5 October 2017

日蘭園芸セミナー日本における収益性の高い温室ビジネス
～収量増加とコスト低減の両立に向けて～

高収益施設園芸生産システムの構築ー効率化のための生育予測

Development of highly-profitable greenhouse horticultural production systems

Growth pre(post)diction improve efficiency in greenhouse production

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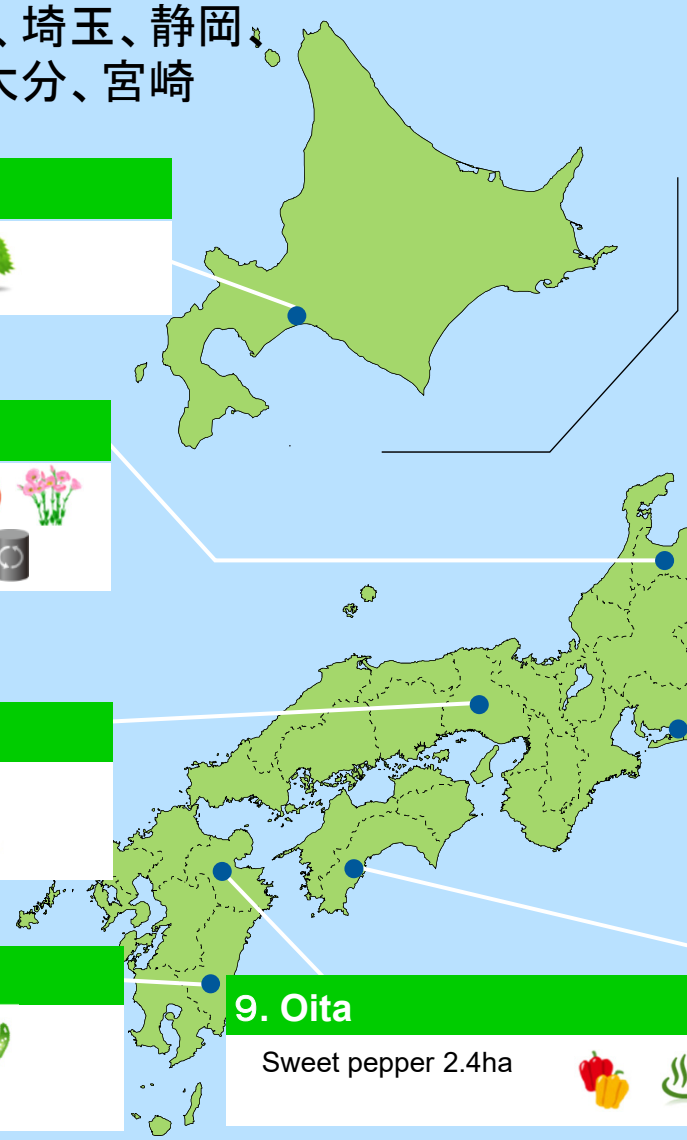
Committee of Next-Generation Type of Greenhouse Horticulture
Japan

The Next-Generation type of base facilities in 10 prefectures
次世代施設園芸10拠点

北海道、宮城、富山、埼玉、静岡、
愛知、兵庫、高知、大分、宮崎



1. Hokkaido
Strawberry 4ha

2. Miyagi
Tomato 1.1ha
Sweet pepper 1.3ha

3. Saitama
Tomato 3.3ha

4. Sizuoka
Tomato 3.2h
Cherry tomato 0.8ha

5. Toyama
Tomato 2.9ha
Lisianthus 1.2ha

6. Aichi
Chery tomato 3.6ha

7. Hyogo
Tomato 1.8ha
Cherry tomato 1.8ha

8. Kochi
Tomato 4.3ha

9. Oita
Sweet pepper 2.4ha

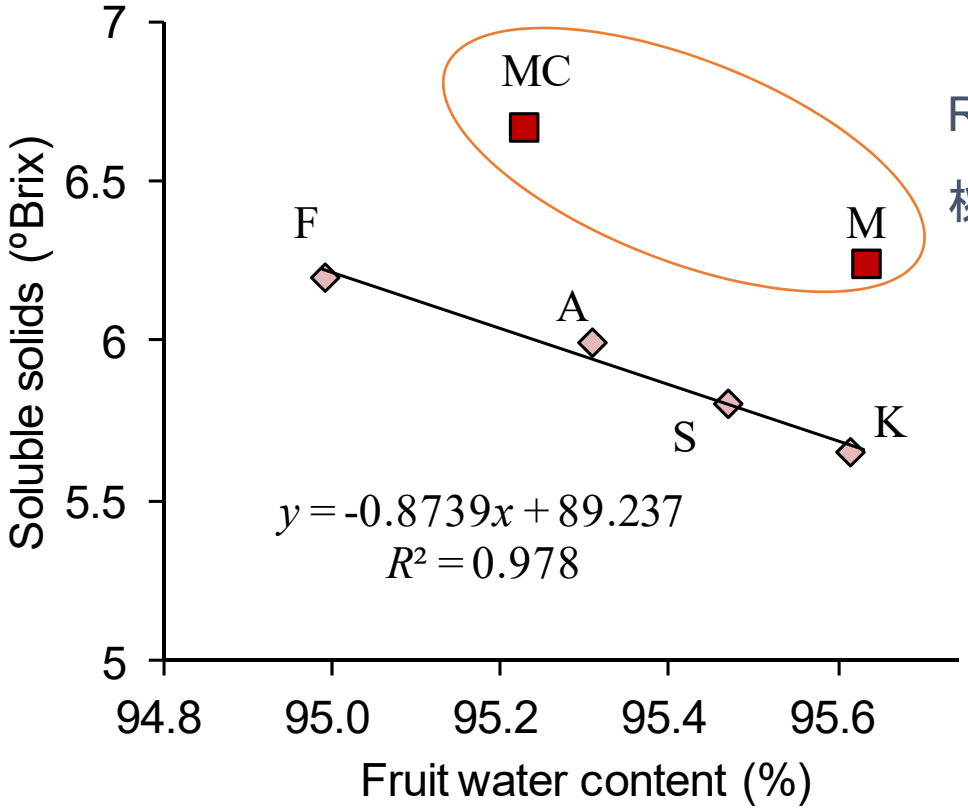
10. Miyazaki
Sweet pepper 2.3ha
Cucumber 1.8ha


