Copper in Organic Fruit

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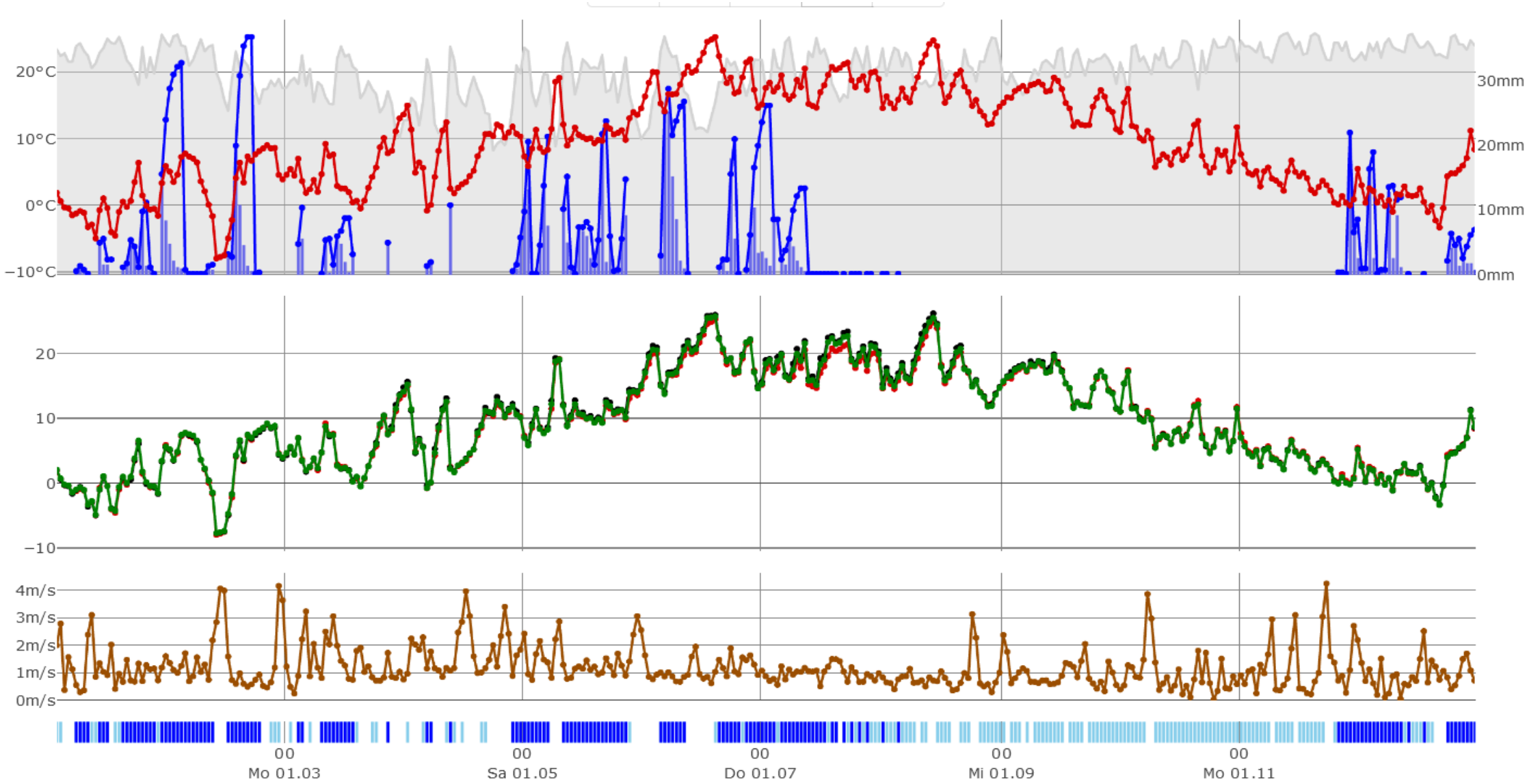
föko
Fördergemeinschaft
Ökologischer Obstbau e

Climatic conditions in 2021: Data from Lake Constance



Data Base Apple and Pear for Fresh Fruit Production
Area included in the Monitoring

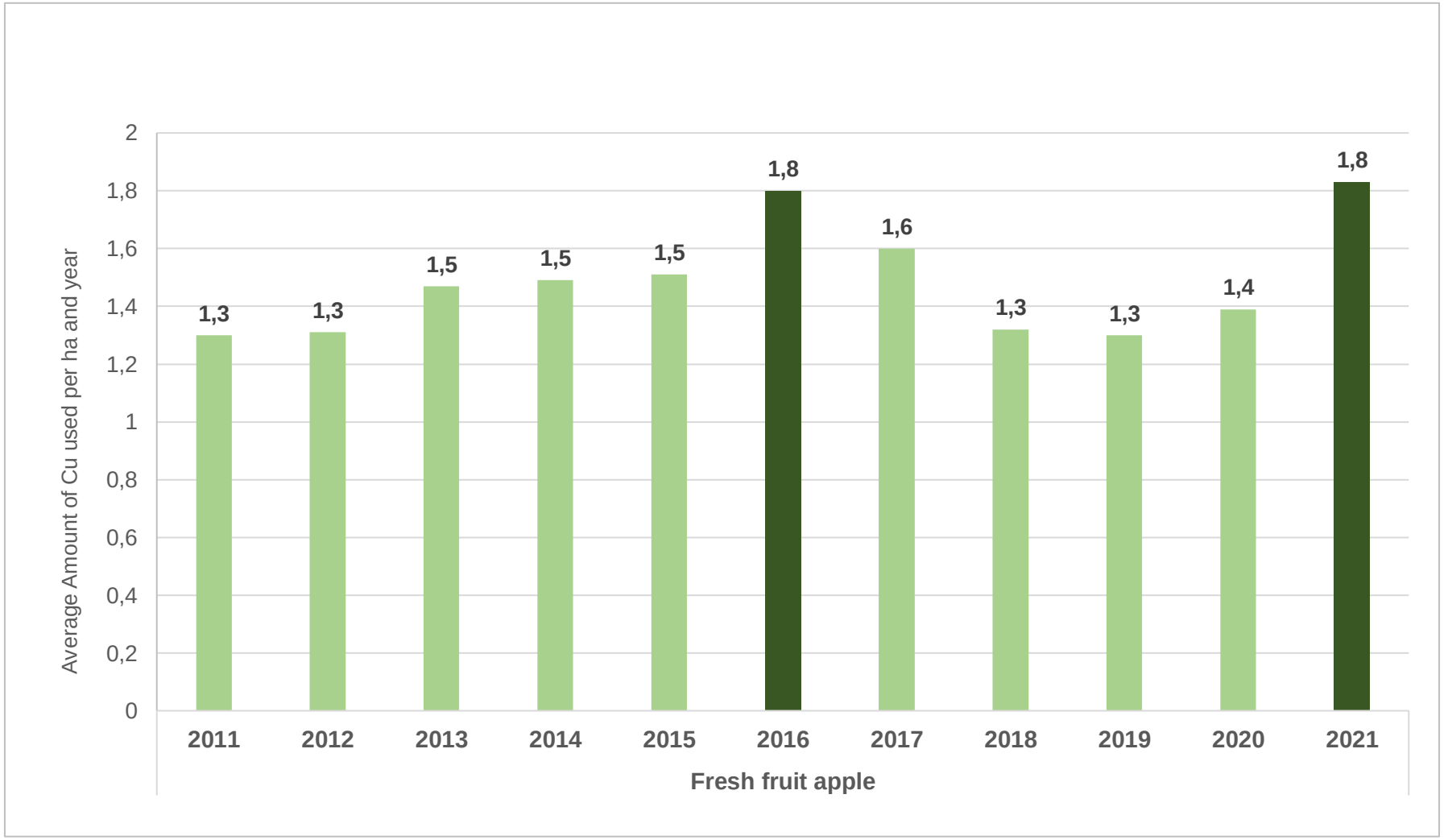
Fruit species	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fresh fruit apple	1517	1617	2126	1934	1981	2737	2123	1684	2058	1248	2504

