Experiments with light reflecting groundcovers and Lumilys® textile in apple production

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Ertragsphysiologie

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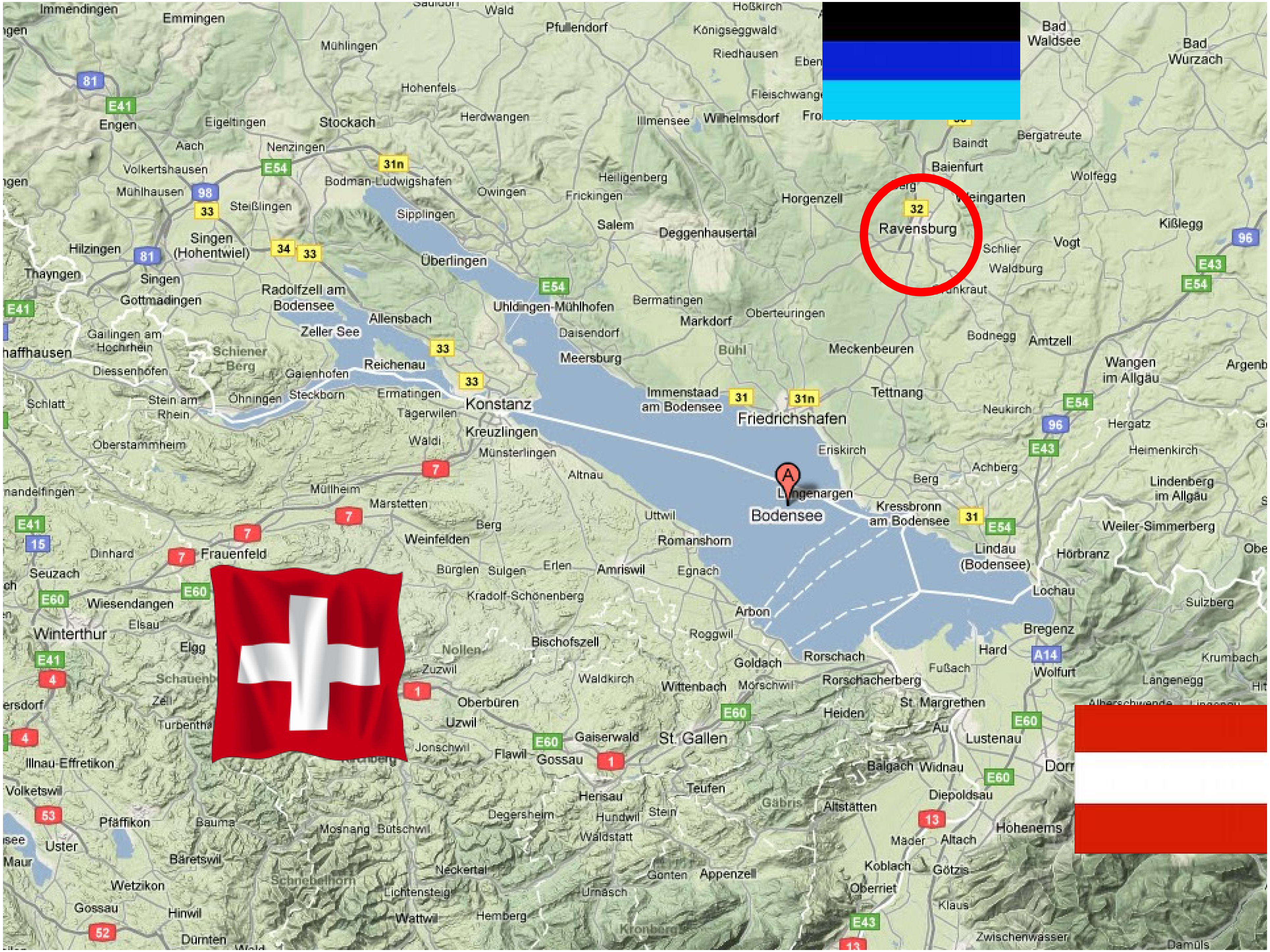
Immendingen
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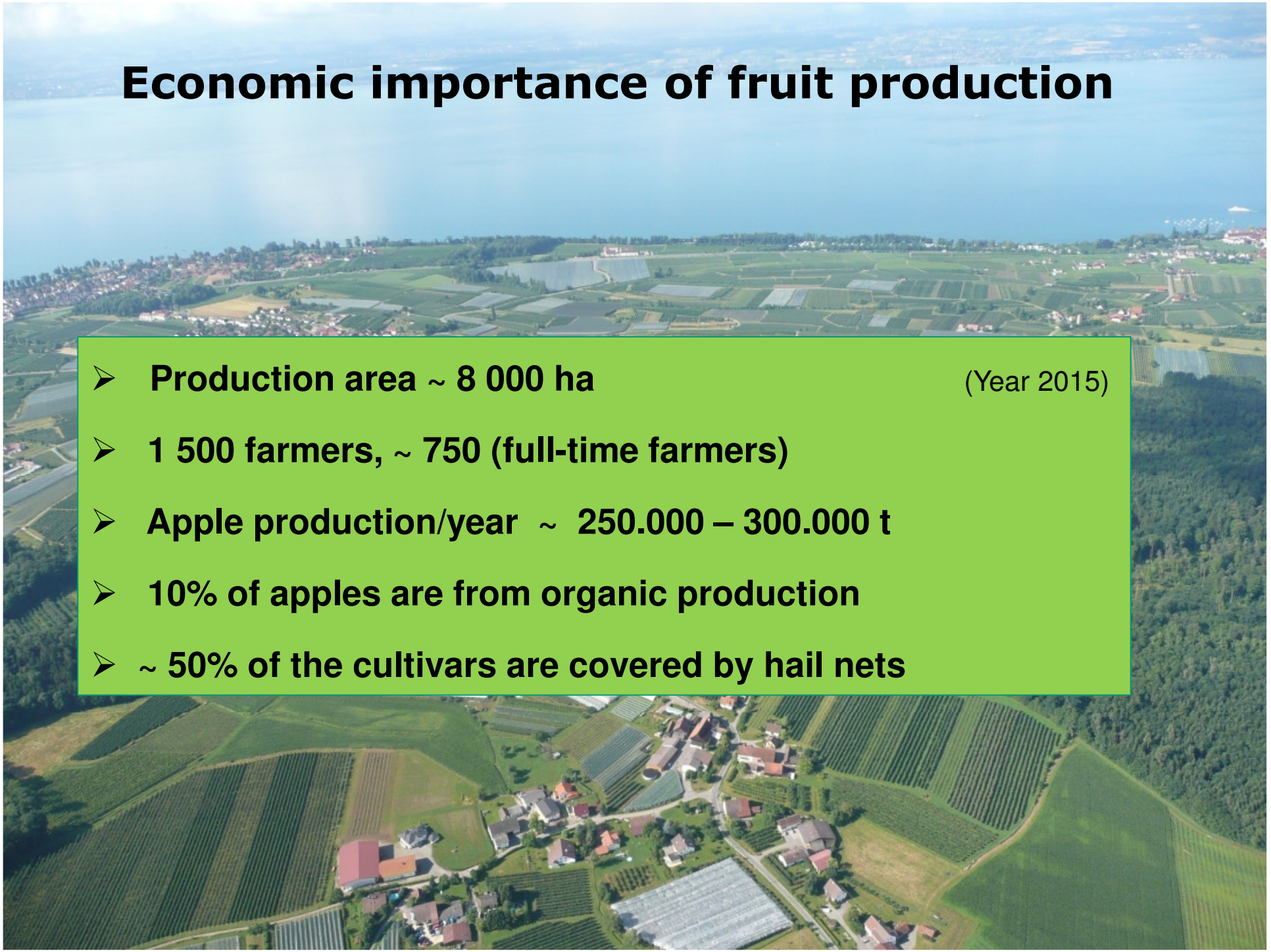
Wald
Pfullendorf
Königseggwald
Riedhausen
Mühlingen
Hohenfels
Bad Waldsee
Bad Wurzach
Engen
Eigeltingen
Stockach
Herdwangen
Illmensee
Wilhelmsdorf
Fleischwangen
Aach
Nenzingen
Baindt
Bergatreute
Baienfurt
Volkertshausen
Bodman-Ludwigshafen
Heiligenberg
Owingen
Frickingen
Horgenzell
Weingarten
Wolfegg
Mühlhausen
Steißlingen
Sipplingen
Salem
Deggenhausertal
Ravensburg
Schlier
Vogt
Kißlegg
Hilzingen
Singen (Hohentwiel)
Überlingen
Waldburg
Thayngen
Singen
Gottmadingen
Radolfzell am Bodensee
Uhldingen-Mühlhofen
Bermatingen
Markdorf
Oberteuringen
Allensbach
Daisendorf
Gailingen am Hochrhein
Zeller See
Schiener Berg
Buhl
Meckenbeuren
Bodnegg
Amtzell
Wangen im Allgäu
Argenbühl
Diessenhofen
Gaienhofen
Reichenau
Meersburg
Immenstaad am Bodensee
Friedrichshafen
Tettnang
Neukirch
Hergatz
Schlatt
Stein am Rhein
Öhningen
Steckborn
Ermatingen
Tägerwilen
Konstanz
Kreuzlingen
Eriskirch
Heimenkirch
Oberstammheim
Waldi
Münsterlingen
Altnau
Achberg
Lindenberg im Allgäu
Müllheim
Berg
Langenargen
Bodensee
Kressbronn am Bodensee
Märstetten
Uttwil
Weiler-Simmerberg
Frauenfeld
Weinfelden
Romanshorn
Lindau (Bodensee)
Hörbranz
Dinhard
Seuzach
Bürglen
Sulgen
Erlen
Amriswil
Egnach
Kradolf-Schönenberg
Lochau
Wiesendangen
Elsau
Winterthur
Arbon
Sulzberg
Bregenz
Bischofszell
Roggwil
Elgg
Nollen
Hard
Krumbach
Zuzwil
Goldach
Rorschach
Wolfurt
Schauenberg
Waldkirch
Wittenbach
Mörschwil
Rorschacherberg
Fußach
Langenegg
Zell
Oberbüren
St. Margrethen
Turbenthal
Uzwil
Heiden
Au
Lustenau
Jonschwil
Gaiserwald
St. Gallen
Flawil
Gossau
Balgach
Widnau
Illnau-Effretikon
Teufen
Volketswil
Herisau
Gäbris
Altstätten
Diepoldsau
Pfäffikon
Bauma
Degersheim
Hundwil
Stein
Uster
Mosnang
Bütschwil
Waldstatt
Mäder
Altach
Hohenems
Bäretswil
Neckertal
Gonten
Appenzell
Koblach
Götzis
Wetzikon
Schnebelhorn
Lichtensteig
Urnäsch
Oberriet
Gossau
Hinwil
Wattwil
Hemberg
Klaus
Dürnten
Kronberg
Zwischenwasser
Damüls

Economic importance of fruit production

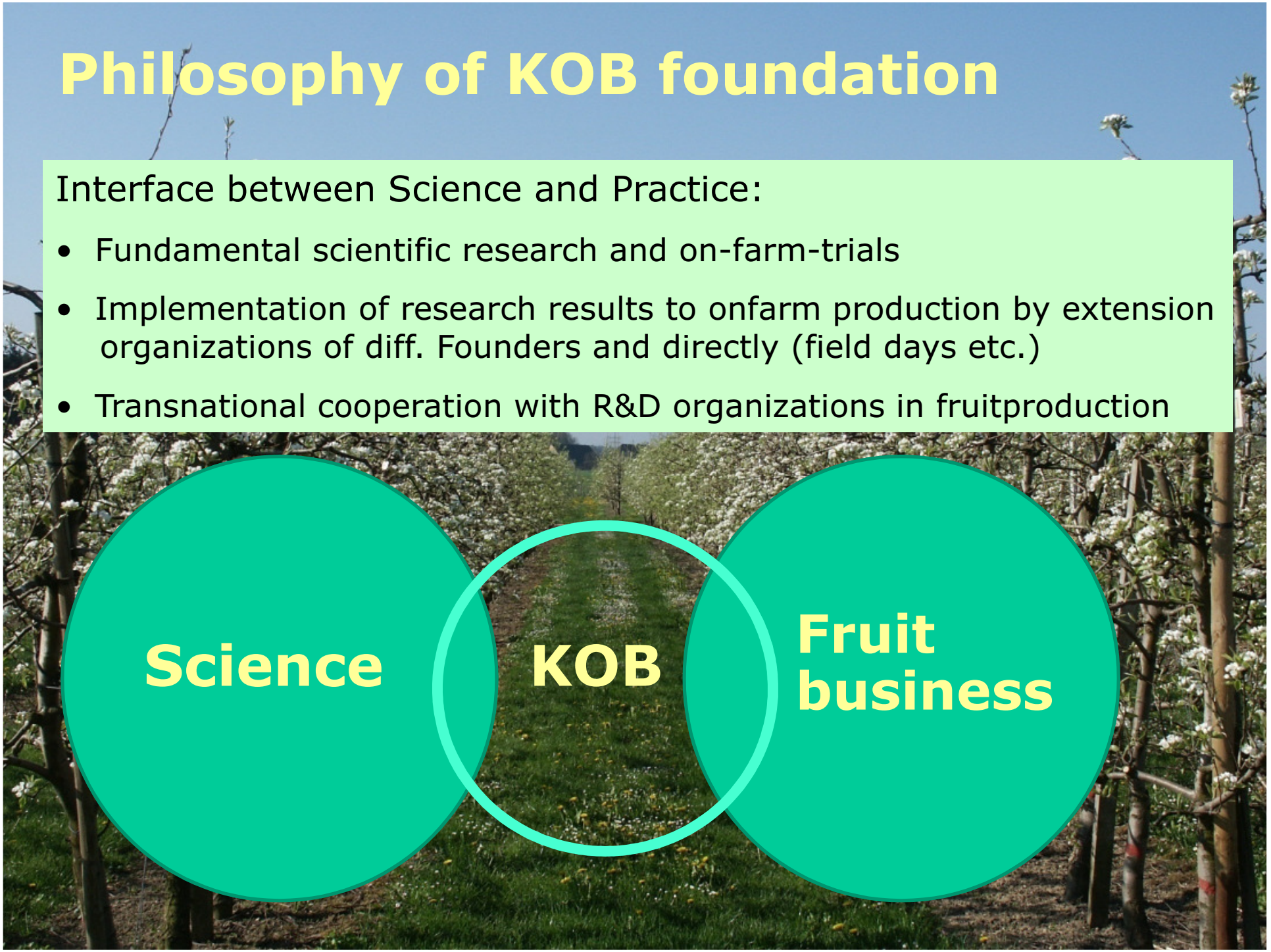


- **Production area ~ 8 000 ha** (Year 2015)
- **1 500 farmers, ~ 750 (full-time farmers)**
- **Apple production/year ~ 250.000 – 300.000 t**
- **10% of apples are from organic production**
- **~ 50% of the cultivars are covered by hail nets**

Philosophy of KOB foundation

Interface between Science and Practice:

- Fundamental scientific research and on-farm-trials
- Implementation of research results to onfarm production by extension organizations of diff. Founders and directly (field days etc.)
- Transnational cooperation with R&D organizations in fruitproduction



Mode of practice „Interface“

National/International research

Research stations
Weinsberg/LTZ
Esteburg
Ahrweiler
ACW Wädenswil (CH)
Laimburg (I)
Haidegg (A)
etc.

