.

LEVEL 4 — SOUTH AFRICAN VALIDATION

What still needs to be established locally?

Source: AgriSun South African Research Programme.

This prevents laboratory specifications, international research and local commercial observations from being treated as though they are the same type of evidence.

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27. CONCLUSION

Reflective orchard ground covers are fundamentally a **light-management technology**.

Their purpose is not to create sunlight.

Their physical function is to redirect a portion of available radiation reaching the orchard floor.

Published research demonstrates that this can alter orchard light distribution and, in certain crops, cultivars and experimental conditions, influence outcomes such as fruit coloration.

But the response is not universal.

Material matters.

Placement matters.

Cultivar matters.

Canopy architecture matters.

Timing matters.

Netting matters.

Climate matters.

And ultimately, commercial relevance matters.

The scientifically responsible question is therefore not:

“DOES REFLECTIVE FILM WORK?”

It is:

“WHAT DOES THIS REFLECTIVE TREATMENT DO, IN THIS CULTIVAR, IN THIS ORCHARD, AT THIS TIME — AND DOES THE RESPONSE HAVE COMMERCIAL VALUE?”

That is the question AgriSun's technical and South African research programmes are designed to answer.

AGRISUN REFLECTIVE SOLUTIONS

Better Light. Applied With Evidence.

Understand the light.

Measure the response.

Build the recommendation from evidence.

CORE SCIENTIFIC REFERENCES

Ju, Z., Duan, Y. & Ju, Z. (1999). Effects of covering the orchard floor with reflecting films on pigment accumulation and fruit coloration in 'Fuji' apples. *Scientia Horticulturae*, 82(1–2), 47–56. DOI: **10.1016/S0304-4238(99)00038-2**.

Blanke, M.M. (2007). Can reflective ground cover compensate for light losses under hail nets? *Acta Horticulturae*, 732. DOI: **10.17660/ActaHortic.2007.732.101**.

Blanke, M.M. (2011). Reflective materials under hailnet improve orchard light utilisation, fruit quality and particularly fruit colouration. *Scientia Horticulturae*, 127(3), 447–451. DOI: **10.1016/j.scienta.2010.09.006**.

Mesejo, C., Gambetta, G., Gravina, A., Martínez-Fuentes, A., Reig, C. & Agustí, M. (2012). Relationship between soil temperature and fruit colour development of 'Clemenpons' Clementine mandarin (*Citrus clementina* Hort. ex Tan.). *Journal of the Science of Food and Agriculture*, 92(3), 520–525. DOI: **10.1002/jsfa.4600**.

Gonzalez, L. & Robinson, T.L. (2023). Effect of different reflective ground covers on light reflection and on the coloring of apples at harvest. *Acta Horticulturae*, 1366. DOI: **10.17660/ActaHortic.2023.1366.47**.

WHITE PAPER — MASTER SCIENTIFIC REFERENCE SECTION

About the References

The scientific references used in this White Paper form part of the **AgriSun Scientific Research Compendium**.

AgriSun distinguishes between:

Published research on reflective orchard ground covers

Research using other orchard light-management technologies

AgriSun product specifications

Commercial field observations

Applications still requiring South African validation

Research conducted using a particular reflective material, cultivar or production system should not automatically be interpreted as product-specific evidence for AgriSun Reflective Orchard Film.

The complete study-by-study evidence assessment is provided in the **AgriSun Scientific Research Compendium**.

A. APPLES — REFLECTIVE GROUND COVER

Ju, Z., Duan, Y. & Ju, Z. (1999)

Effects of covering the orchard floor with reflecting films on pigment accumulation and fruit coloration in 'Fuji' apples.

Scientia Horticulturae, 82(1–2), 47–56.

DOI: 10.1016/S0304-4238(99)00038-2

Crop / Cultivar: Fuji apple

Reflective materials: The experiment compared different orchard-floor materials, including aluminium foil bonded to cloth, aluminium-metallised polypropylene film and polypropylene film.

Research relevance: Direct reflective orchard-floor research.

Key finding: The more reflective treatments increased light within the canopy and were associated with increased anthocyanin accumulation and improved red fruit coloration under the experimental conditions.

Important limitation: The different materials did not perform identically. This study supports the principle that reflective orchard-floor treatments can alter canopy light and Fuji coloration; it is not an AgriSun product-performance trial.

This remains one of the cornerstone studies for the White Paper.

Gonzalez, L. & Robinson, T.L. (2023)

Effect of different reflective ground covers on light reflection and on the coloring of apples at harvest.

Acta Horticulturae, 1366.

DOI: 10.17660/ActaHortic.2023.1366.47

Cultivars: EverCrisp, Honeycrisp, NY1 and NY2.

Materials: Mylar and Extenday.

Research relevance: Particularly important because the experiments investigated not only reflective material but also **deployment configuration and orchard training system**.

