Evaluation of Sludge Application on Agricultural Land in a long-term field study

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Field Trials Started 1980 and are still ongoing

- Field study on agricultural land started in 1980 and still on-going
- Two farms in southern Sweden (Igelösa and Petersborg)
- Digested sludge from the cities of Lund and Malmö
- Sludge application every fourth year

A No sludge

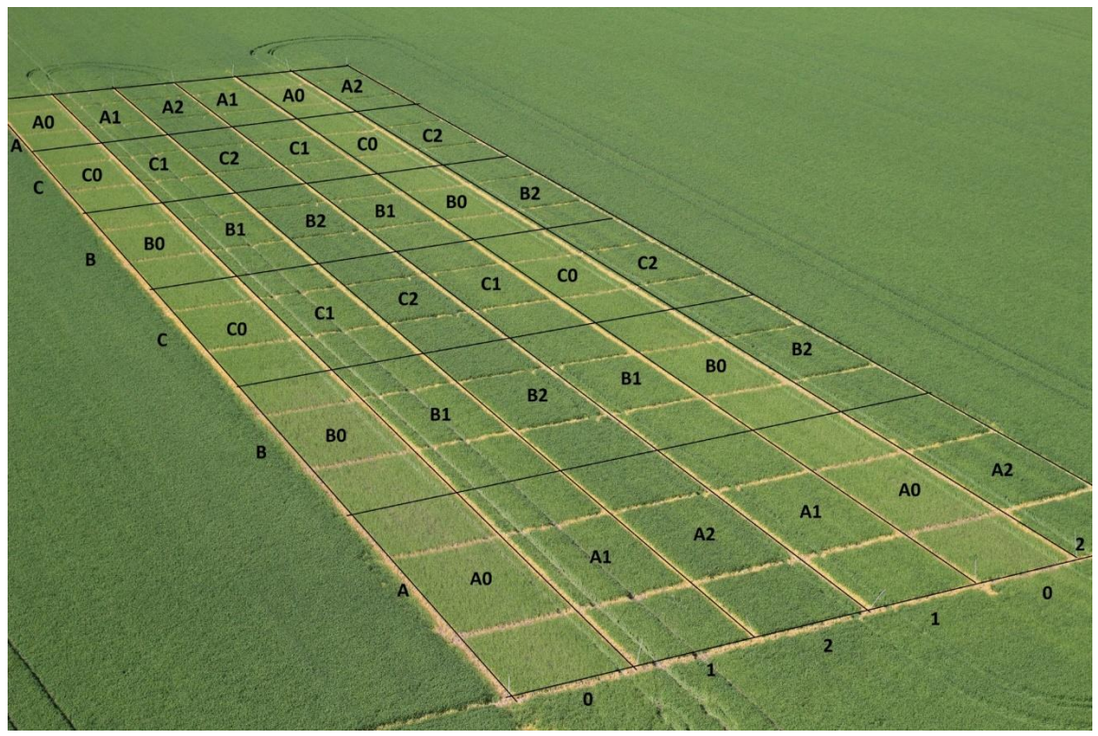
B Sludge. 4 ton DS per hectare every 4th year (1981, 1985, 1989, 1993, 1997, 2001, 2005, 2009, 2013)

C Sludge. 12 ton DS per hectare every 4th year (1981, 1985, 1989, 1993, 1997, 2001, 2005, 2009, 2013)