Universities Appl.Sciences
Weihenstephan
Erfurt
Geisenheim
Brandenburg etc.

Universities
Hohenheim
TUM
WEGA-Network
UEB Prag
Brazil (2)

Dt. Genbank Obst
Meetings
Grünberg
EUFRIN Working groups
COST etc.
div. Projects

KOB

Students Uni HOH
Intern. visitors
Trainees (6-8)
Scient. Project partners
Guest researcher

Öko Advisory Service 2
CoO-Teams 4
ÜgPsB 4,5
County Fruit Advisors 4,5
Privat Fruit Advisors 5

Fruit farmers/Ware house/Store

Industry/Commerce

Textiles

Ravensburg, Ge

Field of activities

Varieties & ecological production **-** Dr. Ulrich Mayr

Physiology – Michael Zoth

Plant protection– Dr. Christian Scheer

Postharvest physiology - Dr. Daniel Neuwald

Fruit market and farm management- Dr. Manfred Büchele

Experimental Ressources

Experimental Area total: 45 ha rounded

I) 30 ha integrated production IP, II) 15 ha ecological production BIO
90% pip fruit, 10 % stone fruit

Storing facilities: 100t cooling and 400t CA-storage (12 rooms),
Storage for science purpose 48 compartements

Lab: 400 sqm. well equiped

Well educated and trained Staff: 6 PhD, 4 M.Sc., 7 Bach.,
10 Students on internships, 4 workers in Lab, 8 workers in the fields ,
70 temporary staff

Contacts to extension and farmers in a higher production level region

Research Station KOB Bavendorf

Improving fruit colouration

- **Apple cultivars are sometimes endangered to develop low colouration:**

  high temperatures, shaded position, covered with leafs, dark hailnet, …

- **Cultivars: Elstar, Fuji, Kanzi, Pinova, Sweetango**

- **Measures: Summer pruning**

  Growth control using PGR‘s
  Prohexadione-Ca [Regalis, Kudos]

  Biostimulants, Fertilizers

  Light reflecting ground covers

  Defoliation

Improving fruit colouration

- **Effects:**

  - lighter canopy

  - better light distribution

  - light / radiation reaches the fruit

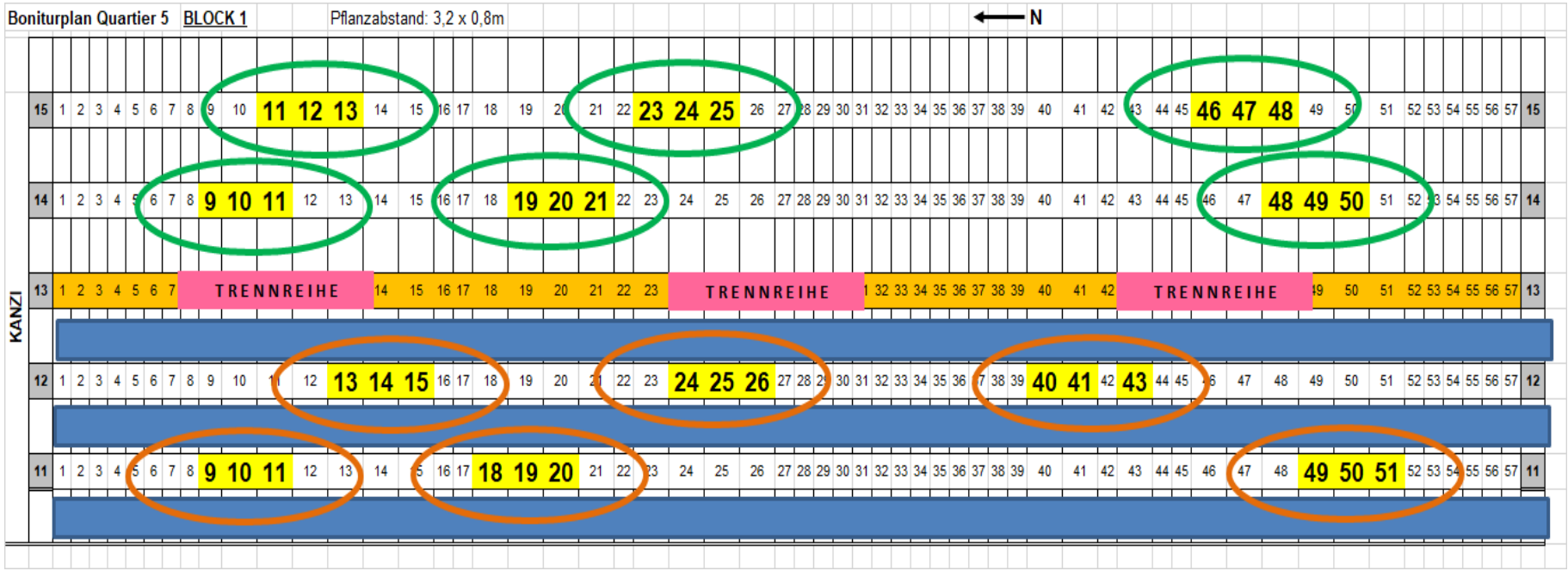
  - maximum light exposition of the fruit surface

- **=> induces anthocyanin synthesis**

  => improves brighter and intensive colouration

Light reflection trial 2012 - A

Simple Test-trial with ‚no-name' reflecting textile



- Apple ‚Kanzi' – colour sensitive variety
- High trained trees (3,40m) under crystal hailnet

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M. Zoth, Stiftung KOB Ravensburg, Germany

Light reflection trial 2012 - A

Simple Test-trial with ‚no-name' reflecting textile

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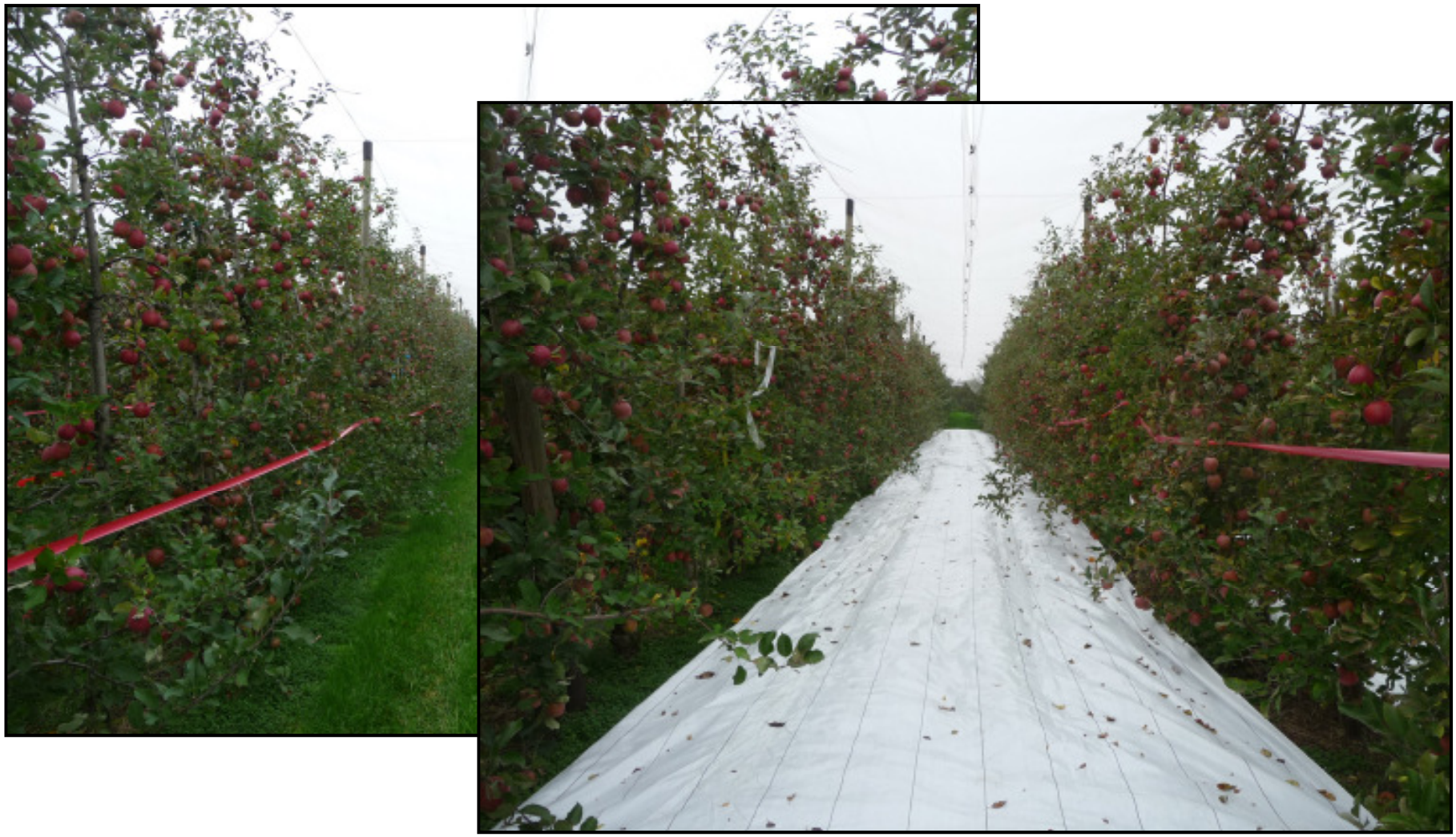
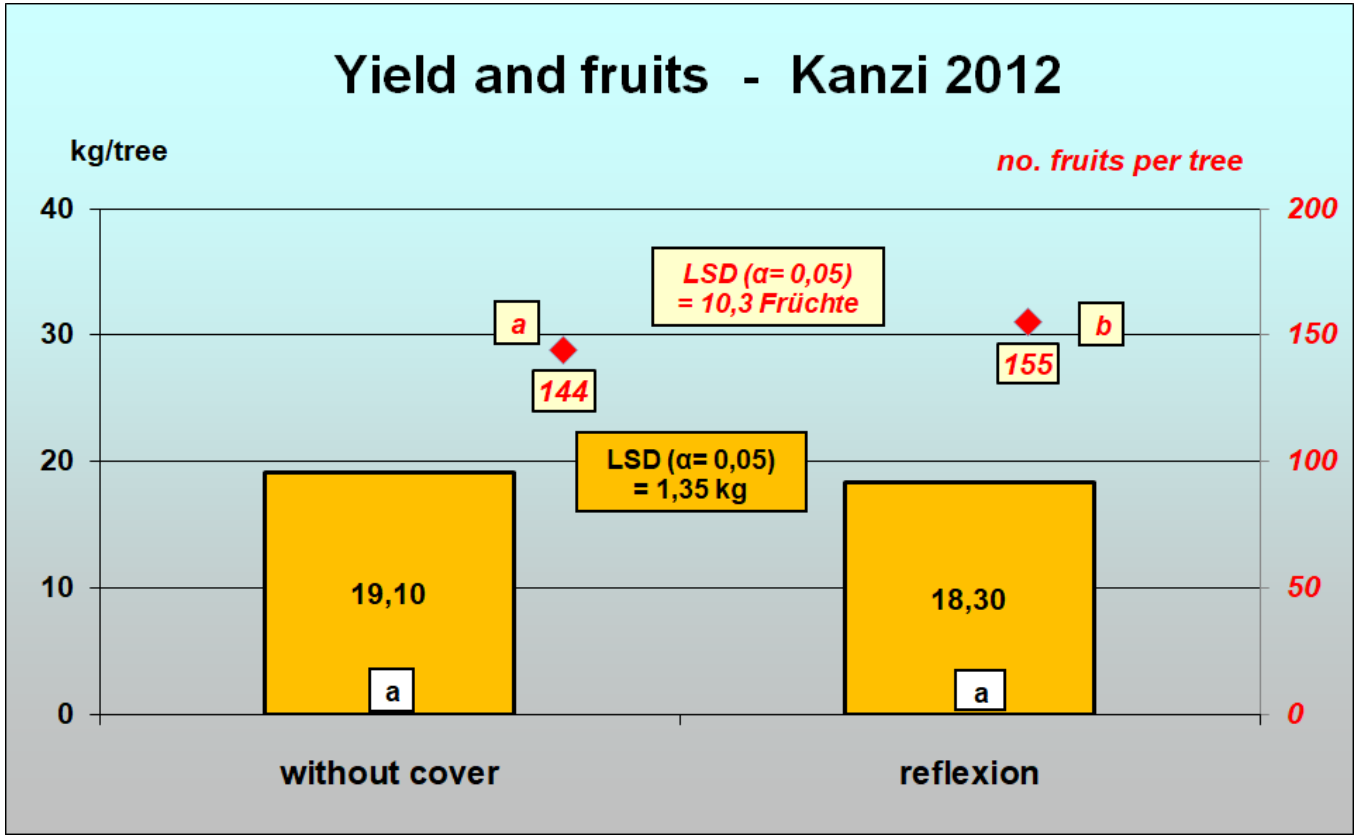
White ground cover – 14d before harvest