The researchers found differences in reflected light and light interception between materials and deployment strategies. Reflective treatments also increased red blush area under the experimental conditions.

Why this matters to AgriSun

This study supports one of the most important principles in our technical programme:

> Material reflectivity alone does not determine how much useful reflected light reaches the canopy.

Material, positioning, coverage and orchard architecture matter.

Funke, K. & Blanke, M.M. — Braeburn research

Can reflective ground cover enhance fruit quality and colouration?

Cultivar: Braeburn apple

White reflective ground cover was used in the grass alleys.

The research reported improved light utilisation and fruit coloration, particularly in lower and more shaded fruit positions.

Fruit size, firmness, starch breakdown and sugar content were not materially affected under the study conditions.

Why this matters

This is useful evidence against making universal claims that reflective ground cover necessarily increases:

- °Brix
- Fruit size
- Firmness

The principal response in this experiment concerned **light utilisation and coloration**.

B. APPLES UNDER HAIL NETTING

Blanke, M.M. (2007)

Can reflective ground cover compensate for light losses under hail nets?

Acta Horticulturae, 732.

DOI: 10.17660/ActaHortic.2007.732.101

Cultivar: Jonagold Wilmuta

System: Black and white hail nets with white reflective ground cover.

The study reported enhanced fruit coloration, particularly in more shaded fruit positions. Fruit size, firmness, starch breakdown and sugar content were mostly unaffected.

Earlier deployment produced a greater colour response than later deployment in that experiment.

Important limitation

This was a specific cultivar, reflective material, orchard and Northern European production environment.

Its timing should not be converted into a universal South African installation schedule.

Blanke, M.M. (2011)

Reflective materials under hailnet improve orchard light utilisation, fruit quality and particularly fruit colouration.

Scientia Horticulturae, 127(3), 447–451.

DOI: 10.1016/j.scienta.2010.09.006

Cultivar: Gala Mondial

Several reflective ground-cover materials were compared beneath black hail net.

The ground covers were deployed approximately **4–5 weeks before anticipated harvest**.

The treatments increased reflected light substantially compared with uncovered grass and improved red coloration and the proportion of well-coloured Class I fruit under the conditions of the experiment. Internal fruit quality and sugar were not adversely affected.

Important interpretation

4–5 weeks is a published Gala Mondial research treatment.

It is **not a universal AgriSun timing recommendation**.

Reflective mulch and canopy light visualisation — 2019

Anthocyanin synthesis and light utilisation can be enhanced by reflective mulch – Visualisation of light penetration into a tree canopy.

Journal of Plant Physiology, 233, 52–57.

DOI: 10.1016/j.jplph.2018.12.008

Cultivar: Braeburn Mariri Red

System: Reflective ground cover beneath crystalline hail net.

The reflective material was deployed seven weeks before harvest and increased reflected light measured 1 m above ground by approximately 1.6–3.9 times under the experimental conditions.

This provides additional support for the physical mechanism of redirecting orchard-floor light into the canopy.

C. SWEET CHERRY

2025 Southern Chile Regina Study

Impact of Reflective Ground Film on Fruit Quality, Condition, and Post-Harvest of Sweet Cherry (*Prunus avium* L.) cv. Regina Cultivated Under Plastic Cover in Southern Chile.

Agronomy, 15(3), 520.

DOI: 10.3390/agronomy15030520

Country: Chile

Cultivar: Regina

Production system: Commercial sweet-cherry orchard under plastic cover.

Treatments

- Control — no reflective ground film
- Reflective film installed **21 days before harvest**
- Reflective film installed **34 days before harvest**

The 34-day treatment corresponded with the colour-break phenological stage.

The experiment used four replicates per treatment.

The study reported treatment effects on several fruit-quality variables. Among the reported observations, the 21-day treatment increased the proportion of fruit larger than 32 mm in the upper canopy and mahogany-coloured fruit in the lower canopy relative to the untreated treatment.

Important limitation

These timings apply to:

Regina + southern Chile + the production system and reflective film investigated.

They should not automatically be assigned to Lapins, Sweetheart, Santina, Skeena or Bing.

Those cultivars remain appropriate candidates for South African validation.

D. PEACHES & NECTARINES

Taiko Peach

Reflective Film Mulching Before Harvest Promotes Coloration and Expression of Ripening-Related Genes in Peach Fruits.

Cultivar: Taiko

Reflective film was deployed **7 days before harvest**.

The researchers investigated fruit coloration, pigmentation, soluble solids, titratable acidity, firmness and expression of genes associated with coloration and ripening.

Correct AgriSun interpretation

Seven days is a published treatment for Taiko peach.

It is not a universal peach or nectarine timing recommendation.

