The effect of mole drainage on the hydrology of a clay-loam soil in the south of Ireland

Ag. Research Forum 10 March 2014

Background

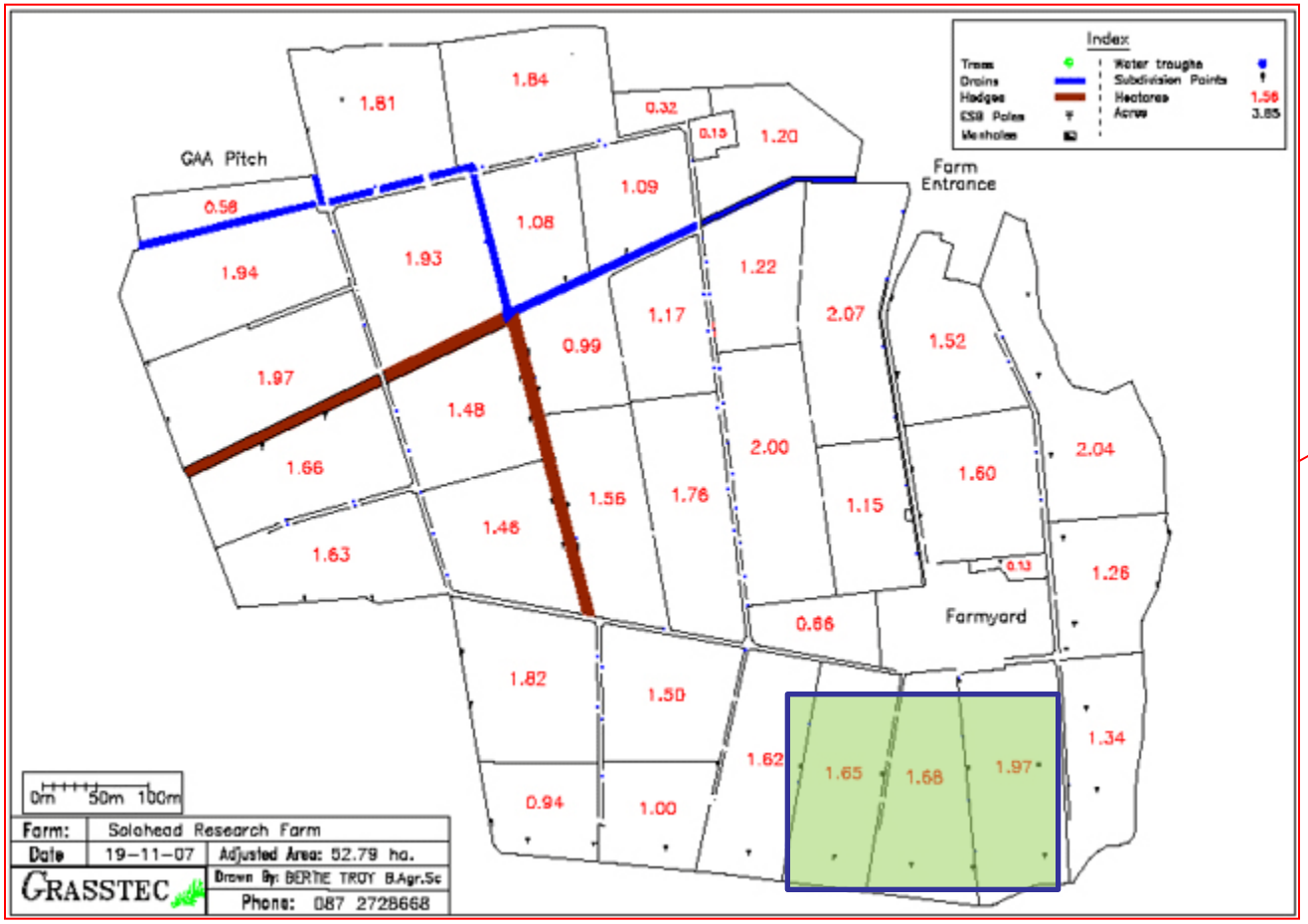
- Marginal land occupies 49% of Irish land area (Gardiner & Radford,1980)
- Poorly drained and prone to waterlogging
- At Solohead Research Farm (Humphreys et al., 2009, 2010):

Time period	Rainfall (mm)	Days Grazing
2003 – 2006	963	255
2007 – 2009	1173	232
2012	1130	198

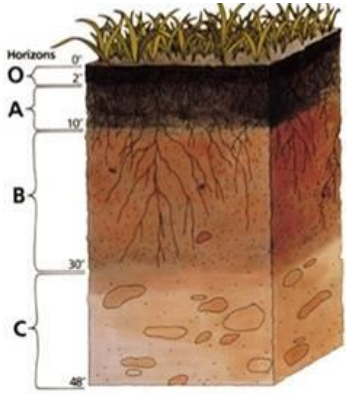
- Artificial drainage is required to reduce the volatility associated with rainfall



Site location



Drainage problem diagnosis



Solohead site: Soil texture and estimated hydraulic conductivity						
	> 2 mm (%)	< 2 mm			USDA textural class	Hydraulic conductivity* (m/day)
Depth (cm)		Sand (%)	Silt (%)	Clay (%)		
0 - 25	11.5	41.3	23.4	35.3	Clay loam	0.0073
25 - 80	25.5	30.9	23.8	45.3	Clay	0.0006
80 - 130	28.3	34.2	21.7	44.1	Clay	0.0006
130 - 200	1.0	5.9	25.8	68.3	Clay	0.0003

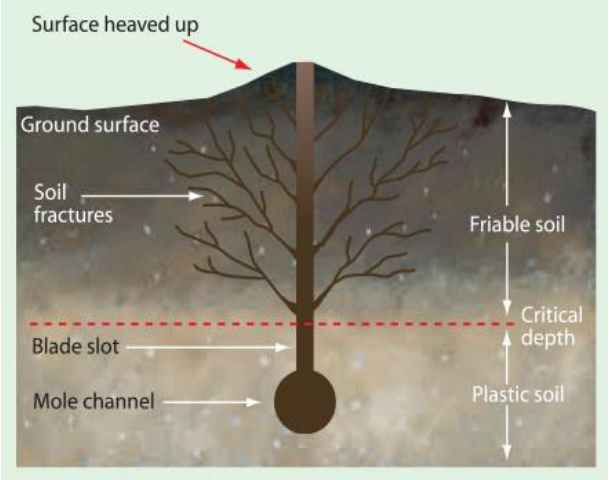
Note: *Estimated using the hydraulic properties calculator by Saxton and Rawls (2006).

- NO permeable layer to be exploited→ Shallow drainage system required

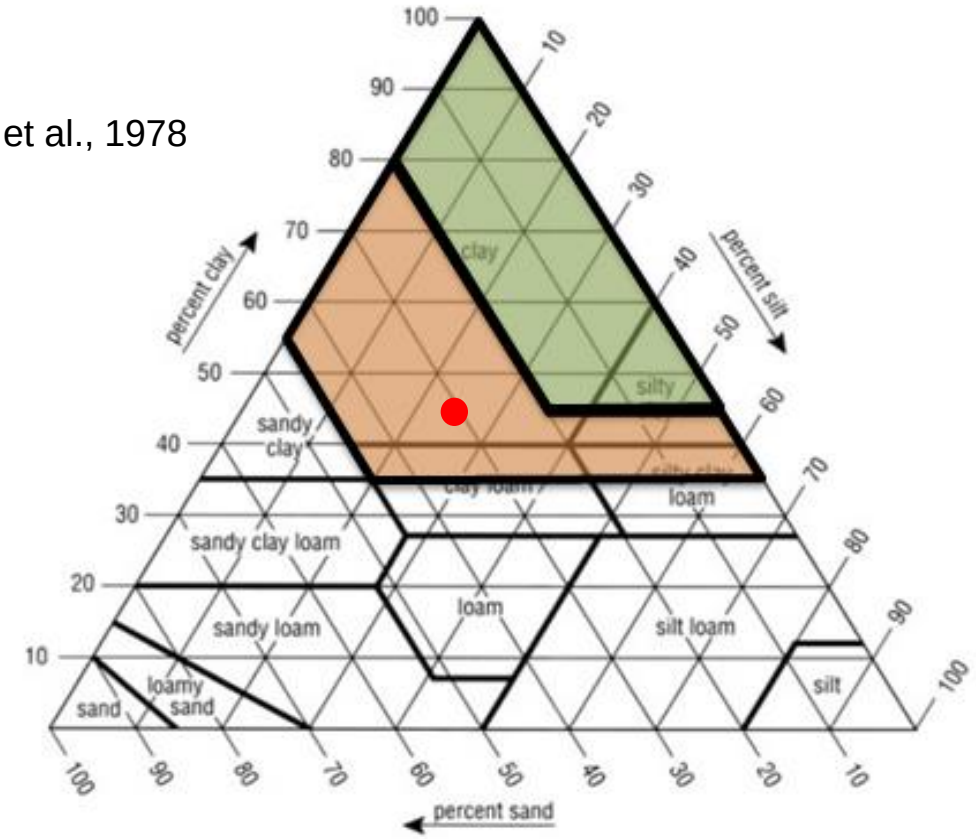
Shallow Drainage

- The aim of shallow drainage is to improve soil structure and increase hydraulic conductivity

- Which shallow drainage technique?