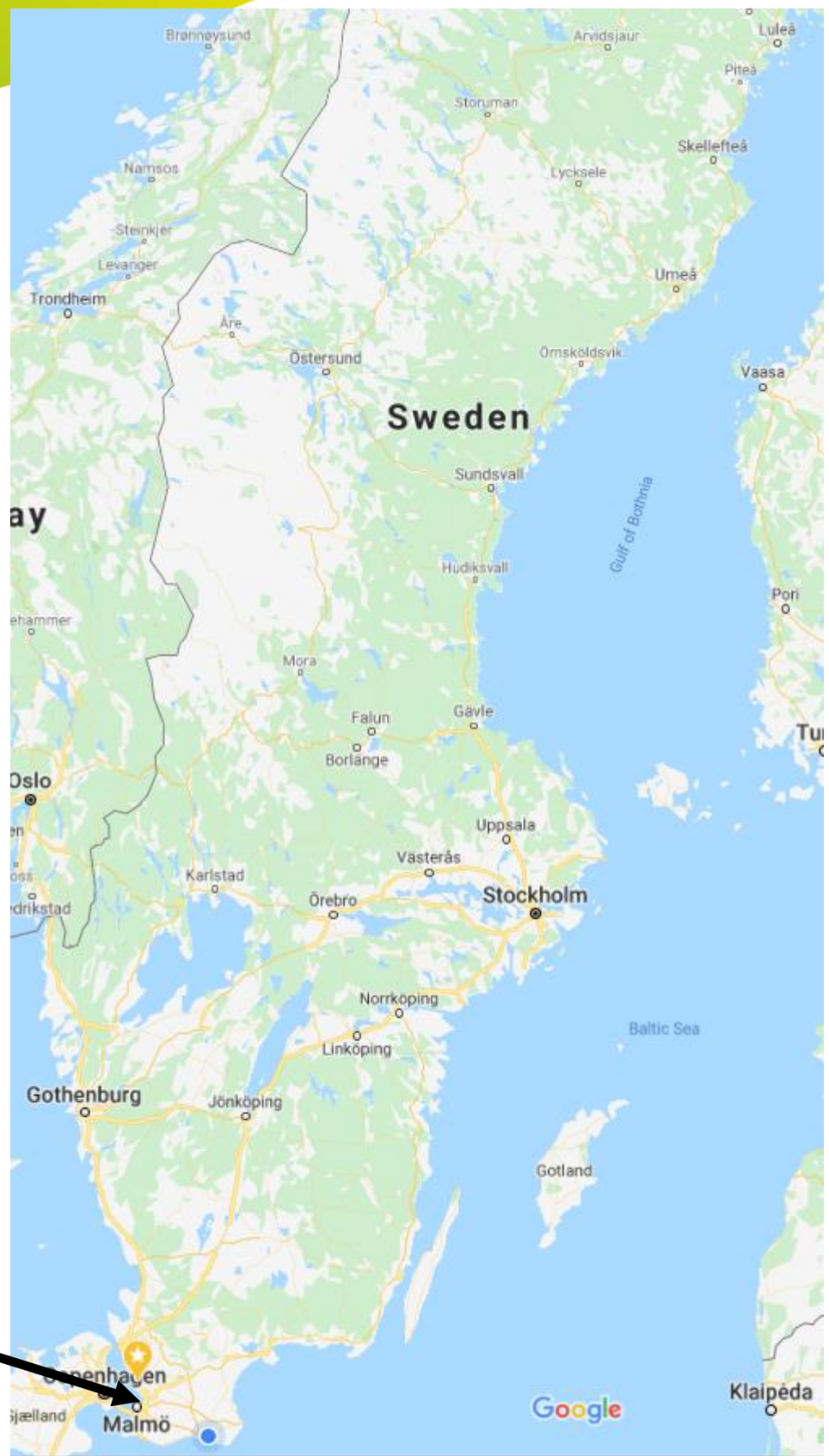
0 No mineral fertilizer

1 NPK ½ N, 1/1 PK

