PHOTON® SG 50

Increase productivity and ensure quality

even under stressful conditions

January 2025

Power Point by Chuck Kupatt, Nicholas Phillips & Wolfgang Benz

What is PHOTON?

- PHOTON ® SG 50 is a high active, solid, dust-free, organic-mineral special fertilizer with a very good price/performance ratio
- Marketing: Successfully on the market in numerous countries in the southern and northern hemisphere since 2015, tested and widely used in both specialty crops and arable farming!
- Formulations: PHOTON® SG 50 (extruder granules) and liquid formulations, also private labels

- Patents: NEW technology, patented worldwide until 2029, mixture patents with new partners granted until 2040 and beyond
- Ingredients: Mix of 4 dicarboxylic acids of natural origin (mainly azelaic acid) with contents of potassium (22% K2O), magnesium and boron.
  Note: Azelaic acid is also used worldwide as an ingredient in cosmetics.

What else about PHOTON?

- Application: Simple application via fertigation/irrigation or foliar treatment, the product is rainproof on the plant after 2-3 hours
- In the plant: Systemic distribution of the active ingredient within 24 hours, degradation in the cell after 2-3 weeks, no residues
- In practice: FOR BEST RESULTS - Targeted, preventative (early) application, depending on the crop, 2 - 4 x applications in combination or in spraying sequence with crop protection/ leaf fertilizer, tried and tested in practice. In fruit growing, up to 6 x applications is also common for late varieties.

- Crops: Can be used in all crops, very good plant compatibility
- Dosage: 20 to 40 g/ha/application, depending on crop, strong effect with low application rate
- Mixability: Very good, with most important crop protection products and foliar fertilizers, synergistic effect with micronutrients and some biostimulants (spray sequences and tank mixtures),

  -> for more information, use our service hotline!

TARGETS for plant production in row crops

PHOTON ® promotes

- In general: early application promotes early leaf development and root growth
- in potatoes, the tuber plant, uniformity of tuber development and increase in size, thus increasing the marketable part.
  It can be used in any production segment, i.e. seed-, table-, processing- (french fries and chips) and starch potatoes
- for sugar beet: increase in yield/ha and adjusted sugar yields
- for grain maize: promotion of cob development and cob weight
- for legumes: support the development of pods and increase the yield

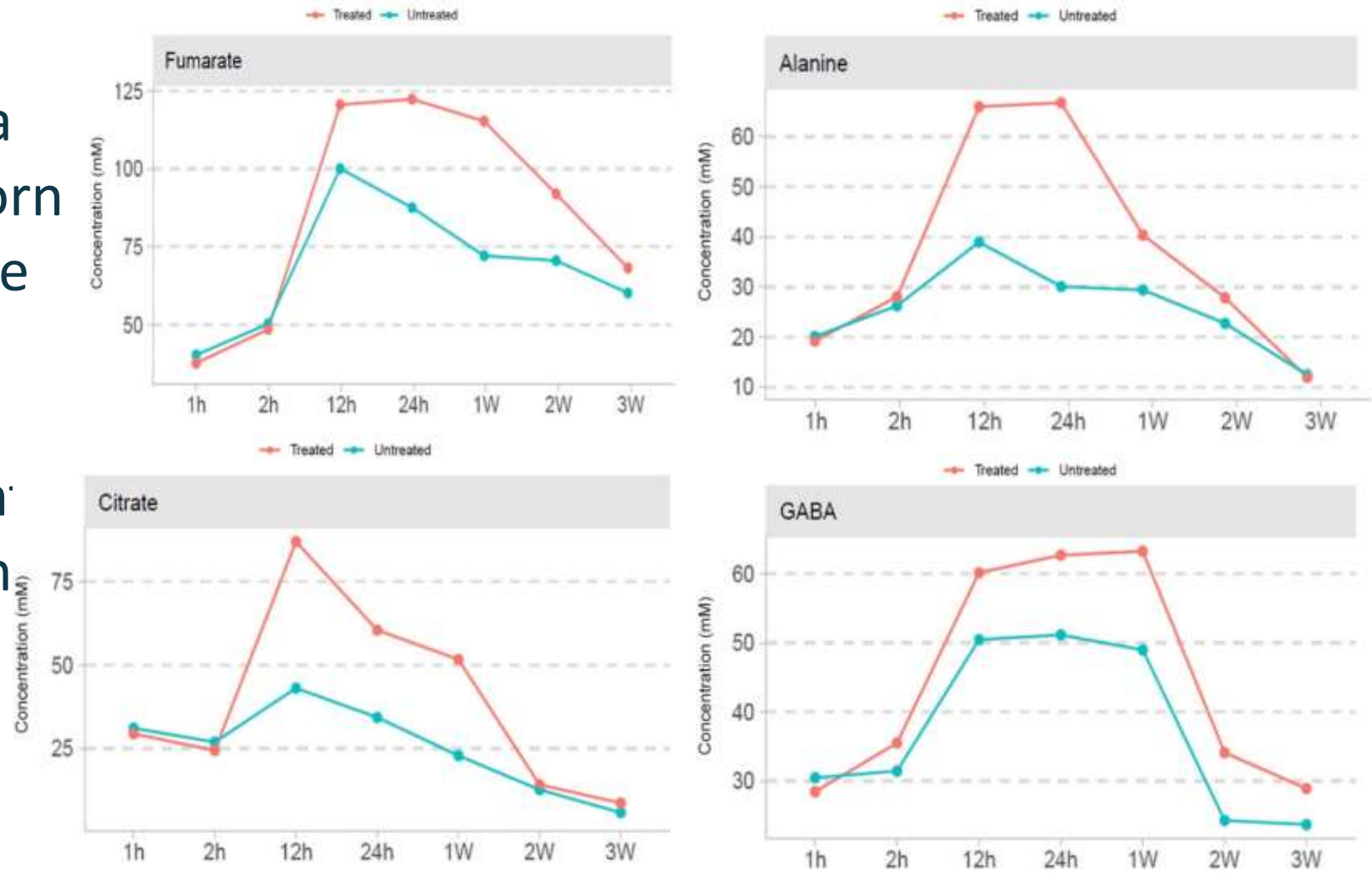
<u>A prerequisite for the best results:</u>

1. follow the instructions for use: use as early as possible, keep an interval of 3 weeks!

2 PHOTON® only works optimally on fields managed with good agronomic practice (soil cultivation, fertilization and plant protection) -> use the service hotline!

How does PHOTON work?

Recent studies by the University of South Africa on soybeans and grain corn confirm earlier data in the literature: PHOTON promotes the formation on a number of importan organic acids, proteins an enzyme systems.



The increased values of ingredients that play a decisive role in the reaction of plants to abiotic stress allow an insight into the biochemical processes in the plant on which the positive (yield-increasing) results in trials with PHOTON are based.

In addition, the graphs provide a reason for the treatment intervals - in order to keep the ingredients at a high level, it makes sense to repeat the treatment after 3 weeks.

Source: Research article

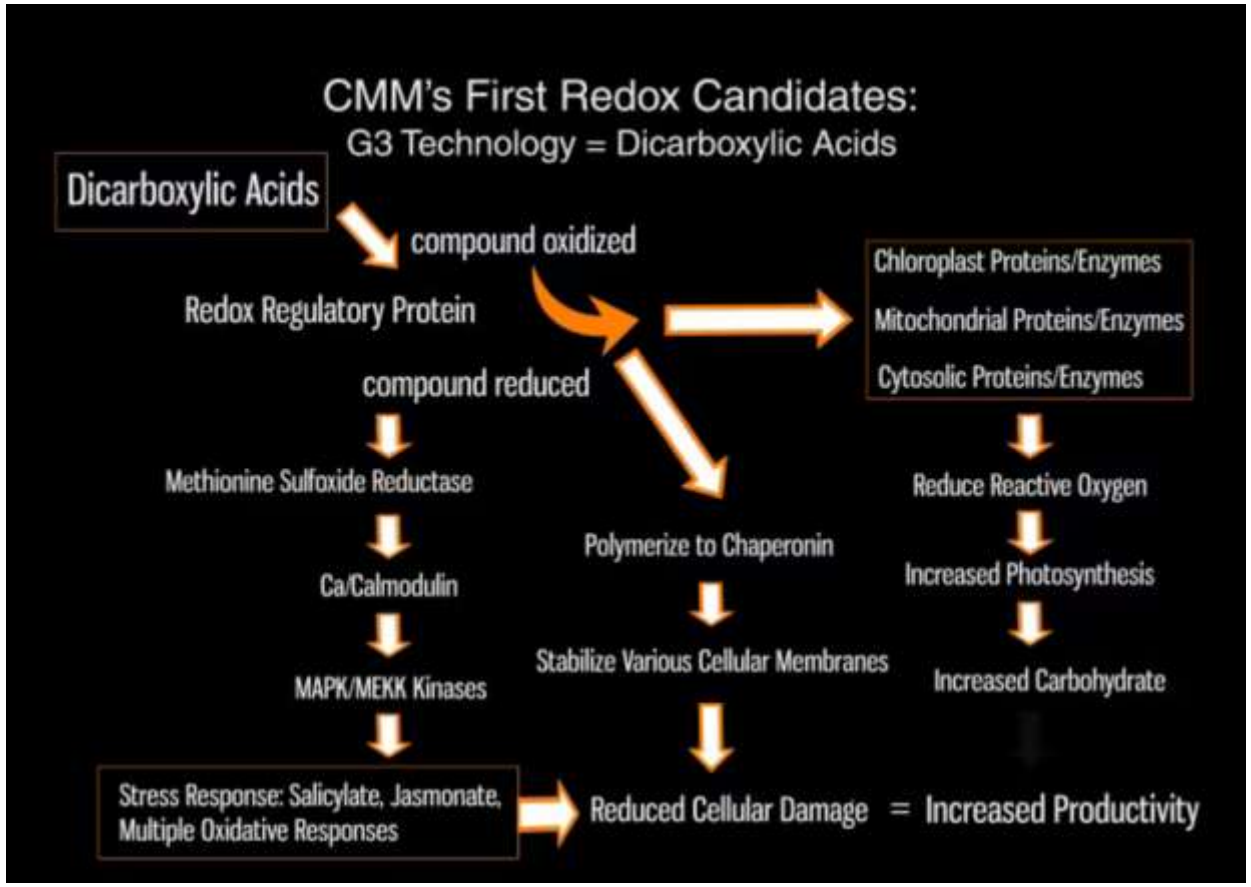
^{1}H-NMR-based metabolomic profiling and proteomic analysis of soybean (Glycine max L.) in response to the application of dicarboxylic acids (Photon) as stress inducers.

