# Efficacy Report

07/20/2021

**Study Title** : Combined Application of "NanoGraphene Fertilizer – 'BOOSTER' & 'NEUTRALIZER' at Hyeong Lee's Cucumber Farm & Electrical Conductivity Measurement

**Product Identity** : Graphene, nano calcium, nano magnesium, nano iron

**Data Requirements** : Proof of crop growth and Electrical Conductivity Value reduction of the soil

**Author** : Sang-cheol Lee _ Researcher at Smartnano Co., Ltd.

**Study completion date** : 06/30/2021

**Testing Facility**
571-4 Bukgahyeon-ri, Bogae-myeon, Anseong-si, Gyeonggi-do, South Korea
Hyeong Lee's Cucumber Farm

**Laboratory Project Number** : ER 012

# GOOD LABORATORY PRACTICE COMPLIANCE STATEMENT

**SUBMITTER** : Sang-cheol Lee [ Smartnano Co., Ltd. ]

**(Signature)** _____ Date: 06/30/2021
**Typed Name** : Sang-cheol Lee
**Title** : Director

**Research Director** : Hyeong-jik Lee [ Nanoagtech Co., Ltd. ]

**(Signature)** _____ Date: 06/30/2021
**Typed Name** : Hyeong-jik Lee
**Title** : Farming Specialist

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# A. EFFICACY STUDY SUMMARY

**STUDY TITLE:** Combined Application of "NanoGraphene Fertilizer – 'BOOSTER' & 'NEUTRALIZER' at Hyeong Lee's Cucumber Farm & Electrical Conductivity Measurement

**LABORATORY PROJECT #:** ER 012

**TESTING FACILITY:** Hyeong Lee's Cucumber Farm in 571-4 Bukgahyeon-ri, Bogae-myeon, Anseong-si, Gyeonggi-do, South Korea

**STUDY DATES:**

**STUDY INITIATION DATE:** (01/18/2021)
**STUDY COMPLETION DATE:** (06/30/2021)

**TEST SUBSTANCE:**

| | |
|---|---|
| **DESCRIPTION:** | Dilute 1 bottle of 500ml 'BOOSTER' 1,000 times with water and apply foliar application to an area of 3,300$m^2$ |
| **INGREDIENT:** | Graphene G4: 0.75g, nano Ca&Mg: 0.6g, nano Fe: 0.15g |
| **DILUTION:** | Dilute 1,000 times with general groundwater and as the foliar fertilization |
| **DESCRIPTION:** | Dilute 1 bottle of 500ml 'NEUTRALIZER' 1,000 times with water and used for irrigation application to an area of 660$m^2$ |
| **INGREDIENT:** | Graphene G3: 6g, nano Ca&Mg: 0.4g, nano Fe: 0.1g |
| **DILUTION:** | Diluted 1,000 times with general groundwater and apply as the irrigation fertilization |

**TEST CONDITIONS:**

| | |
|---|---|
| **WATER**: | Groundwater, hardness: 1,000 mg/L or less |
| **CONTACT TIME** : | Not used |
| **TEMPERATURE** : | **15℃ ~ 25℃ (59°F ~ 77°F)** |

**TEST RESULTS** :

**'NEUTRALIZER'**

1. Confirmed reduced salt content from the soil as a result of applying "NEUTRALIZER".
2. The cucumbers are larger and tastier.

**'BOOSTER'**

1. The harvest has increased by more than 50% resulting in an increase in sales by more than two times.
2. Absorption of calcium and trace elements enhanced immunity and improved overall health of cucumbers.
3. The effectiveness of pesticides has increased (the amount of pesticides usage has been reduced by 50%).
4. All expected effects of calcium, including crop health, quality, disease resistance, and increased yield were confirmed.

Photos at Testing Facility

Improvement in cucumber size is evident.

# B. QUALITY ASSURANCE STATEMENT

**STUDY TITLE:** Combined Application of "NanoGraphene Fertilizer – 'BOOSTER' & 'NEUTRALIZER' at Hyeong Lee's Cucumber Farm & Electrical Conductivity Measurement

**Study #:** ER 012

Quality assurance audits of this study were conducted and reported to management and the director as listed below:

(signature) _____ DATE: 06/30/2021
Typed Name: Lib Kim
Director of Quality Assurance

# C. STUDY REPORT - Detail

**STUDY TITLE:** Combined Application of "NanoGraphene Fertilizer – 'BOOSTER' & 'NEUTRALIZER' at Hyeong Lee's Cucumber Farm & Electrical Conductivity Measurement