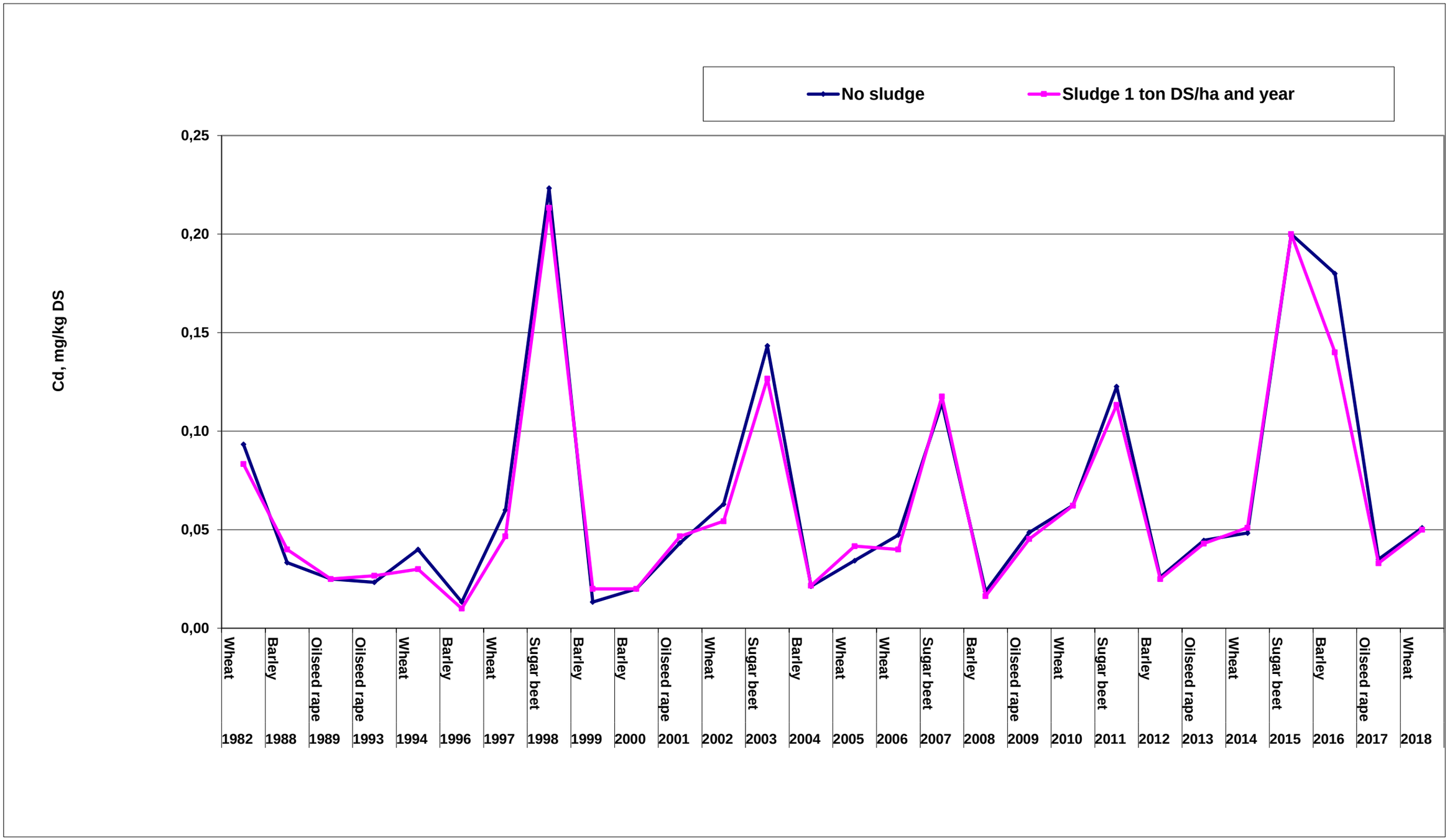
2 NPK 1/1, 1/1 PK



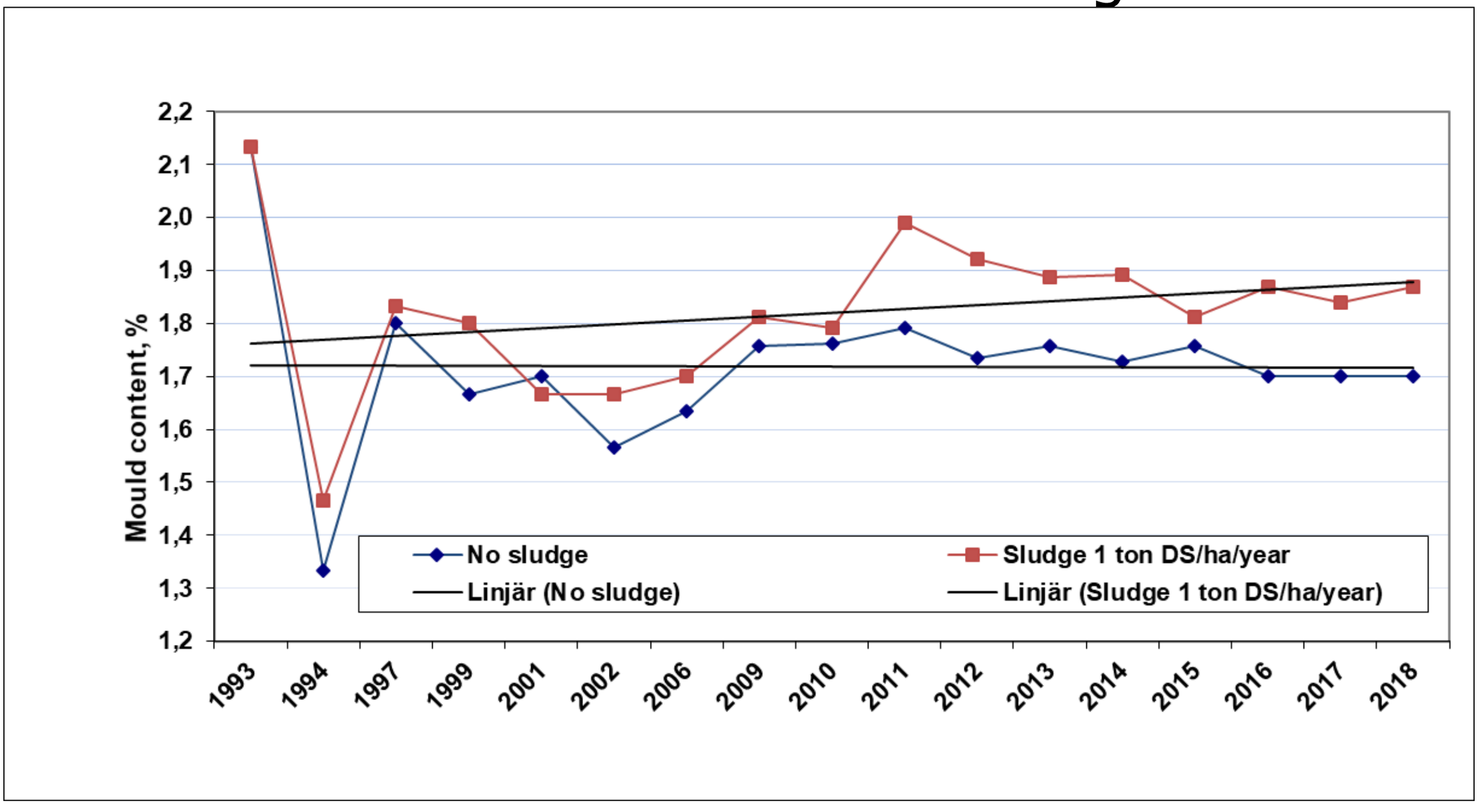
The Field Trials



