Soil biophysical carbon sequestration in response to tillage

Alan Sundermeier, Khandakar Islam,*
Warren Dick, and Randall Reeder

The Ohio State University

Objectives

To evaluate the impact of incremental no-till on concentration and stocks of biological and physical C pools at different depths of soil with reference to conventional tillage

To test the selected biological and physical C pools as early indicators of soil C sequestration

Materials and Methods

Experiment was established at NW Branch of the Ohio Agricultural Res. and Development Center, Ohio

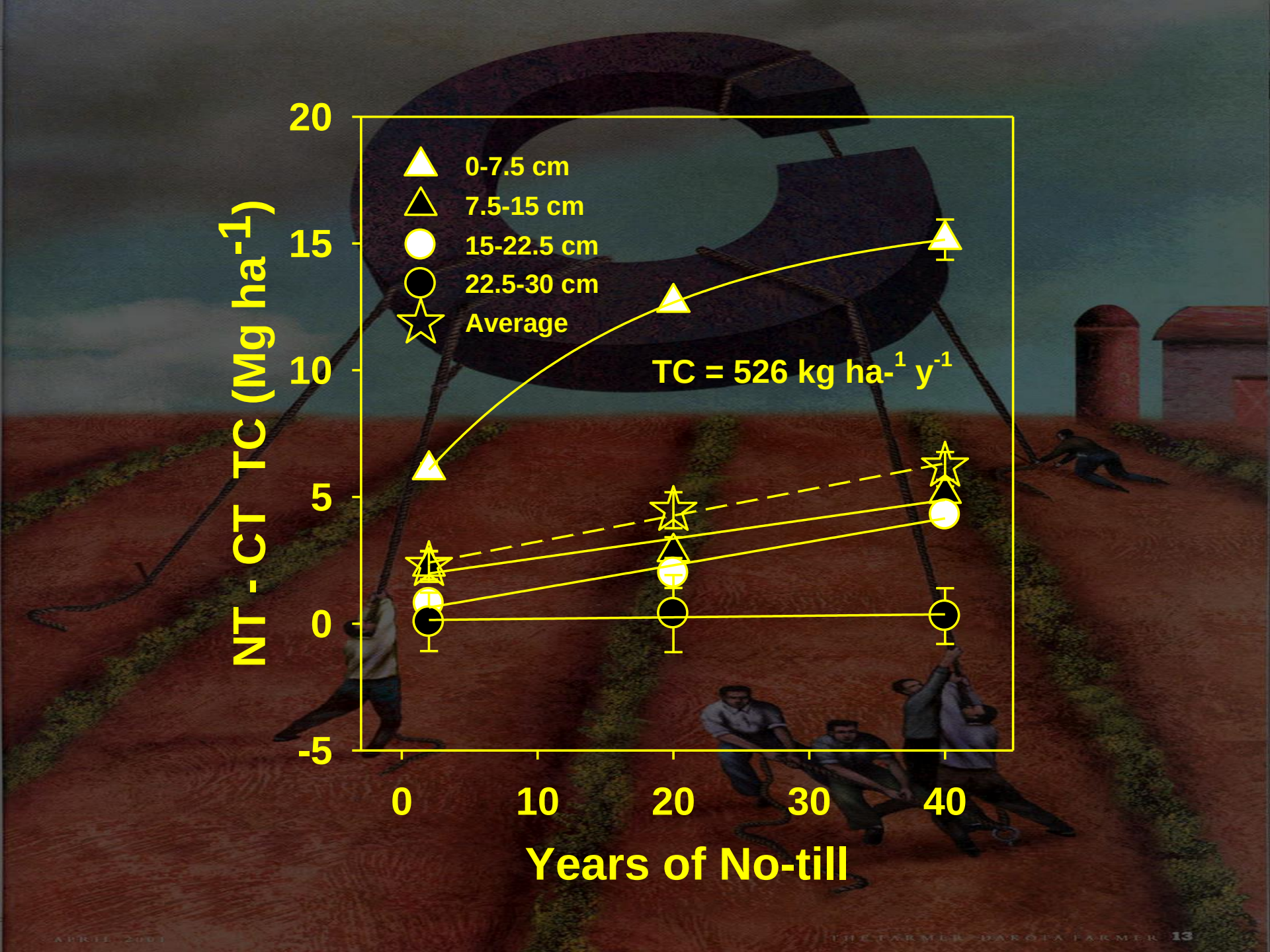
Hoytville clay loam (fine, illitic, active, mesic, mollic Epiaqualf)