Burke et al., 1978



Experimental Objective

- To compare the effectiveness of mole and gravel mole drainage in a clay loam to clay soil in terms of;
  - Removing excess water and
  - Controlling the watertable position

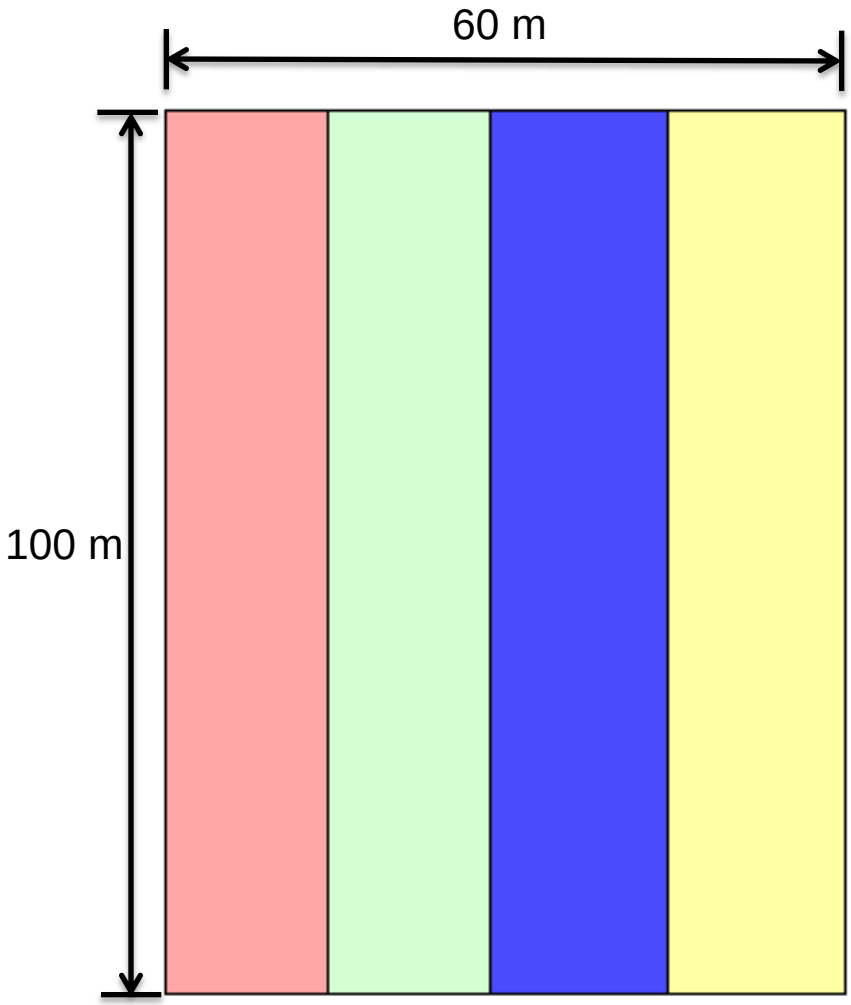


Site Preparation

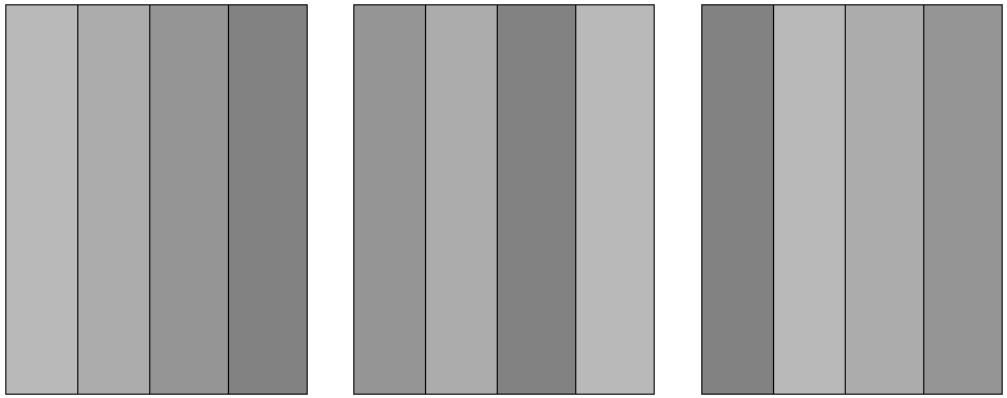
Collector Drain

Hydrological Isolation trench on 3 sides

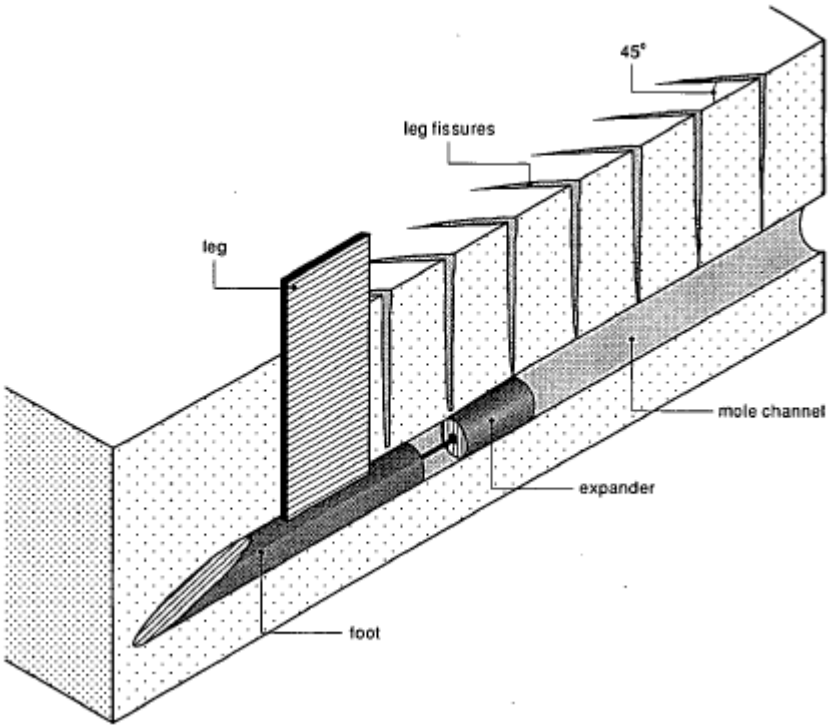
Drainage Treatment Design



- A: Undrained control
- B: Mole drainage installed in Jan. 2011
- C: Mole drainage installed in July 2011
- D: Gravel Mole drainage installed in July 2011

