Bonnie Doon Trial Report Summary- Impact of Organic/ Biological amendments on Dark Green Colour Index (DGCI)

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Abstract

In conjunction with an ongoing ***Poa Annua*** management and a wetting agent trial over the last 100 plus days we have been investigating the impact of organic/biological based amendments on a mixed ***Poa annua/Agrostis*** sward on a practice putting green at Bonnie Doon G.C. Results showed the following:

1. All the results gained were specific to this site under the conditions it was subjected to over the duration of the trial.

2. Treatments N and A were the best and on numerous occasions statistically better than the untreated control.

3. Both Treatments N and A were a massively unexpected surprise. Silica is widely used in the Australian Turf Industry but it has historically been promoted to ‘’harden turf” with little by way to support this claim. It has seldom been used to actively improve turf health. The high analysis (25%) of Treatment N indicates that high Is loading likely has contributed to these results.

4. Treatment A exhibited signs of a cumulative effect with multiple applications required. The response appeared to last around 15-20 days.

5. Treatment O was also a surprise. Possibly in conjunction with supplementary nutrition a different result would have been gained but as a stand alone application on this site and under these conditions the results don’t warrant standalone usage if you are aiming to improve turf quality.

6. Hatake® (Treatment D) caused no significant differences in DGCI readings compared to the control. As no disease was prevalent over the duration of the trial we could not access its efficacy.

7. Treatment F initially gave the lowest readings although over the duration of the trial these were never statistically different to the untreated control.

Background to Treatments

The overall trial looked at the following inputs focusing on Turf Quality as measured by Dark Green Colour Index (DGCI).

Volumetric soil moisture at the 0 to 3.8cm cm depth as measured with a TDR 350 ranged from 4.1 to 62.4% with a mean of 26.7%. Soil temperature at the 3.8 cm depth ranged from 10.6°C to 33°C with a mean of 24.5°C. Organic matter levels ranged from 8.2-20% at a depth of 0-10mm to 7.9-16% at a depth of 10-20mm.

Marmite® and Berocca® tablets (Treatment A)

	Marmite	Berocca
Niacin	✓	✓
Riboflavin	✓	✓
Folic acid	✓	✓
Thiamine	✓	
Yeast extract	✓	
Vitamin B1		✓
Vitamin B12	✓	✓
Vitamin B5		✓
Vitamin B6		✓
Vitamin B7		✓
Vitamin C		✓
Calcium		✓
Magnesium		✓
Zinc		✓
Mannitol		✓

Yeast extract. Brewer's yeast heated to create glutamic acid, which is used by farmers to increase plant growth and boost crop yields.

Niacin (nicotinic acid, vitamin B3, $C_6H_5NO_2$)

Riboflavin (E101, vitamin B2, $C_{17}H_{20}N_4O_6$)

Folic acid. Also called vitamin B9, enables plants to regulate their DNA functions. This acid basically helps a plant to produce DNA, which is a nucleic acid that possesses an organism's genetic information. Folic acid additionally enables plants to produce RNA, a nucleic acid that carries information from DNA to plant cell structures known as ribosomes and helps a plant synthesize protein. Plants need protein to build up the structures in their cells. Folic acid essentially helps plants to grow more heavily and healthily. Because folic acid exists in plants but decomposes rapidly when exposed to strong light (King, 2020)

Vitamin B12 (cobalamin, $C_{63}H_{88}N_{14}O_{14}P$)

Thiamin (vitamin B1, thiamine hydrochloride, $C_{12}H_{17}ClN_4OS$). The effects of thiamine on disease resistance and defence-related gene expression mobilize systemically throughout the plant and last for more than 15 d after treatment (Anh, Kim and Lee, 2005).

Hatake® (Treatment D)

Hatake is a product that contains pure ***Bacillus amyloliquefaciens*** discovered from the microflora of the marine environment in Japan. The strain shows excellent plant pathogen fighting ability and high organic matter degradation activities.

Mode of Action

Organic degradation leading up to 50% reduction in fertiliser usage.

Naturally occurring auxin which regulates and promote growth and yield (10%-30%)

Naturally occurring iturin - Attacks cell walls of fungus and bacteria

Deprives pathogenic fungi of space and nourishment by colonizing plant roots

Produces metabolites that inhibit plant pathogens.

Potassium bicarbonate (Treatment F)

The majority of work investigating this appears to have been done in horticulture on for example roses for black spot and powdery mildew (Horst, 1990). Although no specific rate was determined as being most effective against powdery mildew for black spot it was determined to be a 0.5% solution.

Work has also shown that the form of bicarbonate can also be very disease specific. (Horst, 1990)

This is marketed in the USA under brand names such as Millstop®, Kaligreen® (Monterey Chemical Co) and Amicarb® (first rgistered in 1998 by Helena Chemical Company). The latter label claims efficacy against: Anthracnose, Fusarium, Helminthosporium leaf spot and it also shows efficacy against dolalr spot as a curative application. It is safe for use on: bentgrass, fescues, couchgrass, zoysiagrass and fescue.

Ferric ammonium citrate (Treatment M)

This was included to determine if it was a viable alternative to ferrous sulphate heptahydrate, due to its reduced risk for staining concrete.

Foliar-Pak® CSI (Treatment N)

Foliar-Pak® CSi L is one of the most concentrated liquid silicon products in the US market containing 25% SiO_2 by weight. It is derived from silicic acid.

• Foliar-Pak® CSi L is paired with a specific amino acid that acts as an osmolyte in the plant—which helps keep water in the cell, creating optimal turgor pressure and rigidity in the turf.

• Unlike other silicon products on the market, Foliar-Pak® CSi L is tank-mix compatible with a variety of other products as it is built to not interact with other molecules in the spray tank.

• Owing to its small molecular weight and size, Foliar-Pak® CSi L moves through the foliage very easily, unlike other silicon products such as silicates and slags that are not soluble, and therefore are not readily available for plant uptake and use.

• Silicon delivered from Foliar-Pak® CSi L will increase plant turgidity, resulting in more upright growth, smoother surfaces, better green speed and better wear tolerance.

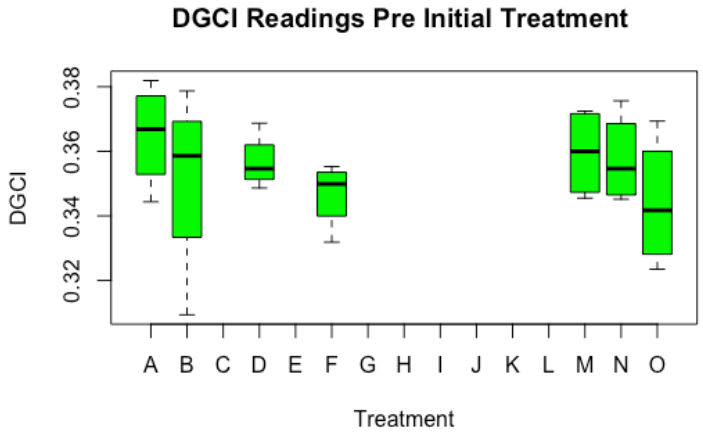
MP Roots® (Treatment O)

A high phosphorus soil and plant enhancing liquid fertiliser with VAM organics. MP ROOTS facilitates maximum leaf uptake of nutrients, delivering freely available phosphorus to stimulate strong root growth. MP ROOTS works to aid root development for turf establishment and recovery from renovation.

Trial Overview

A randomised block trial was marked out after using Edgar II for its design and layout. This comprised 60 x 1m2 plots with a 50mm buffer between each. The profile comprised approximately 50mm of thatch overlying a sandy rootzone. Treatments were applied with 4 replicates of each including a control which was untreated. This trial ran from 26th July 2019 to 4th November 2019.

Product was applied as per label rate in 800L of water (soil applications) depending on the specific treatment being applied with a backpack carbon dioxide spray unit fitted with flat fan spray nozzles and calibrated to apply 800L/Ha.The water source used was rainwater. All treatments were monthly where possible.



