Minimum Tillage- Field Trials in Lower Austria

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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

CZ.1.07/2.2.00/28.0302

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CZ.1.07/2.2.00/28.0302

Tato prezentace je spolufinancovaná z Evropského sociálního fondu a státního rozpočtu České republiky

Experimental sites

Perched water table

in the depression

Tullnerfeld – Gollarn 2009

SOLUTION ⇒

Direct drilling without disc harrow in front of seeder

Conventional tillage- neighbour

29th August 2011 NoTill farm Zaussinger Lower Austria

Lineseed + yellow mustard + oil radish + vetchling

No Tillage sugar beets
Lower Austria

Yield:

2005…….80 t/ha

2009….> 70 t/ha

Sugar content 2005…17.6 %

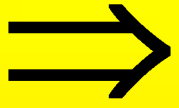
Silage corn in Glyphosate – sprayed winterrye Humpolec CS

September 2012

Per ha in the soil:

25 t flora

5 t fauna

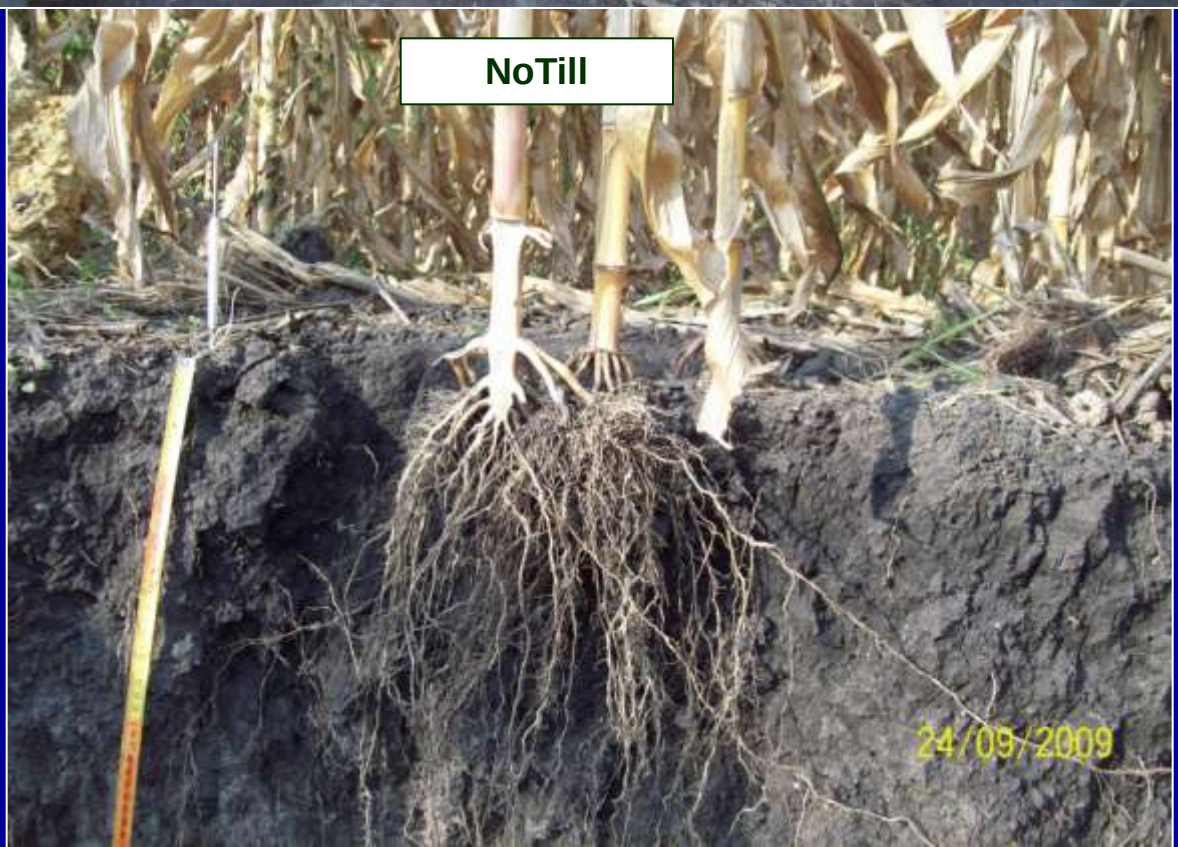


Corresponding

6 livestock units

Work for the farmer


Johann Peck Andau
24/09/2009


NoTill
24/09/2009

International tendencies in Tillage

- 1989..... 10 Mio ha No Till

- 2001..... 65 Mio. ha No Till
- 2002..... 68 Mio. ha No Till
- 2004..... 72 Mio. ha No Till
- 2006……. 90 Mio. ha No Till
- 2014…….>125 Mio. ha No Till

- Countries:

USA (35 Mio. ha), Canada (12 Mio. ha), Brasil, Argentina – Latin America > 60 Mio. ha, Australia (> 10 Mio. ha)

More than 98 % of the No Till land in these countries

Reasons for No Till

- Lowering of production cost
- Fewer passes – less work time → less soil compaction
- Increased productivity – cultivation of larger area possible
- Reduction of fuel consumption

  (250 l → < 80 l/ha)
- Lower machine use
- Prevention of wind – water – tillage erosion
- Increased humus content
- Improved water retention
- Better yield
- Lower carbon dioxide release from the soil → climate – and soil alliances
- Carbon storage in the soil

NoTill Soybean in cornstraw Argentina 2010

NoTill corn
Argentina 2010

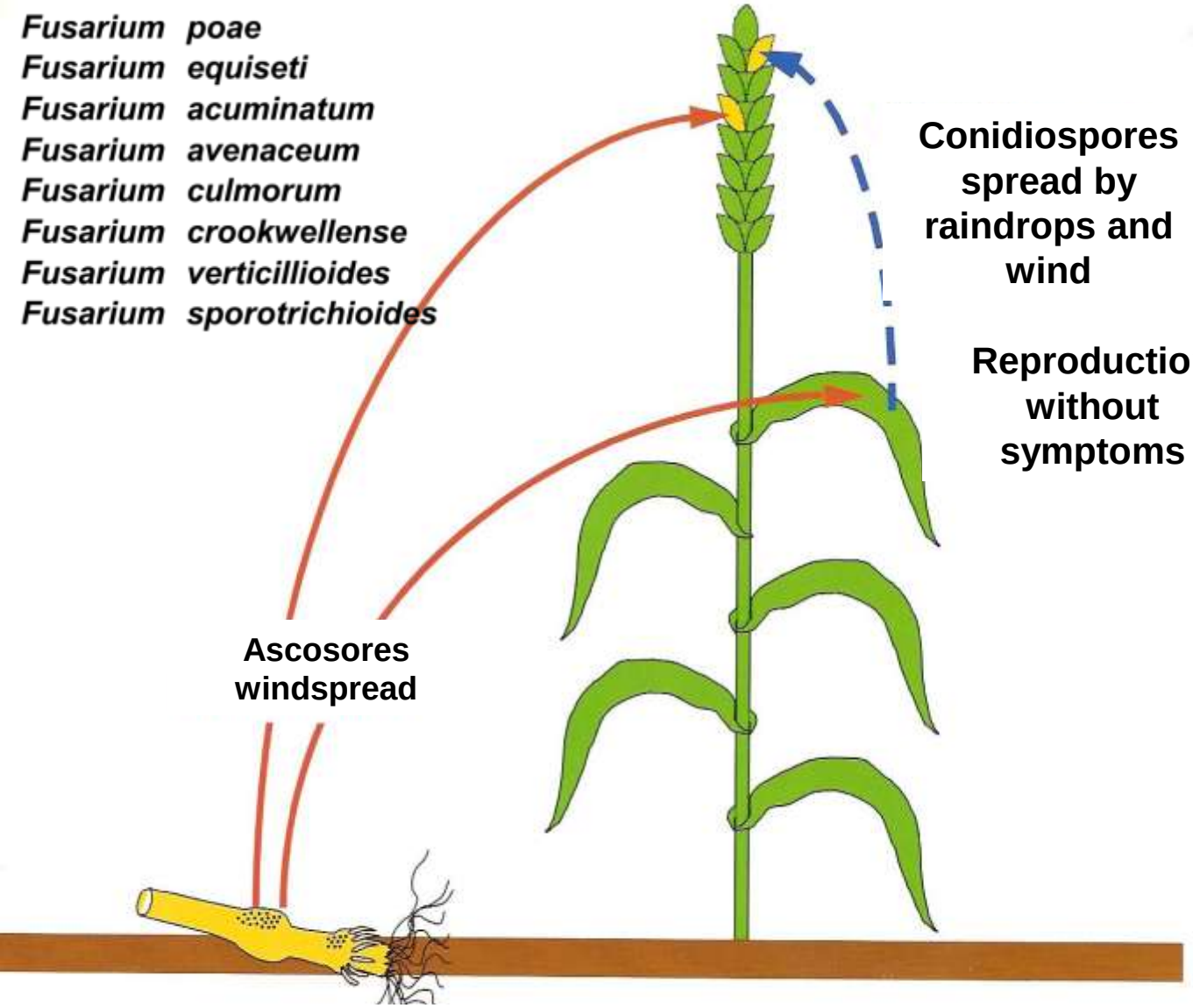
Cultivation Tests Seeding Winter Wheat into stubbles of Sunflower

Dry Rot

Fusarium graminearum

Fusarium graminearum
Fusarium venenatum
Fusarium oxysporum
Fusarium proliferatum
Fusarium langsethiae
Fusarium tricinctum
Fusarium solani

Fusarium poae
Fusarium equiseti
Fusarium acuminatum
Fusarium avenaceum
Fusarium culmorum
Fusarium crookwellense
Fusarium verticillioides
Fusarium sporotrichioides



Conidiospores spread by raindrops and wind

Reproduction without symptoms

Ascosores windspread

Stubbles corn with Perithecies

High risk of dry rot…Fusarium sp….under wet conditions (high humidity, rainfall during bloom

Fungicide during bloom straight to the point

Seeding winterwheat into strawresidues of corn…..fungicidesraying during bloom essential

