Weed control in organic crop rotations for grain production

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Weed control in organic crop rotations for cereal production

- **Crop rotations**
- **Weed control**
- **Results & discussion**

Crop rotations

- **Organic crop rotations**
- **for cereal production**

- **Problems:**
  - yield
  - weeds
  - others

Crop rotations

- **4 different crop rotations**

- **4 locations in Denmark**
  - **different soil types**
  - **different climates**
  - **different weed flora**

Crop rotations

Three-factorial experiment:

- **fraction of legumes in the rotation (crop rotation)**
- **catch crop (with or without)**
- **manure (with or without slurry)**

Crop rotations

Decreasing fraction of legumes:

Rot. 1: 1.5 grass-clover + 1 pulse crop

Rot. 2: 1 grass-clover + 1 pulse crop

Rot. 3: 1 grass-clover

Rot. 4: 1 pulse crop

Crop rotations

- **Rotation 2**
  - **Spring barley with undersown ley**
  - **Grass-clover ley**
  - **Winter wheat**
  - **Pea/barley**

Crop rotations

- **Rotation 2 with catch crops**
  - **Spring barley with undersown ley**
  - **Grass-clover ley**
  - **Winter wheat with ryegrass**
  - **Pea/barley with ryegrass and clover**

Crop rotations

- **Rotation 4 with catch crops**
  - **Oats with undersown clover**
  - **Winter wheat/clover**
  - **Winter wheat/clover**
  - **Pea/barley with ryegrass and clover**

Crop rotations

Years with different crop types

Rot.	Ley	Pulse	Cereal	Row crop
1	1.5	1	2	0
2	1	1	2	0
3	1	0	2	1
4	0	1	3	0

Crop rotations

With manure:

- **40% of nitrogen demand of the rotation applied as slurry**

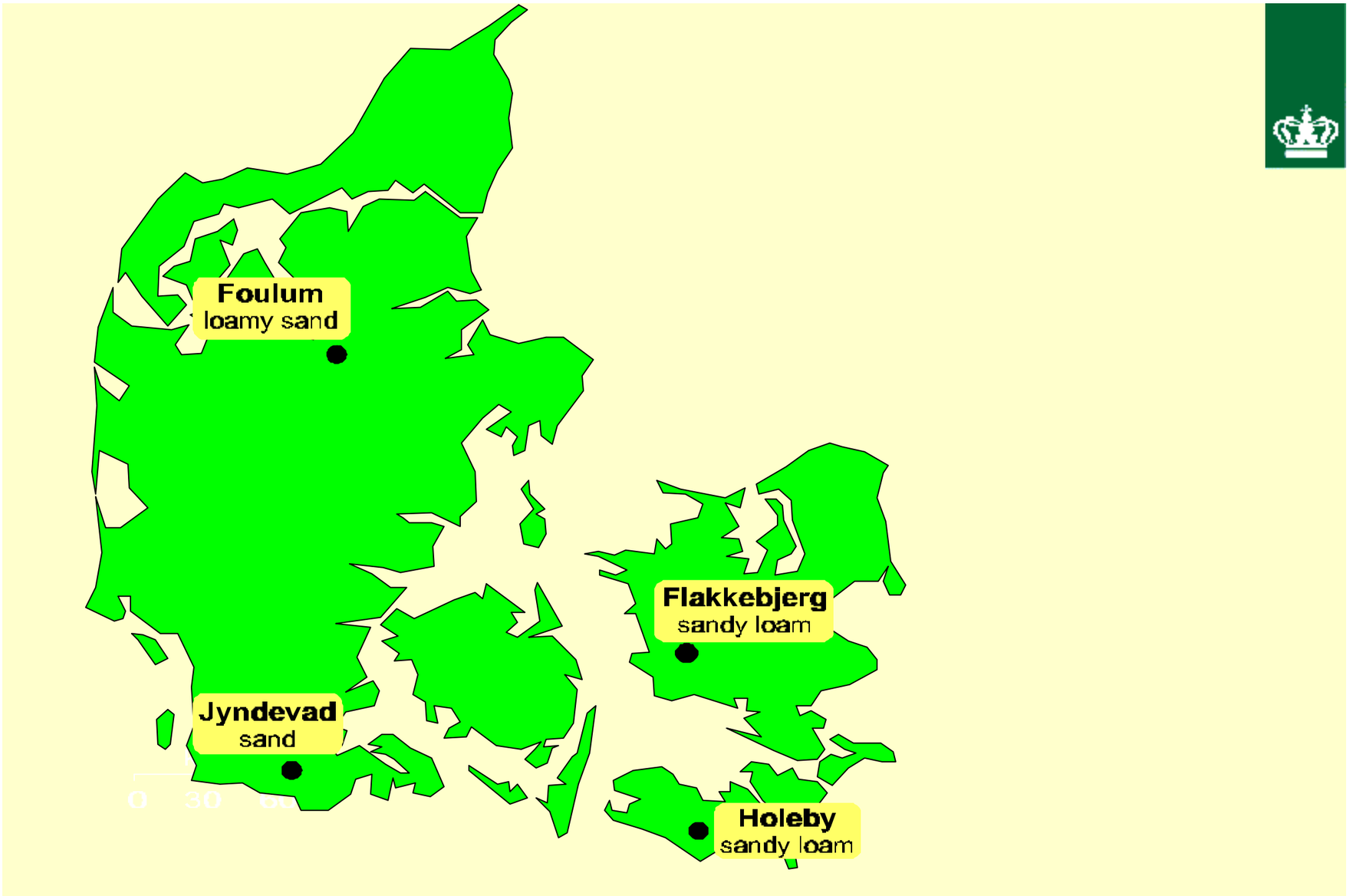
All straw and other plant residue left on the soil

Clover-grass is cut several times and left on the soil

Crop rotations

Manure application:

Crop (rotation)	kg N ha^{-1}
Spring barley (1, 2 & 3)	50
Oats (4)	40
Spring wheat (1)	50
Winter wheat (2 & 3)	50
Winter wheat (4)	70
Sugar beets (3)	50

