



Protecting sunflower from weeds and diseases

Solutions and Innovation
from BASF

Penkin R.V., BASF





Training plan

- Sunflower cultivation technologies (conventional and Clearfield)
- Species composition and harmfulness of weeds
- Sunflower broomrape
- Herbicidal protection of classic sunflower hybrids
- Herbicidal protection of imidazolinone-resistant sunflower (Clearfield system)
- Main diseases of sunflower
- Disease control



Sunflower cultivation technology

CLEARFIELD and CLEARFIELD PLUS[®] technologies

- *EURO-LIGHTNING[®]
- **EURO-LIGHTNING PLUS[®]
- OPTIMO[®]
- ARCHITECT[®]
- PICTOR[®]
- PICTOR ACTIVE[®]
- BASTA[®]

* hybrids resistant to the Euro-Lightning herbicide

** hybrids resistant to the Euro-Lightning Plus herbicide

Conventional technology

- AKRIS[®]
- FRONTIER OPTIMA[®]
- OPTIMO[®]
- ARCHITECT[®]
- PICTOR[®]
- PICTOR ACTIVE[®]
- BASTA[®]





Main weeds in sunflower crops

- The species composition of sunflower weeds includes several hundred species, with adventitious species such as ragweed and velvetleaf moving further north. Their ratio varies across crop cultivation zones. Since the end of the 20th century, the problem of broomrape in Russia has gotten worse.
- The main weeds of sunflower in all zones are **annual grass and dicotyledonous weeds**: cockspur grass, green foxtail, yellow foxtail, red-root amaranth, prostrate amaranth, rough cocklebur, spiny cocklebur, nightshade, common ragweed, fat-hen, field pennycress, field mustard, wild radish, velvetleaf, common knotgrass, lady's thumb, etc.
- **Perennial offset weeds**: creeping thistle, yellow thistle, field bindweed, field sow thistle, Russian knapweed, leafy spurge, winter cress, common wormwood, Austrian wormwood, etc.
- **Perennial rhizomatous weeds**: couch grass, Bermuda grass, sedge, Johnson grass.



Main weeds in sunflower crops

EIL (sunflower seedlings: 4–5 true leaves): 5–8 pcs./m².



Common wild oat. Emergence and flowering

EIL (seedlings: 4–5 true leaves): 4–5 pcs./m².



Green foxtail Emergence and flowering

EIL for couch grass (seedlings: 4–5 true leaves): 2–3 pcs./m².



Couch grass. Emergence and flowering



Bermuda grass. Emergence and flowering

Photos from open sources



Main weeds in sunflower crops



Johnson grass. Emergence and flowering

EIL (seedlings: 4–5 true leaves): 3–4 pcs./m².

EIL (seedlings: 4–5 true leaves): 2–3 pcs./m².



Black bindweed. Emergence and flowering



Winter cress. Emergence and flowering



Fat-hen

Photos from open sources

Main weeds in sunflower crops



Common ragweed. Emergence and flowering

EIL (seedlings: 4–5 true leaves): 2 pcs./m².



Field sow thistle. Emergence and flowering

EIL (seedlings: 4–5 true leaves): 1 pc./m².



Creeping thistle. Emergence and flowering

EIL (seedlings: 4–5 true leaves): 2–4 pcs./m².



Field bindweed. Emergence and flowering

Photos from open sources



Nutrient removal by weeds

Macro- and micronutrient content in the green matter of weeds, $\mu\text{g/g}$

Weeds	Biogenic macronutrients						Micronutrients							
	K	P _{total}	S _{total}	Ca	Mg	Fe	Si	Al	Mn	Na	Zn	Br	Cu	B
Cockspur grass	43,000	2,800	1,900	6,000	2,800	550	1,000	670	270	220	24	26	5.1	3.8
Fat-hen	33,000	3,500	2,500	21,000	4,800	1,800	1,000	1,000	240	76	290	36	6.5	17
Field bindweed	27,000	2,200	2,200	13,000	3,300	630	890	640	100	55	25	33	7.2	18
Large-flowered hemp-nettle	17,000	1,600	1,000	7,900	1,200	180	460	260	140	38	24	42	4.0	14
Red-root amaranth	19,000	2,200	1,400	11,000	2,000	150	350	210	79	61	17	46	3.1	19
Field sow thistle	20,000	1,400	1,100	9,600	2,200	180	520	230	48	66	19	66	2.7	15
Scentless false mayweed	20,000	3,800	2,300	8,400	2,200	760	940	750	190	150	51	39	15	11
Foxtail	38,000	2,900	1,900	8,000	2,900	1,600	780	1,600	200	180	82	34	8.2	5.9
Couch grass	11,000	1,900	1,300	4,600	790	1,300	1,000	1,400	110	48	91	19	5.3	5.1
Creeping thistle	12,000	1,400	3,700	21,000	4,700	370	850	290	52	57	60	110	6.6	14
Average	24,000	2,370	1,930	11,050	2,689	752	779	705	143	95.1	68.3	45.1	6.4	12.3

Belgorod Agricultural Academy research, open-source information



Harmfulness of weeds

- Intense competition for water, territory, and nutrients
- Rapid development compared to sunflower, which is especially dangerous in the early stages of sunflower development
- Serve as reservoirs for many diseases and pests
- Bad infestation can reduce yield by 60–80%
- Reduce product quality

BASF's own trials: Volga region, 2020



It is impossible to get a good and high-quality yield from such fields!!!!