Treatments were applied on the following dates: 26th July, 20th August, 23rd September and 4th November 2019.

Results

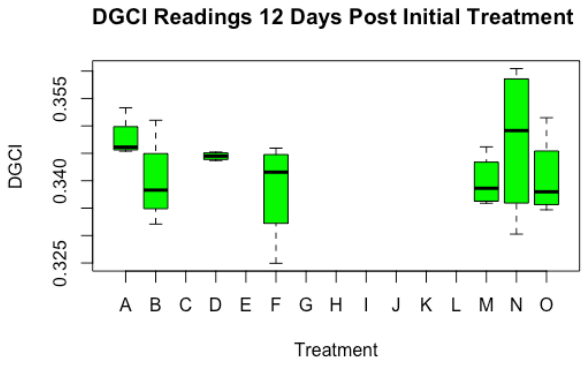
Weather data was recorded from the BOM site and localised data using the OmneTurf system equipped with a combined temperature/humidity sensor and an Apogee PAR sensor.

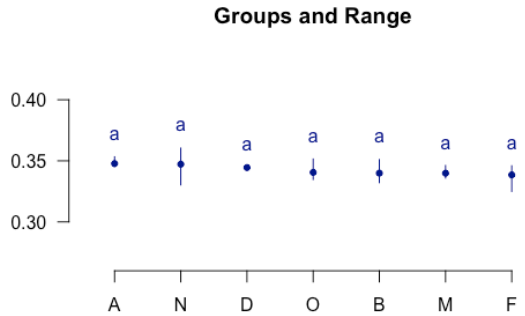
Plots were monitored using digital image analysis and a TDR 350 (Spectrum Technologies) was used to assess soil moisture levels throughout the trial, fitted with 3.8cm rods. 5 random readings were taken per plot.

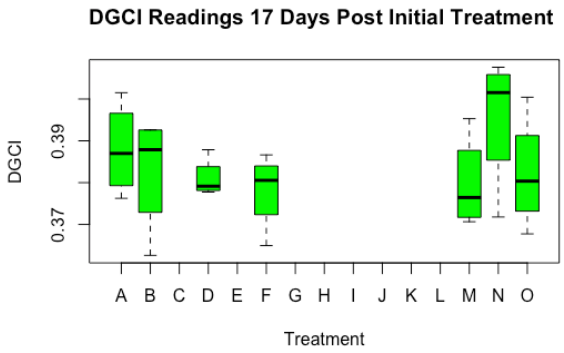
Images were taken monthly in both RAW and PNG format using a modified Canon PowerShot SX260 HS with NDVI filter and an Olympus Stylus respectively. Digital Image Analysis was carried out using Image J and the NCSU Turf Plug in. Statistical analysis was carried out using Programme R Agricola package

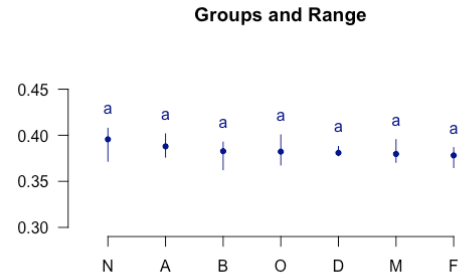
Post Treatment

For all variables with the same letter, the difference between the means is not statistically significant. If two variables have different letters, they are significantly different.