For the area in monitoring, only the area treated with copper compounds was considered. The data are provided by the associations Bioland, Demeter and Naturland.

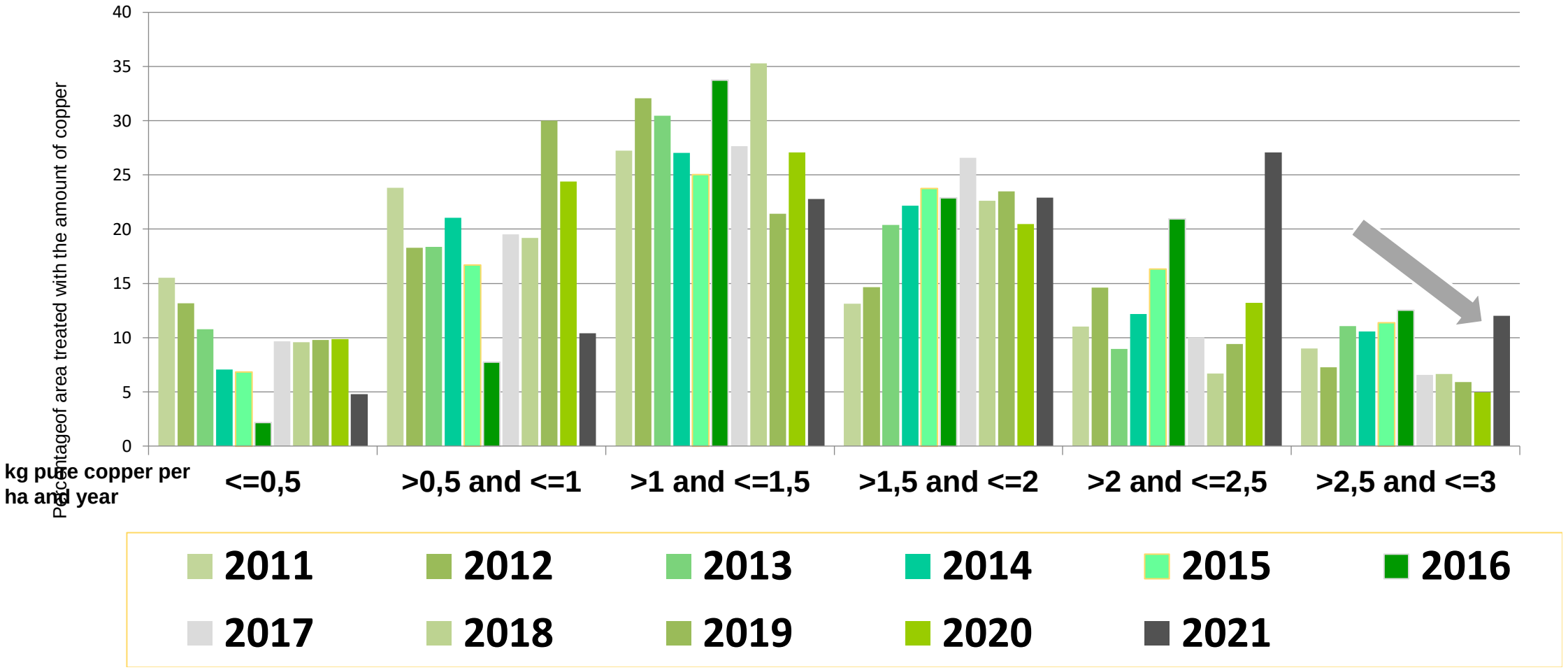
For fresh fruit apple from about 20 to about 60 % of the area under organic cultivation was covered by the monitoring.

For pear, about 11-18 % of the area under organic cultivation was covered. In 2020, only ca. 2 % of the area was monitored (data not reliable).

Amounts of Copper (pure copper in kg/ha) applied in organic apple growing in Germany in the years 2011 -2021



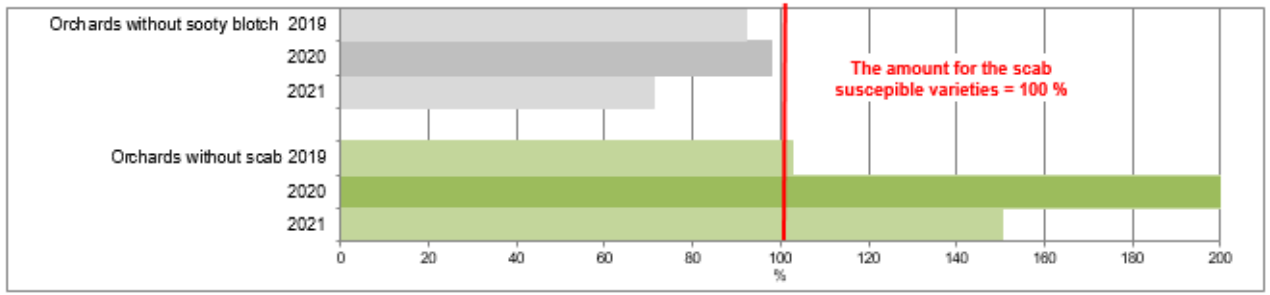
Percentage of the areas treated with copper in increasing amounts (0.5 kg steps) for apple fresh fruit in the years 2011 to 2021



The development of the potential of scab „resistant“ schowi varieties for copper reduction