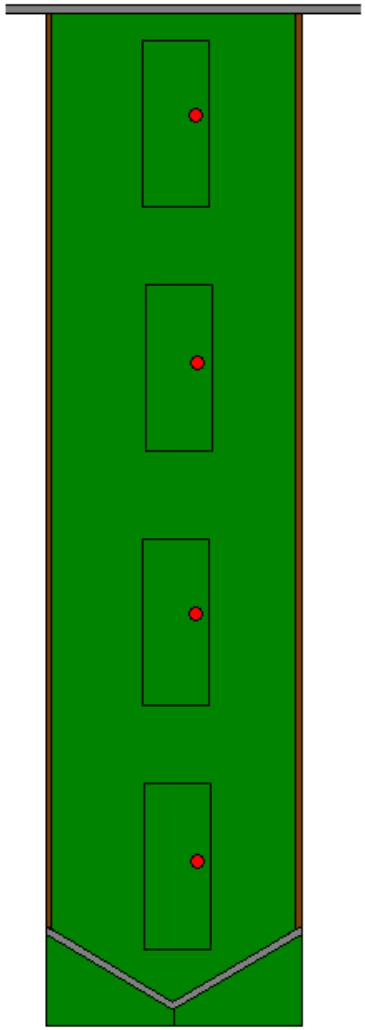


Drainage Treatments: Mole drainage



Drainage Treatments: Gravel mole drainage

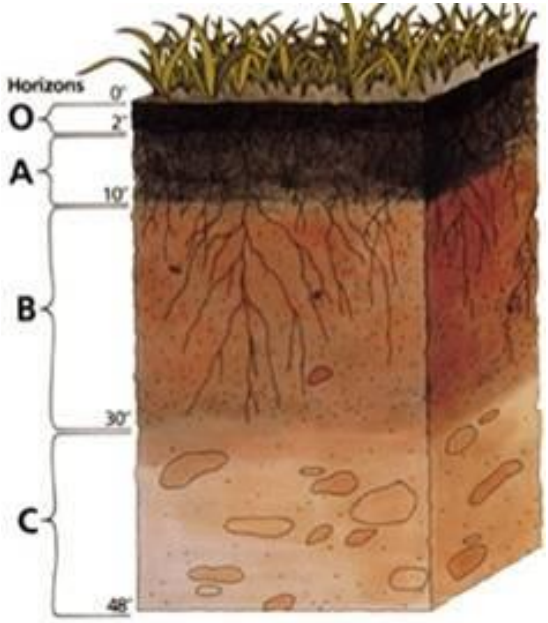
Plot Separation

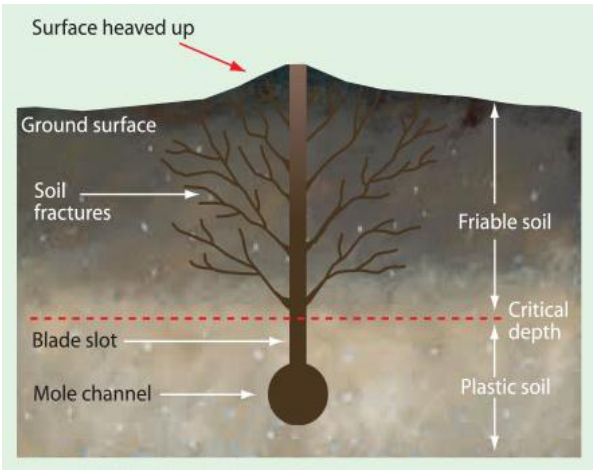


Measurements

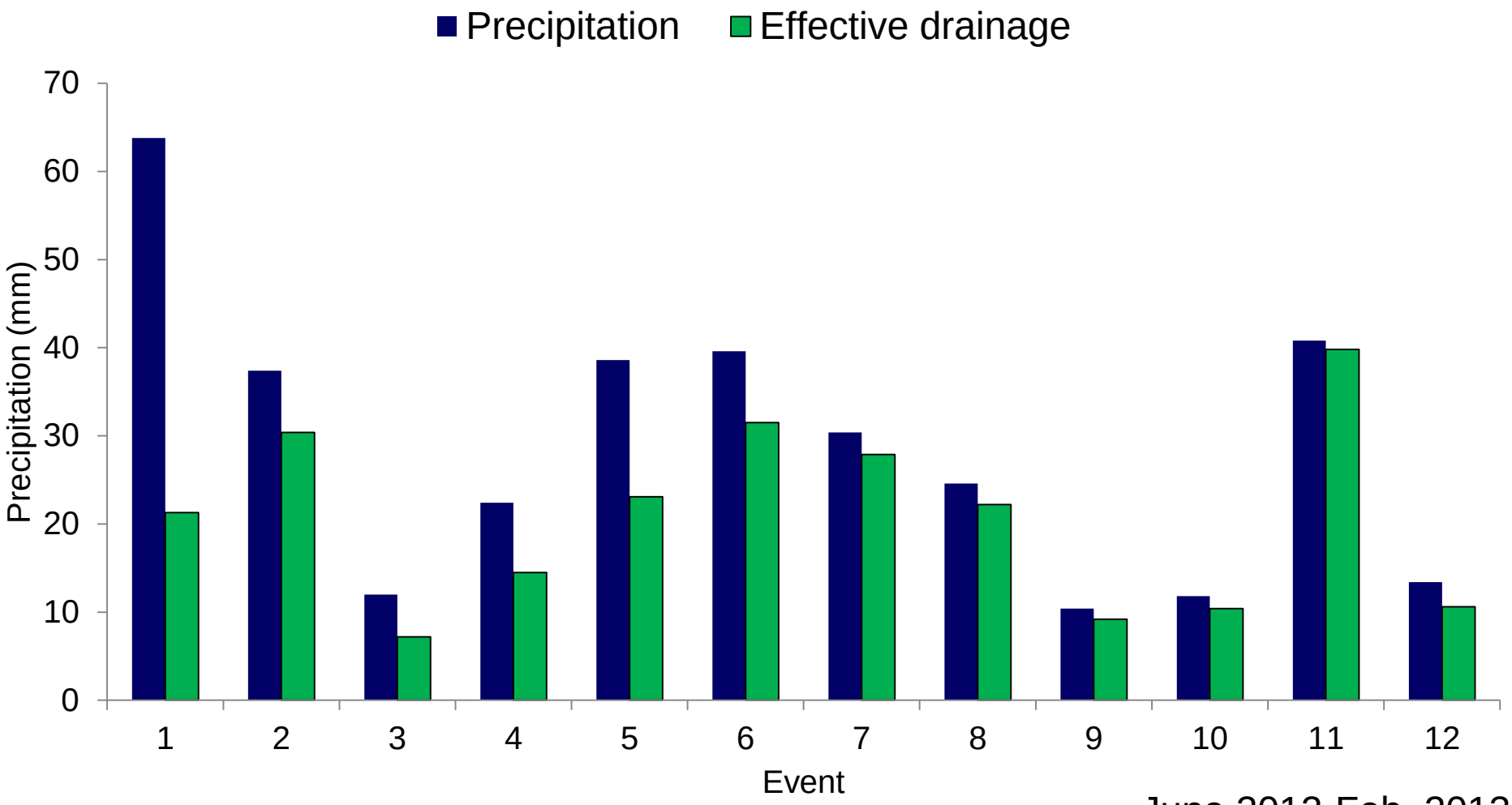
- Overland and subsurface flow; Flow rates were measured continuously using v-notch weir overflow tanks.
- Automated weather station on-site (rainfall, solar radiation, temperature, humidity and wind speed & direction).
- Soil moisture content and watertable depth were measured weekly.