Tomatoes
Japanese and Dutch

Japanese favorite tomatoes 日本品種

農研機構 NARO

High Brix without decrease in water content
糖度が高いが、水分含量は減っていない



Recent popular cultivar

桃太郎系品種

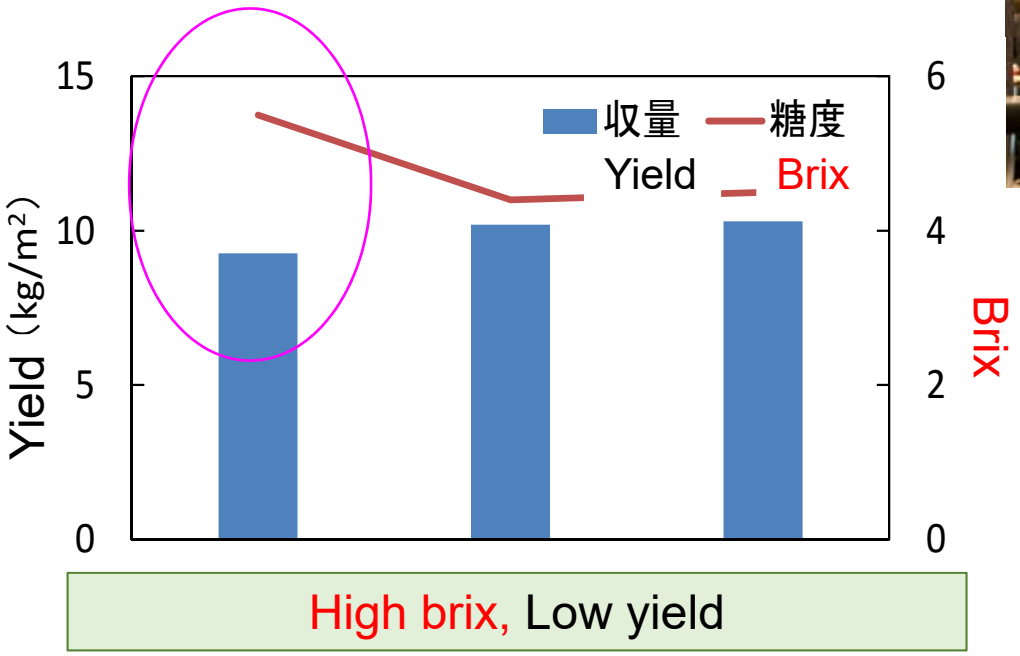
- Sweetness
- Juiciness

甘くてみずみずしい

Higashide, *et al.*, 2012.