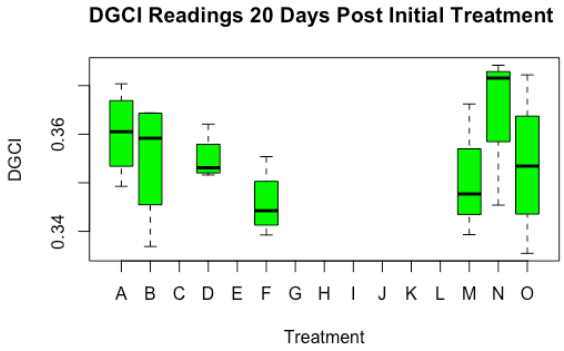


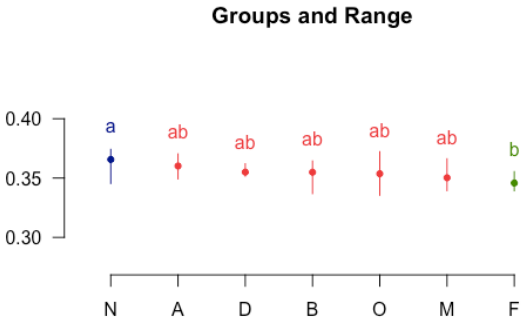


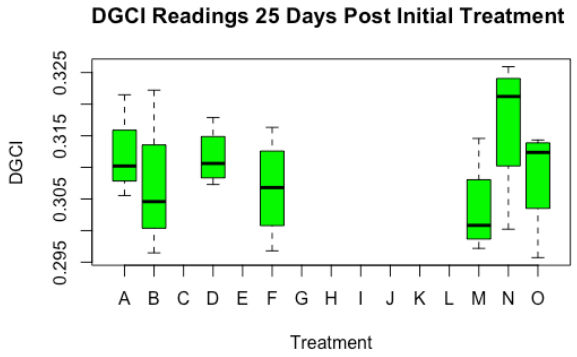


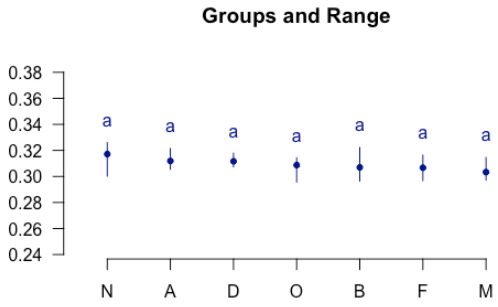


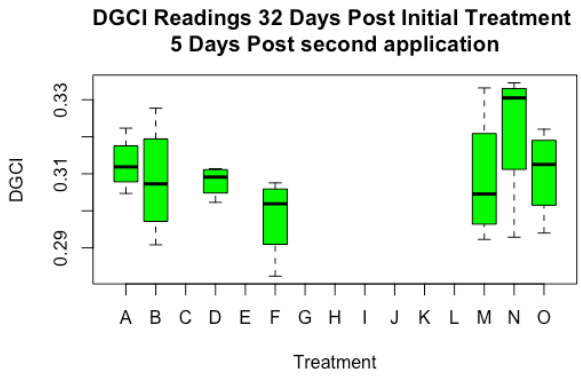
Duncan test for DGCI showed results were significant at a 95% confidence level 20 days post the initial application and 5 days post the second application; 32 days post initial and 5 days post second