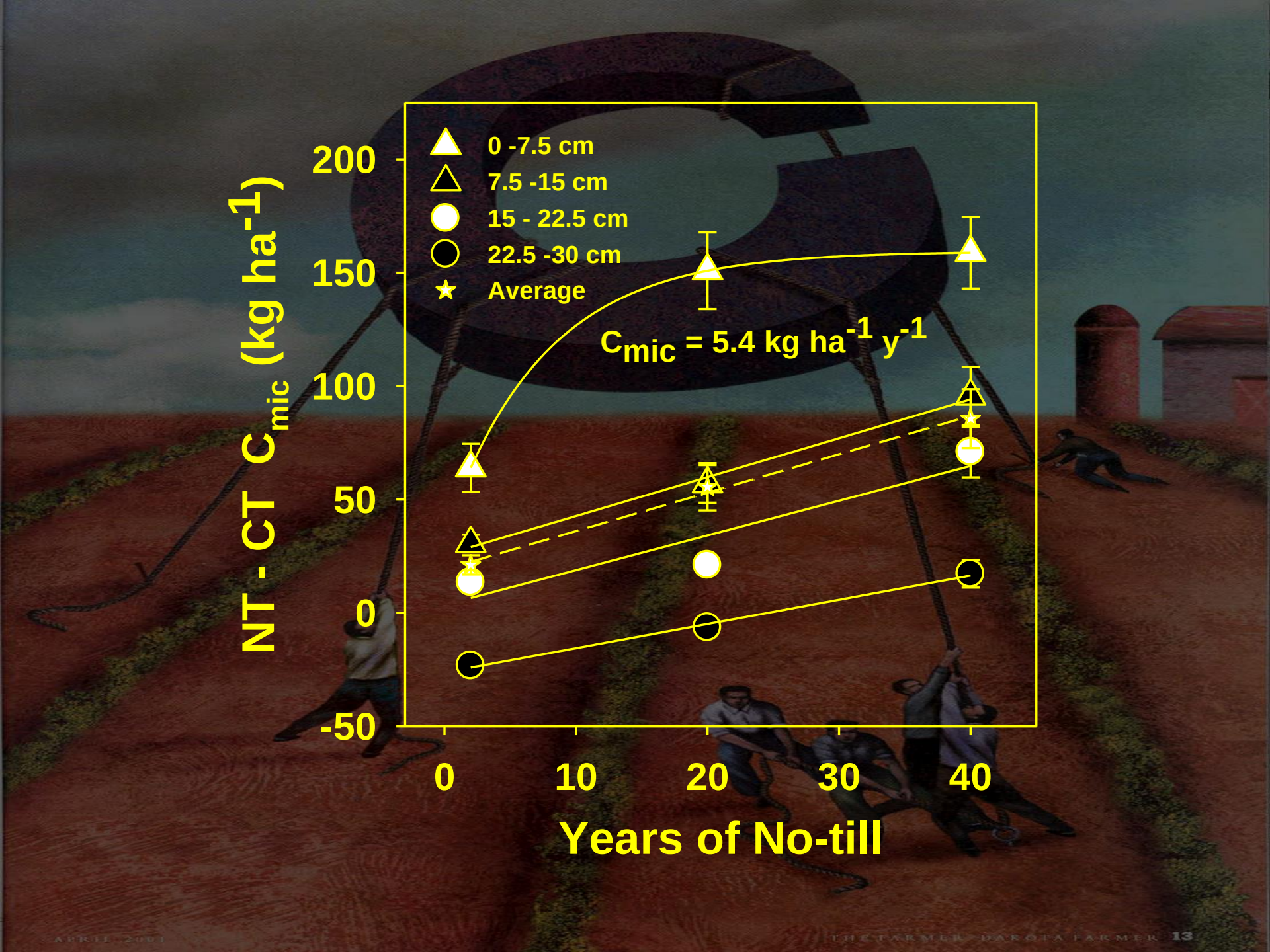
Soil core samples were randomly collected at 0 - 7.5, 7.5 -15, 15 - 22.5 and 22.5 - 30 cm depth from 2, 20, and 40 yr NT and their adjoining CT plots.