Bad infestation of sunflower crops



Protection of classic sunflower hybrids

- Agricultural technique: inter-row tillage to remove weeds
- Soil herbicides (Agris, SE)
- Graminicides during the growing season (Stratos Ultra, EC)



Characteristics of the active ingredients of soil herbicides

Active ingredient	Chemical class	Mechanism of action	Features
Propisochlor, S-metolachlor, metazachlor, dimethenamid	Chloroacetamides	Seedling growth inhibitors	Not mobile in plants; only active against seedlings. Create a herbicide screen on the soil surface
Pendimethalin	Dinitroanilines	Cell division inhibitors	Mostly inhibit seedlings
Mesotrione, isoxaflutole, topramezone	Other substances	Carotenoid inhibitors	Disrupt metabolic processes; pronounced pigment effect
Clomazone	Isoxazolidinones	Carotenoid synthesis inhibitor	Soil and foliar herbicides; mobile in the leaves. Symptoms do not appear until photosynthesis begins
Prometrin, terbuthylazine , metribuzin	Triazines, triazinones	Photosynthesis inhibitors	Soil herbicides; symptoms do not appear until photosynthesis begins
Oxyfluorfen	Diphenyl ethers, phenylphthalamides	Seedling growth inhibitors	Contact herbicides. Active when weed seedlings come into contact with the herbicide film on the soil surface



Registration of main active ingredients of soil herbicides

Active ingredient	Maize	Sunflower	Rapeseed	Soybean	Sugar beet
S-metolachlor	+	+	+	+	+
Propisochlor	+	+	+	+	+
Dimethenamid	+	+		+	+
Metazachlor			+		
Pendimethalin		+			
Mesotrione	+				
Isoxaflutole	+			+	
Topramezone	+				
Clomazone		+	+	+	+
Terbuthylazine	+	+		+	
Metribuzin	+			+	
Prometrin	+	+		+	
Oxyfluorfen/flumioxazin		+		+	

+ : pending registration

Akris®

Highly effective pre-emergence
herbicide for sunflower





Description of the Akris[®] herbicide

Active ingredients	Dimethenamid-P 280 g/L + terbuthylazine 250 g/L
Formulation	Suspension emulsion
Recommended application rate*	2.0–3.0 L/ha
Crop	Sunflower
Weed spectrum	Annual grass and dicotyledonous weeds
Application time	Spraying crops before emergence
Packaging	2x10 L