White ground cover – harvest time



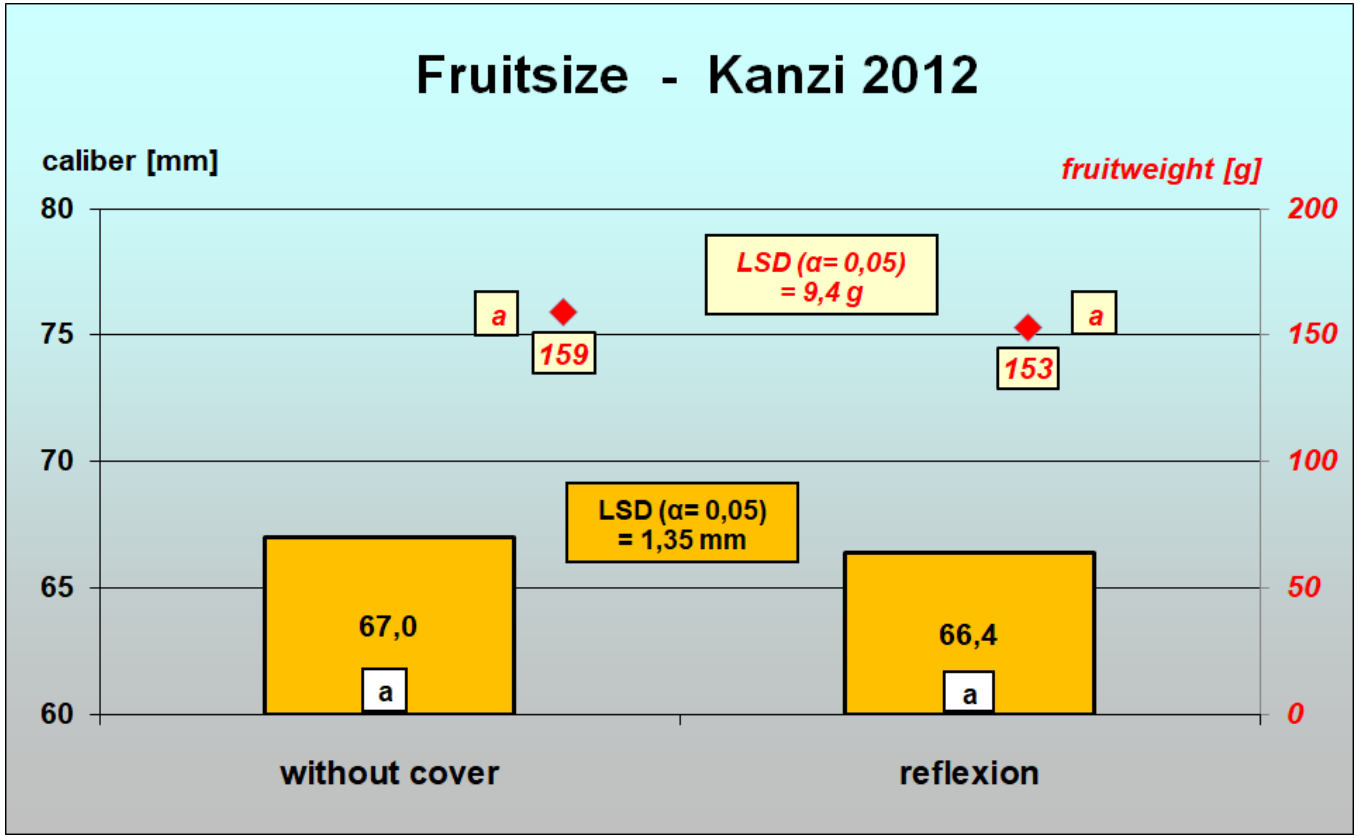
After take-out - lanes

Results Kanzi ground cover 2012



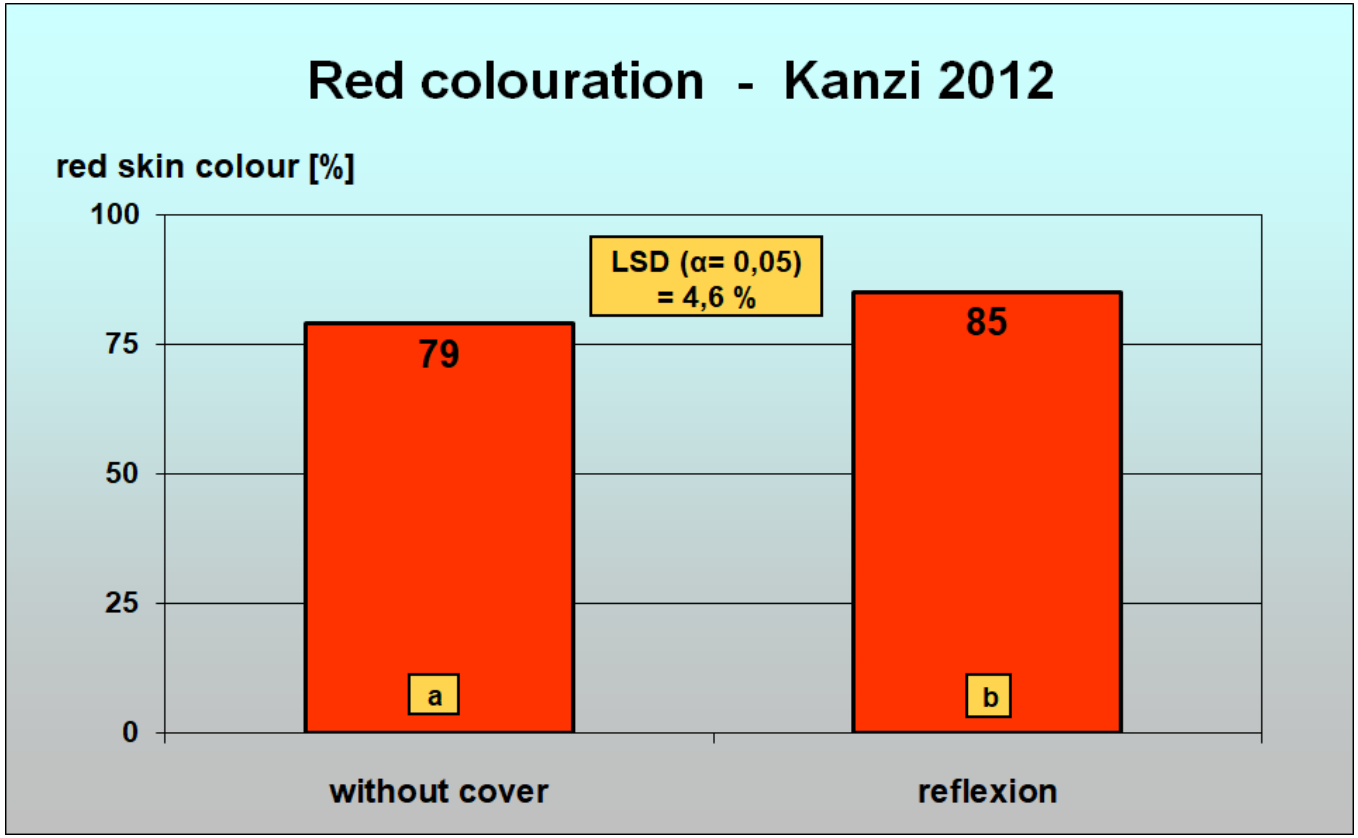
- No statistical difference in yield per tree
- Unfortunately different number fruits per tree.

Results Kanzi ground cover 2012



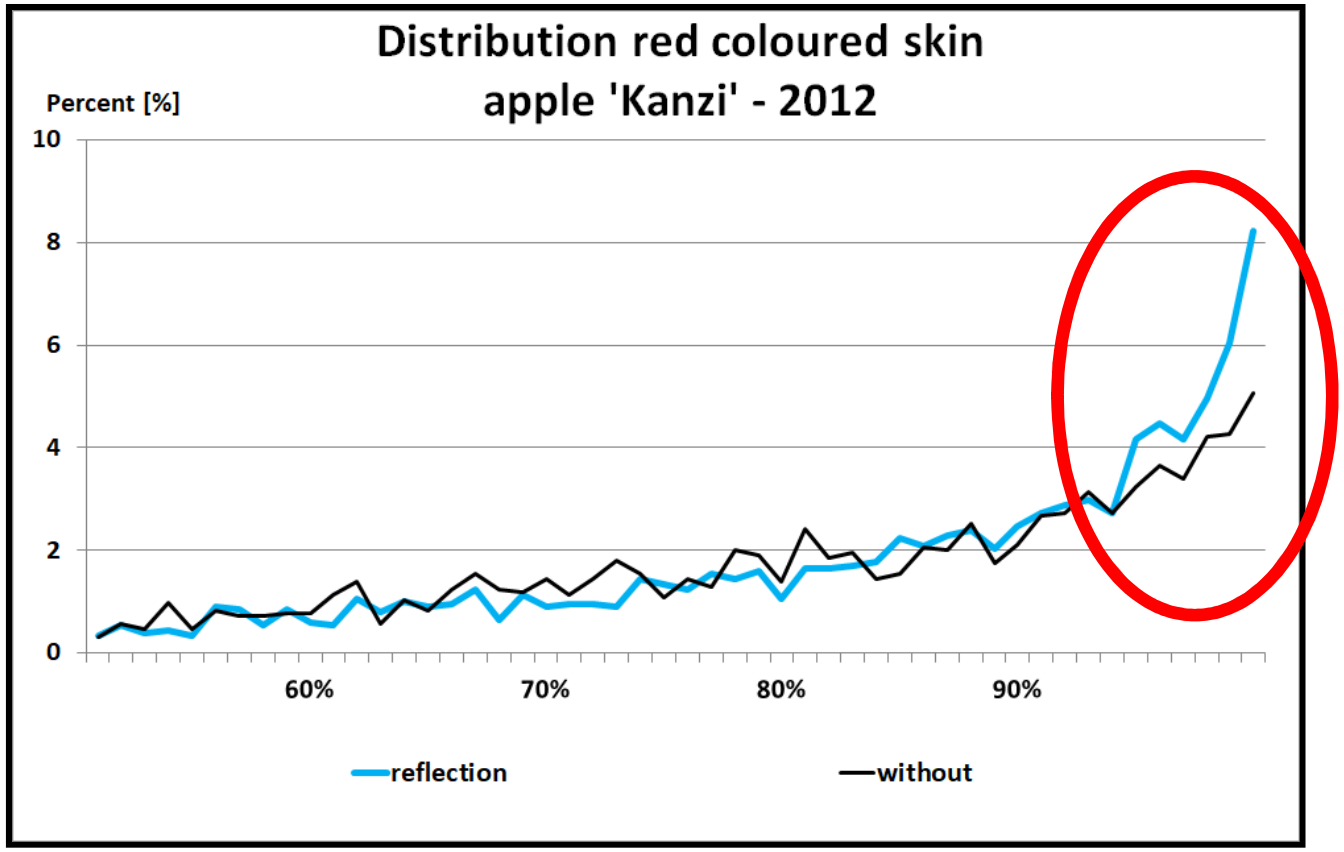
- Slightly smaller fruits with reflexion cover
- No statistical differences

Results Kanzi ground cover 2012



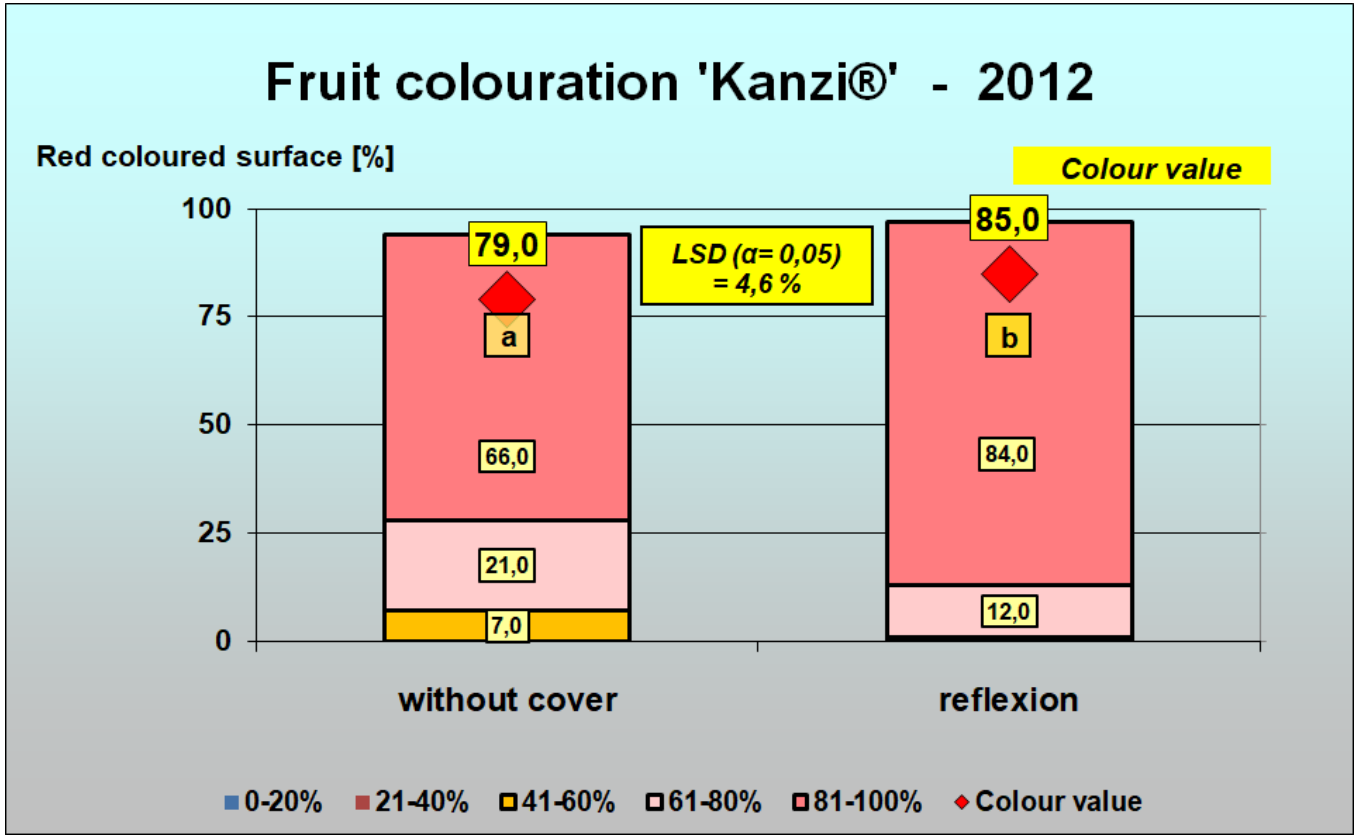
- Better skin colour with reflexion textile
- Statisticaly proofed

Colouration 2012



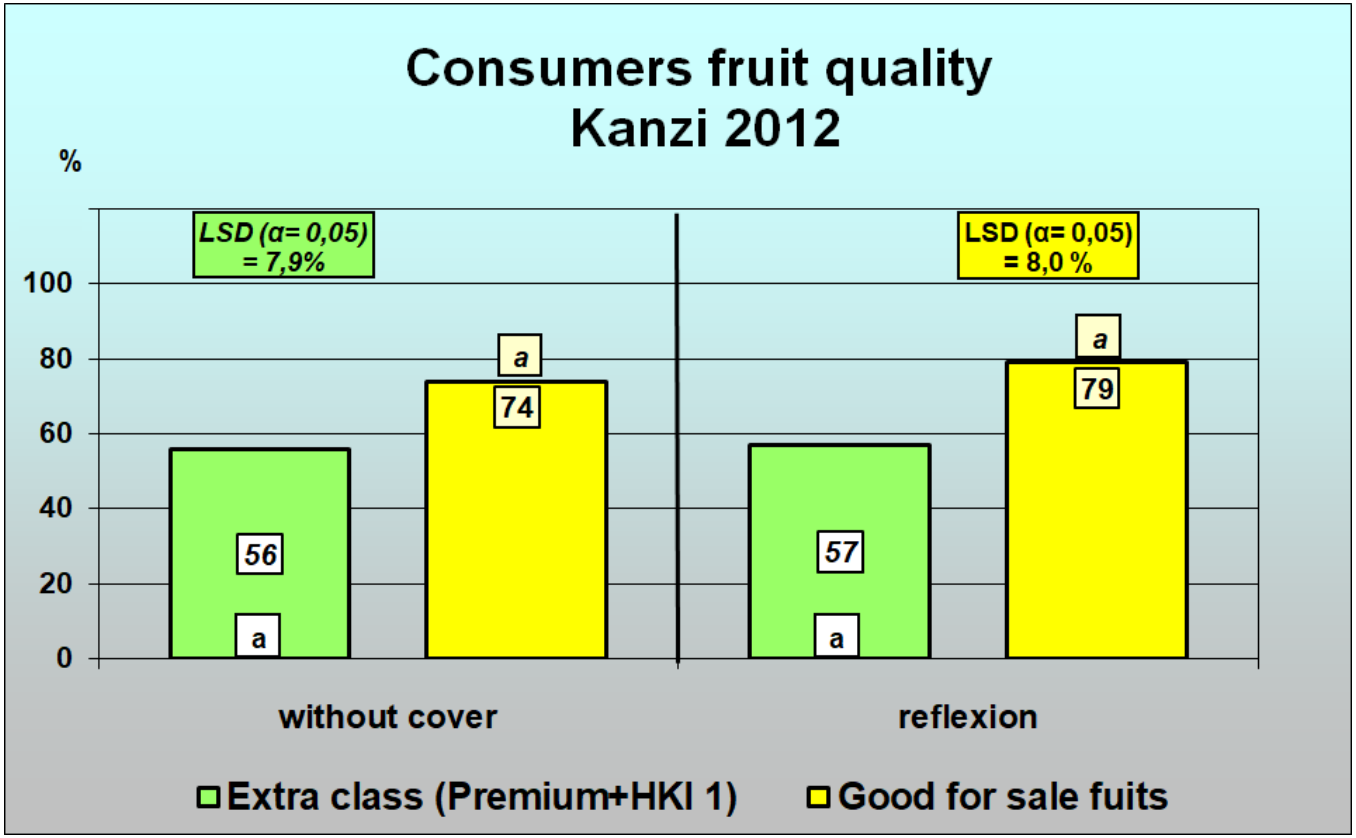
- **Number of intensivly red coloured fruits increased**