Mhlonipheni Nhlakanipho Msomi , * Gerhard Prinsloo , Noluyolo Nogemane

Department of Agriculture and Animal Health, Florida Science Campus, University of South Africa, Johannesburg, Gauteng Province, South Africa

The increased content of important substances in the plant through the use of PHOTON

- stabilizes membranes and cell structures (chaperonin function),
- improves the nutrient efficiency of calcium (calmodulin effect)
- neutralizes damaging radicals.



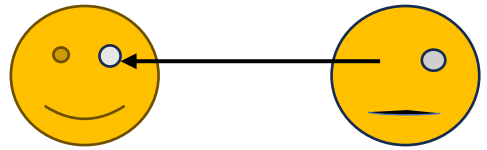
This increases and maintain the photosynthesis performance, as well as fruit/tuber and root formation and thus a sustainable yield.
This is particularly important under stressful conditions.

What role do stress factors play?

Just as in humans, certain environmental influences, e.g. stress caused by pesticides (i.e. Phytotox), cold and heat or radiation stress and other factors, also cause the formation of free radicals in plants.

These can affect the health and vigor of the plant, the condition of the cells, the firmness of tissue and skin, e.g. in fruits.
The PHOTON application can help to counteract this.

Free radicals lack an electron.
They remove this electron from other cells and thus damage their structure.



To make optimum use of the protective effect, it is necessary to use PHOTON right in time and thus also preventively. When used preventively, dicarboxylic acids act as a kind of vaccine ("priming").

In which crops is PHOTON used?

PHOTON has been used worldwide for several years in numerous countries:

- In arable farming (in the USA mainly grain corn and soybeans, approximately 1.3 million hectares in 2024)
- In fruit crops (in the southern hemisphere mainly citrus, pome-, stone- and berry fruit and soft fruit, vine - and table grapes)

The result: improved yield and quality in all important crops, even under stress conditions

Application recommendation (selection)

Culture	Dosage/ Application	Remarks
	40 g/ha (60 ml/ha)	Preventive
Sugar beet	3 - 4 applications, Interval 3-(4) weeks	From NAK_1 in combination with crop protection and fertilization
Cereals, grain maize, legumes, rapeseed	2 applications, see separate instructions	1st juvenile stage, 2nd before generative phase for maize up to 80 cm in height
Citrus fruits	4-6 applications Interval 3 weeks	From 1 month before flowering until harvest
Pome and stone fruit, nuts	4 - 6 applications Interval 3 weeks	From flowering up to 3-4 weeks before harvest
	20-40g/ha (30-60ml/ha)	Preventive
Potatoes, vegetables (all types)	Usually 3-4 applications, interval 3 weeks	Start after planting (drenching also possible) Possible up to 3 weeks before harvest
Wine & table grapes, soft fruit	3 - 6 applications Interval 3 weeks	From flowering to shortly before harvest

Application

- For the sake of simplicity, we recommend volumetric dosing (doser included)
- **Particularly interesting:** Same application rate per ha for foliar application and fertigation/irrigation.
- When used alone, it is best to mix the product with non-ionic surfacants, e.g. Break Thru, Hasten etc.
- In combination with crop protection products, an adjuvant is helpful, but not absolutely necessary
- PHOTON is available in containers of
  500 g (750ml),
  2 x 500g (1kg pack) and
  6 x 1kg pack (6kg carton) available

Application examples from the years 2023 and 2024 in potatoes and sugar beet

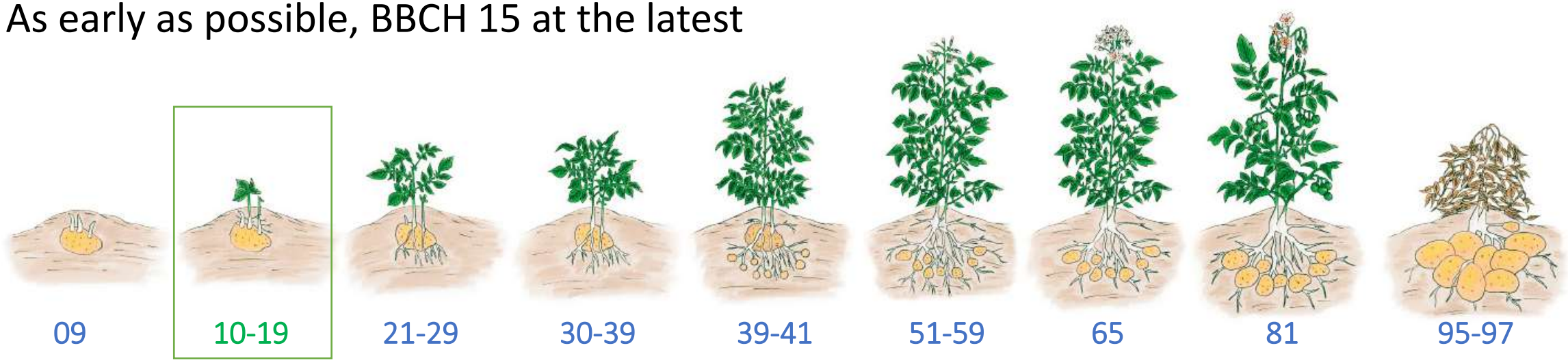
- In 2023 and 2024, the dosages and spraying sequences already tried and tested in other countries were validated throughout Germany (partly in Austria and Italy).
- Objective: Serious recommendation for D-A-CH taking into account the regional location conditions (facts and figures)

2 cultures as an example:

- **Potatoes:** 9 random trials and 10 practical tests, regional focus on Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate and Bavaria
- **Sugar beet:** 10 random trials and 5 practical tests, regional focus on Saxony-Anhalt, Lower Saxony, North Rhine-Westphalia and Bavaria

Potatoes

The ideal time to start the application:
As early as possible, BBCH 15 at the latest



Picture: BOLAP, Speyer, 16.5.2023, late potatoes

September 2023, seed potato

Test results NORD-WEST, Ems-Elbe triangle, Geest

PHOTON SG 50 - Dosage 20 g/ha per application, treated 3 or 4 times

Yield estimate, confirmed by the farmers' harvest data!

Harvest: 2 replicates per variety, each 2.66 x 0.75 m (2 m² area)

Weights and number of tubers (grouped by tuber diameter) are given as an average.

3 locations/ 7 varieties:

Group A: **Location 1**: Madeira, Milwa, **Location 2**: Gala, Wega, Princess

In each case **4 applications at intervals of 2-3 weeks**, **SUBSTANTIAL INCREASE IN YIELD**

Group B: **Location 3:** Soraya, Goldmarie

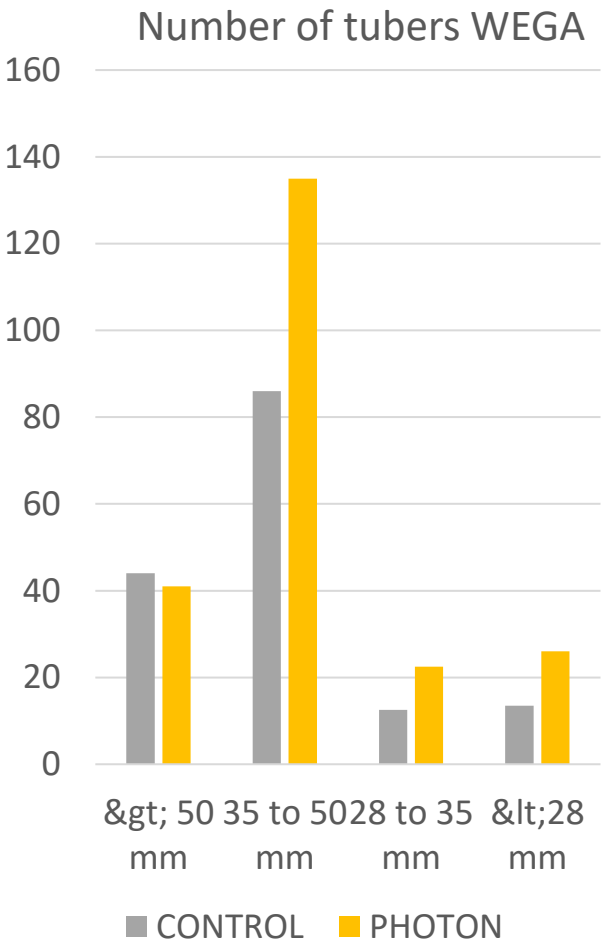
3 applications at short intervals, NO YIELD ADVANTAGE

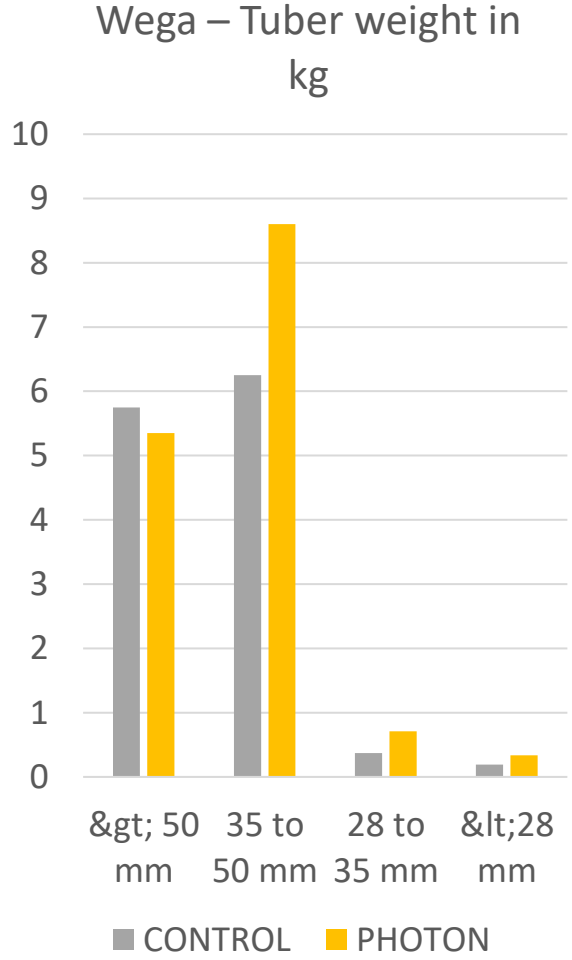
2023: seed potato

NORTH-WEST,
Ems-Elbe
triangle, Geest
Variety: WEGA

Dose: 20 g/ha,
4 applications
Interval: 3 weeks

PHOTON control





Potatoes 2024: A comparison of two locations

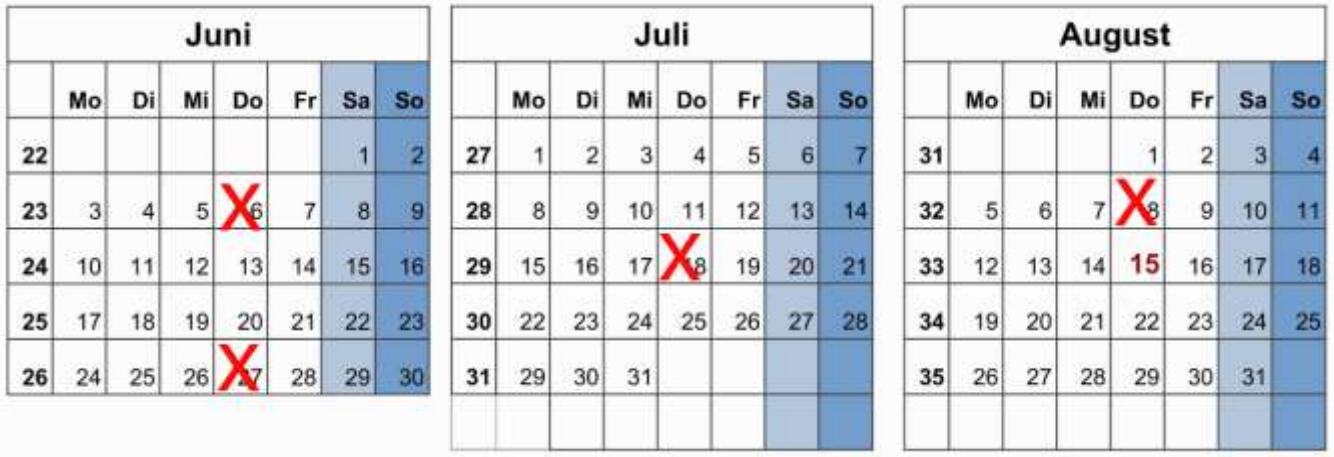
Random plot trial NORD, Lower Saxony, table potato	
Crop Trials , Dr. Paul Reh **Location:** Burgwedel, Hanover region Site is regularly supplied with organic fertilizer (fermentation residues, liquid manure)	
Soil: (heath) sand, 30 BP (soil points) **pH** 5.7 **, Organic matter**: 3.6 %	
Variety: BELANA, Europlant	Spacing between rows: 75 cm Spacing in rows: 32 cm
Planting: 22.04.2024	: 32 cm
Emergence: 02.06.2024	
Irrigation (25mm)**:** 01.06.2024, 30.06.2024	
Precipitation: average 627 mm (Hannover)	
Harvest: 12.09.2024	

Random plot trial SOUTH-EAST Bavaria, starch potato	
Farmtastic, trials and advice **Location**: Irlbach, Straubing district Site is regularly supplied with organic fertilizer (fermentation residues)	
Soil type: silty loam, loess, 80 BP (soil points) **pH** 7.3 **Organic matter** : 2.9 %	
Variety: EUROVIVA, Europlant	Spacing between rows: 75 cm
Planting: 09.04.2024	Spacing in rows: 32 cm
Emergence: 30.04.2024	
Irrigation: no	
Precipitation: average 834 mm	
Harvest: 17.10.2024	

Test program and application

	Product	Formulation	Dosage	Number of applications
1	Untreated Check			
2	PHOTON	SG50	**20g**	**4x**
3	PHOTON	SG50	**40g**	**3x**
4	PHOTON	SG50	**40g**	**4x**

PHOTON 2024 Application:	T1 (BBCH 15)		T2		T3		T4
Irlbach							
Date	14.05.		07.06.		26.06.		16.07.
Difference in days		24		19		20	
Burgwedel							
Date	06.06.		27.06.		18.07.		08.08.
Difference in days		21		21		21	

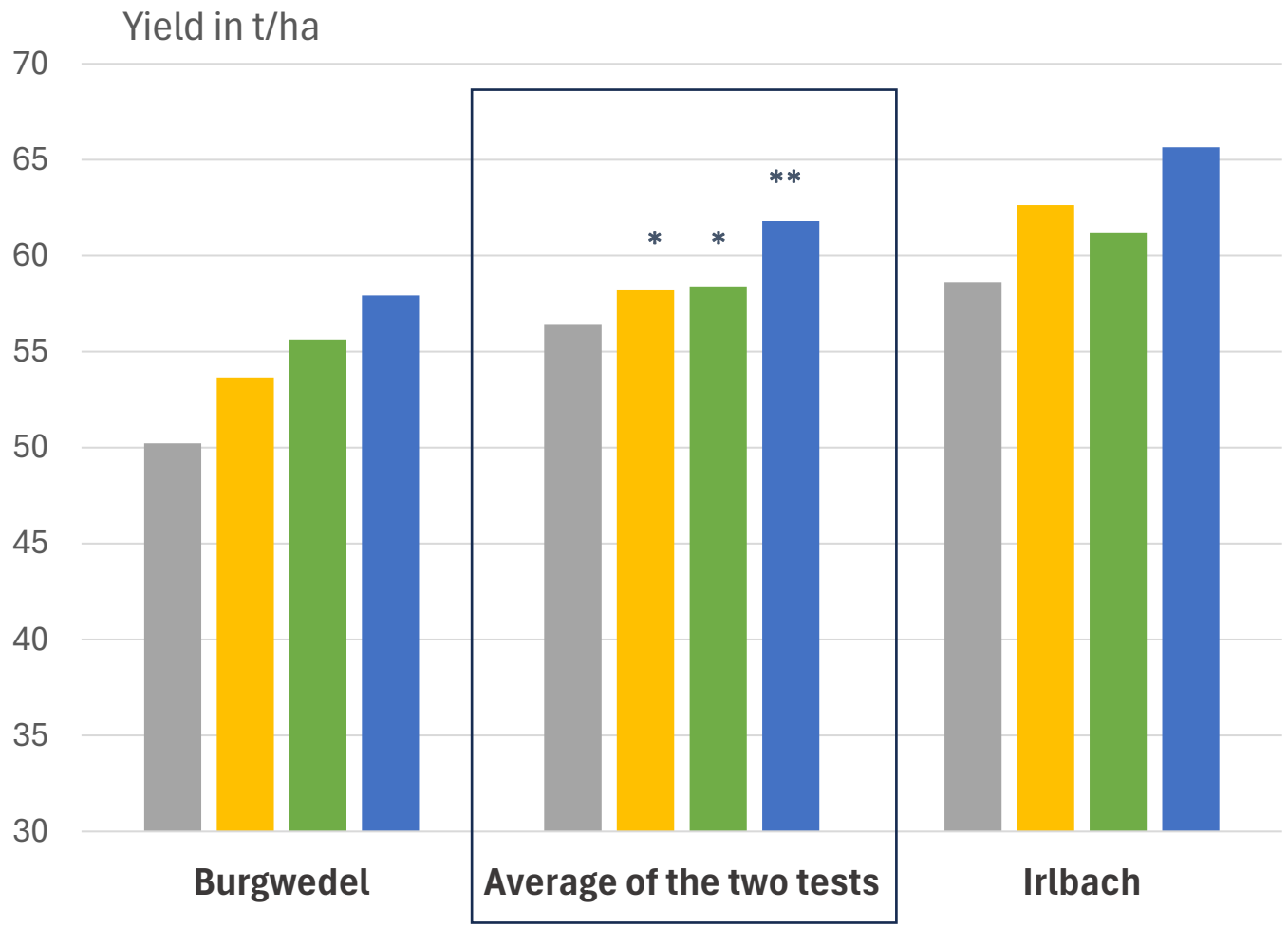


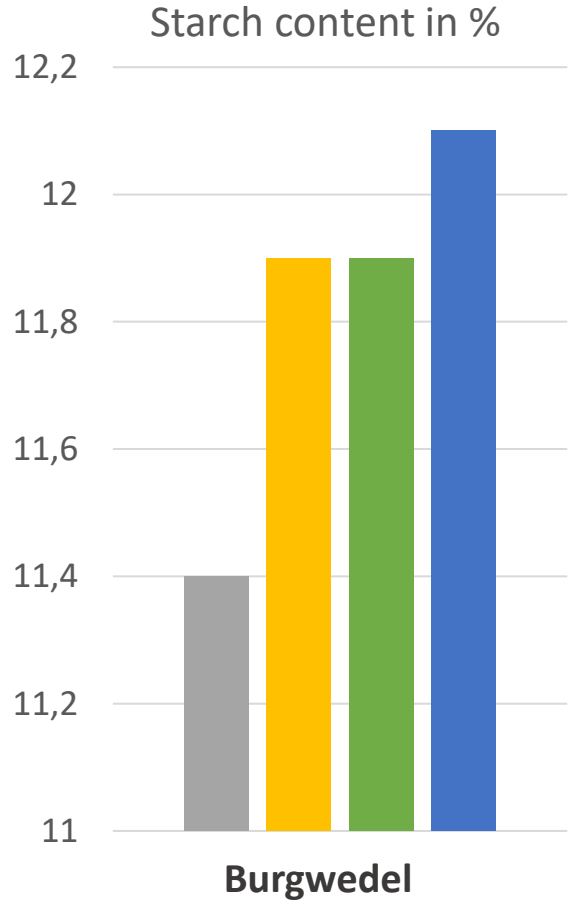
(as an example: Crop Trials application dates, Burgwedel)

Two locations compared: Burgwedel and Irlbach

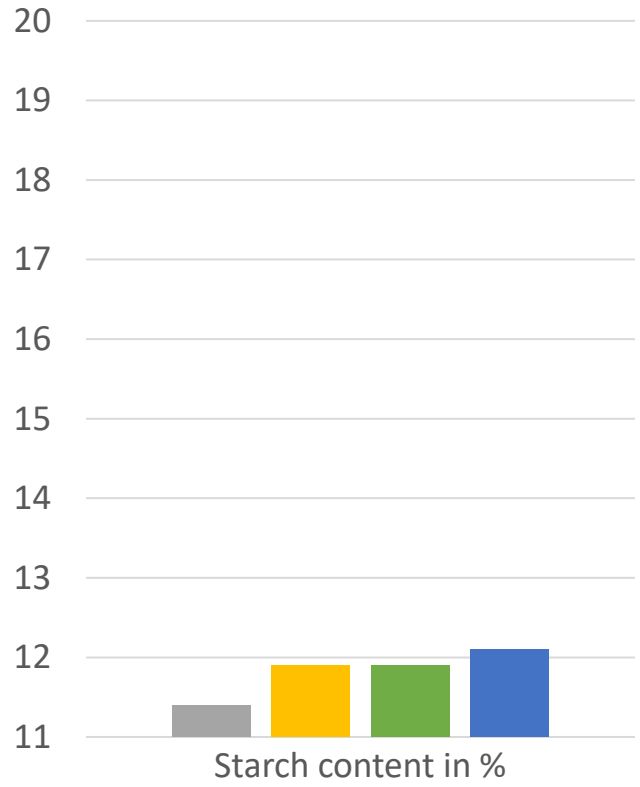
1	Untreated Check
2	PHOTON SG50 - 4x20g
3	PHOTON SG50 - 3x40g
4	PHOTON SG50 4x40g

Statistics:
LSD 0.05 = *
LSD 0.01 = **

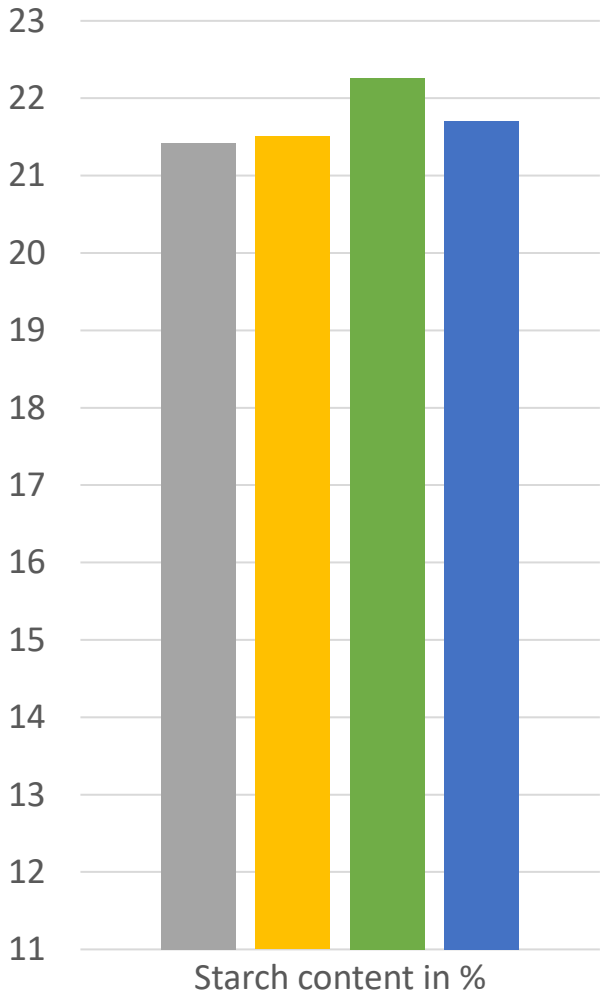




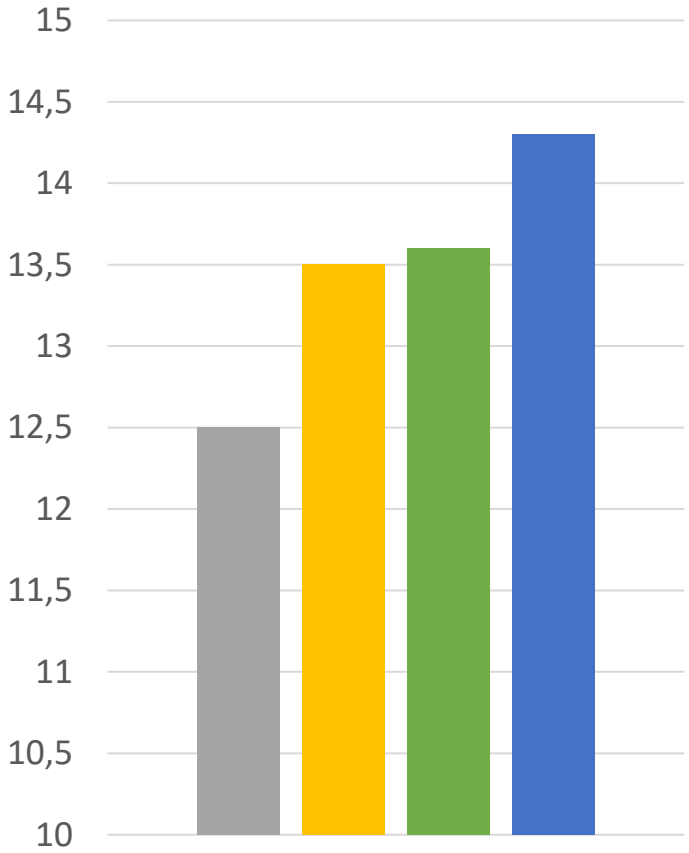
Burgwedel (ware potato)