Results


Horizons
O
A
B
C
0"
2"
10"
30"
48"

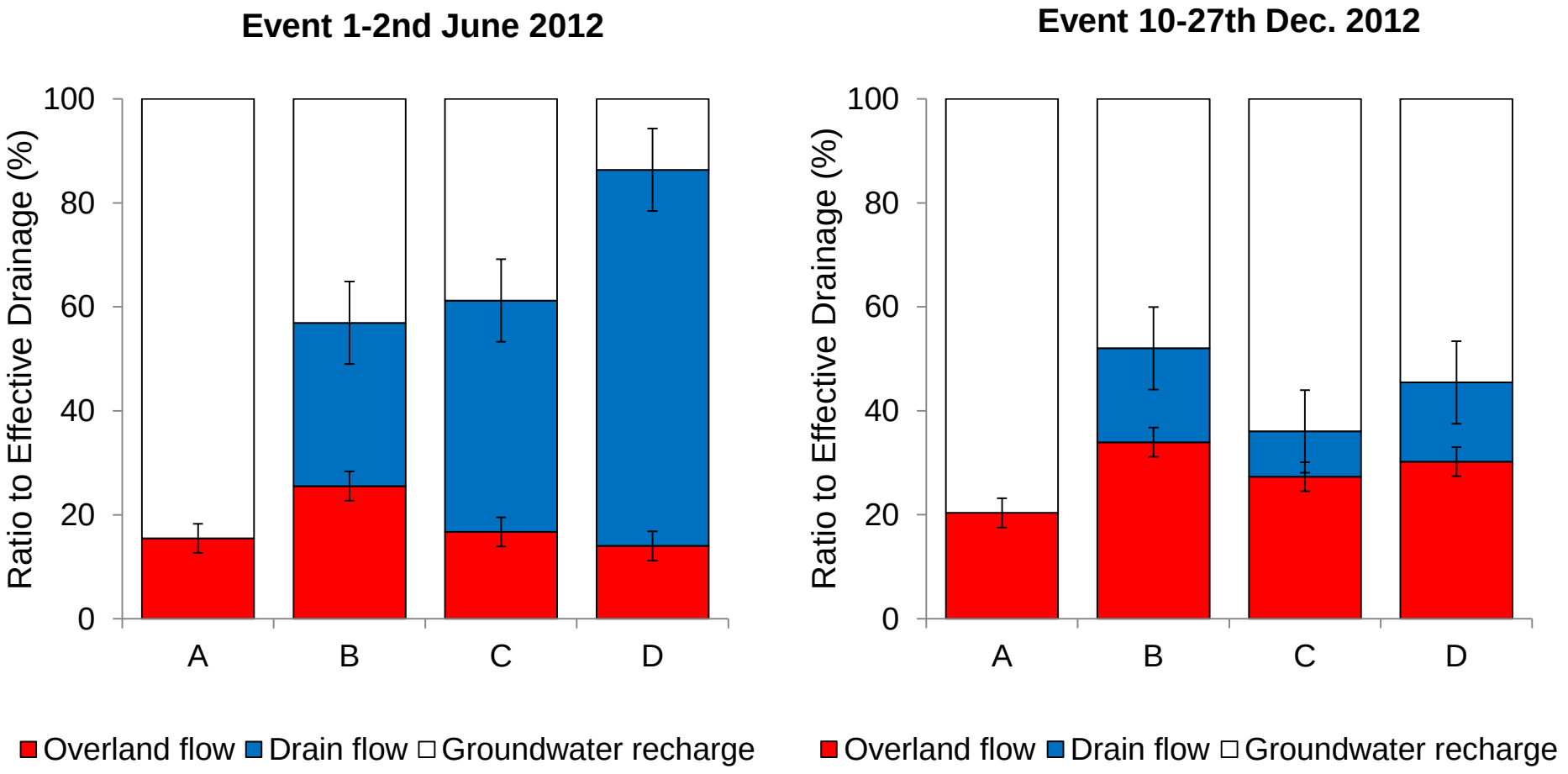

Surface heaved up
Ground surface
Soil fractures
Blade slot
Mole channel
Friable soil
Critical depth
Plastic soil