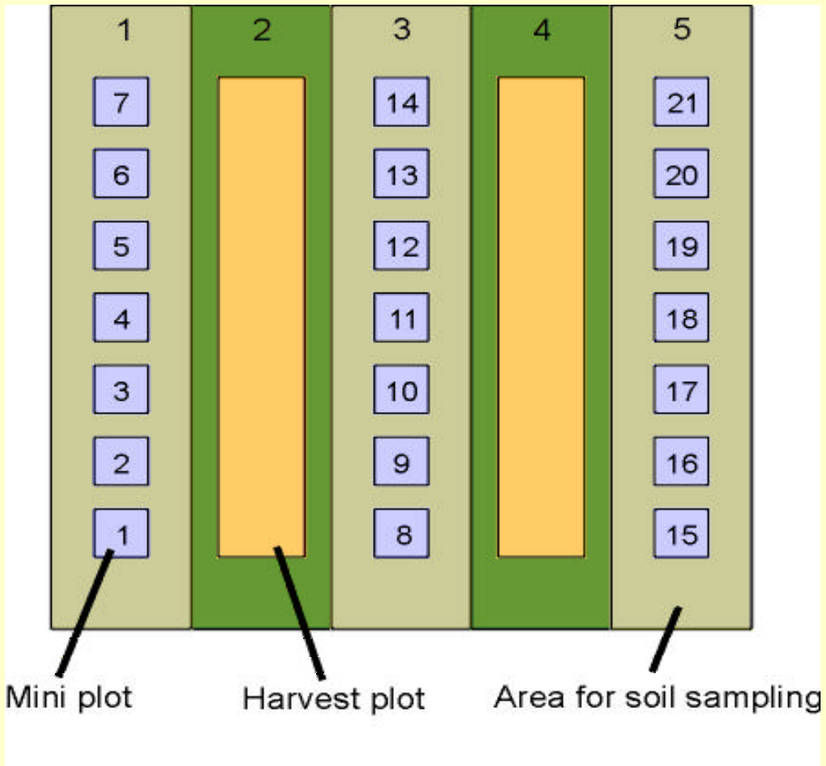

Foulum
loamy sand
Jyndevad
sand
Flakkebjerg
sandy loam
Holeby
sandy loam
0 30

Crop rotations

- 2 replicates (blocks)
- each block with 2 subblocks
- in each subblock 2 combinations of each crop rotation


6 4
7 1
18 2
19 1
30 3
31 4
42 3
43 4
54 3
55 1
66 4
67 2
5 4
8 1
17 2
20 4
29 1
32 3
41 4
44 4
53 2
56 3
65 1
68 2
4 2
9 3
16 3
21 2
28 4
33 2
40 1
45 3
52 4
57 3
64 1
69 2
3 4
10 3
15 3
22 3
27 1
34 2
39 3
46 3
51 4
58 2
63 4
70 2
2 4
11 1
14 2
23 3
26 1
35 2
38 4
47 1
50 4
59 1
62 2
71 3
1 2
12 4
13 4
24 1
25 1
36 3
37 1
48 1
49 2
60 3
61 1
72 2
Plot number
Field number
12 3
Animal manure
Catch crop
Crop rotations
1
2
3
4
N

Plot infrastructure at Flakkebjerg



Weed control

Prevention

- Cultivars which are competitive
- Late sowing of winter cereals
- Placing manure close to crops
- Crop density

Weed control

Optimal mechanical weed control

- **Spring sown cereals and pulses without catch crops:**
  - **pre-emergence harrowing**
  - **post-emergence harrowing**
  - **supplementary harrowing later if needed**

Weed control

- **Winter cereals with and without catch crops:**
  - **pre-emergence harrowing if possible**
  - **post-emergence harrowing if possible**
  - **harrowing early spring**
- **without catch crops:**
  - **supplementary harrowing later if needed**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Weed control

- **Winter wheat at Jyndevad and winter cereals in rotation 4 without catch crops at Foulum since 1998:**
  - **sown at larger than normal row distance**
  - **mechanical hoeing between rows**
  - **supplementary harrowing**

Weed control

- **Winter cereals in rotation 4 with catch crops:**
  - **brush hoeing between rows 2-3 times**

Weed control

- **Sugar beets:**
  - **pre-emergence flame weeding**
  - **hand hoeing in the rows**
  - **mechanical hoeing between rows**
  - **hand weeding**

Weed control - perennials

- **Couch grass:**
  - **without catch crops - stubble cultivation at more than 5 shoots m^{-2}**
  - **with catch crops - stubble cultivation at more than 50 shoots m^{-2}**
  - **cutting the grass-clover more often at more than 5 shoots m^{-2} in the preceding crop**

Weed control - perennials

- **Couch grass thresholds:**
  - **stubble cultivation:**
    - **without catch crops > 5 shoots m^{-2}**
    - **with catch crops > 50 shoots m^{-2}**
  - **cutting the grass-clover more often at more than 5 shoots m^{-2} in the preceding crop**