Irlbach (starch potato)



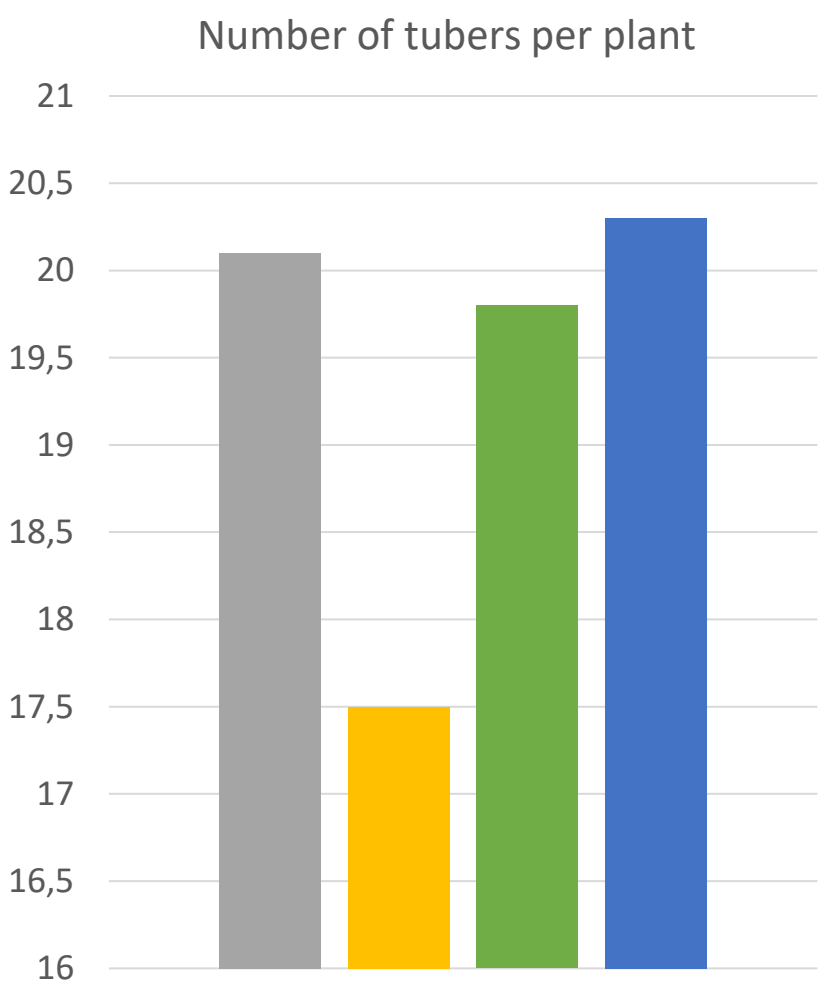
Irlbach, starch yield in t/ha

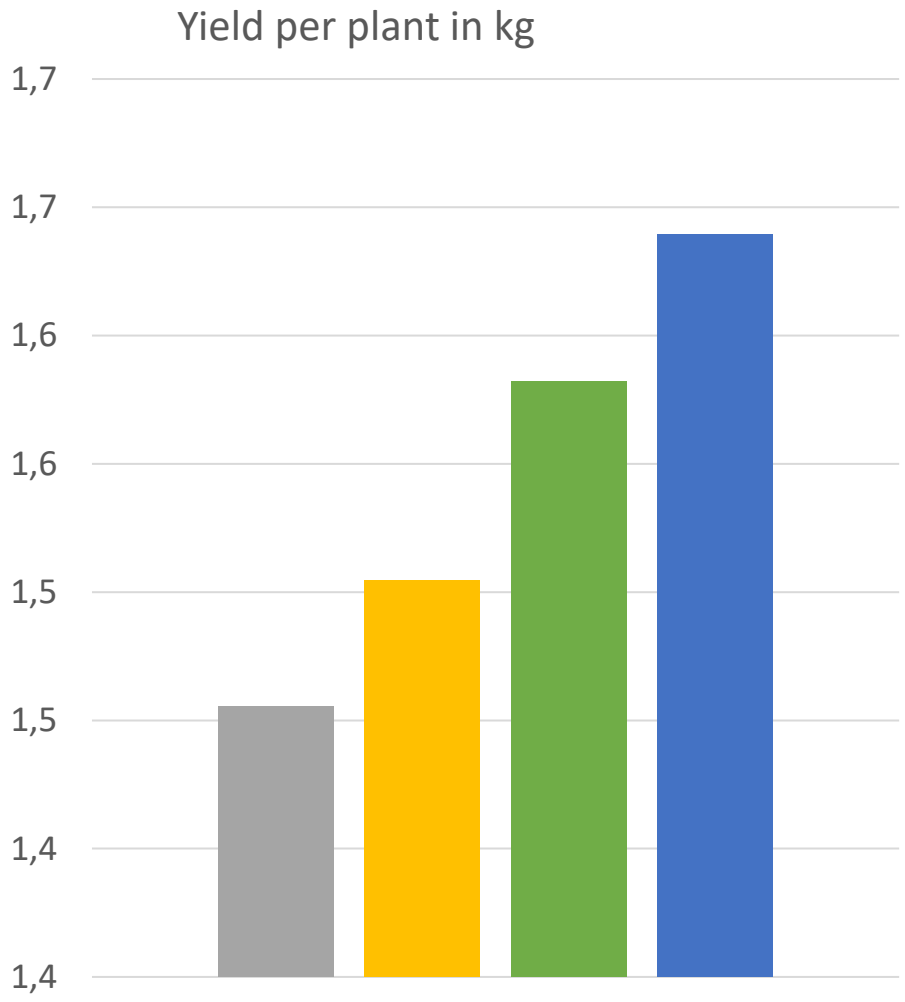


Untreated Check | PHOTON SG50 - 4x20g | PHOTON SG50 -3x40g | PHOTON SG50 4x40g

Burgwedel

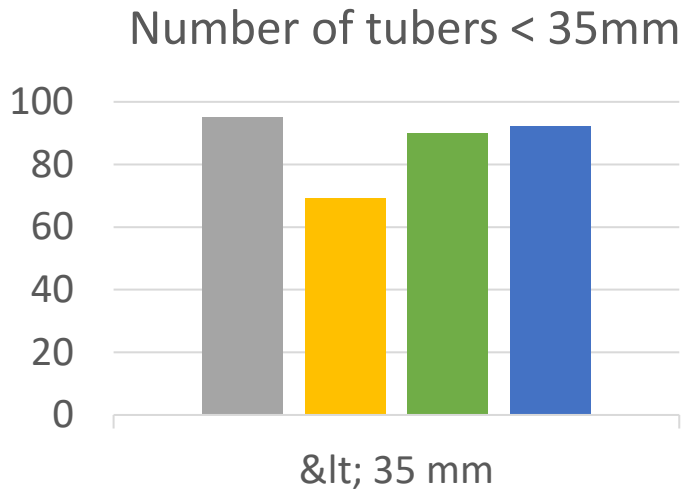
1	Untreated Check
2	PHOTON SG50 - 4x20g
3	PHOTON SG50 - 3x40g
4	PHOTON SG50 4x40g