Results Kanzi ground cover 2012



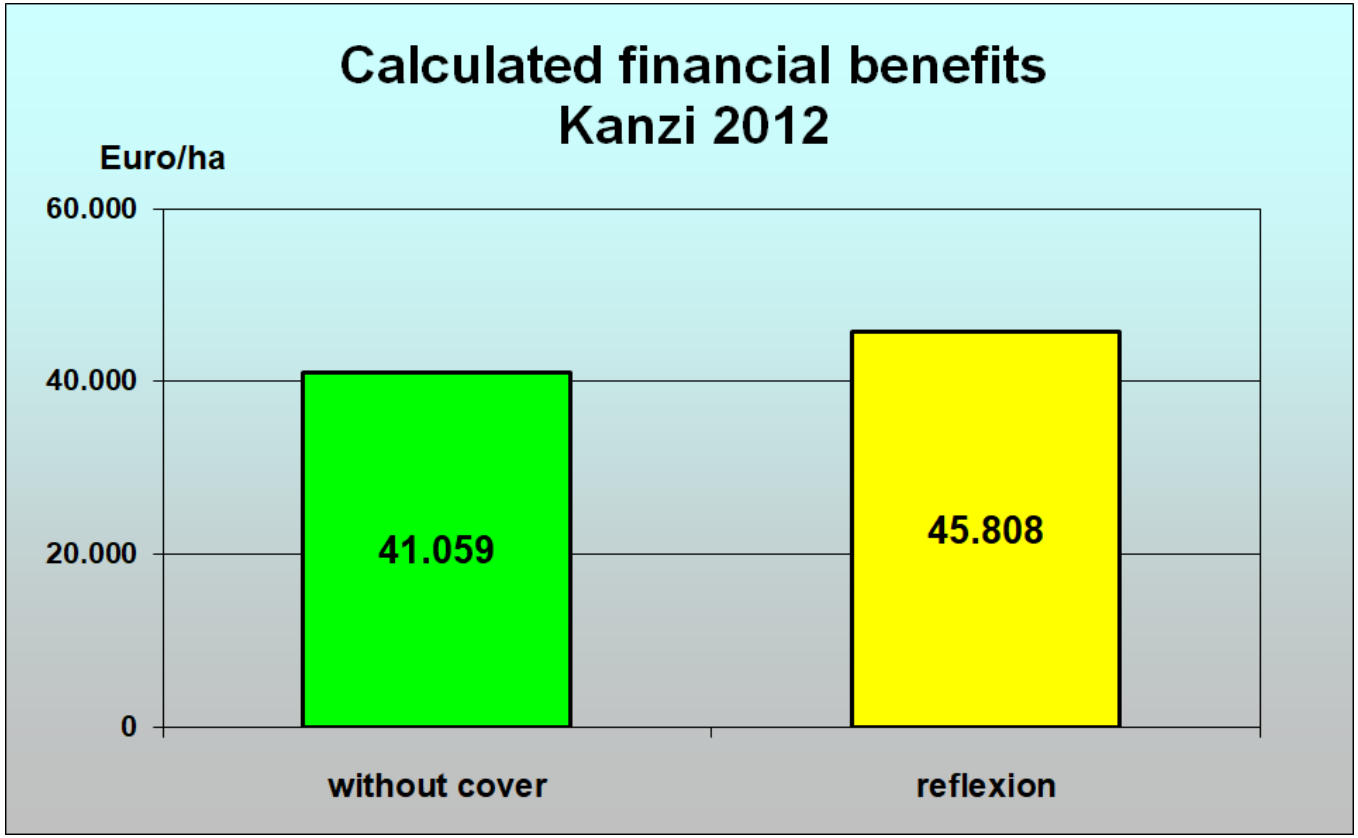
- **Ratio of intensivly coloured fruits was much better with ground cover**

Results Kanzi ground cover 2012



- Slight difference in ‚good for sale fruits‘
- No statistical differences

Results Kanzi ground cover 2012



- **Clear financial advantage with reflexion ground cover**

Kanzi ground cover 2012

- **Effects:**

  - no higher yield

  - better red colouration

  - increased no. of very good coloured fruits

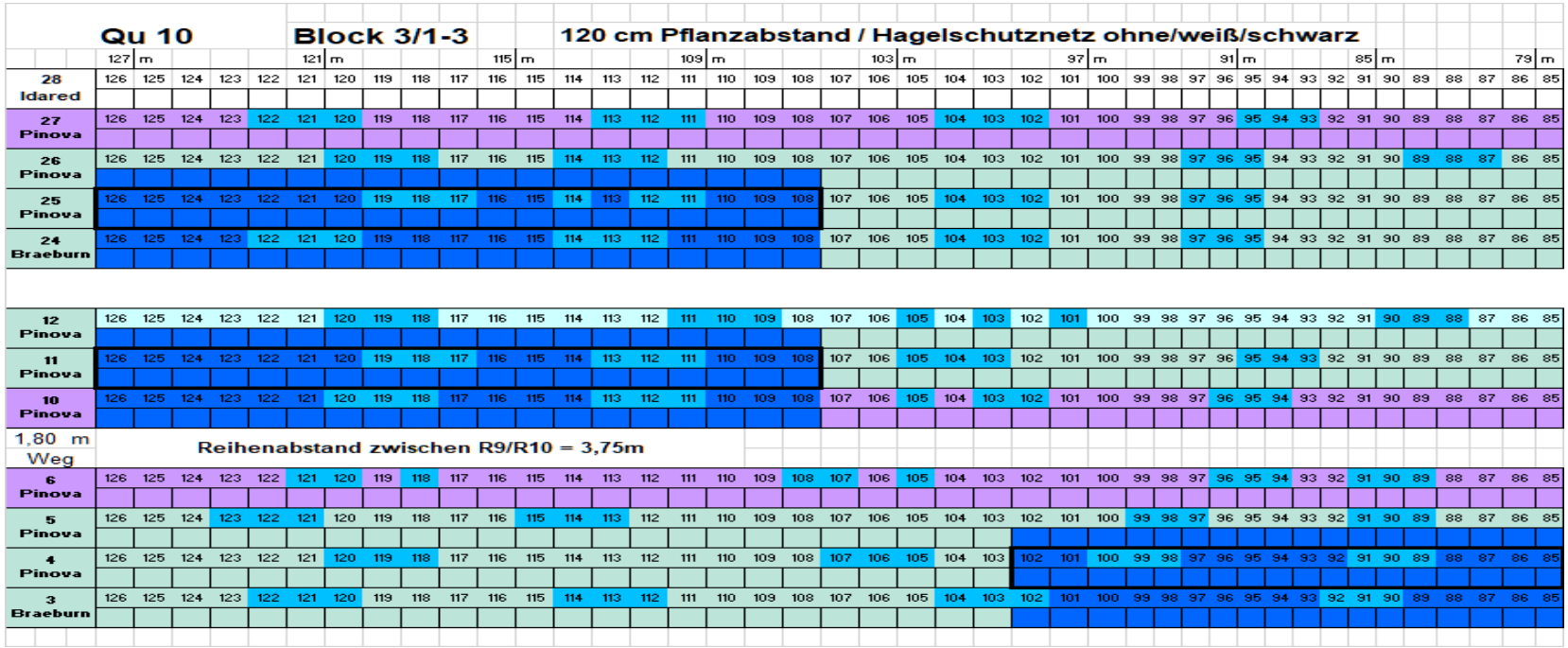
  - slightly higher ratio of ‚good for sale' fruits

  - no higher ratio of Extra + HKI 1 fruits

- **=> Clearly higher calculated financial benefits**

Light reflection trial 2012

Trial B with ‚no-name' reflecting textile



- Apple ‚Pinova' standard – colour sensitive variety
- Mechanical vs. Winter pruning; partly hailnet

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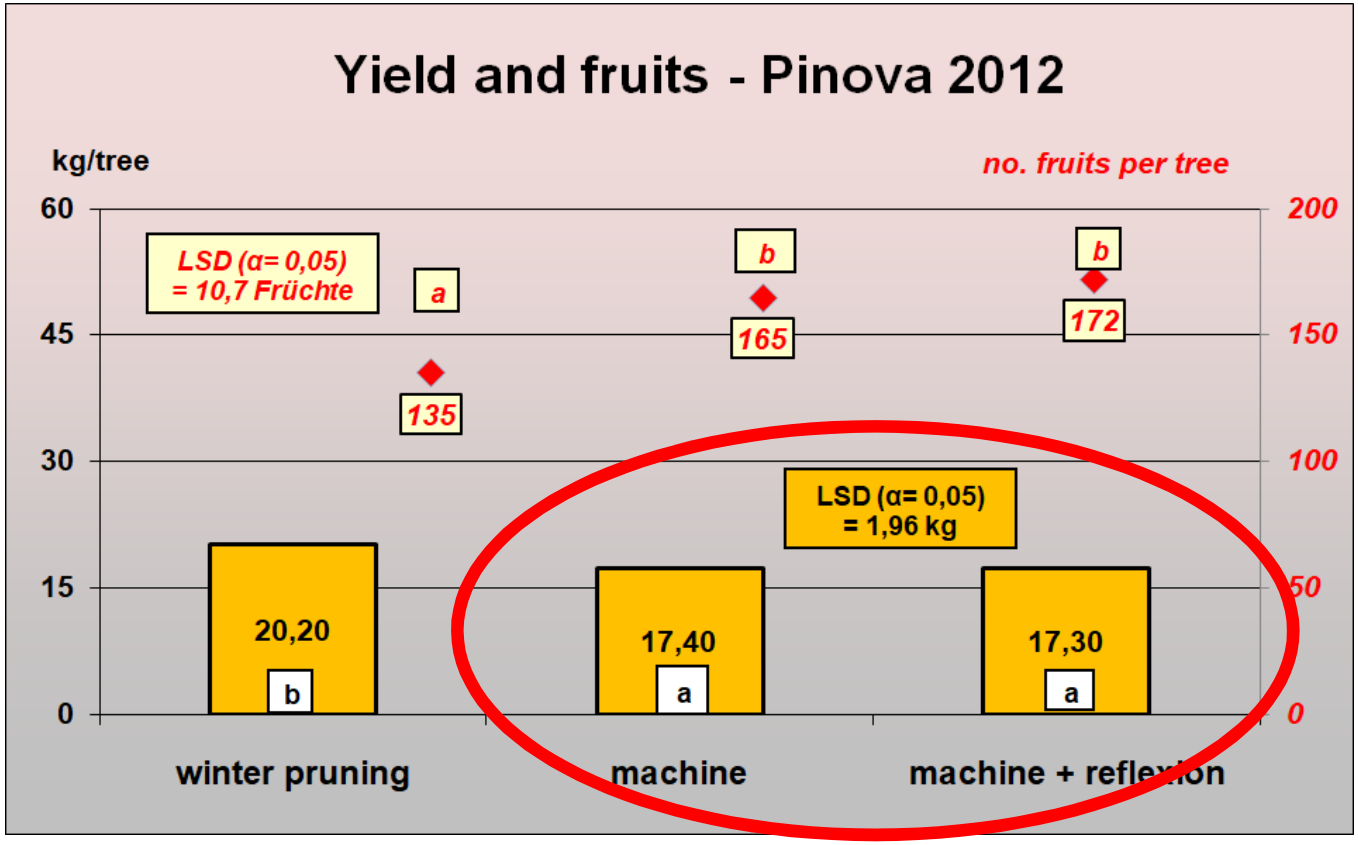
White ground cover – 14d before harvest