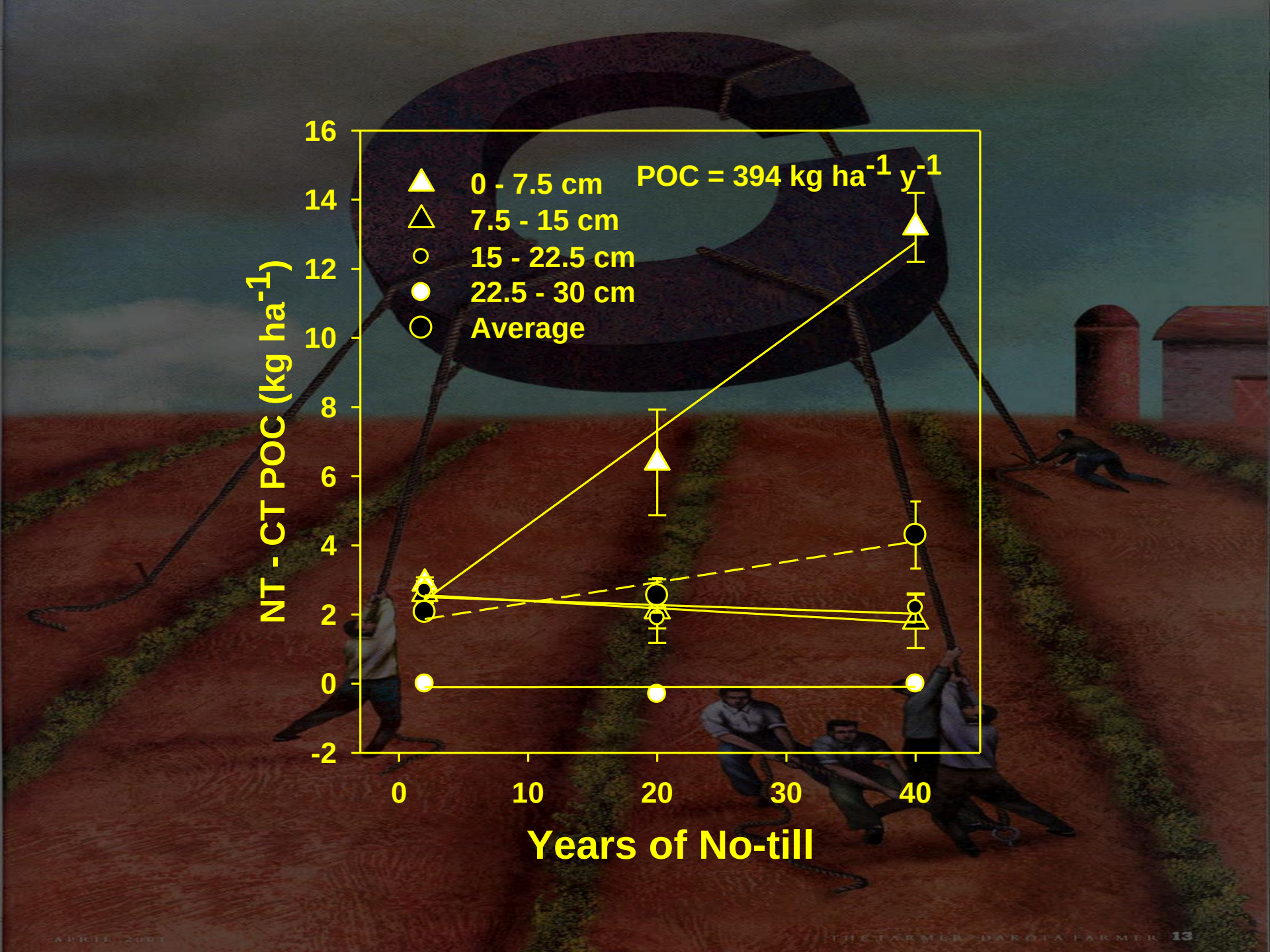
Soil samples were processed and analyzed for concentration and stocks of:

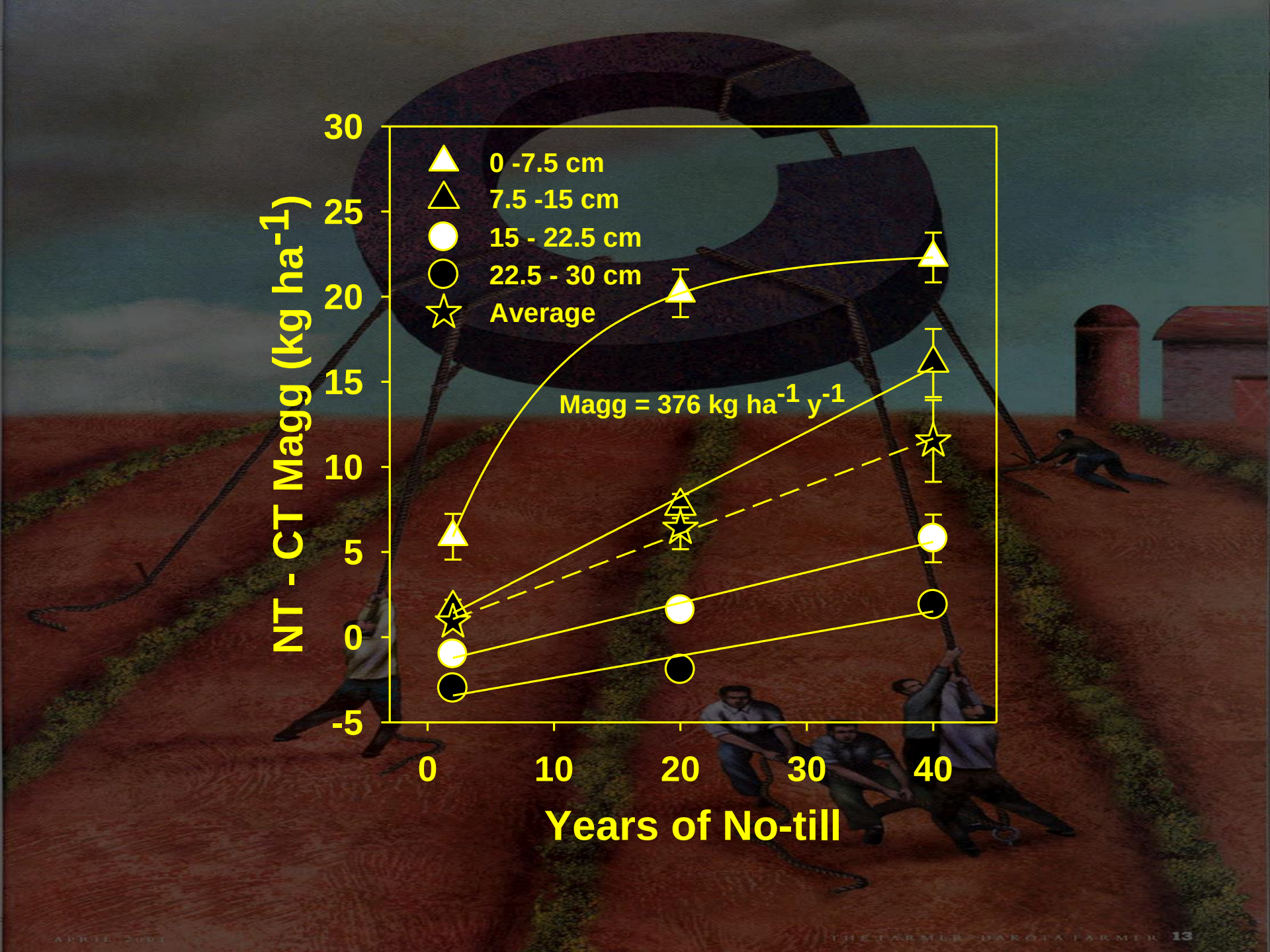
- Total organic C (TC)
- Macroaggregate protected C (C_{Magg})
- Particulate organic C (POC)
- Microbial biomass C (Cmic)
- Basal respiration rates (BR)
- Maintenance respiration (qCO_2) rates
- Macroaggregates
- Selected basic properties