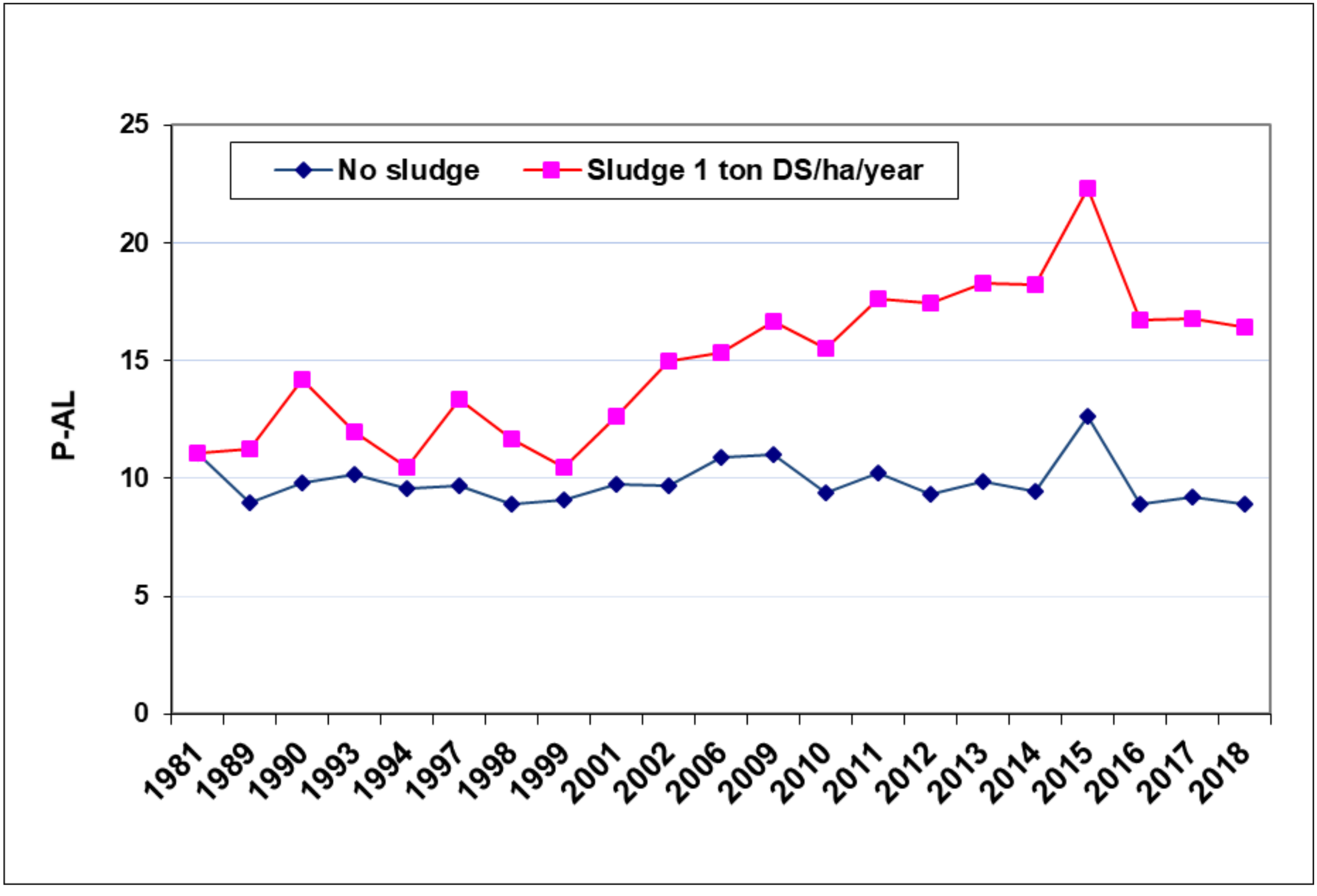
Cadmium content in harvest products Petersborg