**TEST FACILITY** : Hyeong Lee's Cucumber Farm in571-4 Bukgahyeon-ri Bogae-myeon, Anseong-si, Gyeonggi-do, South Korea

**TEST SUBSTANCE IDENTIFICATION**

**TEST SUBSTANCE NAME:** (Graphene: Cas No:1034343-98-0, Nano Calcium & Magnesium hydroxide : Cas No: 39445-23-3, Nano iron hydroxide: Cas No: 11113-66-9)

① Graphene G4: Cas No: 1034343-98-0; Graphene Layer - Median of single layer ranging from 1 to 5 layer; Graphene size - median size of 20nm, Glycerin-based

② Graphene G3: Cas No: 1034343-98-0; Graphene Layer - Median of 5 layers ranging from 1 to 10 layers; Graphene size - median size of 50nm; Water-based

③ Nano Calcium & Magnesium hydroxide: Cas No : 39445-23-3; median size of 5nm

④ Nano iron hydroxide: Cas No: 11113-66-9; median size of 5nm

**DESCRIPTION OF TEST SUBSTANCE:**

**'NEUTRALIZER'**: It is a black liquid fertilizer manufactured by mixing highly concentrated Graphene G3 with nano calcium & magnesium hydroxide and nano iron hydroxide.
It can be stored at room temperature for 2 years and is supplied in various containers ranging from 500ml to 20kg.

**'BOOSTER'**: It is a transparent gold-color liquid fertilizer manufactured by mixing highly concentrated Graphene G4 with nano calcium & magnesium hydroxide, and nano iron hydroxide.
It can be stored at room temperature for 2 years and is supplied in various containers from 500ml to 20kg.

## CHEMICAL CHARACTERIZATION:

**NEUTRALIZER**

: We added a high concentration of Graphene G3 and nano calcium, nano magnesium and nano iron as described above the "test substance name". These are our proprietary materials. Graphene has inherent functions of being a drug delivery system, catalyst and having a chelating effect. Therefore, it delivers a high concentration of molecular-sized nano calcium, nano magnesium, nano iron and other essential trace elements to growing points within plants throughout a plant's growth cycle.

**BOOSTER**

: We added a high concentration of Graphene G4 and nano calcium, nano magnesium and nano iron as described above the "test substance name". These are our proprietary materials. Graphene has inherent functions of being a drug delivery system, catalyst and having a chelating effect. Therefore, it delivers a high concentration of molecular-sized nano calcium, nano magnesium, nano iron and other essential trace elements to growing points within plants throughout a plant's growth cycle.

**STUDY OBJECTIVE:** We reduce the use of chemical fertilizers, increase immunity, strengthen cell walls, confirm increased production, and reduce salt content from the soil.

**TEST METHOD:** Cultivation test conducted according to general farming methods

## D. STUDY MATERIALS TEST METHOD

### PREPARATION OF TEST SUBSTANCE

Dilute 1 bottle of 500ml 'BOOSTER' 1,000 times with water and apply foliar application to an area of 3,300$m^2$
Dilute 1 bottle of 500ml 'NEUTRALIZER' 1,000 times with water and apply irrigation application to an area of 660$m^2$

### PREPARATION OF TEST SYSTEM/STRAINS

Use of 3,000 liter plastic water tank for 1,000-fold dilution

### EXPOSURE CONDITIONS

'BOOSTER' 1,000 times with water and apply foliar application to 3,300$m^2$ of land twice a month, 4 times in total.
'NEUTRALIZER' 1,000 times with water and irrigate 1 bottle of 'NEUTRALIZER' 660$m^2$ immediately after rotary work in the field , and add 1 bottle after 1 month.

### TEST SYSTEM RECOVERY

It improves the soil to one in which plants can grow better (reduced Electrical Conductivity value) by resolving salt accumulation pollution, which prevents crops from growing well due to the accumulation of salts.

## PROTOCOL CHANGES

'BOOSTER' is diluted 1,000 times with water applied foliarly to 3,300$m^2$ farmland twice a month. If calcium deficiency occurs due to high temperature, additional foliar application need to be performed, so there is no change in the protocol.

'NEUTRALIZER' Dilute water 1,000 times in 500ml and irrigate 660$m^2$ of farmland after rotary work before planting. If additional fertilizer spraying is necessary depending on the crop, additional irrigation is performed.

### PROTOCOL DEVIATIONS

There is no reason for the protocol to change.

# E. CONTROLS

**PREPARATION OF CONTROL(S)**
Testing was conducted under the same conditions, dividing fields into two parts; one field sprayed with fertilizer and the other field without fertilizer.