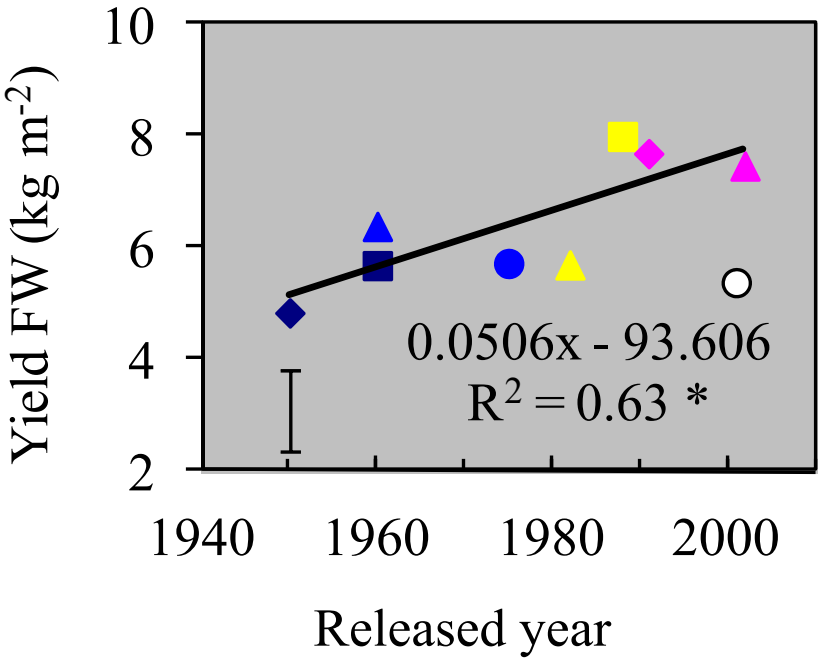
Sweetness > Yield 収量より糖度

NARO 農研機構

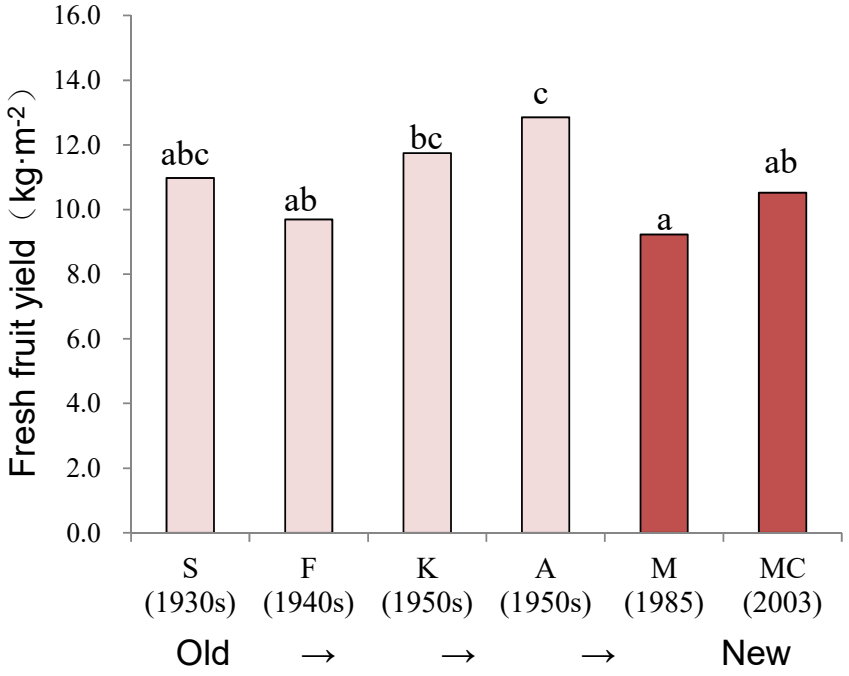


Development of high yielding cultivar in The Netherlands 多収品種の育成

The Netherlands



Japan



By breeding, tomato yield increased about 0.9% per year

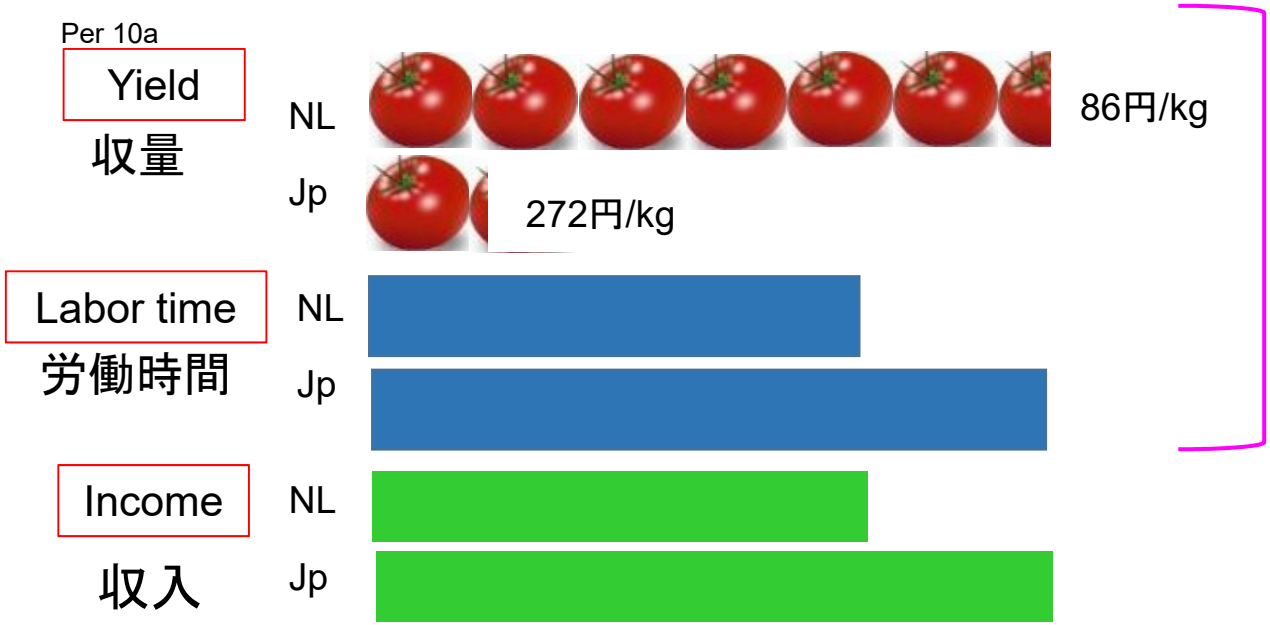
品種の発表年、1年あたり0.9%収量増加

No high-yielding cultivar

品種による多収化なし

Issue of Japanese greenhouse horticulture
わが国の施設園芸の課題

農研機構 NARO



Promote efficiency
効率化が必要

- Yield Improvement 収量の増加
- Reduction of laboring time
  作業時間の削減


Growth pre(post)diction
for improvement of
efficiency in greenhouse
production
The part of this work is undertaken the collaborative research with Wageningen UR