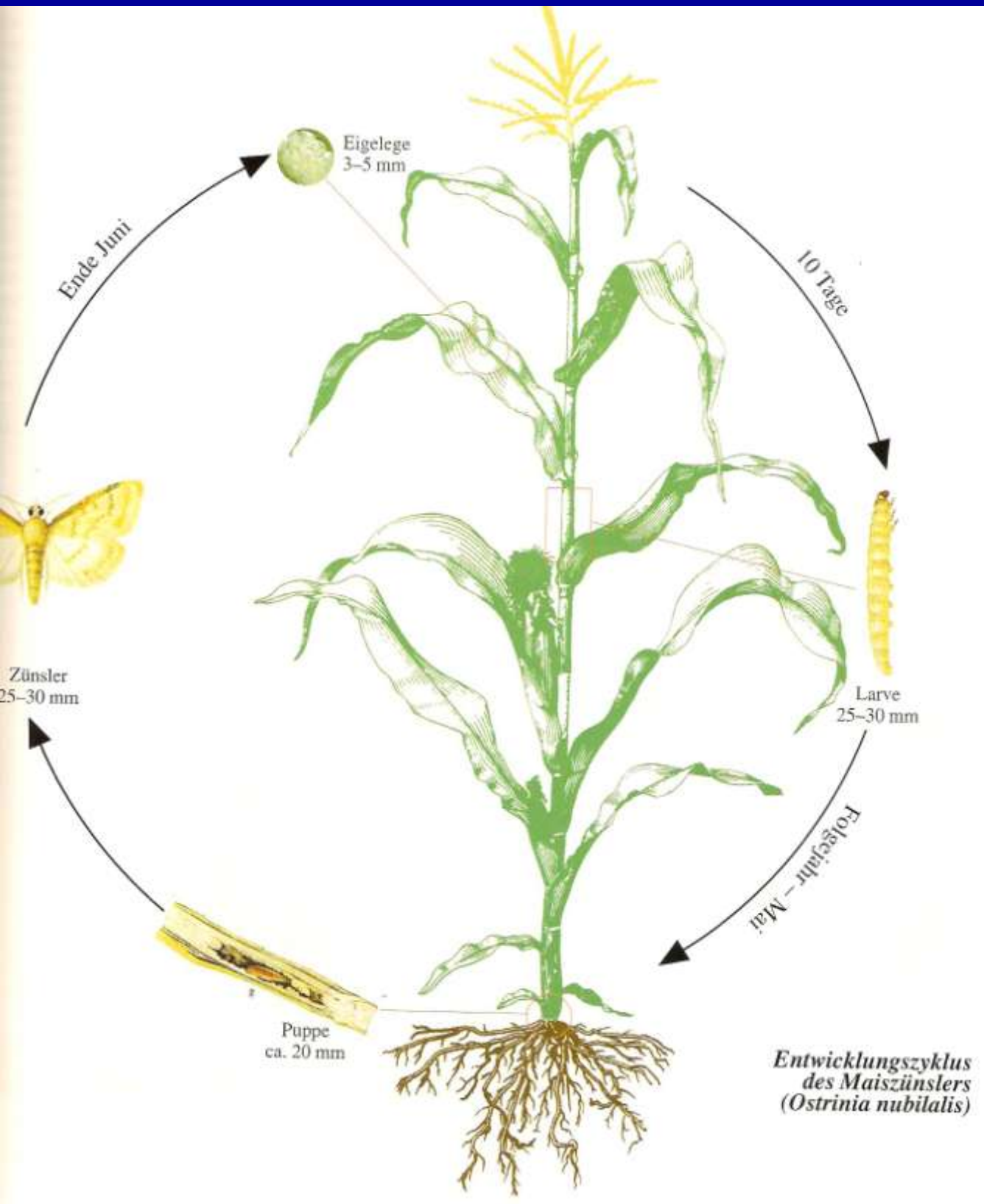
Mykotoxine DON and ZEA

- Threshold food I in µg/kg in grain

	DON	ZEA
Wheat	1250	100
Durum, Oat,	1750	100
Corn	1750	200

Cornborer

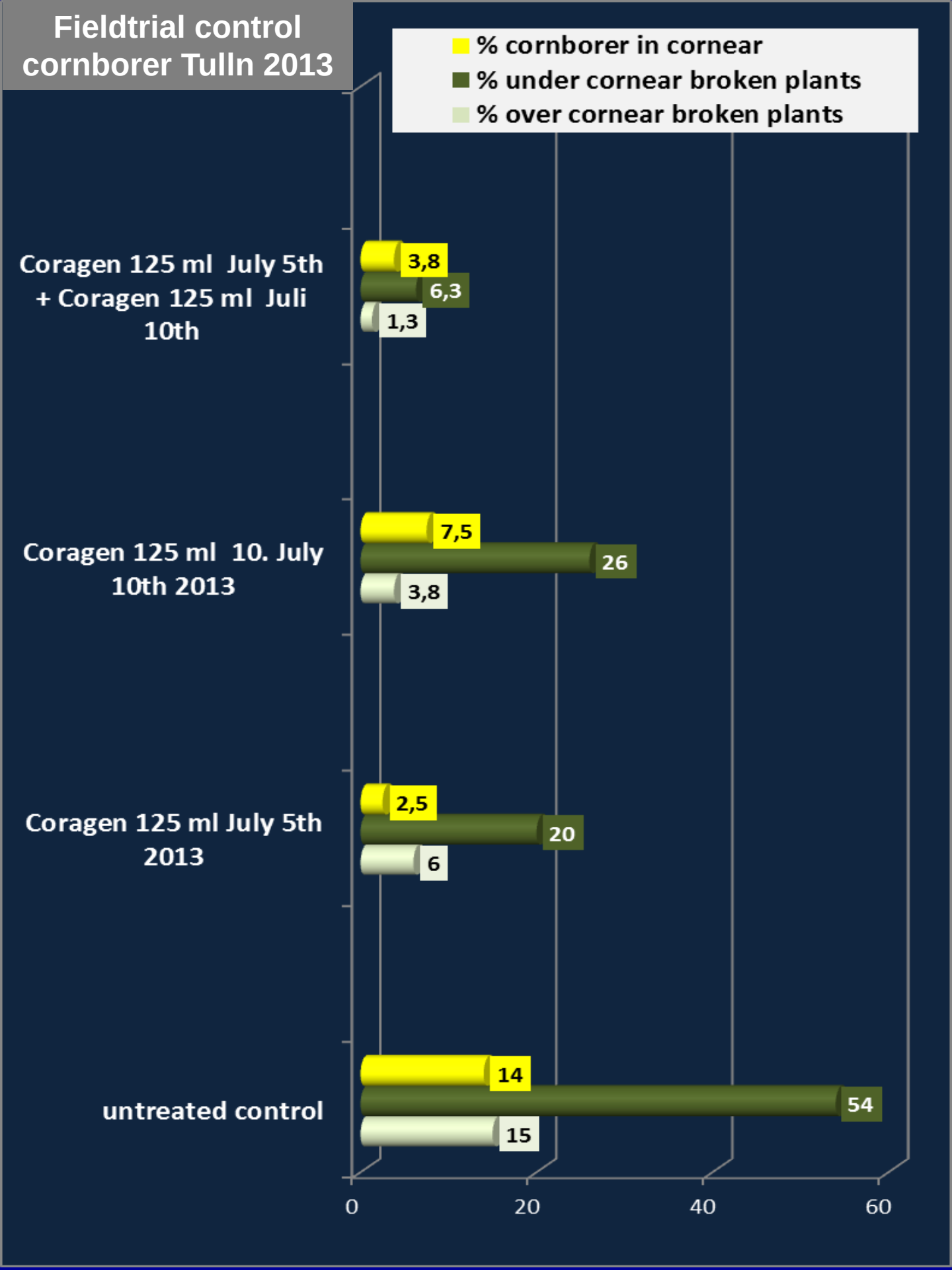
Ostrinia nubilalis

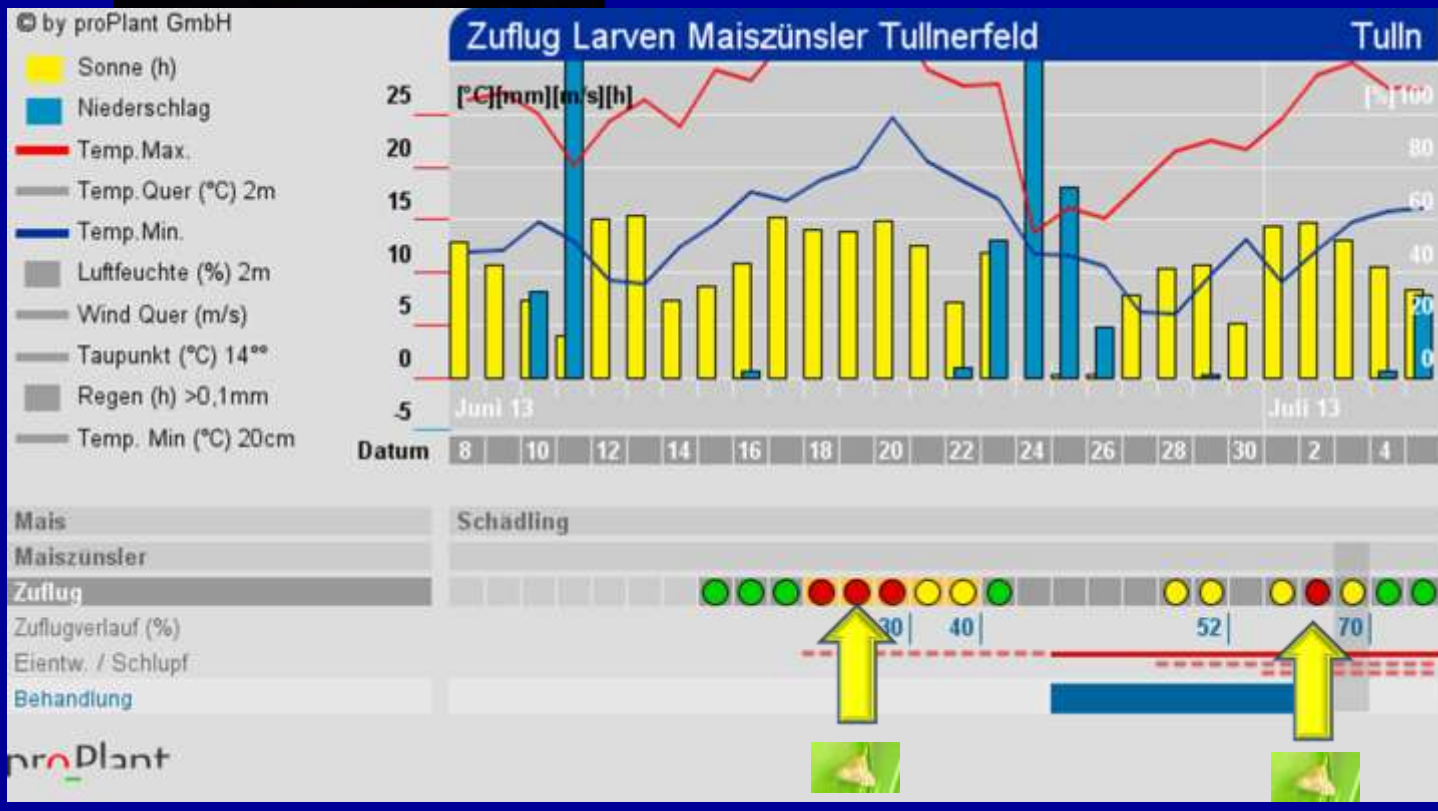


Entwicklungszyklus des Maiszünslers (Ostrinia nubilalis)

NoTill into straw residues corn 2013

Fieldtrial control cornborer Tulln 2013

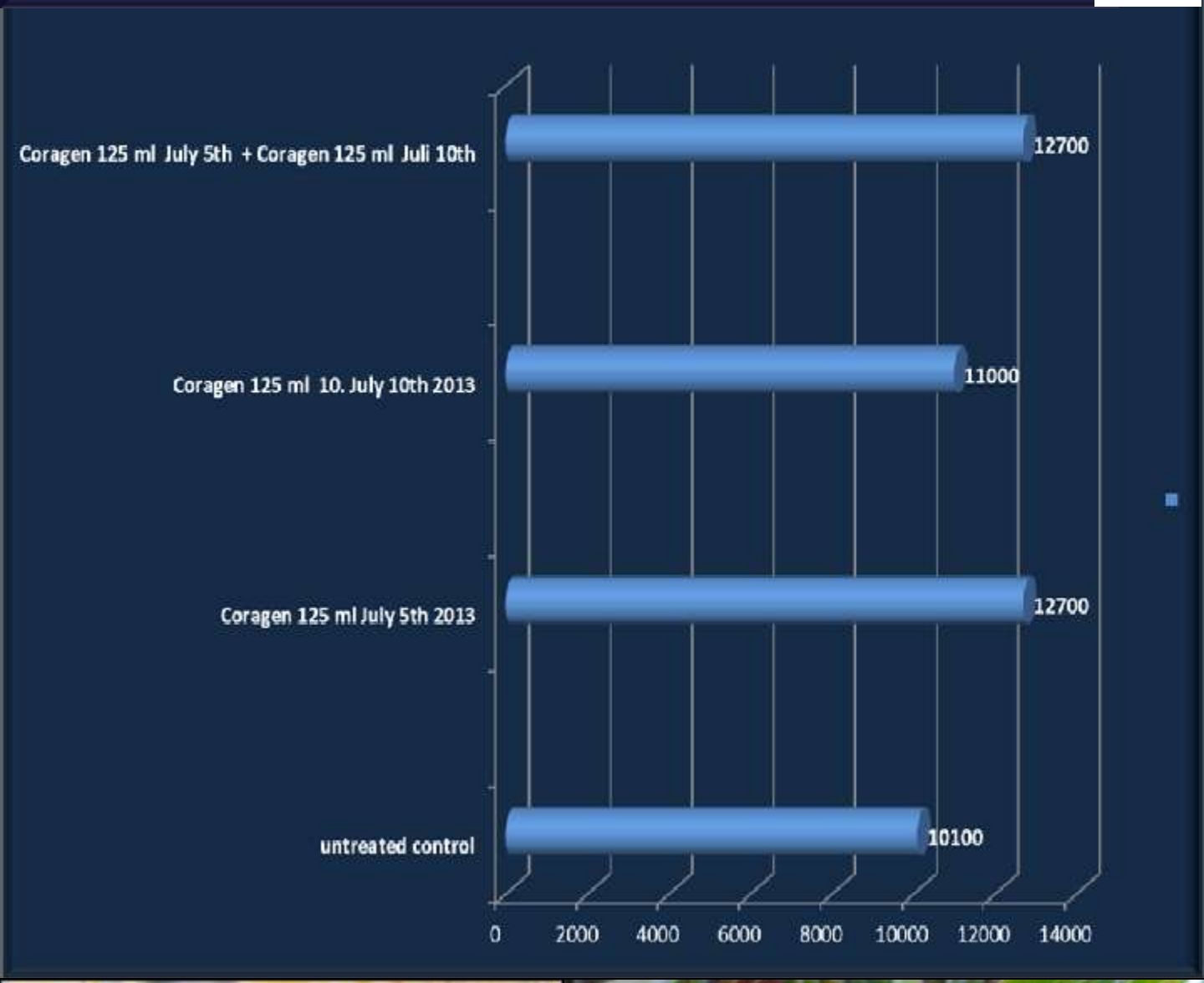




Intensivierungsversuche Land NÖ 2013

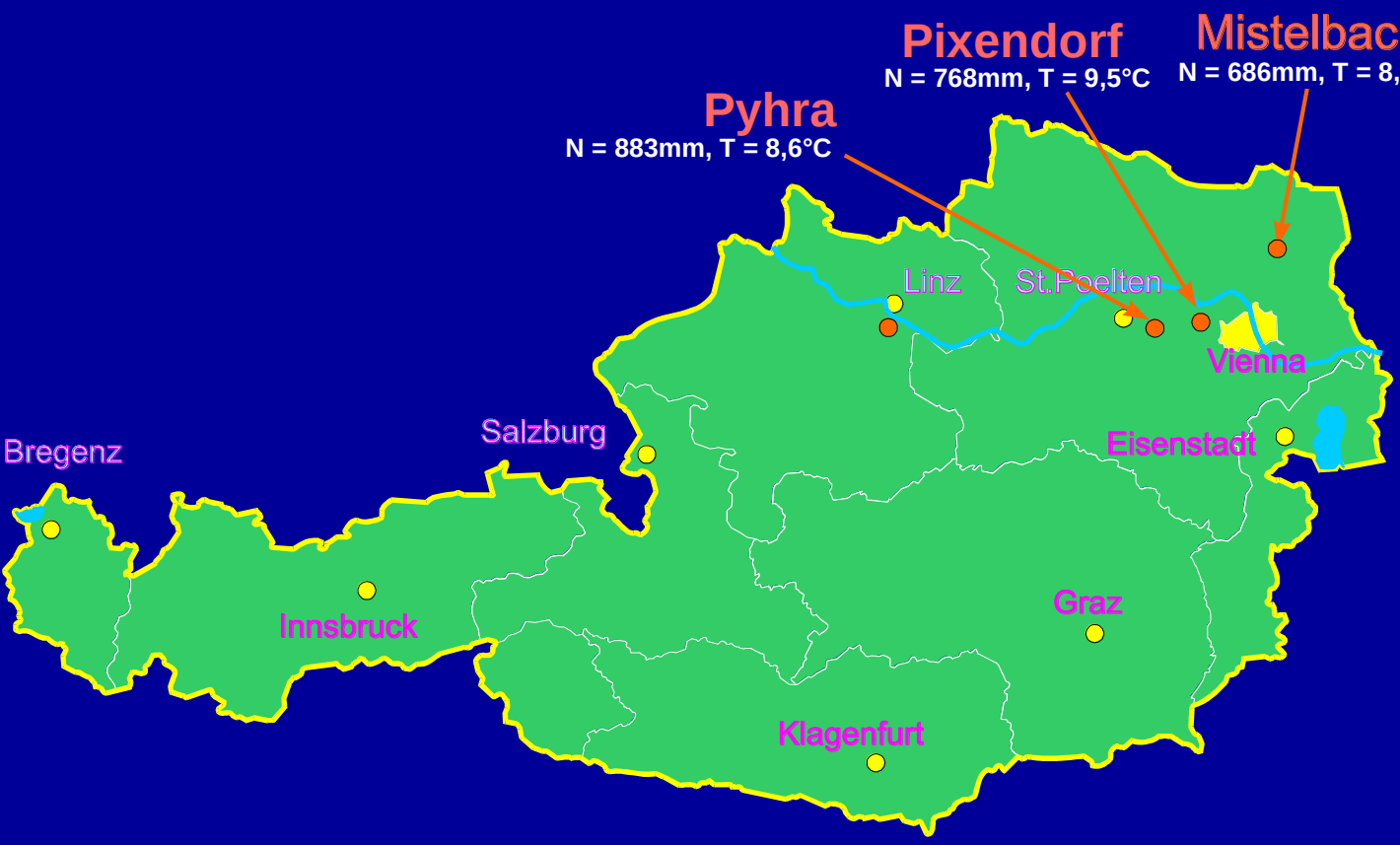
Proplant forecast 2013 for cornborer

Yield cornborer pestcontrol trial Tulln 2013



volunteer barley ⇒ Risk of barley yellow dwarf virus

Soil erosion measurement sites Austria



Experiments started in 1994

soil texture: sandy silt - loamy silt

plot size: 60 m² (4 by 15 m)