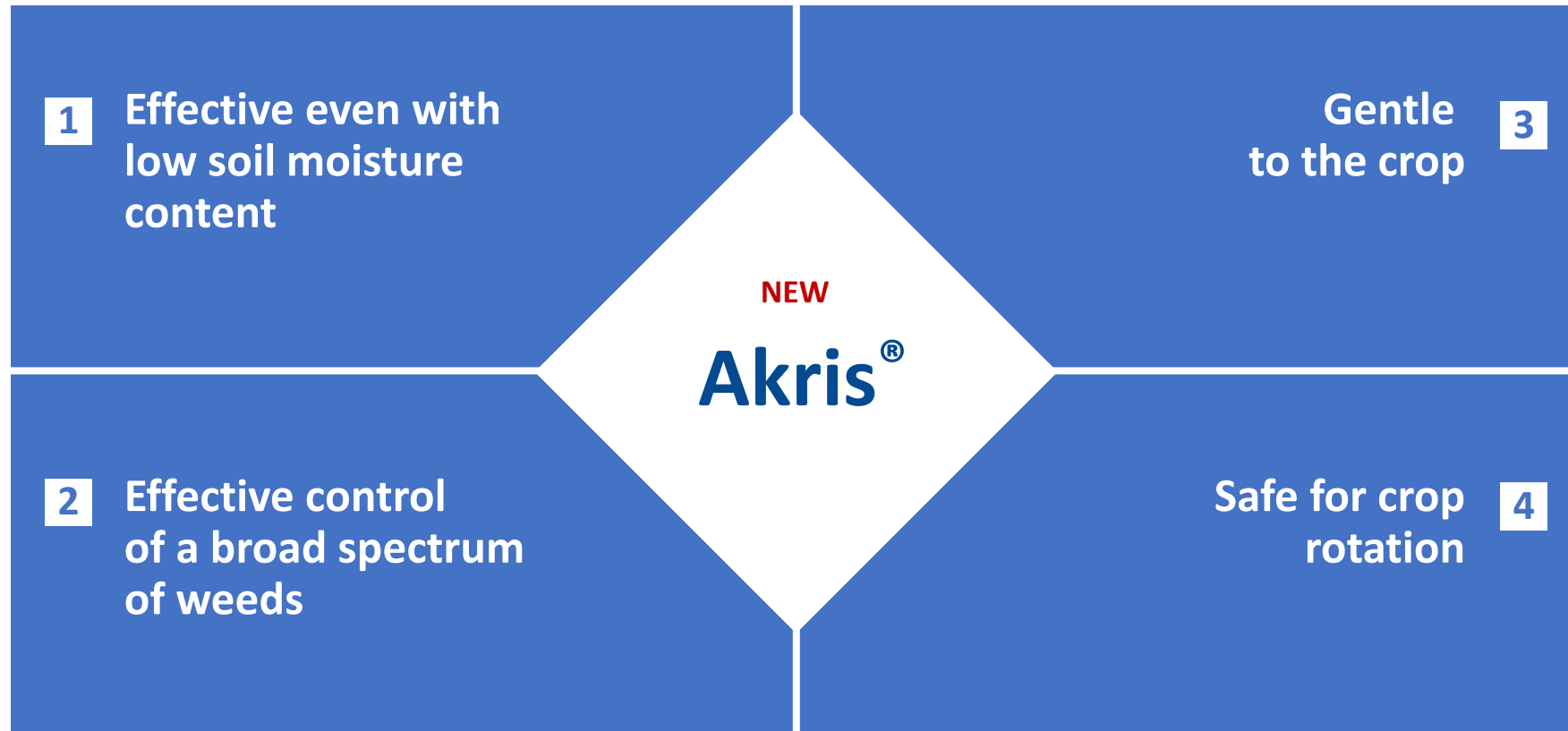
NEW

Highly effective pre-emergence herbicide for sunflower



Advantages of the Akris[®] herbicide

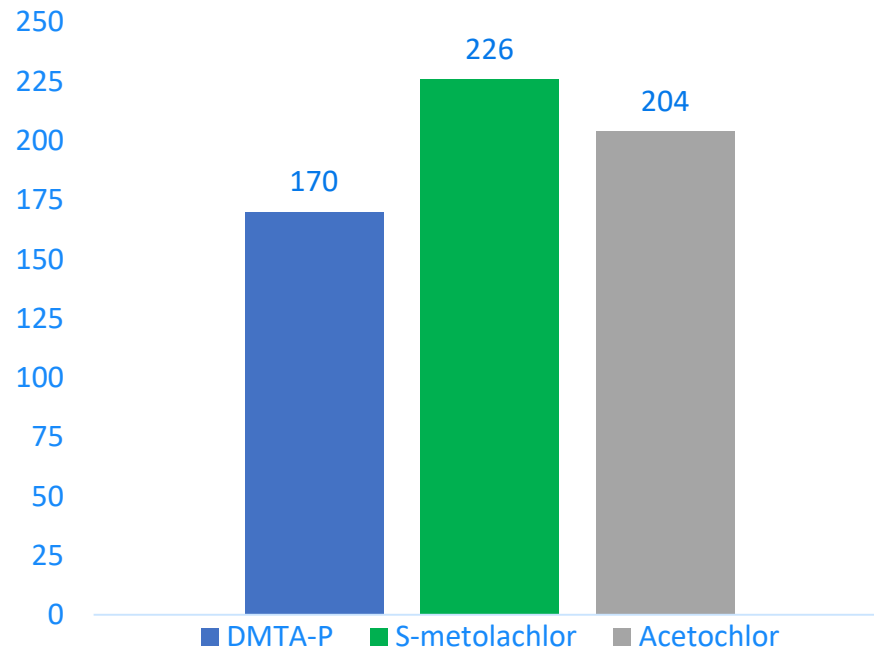
- Weed-free crops!