12 Rainfall Events



June 2012-Feb. 2013

Overland & Drain flow



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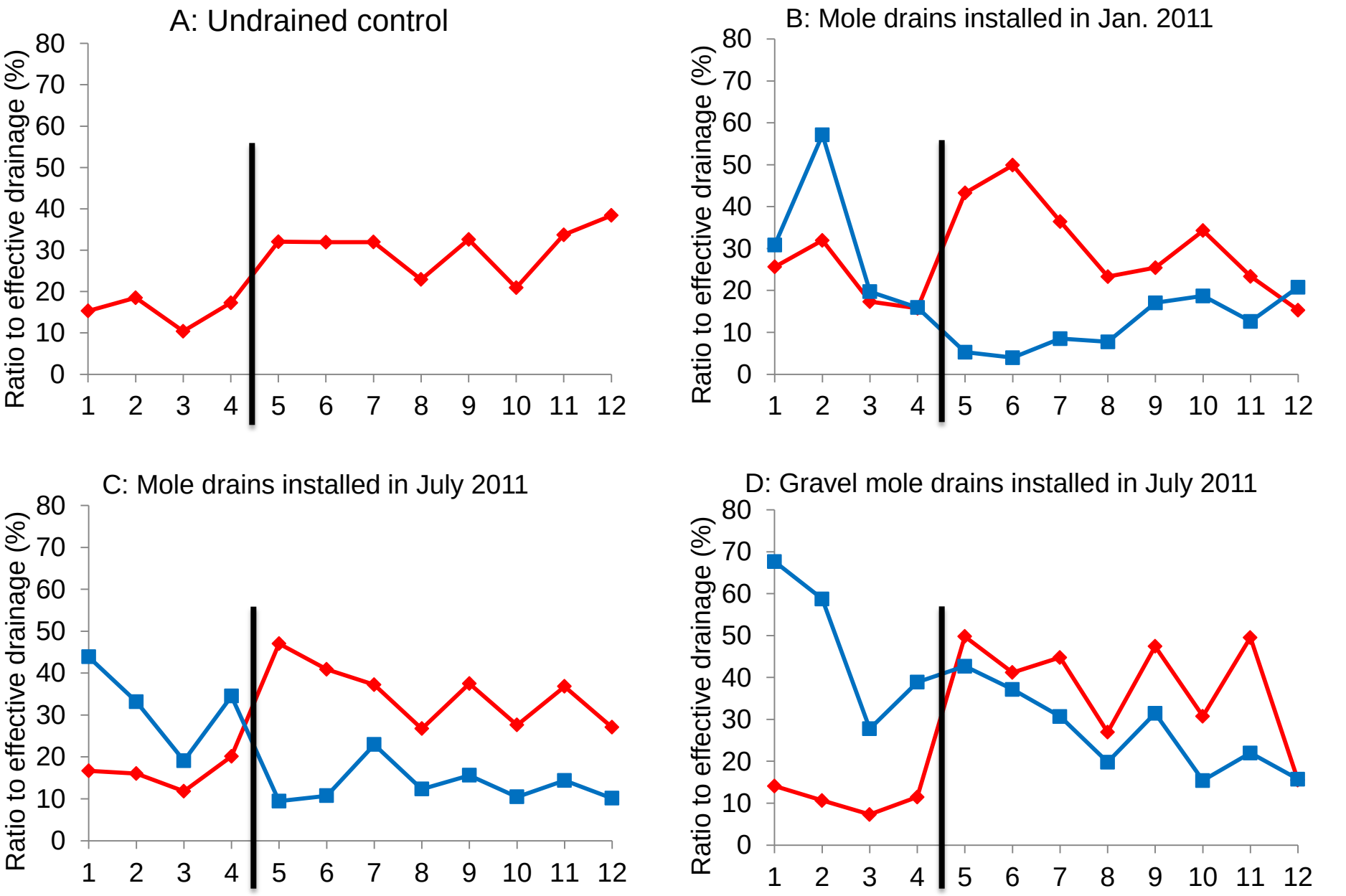
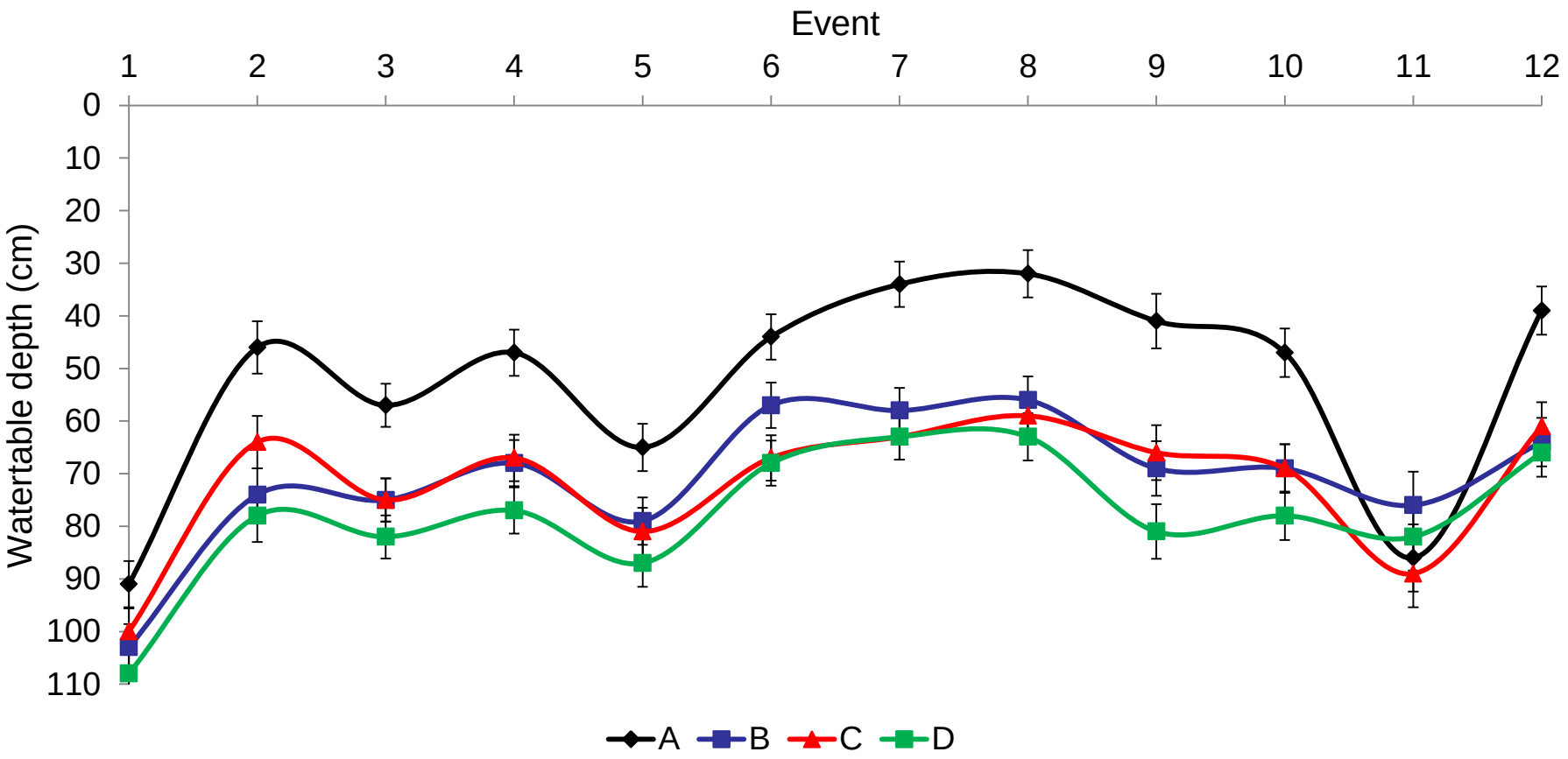
Overland & Drain flow