slope: 5 - 16 %

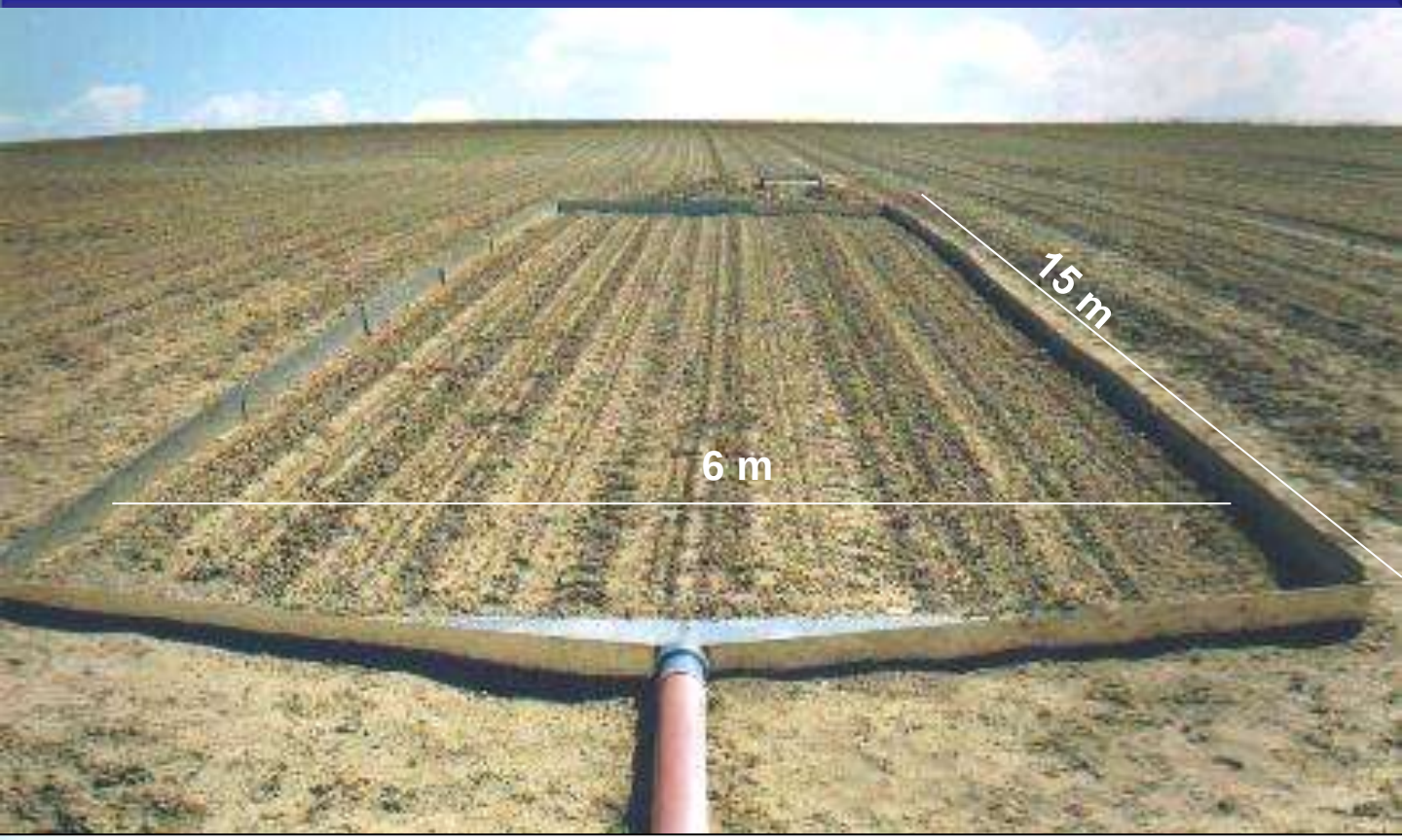
crop rotation: corn - winter wheat

corn - winter wheat - sugar -beets – summer barley - sunflower - winter wheat

Summer harvest - cover crop → spring cultivation

Parameters investigated: runoff, soil loss, nutrients, pesticides - herbicides,

Erosion plots



Sediment flow – grassed waterway

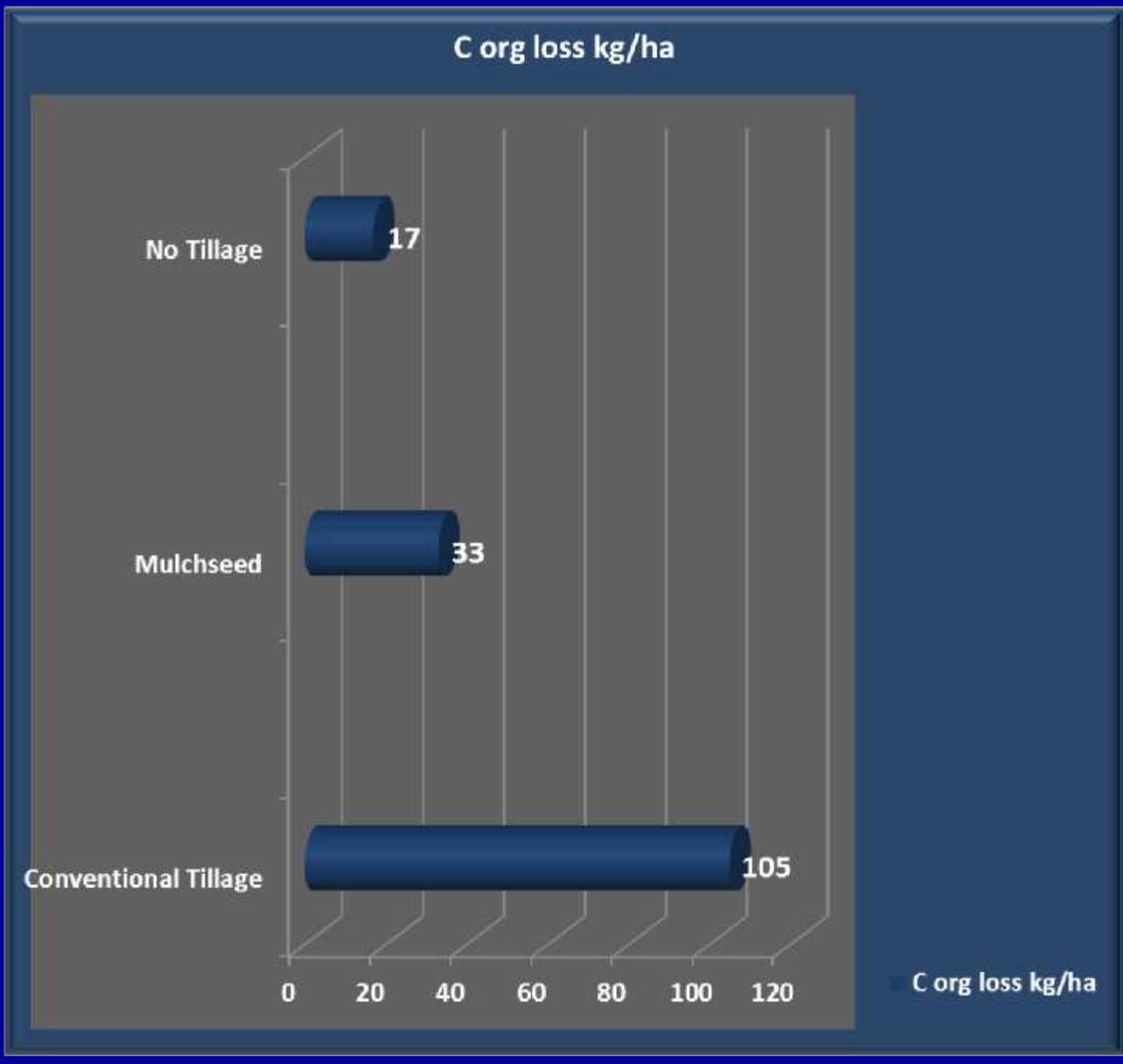
Losses in differnet tillage practise 1994 - 2013

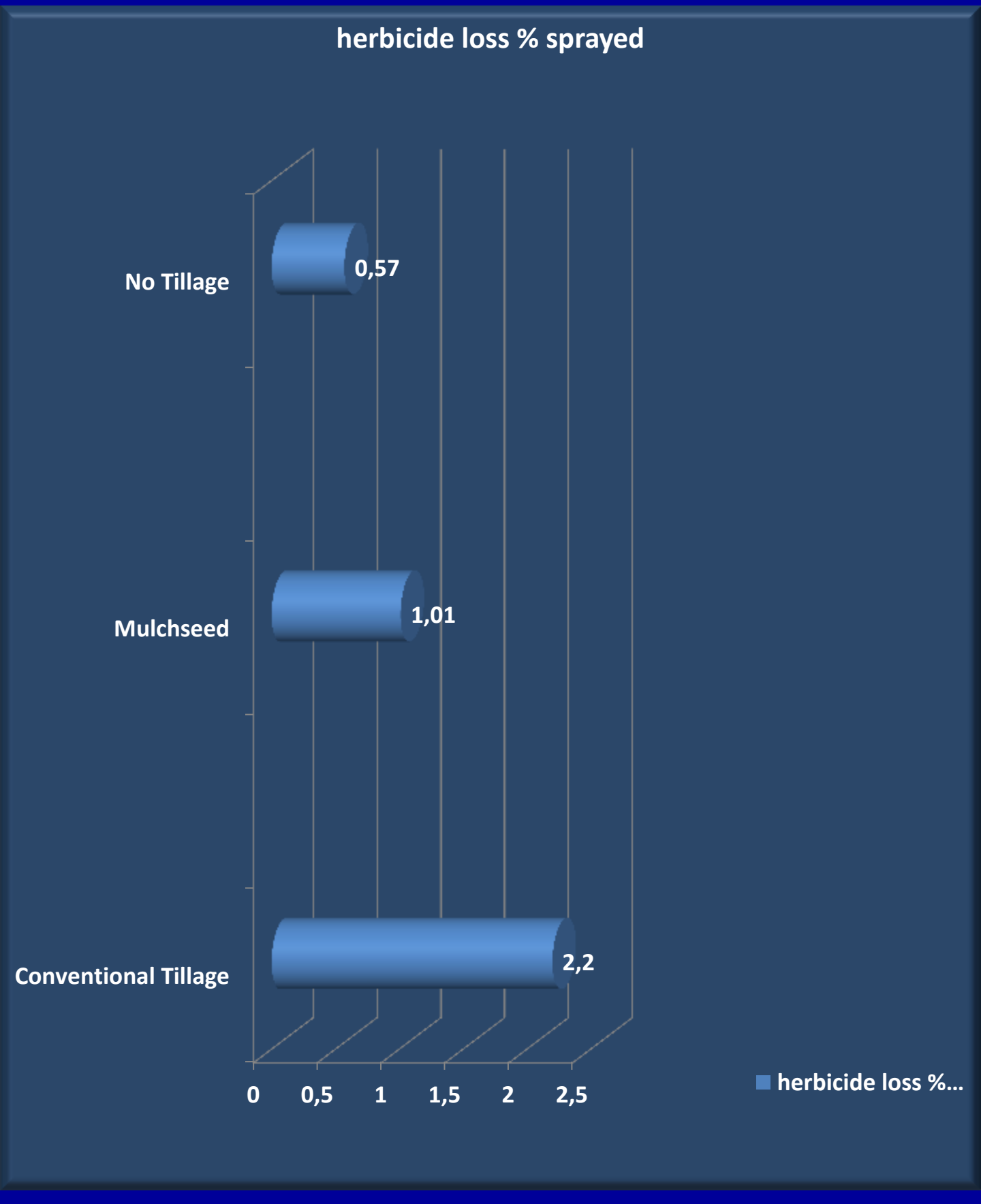
Klik et.al

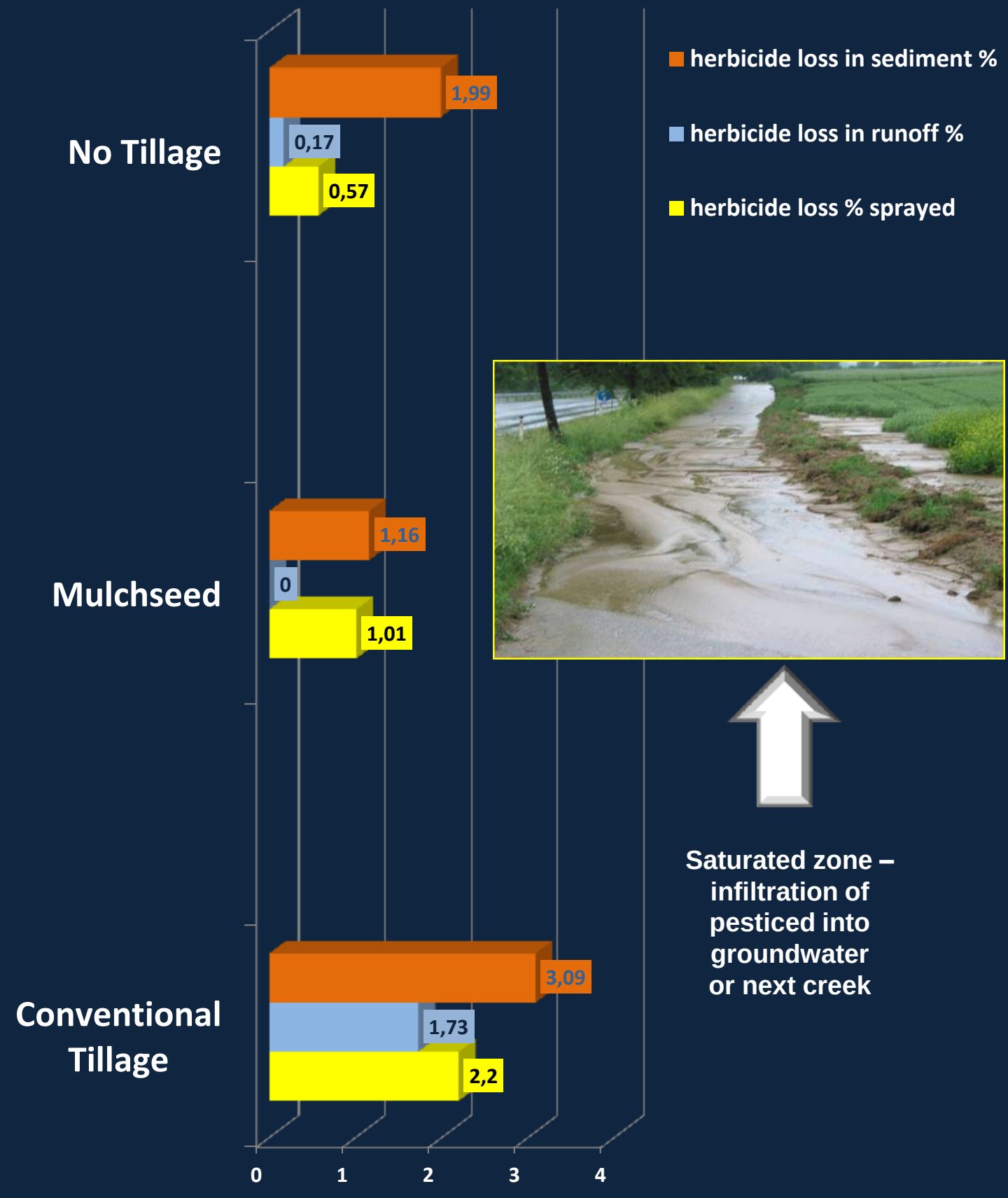
University of Agricultural Science Vienna

	Conventional Tillage	mulchseed	Direct drilling
Soil loss t/ha	9.9	2.2	1.1
reduction		78 %	89 %
Corg - loss kg/ha	105	33	17
reduction		67 %	82 %
N - loss kg/ha	14	6.9	3.8
reduction		51 %	73 %
P - loss kg/ha	7	1.9	0.9
reduction		73 %	87 %
runoff in mm	25.6	22.2	18.7
Herbicide loss % sprayed	2.2 %	1.0 % 55 %	0.6 % 74 %
reduction			
Herbicide loss in runoff	1,73 %	0.87 %	0.17 %
reduction		50 %	90 %
Herbicide loss In sediment	3.09 %	1.16 %	1.99 %
reduction		62 %	36 %