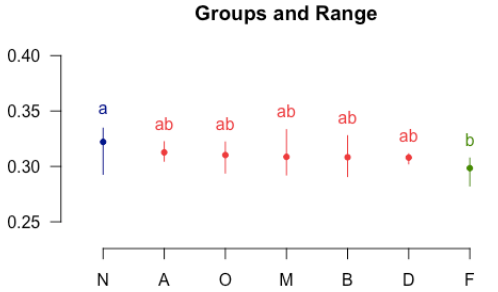


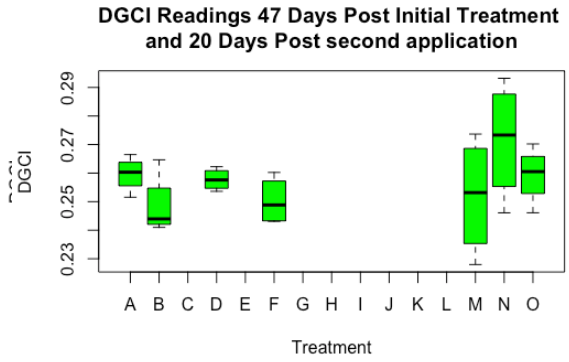


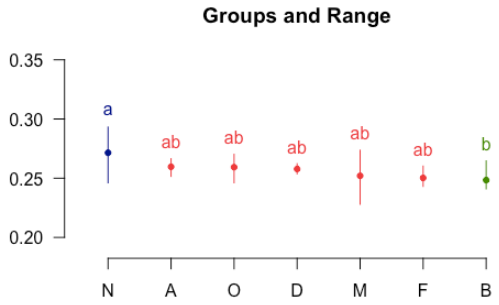


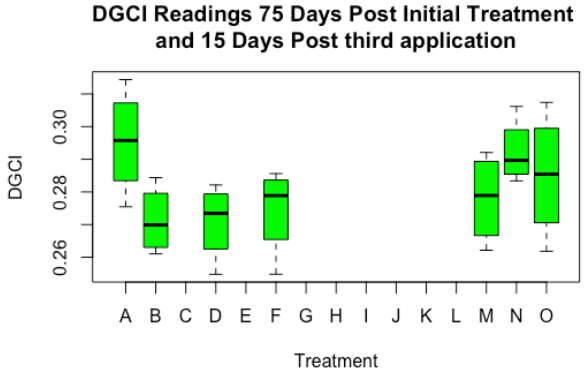


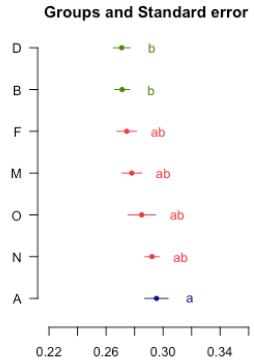


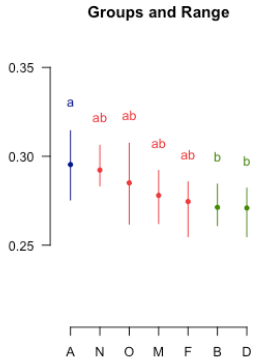


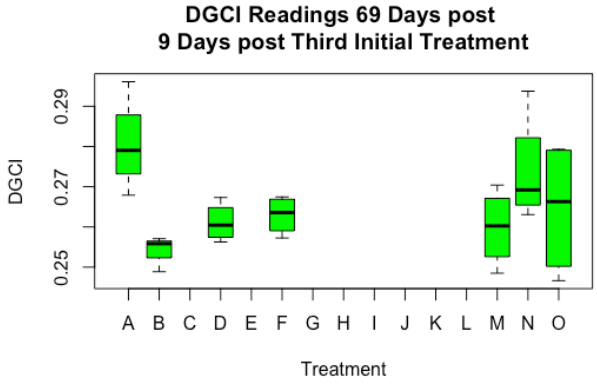

DGCI Readings 47 Days Post Initial Treatment
and 20 Days Post second application
DGCI
0.23
0.25
0.27
0.29
A B C D E F G H I J K L M N O
Treatment

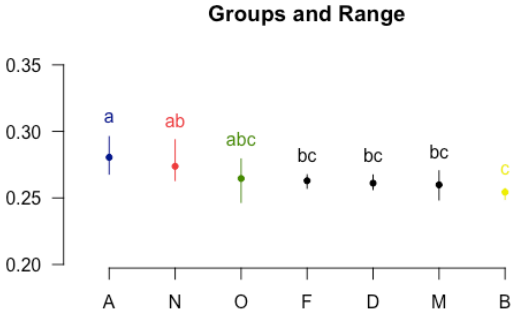

Groups and Range
0.35
0.30
0.25
0.20
a
ab
ab
ab
ab
ab
b
N A O D M F B

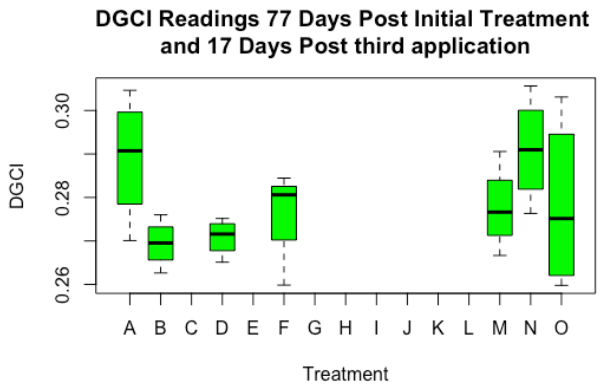

DGCI Readings 75 Days Post Initial Treatment
and 15 Days Post third application
DGCI
0.26
0.28
0.30
A B C D E F G H I J K L M N O
Treatment