Data in greenhouse horticulture
施設園芸で収集するデータと利用

NARO 農研機構

環境・機器

Environment

- Record automatically
- Big data

自動計測
ビッグデータ

生育

Growth

- No record
- Record manually

作業

Labor

計測なし
手動計測

- Standardization 標準化
- Sensing, ICT センシング技術

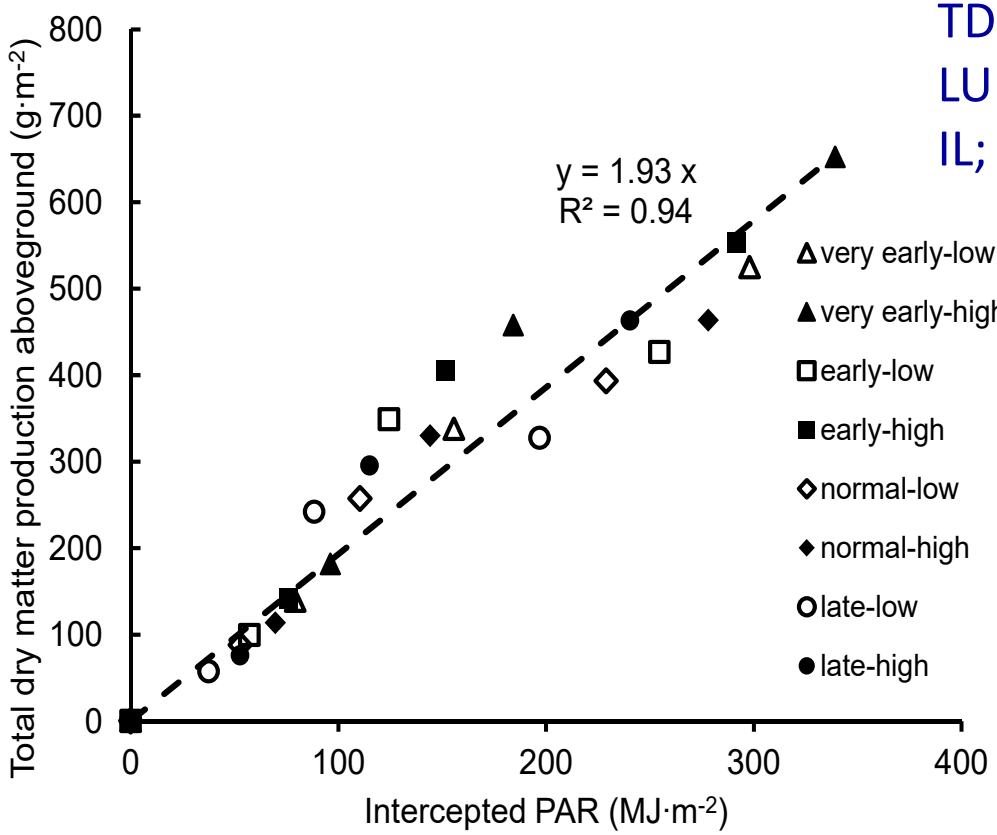
Analysis of Environment–Growth–Labor
環境機器–生育–作業データの紐づけ（関数化）

Dry matter production and intercepted light

NARO 農研機構

TDM = LUE × IL

総乾物生産＝光利用効率×受光量



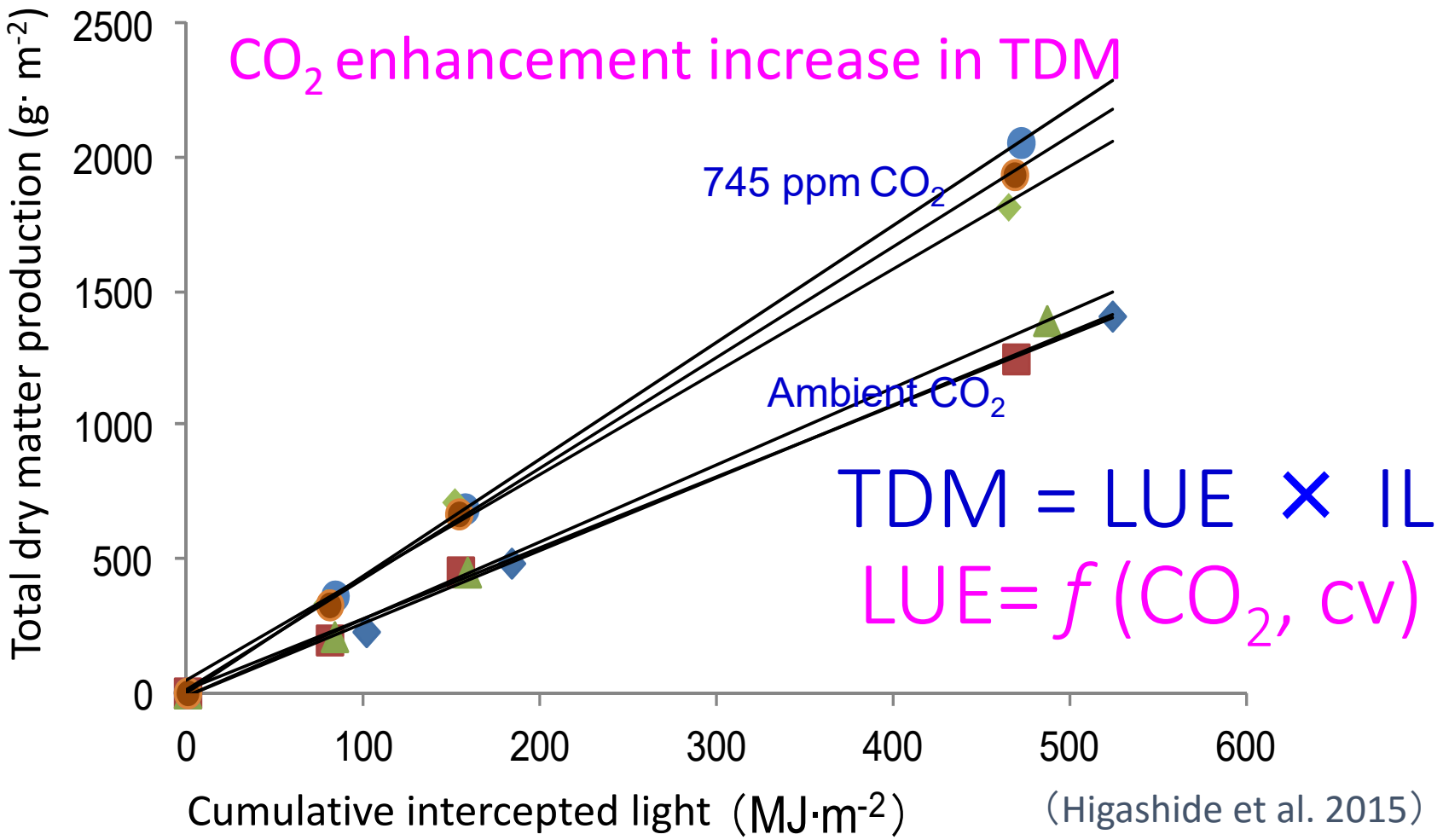
TDM; total dry matter production (g)
LUE; light use efficiency (g MJ^{-1} *PAR*)
IL; Intercepted light (MJ *PAR* m^2 m^{-2})