Soil loss 2 places Lower Austria 1994 - 2013

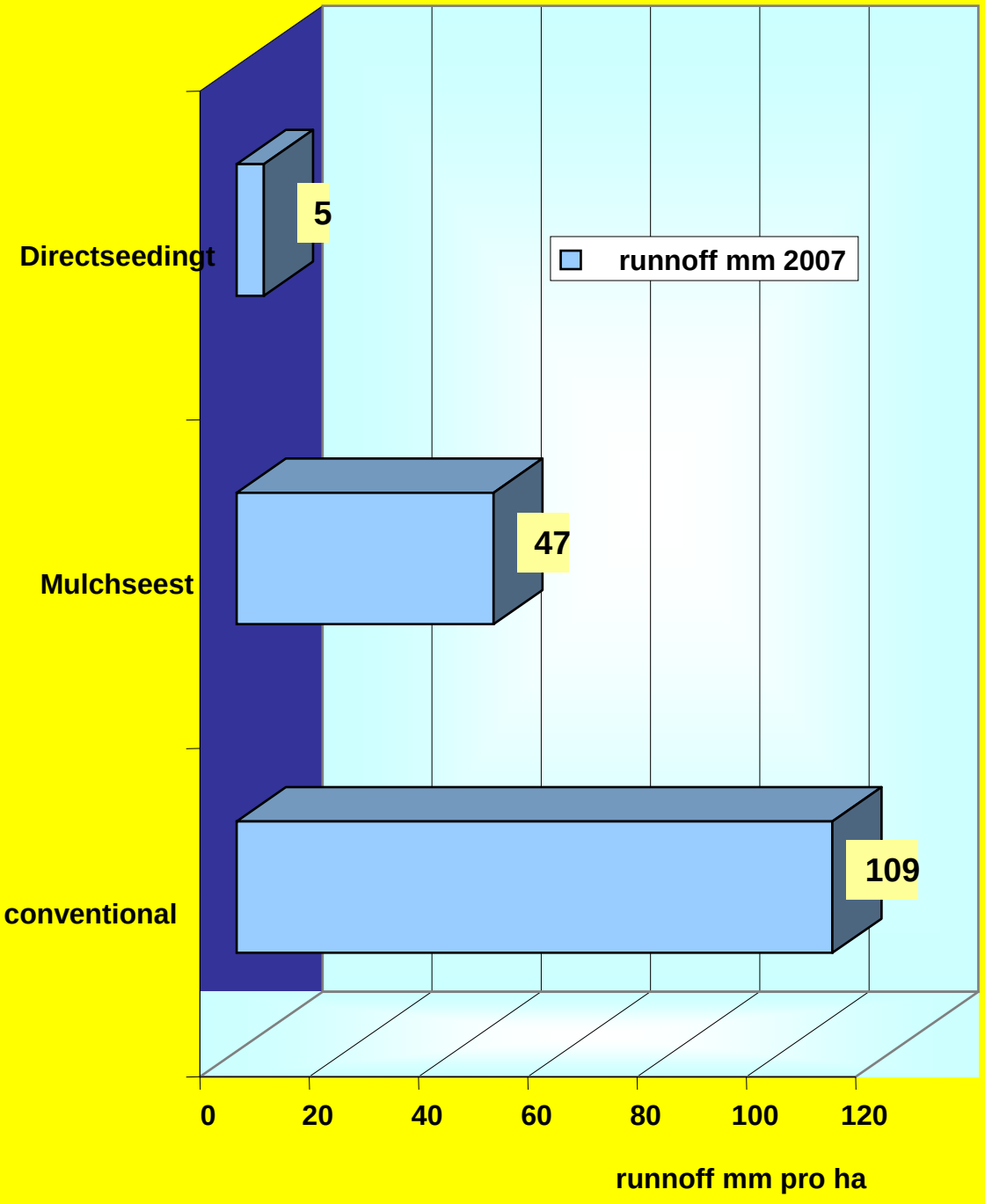

C org loss kg/ha
No Tillage
17
Mulchseed
33
Conventional Tillage
105
0
20
40
60
80
100
120
C org loss kg/ha


herbicide loss % sprayed
No Tillage
0,57
Mulchseed
1,01
Conventional Tillage
2,2
0
0,5
1
1,5
2
2,5
herbicide loss %...


herbicide loss in sediment %
herbicide loss in runoff %
herbicide loss % sprayed
No Tillage
1,99
0,17
0,57
Mulchseed
1,16
0
1,01
Conventional Tillage
3,09
1,73
2,2
0
1
2
3
4
Saturated zone – infiltration of pesticed into groundwater or next creek

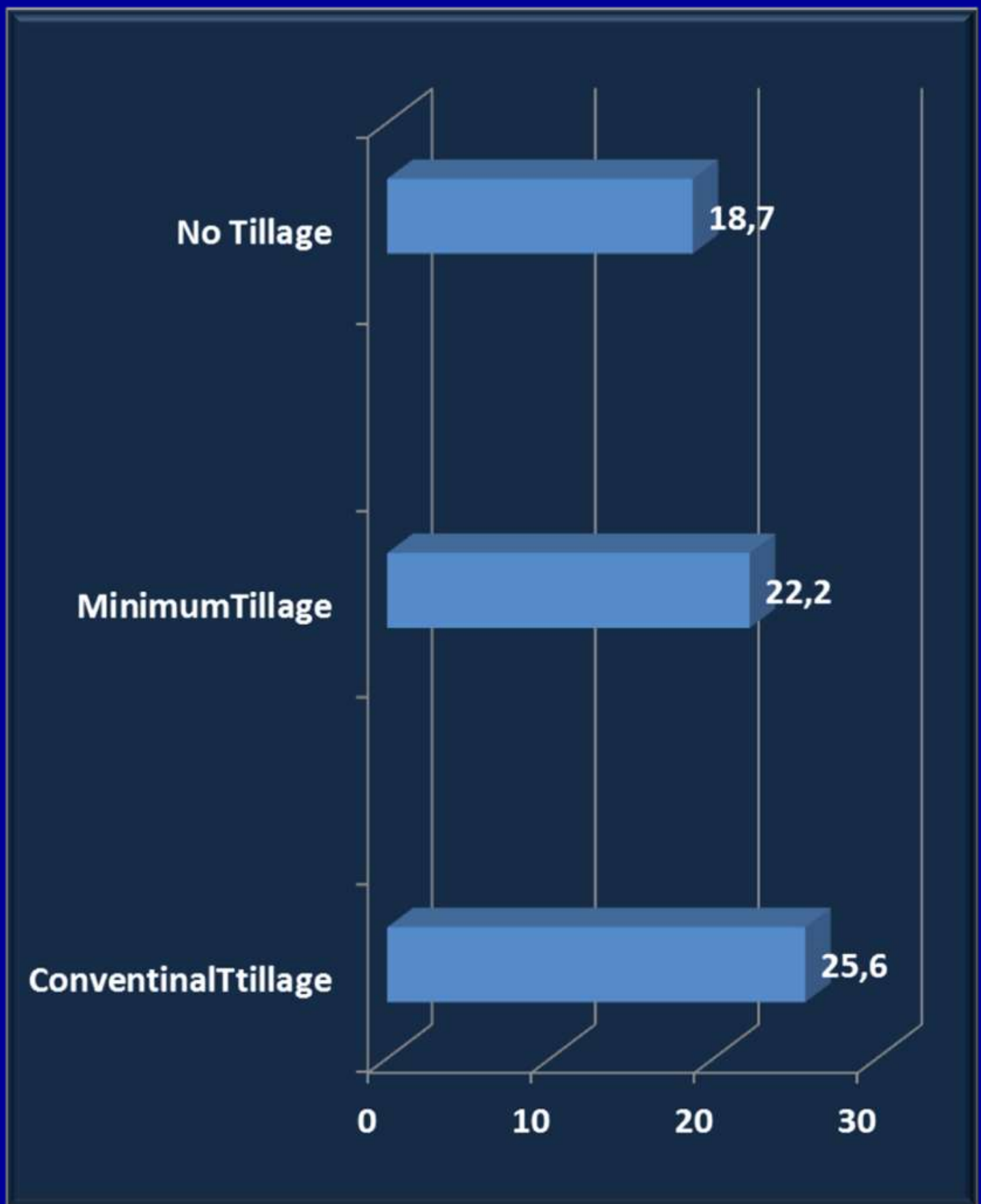
Runnof mm 2007

erosion trial Tullnerfeld




runoff mm/ha Pixendorf - Tulln sunflower 2013
No Tillage
1
MinimumTill age
2,7
Conventinal Ttillage
21
0
20
40

Runoff mm 1994 - 2013



- **Worldwide loss of 10 million ha arable land by soil erosion**

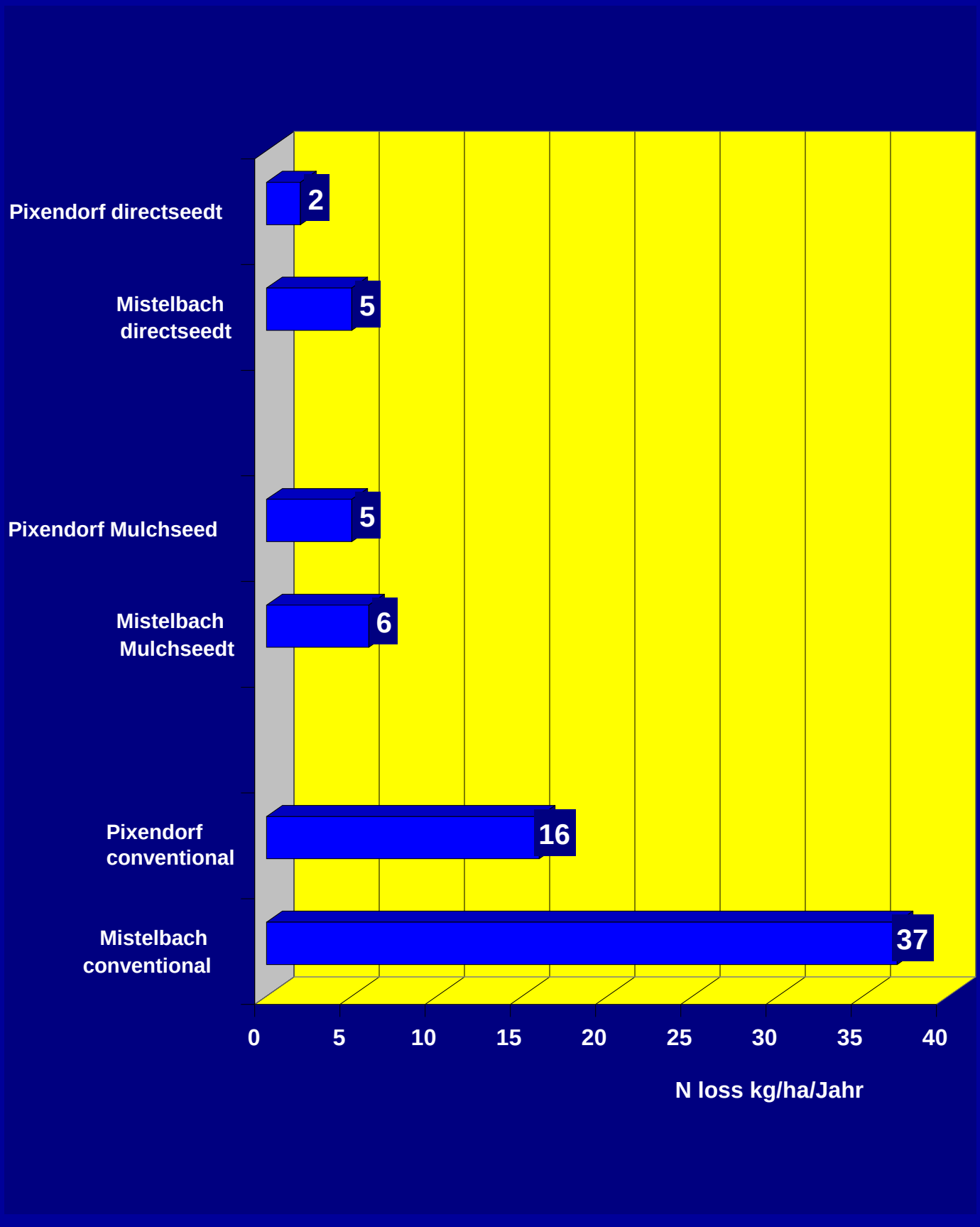
- **0.1 – 1 mm erosion per year tolerable……15 t/ha/year…..0.01 – 40 mm in practice occure**

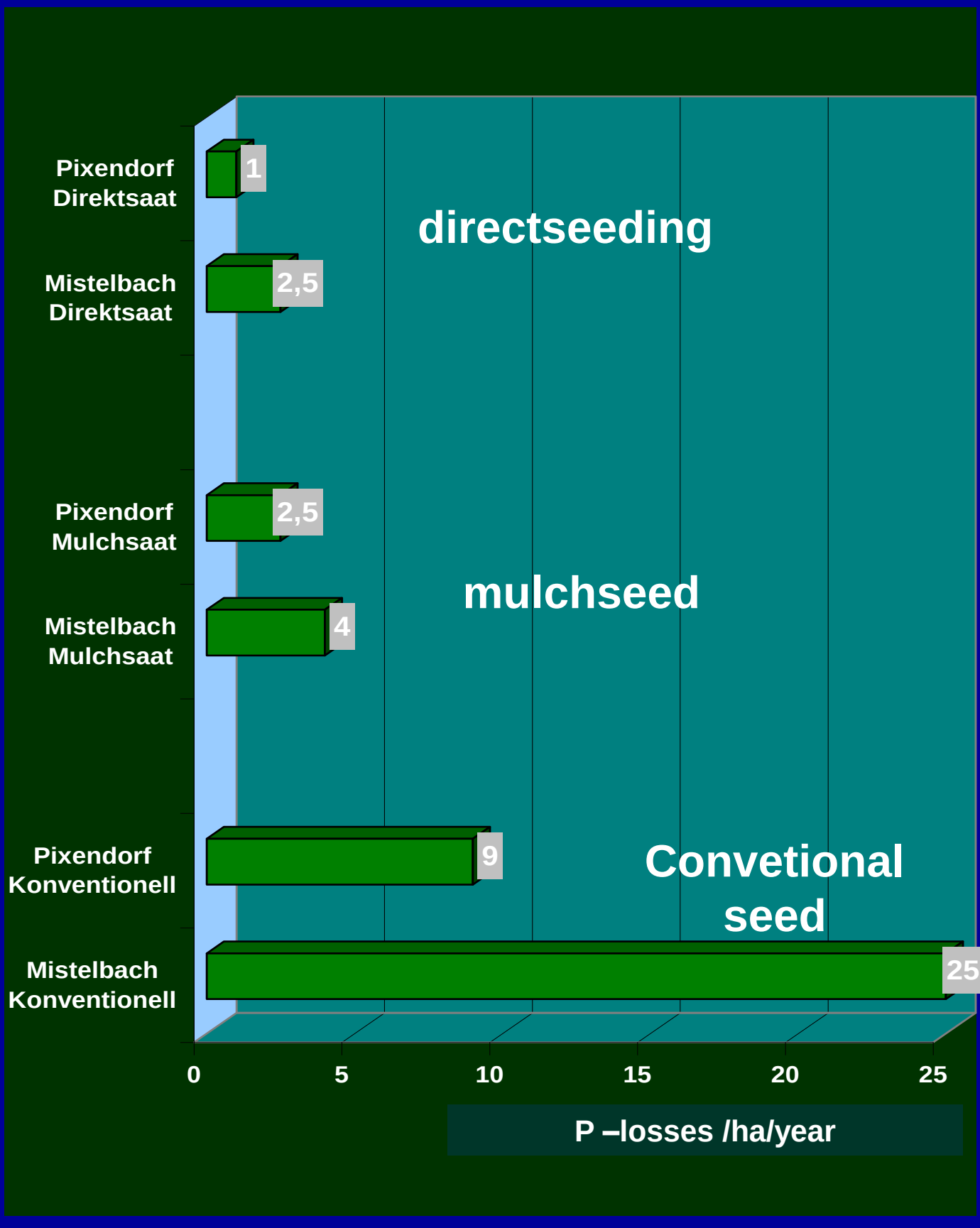
- **Soil regeneration in Central Europe 1t/ha/year**

- **In Western Germany 20 – 50 mm soil layer eroded in the last 50 years → yield reduction 10 – 20 %**

