# CCm Agricultural Trials Summary

## Introduction

CCm Technologies' fertiliser (CCm Growth®) has undergone several different trials to determine the impactthe product has on crop yield and soil health. There have been many positive outcomes of the trails, demonstrating CCmGrowth® as a viable fertiliser that enhances crop yield as well as greatly improving soil health. It should be noted that at least three years of the trials have been randomised and replicated for fairness.

## Soil Trials

Figure 1 displays a timeline of soil trial events, of which the detail of the trials will be discussed below.

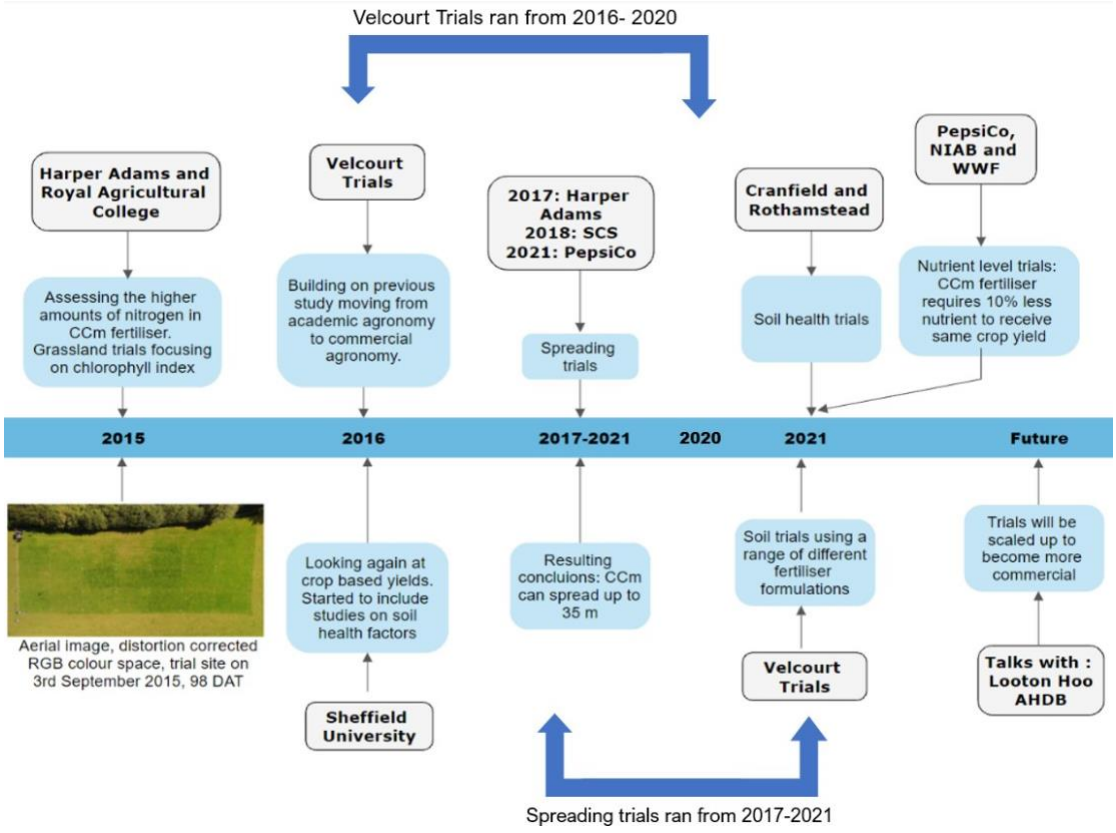



Figure 1: Soil trials timeline of events

## Harper Adams (HA) and Royal Agricultural College (RAC) (2015)

This trial took place on grasslands (Figure 2), where CCmGrowth® was experimented on that contained a higher nitrogen concentration. Chlorophyll index was measured, and across the board, the yield was equivalent or higher than a conventional chemical fertiliser that was tested (Nitram). Due to nitrogen being amain component of chlorophyll, the higher nitrogen concentration caused and increase in the chlorophyll content. Higher chlorophyll content increases photosynthesis rates, leading to an increase in yield production. Although not specifically investigated, data was starting to show how the fertiliser was starting to impact soilhealth though several different methods. Further studies were undertaken to investigate the fertilisers impact on soil health.