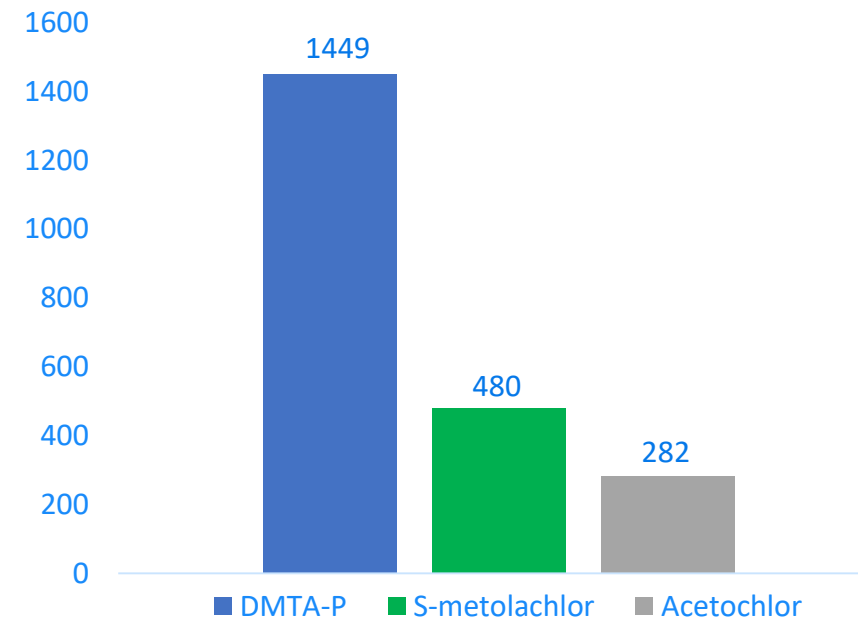


AKRIS®: DMTA-P: bioavailability

Soil adsorption coefficient of the active ingredient, L/kg

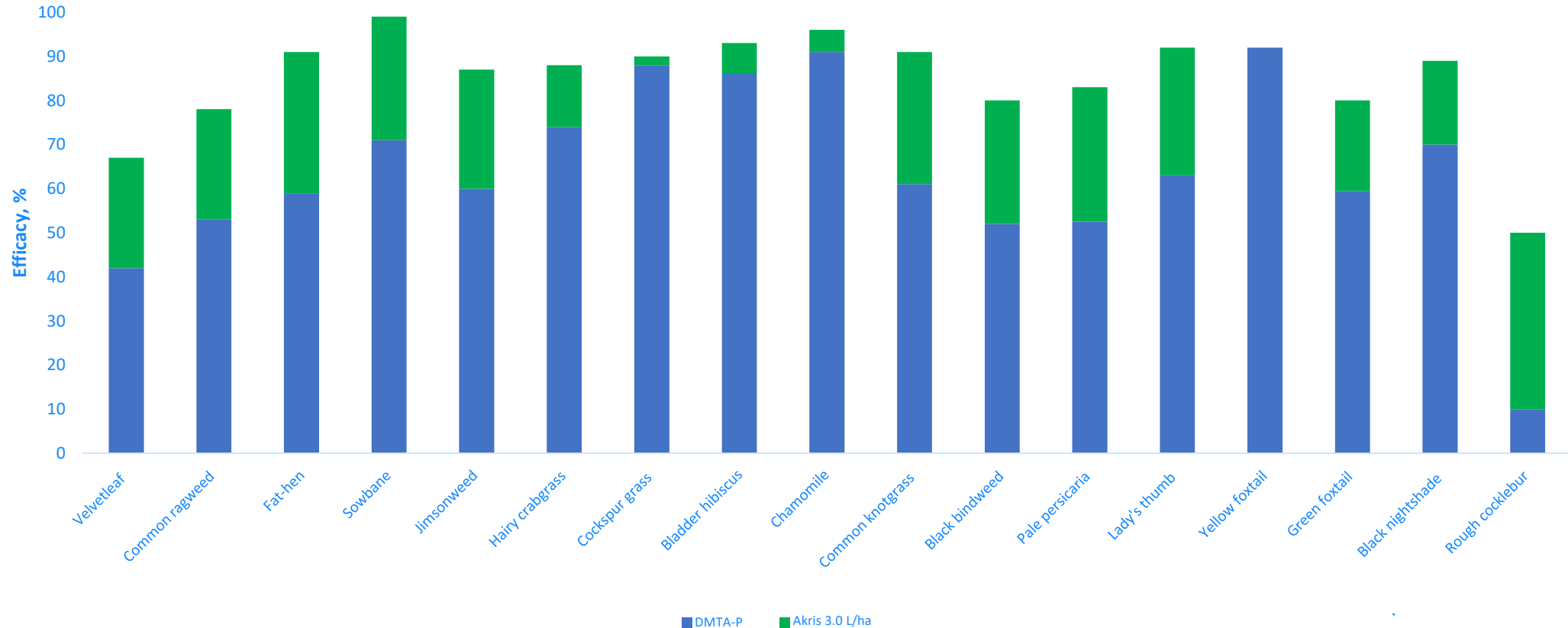


Solubility in water, mg/L



- High solubility in water and low soil absorption improve the availability of the active ingredient for weed control
- Akris persists in the soil at a depth of 3–5 cm for a long time, with the ability to reactivate during precipitation

Akris[®]: What does terbuthylazine, the second active ingredient in the herbicide, do?