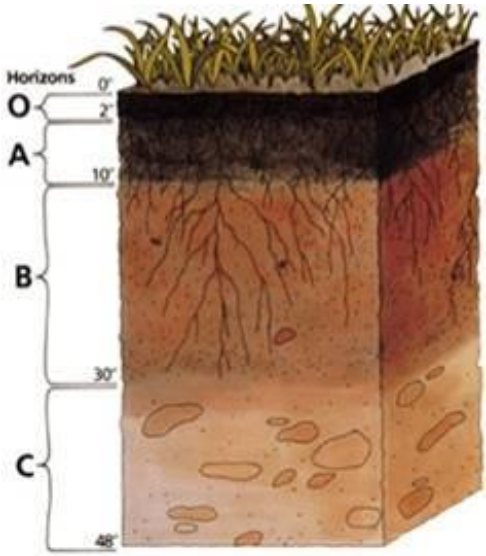
Watertable

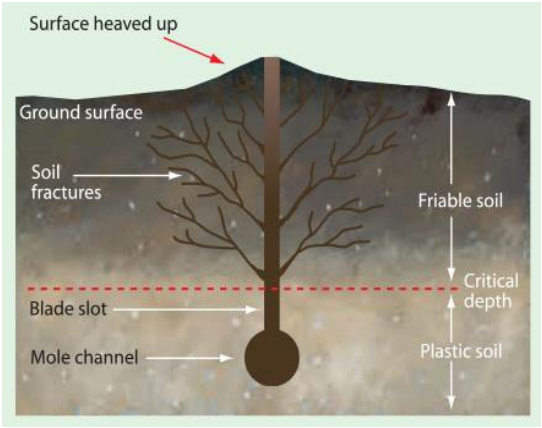


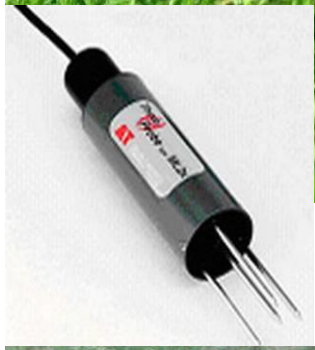
Treatment	A	B	C	D	SEM	Sig.
Mean Post-event WT Depth (cm)	52[a]	71[b]	72[b]	78[b]	4.1	P<0.05

Conclusions

- Both mole and gravel mole drainage were effective (P<0.001) in the removal of excess water off site.
- Gravel mole drainage was more effective (P<0.05) than mole drainage in removing excess water.
- Mole and gravel mole drainage lowered (P<0.05) the water table relative to the control during the experiment.
- The effectiveness of all drainage treatments deteriorated within the time frame of the experiment.
- Due to deterioration of soil macropores formed during moling in persistent wet weather and mole channel collapse







Thank You For Your Attention.

Questions?