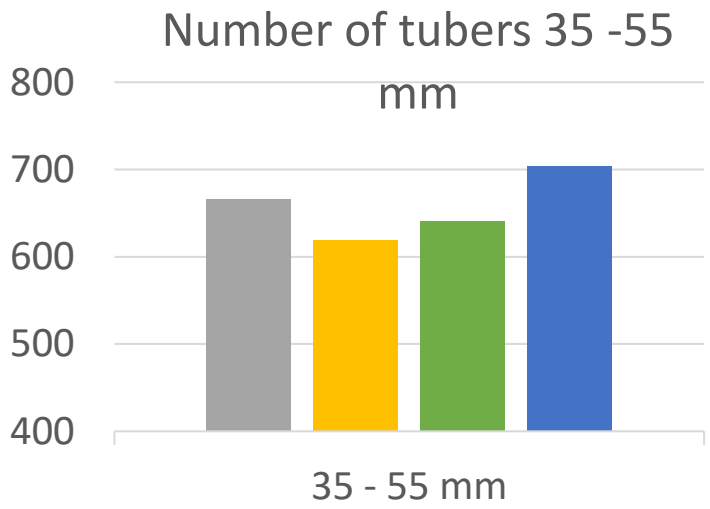


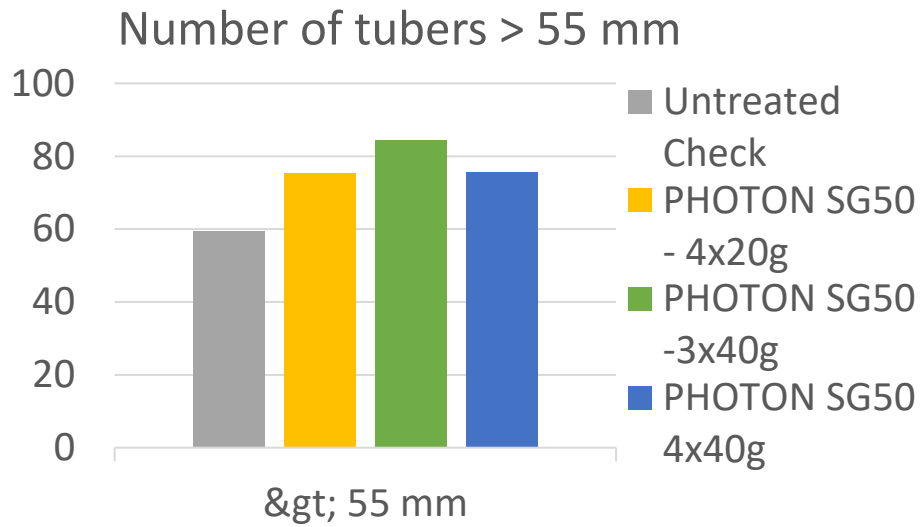


Burgwedel

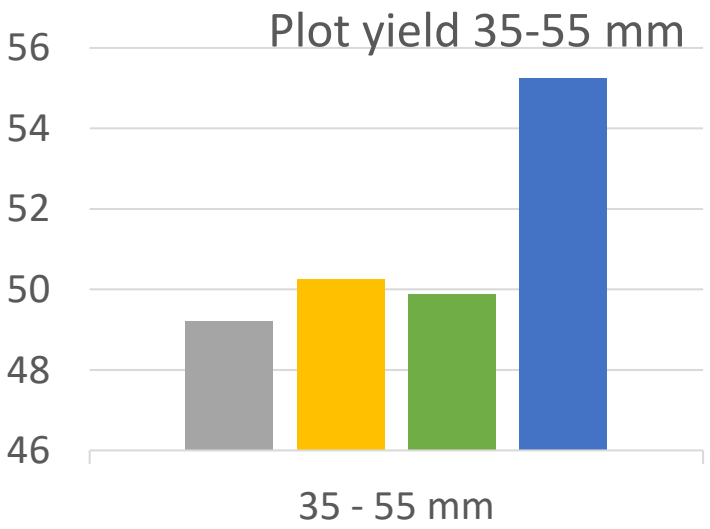
Number by tuber size

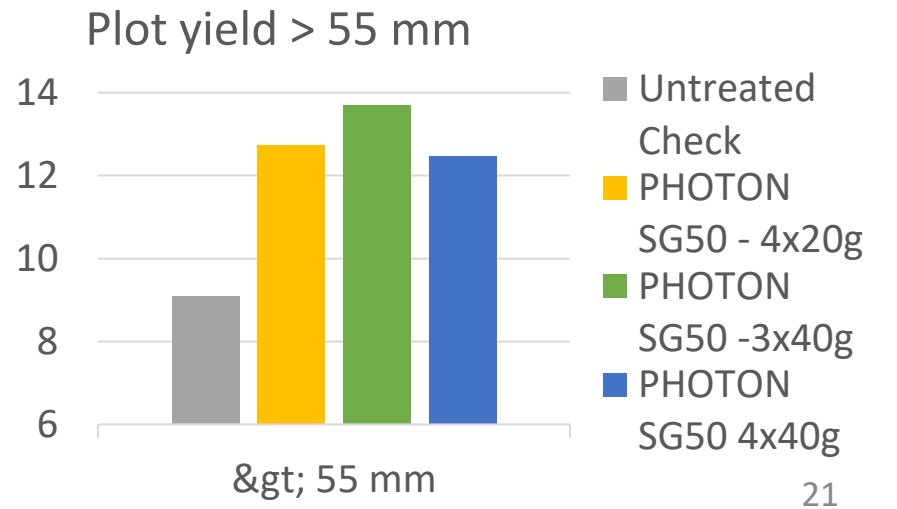






Yield by tuber size





PHOTON ® SG 50 in POTATOES, CONCLUSION:

Using PHOTON® SG 50 correctly, we see the following advantages for the farmer:

- **Yield**: due to a better tuber set and subsequent advantageous tuber development, yield increases of at least 7% to 14%. These results could be achieved in Chile, the UK, the USA and in the trial years 2023/24 in Germany. This at a yield level of 50 to 70 tons/ha
- **External quality**: Significant increase in fraction from 35 to 55 mm and larger
- **Internal quality**: slight increase in starch content (0.5 to 1%)

Use of PHOTON ® SG 50 in POTATOES:

Start of the treatments:

- preventive use is a must!
- As early as possible, prerequisite uniform emergence of the plants, stage: e.g. "potatoes hand-width high", BBCH 15 at the latest

Dosage (in Central Europe)

both in "normal years" and in "expected stress"

- **Standard:** 40 g/ha , (3)- 4 x , 3 weeks interval,

  3 x applications, e.g. for early table potatoes,

  4 x appl. e.g. for table potatoes, processing potatoes (French Fries, Potato Chips etc.) and starch potatoes

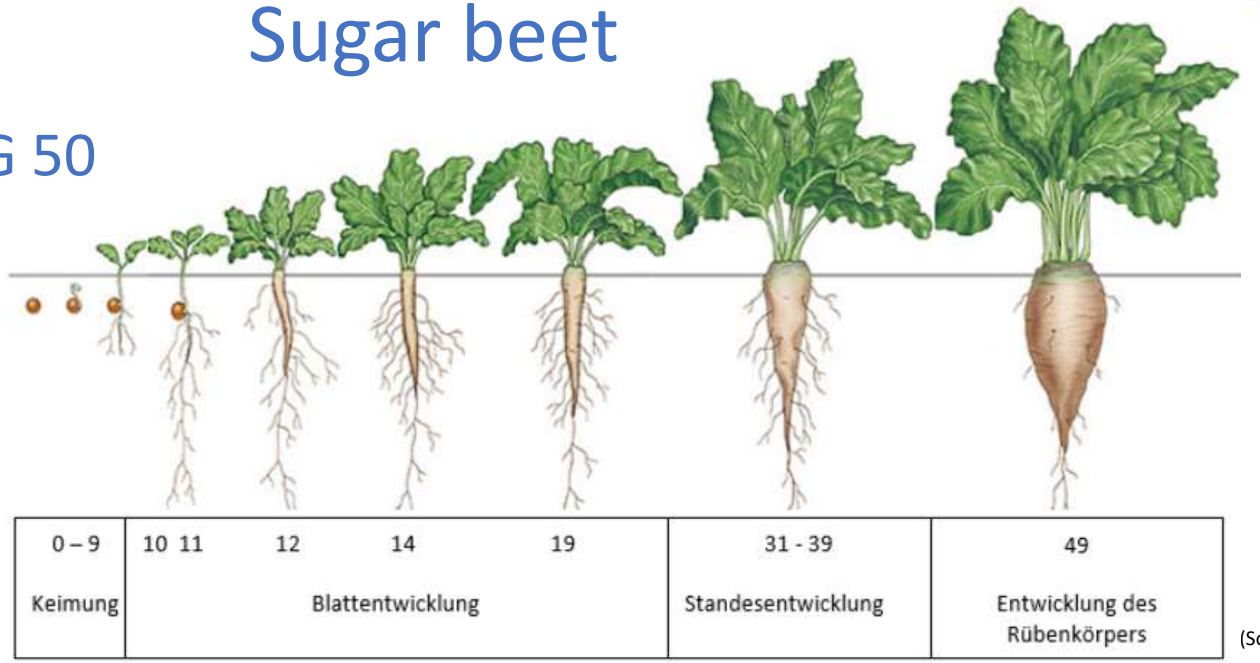
- **Basis:** 20 g/ha, 4 x, 3 weeks interval, e.g. seed potatoes or mixture with biostimulants **(enquire about type and dosage by telephone)**

Sugar beet

2023 and 2024
Test program PHOTON SG 50

All random plot tests:
Treatments 1-4,
Practical test:
only Treatment 1 and 3 or 4.