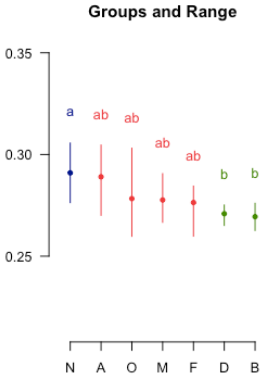

Groups and Standard error
D
B
F
M
O
N
A
b
b
ab
ab
ab
ab
a
0.22
0.26
0.30
0.34

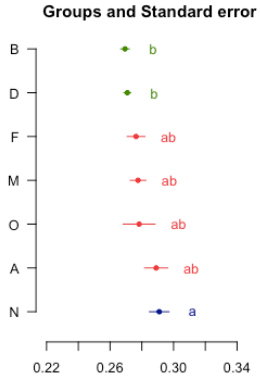

Groups and Range
0.35
0.30
0.25
a
ab
ab
ab
ab
b
b
A N O M F B D


DGCI Readings 69 Days post
9 Days post Third Initial Treatment
DGCI
0.25
0.27
0.29
A B C D E F G H I J K L M N O
Treatment

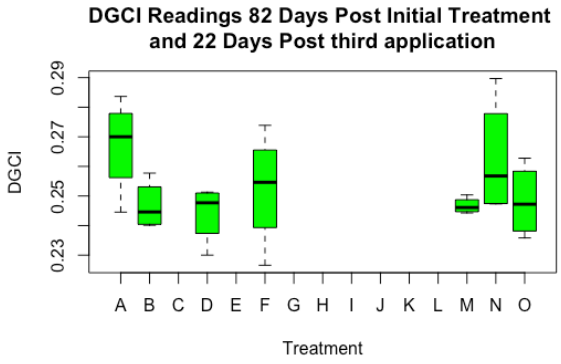

Groups and Range
0.35
0.30
0.25
0.20
a
ab
abc
bc
bc
bc
c
A N O F D M B

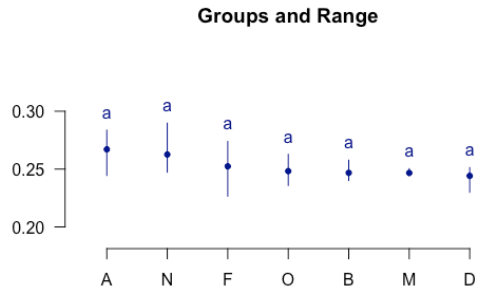

DGCI Readings 77 Days Post Initial Treatment
and 17 Days Post third application
DGCI
0.26
0.28
0.30
A B C D E F G H I J K L M N O
Treatment