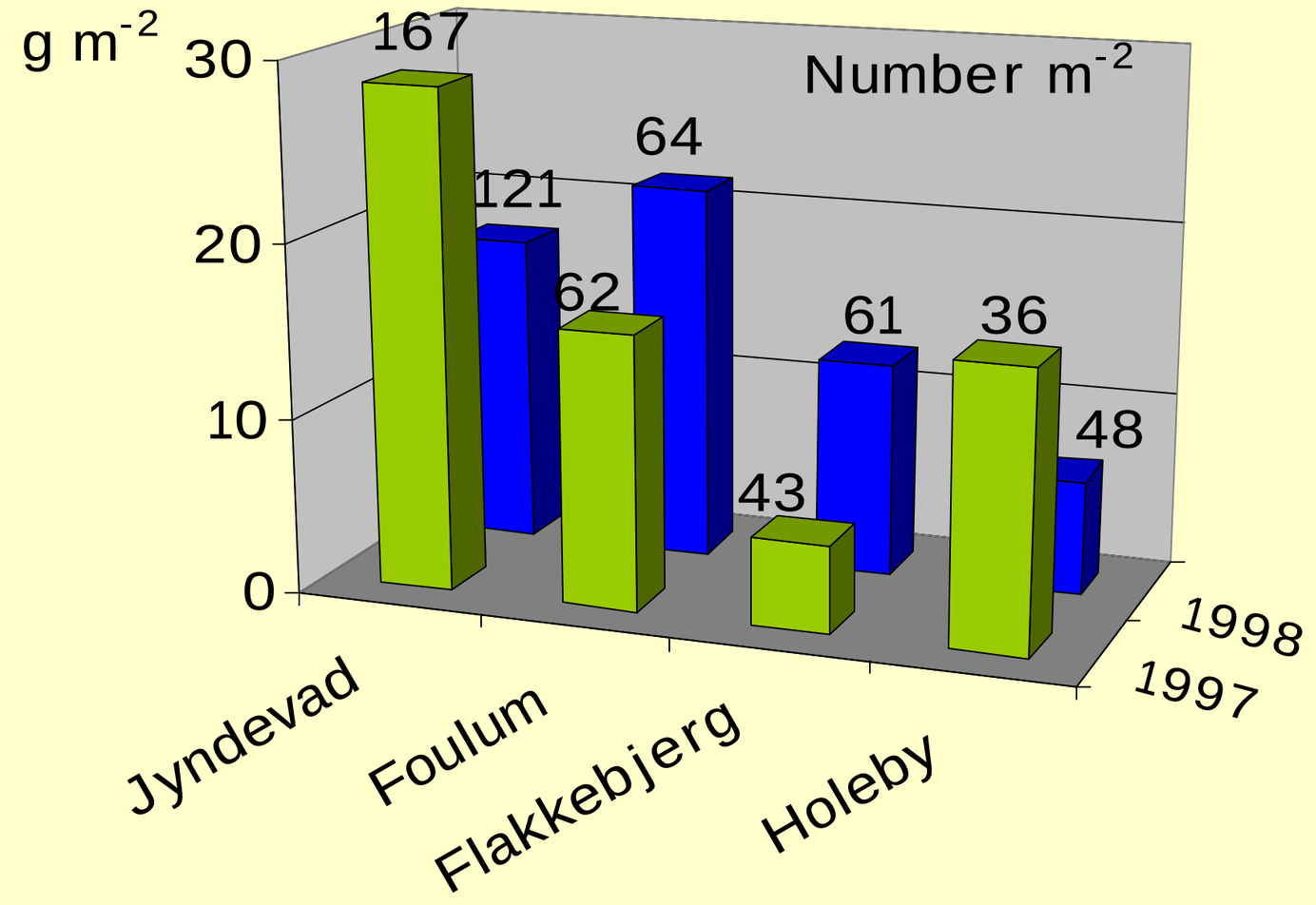
Weed control - perennials

- **Creeping thistles:**
  - **cut below ground and pulled at the anthesis of the cereals**
- **Others (mugwort, curled dock etc.):**
  - **pulled up at sight**
- **Stubble cultivation in systems without catch crops**

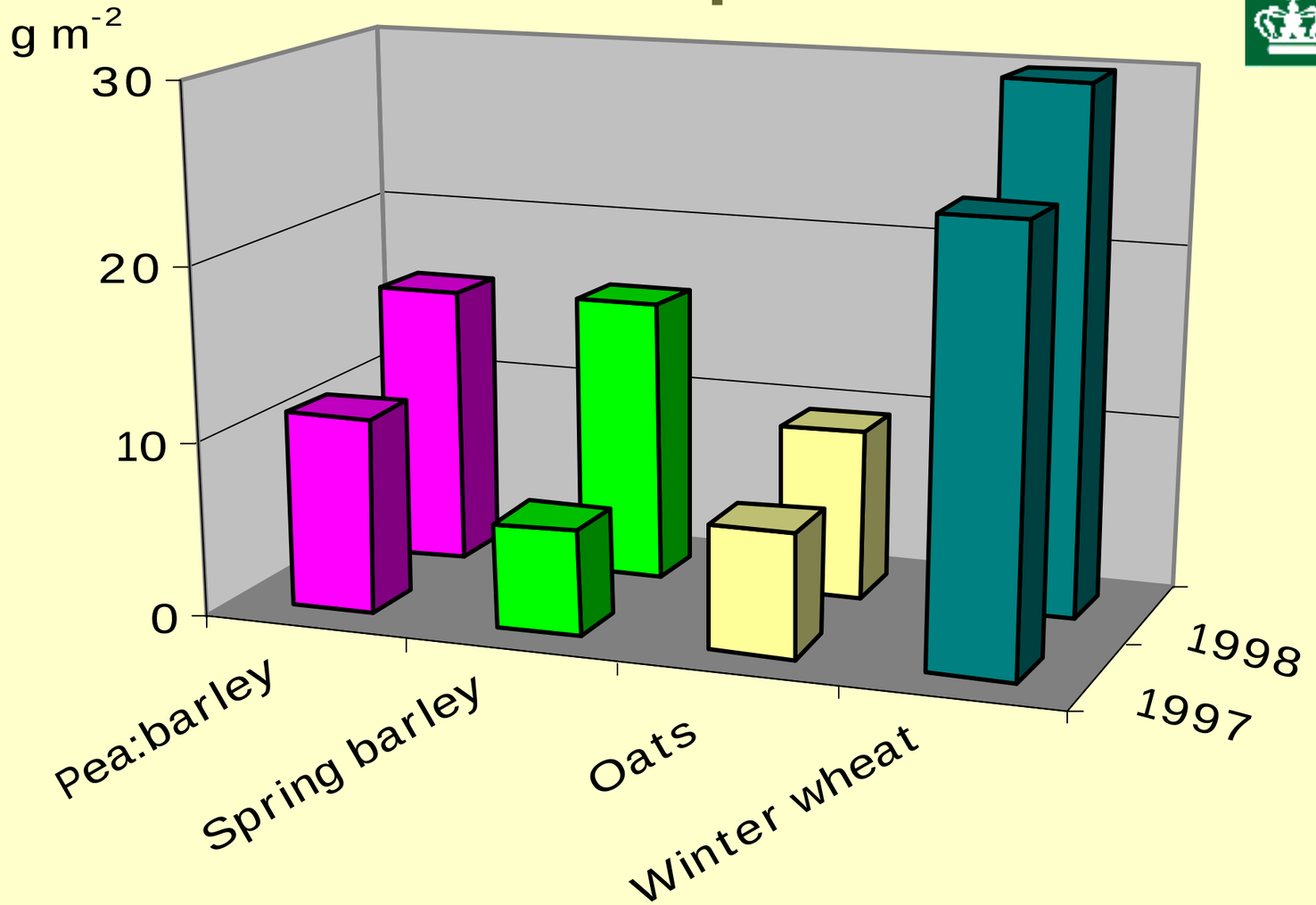
Results

- **Few significant differences**
- **Many interesting tendencies**
- **Only two years results**