Input = Total amount for the scab "resistant" varieties in relation to the susceptible varieties

Output = Percentage of orchards without scab on fruit for the scab "resistant" varieties in relation to the susceptible varieties

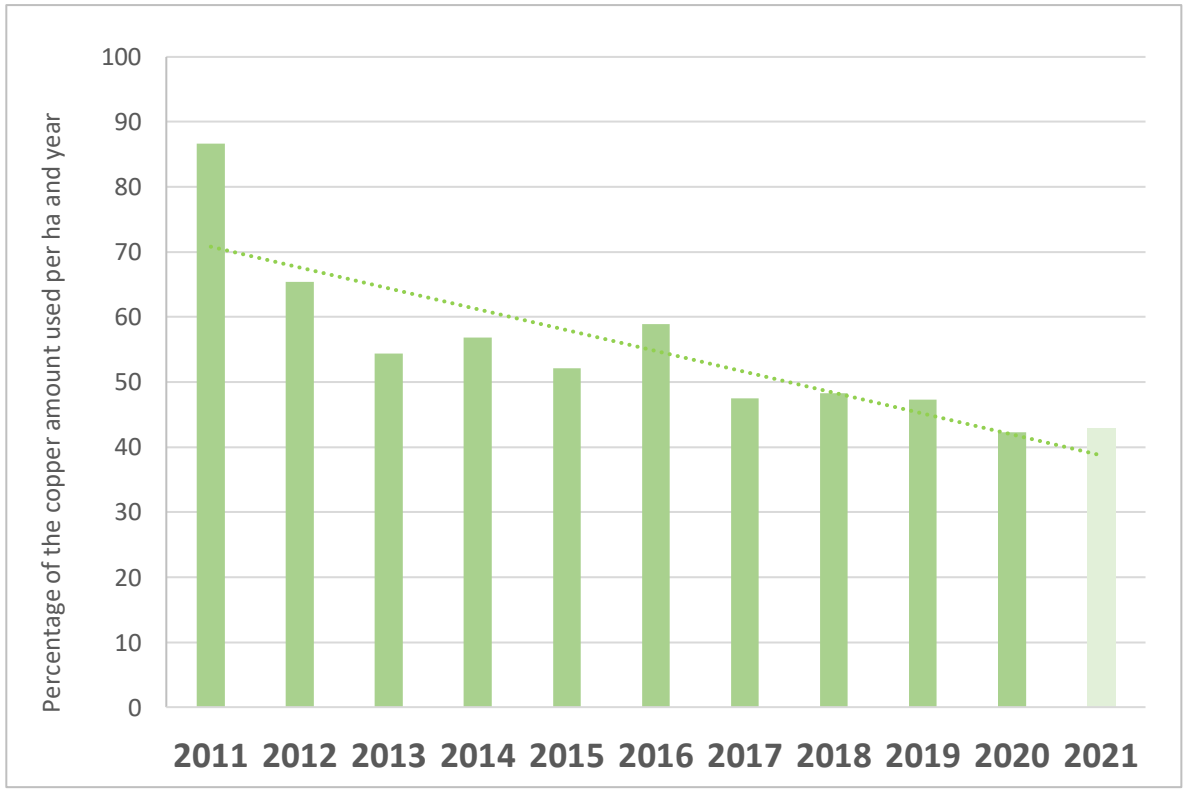


There is a reduction of the reduction…..

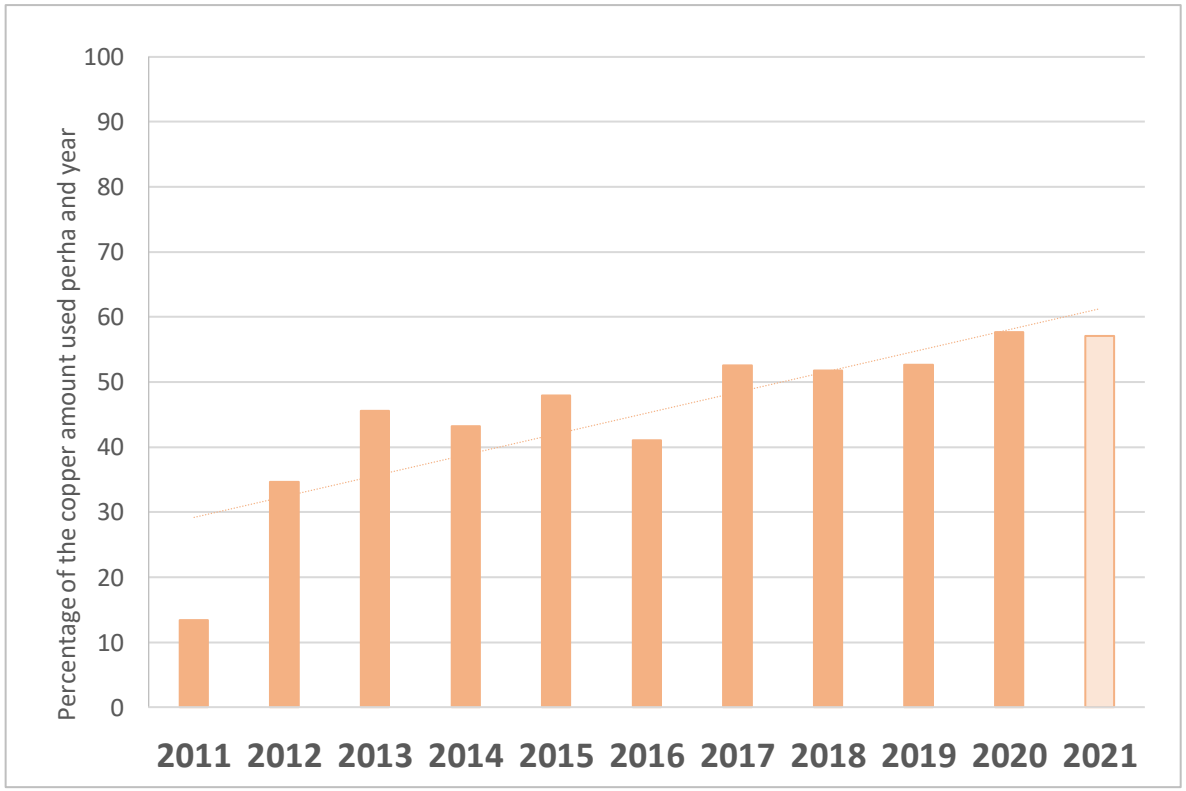
Data from FÖKO for Region Baden Wuerttemberg

Development of the percentage of the amount of pure copper used per ha and year before and after blossom in the period from 2011 to 2021

Before blossom (BBCH > 60)



After blossom (BBCH > 59)



Gefördert durch:
Bundesministerium für Ernährung und Landwirtschaft
BÖLN
aufgrund eines Beschlusses des Deutschen Bundestages

Data from FOEKO, for 2021 perliminary data

Current Need For Action

- **The continuous availability of Curatio was crucial for the success of the past years in copper minimisation. The improved strategies are good adapted in practice. An interruption in the availability of Curatio would lead to a considerable increase of copper use and to a return to „old“ practices with much higher amounts of copper!**

- Availability of Aluminium sulphate and of summer applications of Calcium hydroxide.