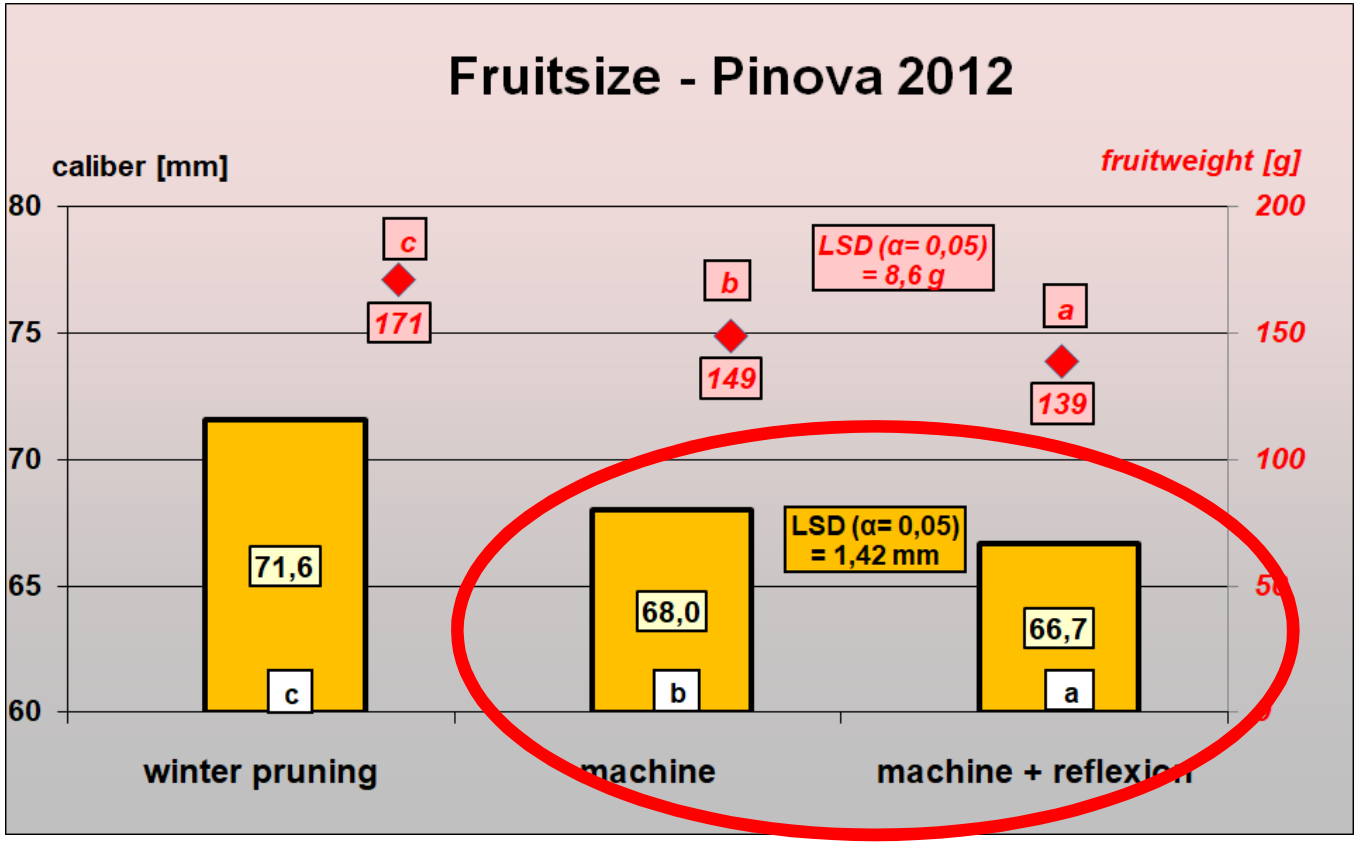
White ground cover – harvest time

Pinova ground cover 2012



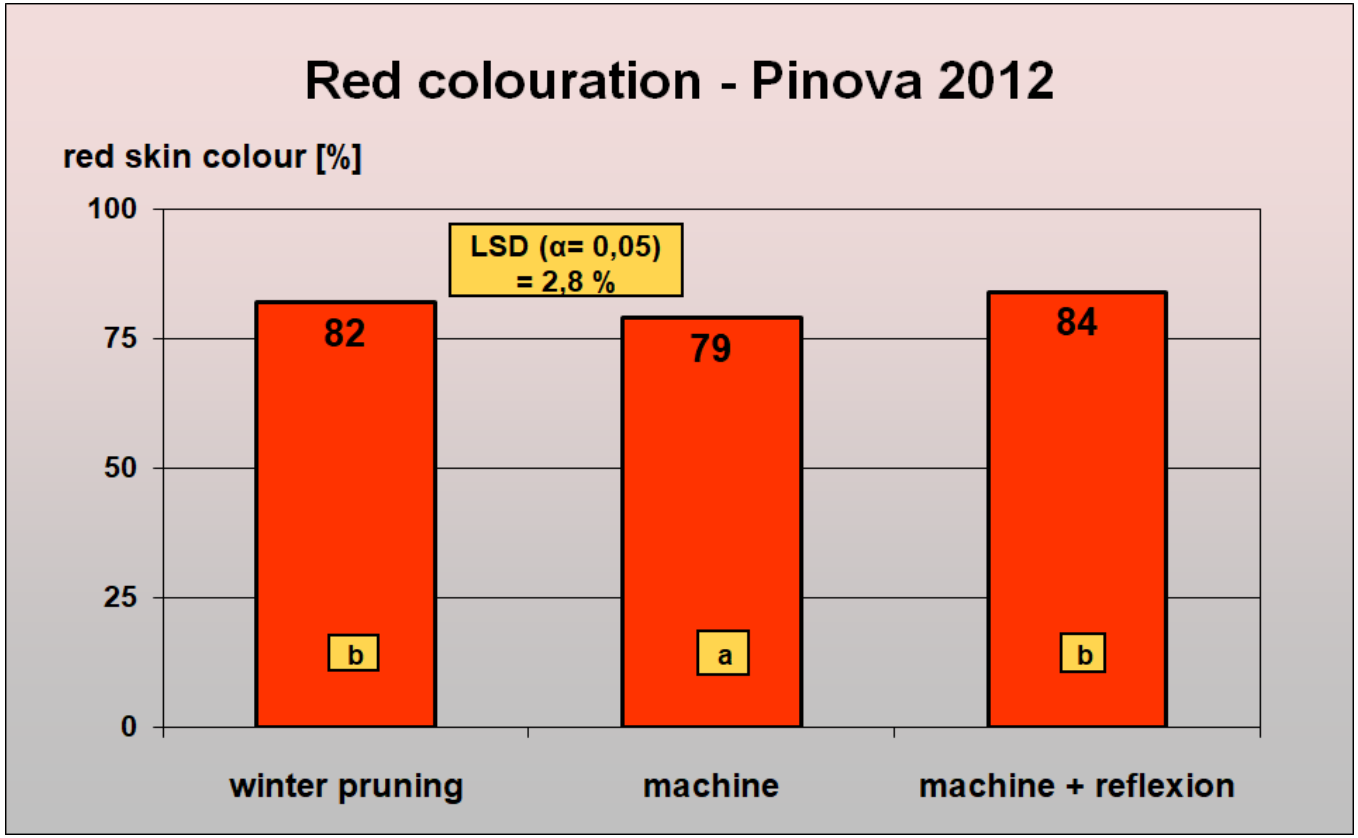
- **MACHINE: No big difference in yield per tree**
- **Unfortunately hight number fruits per tree.**

Pinova ground cover 2012



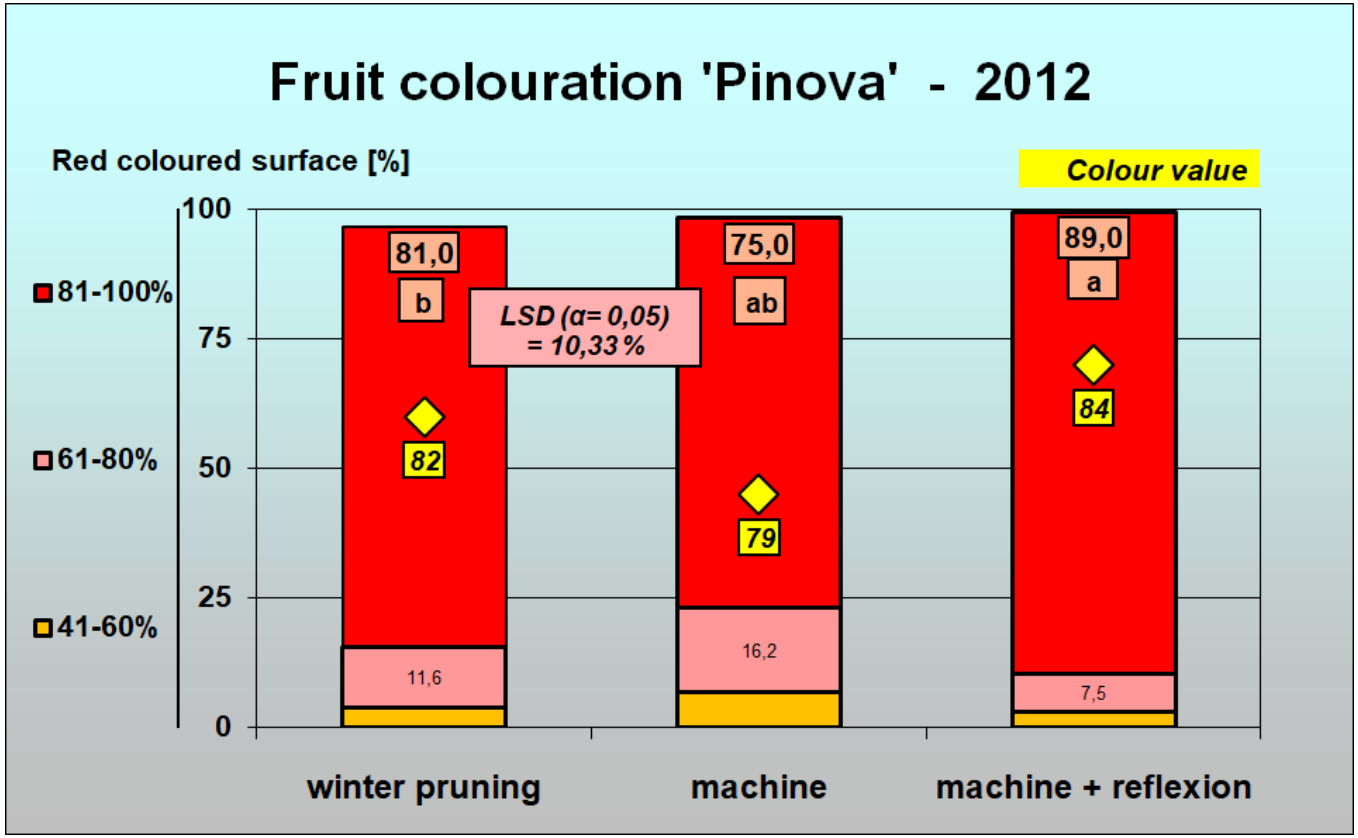
- Visible smaller fruits with reflexion cover
- Clear statistical differences

Pinova ground cover 2012



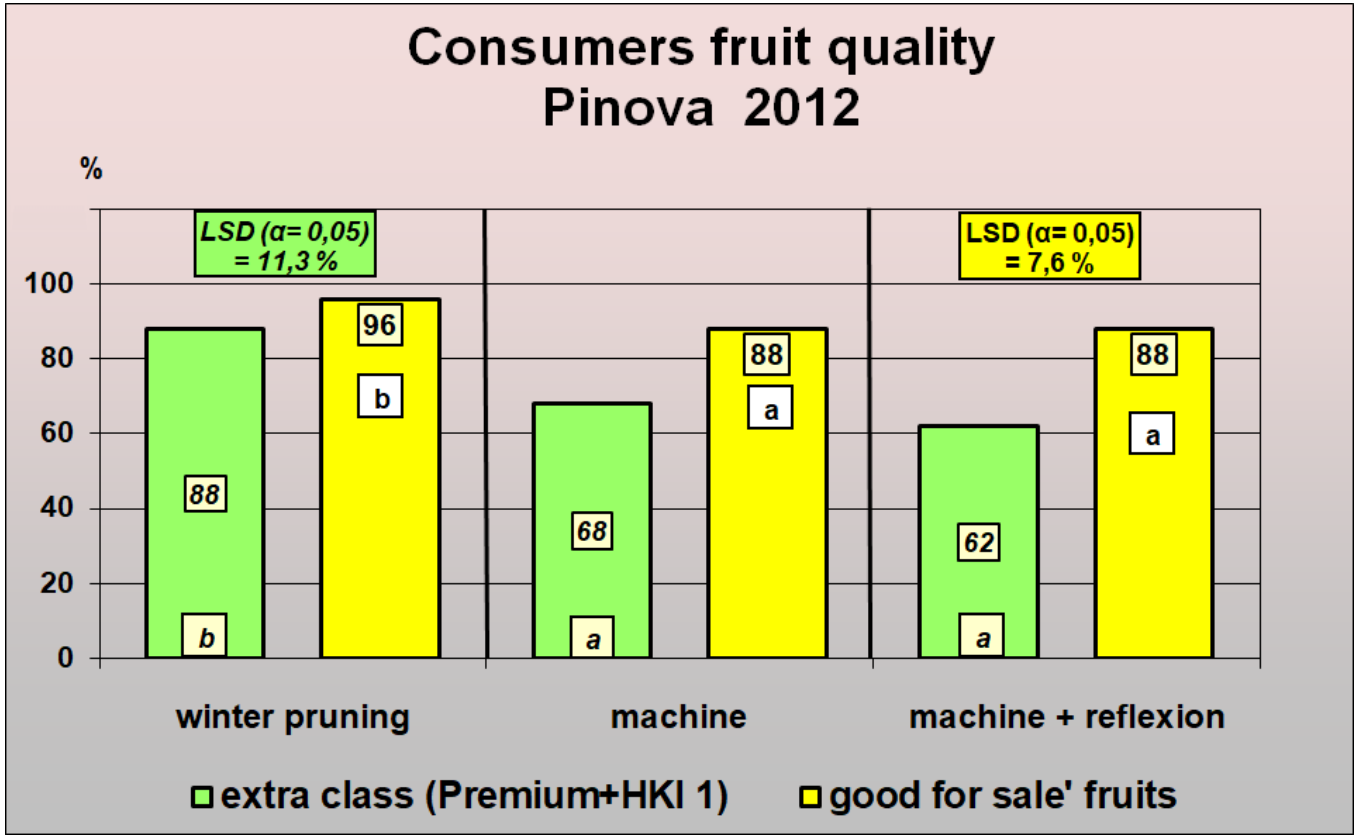
- Better skin colour with reflexion textile
- Statisticaly proofed

Pinova ground cover 2012



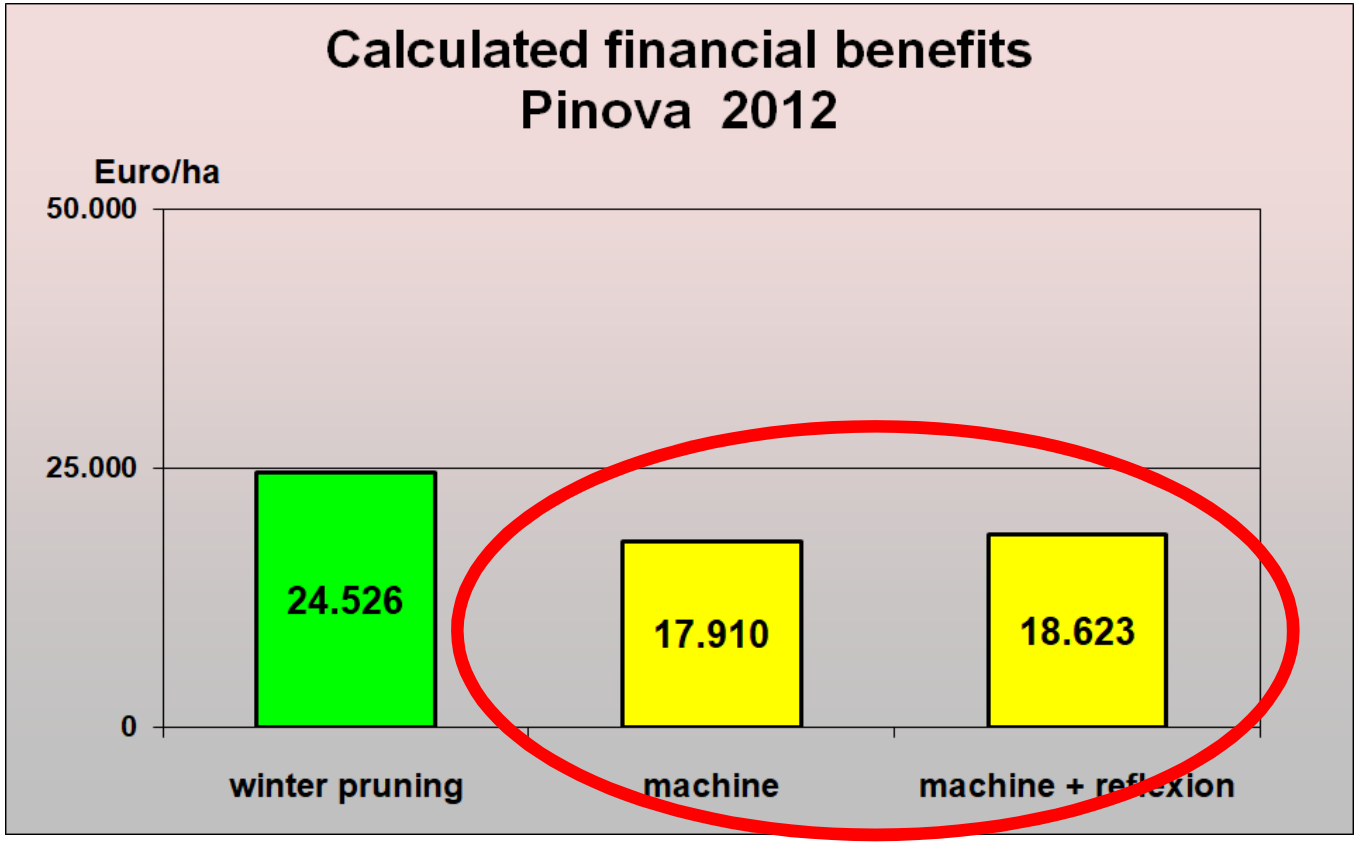
- **Ratio of intensivly coloured fruits was much better with ground cover**

Pinova ground cover 2012



- **Slight disadvantage in ‚extra class' fruits [smaller fruits]**
- **No statistical differences**

Pinova ground cover 2012



- **Slight financial advantage with reflexion ground cover**

  [Because of smaller fruitsize?]