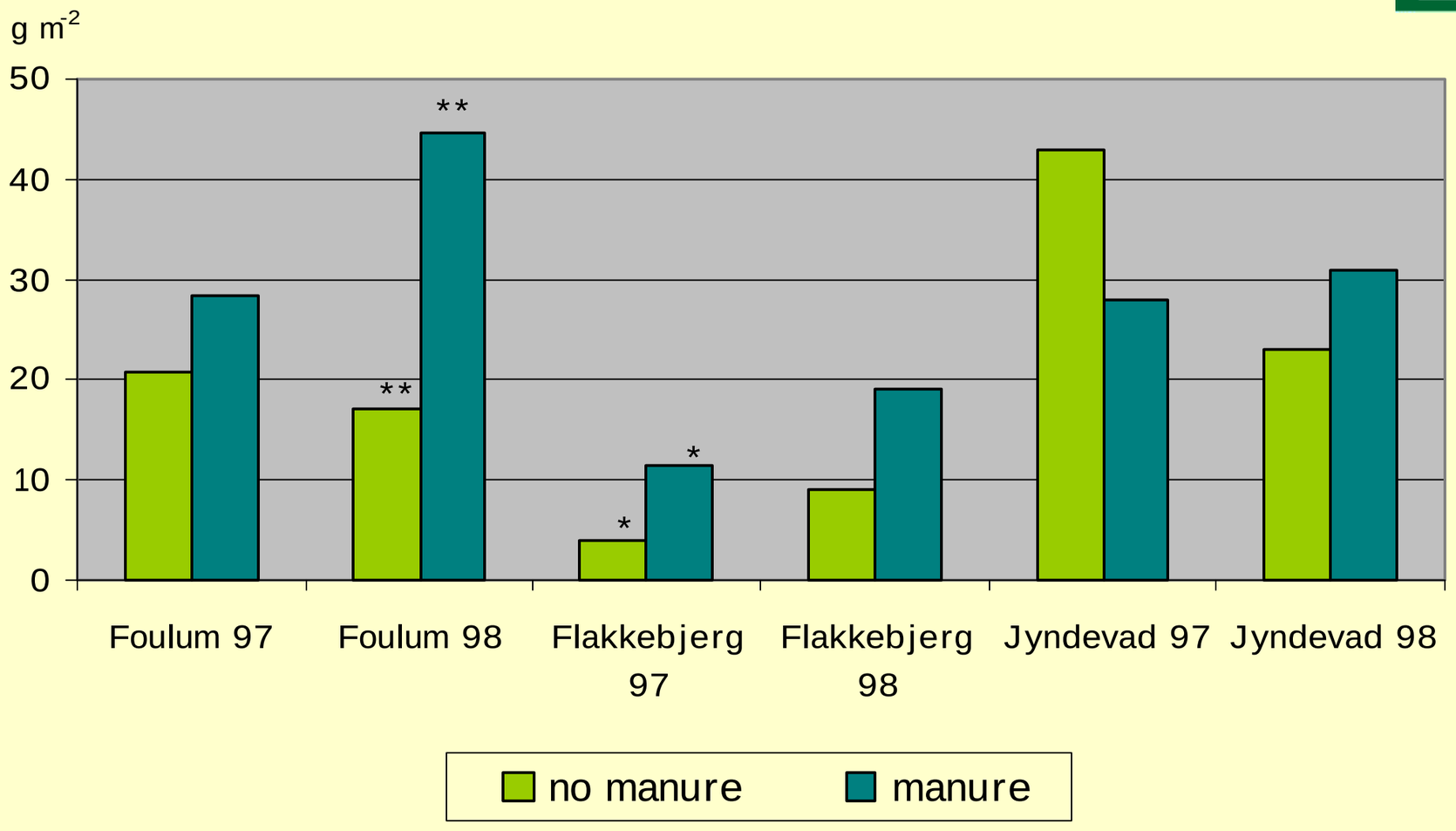
Weeds at 4 locations 2 years



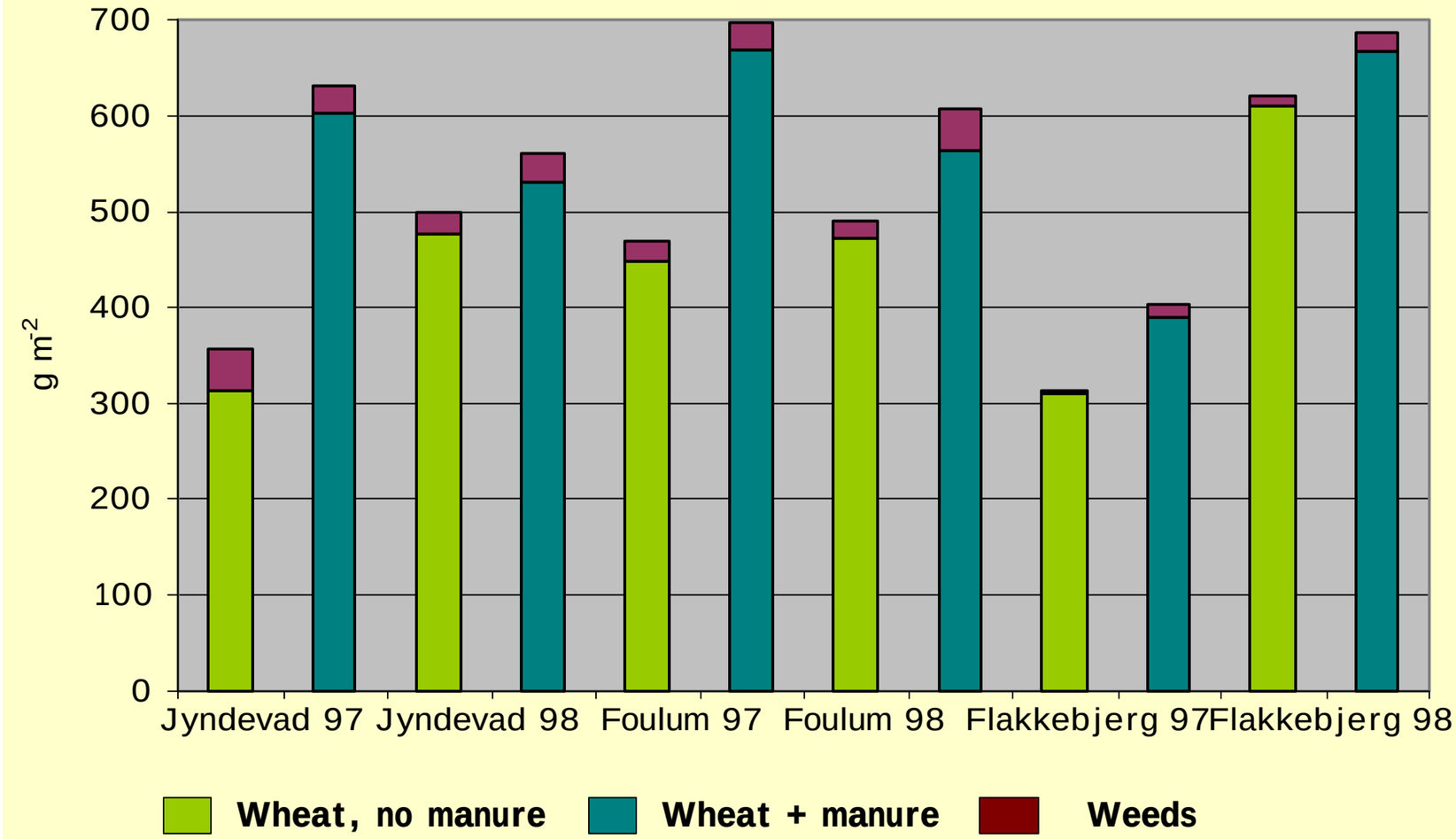
