MOLE DRAINAGE PERFORMANCE IN A CLAY LOAM SOIL

Patrick TUOHY[1, 2], James HUMPHREYS[1], Nicholas HOLDEN[2], Owen FENTON[3]
[1]Teagasc, Animal and Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork, Ireland
[2]UCD School of Biosystems Engineering, University College Dublin, Belfield, Dublin 4, Ireland
[3]Teagasc, Environment Research Centre, Johnstown Castle, Co. Wexford, Ireland
Email: patrick.tuohy@teagasc.ie

Abstract. *Where soils are impermeable to depths of >2.5 m, the cost of a conventional drainage system to control the watertable is generally prohibitive because of the very close drain spacing needed. Under such circumstances a more viable option is to use drainage methods that incorporate soil disruption techniques. These include mole and gravel mole drainage. The success of mole drainage can be highly variable. The stability and long term effectiveness of mole drains depends upon the soil texture, stability of the soil aggregates to wetting and soil moisture status at the time of installation. This study was undertaken on a grassland farm dominated by clay loam and clay textured soils. The soil texture, combined with climate is not ideal for stable mole channel formation. While gravel mole drainage, designed for such situations could be prescribed for the site, the high cost makes this technique unattractive for landowners. National agricultural policy, driven by regional European policy, is placing pressure on such farms to increase productivity, so demand is rising for practical drainage solutions that can be implemented on farms with limited resources for investment. The objective of this study was to compare the effectiveness of mole and gravel mole drainage in removing excess water and controlling the watertable position from a soil with 35-45% clay content in the south of Ireland to determine the effectiveness of both treatments and establish whether the increased cost of the gravel mole drains can be justified in such a soil. Also the installation dates of mole drainage treatments were staggered (January versus July) to assess how soil moisture status during installation affected performance. The study site was poorly drained grassland (2.5 ha), with slope of 1.4% and perched watertable consistently < 1m below ground level (BGL). An open drain was excavated to 2 m BGL adjacent to the site to act as a collector drain for the drainage treatments. The experimental area was hydrologically isolated by a 1m deep ditch. Inside this area four blocks (60 m wide x 100 m long) were established. These were further sub-divided into four plots (15 m x 100 m). The experiment was laid out in a randomized complete block design with four replicates. The four treatments were: (A) no intervention, (B) mole drainage installed in January 2011, (C) mole drainage installed in July 2011 and (D) gravel mole drainage installed in July 2011. Mole drainage was installed at a depth of 0.55 m and spacing of 1.2 m (€291/ha), while gravel mole drainage was installed at a depth of 0.40 m and spacing of 1.2 m (€2816/ha). Rainfall (tipping bucket) and runoff and drain flow from each isolated plot (collection tanks and v-notch weirs) were measured continuously. Watertable depth was measured weekly. The response of treatments to rainfall was analysed for 12 events from June 2012 to March 2013. Data were analysed using ANOVA with treatment as a fixed effect. Both mole and gravel mole drainage were found to be effective in the removal of excess water off site. Drain performance varied between treatments and between events but general trends were evident: Drain flow from gravel mole drains had consistently higher peak flow rates and greater total flows than in other treatments. Therefore, gravel mole drainage was generally more effective than mole drainage in removing excess water. Mole and gravel mole drainage effectively lowered the watertable relative to the control during the experiment. The effectiveness of all drainage treatments deteriorated within the time frame of the experiment. During Event 1 (02/06/12) all drains performed well with high ratios of drain flow to effective drainage. From event 5 there was an increase in total runoff relative to drain flow. In event 6 (14/08/12) ratios of runoff to effective drainage in treatments B, C and D were 50, 41 and 41%, respectively (s.e. 5.9 %, NS), while the ratio of drain flow to effective drainage in the treatments was 4, 11 and 40% respectively, with treatment D outperforming both B and C (s.e. 6.5%, $P<0.05$). At event 10 (27/12/12) ratios of runoff to effective drainage remained high, while drain performance in all treatments was poor. This is attributed to rapid deterioration of soil macropores formed during mole drainage installation in persistent wet weather.*

Key words: *mole drainage, gravel mole drainage, drain flow, watertable.*