Pinova ground cover 2012

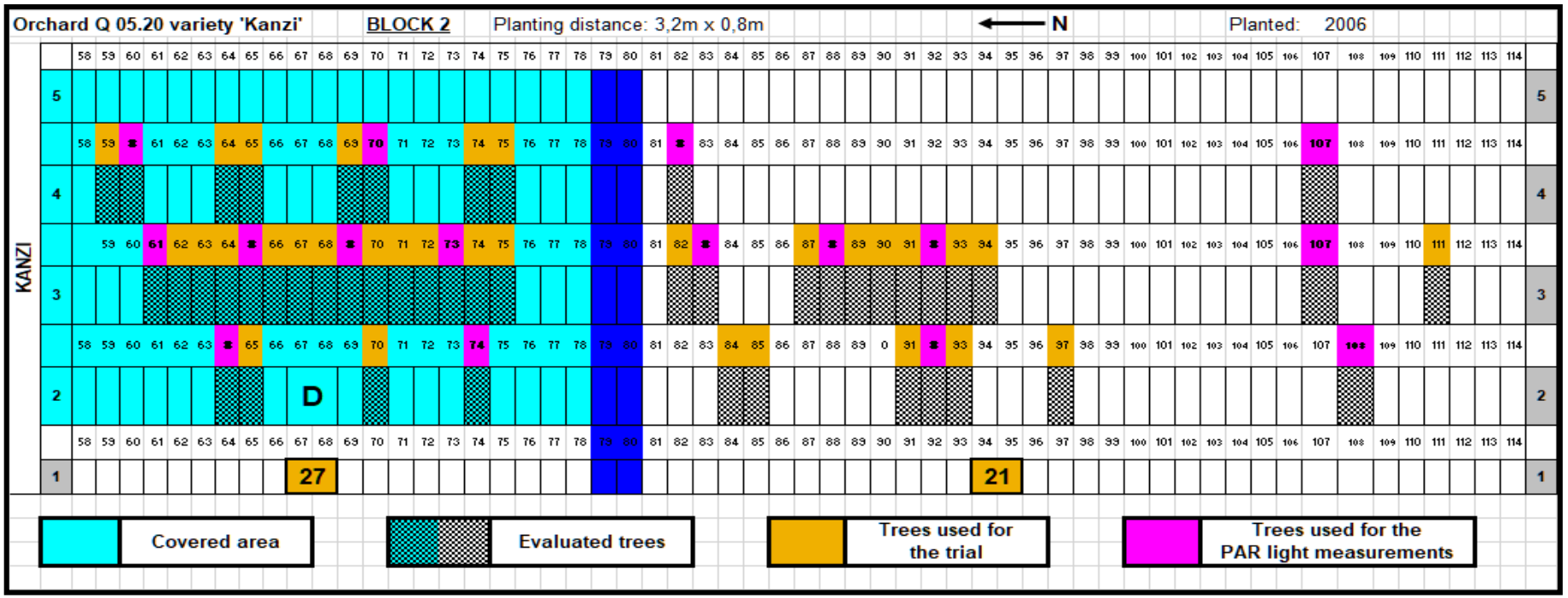
➢ **Effects:**

- no higher yield
- better red colouration
- increased no. of very good coloured fruits
- no higher ratio of Extra + HKI 1 fruits

=> Slightly higher calculated financial benefits

Light reflection trial 2013

Trial with LUMILYS® – Variety Kanzi



- Apple Kanzi – under crystal hailnet, 3,40 m hight
- Ground cover, PAR-measurements

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Lumilys® ground cover – 14d before harvest

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Lumilys® ground cover – harvest time

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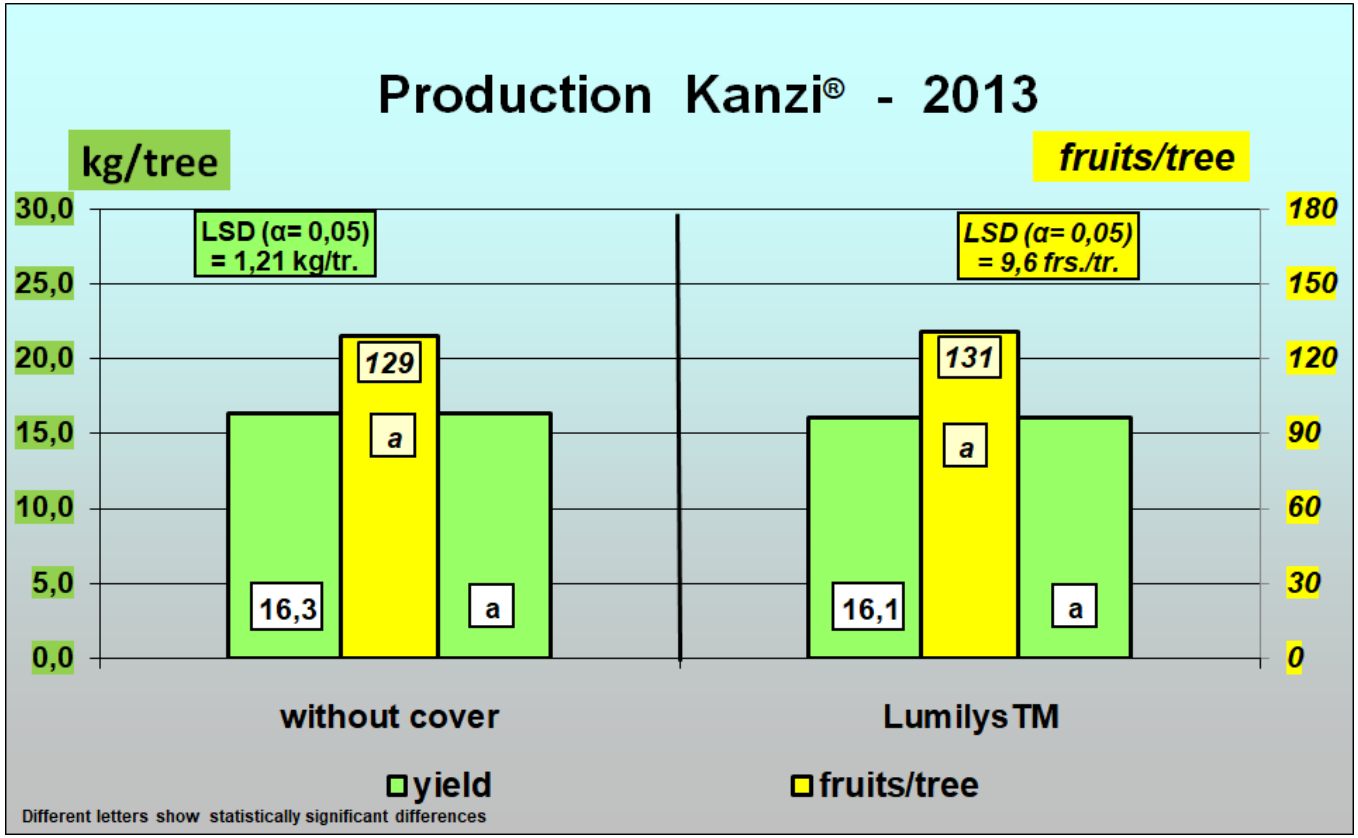
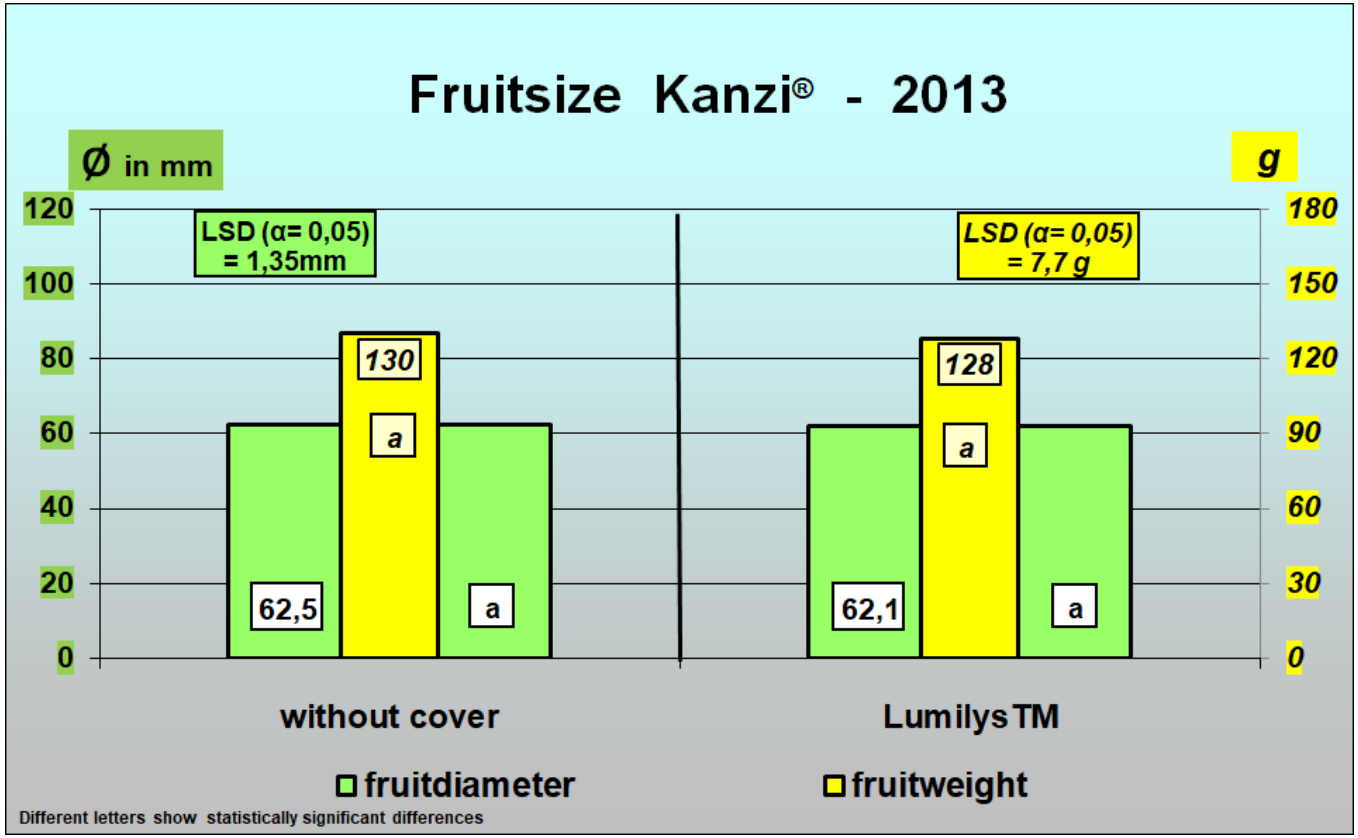
Lumilys® ground cover – Kanzi



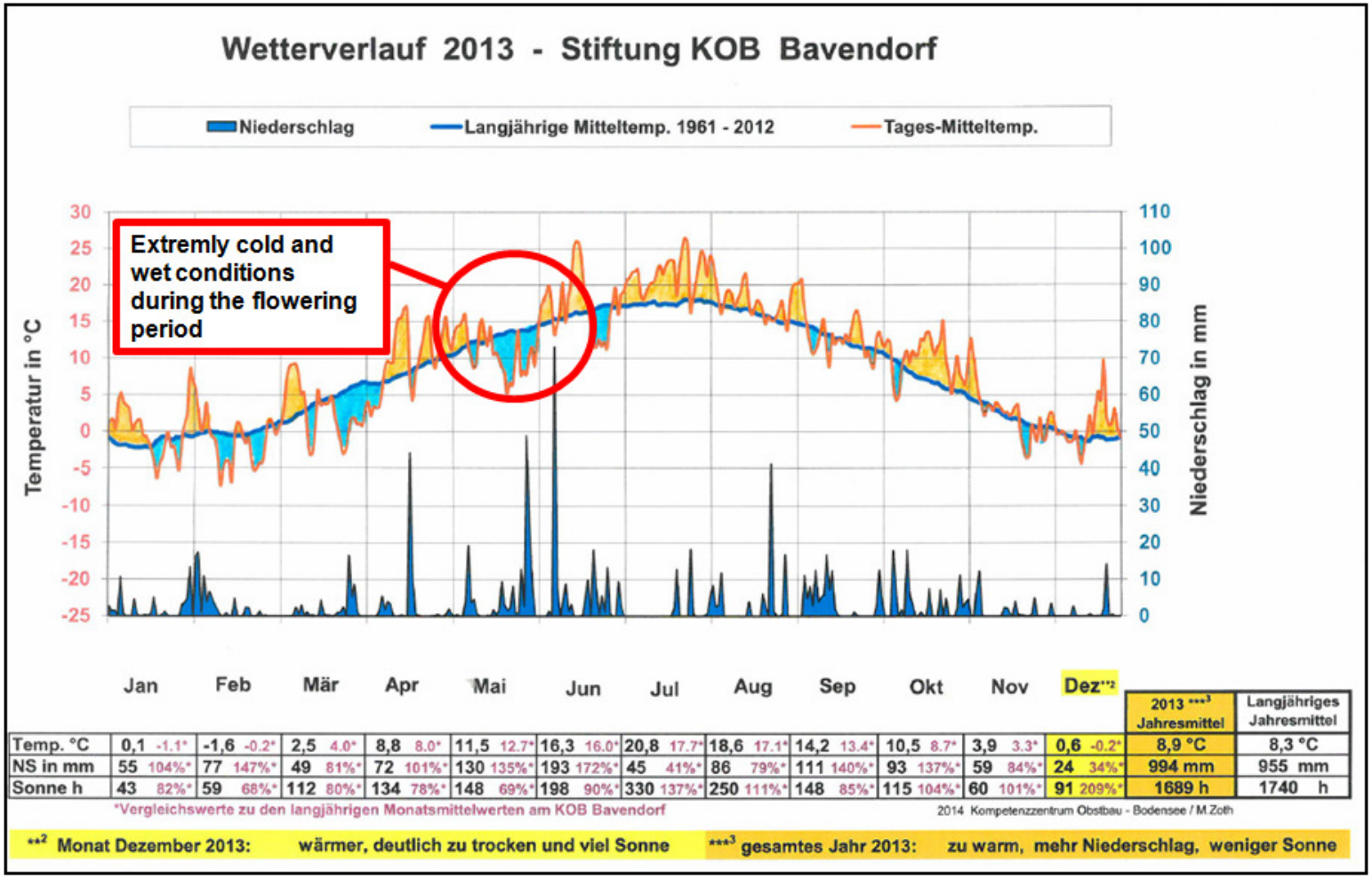
- No difference in yield per tree
- Same amount of fruits per tree