- **World online January 24th 2011: millenium tool plow to the scrap metal**

N - loss per ha and Jahr

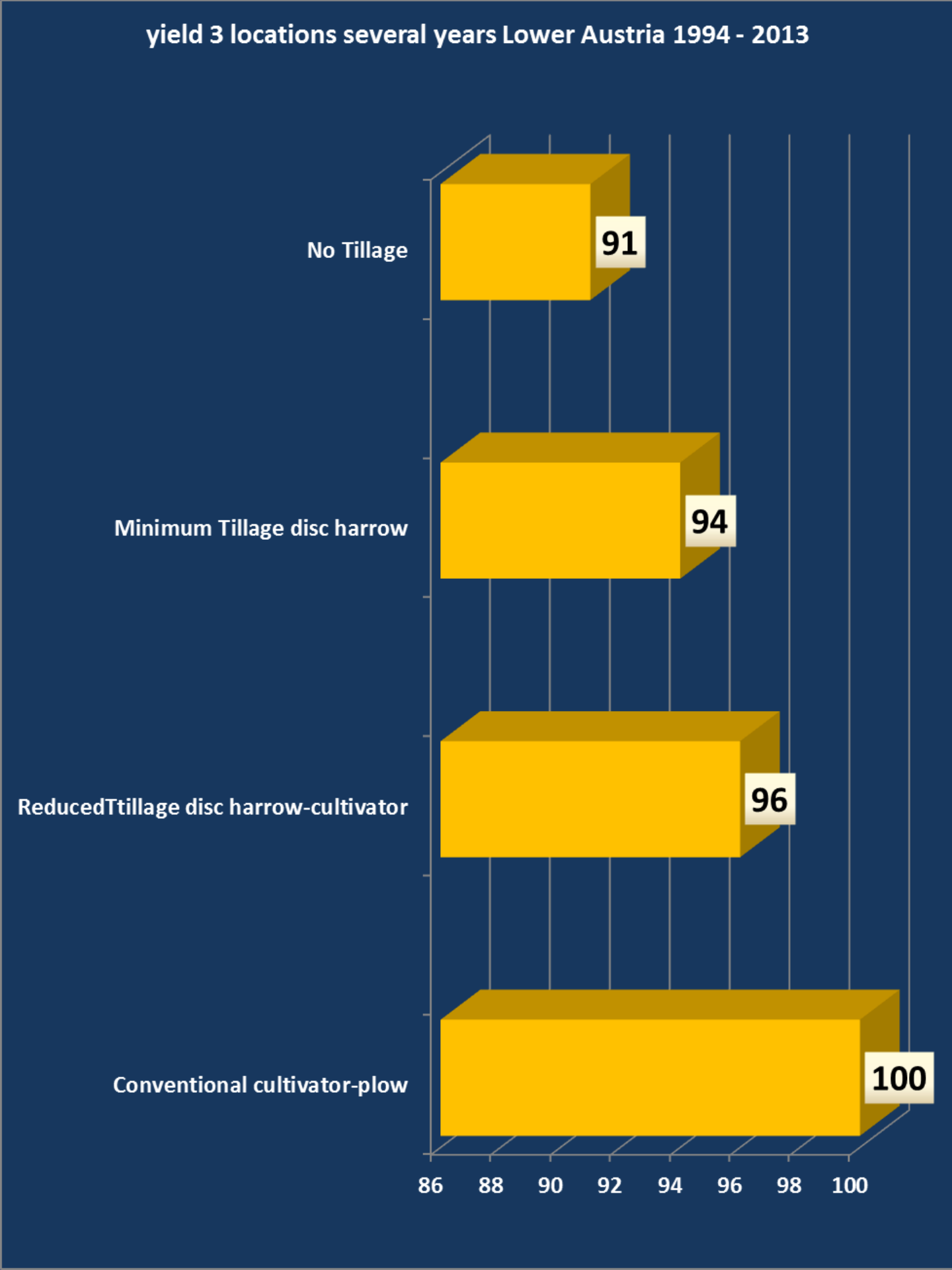


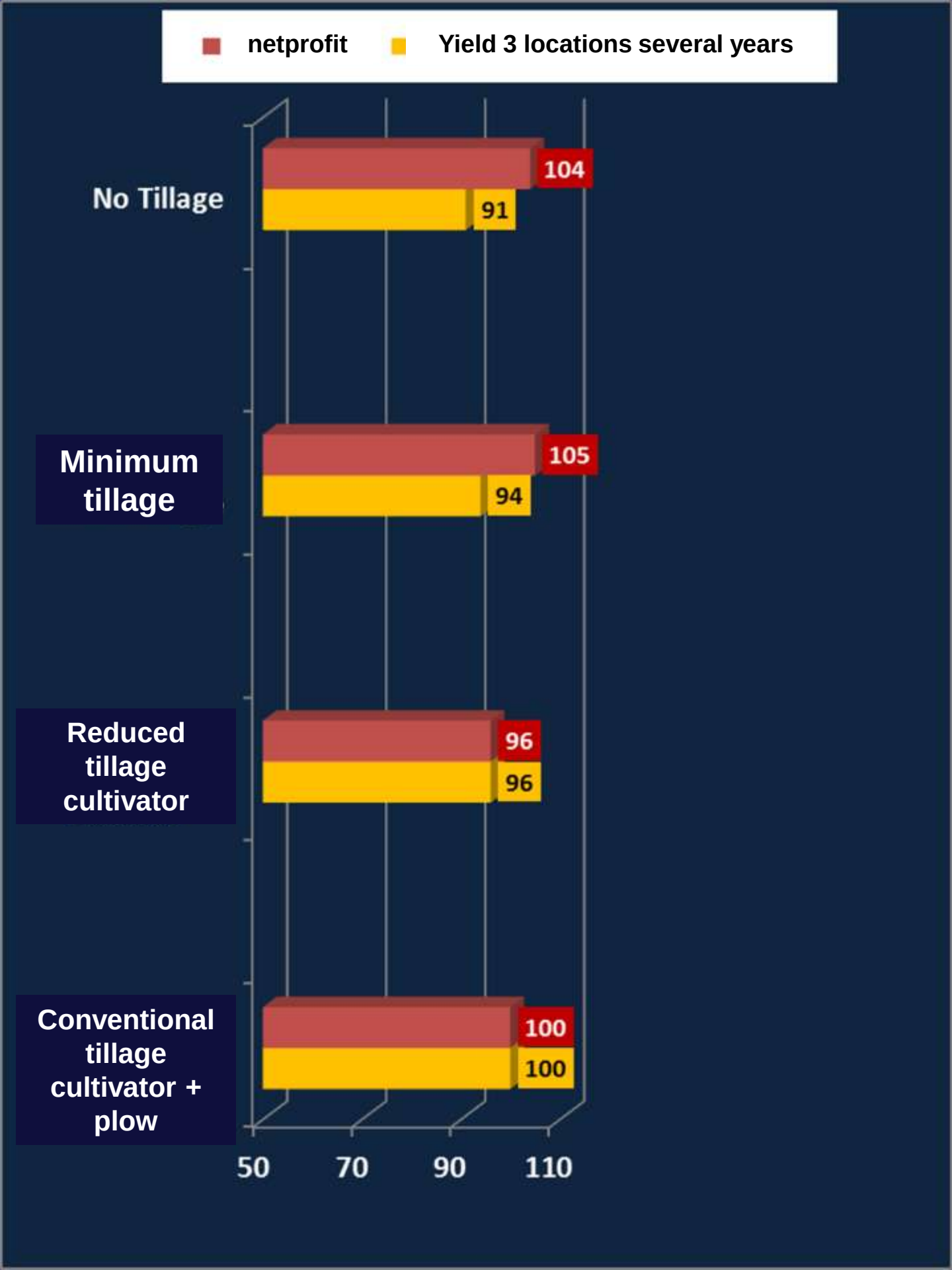

P –losses /ha/year
Pixendorf Direktsaat
1
directseeding
Mistelbach Direktsaat
2,5
Pixendorf Mulchsaat
2,5
mulchseed
Mistelbach Mulchsaat
4
Pixendorf Konventionell
9
Convetional seed
Mistelbach Konventionell
25
0
5
10
15
20
25
P –losses /ha/year

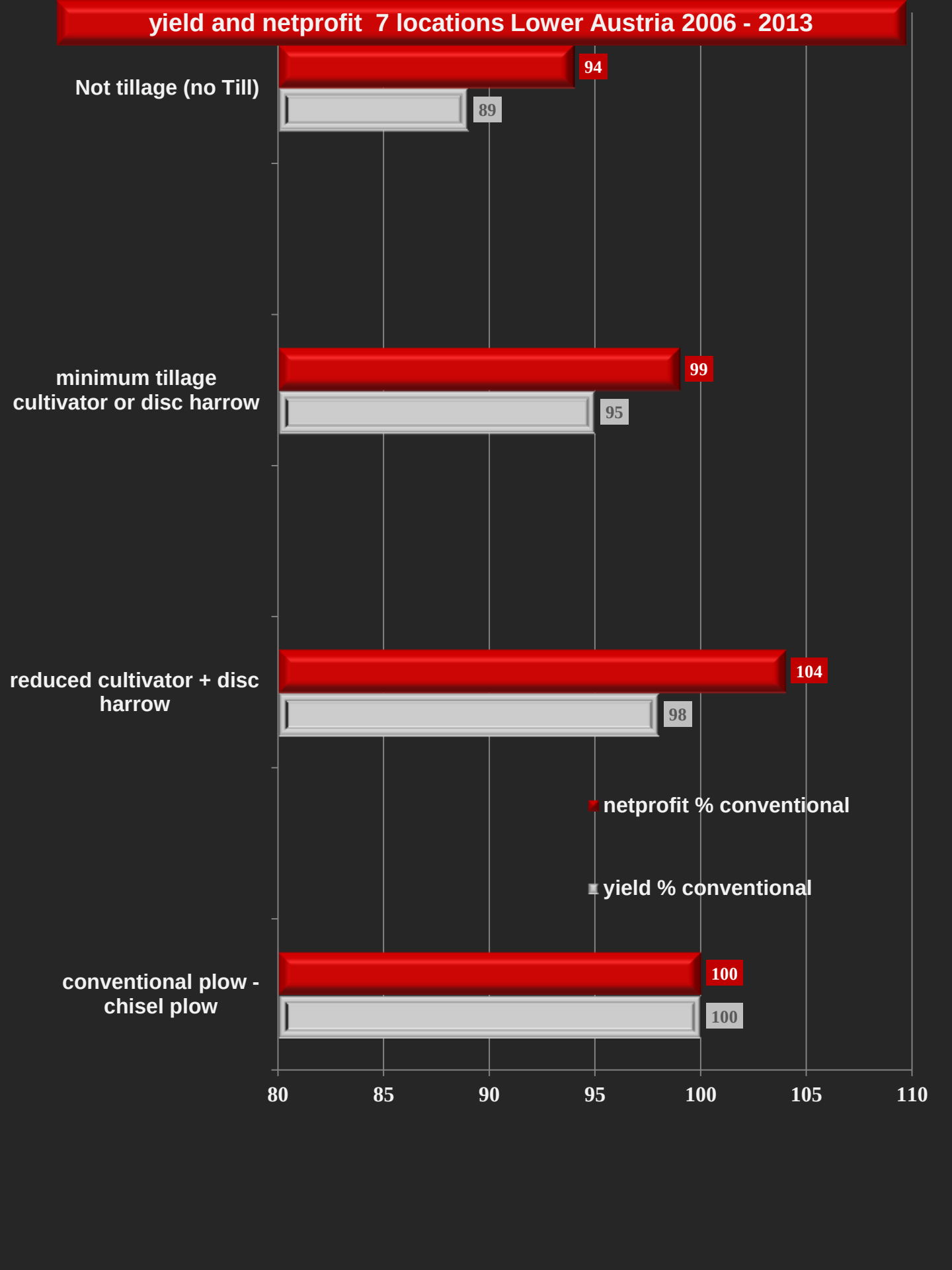
Yield in relative % 1994 – 2013 Mistelbach-Pyhra(St.Pölten)-Pixendorf(Tulln)

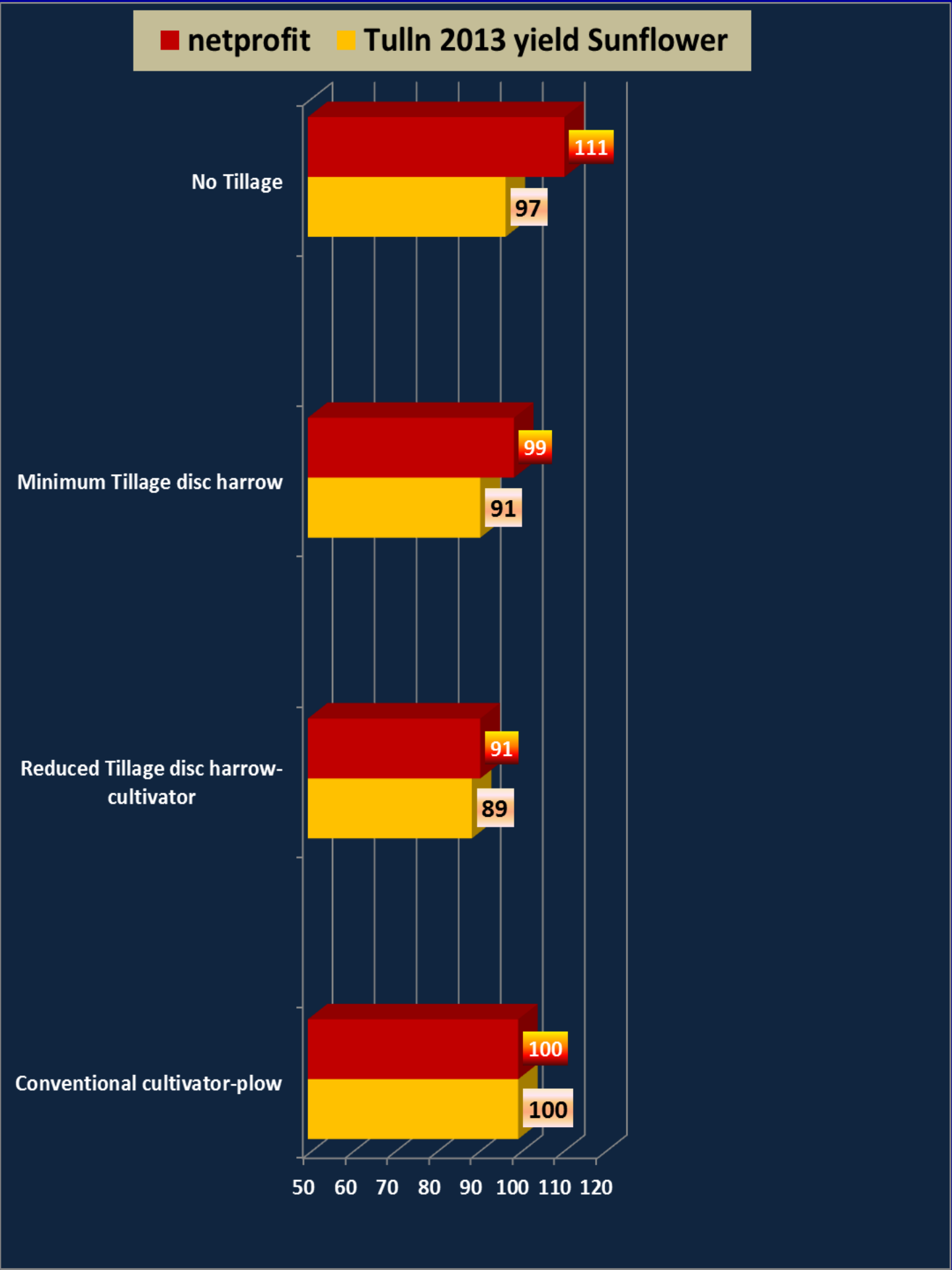
Rosner, Zwatz, Bartmann, Spieß

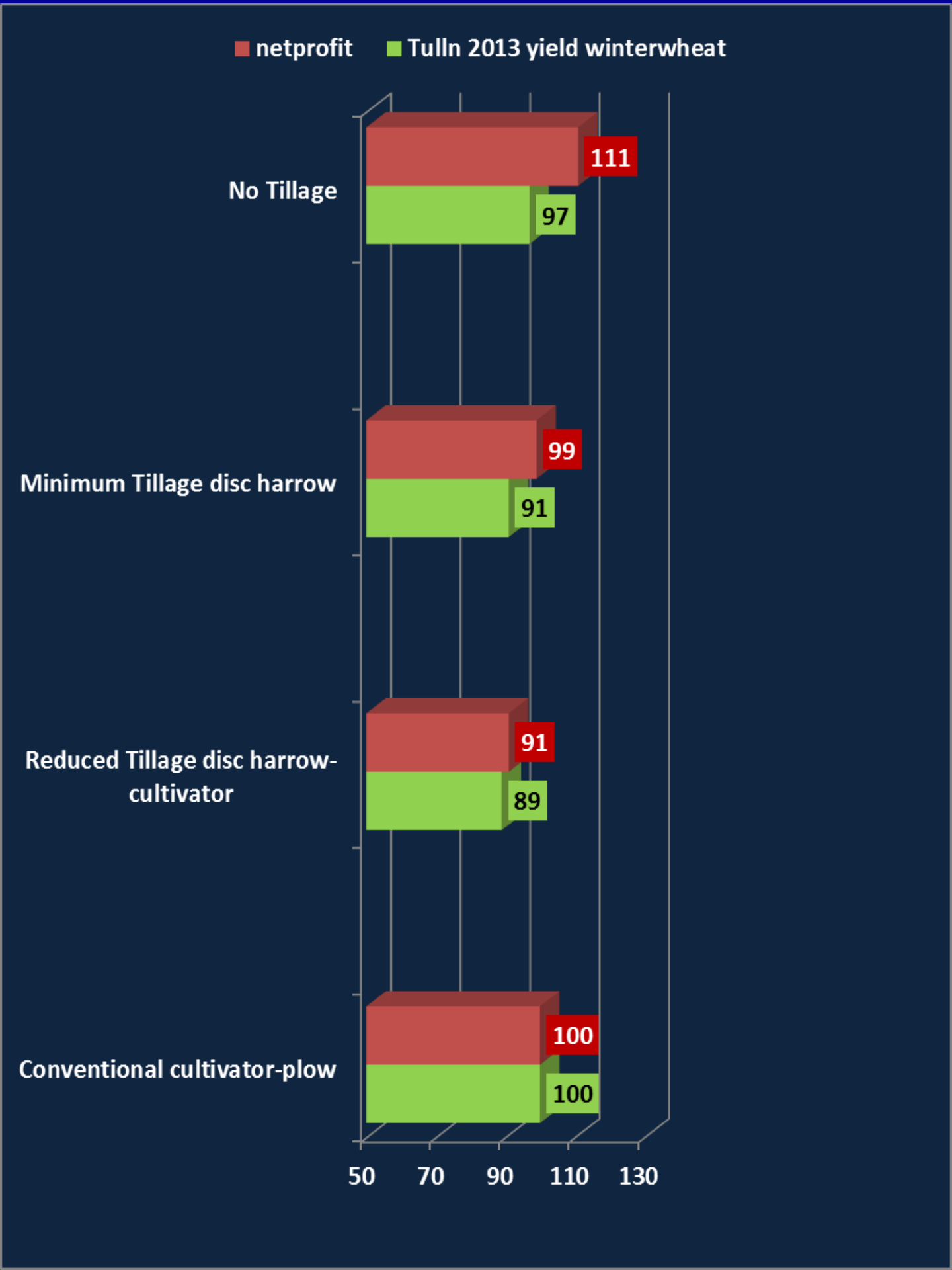
Tillage method/ Yield kg per ha	Mistelbach	Pyhra	Pixendorf
Conventional **Cultivator – plow** **No cover crop**	**100**	**100**	**100**
Cultivator – Mulchseed – Cover Crop: yellow mustard, california bluebell, buckwheat, red clover, oil radish	**96**	**102**	**102**
Cultivator – direct drilling/NoTill Cover crop : 7 kg/ha California Bluebell, 3 kg/ha Yellow Mustard	**93**	**106**	**106**
Cultivator – direct drilling/NoTill cover crop : 80 kg/ha winter rye	**89**	**93**	**93**
Cultivator – direct drilling/NoTill Cover crop :120 kg/ha summer barley	**97**	**112**	**112**

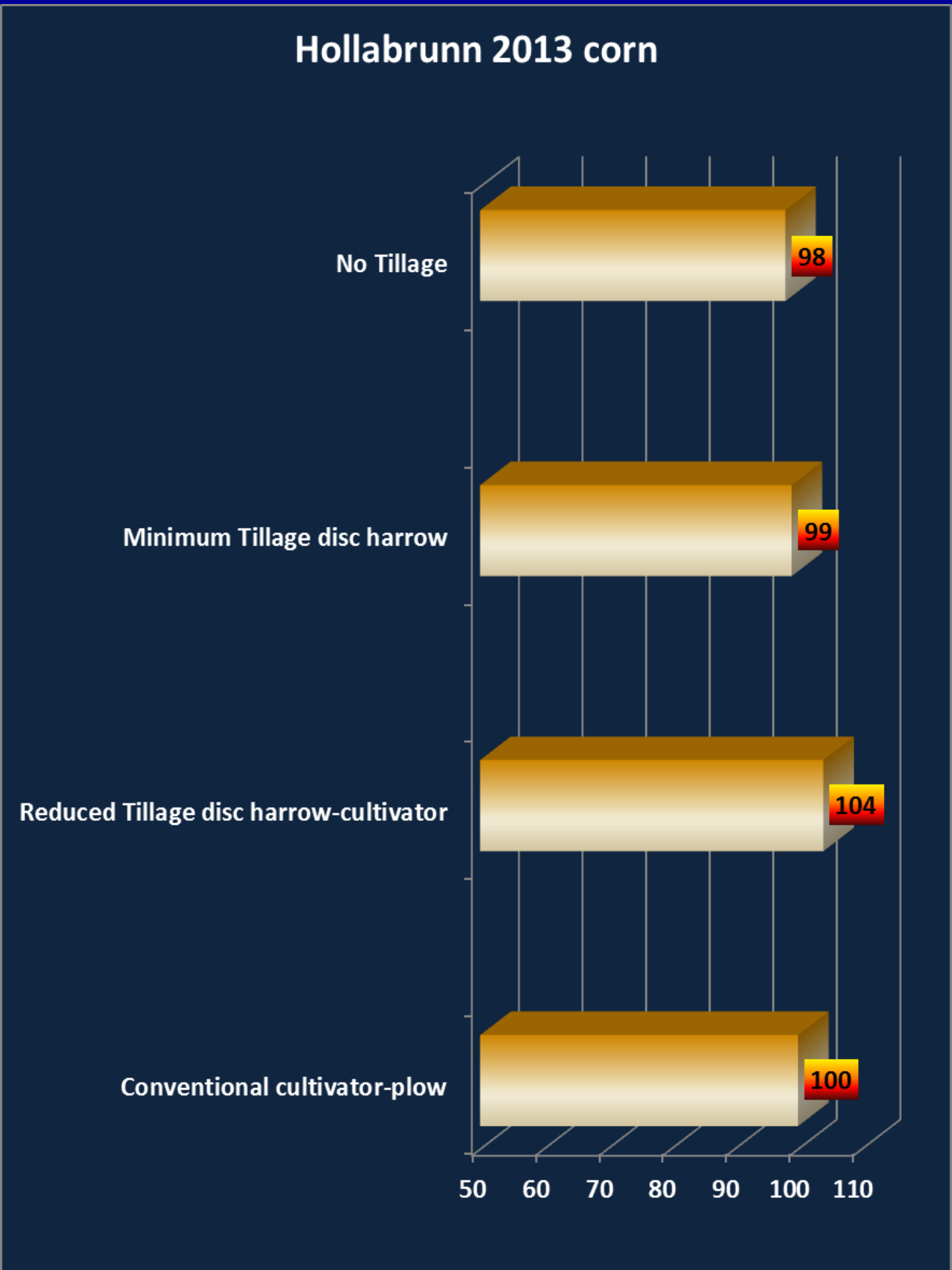

yield 3 locations several years Lower Austria 1994 - 2013
No Tillage
91
Minimum Tillage disc harrow
94
ReducedTtillage disc harrow-cultivator
96
Conventional cultivator-plow
100
86
88
90
92
94
96
98
100


netprofit
Yield 3 locations several years
No Tillage
104
91
Minimum tillage
105
94
Reduced tillage cultivator
96
96
Conventional tillage cultivator + plow
100
100
50
70
90
110

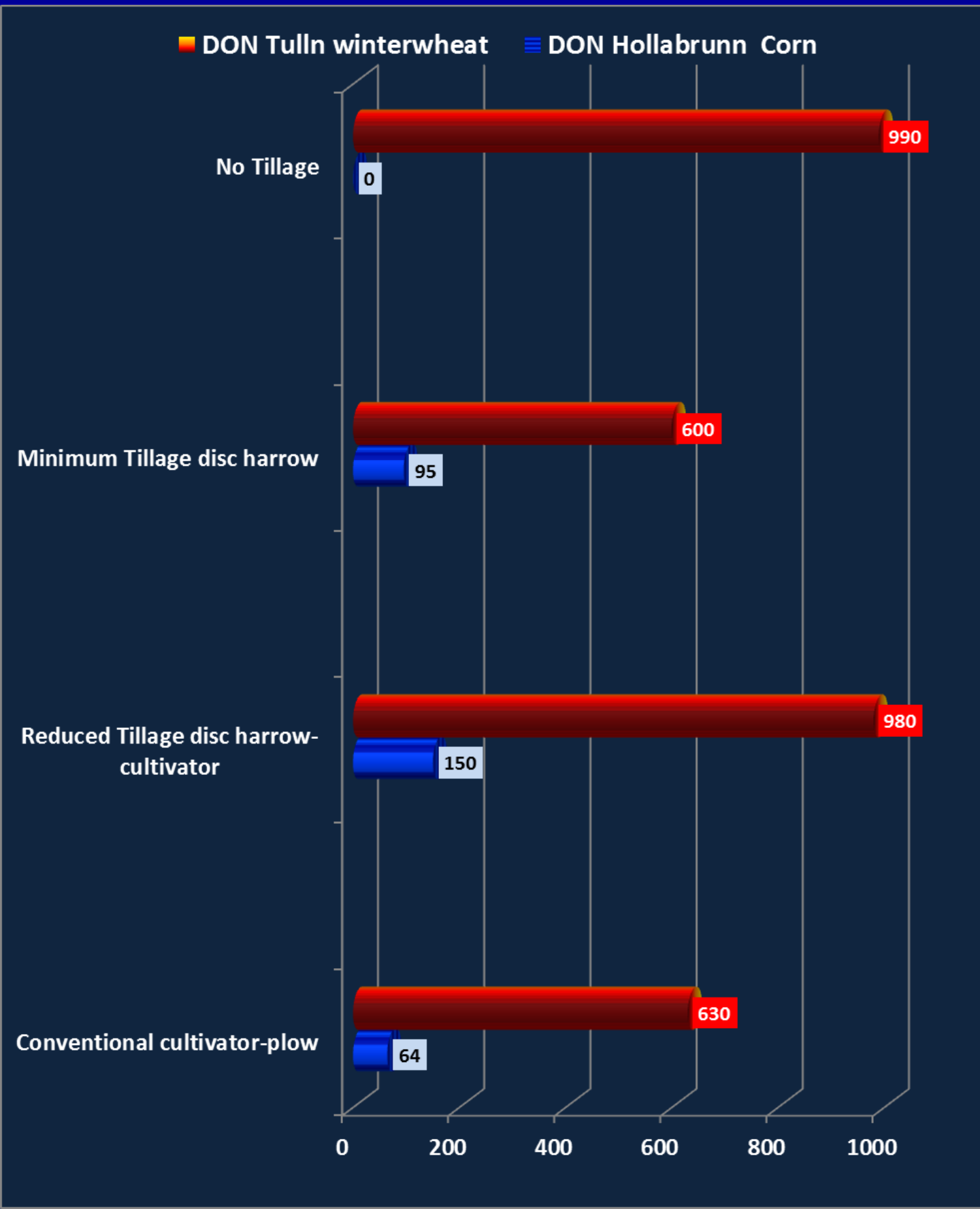

yield and netprofit 7 locations Lower Austria 2006 - 2013
Not tillage (no Till)
94
89
minimum tillage
cultivator or disc harrow
99
95
reduced cultivator + disc
harrow
104
98
netprofit % conventional
yield % conventional
conventional plow -
chisel plow
100
100
80
85
90
95
100
105
110

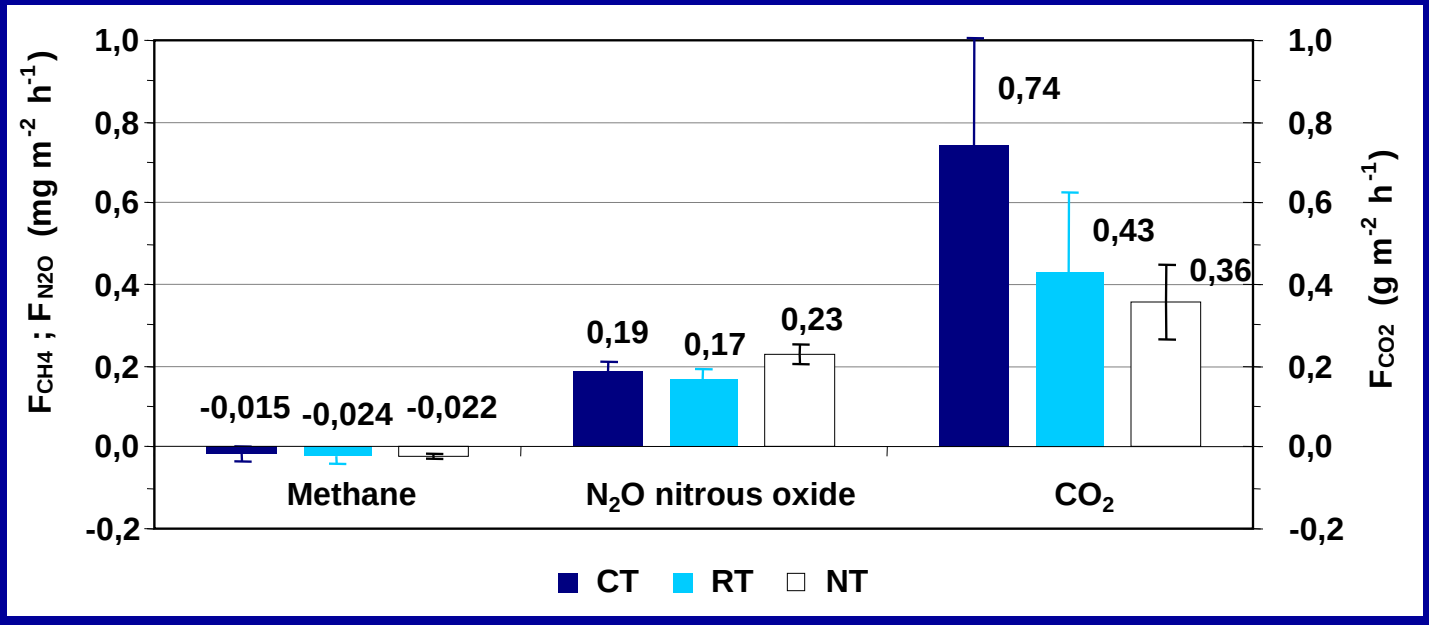

netprofit
Tulln 2013 yield Sunflower
No Tillage
111
97
Minimum Tillage disc harrow
99
91
Reduced Tillage disc harrow-cultivator
91
89
Conventional cultivator-plow
100
100
50
60
70
80
90
100
110
120


netprofit
Tulln 2013 yield winterwheat
No Tillage
111
97
Minimum Tillage disc harrow
99
91
Reduced Tillage disc harrow-cultivator
91
89
Conventional cultivator-plow
100
100
50
70
90
110
130

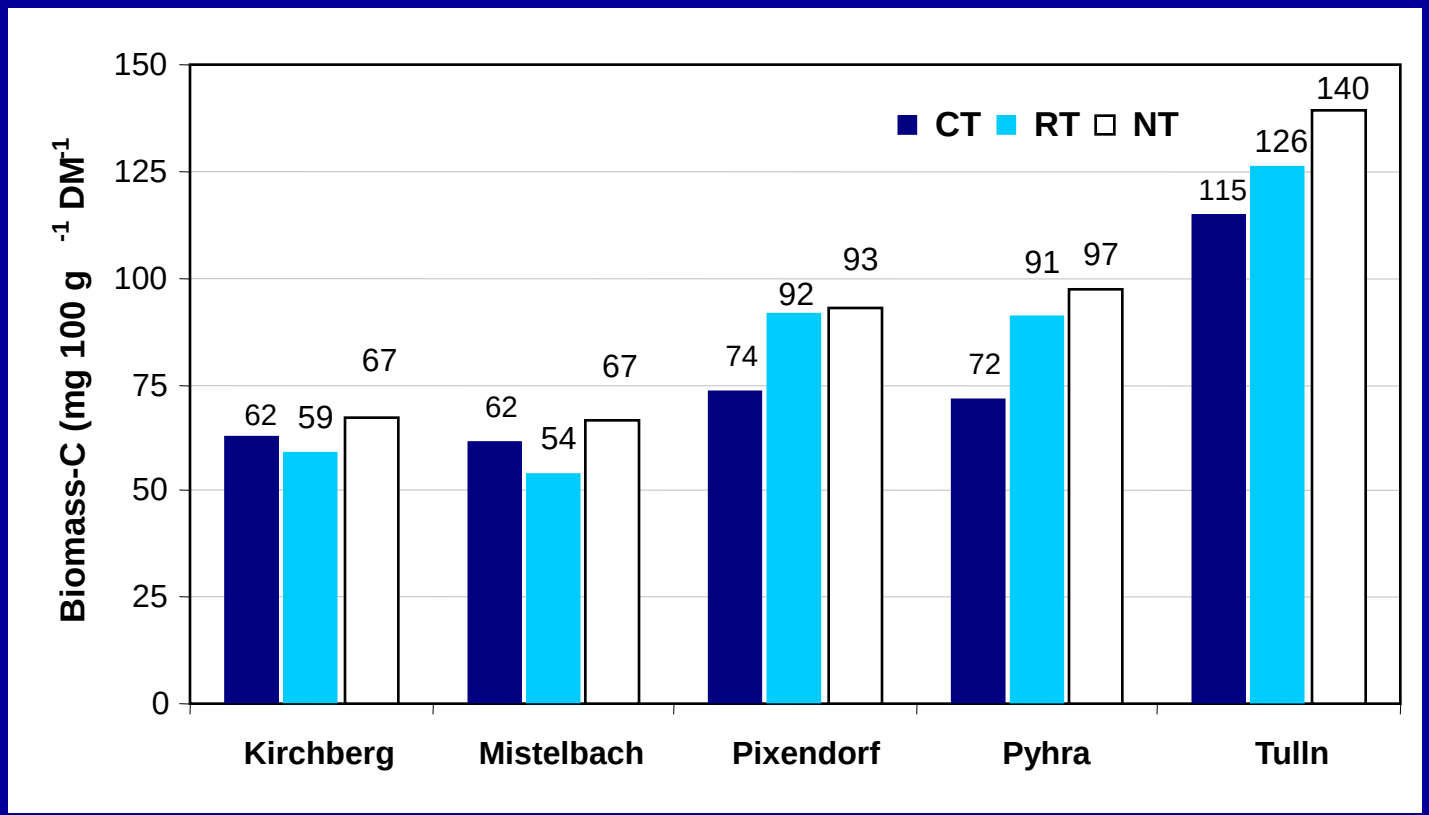

Hollabrunn 2013 corn
No Tillage
98
Minimum Tillage disc harrow
99
Reduced Tillage disc harrow-cultivator
104
Conventional cultivator-plow
100
50
60
70
80
90
100
110

DON 2013


DON Tulln winterwheat
DON Hollabrunn Corn
No Tillage
990
0
Minimum Tillage disc harrow
600
95
Reduced Tillage disc harrow-cultivator
980
150
Conventional cultivator-plow
630
64
0
200
400
600
800
1000

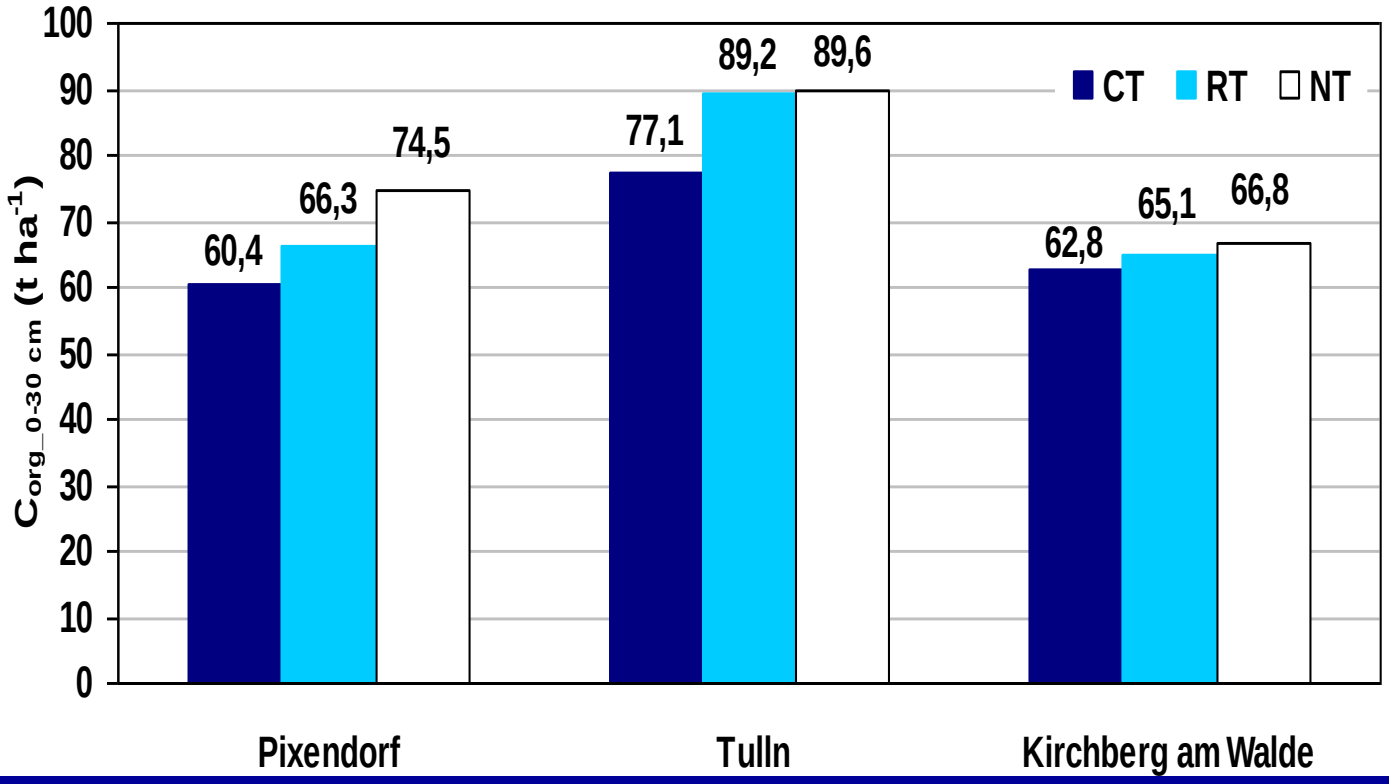


Methane, lauging gas and Carbon doixide flux in closed chamber - *non-steady-state through-flow chamber* - June 9th 2008 Pixendorf (Klik et al.)



Microbial Biomass (mg Biomass-C 100 g-1 dry matter-1 (DM) (Klik et al.)

Organic Carbon in soil 0 – 30 cm

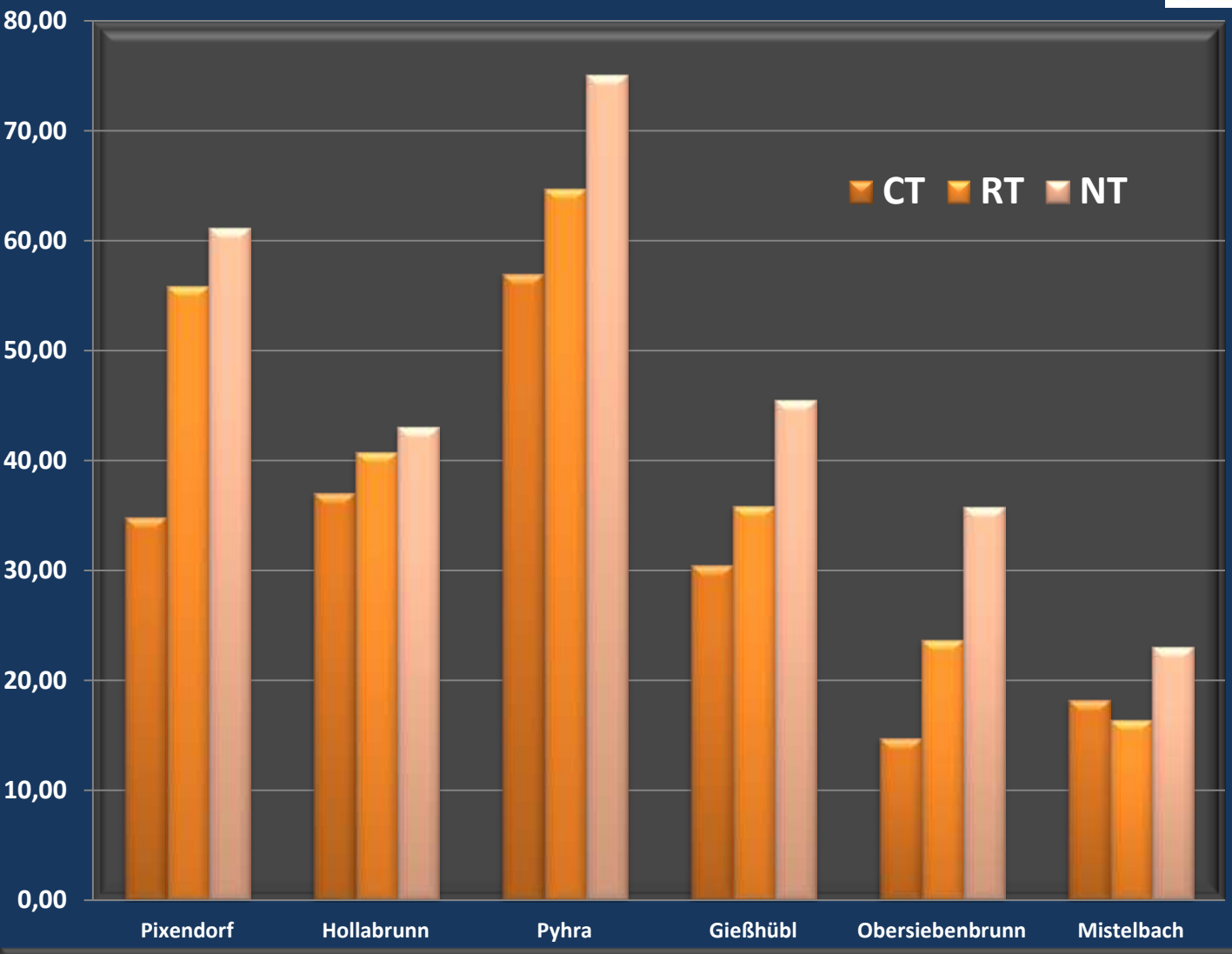


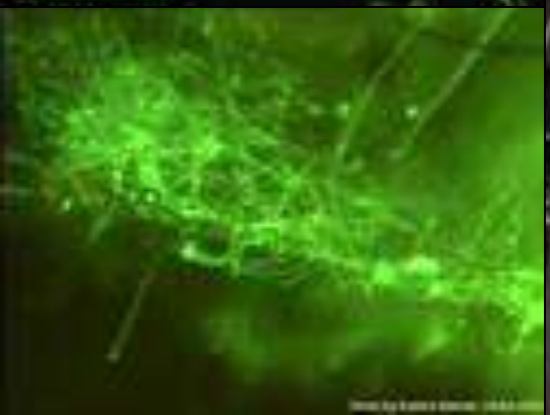
→ CT << RT < NT

(Trümper G. u. A.Klik)

Sugar Beet harvester
Tare weight: 40 t
Tank volume: > 30 t
Total weight: > 70 t

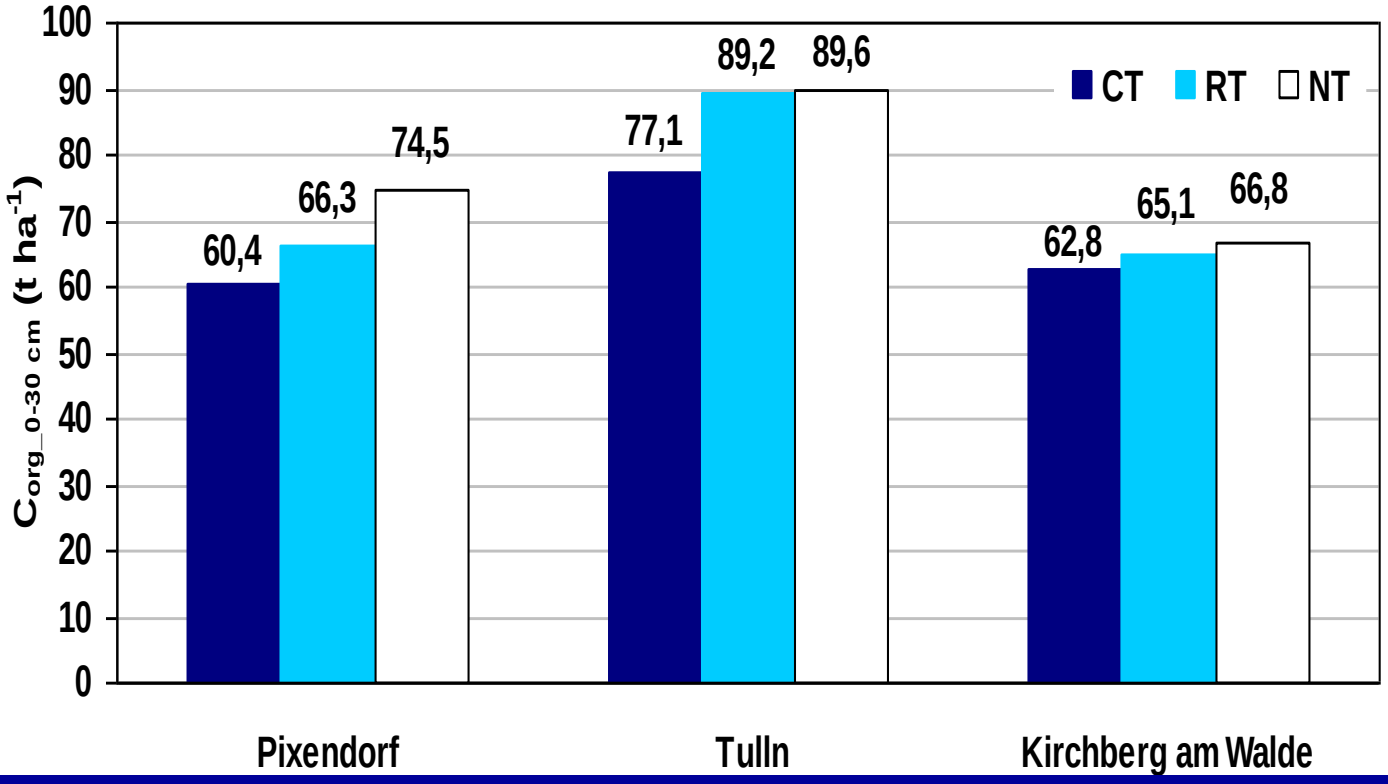
Aggregatte stability 2013





Organic Carbon in soil 0 – 30 cm

(Trümper G. u. A. Klik)