$$IL = (1 - e^{-k\,LAI}) \cdot PAR$$

⇒Yield ≈ TDM × Fraction of fruit DM

⇒収量 ≈ 総乾物生産 × 果実への分配
(総乾物生産の一定部分が収量)

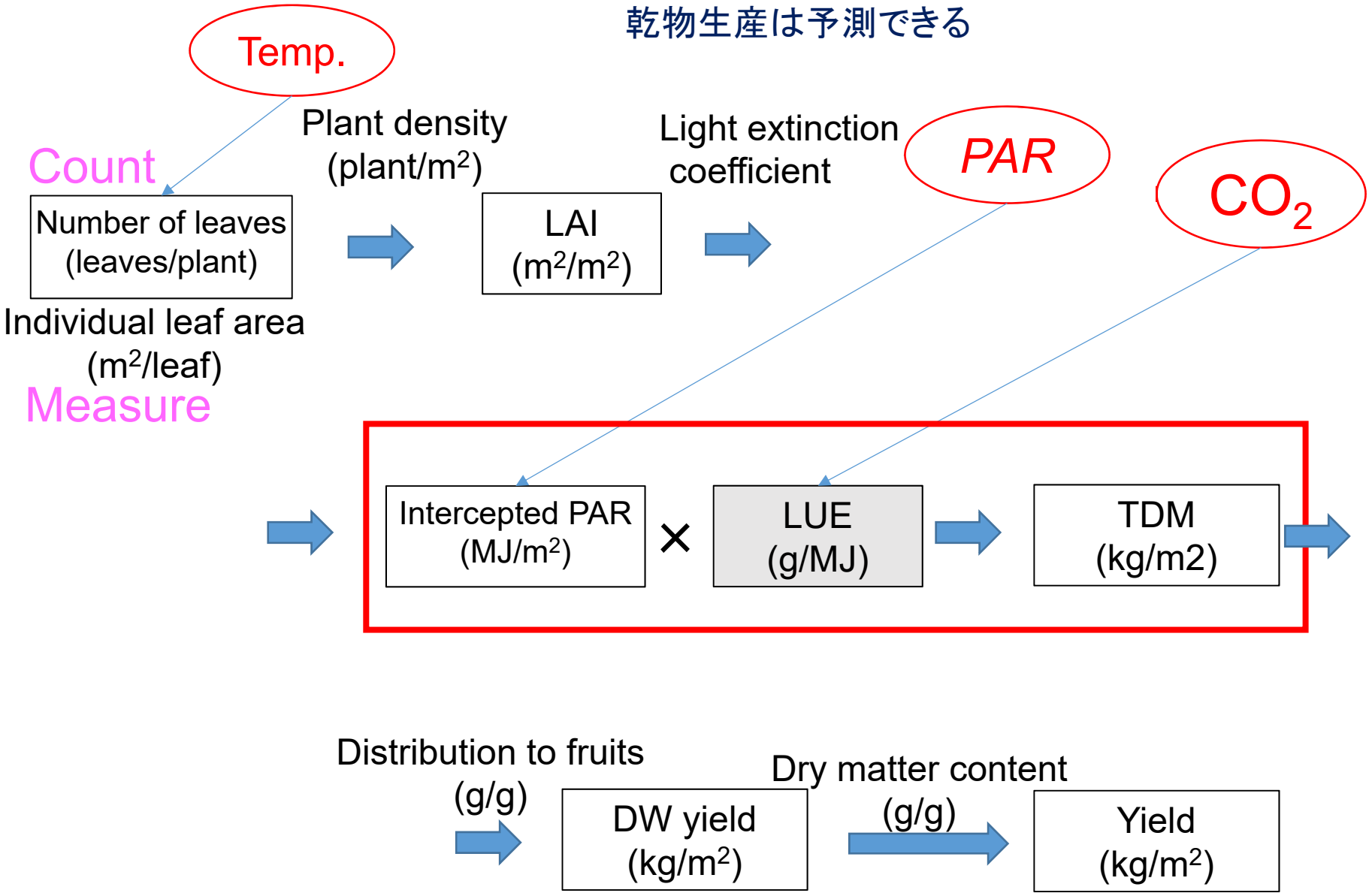
CO_2 enhancement improve dry matter production of tomatoes CO_2施用で乾物生産増加