The second active ingredient allows for more effective control of dicotyledonous weeds and adds effectiveness against grass weeds



Efficacy of various application rates

Control



Bad infestation with fat-hen and cockspur grass

Akris 2.0 L/ha



Occasional weeds. Weeds are severely inhibited

Akris 2.5 L/ha



7 days after application

Akris 3 L/ha



Lipetsk Agricultural Center
BASF, 2020

Efficacy of various application rates



35 days after application



Lipetsk Agricultural Center BASF, 2020

Efficacy vs. competitors



Before harvesting

Control

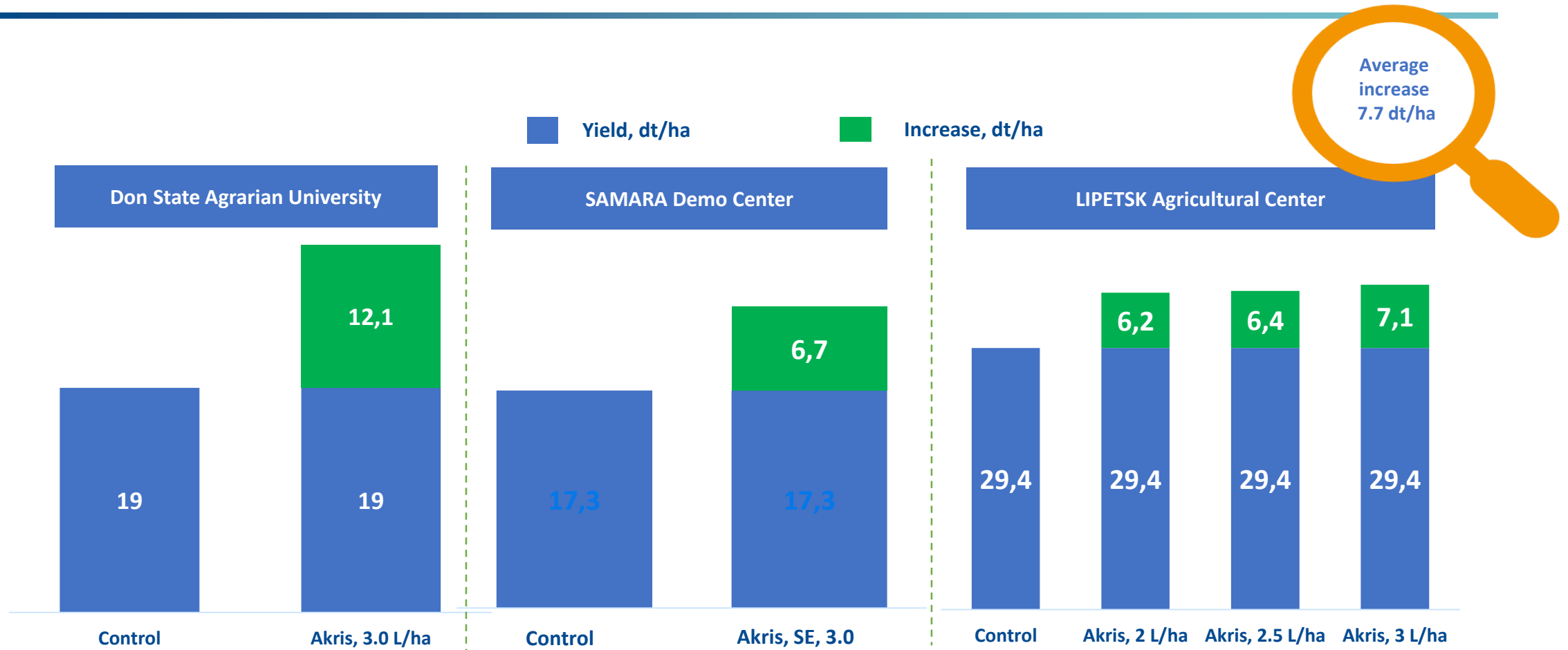


Akris 2.5 L/ha



Lipetsk Agricultural Center BASF, 2020

Effect of Akris[®] on sunflower yield Russia, 2020



The Akris herbicide is highly effective against weeds in various regions of Russia



Recommendations for use

- The herbicide should be applied to the soil during, immediately after, or several days after sowing. The soil should be properly prepared and not dry.
- The Akris herbicide should not be applied on sunflower at late stages (emergence, seed lobes, and the first pair of leaves).
- The herbicide is highly effective when applied correctly and increases yield significantly.

AKRIS[®]: recommendations for use



Humus level



Weed infestation

AKRIS[®]
2.0–3.0 L/ha





Sunflower broomrape



- Sunflower broomrape is a parasitic plant that lives off the nutrients and water of its host plant.
- Broomrape can remain in the soil without emerging, remaining viable for up to 8–12 years.
- If the soil is heavily contaminated with seeds, broomrape can destroy up to 100% of the sunflower crop.
- Broomrape has high seed productivity; one plant produces up to 500–700 thousand small seeds that easily spread in the field.
- Broomrape is an extremely aggressive weed that quickly overcomes sunflower resistance. To date, 8 races of broomrape are known.