Weeds in different crops at Foulum



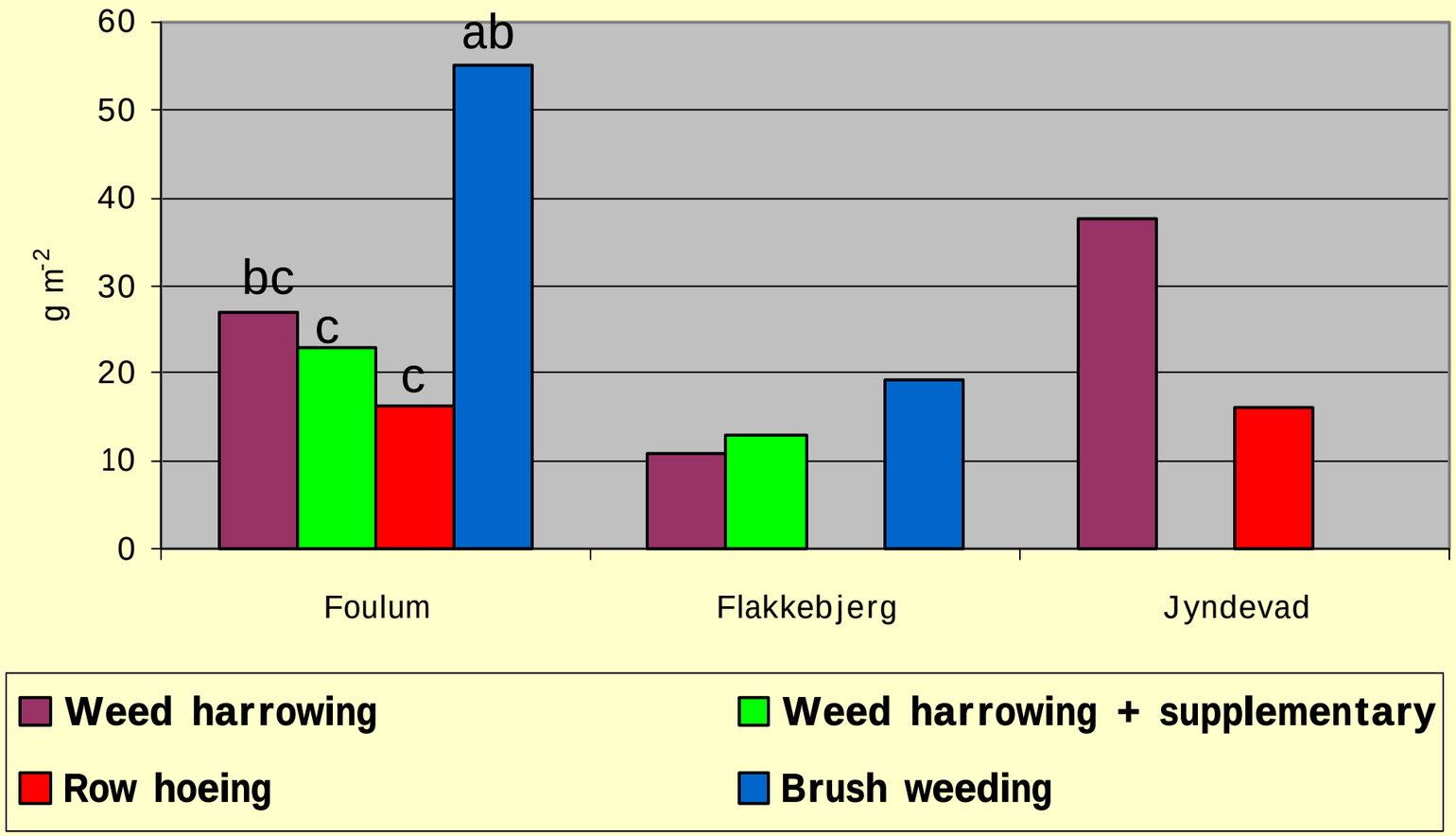
Effect of manure on weeds in winter wheat