- Availability of new alternative products to practice: Registration of NEU 1143 and start of on farm trials to introduce this product in the strategy and in practice. **We are still waiting and there is again delay!**

- Develop variety-specific combination strategies for scab tolerant varieties (Project Oekoapfelforward)

- Maintain and increase the acceptance of all partners of the food chain for small „spots“ of scab infection on fruits.

- **Organic breeding programme** for pome, stone and small fruit in cooperation with the FOEKO network and Apfel:gut , breeders, research stations and fruitgrowers with the aim to develop robust varieties suitable for organic fruit growing.

- Introduce new robust varieties to the market with a professional variety concept and increase the awareness in the whole production chain for the danger of a decrease of the genetic biodiversity of our fruit varieties.

COPPER IN VITICULTURE

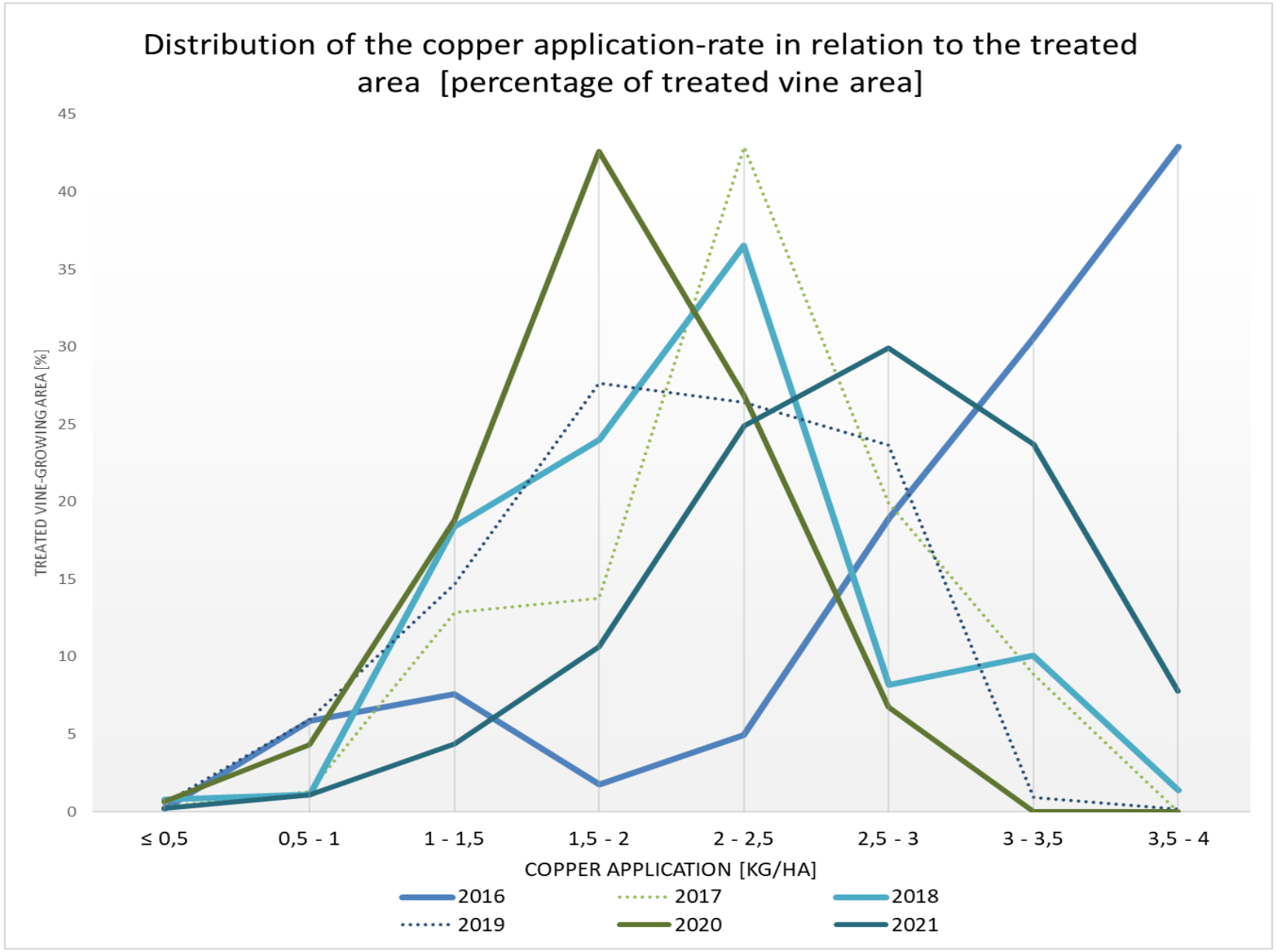
HANNEKE SCHÖNHALS (ECOVIN)