Sunflower plants affected by broomrape





Clearfield® Plus production system components



Seeds

Highly productive hybrids

18 hybrids from major seed producers



Herbicide

Innovative formulation → A new standard for weed control **with a flexible/reduced concentration of the active ingredient** to unlock the full potential of sunflower yield

1.6 L/ha: a standard for control of a broad spectrum of weeds

2.0 L/ha: effective control of difficult-to-eradicate weeds and broomrape



Description of the Euro-Lightning[®] Plus herbicide

Active ingredients	Imazamox 16.5 g/L Imazapyr 7.5 g/L
Formulation	Soluble concentrate (SC)
Recommended application rate*	1.6–2.0 L/ha
Crop	Sunflower hybrids resistant to the Euro-Lightning Plus herbicide
Weed spectrum	Annual grass and dicotyledonous weeds
Application time	Spraying crops at the early phases of weed growth (2–4 leaves) and when the crop has 4–6 true leaves
Packaging	2x10 L

- A two-component herbicide against a broad spectrum of weeds for the Clearfield Plus system



Biological effectiveness of weed control technologies



Control without herbicide



Tillage



S-metolachlor 960 g/L, 1.6 L/ha



Tribenuron methyl 750 g/kg, 45 g/ha



Euro-Lightning Plus, 1.6 L/ha



Euro-Lightning Plus, 2.0 L/ha

BASF trials, Rostov Region.

BASF trial, Rostov Region, 2019



Control



Euro-Lightning Plus 2 L



- Hybrid not resistant to broomrape

Absence of broomrape 2 months after treatment



Weed control system for sunflower

- Clearfield® Plus System

EURO-LIGHTNING PLUS IS INTENDED FOR USE ON Clearfield Plus HYBRIDS ONLY

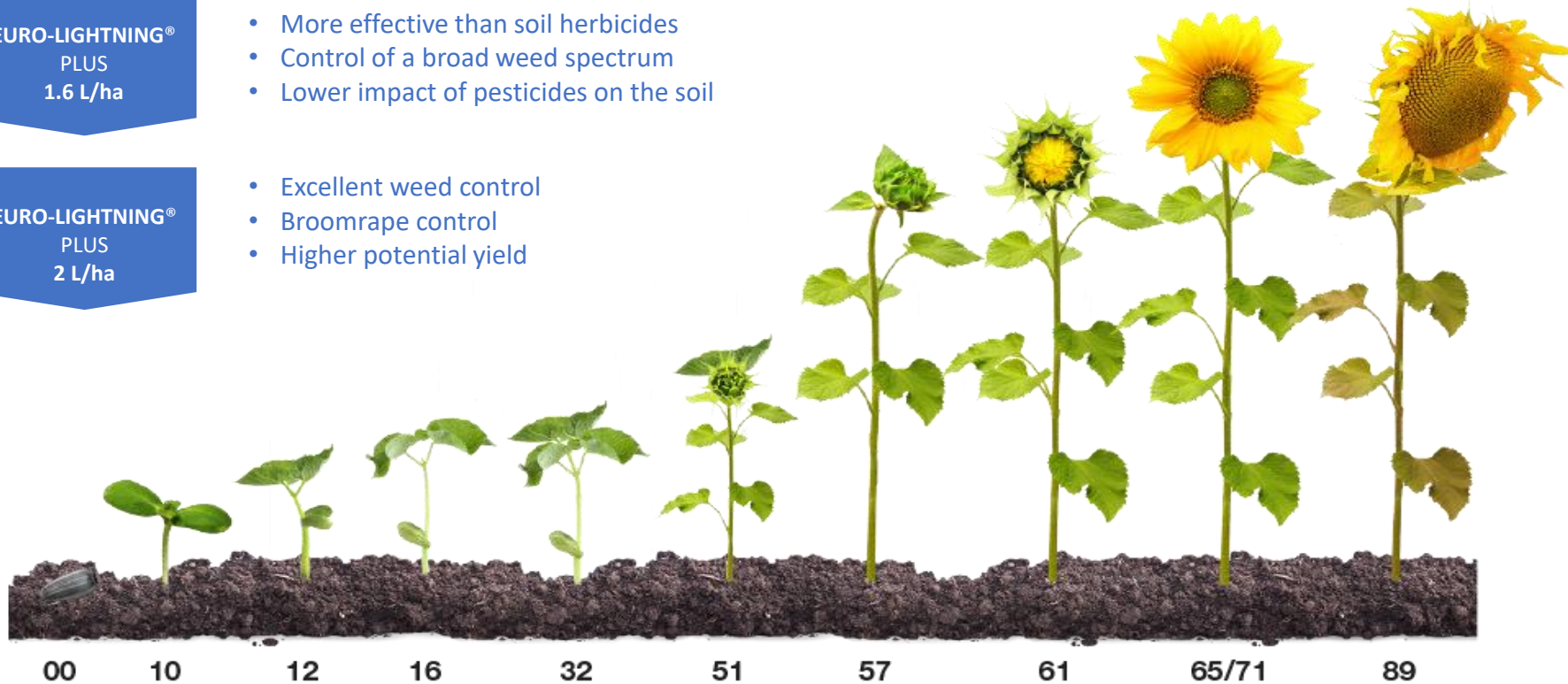


EURO-LIGHTNING® PLUS
1.6 L/ha

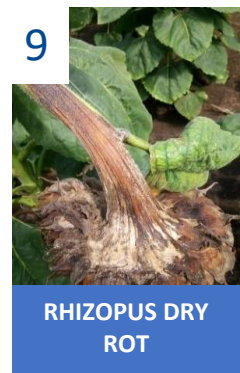
- More effective than soil herbicides
- Control of a broad weed spectrum
- Lower impact of pesticides on the soil

EURO-LIGHTNING® PLUS
2 L/ha

- Excellent weed control
- Broomrape control
- Higher potential yield



Main diseases of sunflower



Photos 1, 2, 3, 5, 6, and 7: BASF

Photos 4, 8, 9, and 10: I.I. Shulyak



What harm can sunflower diseases cause?