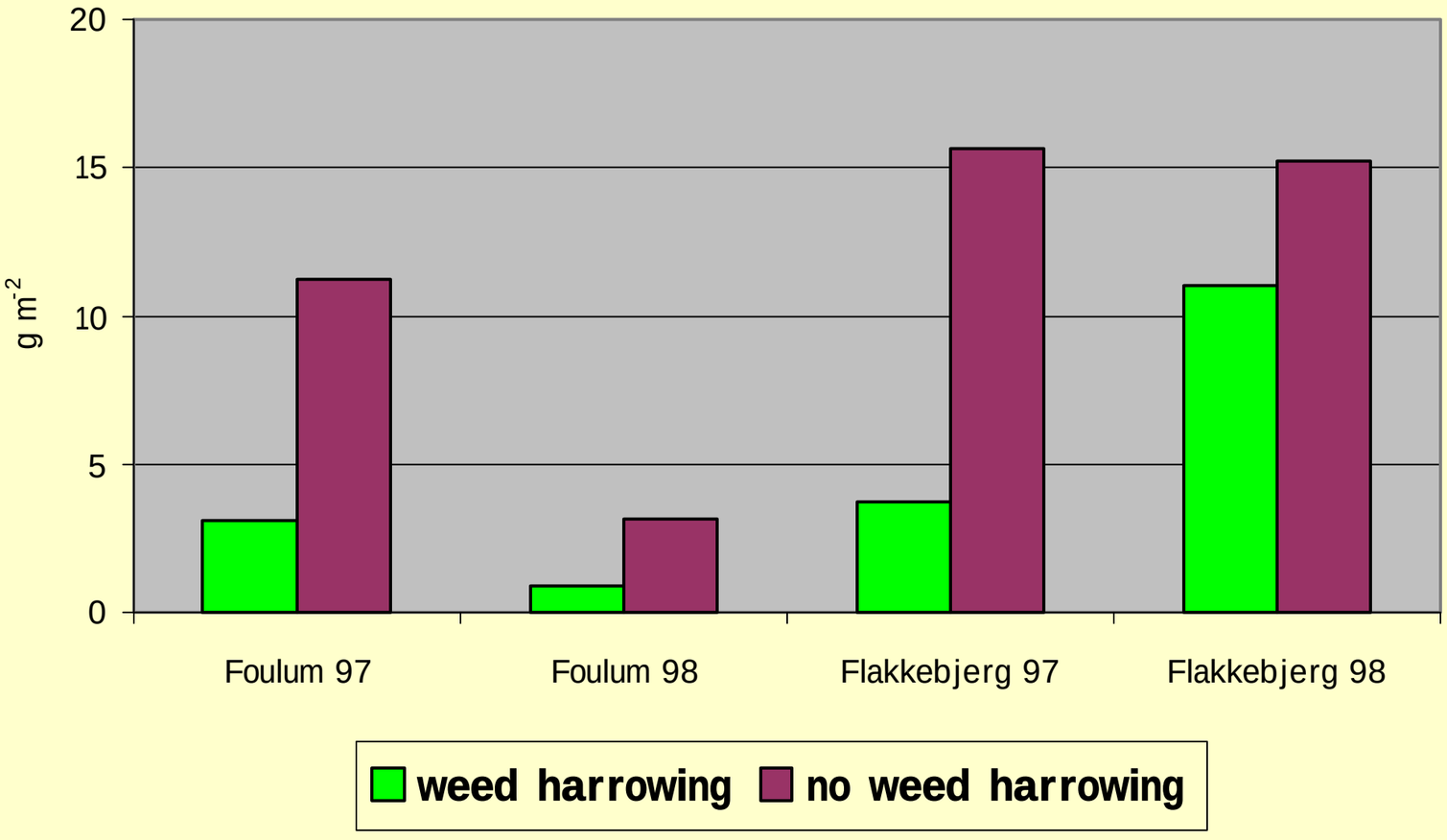
Effect of manure on weeds and wheat



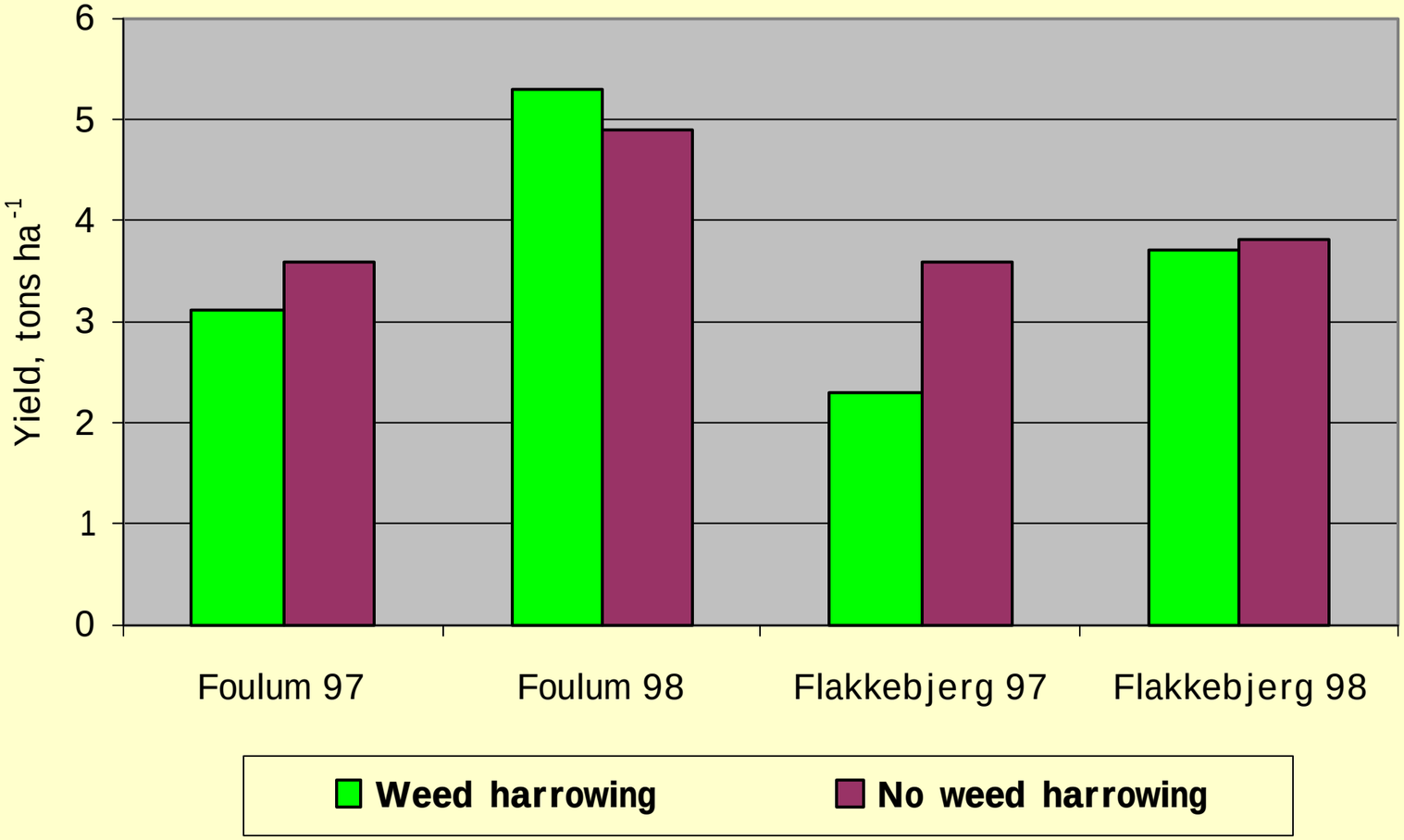
Effect of weed control in winter wheat 1998