→ CT << RT < NT

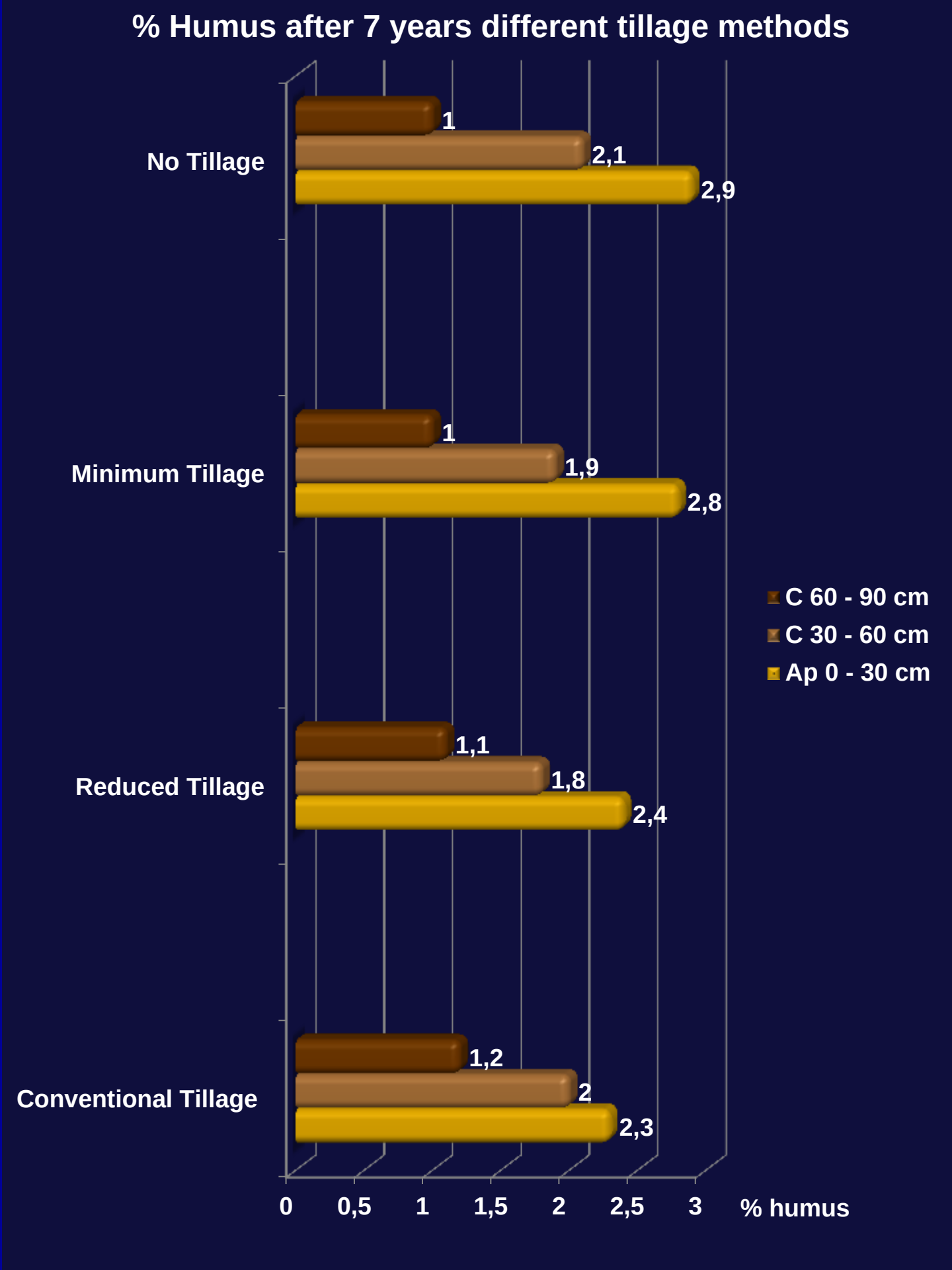
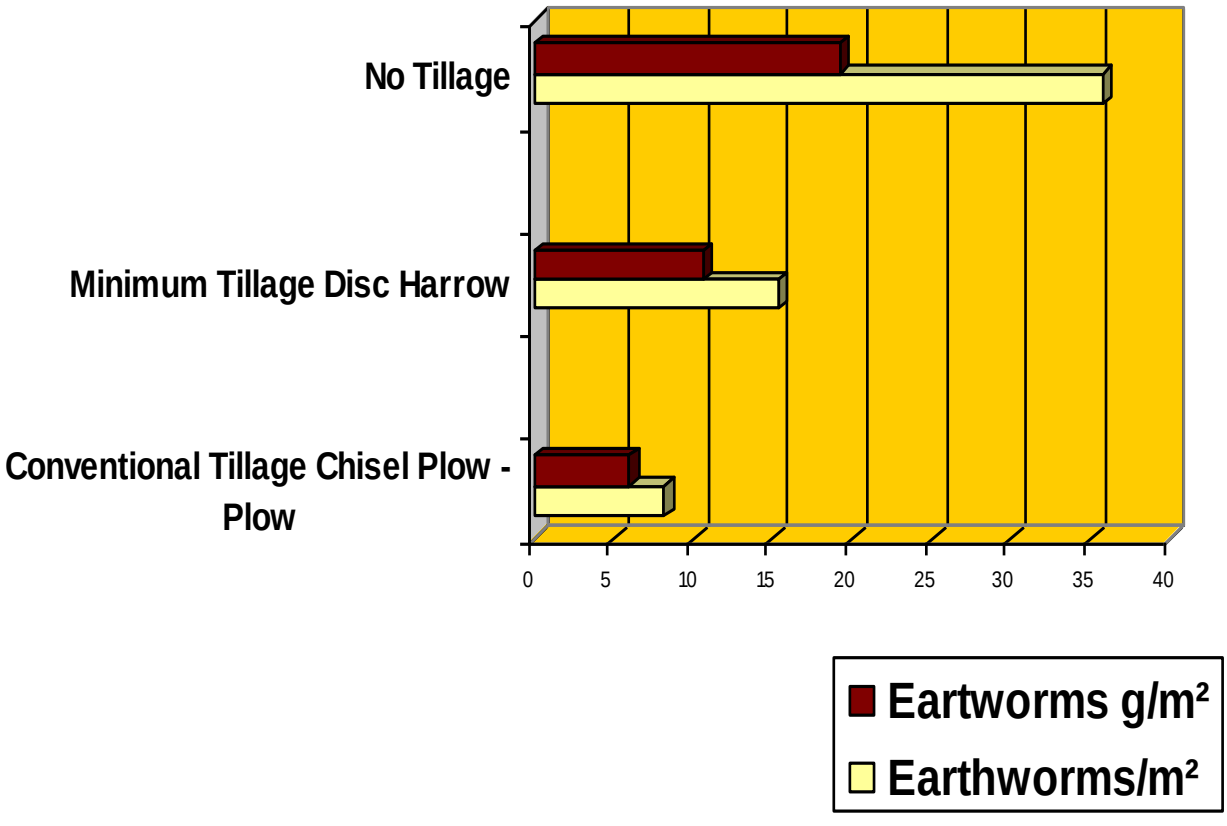

% Humus after 7 years different tillage methods
No Tillage
1
2,1
2,9
Minimum Tillage
1
1,9
2,8
Reduced Tillage
1,1
1,8
2,4
Conventional Tillage
1,2
2
2,3
C 60 - 90 cm
C 30 - 60 cm
Ap 0 - 30 cm
0
0,5
1
1,5
2
2,5
3
% humus

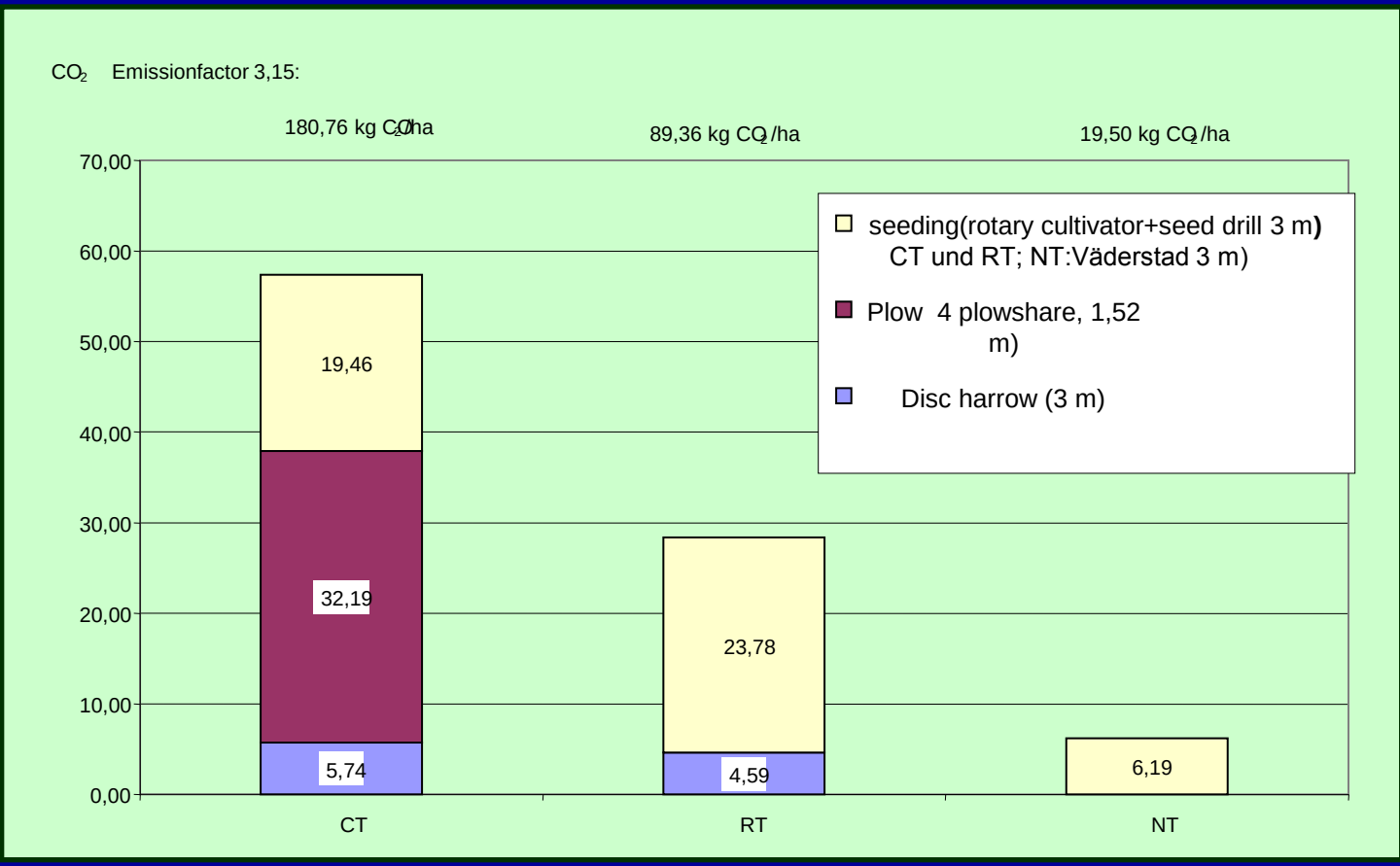
Figure 1: number and weight of Earthworms 0-30 cm 2004 - 2006

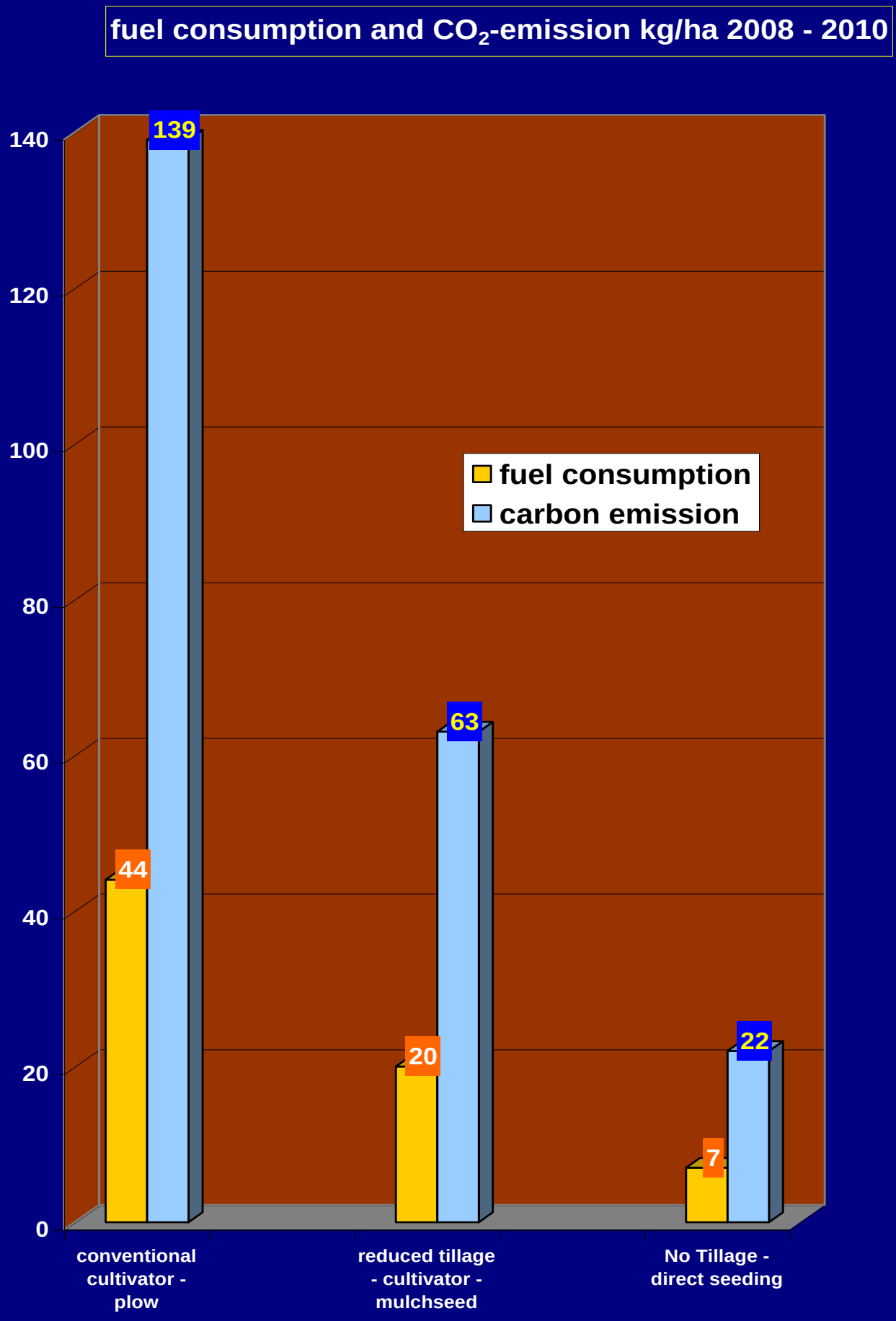


Tests of CO_2 emission by cultivation

Tulln 2008

	CT	RT	NT
Fuel consumption(l/ha)	57	28	6,2
Working time(min/ha)	125,5	57	15




fuel consumption and CO_2-emission kg/ha 2008 - 2010
140
120
100
80
60
40
20
0
139
44
63
20
22
7
fuel consumption
carbon emission
conventional cultivator - plow
reduced tillage - cultivator - mulchseed
No Tillage - direct seeding

Conclusion

•Mulch –and direct –seeding systems are fully developed and go well in practice.

•The economical benefits must not ignore the nutrient – pesticide and soil movement (erosion).

•Cereal – maize crop rotation needs a shallow mulch of crop residuals for a fast decomposition as a phytosanitary need.

•After harvest the growth of volunteer cereals has to be interrupted, they stand for a green bridge for plant diseases like barley yellow dwarf virus or Fusarium sp. and pests like aphids as a vector for the virus.

•An immediately seeding of cover crops after harvest for a good development of the green manure.

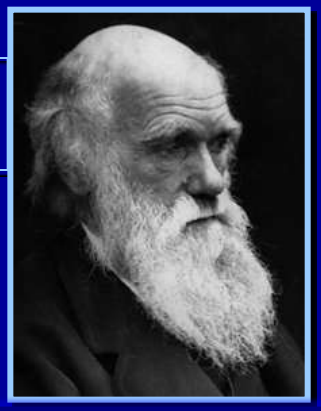
•The production of Mycotoxins by Fusarium disease (Dry Rot)is to be interrupted by shallow soil tillage and a adopted crop rotation.

•A reduction of the costs is possible and necessary.

•A prescription is not possible and depends from the crop rotation and natural situation.

It is not the strongest species which survives, also not the most intelligent one, but that which reacts fastest to changes.

Charles Darwin



All against nature has no long term existence (survival)

Thank you for your attention

Results:
www.landimpulse.at/agroinnovation/downloads