総乾物生産＝光利用効率×受光量

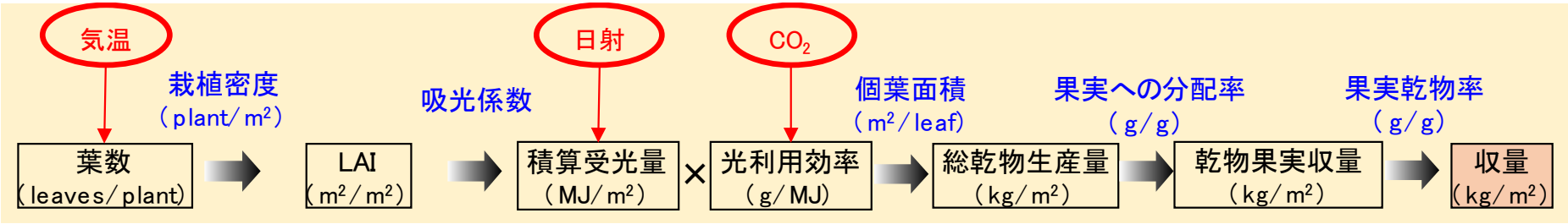
光利用効率：品種とCO_2の関数

Dry matter prediction based on intercepted light

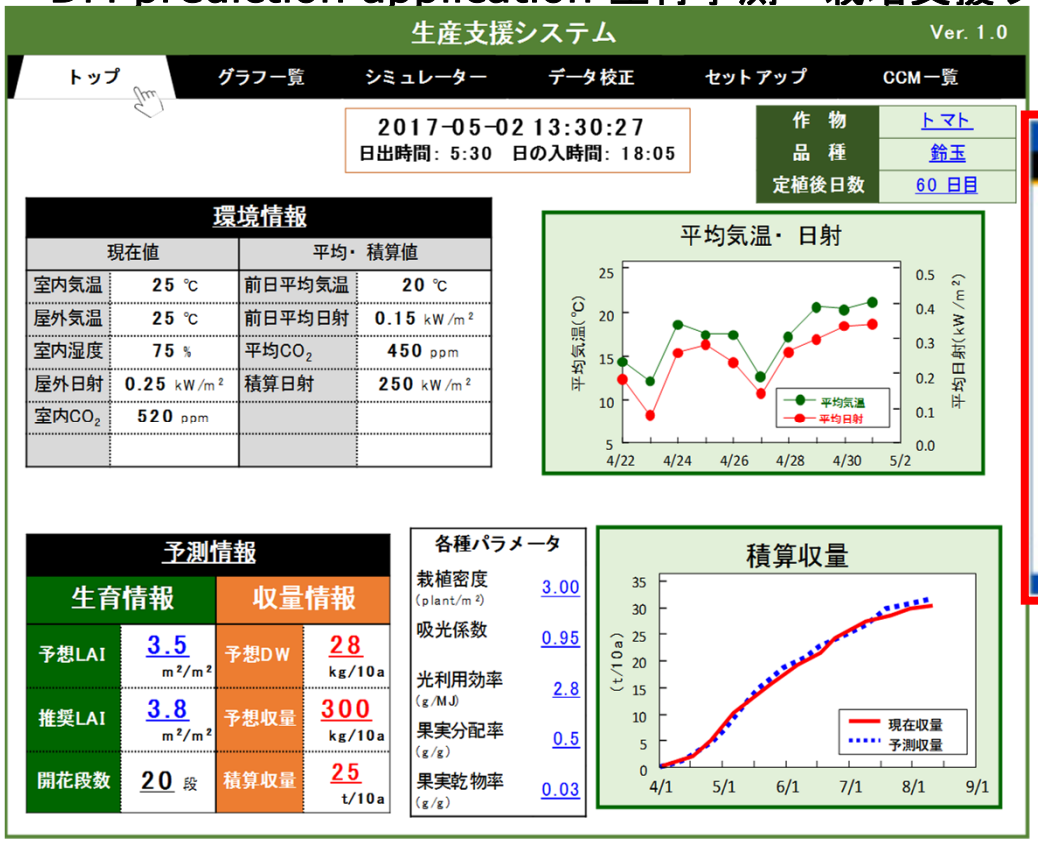


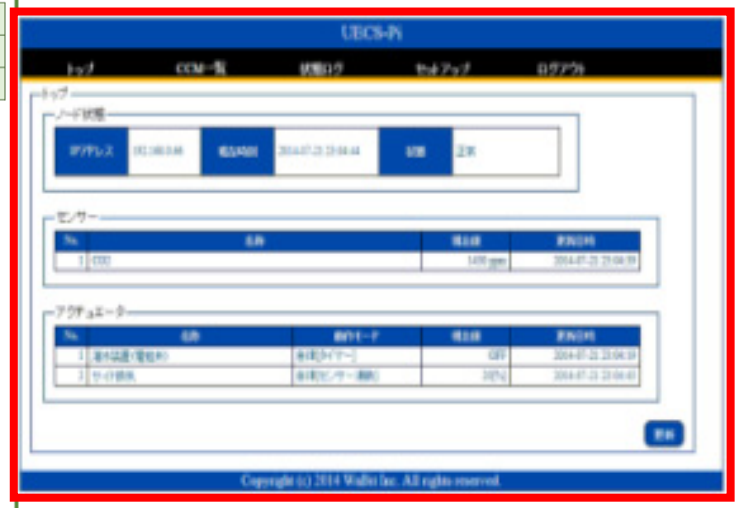
Dry matter prediction application 生産予測アプリ

農研機構 NARO



DM prediction application 生育予測・栽培支援ツール（UECS）



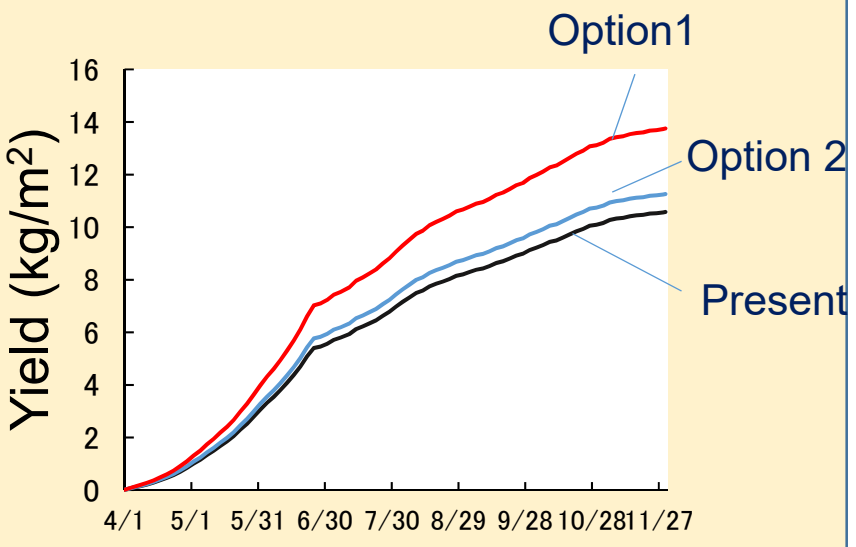


イメージ図

Improvement of production based on the prediction 予測に基づく効率化

Environ. + Growth

環境　　生育



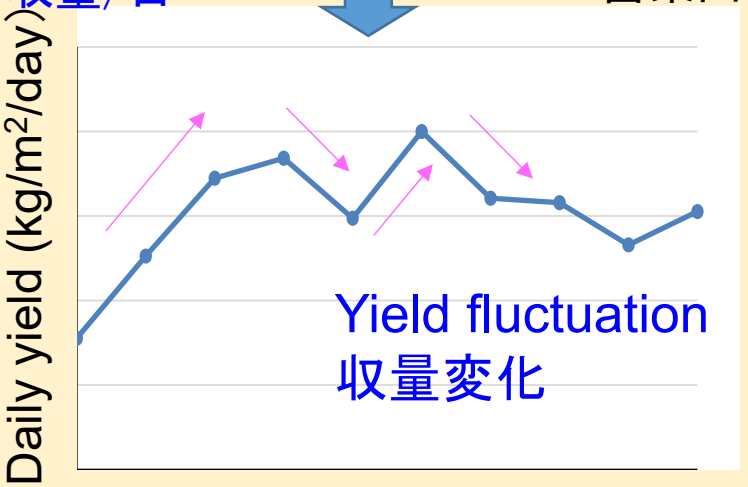
- Improvement of management
- Trial calculation for installing
- Planning
  - 生産手法の改善
  - 設備導入の試算
  - 長期の作業計画

Environ. + Growth + Labor

環境　　生育　　作業

Yield prediction（kg/day）
収量/日

Selling
営業出荷



Labor time/day＝*f* (Yield/day)
作業時間/日

Labor planning

作業計画：従業員シフト、残業

Decision-making based on the perdition
生育予測を利用して方針決定

Prediction

Post-diction

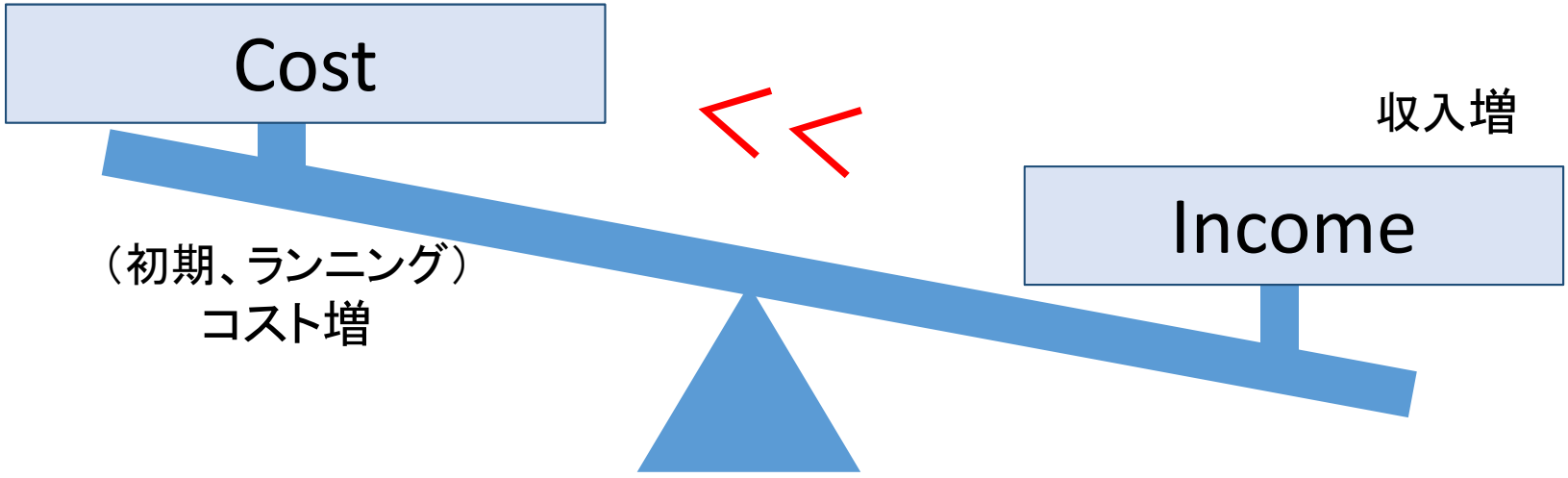
Cultivar
Facilities
Environmental control
Labor
Energy