Pooled data, 2000–2017 (All-Russian Research Institute of Oil Crops, All-Russian Research Institute of Plant Protection)

*Averaged field data

**Averaged laboratory data

Disease	Yield loss, dt/ha*	Decrease in oil content, %**
White rot	6–10	30–45
Gray mold	4–6	30–50
Phoma rot	8–10	25–35
Phomopsis blight	9–15	40–50
Alternaria spot	3–7	25–40
Rust	4–9	30–45
DOWNY MILDEW	5–10	20–30

Fungicide application



Control (without fungicide): BASF Volga Demo Center, 2020



100% development and spread of rust on sunflower. Pronounced symptoms across all layers

Control (without fungicide): BASF Volga Demo Center, 2020



Rust of the lower and middle leaves

Optimo (pyraclostrobin 200 g/L), EC 0.5 L/ha (BBCH 32–33): 6–8 leaves of the crop



More than 1 month after application; occasional symptoms (pustules) on the lower and middle leaves. Treated plants are noticeably different from control plants.



Optimo, EC 0.5 L/ha (BBCH 32–33): 6–8 leaves of the crop



General view of plants after treatment with Optimo, EC

Pictor Active (pyraclostrobin 250 g/L + boscalid 150 g/L), SC 0.8 L/ha (BBCH 32–33): 6–8 leaves of the crop