Figure 2: Grassland trials from HA and RAC

Velcourt Trials (2016-2020)

Building upon the academic trials from HA and RAC, the Velcourt trials were a step into the commercial agronomy sector. The field trials were the same but on a bigger site and the results were also the same, thatCCm fertiliser improved or maintained the same amount of yield as a conventional chemical fertiliser.

Sheffield University (2016-2020)

More field trials were undertaken to determine how CCmGrowth improves soil health. This study showed how the CCmGrowth® increased soil organic matter (SOM), increased water retention (30-60%), increased lengthof wilt time on crops and increased bio flora and fauna.

Spreading Trial with various organisations (2017-2021)

Three spreading trials were undertaken to determine the distance that CCmGrowth can be spread. Farmersare looking for a spread of over 30m and CCm's fertiliser is able to be spread evenly to 35m.

Cranfield and Rothamstead (2021)

Field trials have from Cranfield University have shown that up to 50% less nutrients are needed in CCm's fertiliser to have the same crop yield compared to conventional chemical fertilisers. Additional analysis alsotook place regarding soil health such as root length, carbon feedstocks and soil carbon. The soil organic carbon (SOC) at Cranfield is already high, so for CCm to increase the SOC would be a great start.

Research has also been completed to determine leaching and runoff rates. CCm fertiliser growth has beenshown to reduce leaching by 80% as well as reducing the contaminants in the leachate, meaning the runoff is cleaner. This demonstrates that the nutrients are being held in the soil and not being released through runoff. Cranfield University will be building upon information from the Sheffield fertiliser formulation ($^{13}C$) to determine the physical pellet nutrient and carbon composition. This will be done by using neutron scannersand spectroscopy to determine if the nutrients are spread evenly throughout the pellet and between each pellet.

Velcourt Trails (2021)

Velcourt trials demonstrate that 20% less nutrient levels are needed in the fertiliser to create the same amount of yield as a conventional fertilisers. Velcourt completed trials on a broader range of formulations.This included Bagley digestate, urea, biochar (first field trials).

Results demonstrated that these fertiliser additions produced 11 tonnes of crop yield per hectare. In comparison. Untreated digestate that is spread to land produces 5 tonnes of yield per hectare.

PepsiCo, NIAB and WWF (2021)

Trials with PepsiCo, NIAB and WWF demonstrated a 10% decrease in nutrients in the fertiliser are able toproduce the same amount of yield as conventional fertilisers.

Future Studies

Further studies need to be done to determine if the same results would occur on a larger scale. CCm Technologies will be continuing to scale up future trials and talks are already occurring with Luton Hoo andthe AHDB.

CCm Trials (2021)

On site there have been studies into Volatilisation and Leaching performed, this testing is ongoing.

Leaching:

In order to compare ammonium nitrate (AN), 6mm pellets (6), Competitor Pellets (C), 3mm pellets (3), Formulation 2 pellets (F) and Ash pellets (A) the following experiment was set-up.

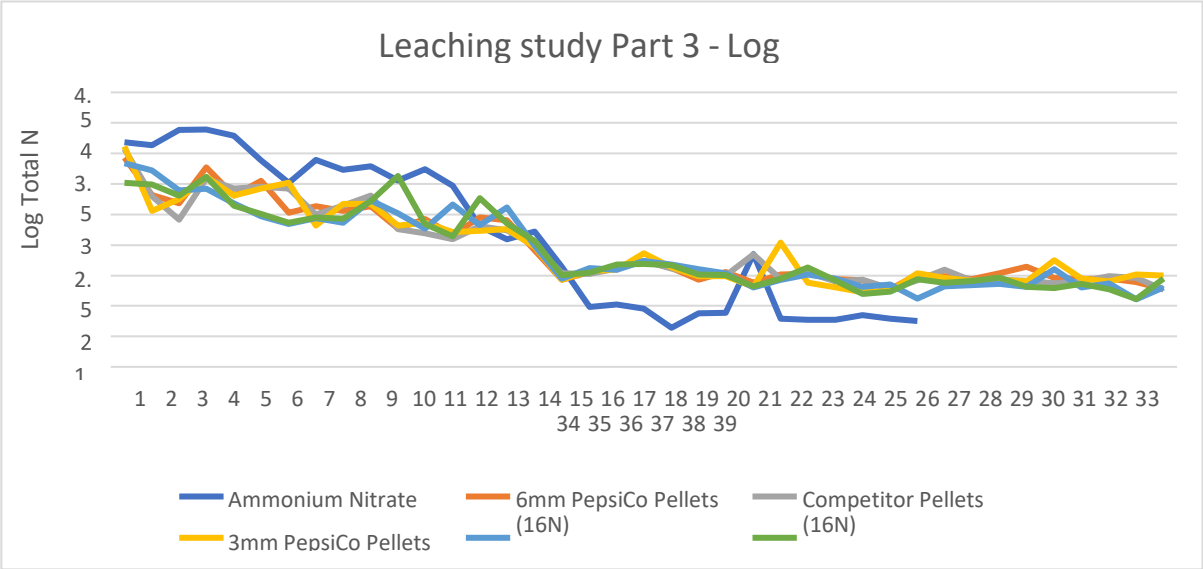
6 separate chromatographic columns were filled with approximately 2 inches of sand onto which sufficientmaterial (either AN, 6, C, 3, F or A) was placed into the respective columns to give the same N content of approximately 35 N. 100ml of water was added to each column and allowed to stand overnight.