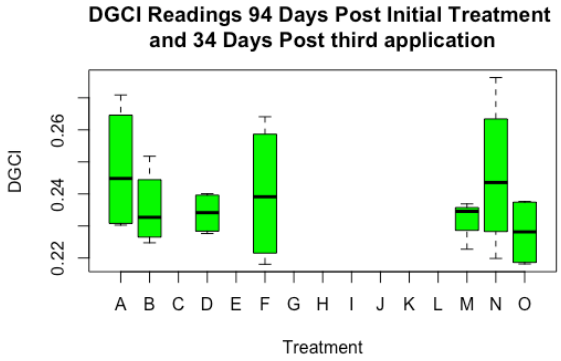

Groups and Range
0.35
0.30
0.25
a
ab
ab
ab
ab
b
b
N A O M F D B

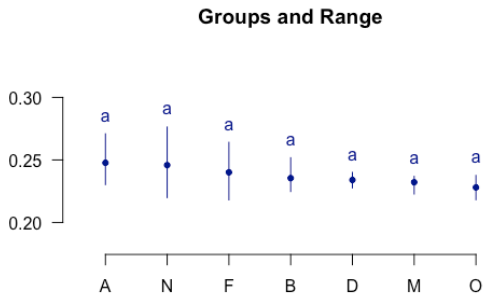

Groups and Standard error
B
D
F
M
O
A
N
b
b
ab
ab
ab
ab
a
0.22
0.26
0.30
0.34

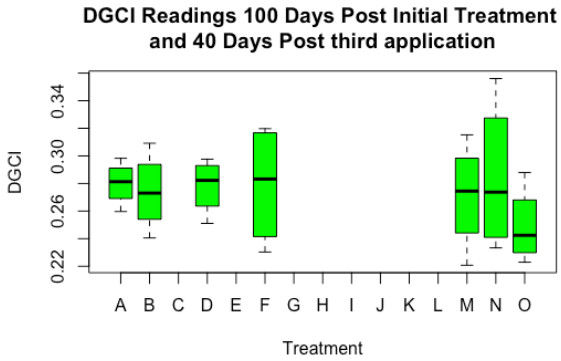
Duncan test for DGCI showed results were significant at a 95% confidence level 32 days post the initial and 5 days post the second application, 47 days post the initial application and 20 days post the second application, 69 days post the initial application and 9 days post the third application, 75 and 77 days post the initial application and 15 and 17 days respectively post the third application.