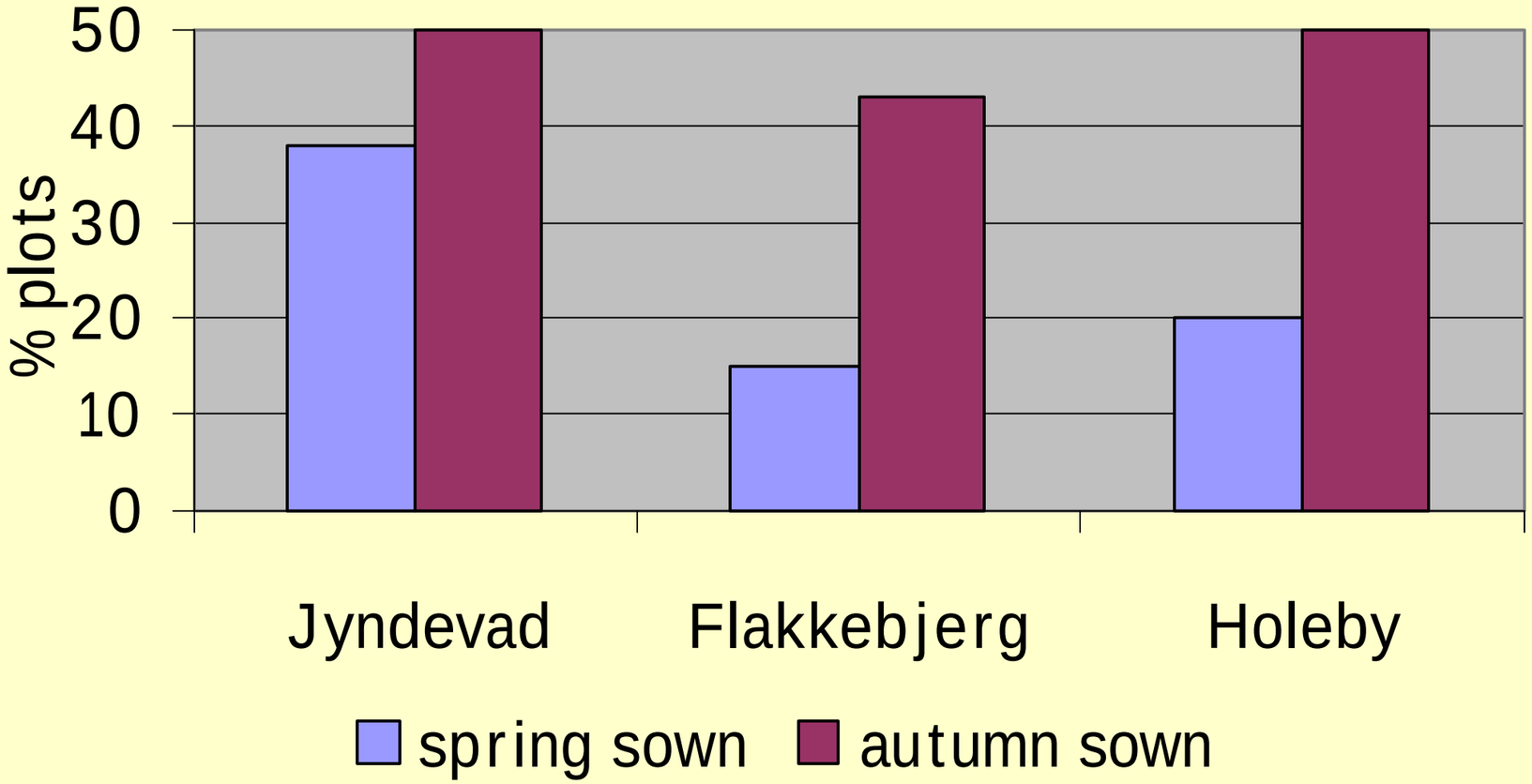
Effect of weed harrowing in oats



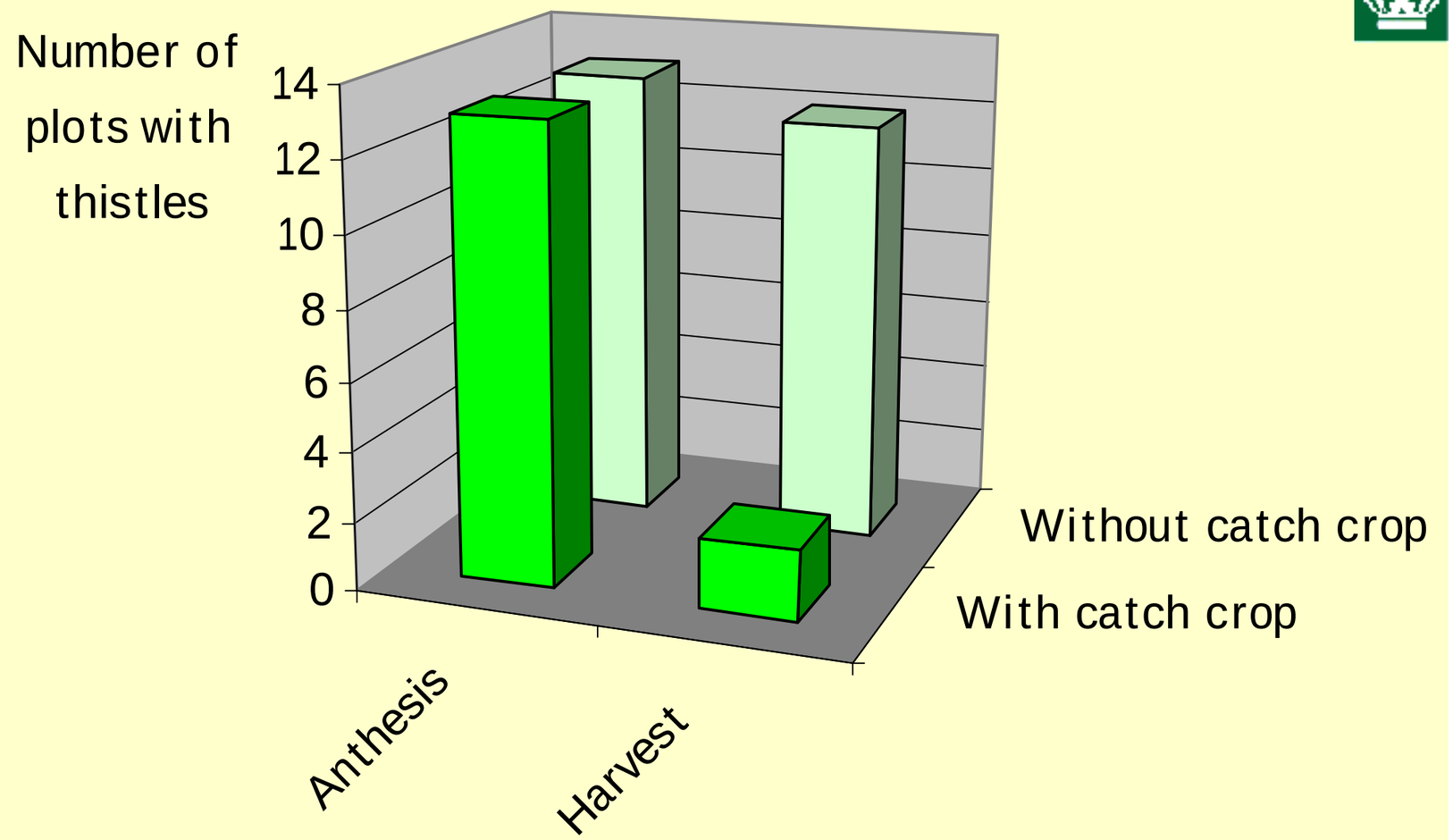
Effect of weed harrowing in oats



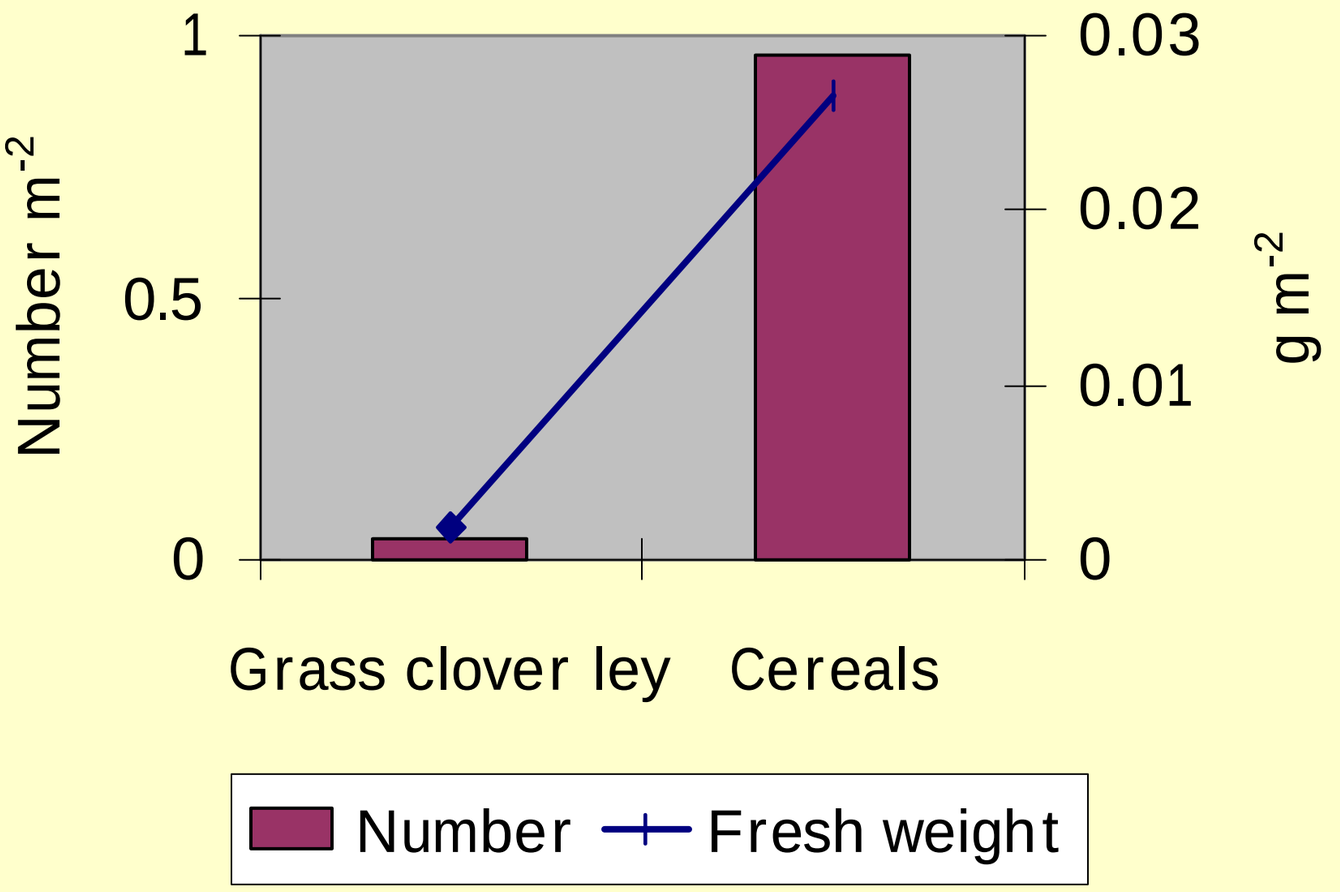
Percentage of plots with couch grass



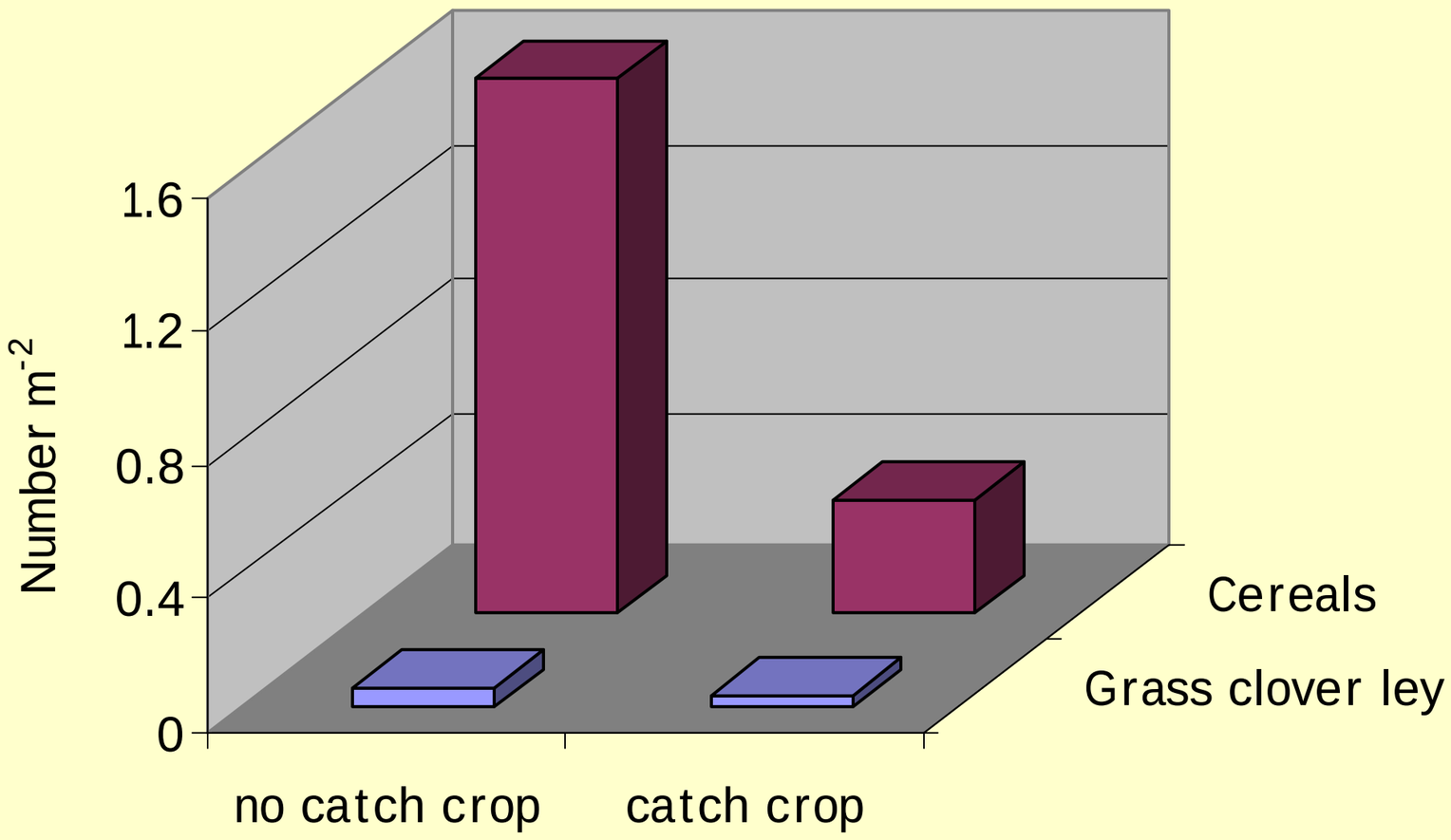
Effect of catch crop on creeping thistle 1998



Effect of previous crop on creeping thistle in wheat 1999



Effect of previous crop and catch crop on creeping thistle in wheat 1999



Summary

- Most weeds on lighter soils
- Most weeds in winter wheat
- Most weeds with manure
- Good effect of row hoeing in winter wheat
- Good effect on weeds of weed harrowing in oats - no effect on yield

Summary

- Most weeds on lighter soils
- Most weeds in winter wheat
- Most weeds with manure
- Good effect of row hoeing in winter wheat
- Good effect on weeds of weed harrowing in oats

Summary

- **Most couch grass in winter sown cereals**
- **Most creeping thistle without catch crop**
- **Most creeping thistle with cereals as previous crop**

Summary

- **Most creeping thistle without catch crop**
- **Most creeping thistle with cereals as previous crop**

References

Rasmussen, I.A.; Askegaard, M. & Olesen, J.E. (1999): Ukrudt i økologiske kornsædskifteforsøg (Weed occurrence in organic cereal crop rotations experiments). In: DJF-rapport no. 10, 16th Danish Plant Protection Conference, pp. 17-28. With English summary and subtitles.

References

Rasmussen, I.A.; Askegaard, M. & Olesen, J.E. (in press): Plant protection in organic crop rotation experiments for grain production. In: Designing and testing Crop rotations for Organic Farming (eds. J.E. Olesen, R. Eltun, M.J. Gooding, E.S. Jensen & U. Köpke) FØJO-report no. 5, 1999.