All applications in combination with 0.5 l/ha HASTEN Adjuvant



(Source: LWK Lower Saxony)

Application dates according to stage			BBCH 11 to 13	BBCH 15 to 19	BBCH 33-35	BBCH 39 to 42
Variants		Dosage in g/ha	1 to 5 sheets	5 to 9 sheets	30 to 50%	over 90%
			Herbicides	Insecticide	Closing date	Closing date
			NAK 1 to 3	Treatments	Insecticides, fungicides	Fungicides
1	Control	/				
2	PHOTON	20 g/ha	x	x	x	x
3	PHOTON	40 g/ha	x	x	x	
4	PHOTON	40 g/ha	x	x	x	x

Two sugar beet locations compared

Random plot trial NORD, Lower Saxony	
BioChem agrar **Location:** Hameln, Lower Saxony	
Soil type: Loamy silt, BP: 70 **pH:** **Organic matter**:	
Variety: CALLEDIA, KWS Saatzucht	
Planting date: 19.04.2023	10 plants/m²
Emergence: 01.05.2023	**Row closure:** 10.07.2023
Precipitation: 2023: 981 mm, 2017 to 2024 average 669 mm/year	
Harvest: 01.10.2023	

Random plot trial southwest, Baden-Würtemberg	
Crop Trials, Dr. Paul Reh, Station South **Location:** Neidenstein, Kraichgau, Baden-Wuerttemberg	
Soil type: Silty loam **pH:** 6.3 **Organic matter**: 2.9%	
Variety: FITIS, SES van der Haave	
Planting date: 8.4.2024,	Seed density: 100 000 seeds/ha
Emergence: 25.4.2024	
Precipitation: average 650 mm/year	
Test harvest: 30.7. 2024, leaves still healthy	
Main harvest: 25.9. 2024 ***(leaves in the Photon trial severely damaged, despite 2 x fungicide measures on 22.7. and 12.8.2024)***	

Sugar beet 2023 and 2024

PHOTON application intervals well chosen - successful treatment

Random plot test, 2023, Hameln

2023	April			May						June					July			august	Sept.	Oct.
Hameln		19.4		1.5	9.5		25.5	28.5		3.6		13.6		26.6		25.7		5.8		1.10
		Sowing		*Emergence*	Herbicide 1 PHOTON		Herbicide 2	PHOTON		Herbicide 3		Fertilization		PHOTON		Fungicide		PHOTON		Harvest

FARMER test, 2024, Hameln

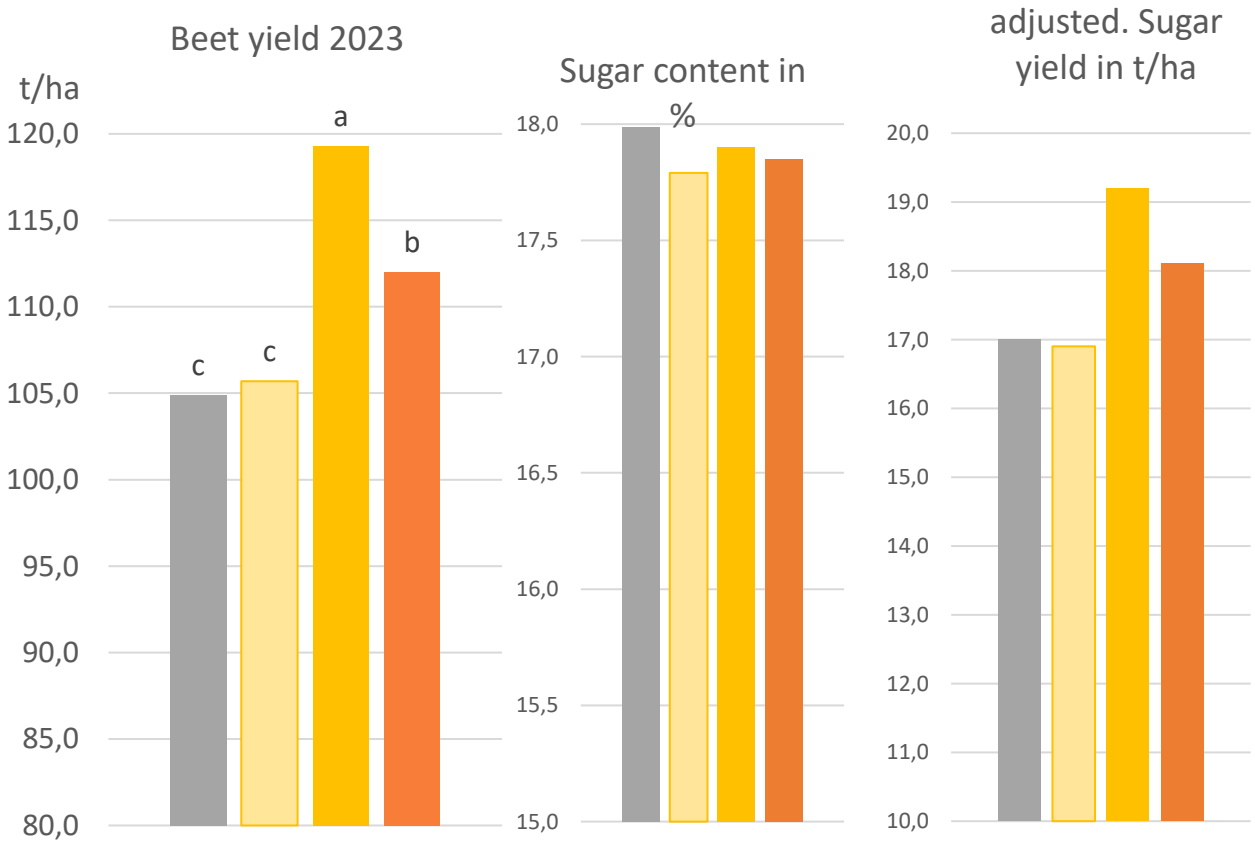
2024	March		April			May				June					July			august	Sept.	Oct.
Hameln	6.3.	21.3.	13.4	16.4.	26.4.	7.5		25.05.	27.5.	1.6	6.6		19.6			25.7			20.8.	8.10
	Fertilization + herbicide 1	Fertilizer.	**Sowing**	Herbicide 2 Roundup	*Emergence*	Herbicide 3 PHOTON		PHOTON	Harrow	Herbicide 4	Fertilization		PHOTON			Fungicide			Fungicide	Harvest

2023

Location: Hameln, direct sowing
Soil type: loamy silt, BP: 70
Variety: CALLEDIA, KWS Saatzucht

Random plot trial

Untreated. contr.
PHOTON 20g, 4 applic.
PHOTON 40g, 3 applications
PHOTON 40g, 4 applic.

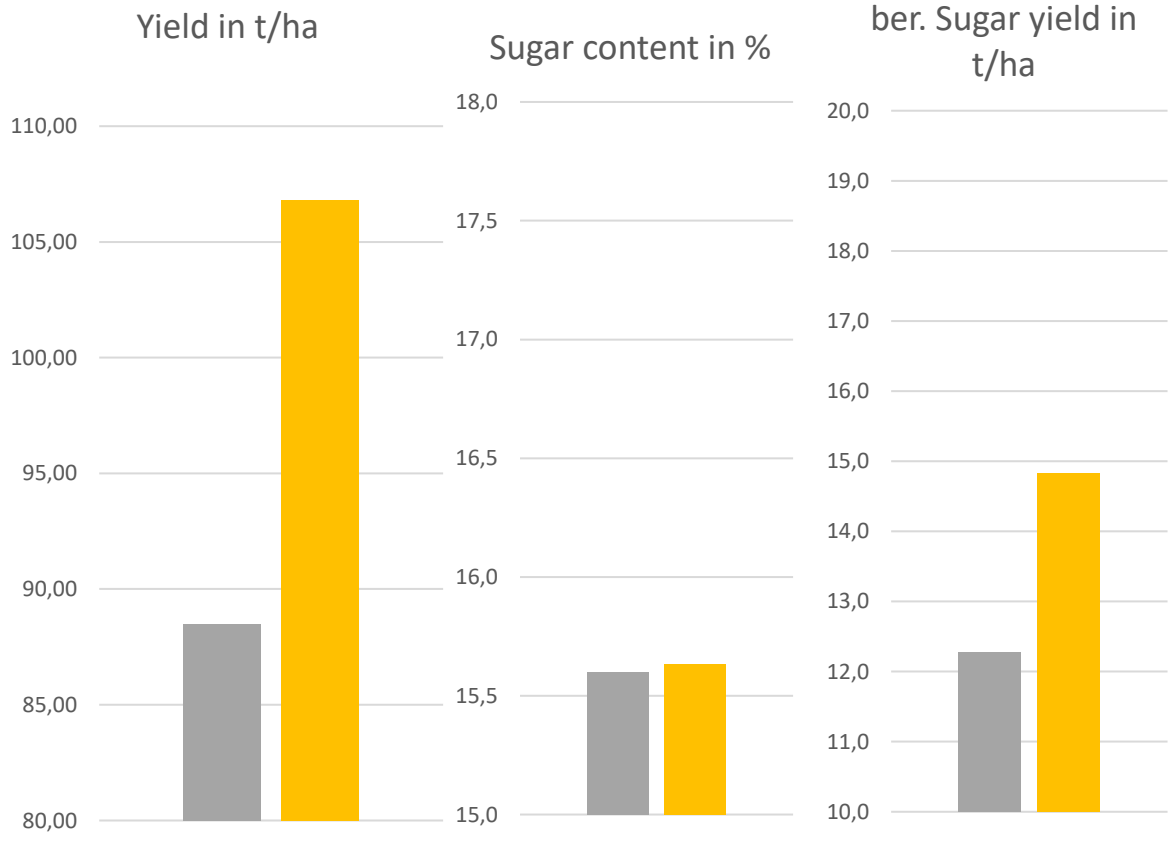


2024

Location: Hameln, mulch sowing
Soil type: loamy silt, BP: 70
Variety: HIBOU SES van der Haave

Farmer test

untreated. contr.
PHOTON 40g, 3 applications



Neidenstein, Baden-Würtemberg, 2024

Random plot trial South-West,
Location: Neidenstein, Kraichgau, Baden-Wuerttemberg

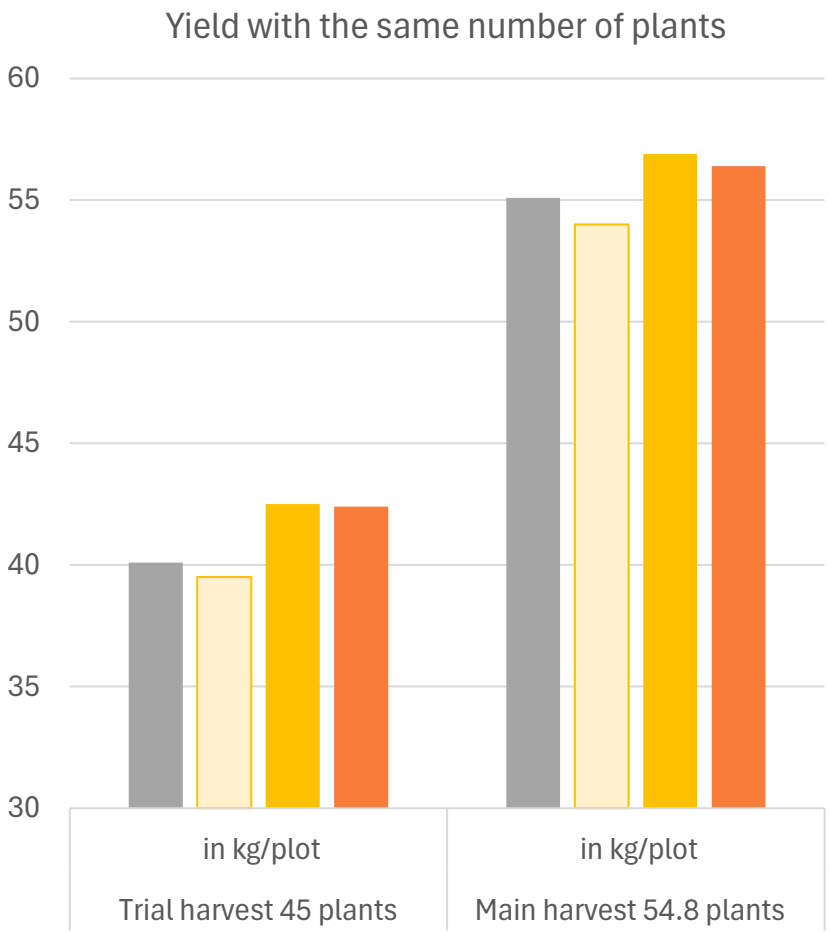
Soil: Silty loam

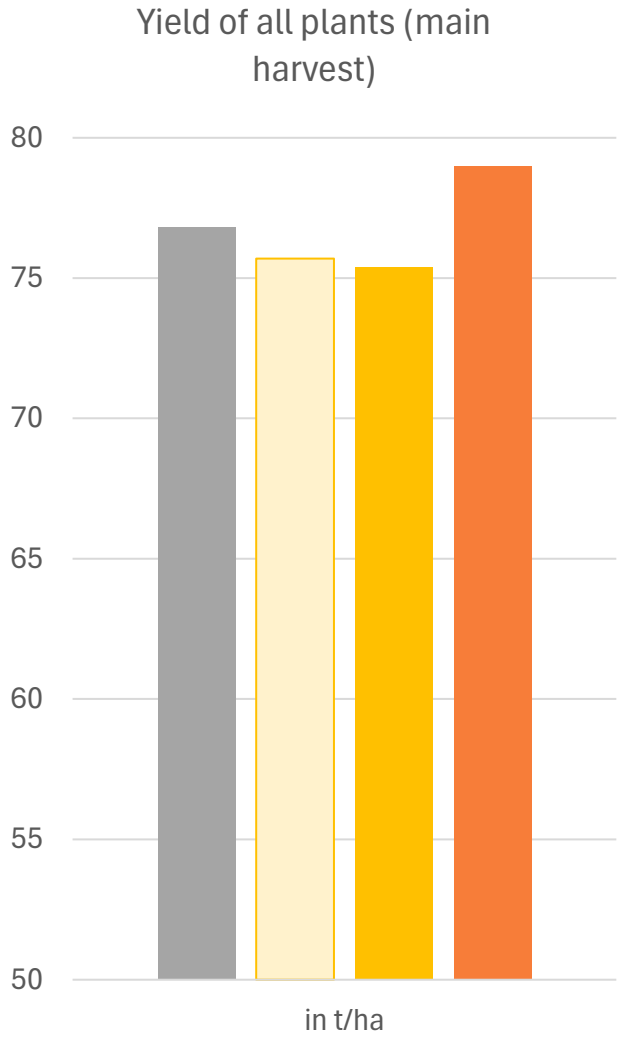
Variety: FITIS, SES van der Haave

30.7. 2024 : test harvest
(leaves still healthy)

25.9. 2024 : Main harvest
(Leaves severely damaged in the Photon trial despite 2 x fungicide treatments on 22.7. and 12.8.2024)

1	Control
2	PHOTON SG 50, 20g/ha, 4x
4	PHOTON SG 50, 40g/ha, 3x
5	PHOTON SG 50, 40g/ha, 4x





Development of infestation of a mixed infection of CERCOSPORA BETICOLA (CERCBE) with Uromyces betae and Ramularia beticula, also sporadic infestation with SBR/Stolbur detected.
CONTROL CELLS (observation window), without plant protection measures to record the development of the disease.
30.7. 2024 : Trial harvest, leaves still healthy
25.9. 2024 : Main harvest, leaves severely damaged in the Photon trial (despite 2 x fungicide treatments on 22.7. and 12.8.2024).

Date	CONTROL (without plant protection measures)	
	CERCBE Infestation level %	CERCBE distribution in %
23.07.2024	1	30
07.08.2024	9	99
20.08.2024	44	100
06.09.2024	95	100
26.09.2024	93	100

Conclusion: Further treatment with "double control"
or incorporation of fungicide and insecticide measures into the fertilizer trial from the outset (2 blocks)

PHOTON® SG 50 in SUGAR BEETS, CONCLUSION:

If PHOTON® SG 50 is used correctly, we see the following advantages for the farmer:

Yield: at a yield level of 70 to 100 tons/ha, we expect an additional yield of at least 5 to 10 tons/ha on average, even under favourable conditions.
Prerequisite is: varieties with good resistance/tolerance properties are grown at the location and the fungicides and insecticides used are applied in accordance with the instructions for use (keeping an eye on threshold and apply products in time!)

Quality: slightly increased sugar content after PHOTON application, partial reduction of the alpha amino N content

In total: we see an increase in the adjusted sugar yield
of at least 0.5 to 1.5 t/ha on average

Use of PHOTON ® SG 50 in sugar beet:

Start of the treatments:

- Basically preventive use
- as early as possible, with uniform emergence provided.
  Stage: best at the beginning of the 2-leaf stage,
  4-leaf stage of sugar beet at the latest (e.g. NaK2)

Dosage:

Both in "normal years" and in years with "expected stress"

Central Europe: 40 g/ha , 3 - 4 x , 3 weeks apart

Further information is available at:

www.photoneurope.de

You can also request PDFs and presentations on the individual crops by e-mail at ***info@photoneurope.de***

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Commercial Director: Nicholas Philipps

www.photonyield.com/de-de

Patent Act No., US 8846573, US 11638401
European Patent EP 2549864.