Washington Multi-Crop Research Programme

Schmidt, Hanrahan, Castillo & McFerson reported a large programme of replicated field trials involving reflective ground covers in commercial:

- Apple
- Pear
- Sweet cherry
- Peach
- Nectarine

orchards in Washington State.

The programme included more than 50 replicated field trials conducted from 2005 onward.

DOI: 10.17660/ActaHortic.2014.1058.37

This is useful evidence that reflective ground-cover technology has been investigated commercially across several temperate fruit crops.

It should **not** be used to assign one timing or expected response to every cultivar within those crops.

E. PLUM

Kim, E.J., Choi, D.G. & Jin, S.N.

Effect of pre-harvest reflective mulch on growth and fruit quality of plum (*Prunus domestica* L.).

Acta Horticulturae, 772.

DOI: 10.17660/ActaHortic.2008.772.54

Treatments

Reflective film was installed:

- 1 week before harvest
- 2 weeks before harvest
- 3 weeks before harvest
- 4 weeks before harvest

The researchers measured light intensity, soil moisture and fruit-quality variables.

Reflective film increased light intensity by up to 16% in the experiment.

The researchers reported that the **three-week treatment produced the highest fruit quality in that experiment**.

Critical wording

We should **never** turn that into:

> "Install AgriSun three weeks before plum harvest."

Instead:

> "In this published plum experiment, the three-week treatment produced the highest fruit-quality response among the timings tested."

Cultivar-specific South African timing still requires validation.

F. PEARS

There is useful pear evidence, but we need to distinguish between **peer-reviewed publications** and industry research reports.

Washington Tree Fruit Research Commission work investigated Daybright reflective ground cover in Bartlett pear orchards and reported horticultural responses, including effects on yield through fruit set and/or fruit size.

This evidence is useful for the **Scientific Research Compendium**, but because this source is an industry project report rather than the same level of peer-reviewed journal evidence as the Fuji or Clemenpons papers, it should be labelled accordingly.

For South African blushed pears:

Forelle and Rosemarie remain local research priorities.

And any South African research involving evaporative cooling must remain clearly labelled as **evaporative-cooling research**, not reflective-ground-film research.

G. CITRUS

Mesejo, C., Gambetta, G., Gravina, A., Martínez-Fuentes, A., Reig, C. & Agustí, M. (2012)

Relationship between soil temperature and fruit colour development of 'Clemenpons' Clementine mandarin (*Citrus clementina* Hort. ex Tan.).

Journal of the Science of Food and Agriculture, 92, 520–525.

DOI: 10.1002/jsfa.4600

Cultivar: Clemenpons Clementine

Treatment: Reflective white plastic mulch.

The purpose of the research was primarily to investigate the relationship between **soil/root-zone temperature and rind colour development**.

The reflective mulch:

- Increased reflected light
- Reduced maximum soil temperature
- Reduced soil-temperature range

The major treatment differences were established approximately **70–30 days before harvest**.

Under the experimental conditions, colour break occurred approximately two weeks earlier in treated trees.

Critical limitation

70 – 30 DAYS IS NOT AN INSTALLATION RECOMMENDATION.

It describes the period during which important treatment differences developed in this particular Clemenpons experiment.

This study does **not** establish a timing programme for:

Nadorcott, Tango, Nova, Navel, Valencia, Midknight, Delta, Eureka or Lisbon.

H. MANGO

For the current White Paper:

DO NOT INCLUDE MANGO AS ESTABLISHED REFLECTIVE-GROUND-FILM EVIDENCE.

We have not verified a sufficiently strong directly applicable peer-reviewed commercial mango reflective-ground-film study to place mango alongside Fuji, Gala, Regina or Clemenpons as an established evidence example.

Mango belongs in:

South African Research Priorities → Exploratory / Strategic Research

until better direct evidence is established.

That is a much safer scientific position.

I. SUNBURN

The White Paper should contain sunburn science primarily to explain why **light management must not be confused with sunburn prevention**.

The dedicated **Apple Sunburn & High-Temperature Management Guide** should contain the detailed sunburn bibliography.

The important evidence distinction remains:

South African kaolin research

provides evidence about apple sunburn and cultivar responses under South African conditions.

But:

Kaolin particle film ≠ reflective orchard ground film.

Therefore AgriSun must not use South African kaolin results as evidence that AgriSun ground film prevents sunburn.

AgriSun distinguishes between evidence for a horticultural principle and evidence for a specific product. Published research using reflective orchard ground covers may support the scientific principle that orchard-floor reflectivity can alter the orchard light environment. Unless AgriSun Reflective Orchard Film itself was used in the experiment, the study should not be represented as product-specific performance evidence

SCIENTIFIC REFERENCES

The scientific literature cited in this White Paper forms part of the AgriSun Scientific Research Compendium. The Compendium contains the complete study details, materials, treatments, application timings, measured outcomes, limitations and DOI records used throughout the AgriSun Grower Technical Library.