Mould content in soil Petersborg



Phosphorus content in soil Petersborg



Conclusions

Effect on the harvest amount

- In all of the experiments the crops have responded with an increased harvest as a result of sludge application. On average, a crop increase of around 7% is obtained.
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- Based on 2018 crop prices, the sludge application has increased the value of the harvest with about 65 Euro per hectare and year.

Conclusions (continued)

Impact on soil metal content

- The content of copper, mercury and zinc have increased in both experimental sites

- For all other metals there is not statistically significant difference shown.

The quality of sludge

- The content of all heavy metals in the sludge has decreased considerable over time

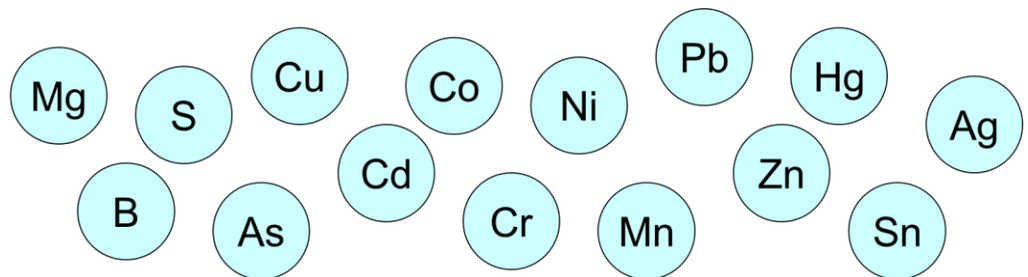
- Sludge is primarily a phosphorus fertilizer but in addition a positive effect is obtained by the fact that nitrogen and carbon is also present in the sludge

- The content of mould in sludge is probably a factor that contributes positively to the size of the harvest

Conclusions (continued)

Heavy metals in crop products

- The heavy metal, which over the years has been discussed the most in Sweden is cadmium
- No significant difference in uptake of cadmium between blocks with and without sludge application, even at triple sludge application rates
- Cadmium generally appears in larger amounts in sugar beet, with on average, twice as high uptake as in cereal. The variation between crops and year are great
- Although cadmium has been given considerable interest during the tests, it is important to note that 14 other metals have also been analysed in the crops. None of these metals have been detected at elevated concentrations even at triple sludge application rates
- Under the conditions prevailing at the test locations, sludge application to arable land, has not been shown to have any effect on the plant's uptake of heavy metals



Conclusions (continued)

Impact on soil plant nutrition aspects

- Phosphorus rates are rising
- The potassium concentration between and with sludge in the soils is not measurable
- The content of mould is higher in the soils that received sludge compared to soils not receive any sludge. The sludge application, however, has not managed to increase the mould content relative to the level when the test began 30 years ago in Igelösa but in Petersborg
- The nitrogen content in the soil layer from 0 to 60 cm has increased

- **Soil fertility is rising**

Conclusions (continued)

- Positive for earthworms
- Positive for micro life
- No increased uptake of organic substances in the crops
- The study shows that the content of microplastics in sludge fertilizers does not contain more microplastics than soil that has not been sludge fertilized.
- With the assay methods available today, no evidence of antibiotic-resistant bacteria or bioavailable metals could be found in the soil analyzed in the experiment

My conclusion

- **Good quality sludge can (should?) be used on arable land**