# F. STUDY ACCEPTANCE CRITERIA

**STUDY REQUIREMENTS**
Dilute 1 500ml bottle of 'BOOSTER' 1000 times in water and apply foliar application to an area of 3,300 ㎡.

Dilute 1 500ml bottle of 'NEUTRALIZER' 1,000 times in water and irrigate an area of 660 ㎡.

Afterwards, soil samples are collected from the front, center, and back of the test land, and then the electrical conductivity of each is measured and the average value is checked.

# G. DATA ANALYSIS

**CALCULATIONS**
Measure the electrical conductivity value of cucumber cultivation soil and compare the measured values before and after cucumber cultivation.

**STATISTICAL ANALYSIS**
Statistical analysis was conducted by summing the yield based on the area of a 660$m^2$ cucumber greenhouse.

# H. STUDY RETENTION

**Data Retention**
Prepare and preserve research reports.

**Specimen Retention**
Testing facility is permanent. However, agricultural products are not preserved. Therefore, they are replaced with photos and reports.

# I. STUDY RESULTS

**NEUTRALIZER**

1. Electrical Conductivity value decreased by 5.5 from 18.9 to 13.4.
2. Confirmed reduced salt content from the soil as a result of applying "NEUTRALIZER".

**BOOSTER**

1. The harvest has increased by more than 50% resulting in an increase in sales by more than two times.
2. Absorption of calcium and trace elements enhanced immunity and improved overall health of cucumbers.
3. The effectiveness of pesticides has increased (the amount of pesticides usage has been reduced by 50%).
4. All expected effects of calcium, including crop health, quality, disease resistance, and increased yield were confirmed.

# J. STUDY CONCLUSION

**NEUTRALIZER**

NEUTRALIZER improves the structure of the soil and revitalizes the soil by breaking down accumulated salt from the soil. It also stimulates nitrogen (N), phosphorus (P) and potassium (K) within the soil.

**BOOSTER**

BOOSTER promotes the healthy growth of plants and increases resistance to diseases by maximizing the movement of nano calcium, nano magnesium, nano iron and other trace elements precisely and continuously. It is a comprehensive bioactive plant agent that helps plants overcome various physiological disorders under adverse growing conditions. Taste of plants and productivity of plant growth are also increased with BOOSTER.

**REPORT SUBMITTED BY:**

**Sang-cheol Lee**_____ _____
Study director Study completion date: 06/30/2021

Appendix 1. Measurement of Electrical Conductivity (EC) Value at Local Government R&D Center

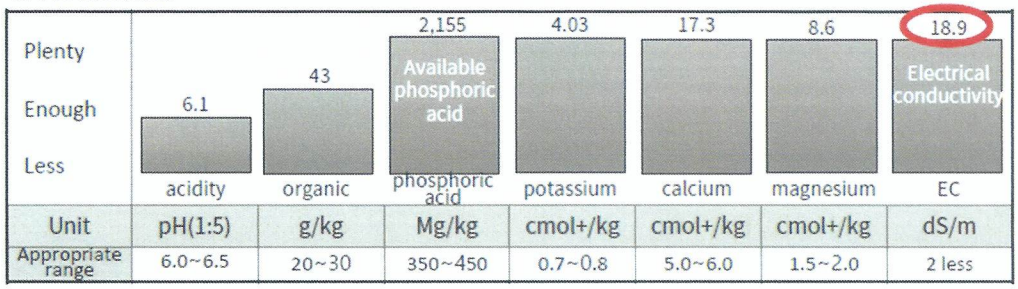
## Before Prescription: EC value 18.9

### Field soil fertilizer use prescription

■ Farmland status

| | | | | | | |
|---|---|---|---|---|---|---|
| Survey number | 2021-3 | Crop name | Cucumber | | Area | 3,300㎡ |
| Cultivator name | Hyeongjik Lee | Plow | 571-4, Bukgahyeon-ri, Bogae-myeon, Anseong-si, Gyeonggi-do | | | |
| Cultivator address | Anseong-si, Gyeonggi-do | | | | | |
| Soil type | Wet fields | soil composition | silty soil | location | Gojeon-dong | Drainage grade | slightly good |
| Soil properties | There is a risk of moisture due to high groundwater or waterlogged soil, so improved drainage and management of drainage facilities are necessary, and cultivation of crops resistant to moisture is recommended. | | | | | | |

■ Soil test results




| | acidity | organic | phosphoric acid | potassium | calcium | magnesium | EC |
|---|---|---|---|---|---|---|---|
| Unit | pH(1:5) | g/kg | Mg/kg | cmol+/kg | cmol+/kg | cmol+/kg | dS/m |
| Appropriate range | 6.0~6.5 | 20~30 | 350~450 | 0.7~0.8 | 5.0~6.0 | 1.5~2.0 | 2 less |

In general, intelligence is good. It is best to apply less phosphate fertilizer.