Lumilys® ground cover – Kanzi



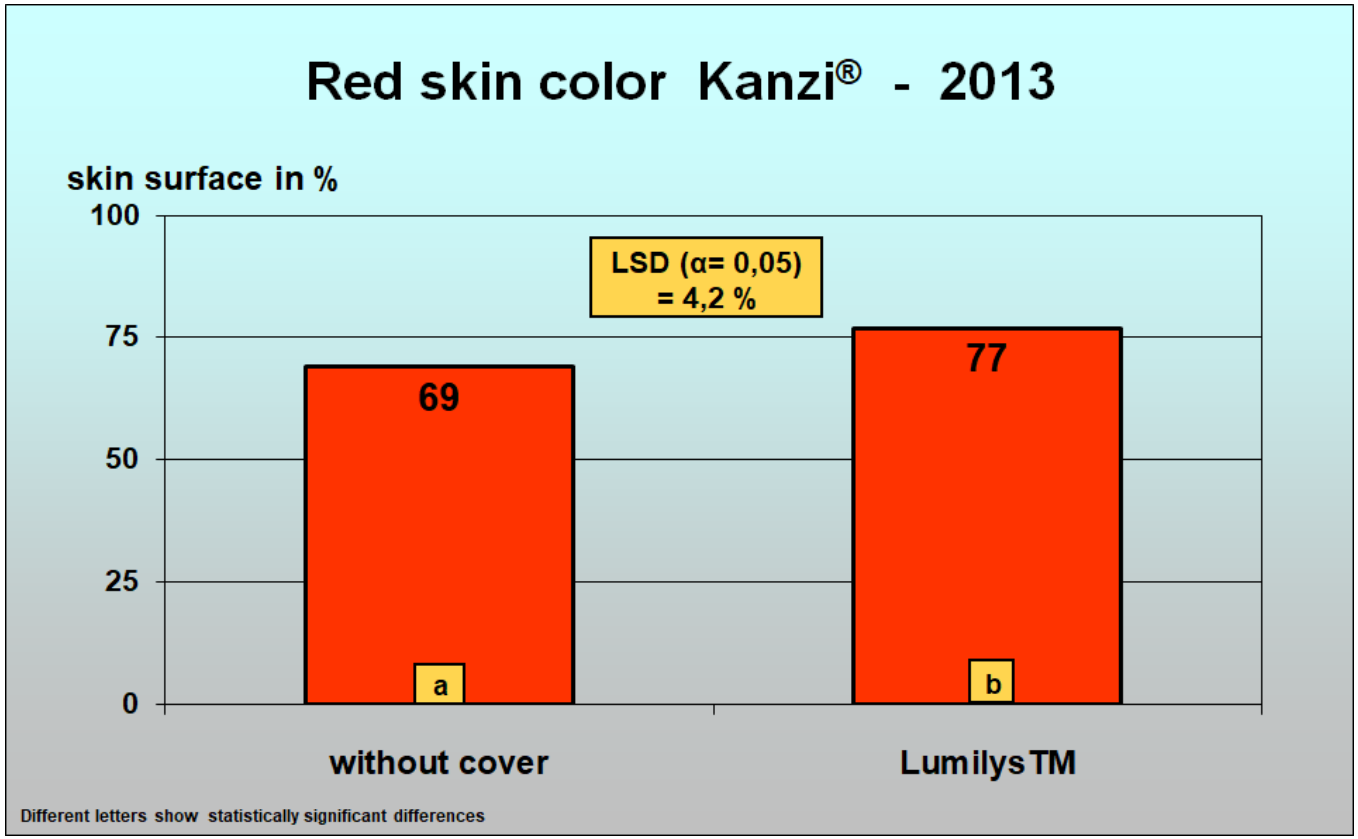
- Almost the same fruitsize
- Unfortunately in general small fruits

Weather conditions 2013



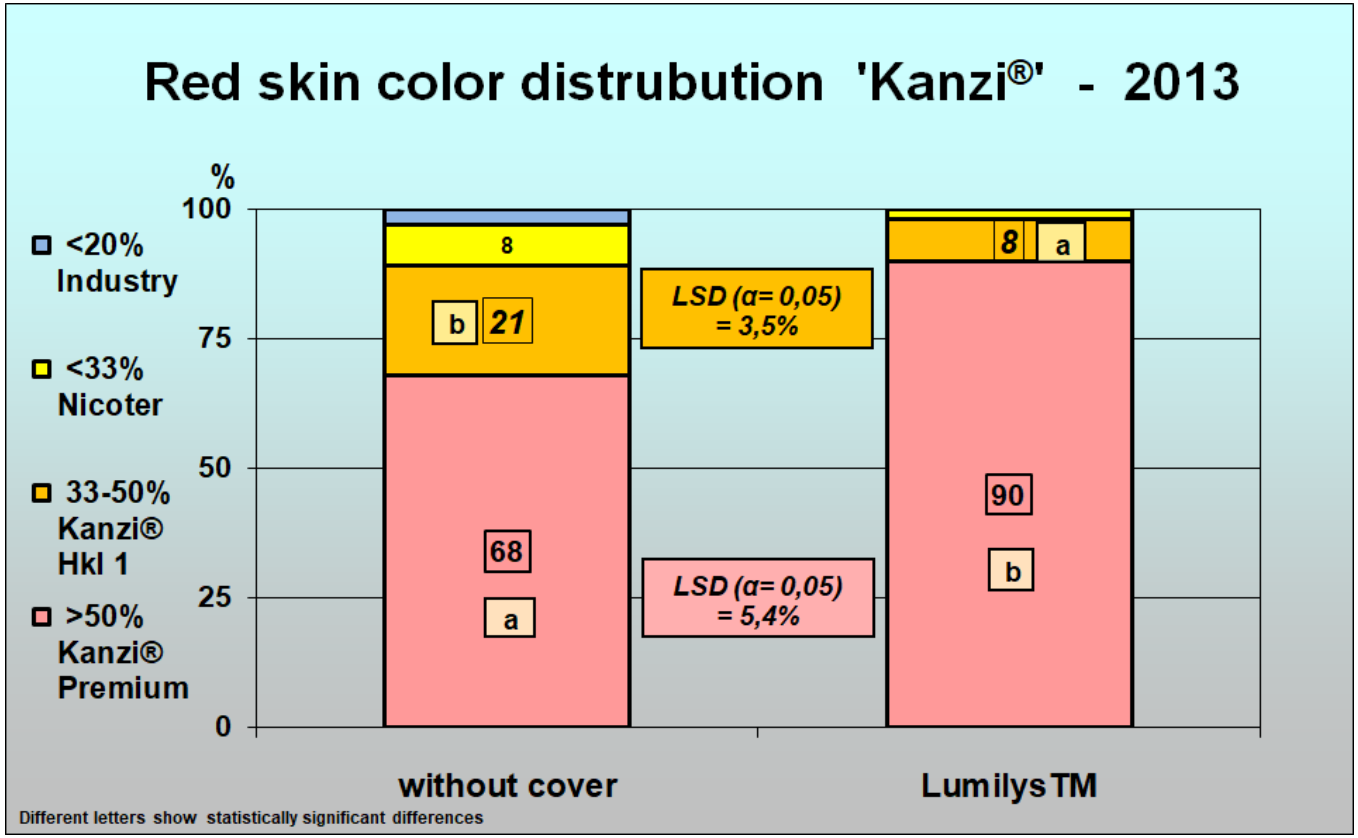
- **Low temperature during cell division period and summer**

Lumilys® ground cover – Kanzi



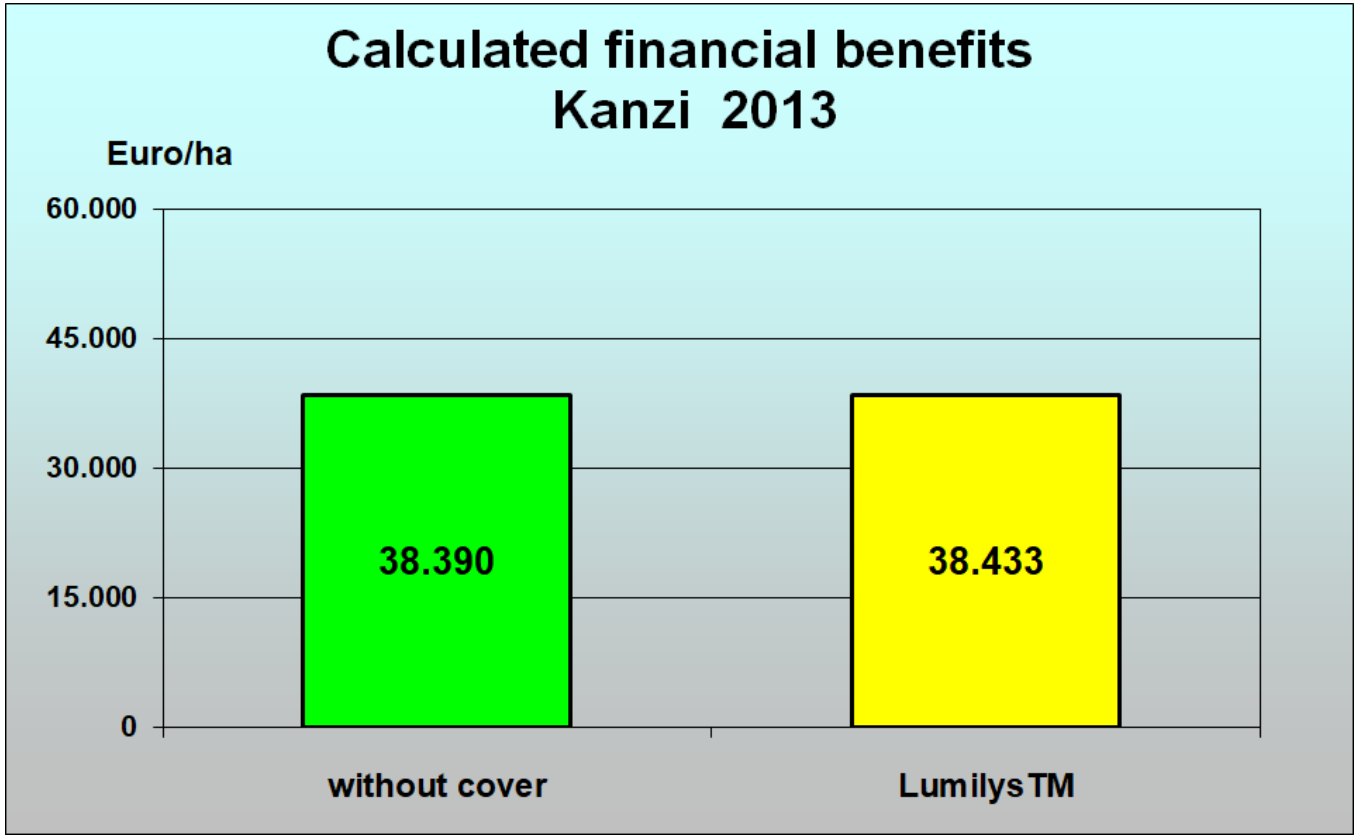
➢ **Clearly better red skin colour**

Lumilys® ground cover – Kanzi



- Much more coloured Premium fruits
- Clearly higher ratio of Kanzi® quality

Lumilys® ground cover – Kanzi



- No financial advantage using the ground cover
- The smaller fruit size 2013 might be the reason

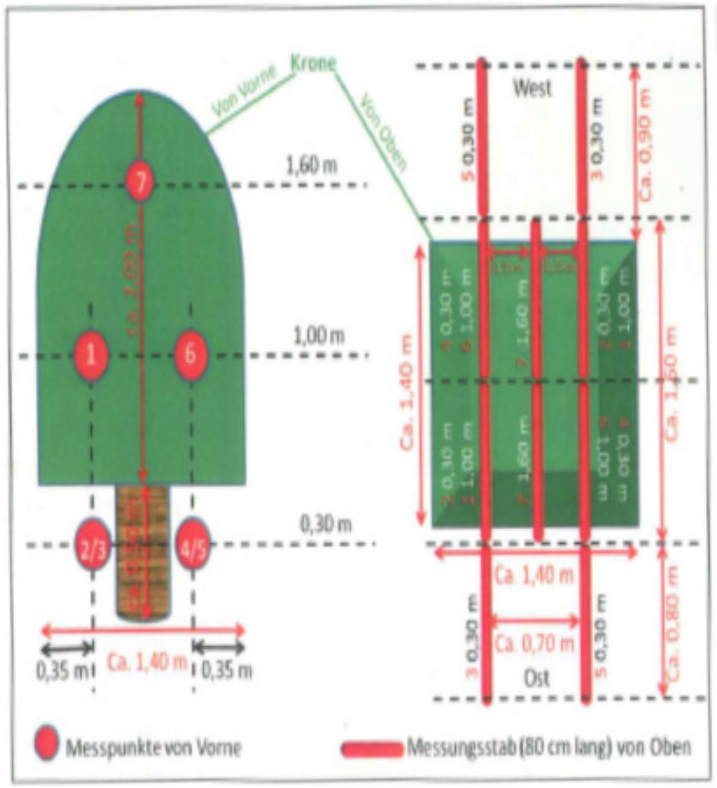
Lumilys® ground cover 2013 - Kanzi

➢ **Effects:**

- no higher yield
- better red colouration
- higher ratio of Extra + HKI 1 fruits

=> But no higher calculated financial benefits

Lumilys® PAR-measurements



- **Using AccuPAR LP-80 ceptometer**
- **Ground measurement at 30 / 90 / 150 / 180 cm height**