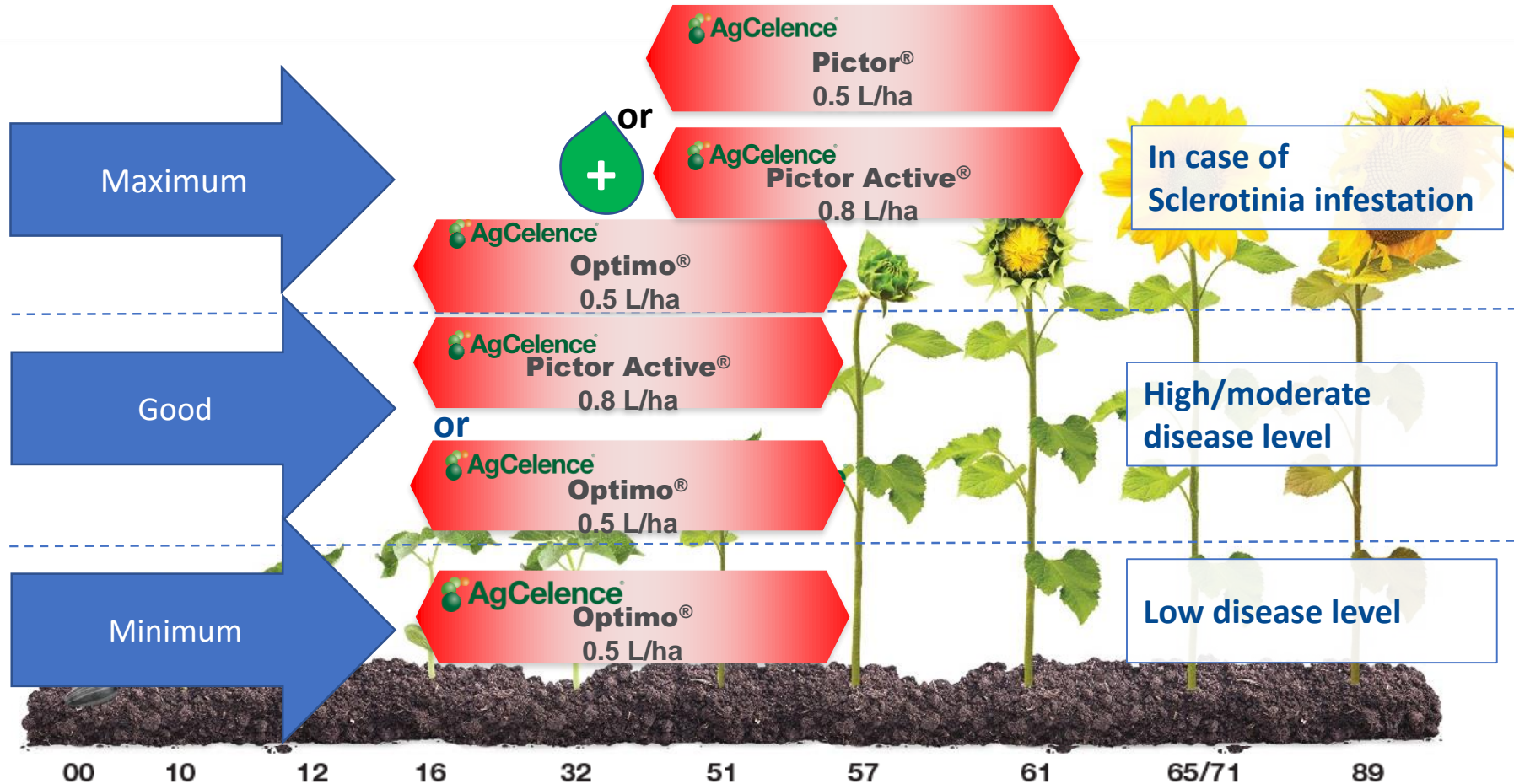


Appearance of plants after treatment.



Disease control system for sunflower

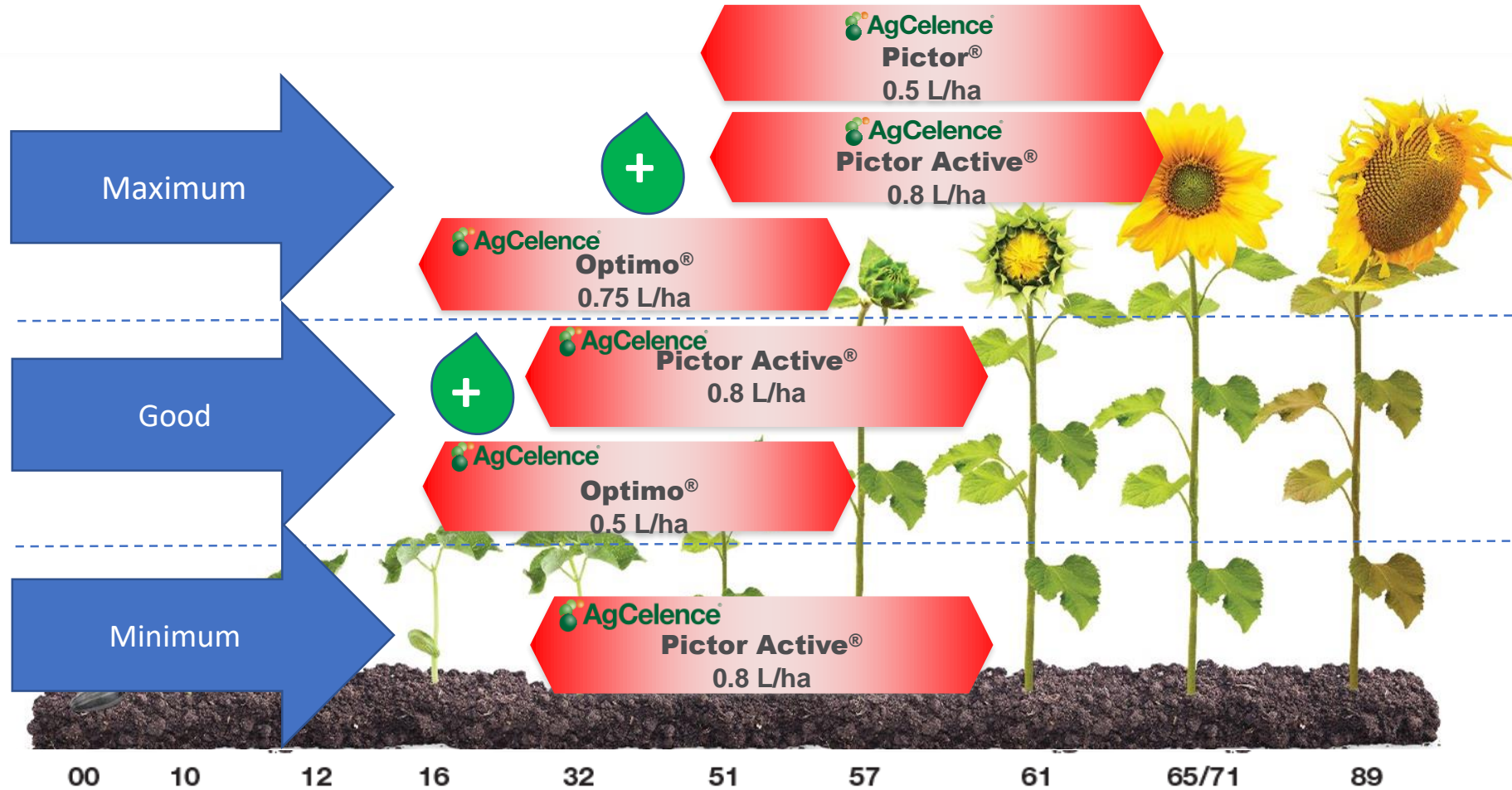
- Protection of oil-bearing sunflower





Disease control system for sunflower

- Protection of confection sunflower



*BASF trial results



Thank you!