■ Recommended amount of fertilizer (kg/3,300m²) Select and use only one type of fertilizer and compost.

| division | Nitrogen fertilizer | | Phosphate fertilizer | Potash fertilizer | lime |
|---|---|---|---|---|---|
| | Element | Ammonium Sulfate | | | |
| basic compost | 0 | 0 | 0 | 0 | 329 |
| additional compost | 0 | 0 | 0 | 0 | |

<Reference> Amount of chemical fertilizer ingredients per 10a (base fertilizer/additional fertilizer): nitrogen (0.0/0.0), phosphoric acid (0.0/0.0), potash (0.0/0.0)kg

■ Person in charge's opinion
▶ When growing cucumbers (greenhouse), use the recommended amount of base fertilizer and adjust the amount of additional fertilizer slightly depending on the growth condition.

Anseong-city Agricultural Technology Cent

Soil test date: Jan 18, 2021 Issue date: Jan 21, 2021 Contact person: Woojeong Park Telephone: 041-750-3553

Nanoagtech, an agricultural corporation / Tel : 063-535-0058 / email-nanoagtech@naver.com

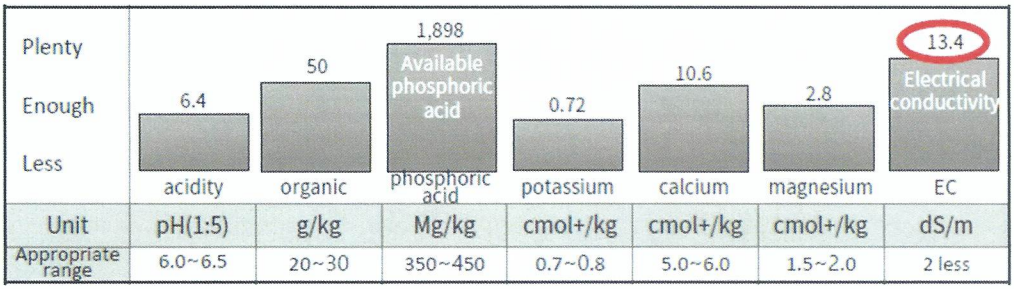
## After Prescription: EC value 13.4 (5.5 decrease)

### Field soil fertilizer use prescription

■ Farmland status

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Survey number | 2021-3 | Crop name | Cucumber | | | Area | 3,300㎡ |
| Cultivator name | Hyeongjik Lee | Plow | 571-4, Bukgahyeon-ri, Bogae-myeon, Anseong-si, Gyeonggi-do | | | | |
| Cultivator address | Anseong-si, Gyeonggi-do | | | | | | |
| Soil type | Wet fields | soil composition | silty soil | location | Gojeon-dong | Drainage grade | slightly good |
| Soil properties | There is a risk of moisture due to high groundwater or waterlogged soil, so improved drainage and management of drainage facilities are necessary, and cultivation of crops resistant to moisture is recommended. | | | | | | |

■ Soil test results




| | pH(1:5) | g/kg | Mg/kg | cmol+/kg | cmol+/kg | cmol+/kg | dS/m |
|---|---|---|---|---|---|---|---|
| Unit | | | | | | | |
| Appropriate range | 6.0~6.5 | 20~30 | 350~450 | 0.7~0.8 | 5.0~6.0 | 1.5~2.0 | 2 less |

In general, intelligence is good. It is best to apply less phosphate fertilizer.

■ Recommended amount of fertilizer (kg/3,300m²) Select and use only one type of fertilizer and compost.

| division | Nitrogen fertilizer | | Phosphate fertilizer | Potash fertilizer | lime |
|---|---|---|---|---|---|
| | Element | Ammonium Sulfate | | | |
| basic compost | 0 | 0 | 0 | 35 | 0 |
| additional compost | 0 | 0 | 0 | 18 | |

<Reference> Amount of chemical fertilizer ingredients per 10a (base fertilizer/additional fertilizer): nitrogen (0.0/0.0), phosphoric acid (0.0/0.0), potash (18.6/10.0)kg

■ Person in charge's opinion
▶ When growing cucumbers (greenhouse), use the recommended amount of base fertilizer and adjust the amount of additional fertilizer slightly depending on the growth condition.

Anseong-city Agricultural Technology Cen

Soil test date: Mar 10, 2021 Issue date: Mar 10, 2021 Contact person: Woojeong Park Telephone: 041-750-3553

## Appendix 2. Photos at Testing Facility