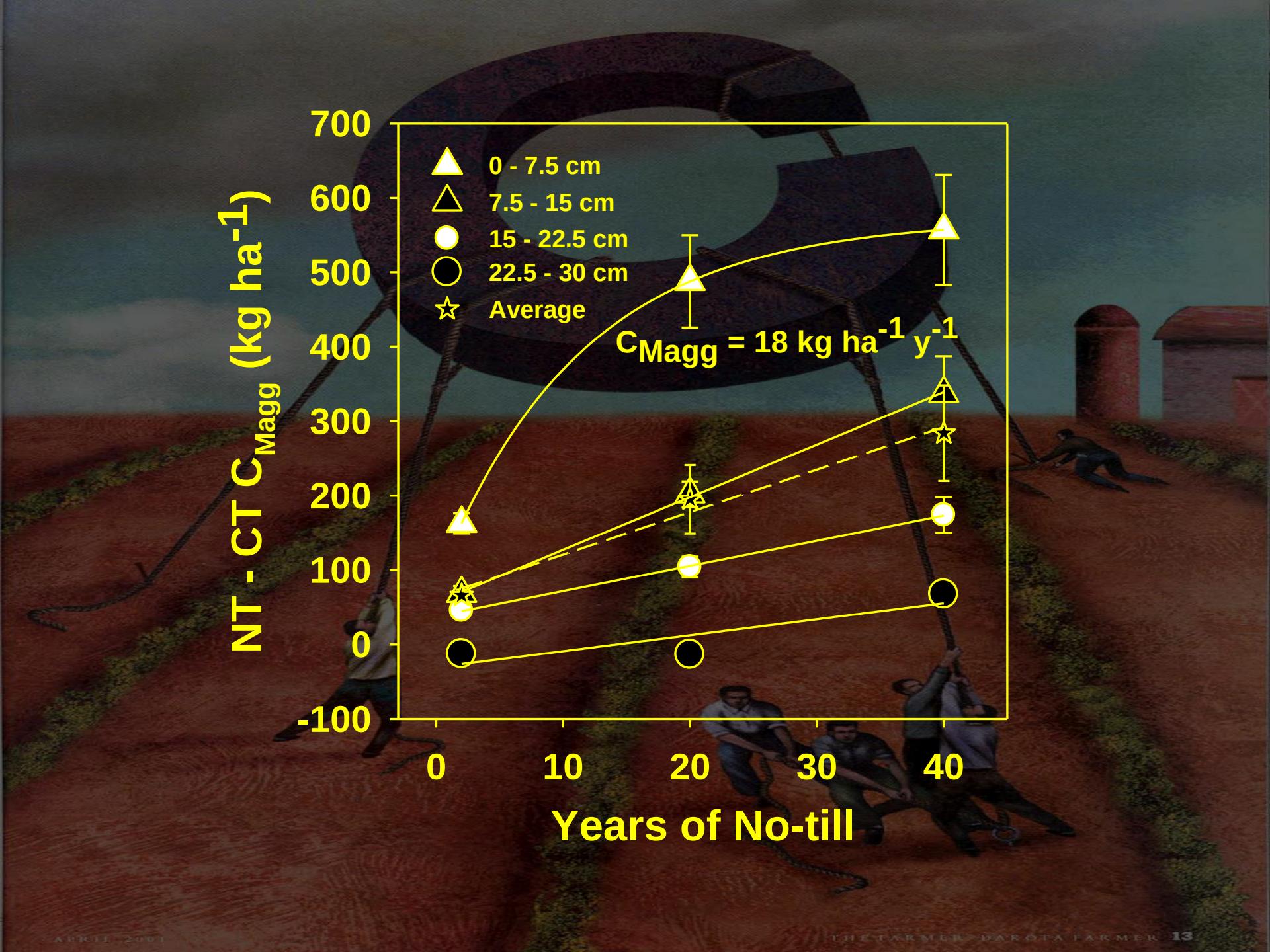

Results and Discussion

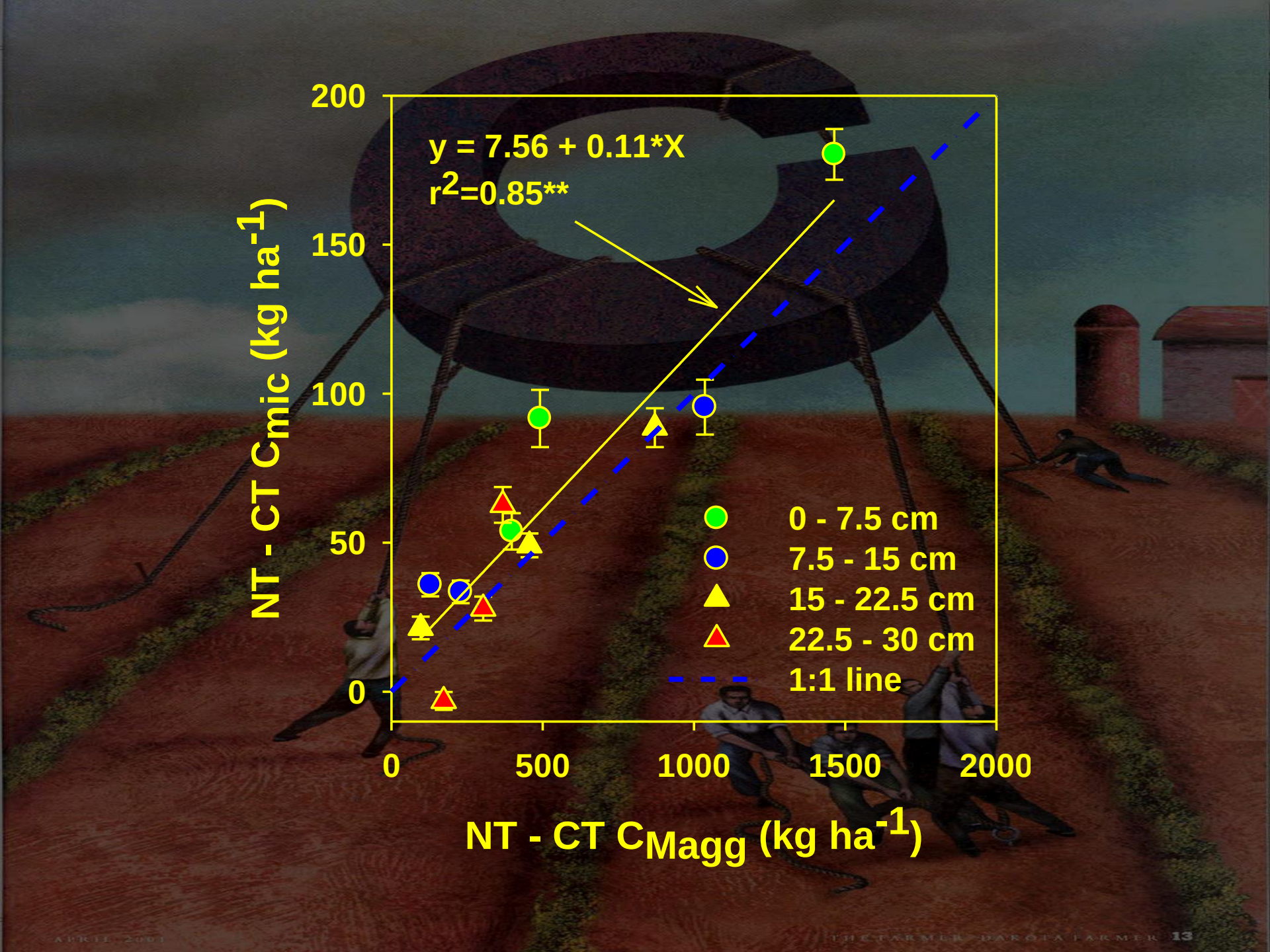

20
15
10
5
0
-5
NT - CT TC (Mg ha-1)
0-7.5 cm
7.5-15 cm
15-22.5 cm
22.5-30 cm
Average
TC = 526 kg ha-1 y-1
0
10
20
30
40
Years of No-till


0 -7.5 cm
7.5 -15 cm
15 - 22.5 cm
22.5 -30 cm
Average
C_{mic} = 5.4 kg ha^{-1} y^{-1}
NT - CT C_{mic} (kg ha^{-1})
200
150
100
50
0
-50
0
10
20
30
40
Years of No-till


16
14
12
10
8
6
4
2
0
-2
NT - CT POC (kg ha-1)
0 - 7.5 cm
7.5 - 15 cm
15 - 22.5 cm
22.5 - 30 cm
Average
POC = 394 kg ha-1 y-1
0
10
20
30
40
Years of No-till


30
25
20
15
10
5
0
-5
NT - CT Magg (kg ha-1)
0 -7.5 cm
7.5 -15 cm
15 - 22.5 cm
22.5 - 30 cm
Average
Magg = 376 kg ha-1 y-1
0
10
20
30
40
Years of No-till


700
600
500
400
300
200
100
0
-100
0
10
20
30
40
Years of No-till
NT - CT C_{Magg} (kg ha^{-1})
0 - 7.5 cm
7.5 - 15 cm
15 - 22.5 cm
22.5 - 30 cm
Average
C_{Magg} = 18 kg ha^{-1} y^{-1}


y = 7.56 + 0.11*X
r2=0.85**
0 - 7.5 cm
7.5 - 15 cm
15 - 22.5 cm
22.5 - 30 cm
1:1 line
NT - CT Cmic (kg ha-1)
NT - CT CMagg (kg ha-1)
0
50
100
150
200
0
500
1000
1500
2000

Conclusions

Greater C sequestration in NT over CT is related to **placement** of crop residues and **bio-physical protection** of C in macroaggregates

Among the C pools, C_{mic} is a **sensitive indicator** of C sequestration

However, quadratic response of C sequestration over time suggests that NT soil is not an **infinite** C sink.