品種
施設・設備
環境制御
労務
エネルギー

予測、試算

Improvement of Yield, Quality

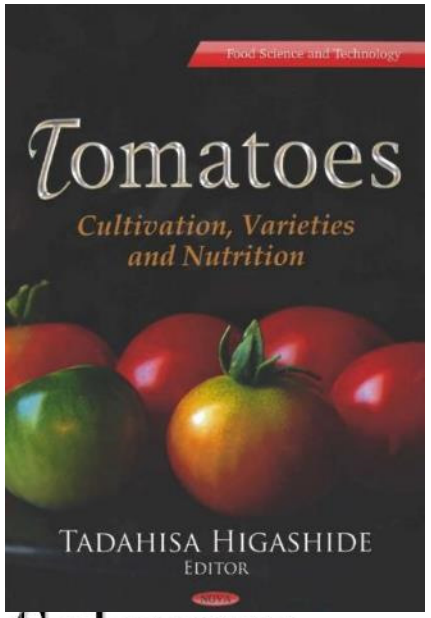
収量・品質の向上

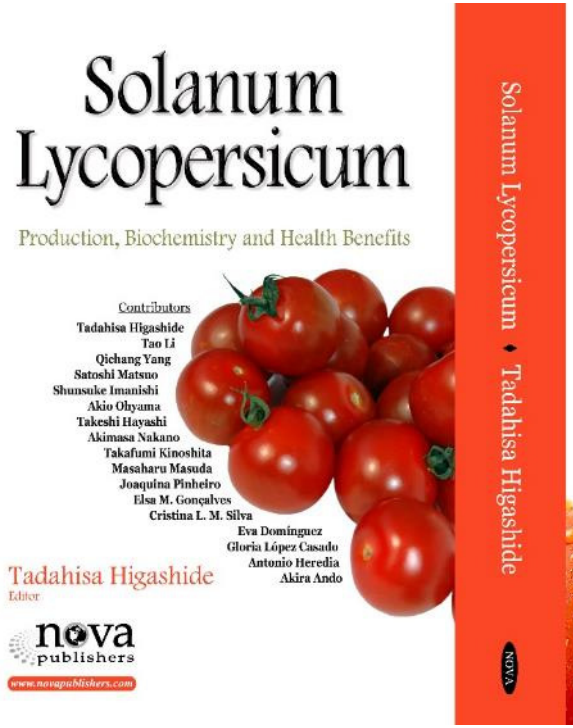


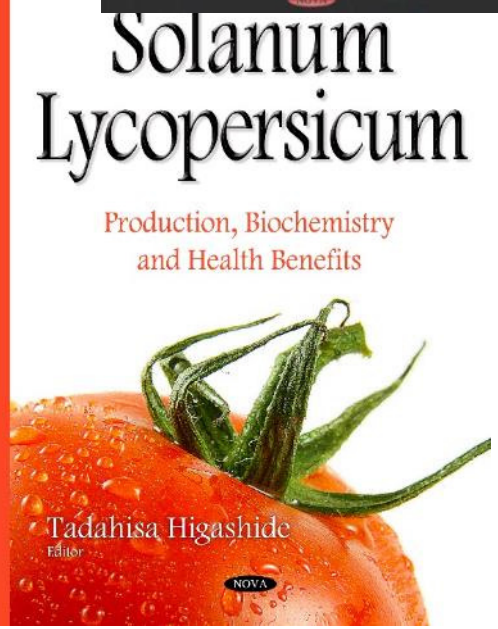
Reference

- Higashide, T. (2015) Solanum Lycopersicum: Production, Biochemistry and Health Benefits.（Nova Publishers, USA）.
- Higashide, T. (2013) Tomatoes: Cultivation, Varieties and Nutrition.（Nova Publishers, USA）.

- Higashide, et al. 2017. HortScience 52: 656–691.
- Higashide, et al. 2014. Bull. Natl. Ins. Veg. Tea Sci. 13: 27–33.
- Higashide, et al. 2015. Hort. J. 84: 111–121.
- Higashide, et al. 2012. HortScience 47: 1408–1410.
- Higashide, T. and E. Heuvelink. 2009. J. Amer. Soc. Hort. Sci. 134: 460–465.
- Higashide, T. 2009. Agric. For. Meteorol. 149: 756–762.
- Higashide, T. 2009. HortScience 44: 1874–1878.







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