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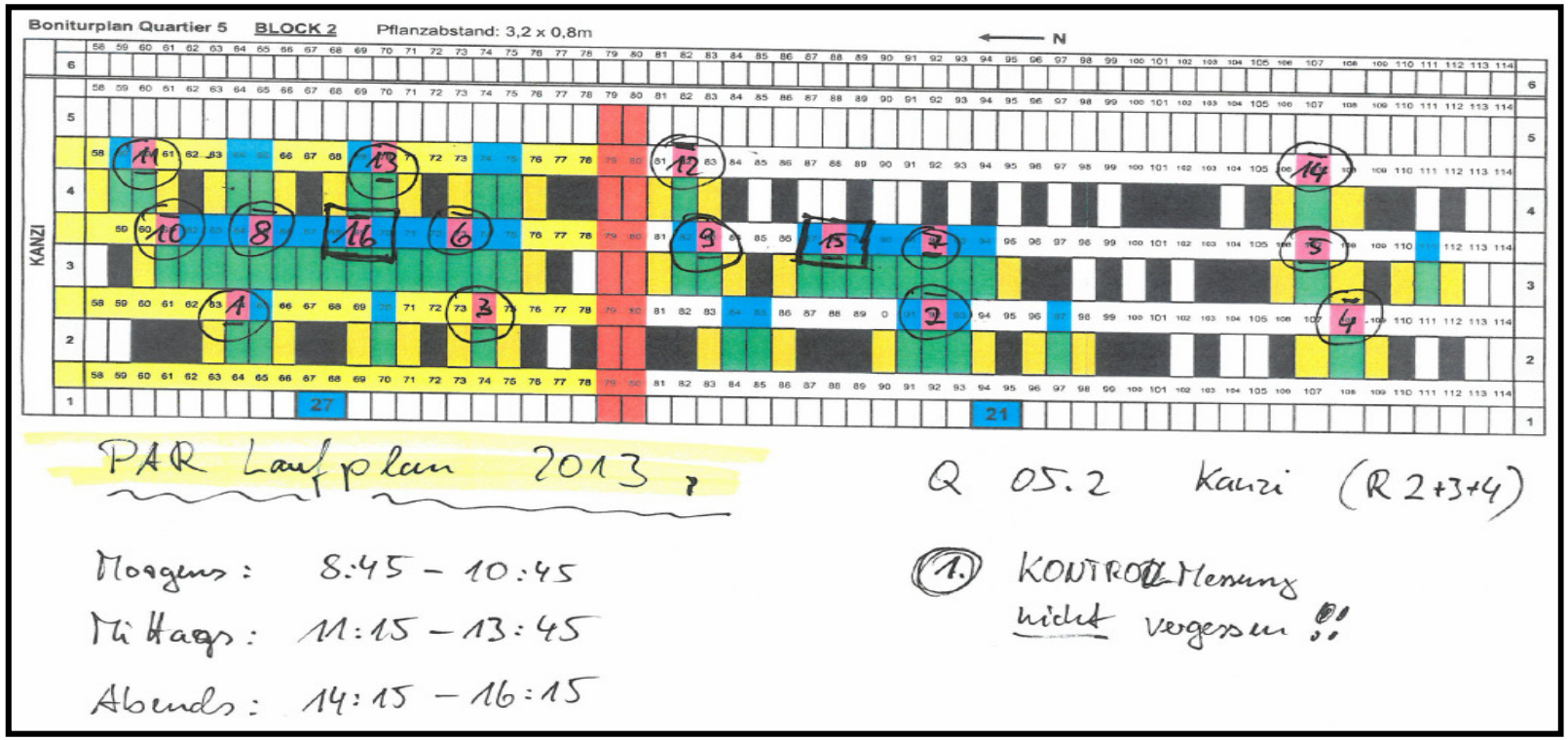
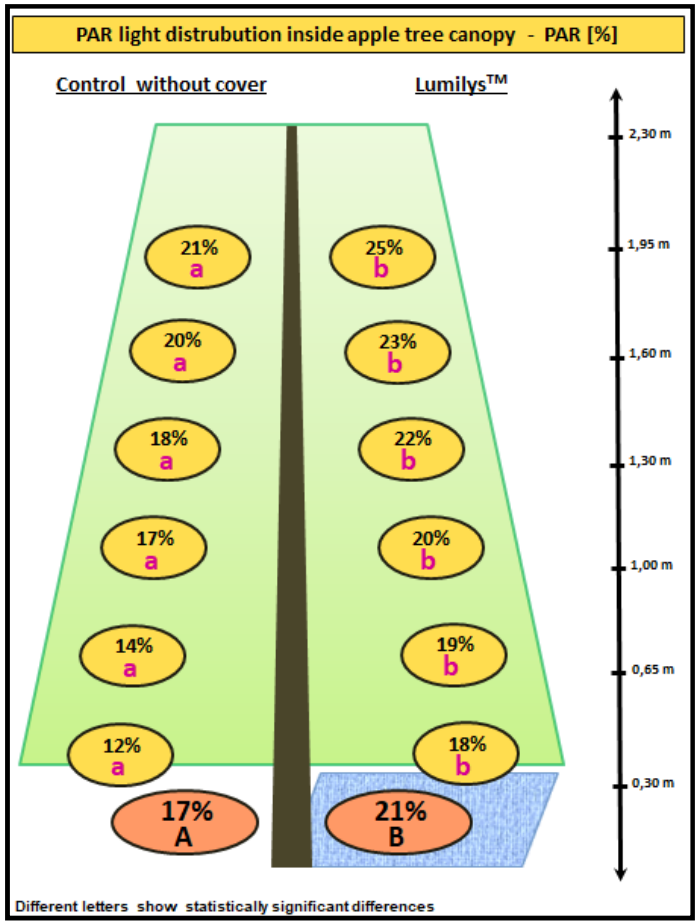
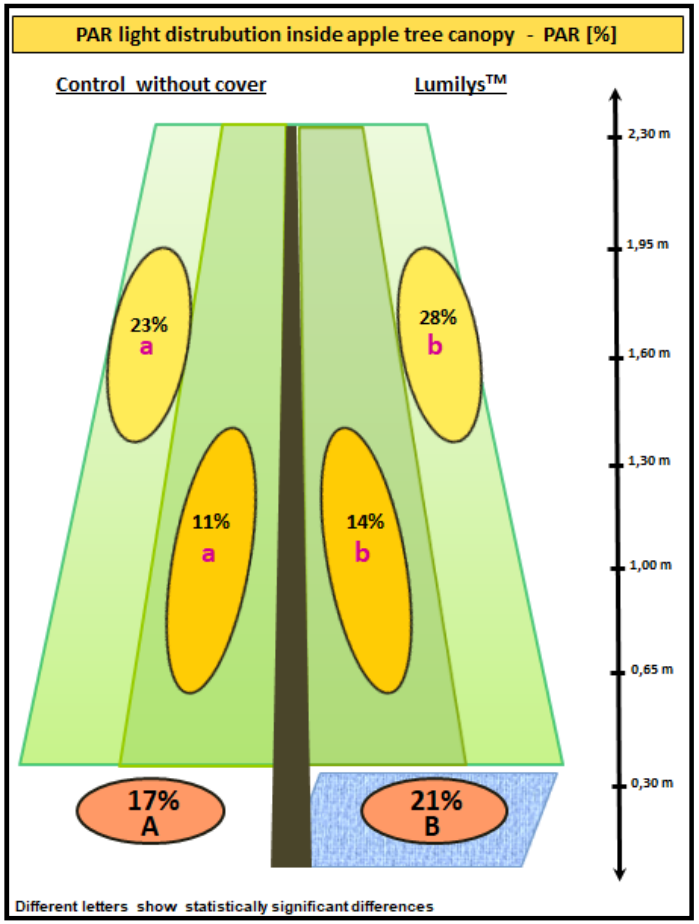
Lumilys® PAR-measurements



- **Each plot one tree, alternating, east+west, north+south**
- **Morning, noon and evening / sunny and cloudy sky**
- **18 measurements/tree, 9 upside + 9 downside**

Lumilys® PAR-measurements





- **Increased PAR availability with Lumilys® textile**
- **Higher in the lower canopy part and outside canopy**

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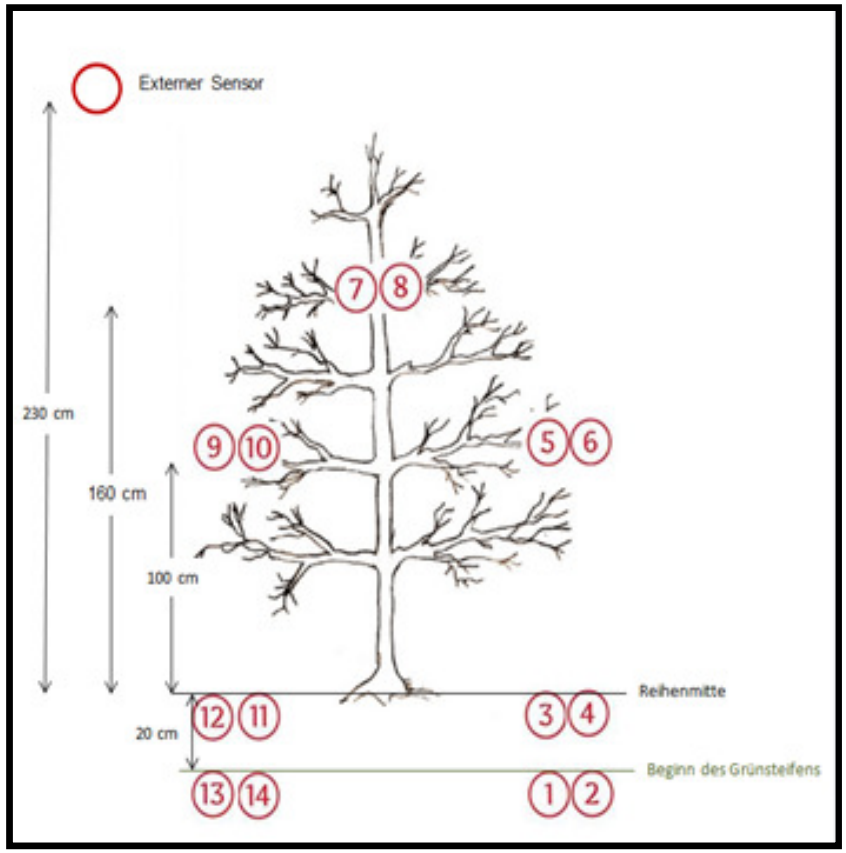
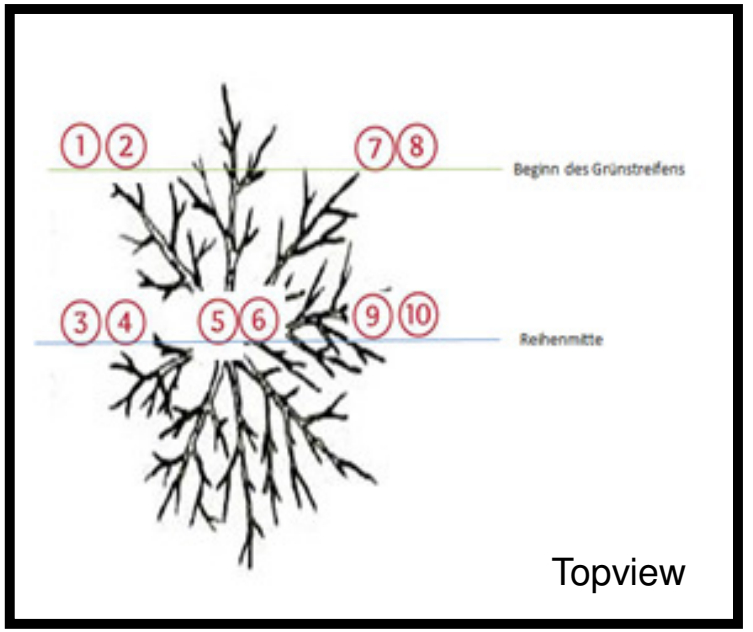
Pinova PAR-measurements - 2015

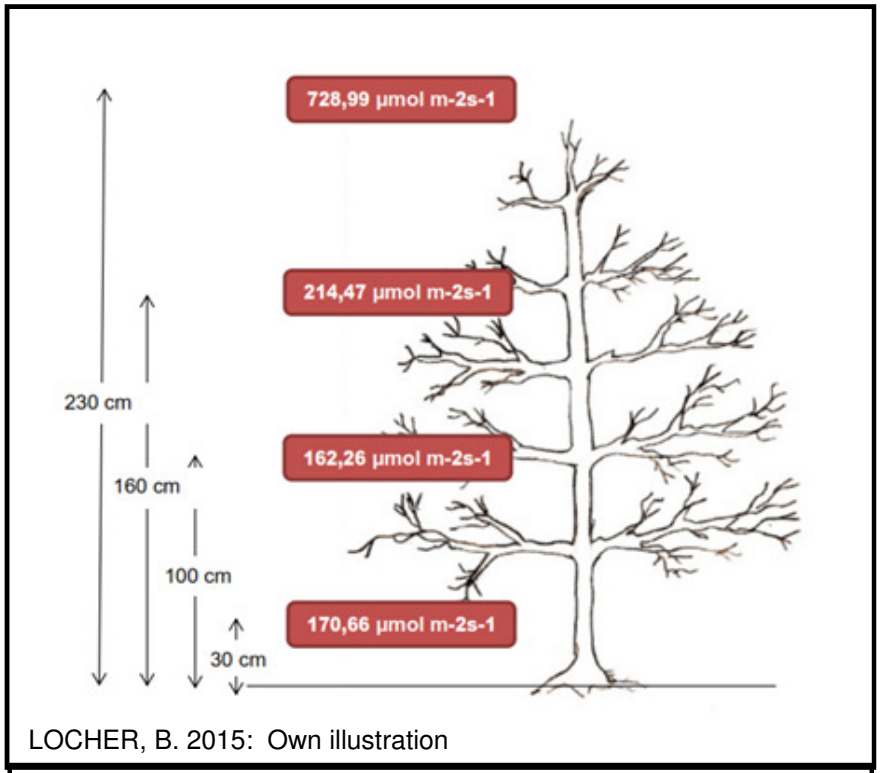




LOCHER, B. 2015: Own illustration

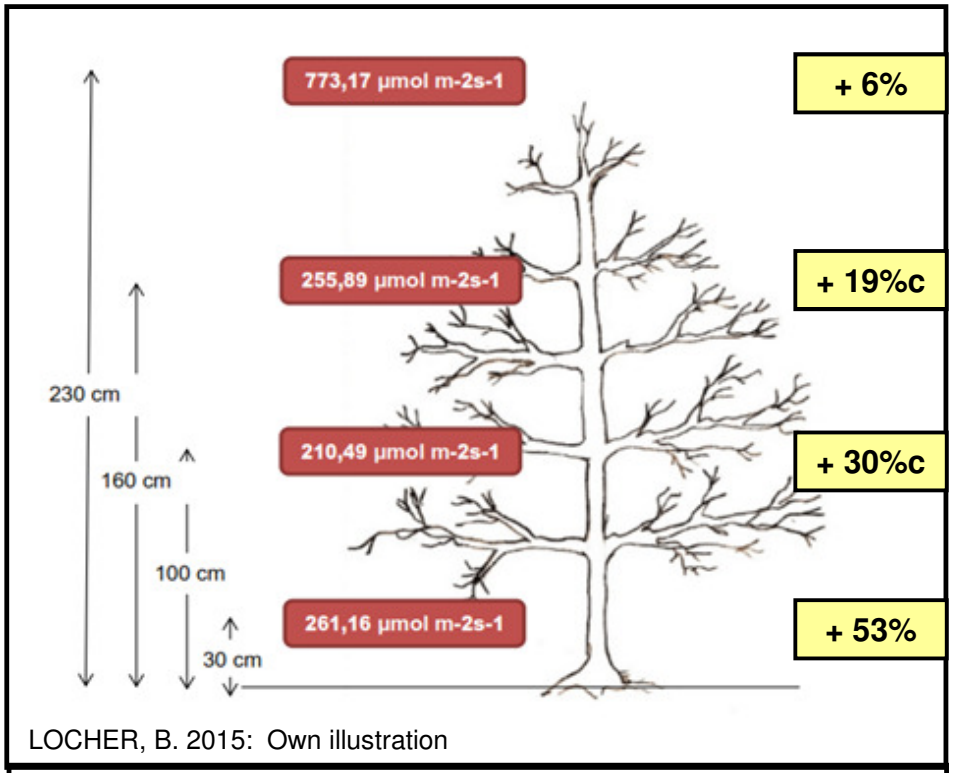
- **14 measurements/tree, all upside**
- **Three heights with 30 / 100 / 160 cm + top sensor (230cm)**

Pinova PAR results - 2015



LOCHER, B. 2015: Own illustration

Without reflective ground cover



LOCHER, B. 2015: Own illustration

With reflective ground cover

- **Increased PAR availability vertical over the canopy**
- **Clear PAR increase in the lower canopy part with cover**

Conclusion: reflective ground cover

- Reflective textile increases light availability
- The PAR distribution inside canopy is better
- Significant more colouration of the fruits
- Significant more fruits in better colour category
- But better financial benefit is insecure

Colour is often not payed that good
Depending on fruit size development and cropload

Conclusion: reflective ground cover

Under south german conditions:

- **Colour sensitive cultivars – Kanzi, Fuji, Elstar …**
- **Best price varieties – Kanzi, SweeTango, ..**
- **Not necessary in all years**
- **Decision to use the reflective cover is not easy**

Other methods might be sophisticated

DEFOLIATION

Defoliation devices

ERO-Defoliationtype, ERO GmbH, Simmern

OLMI-Defoliation unit, KOL-Technik, St. Peter a.O. Austria

- **Defoliation 2-3 weeks before harvest increases colour**

Thank you

for your attention