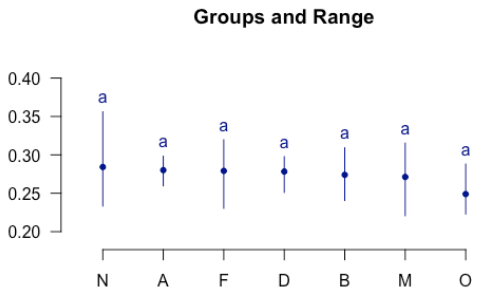


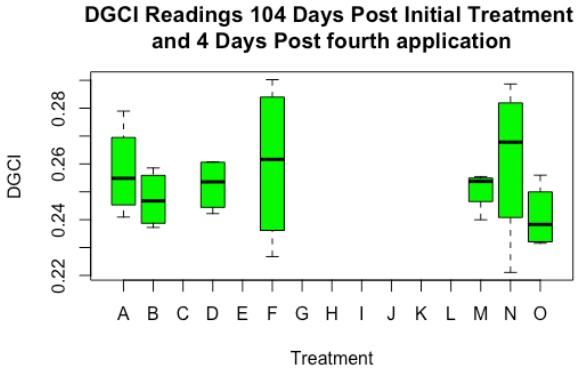


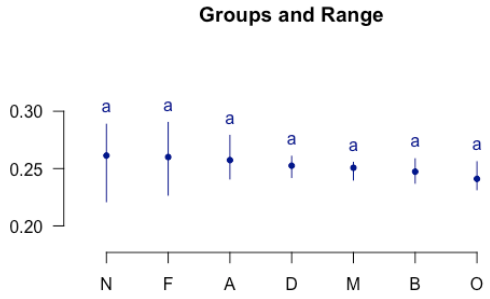


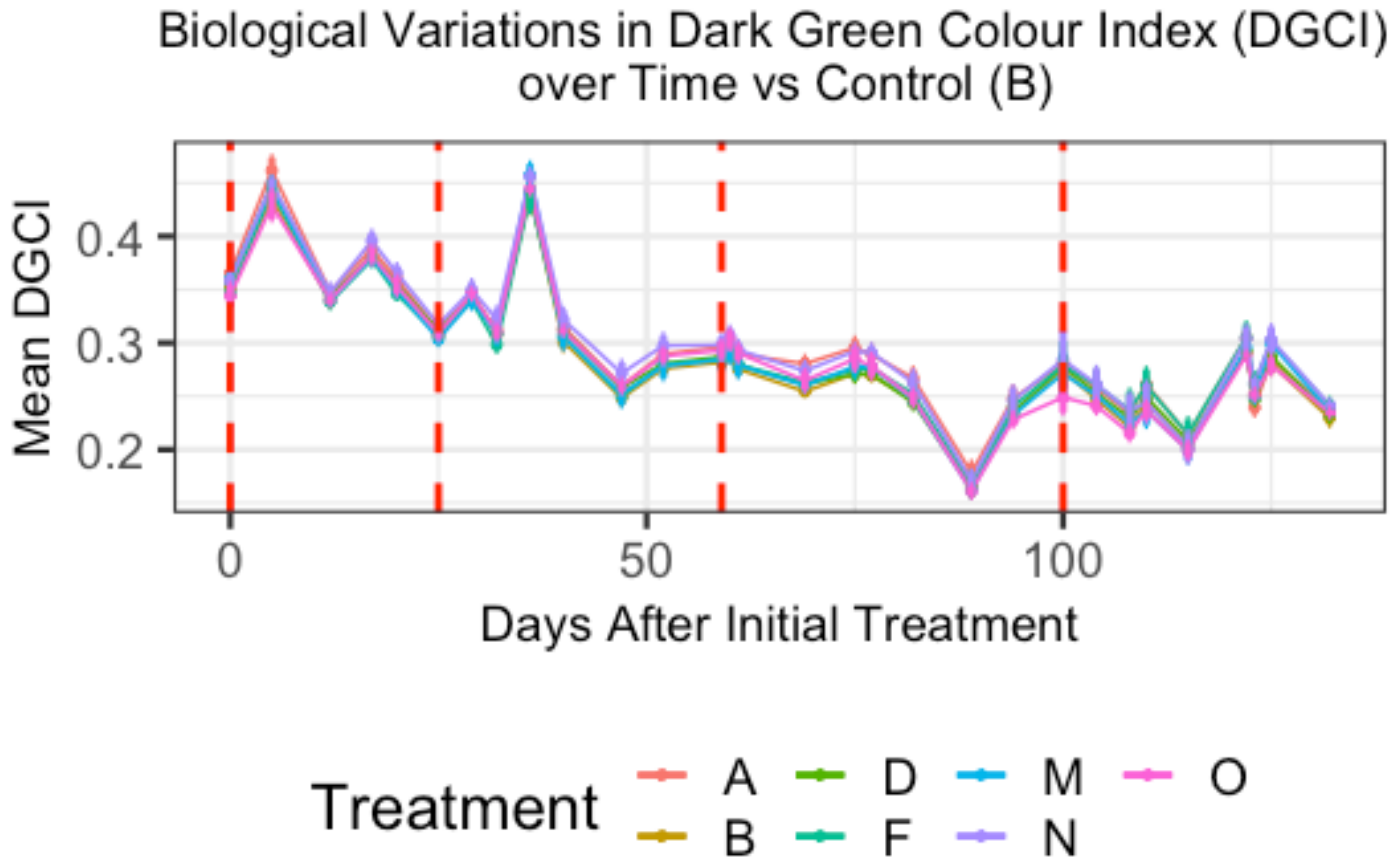







DGCI Readings 104 Days Post Initial Treatment
and 4 Days Post fourth application
DGCI
0.22
0.24
0.26
0.28
A B C D E F G H I J K L M N O
Treatment


Groups and Range
0.30
0.25
0.20
a a a a a a a
N F A D M B O


Biological Variations in Dark Green Colour Index (DGCI)
over Time vs Control (B)
Mean DGCI
0.4
0.3
0.2
0
50
100
Days After Initial Treatment
Treatment
A
B
D
F
M
N
O

References

Ahn, I., Kim, S., Lee YH,. Vitamin B1 Functions as an Activator of Plant Disease Resistance, Plant Physiol. 2005 Jul; 138(3): 1505–1515.

King, Y. The Effects of Vitamin C & Folic Acid on the Growth of Plants.2020. https://www.hunker.com/13429040/the-effects-of-vitamin-c-folic-acid-on-the-growth-of-plants