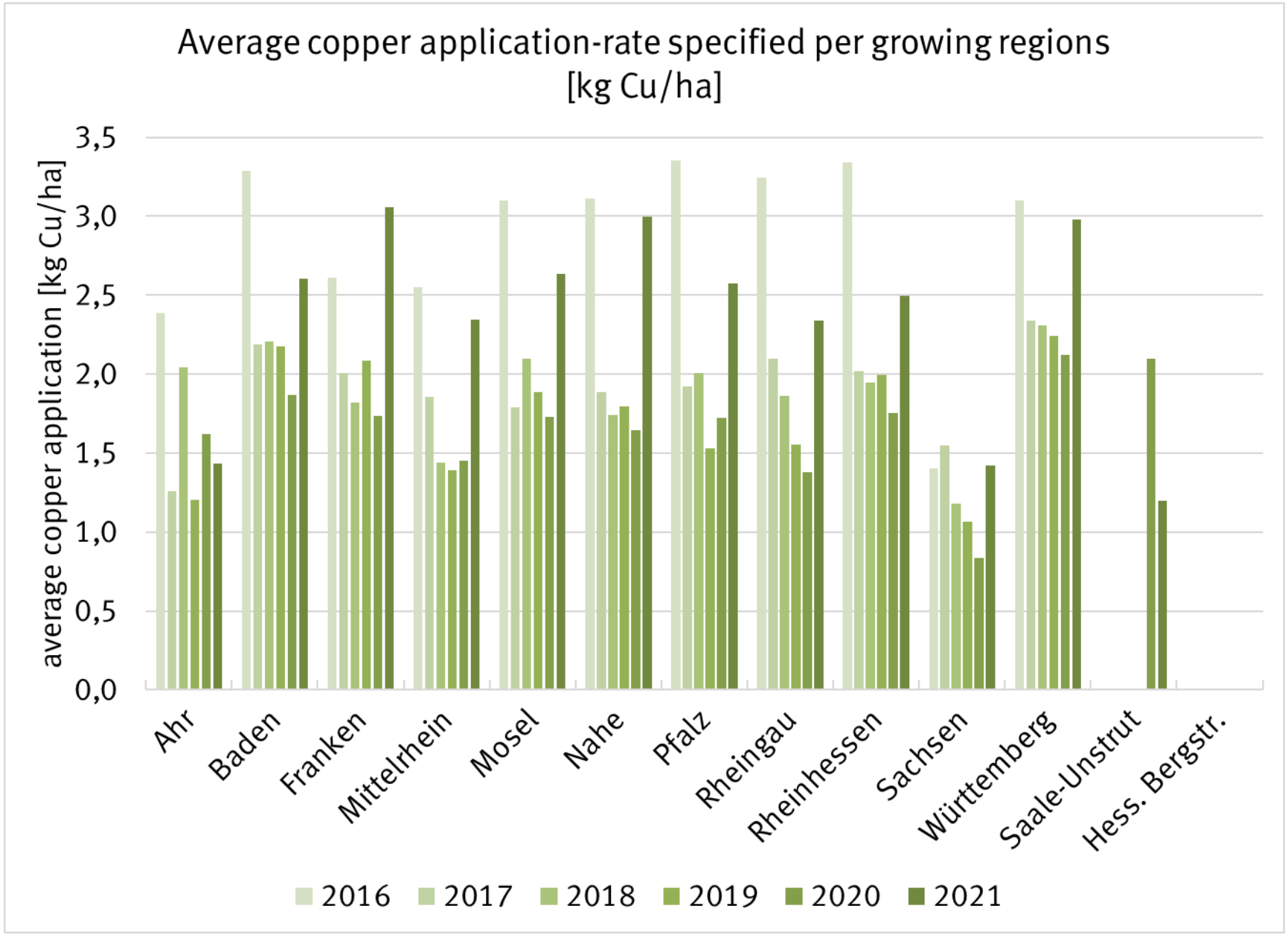
viticulture - data base	2018	2019	2020	2021
total vine-growing area in Germany [ha]*	102.873	103.079	103.180	103.361
total organic vine-growing area in Germany [ha]**	9.300	10.600	11.900	12.500
percentage organic of total vine-growing area in Germany [%]	9,0%	10,3%	11,5%	12,1%
vine-growing area included in this monitoring [ha] (data from organic farming associations)	2.069	2.469	2.547	2.555
percentage monitored area of total organic vine-growing area in Germany [%]	22,2%	23,3%	21,4%	20,4%
monitored area treated with copper [ha] (data from organic farming associations)	1.993	2.300	2.454	2.474

* source: Statistisches Bundesamt (Destatis), 2022

** source: BÖLW, 2022: Branchen Report 2022 Ökologische Lebensmittelwirtschaft


Weighted average copper application rate over the years
2013 - 2021
average copper application [kg Cu/ha]
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
2,18
2,40
1,82
3,23
2,03
2,09
1,98
1,83
2,67
2013
2014
2015
2016
2017
2018
2019
2020
2021


Distribution of the copper application-rate in relation to the treated area [percentage of treated vine area]
TREATED VINE-GROWING AREA [%]
45
40
35
30
25
20
15
10
5
0
≤ 0,5
0,5 - 1
1 - 1,5
1,5 - 2
2 - 2,5
2,5 - 3
3 - 3,5
3,5 - 4
COPPER APPLICATION [KG/HA]
2016
2017
2018
2019
2020
2021


Average copper application-rate specified per growing regions
[kg Cu/ha]
average copper application [kg Cu/ha]
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
Ahr
Baden
Franken
Mittelrhein
Mosel
Nahe
Pfalz
Rheingau
Rheinhessen
Sachsen
Württemberg
Saale-Unstrut
Hess. Bergstr.
2016
2017
2018
2019
2020
2021

NEED FOR ACTION CONCERNING COPPER IN ORGANIC VITICULTURE

- Clarification of the admission of acidic alumina and potassium phosphonate
- Optimization of the copper use and other plant health care strategies
- Development of new alternatives, strategies and synergies
- PIWI (fungus resistant grapevines): cultivation of new varieties, continuing research for new varieties, propagation
- No further reduction of the maximum copper application per year

Use of copper in the organic potato production

Dr. Stephanie Fischinger & Carolin Grau
09.11.2023

Bild: Bioland e.V., Sonja Herpich

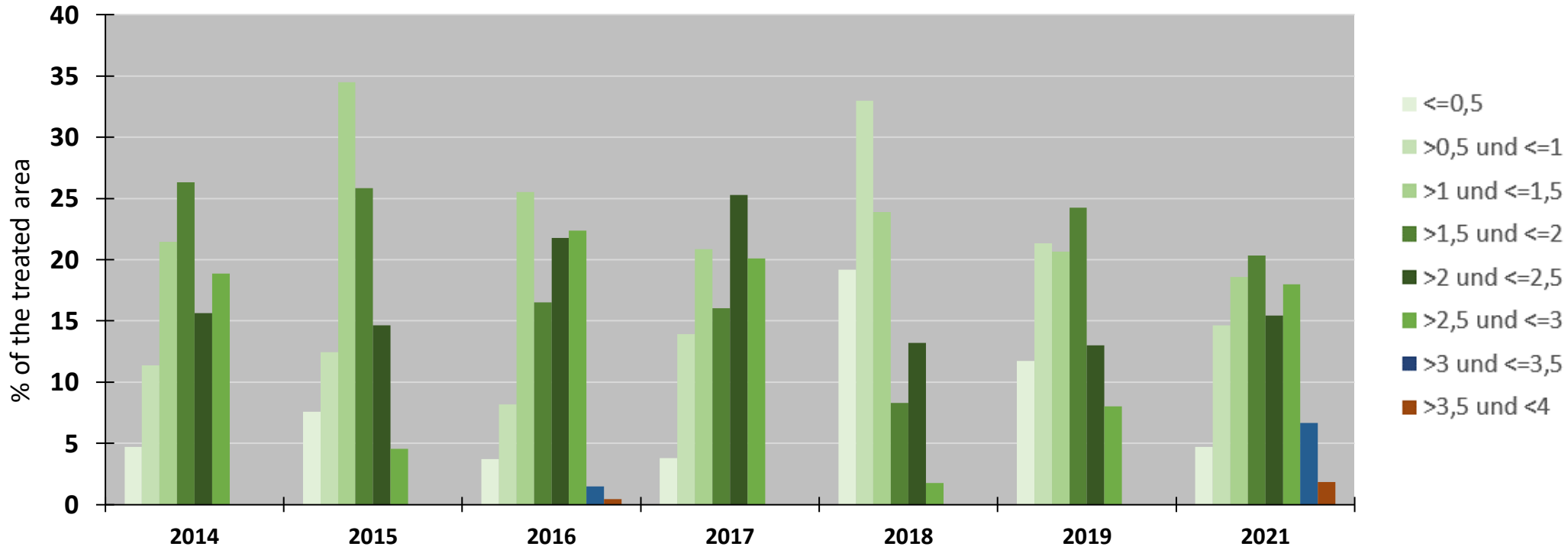
Use of copper in the organic potato cultivation

Germany from 2014 to 2022

	2014	2015	2016	2017	2018	2019	2020	2021
Total area planted with organic potatoes [ha]	8.500	8.600	8.700	8.900	9.300	10.100	10.200	9.630
Total area treated with copper, evaluated area [ha]	2.330	2.140	2.143	2.513	2.399	2.453	n.d.	4.105
Ø kg ha^{-1} on the treated surfaces	1,54	1,50	2,20	2,00	1,10	1,20	n.d.	1,88

Annual area treated with copper

in kg Cu per ha in the organic potato production



Ø kg ha^{-1} on the treated surfaces	1,54	1,50	2,20	2,00	1,10	1,20	1,88
Ø average annual precipitation [mm]	727,1	701,3	733,1	858,7	586,3	735	801,1

Weather conditions in 2021

- dry spring with a record cold in April and May
- until the end of the growing season in July, the weather was characterized by unstable conditions with frequent heavy rainfall episodes
- almost permanently wet until the end of August:

persistently high pressure of *phytophthora infestans*

many farmers fully utilized the 3 kg Cu ha^{-1}

in mid-July the maximum permissible amount of copper was set at 4 kg ha^{-1} (emergency approval)

Cu reduction strategy (potatoes)

Conclusion

- almost all major breeders are working on better responses to *phytophthora infestans* and both field-resistant and R-gene-resistant varieties are increasing massively

→ thus, helping us significantly to minimize copper

- it should be noted that there is a high risk of resistance breaking as long as R-gene resistance acts as a single gene resistance

→ a certain amount of copper is therefore necessary for resistance protection (max. 50 % of normal use)

→ it will take some time before multigene-resistant varieties are ready for practical use

Cu reduction strategy (potatoes)

Conclusion

- copper preparations are making significant progress in research
- application technology and adhesives are constantly being further developed
- research projects dealing with copper minimization
  (e.g.: EffiKar *(Selektion und Züchtung nährstoffeffizienter Phytophthora-resistenter Kartoffelzuchtstämme für einen nachhaltigen ökologischen Landbau)*)

Copper as plant protection application is still currently essential and indispensable for growing organic potatoes in Germany.

Cu reduction strategy (potatoes)

Tolerant/Resistant varieties

- the focus is now on new tolerant/resistant varieties
- for example, Bioland e.V. has implemented the requirement that **10 % of the area under potato cultivation** must be planted with varieties that are above-average resistant or resistant to *phytophthora infestans* according to the variety list

→ the implementation took place in 2022

→ a list with varieties is available and is expanded annually with newly available resistant varieties

BUT: Years like 2021 show us that potato cultivation still relies on copper as the only effective agent.

Examples of tolerant varieties

Bioland

Belmira

Lady Jane

Nola

Oscar

Fotos: Christian Landzettel, Bioland e.V.

The number of suitable varieties with resistance to *phytophtora infestans* is increasing.

Copper monitoring in Germany: Hop cultivation

Florian Weihrauch ● Hop Research Center Hüll ● Wolnzach

Average output of elementary copper [kg/ha*a] for plant protection in organic hop cultivation in Germany

Source: Database F. Weihrauch

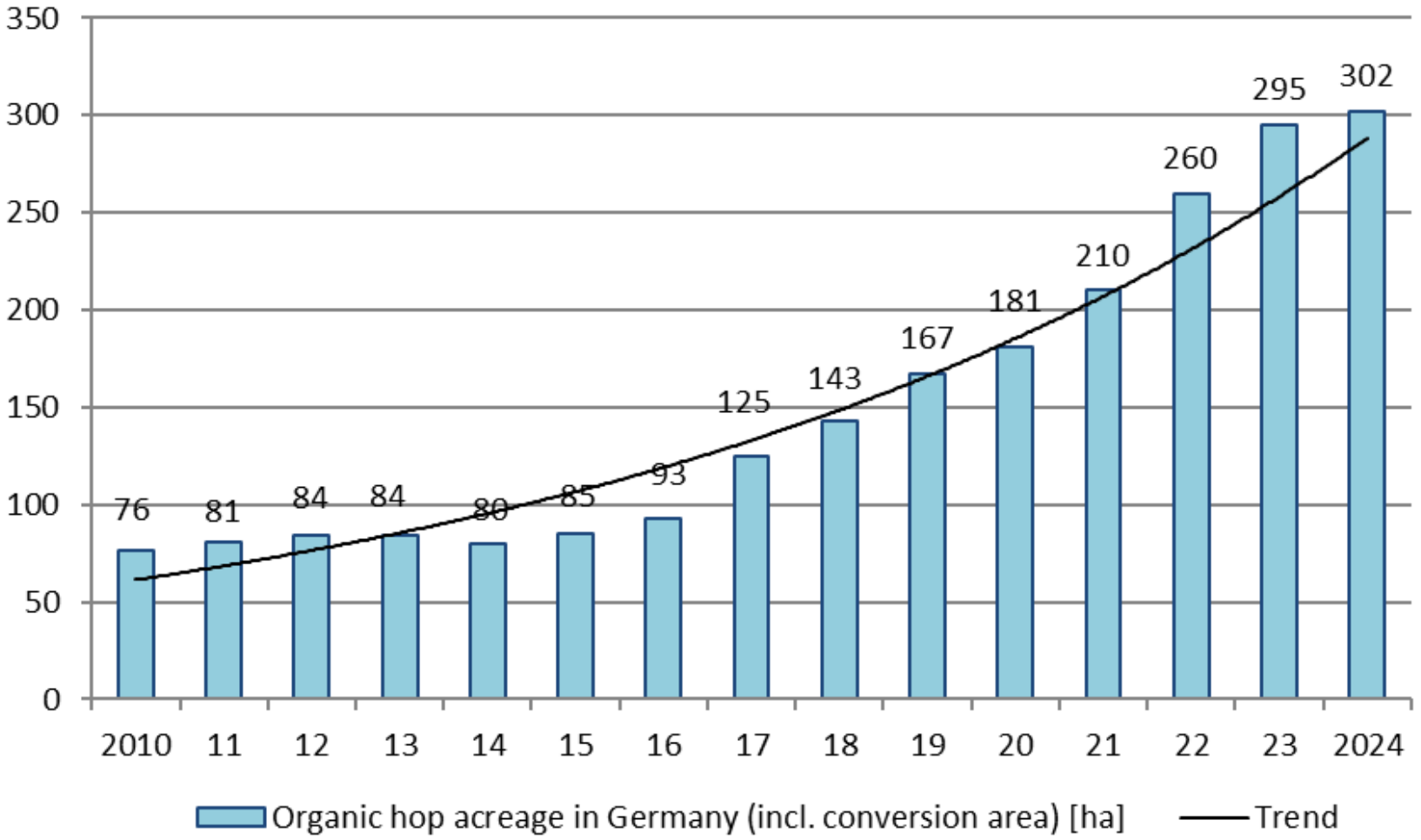
Year	2010	11	12	13	14	15	16	17	18	19	20	21	22	23	2024
Number of farms	7	8	8	8	7	7	7	8	9	9	11	13	15	18	18
Farms in associations	6	7	7	7	7	7	7	8	9	9	10	12	14	16	16
Acreage [ha] (incl. conversion area)	76	81	84	84	80	85	93	125	143	167	181	210	260	295	302
Acreage treated with copper [%]	100	100	100	100	100	100	100	97,4	100	100	100	100	100	97,3	
Average output [kg] of elementary copper	**3.9**	**3.7**	**3.6**	**2.6**	**3.3**	**1.5**	**3.6**	**3.2**	**1.6**	**2.9**	**3.4**	**3.7**	**2.5**	**2.8**	

Certified area under crop 2023: 230 ha; 65 ha in conversion till 2024/25

Meanwhile, Germany has developed three centres of organic hop cultivation, viz. the Hallertau in Bavaria (93 ha), Hersbruck in Franconia (89 ha) and Tettnang in Baden-Württemberg (106 ha). This also means greater variability in weather conditions and, therefore, in the use of copper over the years. With >7% of its overall area, Tettnang near Lake Constance will soon be in the vanguard of organic hops in Germany; disease pressure, however, is greater there than in other growing regions.

Development of the organic hop acreage in Germany, 2010 — 2024

Source: Database F. Weihrauch



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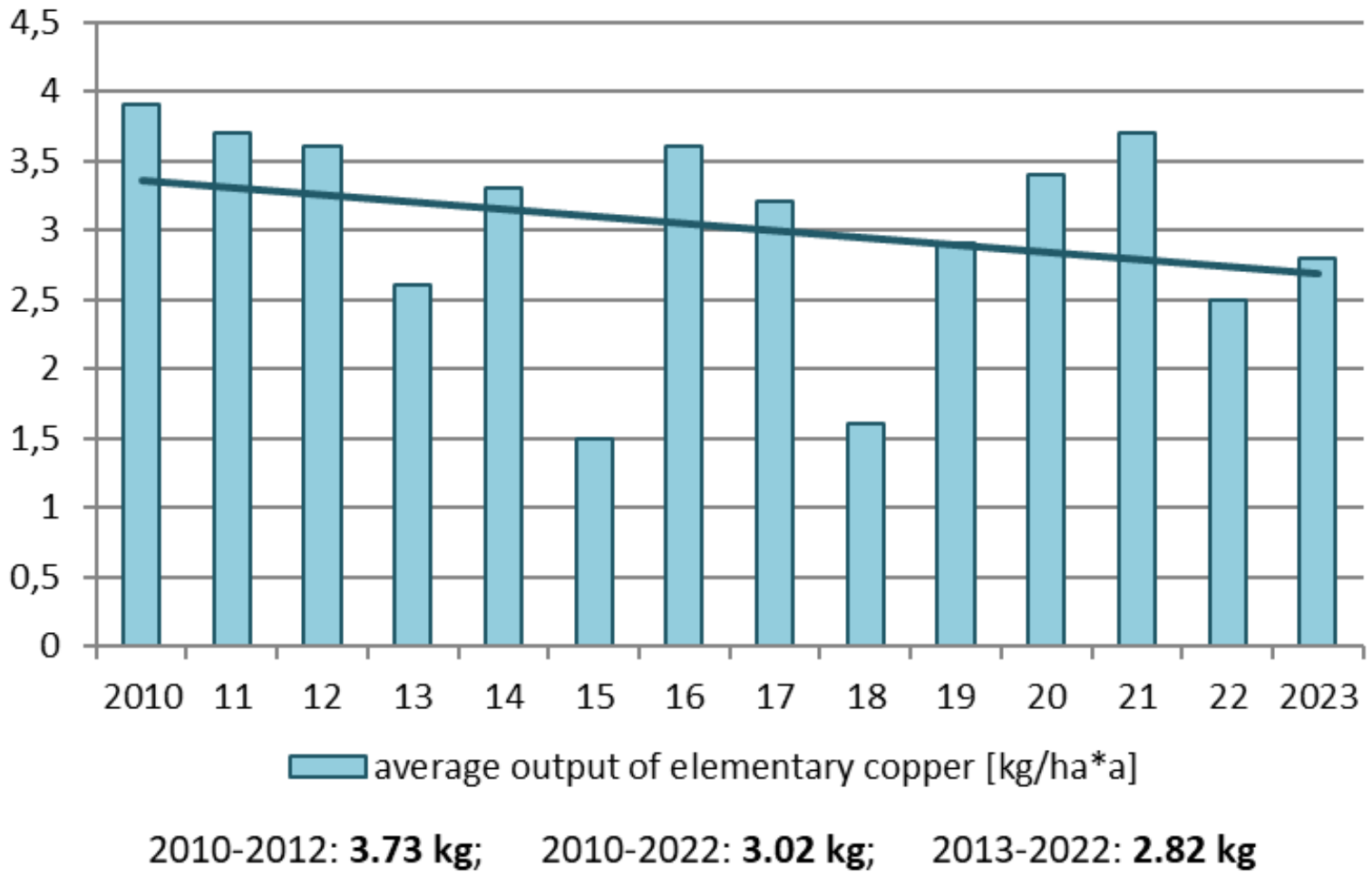
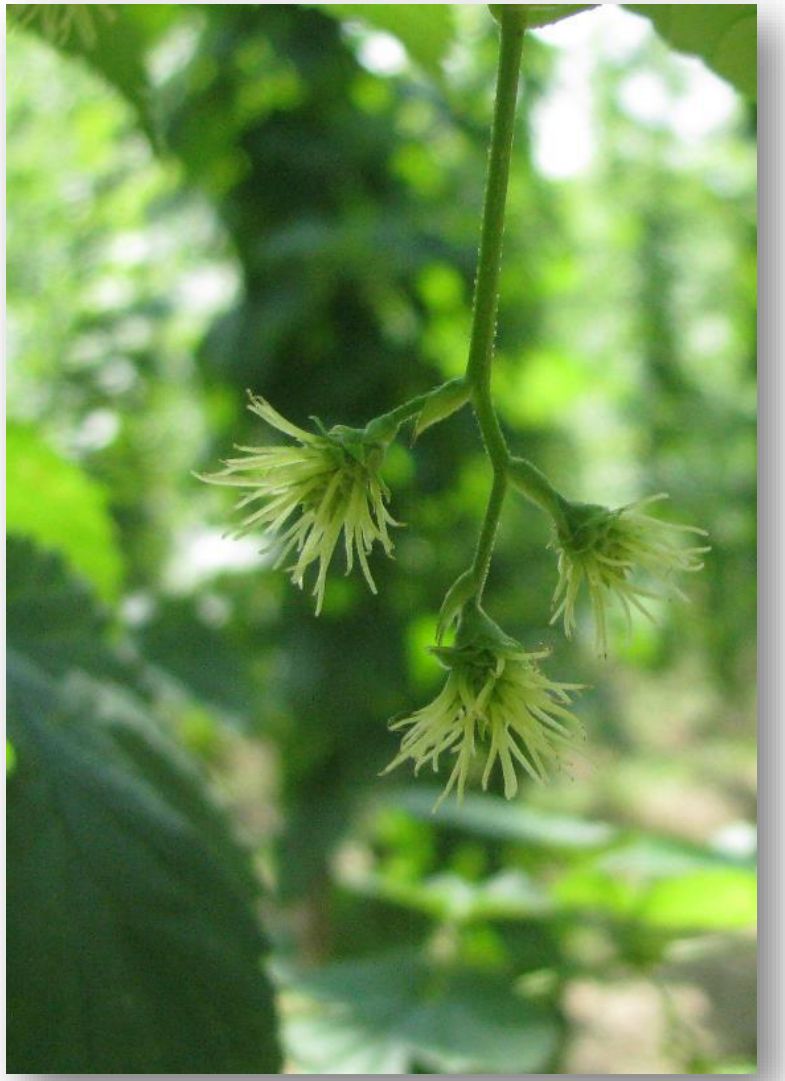


2010-2012: **3.73 kg**; 2010-2022: **3.02 kg**; 2013-2022: **2.82 kg**



Organic vegetables cultivation (open field)

Organic vegetables	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total organic vegetables cultivation area in Germany*	10.470 ha	10.470 ha	10.749 ha	10.750 ha	12.399 ha	13.728 ha	14.344 ha	14.777 ha	16.378 ha	18.200 ha
Of which recorded in monitoring**	2559 ha	1.268 ha	1.725 ha	5.160 ha	2.743 ha	3.375 ha	5.472 ha	5.139 ha	-	5.968 ha
Percentage of total area	24,5 %	12,11 %	16,05 %	48,00 %	22,12 %	24,59 %	38,15 %	34,78 %	-	32,79
Percentage of recorded area treated with copper	3,9%**	3,9%**	9,4%**	5,0%**	14,42 %	8,51 %	4,25 %	5,57 %	-	11,1 %

* In organic vegetable growing, there is in principle a not inconsiderable proportion of land which is farmed according to the criteria of the EU Organic Regulation and was not recorded here.

** Data from Bioland and Naturland. No data from Demeter because Demeter didn't allow Cu application in vegetables cultivation until yet.

Organic vegetables cultivation (open field)

Organic medical and aromatic plants	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total area of organic medical and aromatic plants cultivation	ca. 800 ha	ca. 800 ha	ca. 800 ha	ca. 800 ha	ca. 800 ha	ca. 800 ha	ca. 800 ha	ca. 800 ha	ca. 800 ha	ca. 800 ha
Of which recorded in monitoring**	0,0 ha	0,0 ha	0,0 ha	0,0 ha	0,0 ha	0,0 ha	0,0 ha	0,0 ha	0,0 ha	0,0 ha
Percentage of total area	---	---	---	---	---	---		---	---	---
Percentage of recorded area treated with copper	---	---	---	---	---	---		---	---	---

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Copper application rates in organic vegetable crops 2019

Crop	Ø Cu in kg/ha on treated areas	Evaluated area treated with Cu in ha	Percentage of total area treated with Cu in %
Onions	**1,82**	**10,63**	**4,40**
Pumpkin	**0,80**	**40,03**	**10,7**
Asparagus	**0,64**	**78,15**	**17,20**
Cucumber	**3,00**	**112,54**	**94,2**
Carrots	**0,57**	**43,43**	**8,10**
Celery	**0,90**	**1,20**	**5,40**
Vegetables others*	**1,04**	**75,15**	**12,70**
Greenhouse crops	-	**0,00**	**0,00**

* Vegetable crops in small sets cultivated in open field.

Copper application rates in organic vegetable crops 2021

Crop	Ø Cu in kg/ha on treated areas	Evaluated area treated with Cu in ha	Percentage of total area treated with Cu in %
Leek	**1,82**	**19,00**	**96,98**
Pumpkin	**3,00**	**140,00**	**57,64**
Asparagus	**3,00**	**280,00**	**100,00**
Cucumber	**1,00**	**12,00**	**100,00**
Celery	**2,50**	**32,20**	**95,15**
Vegetables others*	**2,04**	**75,15**	**28,17**
Greenhouse crops	**2,03**	**3,68**	**38,01**

* Vegetable crops in small sets cultivated in open field.

1. Achievement of the objectives within the framework of the Cu strategy (organic vegetable cultivation / horticulture)

- Cu is currently indispensable in organic vegetable cultivation.
- A reduction to 2.5 kg/ha/year over 5 years seems possible for vegetable cultivation.
- A flexible interpretation of this rule within a period of time would be desirable.
  → demand depending on crop, year and weather (risk minimization)

2. Work and research needs

- Variety breeding - more resistant or tolerant varieties necessary.
- For expected new indications efficacy trials are necessary
- Cultivation methods --> development, testing of new cultivation methods (optimisation of crop management and irrigation to improve the crop climate, further development of weed control methods including practical trials)
- Development of a Cu-reducing application technique for the application of Cu agents in organic vegetables cultivation.
- Development of practicable crop specific forecast models (analogous to Öko-Simphyt)