The filtrate was then drained into separate containers for the following analysis performed using a Palintestphotometer:

Ammonia (N mg/l), Ammonium (N mg/l), Phosphorous (P mg/l), Nitrate (N mg/l), Nitrite (N mg/l) and pH.

Photo of testing apparatus:

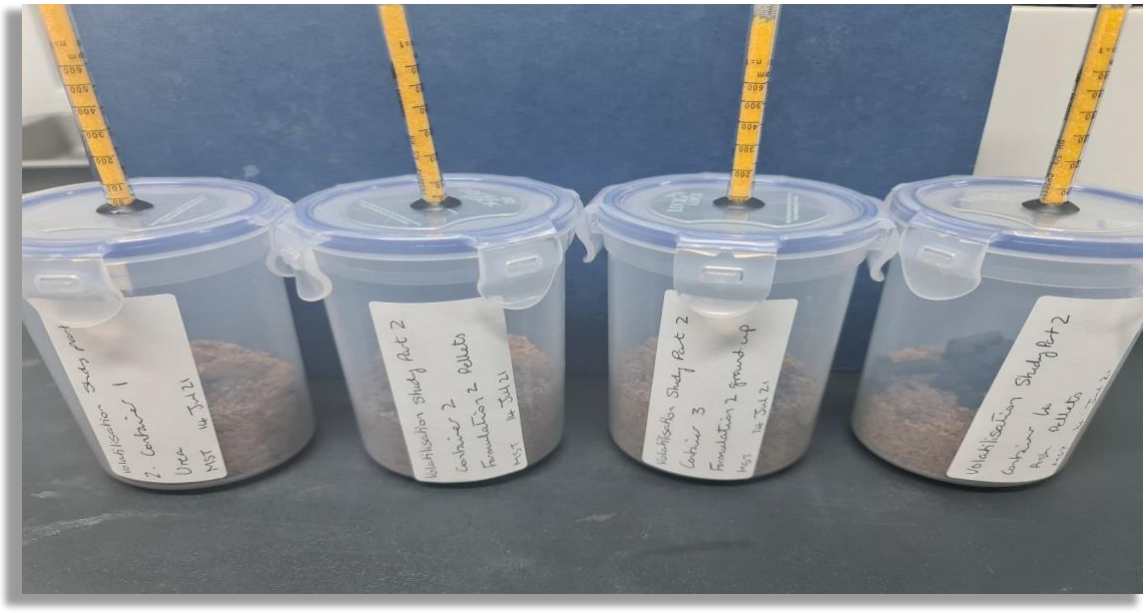
Graph of results (to current date)




Volatilisation:

In order to compare the amount of volatiles given off by Urea (UAN), Formulation 2 pellets (F), Ground-up Formulation 2 pellets (GF), Ash pellets (A) and Minworth Sludge (MS) the following experiment was set-up.

4 separate containers were filled with 50ml of sand and 50ml of soil which was well mixed. Sufficient quantity of material (UAN, F, GF, A and MS) was placed into the respective containers to give approximatelythe same N content. 10ml of water was added immediately prior to closing the container. The lids of the containers were connected to Draeger simultaneous testing adapters into which the Ammonia 5/a Draeger tubes were connected. The containers were allowed to stand until no further emissions were noted with reading taken each day.



Photos of testing apparatus

Graph of results: