THE EFFECT OF VARIOUS NUTRIENT FORMULATIONS ON THE GROWTH AND PRODUCTION OF HYDROPONIC **MELON (*Cucumis melo* L.)**

THESIS

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One of the requirements to obtain
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BACHELOR PROGRAM OF AGROECOTECHNOLOGY
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UNIVERSITAS DIPONEGORO
SEMARANG
2024

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Semarang, 6 November 2024

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SUMMARY

ALMIRA LIVIA. 23020220130101. 2024. The Effect of Various Nutrient Formulations on the Growth and Production of Hydroponic Melon (*Cucumis melo* L.). (Supervisors: **KARNO** and **ROSYIDA**)

This study aims to assess various nutrient formulations and varieties on the growth and production of melon plants hydroponically. The research was conducted from April to July 2024. The research was conducted in *a* melon *greenhouse* and the Laboratory of Physiology and Plant Breeding, Department of Agriculture, Faculty of Animal Husbandry and Agriculture, Diponegoro University, Semarang.

The experimental design used was a *split plot* arranged based on a completely randomized design. The main plots were varieties, namely Golden Aroma (V1) and New Century (V2). The subplots were nutrient formulations, namely *Hoagland* (N1), *Cooper* (N2), *Steiner* (N3), and *Goodplant* (N4). Each experimental unit was planted with 4 plants with 3 replications. Growth parameters observed were plant height, number of leaves, stem diameter, leaf greenness, total chlorophyll content, carotenoid content, nitrate reductase (ANR) activity, number of stomata, male flower emergence time, and female flower emergence time. Production parameters observed were number of male flowers, number of female flowers, fruit diameter, fruit length, fruit flesh thickness, fruit weight, fruit sweetness level, and vitamin C content. Environmental conditions observed were air temperature and humidity. The data obtained were analyzed using *Analysis of Variance* followed by the Honest Real Difference test (BNJ) at the 5% level.

The results showed that *Hoagland*, *Cooper*, and *Goodplant* nutrient formulations were significantly higher than *Steiner* on leaf greenness parameters. *Cooper* nutrient formulation was significantly higher than *Goodplant* in total chlorophyll content of leaves. *Hoagland* and *Cooper* nutrient formulations were significantly higher than *Goodplant* in fruit length and fruit weight. *Cooper* nutrient formulation was significantly higher than *Steiner* on male flower emergence time. The Golden Aroma variety was significantly higher than New Century in stem diameter, leaf greenness, leaf total chlorophyll content, leaf carotenoid content, stomatal number, fruit diameter, fruit flesh thickness, and fruit sweetness. Various nutrient formulations on both varieties showed no significant difference in fruit diameter. The interaction between *Hoagland* and *Cooper* nutrient formulations on Golden Aroma variety was significantly higher than *Goodplant* on fruit length and fruit weight parameters.

The conclusion of this study is that the Golden Aroma variety responds to increased growth and production of melon plants on *Hoagland* and *Cooper* nutrient formulations, but responds to decreased growth and production of melon plants on *Goodplant* nutrient formulations shown in the parameters of fruit length and fruit weight. The New Century variety gave the same growth and production response to the application of *Hoagland*, *Cooper*, *Steiner*, and *Goodplant* nutrient formulations.

PREFACE

Melon (*Cucumis melo* L.) is one of the horticultural crops that has been widely cultivated and developed. One common method of melon cultivation is hydroponics. Melons cultivated hydroponically have a higher selling price than melons grown conventionally on the ground. The great opportunities possessed by hydroponic melons require further development, as well as improvements in the aspects of growth and production. Increased growth and production of melons can be done by giving nutrient formulations and choosing the right varieties. This study aims to determine the effect of various nutrient formulations and melon varieties on the growth and production of hydroponic melon plants.

Praise to God Almighty, who has given His grace and guidance so that the author can complete the research and thesis entitled "The Effect of Various Nutrient Formulations and Varieties on the Growth and Production of Melon Plants (*Cucumis melo* L.) Hydroponically". The author realizes that the preparation of this thesis is inseparable from the help, support, and guidance of various parties. Therefore, the author would like to express his deepest gratitude to:

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The author realizes that this thesis is far from perfect, so constructive criticism and suggestions are highly expected by the author in order to improve quality in the future. Finally, the author hopes that this thesis can provide benefits for anyone who reads it.

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Author

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CHAPTER I

INTRODUCTION

1.1. Background.

Melon (*Cucumis melo* L.) is one of the horticultural crops that has high economic value and increasing demand in both local and international markets. Melon has the potential to increase social, economic, and health development for the community, especially in increasing farmers' income, sources of community nutrition, and expanding employment opportunities (Daryono and Maryanto, 2018). Melon fruit has great potential to become a superior fruit product. Melon fruit is much favored by the public and has nutritional content that is good for health. Melon fruit contains about 94% water, which provides a cool and soothing taste, as well as a high content of fiber and vitamin C, which is good for health, such as digestion and increasing the body's resistance to infection (Sinaga, 2023).

Hydroponic melon cultivation has been widely practiced to improve the quality and production of melon plants. The hydroponic method has advantages in optimizing water use and better environmental control for plants (Tangkesalu *et al.*, 2023). Hydroponic cultivation of melons allows for better control of nutrients, water, and environmental conditions needed by plants. Hydroponic cultivation enables faster growth and higher yields due to direct root interaction with oxygen, optimal acidity and increased nutrient uptake, and balanced nutrient levels (Purbesalu et al., 2023).

and balanced nutrient levels (Purbajanti *et al.*, 2017). The effectiveness of hydroponic melon cultivation is influenced by several factors, such as the nutrient formulation and the variety used. Until now, there is no specific and uniform recommendation for the concentration of nutrient formulations for each variety of melon in the hydroponic system (Furoidah, 2018).

The treatment of various nutrient formulations and melon varieties is an effort to increase the growth and production of melon plants. The right nutrient formulation can affect plant growth and development, because nutrients act as a source of essential nutrients in hydroponic plant cultivation (Nugraha and Anas, 2015). Superior melon varieties are one way to increase plant growth and production. Superior varieties of melon plants have high production capabilities, short harvest age, and a high level of sweetness (Amzeri *et al.*, 2021).

Research by Li and Cheng (2015) showed that the treatment of various *Hoagland* nutrient formulations gave the highest results on the parameters of plant height, stem diameter, and number of leaves of cucumber plants, namely 13.8 cm, 5.39 mm, and 7.4 leaves. Research by Shah *et al.* (2009) showed that the *Cooper* nutrient formulation treatment gave the highest results on the parameters of stem length and weight per fruit of cucumber plants, namely 195.70 cm and 265.6 grams per fruit. Research by Santiago-López *et al.* (2016) showed that the *Steiner* nutrient formulation treatment gave the highest results on the parameters of weight per fruit and fruit diameter of cucumber plants, namely 359.3 grams and 5.2 cm. Research by Chairudin *et al.* (2024) showed that the treatment of

Goodplant nutritional formulation on melon plants yielded the lowest results in plant height, number of leaves, stem diameter, fruit weight, and fruit diameter, namely 132.67 cm, 16.56 leaves per plant, 5.19 mm, 0.73 kg, and 37.56 mm.

Research by Sumartono *et al*. (2017) showed that the Golden Aroma variety compared to the Action 434 and Jade Dew varieties had a significant effect with the highest results found in plant height, fruit weight, and fruit diameter, namely 227.8 cm, 1.49 kg, and 13.89 cm. Research by Hardanto *et al.* (2023) showed that the Golden Aroma variety compared to the Jumbo F1 variety gave the highest yield of 8.87(^{o})brix. The New Century variety is included in the hami or hamigua type melon which has an oval shape and orange flesh. Research by Ngo-Hoang (2024) showed that hami melon varieties have the largest weight compared to Taki and Inthanon RZ varieties, which is 2.8 kg.

This research is important because there is no specific nutritional formulation recommendation to increase growth and production in each melon variety. Therefore, research on various nutrient formulations and melon varieties was conducted to determine the best nutrient formulations that can support the growth and production of various melon varieties optimally.

1.2. Objectives

The objectives of this research are:

1. To examine the effect of different nutrient formulations on the growth and production of hydroponic melon plants.

2. To examine the effect of different melon varieties on the growth and production of hydroponic melon plants.
3. To examine the interaction effect of various nutrient formulations and melon varieties on the growth and production of hydroponic melon plants.

1.3. Benefits

The benefits of this research are:

1. Obtain information on the effect of different nutrient formulations on the growth and production of hydroponic melon plants.
2. Obtain information on the effect of various melon varieties on the growth and production of hydroponic melon plants.
3. Obtain information on the effect of interaction factors of various nutrient formulations and melon varieties on the growth and production of hydroponic melon plants.

1.4. Hypothesis

The hypothesis of this research is:

1. Formulation Nutrition *Cooper* provides influence best on the growth and production of melon plants in hydroponics
2. The New Century variety has the best effect on the growth and production of hydroponic melon plants.
3. There is an interaction effect of various nutrient formulations and melon varieties on the growth and production of hydroponic melon plants.

CHAPTER II

LITERATURE REVIEW

2.1. Melon Plant (*Cucumis melo* L.)

Melon (*Cucumis melo* L.) is a horticultural plant that is much favored by the people of Indonesia, because it has a good taste and contains good nutrition. Melon fruit has a content of about 94% water which gives a cool and soothing feeling, as well as high fiber content and vitamin C which is good for health such as digestion and increases the body's resistance to infection (Sinaga, 2023). Melon plants, along with watermelon (*Citrullus lanatus)*, cucumber (*Cucumis sativus)*, and pumpkin (*Cucurbita* spp.), are included in one family, Cucurbitaceae, which consists of 15 tribes, 97 genera, and 940-980 species (Khalaf and Raizada, 2016). Classification of melon plants according to Linné (1753) is as follows:

Kingdom : Plantae

Division : Tracheophyta

Class : Magnoliopsida

Order : Cucurbitales

Family : Cucurbitaceae

Genus : Cucumis

Species : *Cucumis melo* L.

Melon plants have different morphologies in each variety. Melon plants are annual herbaceous plants that have tendrils, fibrous roots, bright yellow flowers that can self-pollinate or be pollinated naturally, and fruit that is round to oval or narrow cylindrical in shape (Shahwar *et al*., 2023). Melons have a sweet taste, crunchy pulp texture, diverse pulp color, and a distinctive aroma. Melons are a type of pumpkin plant that belongs to the same family as watermelons and cantaloupes, but the fruit size is smaller and perfectly round compared to cantaloupes (Setyowibowo 2023).

Melon plants are annuals that thrive in tropical and subtropical climates. Melons can grow at altitudes ranging from 0 to
2,000 meters above sea level (Pardosi *et al*., 2022). Melon is a plant that is easily affected by climate change. Melon growing conditions are at a temperature of 26 - 30 $^{\circ C}$,the highest temperature is 41 $^{\circ C}$and the lowest temperature is 10 - 15 $^{\circ C}$and air humidity ranges from 60 - 80% (Paryadi and Hadiatna, 2021).

2.2. Hydroponic Melon Plant Cultivation

Hydroponic melon cultivation uses a *greenhouse* as an effort to cultivate with a controlled climate. Hydroponics is the cultivation of plants without using soil, but using nutritious mineral solutions or other materials that contain nutrients such as *cocopeat*, coconut fiber, mineral fiber, sand, broken bricks, and so on (Siregar and Novita, 2021). Hydroponic cultivation of melon plants is more efficient than using other growing media. Hydroponic cultivation of plants does not require a large area of land, because what must be considered is the provision of nutrients, water circulation, and water circulation.

Another advantage is that controlling plants for health and development is easier, free from pests and diseases, and allows for off-season breeding (Purbajanti *et al*., 2017).

Melon cultivation using a hydroponic system can be done using the substrate hydroponic method. Using substrate media such as *cocopeat* as a substitute for soil can support plants and bind nutrient solutions in hydroponic systems. *Cocopeat* media has the advantage of high water storage capacity which contains essential nutrients that are good for plants (Ariessandy *et al*., 2022). *Cocopeat* media in melon cultivation can be used for several growing season periods. The use of *cocopeat* or coconut fiber media as a melon substrate has higher fruit fresh weight per plant and total fruit soluble solids compared to husk charcoal media (Indrawan *et al.*, 2021).

The hydroponic system with *drip* irrigation is carried out by providing water for watering by *dripping* directly into the planting medium with the help of *drip* drips so that it is more efficient. The drip irrigation system can provide optimal production and the use of irrigation water becomes more efficient and effective in melon cultivation (Nora *et al*., 2020). Hydroponic cultivation of melon plants is strongly influenced by nutrition and environmental conditions. The hydroponic cultivation system depends on the source of nutrients from chemicals or dissolved organics.

It is also influenced by the environment that supports root development, such as water pH and dissolved oxygen (Putra *et al.*, 2018).

2.3. Nutrient Formulation

Hydroponic nutrients are generally formulated from macro and micro nutrients. Hydroponic nutrients are divided into two types, namely nutrients containing macro elements such as N, P, K, S, Ca, and Mg, and those containing micro elements such as Zn, Cl, Cu, Na, Fe, B, and Mo. The hydroponic nutrient solution comes from AB mix fertilizer, which consists of concentrates A and B. Concentrate A contains calcium nitrate, potassium nitrate, and Fe chelators, while concentrate B contains a mixture of potassium dihydrogen phosphate, ammonium sulfate, potassium sulfate, potassium nitrate, magnesium sulfate, manganese sulfate, copper sulfate, zinc sulfate, and various other microelements (Purwanto *et al.*, 2018).

The macro and micro nutrients needed by each plant and variety are different. The nutrients provided for hydroponics must be tailored to the needs of the plants and given on an ongoing basis. The content of elements in nutrients affects the vegetative, generative, and production phases of melon plants. Nitrogen nutrients in nutrients affect the growth of stems, branches, and leaves (Rivandy *et al.*, 2024). Phosphorus and potassium nutrients can help in the process of flower formation in plants. Fruit development and ripening are supported by nutrients containing phosphorus (P), potassium (K), nitrogen (N), and calcium (Ca) (Darmawan *et al.,* 2024).

Nutrient formulations are needed to provide the macro and micro nutrients that plants need in a precise and balanced manner. Plants can grow well if all the nutrients needed are met in sufficient and balanced amounts (Sembiring and Maghfoer 2018). Appropriate nutrient formulations can increase the growth and production of melon plants. The availability of essential nutrients that are not in accordance with the needs of plants disrupts plant metabolism, causing melon growth to be suboptimal (Bazaz *et al.*, 2022). Various nutrient formulations have been developed to increase growth and production in hydroponic plant cultivation. Nutrient formulations according to *Hoagland, Cooper, Steiner,* and *Goodplant* can be seen in Table 1.

Table 1. Nutrient Formulations According to *Hoagland*, *Cooper*, *Steiner*, and *Goodplant*

Nutrient	***Hoagland***	***Cooper***	***Steiner***	***Goodplant***
	mg/L			
N	210.00	236.00	168.00	202.00
P	31.00	60.00	31.00	88.00
K	234.00	300.00	273.00	327.00
Ca	160.00	185.00	180.00	164.00
Mg	34.00	50.00	48.00	80.00
S	64.00	68.00	336.00	135.00
Fe	2.50	12.00	4.00	2.60
Cu	0.02	0.10	0.02	0.70
Zn	0.05	0.10	0.11	0.10
Mn	0.50	2.00	0.62	0.70
B	0.50	0.30	0.44	0.40
Mo	0.01	0.20	-	0.01
Total	736.58	913.7	1041.19	1000.51

The main principle in preparing nutrient solutions is the composition of nutrients designed based on the rules of fertilizer absorption by plants. The various formulations of nutrients given to plants are based on various considerations.

about the development and behavior of these plants (Li and Cheng, 2015). Nutrition in hydroponic melon cultivation requires macro and micro nutrients that can meet the needs of melon plant growth and production. According to Thakur *et al.* (2023), the macro-element requirements for melon plants in general are nitrogen at 200 mg/L, phosphorus at 45 mg/L, potassium at 285 mg/L, calcium at 115 mg/L, and magnesium at 30 mg/L. Hydroponic melon cultivation still faces challenges related to the accuracy of nutrient formulations. Until now, there are no recommendations for specific and uniform concentrations of nutrient formulations for each variety of melon in hydroponic systems (Furoidah, 2018). The *Hoagland* nutrient formulation yielded the highest results in the parameters of plant height, stem diameter, and number of leaves of cucumber plants, namely 13.8 cm, 5.39 mm, and 7.4 leaves (Li and Cheng, 2015). The *Cooper* nutrient formulation yielded the highest results in the parameters of stem length and weight per fruit of cucumber plants, namely 195.70 cm and 265.6 grams per fruit (Shah *et al.*, 2009). The *Steiner* nutrient formulation treatment yielded the highest results in the parameters of weight per fruit and fruit diameter of cucumber plants, namely 359.3 grams and 5.2 cm (Santiago-López *et al.*, 2016). *The Goodplant* nutrient formulation treatment on melon plants yielded the lowest results in plant height, number of leaves, stem diameter, fruit weight, and fruit diameter, namely 132.67 cm, 16.56 leaves per melon plant, plants, 5.19 mm, 0.73 kg, and 37.56 mm (Chairudin *et al.*, 2024).

2.4. Melon Variety

Plant varieties are a group of plants of a type whose characteristics are similar in terms of genetic, morphological, and physiological traits. Plant varieties are obtained from the plant breeding process carried out by crossing and selection, which aims to obtain a combination of characteristics of the desired plant traits (Zulfikri *et al*., 2015). Differences in morphological characters such as skin color, fruit pulp color, fruit texture, fruit shape, and *net-like* images on the fruit are differences in characters that can be found in melon plants. Factors that can affect differences in morphological characters in melon plants include genetic varieties and the environment where plants are cultivated (Huda *et al.*, 2019).

Melon variety assembly by hybridization is a technique to obtain plants with desired characters. The assembly of superior melon varieties is carried out by hybridization techniques followed by plant selection (Amzeri *et al*., 2020). The assembly of hybrid melon varieties is an effort to produce superior melon seeds. The assembly of hybrid melon plant varieties is directed to have high production capacity, short harvest age, and a high level of sweetness (Amzeri *et al.*, 2021).

Superior melon varieties that are not yet widely marketed, such as Golden Aroma and New Century, are varieties that have the potential to be developed. The melon varieties Golden Aroma and New Century are seeds from Known You Seed, Taiwan (Iqbal *et al*., 2018). Golden Aroma has an oval round fruit shape, green skin, tight mesh, and orange flesh.

Golden Aroma compared to two other varieties tested has a fruit weight of 1.49 kg, fruit diameter of 13.89 cm, and plant height of 227.8 cm (Sumartono *et al*., 2017). The fruit sweetness level of the Golden Aroma variety is 8.87^{o}Brix (Hardanto *et al*., 2023).

The New Century variety, based on the variety description, has an oval-round fruit shape, light yellow skin with a slight mesh, orange flesh color, and a weight per fruit of 1.8 to 2.7 kg. The New Century variety is included in the hami or hamigua type melon, which has an oval-shaped fruit and orange flesh. Based on Ngo-Hoang's research (2024), the hami melon has the highest weight among the other three varieties, which is 2.8 kg.

CHAPTER III

MATERIALS AND METHODS

The research was conducted from April to July 2024 at the *Greenhouse* and Laboratory of Plant Physiology and Breeding, Department of Agriculture, Faculty of Animal and Agricultural Sciences, Diponegoro University, Semarang.

3.1. Research Materials

The materials used in this study consisted of tools and materials. The materials used included melon seeds of Golden Aroma and New Century varieties, water, coarse and fine *cocopeat*, AB mix solution materials (Calnit, Kalinitra, MKP, MAP, FE EDTA, $CaCl_2$, MAG-S, Micro Zn, Micro Mn, Micro Cu, ZA, Urea, Inabor, Sodium Molybdate, and SOP), fungicides with active ingredients propined 70% and mankozeb 80%, bactericides with active ingredient streptomycin sulfate 20%, and insecticides with active ingredients abamectin 2% + Nitenpiram 30%, and HCl. Tools used included *polybags (*35 x 35 cm), TDS (*Total Dissolved Solid)* meter, pH meter, mortar and pestle, *hand refractometer,* vernier caliper, SPAD, digital scale, *thermohygrometer,* lux meter, scissors, rope, water pump, PE hose, *drip emitter* and *drip stick,* seedling *tray,* 10L and 50L buckets, 5L jerry cans, labels, raffia rope, knife, ruler, *sprayer,* filter paper, spectrophotometer, stationery, and documentation tools.

3.2. Research Methods

3.2.1. Experiment Design

This research was conducted using a *Split Plot Design* based on a 2 x 4 factorial completely randomized design (CRD), so there were 8 treatment combinations. The main plot was melon varieties with 2 varieties, namely:

V1 = Golden Aroma

V2 = New Century

The subplots were nutrient formulations with 4 nutrient formulations,

namely: N1 = *Hoagland*

N2 = *Cooper* N3

= *Steiner* N4

= *Goodplant*

Treatments with 3 replications, resulting in 8 × 3 = 24 experimental units. Each experimental unit planted 4 plants, so the total plants in this study were 96 plants.

3.2.2. Research Procedure

This research was conducted in several stages, namely research preparation, transplanting, maintenance, harvesting, data collection, and data analysis.

Research preparation included cleaning and sterilizing the *greenhouse*, preparing planting materials, preparing planting media, and preparing stock solutions A and B according to the nutritional formulation.

Cleaning and sterilization of the *greenhouse* was done one month before transplanting. *Greenhouse* sterilization is done by spraying fungicides (active ingredient: propineb 70%) and insecticides (active ingredient: profenofos 50%) to all parts of the *greenhouse* as shown in illustration 1.

Greenhouse Sterilization with Fungicides and Insecticides Preparation of planting materials using melon seeds of Golden Aroma and New Century varieties.

and New Century varieties that were sown in seedling *trays*. Melon seeds were soaked in water for 12 hours. Seeds that drowned in water were selected for soaking using paper towels for 1-2 days. Seed moisture was maintained by spraying water once a day. In the next stage, seeds that already had radicles were planted into *cocopeat* seedling media with the radicle position at the bottom. Seeds that have been sown are placed in a *greenhouse* and watered regularly in the morning and evening.

±Preparation of planting media is done by putting *cocopeat* planting media into *polybags* (35 cm x 35 cm) with a weight of 2.5 *kg/polybag*. The next stage *polybags* that have been filled with planting media are placed into the *greenhouse* and leached using raw water until the water overflows out of the *polybag*. The overflow of water is then collected and measured for solute levels using a TDS meter, reaching 200-300 ppm. Planting media preparation activities can be seen in illustration 2.

(a) (b)

Planting Media Preparation (a) Filling the *Cocopeat* Media into the Polybags *Polybag* (b) Checking the Dissolved Substance Content of *Cocopeat*

Preparation of stock solutions is done by calculating the fertilizer requirement of each nutrient formulation (*Hoagland*, *Cooper*, *Steiner*, and *Goodplant*) (Appendix 3). The next step is to weigh the weight of fertilizer used for one planting period according to the calculated nutrient formulation. The preparation of stock solutions A and B is done separately. The ingredients that have been weighed are then put into a bucket to be dissolved with water and stored using a closed jerry can. Nutrient preparation activities can be seen in illustration 3.

(a) (b)

Illustration 3. Making Stock Solution (a) Weighing Stock Solution Materials A and B (b) Process of Making Stock Solution

Transplanting melon seeds that have been sown for 14 DAS (Days After Sowing) and have 2 true leaves. Planting is done by making a planting hole in the center of the *polybag*, then the seedlings are planted in an upright position. The transplanting activity can be seen in illustration 4.

(a) (b)

Illustration 4. Transplanting (a) Melon seedlings aged 14 DAS ready to be transplanted (b) Transplanting Process

Maintenance, including watering with raw water and nutrients, propagation, pruning (lateral buds, leaves, and shoots), pest control, pollination, fruit selection, and harvesting.

Raw water watering is done with drip irrigation. Nutrient watering or fertigation is done by dripping, stock solutions A and B are diluted with water until a concentration is obtained that matches the nutritional needs of melon plants in each phase (Appendix 3). Irrigation and fertigation are carried out in the morning and evening (Appendix 4). Watering activities can be seen in illustration 5.

(a) (b)

Watering (a) Dilution of nutrient solution (b) Fertigation

Propagation is carried out on melon plants when the plants are 7 DAP (Days After Planting) or on stems that are tall enough. This propagation process is carried out during the growth of the main stem by wrapping the plant stem around the rope.

Pruning is done on lateral shoots, leaves, and *tops*. Pruning of lateral shoots was carried out starting at the age of 7 DAP on lateral branches that grew other than on the 8th to 13th branches, as well as on all lateral branches that grew after fruit selection. Leaf pruning is done by cutting the leaves located below the 7th branch at 28 days after planting. Shoot pruning is done by cutting the shoots of plants that grow above the 30th branch after the plants are more than 28 days old.

Pest control is carried out by spraying pesticides. Control of fungal diseases is carried out as a preventive measure by spraying fungicides with the active ingredient Propineb 70% at a dose of 0.5 g/liter of water while for control using a dose of 3.0 g/liter of water. Bacterial control as a preventive measure is carried out with bactericides with the active ingredient streptomycin sulfate 20% at a dose of 1.5 g/liter of water, and control of whitefly attacks is carried out by spraying insecticides with the active ingredients Abamectin 2% and Nitenpiram 30% at a dose of 1.5 g/liter of water.

Pollination was carried out in the morning by applying pollen from 2 male flowers to 1 female flower located on the 8th to 13th branches evenly, then the top leaves on the female flower branches were trimmed and only left 1 leaf in front of the pollinated female flower. Female flower

Female flowers that have been successfully pollinated show an enlargement of the fruit ovules. Melon plant pollination activities can be seen in illustration 6.

(a) (b)

Pollination on Melon Plants (a) Pollination Process (b) Results of Pollination Fruit selection is carried out by leaving 1 fruit per plant or 1 fruit per plant.

When the plants are 30 HST old, the criteria for fruit color, shape, and size are considered. Melon fruits are selected when they are 5-10 cm in diameter, and the selected fruits are those that are not affected by pests, are not deformed, and are uniform in size (Darwiyah *et al*., 2021). Fruit selection activities can be seen in illustration 7.

(a) (b)

Melon Fruit Selection (a) Retained fruit (b) Pruned fruit

Harvesting is done after the Golden Aroma and New Century melon varieties are 45 days after pollination or when the plants are 70 - 80 HST. Harvesting characteristics of *netted* melons include fully formed *nets*, cracks around the fruit stalks, surface changes between the nets, and leaves near the fruit stalks.

color, and the leaves near the fruit stalk are dry (Huda *et al*., 2019). Harvesting is done in the morning by cutting the fruit stalk with a T shape using scissors. The criteria for ready-to-harvest fruits can be seen in illustration 8.

(a) (b)

Illustration 8. Characteristics of Melon Fruit Ready for Harvest (a) Flag Leaves and Tendrils Drying (b) Abscesses on the Fruit Stalk Appearing

3.2.3. Research Parameters

The observed parameters include environmental parameters, growth, and production of melon plants. Environmental parameters: temperature (°C) and air humidity (%). Observations were made by measuring the temperature and humidity of the air in the *greenhouse* every day using a *thermohygrometer*. Measurements were taken in the morning (07.00 - 08.00), afternoon (12.00 - 13.00), and evening (16.00 - 17.00).

Plant growth and production parameters:

1. Plant height (cm)

   Measurement of plant height was carried out at intervals of 7 days starting from the age of 7 - 28 HST using a meter with units of cm. Height

Plant height was measured from the stem of the plant visible at ground level to the tip of the plant's growing point.

2. Number of leaves (strands)

   Observations were made by recording the number of leaves starting from the age of 7-28 HST. Observations were made on leaves that had fully bloomed.

3. Stem diameter (mm)

   Measurement of stem diameter was carried out at intervals of 14 days starting from the age of 14 - 70 HST on the main stem of the plant using a caliper with units of mm.

4. Leaf greenness (SPAD)

   Measurement of leaf greenness was carried out at 14-day intervals starting from 14 HST until 70 HST. Data collection was carried out on branches 9, 10, 11, and 12, then averaged using the SPAD tool and the number that appeared on the tool was recorded.

5. Total chlorophyll content of leaves (mg/g)

   Observation of chlorophyll content parameters using leaves on the 8th branch with a spectrophotometer. Measurement of leaf chlorophyll content was carried out using a spectrophotometer (Sari, 2020). The spectrophotometric method involves the preparation of tools and materials, as well as sample preparation. Leaf samples were weighed at 0.25 g, then ground with a mortar and extracted with 25 ml of 80% *acetone* solution, then homogenized. The leaf extract was filtered using Whatman paper/filter paper into a *beaker glass.* Next, the chlorophyll and carotenoid content of the wet samples were measured by

UV-Vis Spectrophotometric method at λ 6 6 3 , λ 6 4 6 , λ470 nm. The absorbance results were entered into the formula:

Chlorophyll content = (22.7 × λ663 + 2.69 × λ646) + (1.29 × λ646 - 4.68 × λ663)

Description:

λ646= absorbance at wavelength 646 nm λ663=

absorbance at wavelength 663 nm

6. Leaf carotenoid content (mg/g)

Observation of leaf carotenoid content using leaves on the 8th branch with a spectrophotometer. Leaf carotenoid content was obtained using a spectrophotometer (Sari, 2020). The spectrophotometric method involves the preparation of tools and materials, followed by sample preparation. Leaf samples were weighed at 0.25 g, then ground with a mortar and extracted with 25 ml of 80% *acetone* solution, then homogenized. The leaf extract was filtered using Whatman paper/filter paper into a *beaker glass*. After that, the wet samples were measured for chlorophyll and carotenoid content using the UV-Vis Spectrophotometric Method at λ663, 646, 470 nm. Carotenoid content was calculated using the following formula:

$$\text{LevelCarotenoids} = \frac{(\lambda 470 + 0.114 \times \lambda 663 - 0.630 \times \lambda 646) \times V \times 1000}{112.5 \times W}$$

Description:

λ470 = absorbance at wavelength 470 nm λ646 =

absorbance at wavelength 646 nm λ663 = absorbance at

wavelength 663 nm

V = volume of extract (ml)

W = sample weight (g)

7. Nitrate reductase activity (µmol NO_2^-/g/h)

Observation of nitrate reductase activity using leaves on the 8th branch with a spectrophotometer. Observations of Nitrate Reductase Activity (ANR) were carried out by spectrophotometric method (Pagalla and Jannah 2023). The spectrophotometric method involves the preparation of tools and materials, followed by sample preparation. Leaf samples were weighed at 0.2 g and placed into a black plastic tube containing 5 ml of 0.1 M phosphate buffer solution with pH 7.5, then incubated at room temperature for 24 hours. After the first incubation, the solution was replaced with 0.1 M phosphate buffer pH 7.5 to which 0.1 ml of 0.05 M $NaNO_3$ solution had been added, and then incubated again for 2 hours at room temperature. During the second incubation, test tubes were prepared by adding 0.2 ml of 1% sulfanilamide solution and 0.2 ml of 0.02% N-naphthyl ethylene diamide solution. After the second incubation was complete, 0.1 ml of the incubated solution was added to the test tube. When the solution turned pink, 2.5 ml of distilled water was added until the volume of the solution reached 3 ml, then shaken. Observations were made with a spectrophotometer at a wavelength of 540 nm. ANR levels were calculated by the formula:

$$ANR = \frac{AS}{A0} (x) \frac{1000}{B} (x) \frac{1}{T} x \frac{500}{1000} \text{ .... } (\mu mol\ NO_2^-/g/h)$$

Notes:

AS = absorbance value of sample

solution A0 = absorbance value of

standard (0.0142)

B = fresh weight of leaf sample

(g) T = incubation time (hours)

8. Number of stomata ($^{Stomata/mm^2}$)

The number of stomata is determined by preparing leaf slides using nail polish and observing the number of stomata per field of view in ^{mm2}.

9. Time of male flower emergence (HST)

Observations were made by recording the age of the plant when the male flowers bloomed for the first time.

10. Time of female flower appearance (HST)

Observations were made by recording the age of the plant when the female flowers bloomed for the first time.

11. Number of male flowers (flower/plant)

Observations were made by counting all male flowers that successfully bloomed on each plant. Calculation of the number of male flowers is only done on male flowers that appear on the main branches of the plant.

12. Number of female flowers (flowers/plant)

Observations were made by counting all flowers that successfully bloomed from the 8th to 13th lateral buds.

13. Fruit diameter (cm)

Measurement of fruit diameter was carried out using a caliper. The center of the melon fruit was cut horizontally, then the widest part was measured.

14. Fruit length (cm)

Fruit length was measured by vertically measuring the base to the other end, using a centimeter (cm) ruler.

15. Fruit weight (kg)

Fruit weight was measured by weighing each plant's fruit with a digital scale calibrated in grams at harvest time.

16. Fruit flesh thickness (cm)

Measurement of fruit flesh thickness is done on melon fruit that is split, then measured in the middle near the seeds to the edge near the skin of the fruit using a ruler with units of centimeters (cm).

17. Fruit sweetness level (°Brix)

Fruit sweetness was measured by taking a small amount of fruit flesh from 3 different parts (near the skin, center, and near the seeds) as samples. The pulp was crushed until the juice came out, then piped into a *hand refractometer* to read the level of sweetness of the fruit that appeared.

18. Vitamin C (mg/g)

Vitamin C content in melon fruit was measured by iodimetry or iodine titration method. Melon fruit flesh was weighed 5 grams, then crushed until smooth. The smooth pulp was dissolved with 100 ml distilled water and filtered. A total of 10 ml of test solution (sample extract) was placed in a glass beaker. Add 2 mL of 1% amylum solution, 2 drops of H_2SO_4, and 20 mL of distilled water to the sample extract, then titrate with 0.1 N iodine solution until the color turns dark blue (J.S.()).

until the color changes to dark blue (Jumi *et al*., 2023). Vitamin C content can be calculated with the following formula (Nisa *et al*., 2020):

$$\text{Vitamin C content mg/gram} = \frac{(VI)_2 \times (NI)_{(2)} \times Mr(C)_{(2)}(H)_{(8)}(O)_{(6)}}{\text{Sample Weight (g)}}$$

Description:

$V\ I_2$ = Titration volume (mL)

NI_2 = Iodine normality (N)

Mr. Vitamin C = Ascorbate molar mass 176 grams/mol

3.2.4. Data Analysis

The mathematical model used in the Split Plot Design based on a completely randomized design is as follows:

$$Yijk = \mu + Vi + \delta ik + Nj + (VN)ij + \varepsilon ijk$$

Description:

Yijk = Observation of variety factor at the i-th level, nutrient formulation factor at the j-th level and k-th replication

μ = General average

Vi = Effect of the i-th treatment of the variety factor

δik = Random effect for the main plot

Nj = Effect of the jth treatment of the nutrient formulation factor

(VN)ij = The interaction effect of the i-th level of factor V and the j-th level of factor N εijk = Random effect for plot children

The statistical hypotheses tested in the study were:

Effect of Main Plots

$H0$: $V1 = V2 = 0$; There is no significant effect of varietal factors on melon production and growth.

$H1$: There is at least one i where $Vi \neq 0$; There is an effect of varietal influence on melon production and growth.

Influence of Plots

$H0$: $N1 = N2 = N3 = N4 = 0$; There is no significant effect of nutrient formulation factor on the production and growth of melons.

$H1$: There is at least one j where $Nj \neq 0$; There is a significant effect of nutrient formulation factors on melon production and growth.

Effect of Interaction of Main Plots and Subsidiary Plots

$H0$: $V1N1 = V2N1 = \dots\dots\dots\dots = 0$; There is no interaction effect of nutritional formulation factors and varieties on the production and growth of melons.

$H1$: There is at least one pair *i,j* with $\delta ik\ Nj \neq 0$; There is an interaction effect of nutrient formulation factors and varieties on melon production and growth. **Statistical Analysis**

The data obtained is analyzed using *Analysis of Variance* (ANOVA) with a real level of 5% to determine the effect of treatment on the parameters observed. If the results allow it to be continued, it will be continued with the *Honest Significant Difference Test* (BNJ) or commonly referred to as Tukey's *Honest Significant Difference Test* (HSD) at the 5% level.

CHAPTER IV

RESULTS AND DISCUSSION

4.1. Environmental Conditions

Based on observations of environmental conditions in the *greenhouse* during the study (Appendix 5), it was found that the average daily temperature in the morning was 28.$^{8°C}$, in the afternoon was 36.$^{4°C}$, and in the evening was 32.$^{8°C}$. The maximum temperature recorded was 42.$^{5°C,}$while the minimum temperature recorded was 25.$^{0°C.}$According to Sugiarto *et al.* (2022), the optimal temperature for vegetative growth in melon plants is$^{25°C}$-$^{30°C}$and for the flowering period is$^{30°C.}$Temperatures that are too high can affect the growth and production of melons. An ambient temperature of$^{37°C}$is too high for melon plant growth, thus reducing its production (Christy, 2020).

Relative humidity (RH) in the *greenhouse* during the study showed a daily average of 68.9% in the morning, 37.3% in the afternoon, and 44.8% in the evening. The maximum humidity recorded was 89%, while the minimum humidity recorded was 29%. According to Pertami *et al.* (2024), the ideal humidity for melon cultivation is between 70–80%. Temperature and humidity data during the study showed high temperatures and low relative humidity. According to Paryadi and Hadiatna (2021), melon growing conditions are at a temperature of 26–30 $^{°C,}$the highest temperature is 41 $^{°C}$, and the lowest temperature is 10–15 $^{°C}$, with air humidity ranging from 60–80%.

4.2. Compilation of Results of Analysis of Variance and Further Test of Honest Real Differences

The compilation of the results of all parameters based on the analysis of variance and the Honest Real Difference further test aims to determine the effect of the treatment of various nutrient formulations and melon varieties on the growth and production of melon plants. The compilation of all parameters can be seen in Table 2.

Compilation of All Parameters of Growth and Production of Melon Plants (*Cucumis melo* L.) Hydroponically on Various Nutrient Formulations and Melon Varieties

Parameter	Variety (V)	Nutrition (N)	Interaction (V x N)
Plant Height	tn	tn	tn
Number of Leaves	tn	tn	tn
Stem Diameter	*(a/b)	tn	tn
Leaf Greenness	*(a/b)	*(a/a/b/a)	tn
Total Chlorophyll Content Leaf	*(a/b)	*(ab/a/ab/b)	tn
Leaf Carotenoid Content	*(a/b)	tn	tn
Nitrate Activity Reductase	tn	tn	tn
Number of Stomata	*(a/b)	tn	tn
Flower Emergence Time Male	*(b/a)	*(ab/a/b/ab)	tn
Flower Emergence Time Female	*(b/a)	tn	tn
Number of Male Flowers	*(b/a)	tn	tn
Number of Female Flowers	*(b/a)	tn	tn
Fruit Diameter	*(a/b)	tn	*(N1 : a/b) (N2: a/b) (N3: ab/b) (N4: ab/ab)
Fruit Length	*(b/a)	*(a/a/ab/b)	*(V1: b/b/bc/c) (V2: a/a/a/a/a)
Thickness of Fruit Flesh	*(a/b)	tn	tn
Fruit Weight	*(b/a)	*(a/ab/bc/c)	*(V1: ab/bc/cd/d) (V2: a/a/ab/a)
Fruit Sweetness Level	*(a/b)	tn	tn
Vitamin C Content	tn	tn	tn

Notes: (*) significant effect at the 5% level; (tn) no significant effect; (a, b, c, d) superscript.

The main plot treatment, namely varieties, had a significant effect on stem diameter, leaf greenness, total leaf chlorophyll content, leaf carotenoid content, number of stomata, time to appear male flowers, time to appear female flowers, number of male flowers, number of female flowers, fruit diameter, fruit length, fruit weight, fruit flesh thickness, and fruit sweetness level (Table 2). Subsidiary treatments, namely nutrition, had a significant effect on the parameters of leaf greenness, total leaf chlorophyll content, time to male flower emergence, fruit length, and fruit weight. There was an interaction effect on the parameters of leaf greenness, fruit diameter, fruit length, and fruit weight (Table 2).

4.3. Plant Height

The treatment of various nutrient formulations, varieties, and the interaction between the two based on the analysis of variance did not give a significant effect on the height parameter of 28 HST melon plants (Appendix 6). The height of 28 HST melon plants at various nutrient formulations and melon varieties can be seen in Table 3.

Table 3. Plant Height of Melon at 28 HST on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	-------------cm-------------		
Hoagland	219.42	205.75	212.58
Cooper	213.17	214.42	213.79
Steiner	213.75	214.92	214.33
Goodplant	207.83	205.67	206.75
Average	213.54	210.73	

The treatment of various nutrient formulations, varieties, and the interaction between the two did not significantly affect the height of 28 HST melon plants (Table 3). This is presumably because the nutrient content in the *Hoagland*, *Cooper*, *Steiner*, and *Goodplant* nutrient formulations (Appendix 3) can meet the basic nutritional needs for melon plant growth. According to Bazaz *et al.* (2022), if the availability of essential nutrients is less than the amount needed by plants, the growth of melon plants is not optimal because plant metabolism is disrupted. Melon plant height at 28 HST was not affected by the nutritional formulation, presumably because it was in the generative phase. According to Asri *et al.* (2021), nutrients absorbed by plants in the generative phase can be utilized by plants to increase the photosynthesis process, then the photosynthate produced will be allocated for the formation and development of *sinks (*flowers, seeds, or fruit) in plants.

The parameter of melon plant height shows that the Golden Aroma variety is 213.54 cm, not significantly different from the height of melon plants of the New Century variety, which is 210.73 cm (Table 3). This is thought to occur because the height of melon plants at 28 HST is more influenced by environmental factors. According to Maulani (2019), environmental factors can influence the growth and development of melon plants, such as water, temperature, and humidity. Melon plants grown in *greenhouses* have the same environmental conditions, resulting in relatively uniform plant height. Environmental factors in melon plants cultivated in *greenhouses* have controlled environmental conditions, so that plants can grow stable and uniform compared to outside the *greenhouse (*Ramdhan, 2023).

4.4. Number of Leaves

The treatment of various nutrient formulations, varieties, and the interaction between the two based on the analysis of variance had no significant effect on the parameter of the number of leaves of 28 HST melon plants (Appendix 7). The number of leaves of 28 HST melon plants at various nutrient formulations and melon varieties can be seen in Table 4.

Table 4. Number of Leaves of Melon Plants at 28 HST on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	------------- strands -----------		
Hoagland	27.08	27.00	27.04
Cooper	26.75	27.67	27.21
Steiner	26.83	27.83	27.33
Goodplant	26.50	27.42	26.96
Average	26.79	27.48	

The treatment of various nutrient formulations and melon varieties, as well as the interaction between the two, did not have a significant effect on the number of leaves of melon plants at 28 days after sowing (Table 4). Various nutrient formulations given to melon plants can fulfill the basic needs of melon plants, especially the element nitrogen. According to Ariessandy *et al.* (2022), if the essential nutrients needed by plants are not fulfilled, plant growth will be less than optimal, one of which is the nitrogen element which has an important role in the formation of cells, tissues and plant organs. Nitrogen influences the number of leaves because it plays a role in the process of leaf formation (Fitri *et al.*, 2021). Melon plants at 28 days after sowing (DAS) have entered the generative phase and fruit formation, so the parameter of the number of leaves of melon plants is not influenced by various formulations.

According to Nursyamsi *et al*. (2023), melon plants that enter the generative or flowering phase will divert the results of photosynthesis (photosynthate) to the *sink* (flowers, fruits, and seeds) to support development and improve the quality of the yield.

The parameter of the number of leaves on melon plants shows that the Golden Aroma variety, which has 26.79 strands, is not significantly different from the number of leaves on melon plants of the New Century variety, which has 27.48 strands (Table 4). The parameter of the number of leaves on 28 HST melon plants is thought to be more influenced by environmental factors. According to Ramdhan (2023), plants cultivated in *greenhouses* have controlled environmental conditions, allowing them to grow more uniformly than plants outside *greenhouses.* The number of leaves on melon plants is positively correlated with plant height. Leaves grow on each segment of the plant stem, where the growth of plant height is in line with the growth of the number of leaves on melon plants (Rudiyanto *et al.*, 2023).

4.5. Stem Diameter

The treatment of varieties has a significant effect, while the treatment of nutrient formulations and the interaction between the two do not significantly affect the parameters of stem diameter of melon plants measuring 70 HST based on analysis of variance (Appendix 8). The stem diameter of 70 HST melon plants at various nutrient formulations and melon varieties can be seen in Table 5.

Table 5. Stem Diameter of Melon Plants at 70 HST on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	-------------mm-------------		
Hoagland	10.68	8.82	9.75
Cooper	11.05	9.22	10.14
Steiner	11.04	9.03	10.04
Goodplant	10.74	9.09	9.92
Average	10.88[a]	9.04[b]	

Notes: Different superscripts on the average row indicate significant differences ($P < 0.05$).

The treatment of melon varieties showed significantly different results in the parameter of stem diameter of melon plants aged 70 HST (Table 5). The parameter of stem diameter of melon plants shows that the Golden Aroma variety is 20.35% significantly larger than the New Century variety (Table 5). According to Haekal *et al.* (2024), different plant varieties have different effects on growth and yields in each variety. The stem diameter of melon plants in the Golden Aroma and New Century varieties showed significantly different results, presumably due to the influence of genetic factors in both varieties. Minarni and Ulinnuha's research (2023) showed that the diameter of the melon stem of the Golden Aroma variety ranged from 7.5 to 7.9 mm, while based on the variety description (Appendix 1), the diameter of the New Century stem ranged from 5.8 to 6.5 mm.

The stem diameter parameter is not significantly different in the treatment of various nutritional formulations, presumably because it contains nitrogen elements that are sufficient for the growth of melon plant stems. Nitrogen nutrients can influence the growth of stems, branches, and leaves on a plant (Darwiyah *et al.*, 2021). Total nitrogen element in *Hoagland* formulation

169.28 grams, *Cooper* 185.26 grams, *Steiner* 135.81 grams, and *Goodplant* 183.76 grams (Appendix 3). According to Julia *et al*. (2023), nitrogen nutrients that are fulfilled through fertilization can optimally stimulate plant growth, one of which is stem diameter.

4.6. Leaf Greenness

The treatment of various nutrient formulations and varieties had a significant effect, while the interaction between the two had no significant effect on the parameter of greenness of the leaves of 28 HST melon plants based on analysis of variance (Appendix 9). The greenness of the leaves of 28 HST melon plants at various nutrient formulations and melon varieties can be seen in Table 6.

Greenness of Melon Plant Leaves at 28 HST on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	-------------SPAD-------------		
Hoagland	38.18	36.96	37.57[a]
Cooper	38.82	37.01	37.92[a]
Steiner	36.74	34.48	35.61[b]
Goodplant	38.07	37.89	37.98[a]
Average	37.95[a]	36.58[b]	

Notes: Different superscripts in the average row and average column indicate significant differences ($P < 0.05$)

The greenness parameter of the leaves of 28 HST melon plants in *Hoagland*, *Cooper*, and *Goodplant* nutritional formulations showed an effect that was not significantly different, but significantly different from *Steiner* (Table 6). The greenness parameter of the leaves showed that the *Hoagland* nutrient formulation was 5.50%, *Cooper* was 6.45%, and *Goodplant* was 6.66% significantly higher than *Steiner*.

According to Nasution *et al*. (2019), fertile and nutrient-rich plants will have green leaves, indicating sufficient nitrogen (N) content. The total nitrogen element in the *Hoagland* nutrient formulation was 169.28 grams, *Cooper* was 185.26 grams, *Steiner* was 183.76 grams, and *Goodplant* was 11.57 grams (Appendix 3). The *Steiner* nutrient formulation was significantly lower than *Hoagland, Cooper,* and *Goodplant* nutrients, presumably due to the lowest total nitrogen element. According to Hu *et al.* (2022), there is a positive correlation between nitrogen availability and chlorophyll; nitrogen stimulates gene expression related to photosynthesis and nitrogen metabolism, which is shown in the greenness of the leaves.

The greenness of the leaves in various nutritional formulations is strongly influenced by the element nitrogen (N) because it can affect the chlorophyll content of the leaves. Providing adequate nutrients to plants causes plant growth to be more optimal, especially the elements N and Mg which play a role in chlorophyll formation (Sembiring and Maghfoer, 2018). Leaf greenness increases along with higher chlorophyll levels. Chlorophyll is a green pigment in chloroplasts that affects the level of greenness of a plant's leaves (Yama and Kartiko, 2020).

The parameter of leaf greenness in 28 HST melon plants showed that the Golden Aroma 3.75% variety was significantly higher than the New Century variety (Table 6). This is thought to be due to differences in genetic factors between varieties. According to Suliswati *et al.* (2020), genetic differences in plant varieties can affect photosynthetic ability, which contributes to differences in plant growth. Each variety has a different photosynthetic ability

. According to Taiz *et al.* (2015), genetic variations in plants can have a significant impact on photosynthetic efficiency, which affects chlorophyll content and leaf greenness.

4.7. Total Chlorophyll Content of Leaves

The treatment of various nutrient formulations and varieties had a significant effect, while the interaction between the two had no significant effect on the parameters of chlorophyll A, chlorophyll B, and total chlorophyll content of melon plant leaves based on analysis of variance (Appendix 10). The total chlorophyll content of melon plant leaves in various nutrient formulations and varieties can be seen in Table 7.

Table 7. Chlorophyll A, Chlorophyll B, and Total Chlorophyll Levels of Melon Plant Leaves on Various Nutrient Formulations and Varieties

Treatment	Chlorophyll A	Chlorophyll B	Total Chlorophyll
	-------------	mg/g	-------------
Variety			
Golden Aroma	11.06^{a}	4.32^{a}	20.18^{a}
New Century	9.07^{b}	3.70^{b}	16.57^{b}
Nutrition			
Hoagland	10.04^{ab}	4.03^{ab}	18.36^{ab}
Cooper	10.93^{a}	4.40^{a}	19.93^{a}
Steiner	9.86^{ab}	3.84^{ab}	17.98^{ab}
Goodplant	9.44^{b}	3.78^{b}	17.23^{b}
Interaction			
V1N1	11.10	4.39	20.27
V1N2	11.83	4.66	21.54
V1N3	11.26	4.31	20.50
V1N4	10.07	3.92	18.40
V2N1	8.99	3.66	16.45
V2N2	10.04	4.15	18.32
V2N3	8.46	3.36	15.45
V2N4	8.80	3.63	16.05

Notes: (a and b) superscripts indicating significant differences ($P<0.05$)

Cooper nutrient formulation produces average levels of chlorophyll a, b, and total leaf chlorophyll of melon plants that are significantly higher than *Goodplant*, namely 15.78%, 16.40%, and 15.67%, respectively (Table 7). *Cooper* nutrient formulation contains the most optimum nitrogen (N) element to increase the total chlorophyll content of melon plant leaves compared to *Goodplant*. According to Munardianto and Ernita (2020), nutrient composition can significantly affect chlorophyll synthesis in plants, especially the nitrogen element. The total nitrogen element in *Cooper's* nutrient formulation was 185.26 grams while *Goodplant* was 183.76 grams (Appendix 3). The provision of higher N (up to its optimum limit) will increase the amount of chlorophyll formed. Providing sufficient nutrients to plants causes plant growth to be more optimal, especially N and Mg elements that play a role in chlorophyll formation (Sembiring and Maghfoer, 2018). The unfulfilled N element causes decreased chlorophyll levels in the leaves. According to Winarti *et al.* (2022) N deficiency causes a decrease in plant growth and yield because chlorophyll formation is disrupted.

The Golden Aroma variety showed significantly higher chlorophyll a, b, and total leaf levels compared to New Century, which were 21.94%, 16.76%, and 21.79%, respectively (Table 7). This is thought to be due to the better growth of Golden Aroma. Plants with optimal growth have higher chlorophyll levels, because an increase in chlorophyll is related to an increase in photosynthetic activity (Yama and Kartiko, 2020). The difference in total chlorophyll content of melon plant leaves in the Golden melon varieties

Aroma and New Century shows genetic variation between the two varieties. According to Pessarakli (2016), different plant genotypes have varying abilities in growth, thus affecting chlorophyll synthesis and photosynthetic efficiency.

The observation of chlorophyll content in melon leaves was carried out on chlorophyll a and chlorophyll b. According to Croft and Chen (2018), chlorophyll a and chlorophyll b are the main pigments in photosynthesis. Chlorophyll a is the dominant component and is centered in the reaction and light harvesting complex, while chlorophyll b functions as a light harvesting accessory pigment. According to Naomi *et* al. (2018), chlorophyll a absorbs red, blue, and violet light and reflects green light, while chlorophyll b absorbs blue-orange light and reflects yellow-green light. Chlorophyll is a pigment that plays an important role in the process of plant photosynthesis. According to Rivandy *et al.* (2024), a high concentration of chlorophyll increases the efficiency of photosynthesis, thus supporting the provision of energy reserves needed for plant growth and development.

4.8. Leaf Carotenoid Content

The treatment of varieties had a significant effect, while the treatment of various nutrient formulations and the interaction between the two did not significantly affect the parameters of carotenoid content of melon plant leaves based on analysis of variance (Appendix 11). Carotenoid content of melon plant leaves on various nutrient formulations and melon varieties can be seen in Table 8.

Table 8. Carotenoid Content of Melon Plant Leaves on Various Nutrient Formulations and Varieties

Nutrient	Variety		Average
	Golden Aroma	New Century	
	------------mg/g------------		
Hoagland	46.03	37.92	41.97
Cooper	47.96	42.34	45.15
Steiner	46.00	37.11	41.55
Goodplant	41.77	36.85	39.31
Average	45.44[a]	38.55[b]	

Notes: Different superscripts on the average row indicate significant differences ($P < 0.05$).

The Golden Aroma melon variety has an average leaf carotenoid content of 17.87%, which is significantly higher than New Century, presumably due to genetic variation (Table 8). According to Tuan *et al.* (2019), carotenoid content in two melon varieties shows that there are differences in the level of expression of carotenoid biosynthesis genes in the two varieties. *Hoagland, Cooper, Steiner*, and *Goodplant* nutrient formulations had no significant effect on leaf carotenoid levels. This is thought to be because leaf carotenoid levels are more influenced by plant genetic factors. The comparison of chlorophyll and carotenoid content is genetic, where genetic differences in each plant will affect the ability to synthesize carotenoids (Manurung *et al.*, 2020).

High carotenoid levels in Golden Aroma can maintain optimal growth because it increases protection against plant damage. Increased leaf carotenoid levels in melon varieties contribute to the ability of plants to cope with oxidative stress caused by various environmental factors (Sharma *et al.*, 2020). Carotenoid and chlorophyll levels are interconnected and play a role in assisting plant growth and photosynthesis processes. Carotenoids also function to protect chlorophyll from high light.

Carotenoids also function to protect chlorophyll from high light, so that the carotenoid content in plants adjusts to its chlorophyll (Hendriyani *et al.*, 2018). Leaf carotenoids function as companion pigments that expand the spectrum of light that can be used for photosynthesis (Nisar *et al.*, 2015).

4.9. Nitrate Reductase Activity (ANR)

The treatment of various nutrient formulations, varieties, and the interaction between the two did not give a significant effect on the activity of nitrate reductase (ANR) in melon plants (Appendix 12). The nitrate reductase activity of melon plants on various nutrient formulations and varieties can be seen in Table 9.

Nitrate Reductase Activity of Melon Plants on Various Nutrient Formulations and Varieties

Nutrient	Variety		Average
	Golden Aroma	New Century	
	-------- (µmol NO_2^-. g^{-1}. h^{-1}) ------		
Hoagland	3205.00	4035.59	3620.29
Cooper	3205.00	2026.82	2,615.91
Steiner	2787.45	2110.34	2448.89
Goodplant	3469.07	3,665.44	3567.26
Average	3166.63	2959.55	

The treatment of various nutrient formulations, varieties, and the interaction between the two did not have a significant effect on the activity of nitrate reductase (ANR) in melon plants (Table 9). It is suspected that the nutrient needs of melon plants are met, especially the nitrogen element. According to Listia *et al.* (2019), nitrogen assimilation into organic molecules depends on the reduction of NO($^{3-)}$by the enzyme *nitrate reductase* in plant tissues. Various nutritional formulations have no effect on ANR, presumably because plants store more nitrate as nitrogen reserves rather than using them in metabolism.

reserves rather than using them in metabolism. According to Srivasta (1980) cited by Desiliani and Ratnawati (2018), nitrate in the tissue does not correlate with ANR because more nitrate is in the storage pathway compared to the metabolic pathway. Golden Aroma and New Century varieties showed no significant effect on ANR, presumably because they were more influenced by external factors. According to Pagalla and Jannah (2023), ANR is influenced by the amount of light absorbed by the leaves, pH of the growing medium, temperature, humidity, plant age, types of inhibitors (such as tannins and phenols), and the amount of substrate.

4.10. Number of Stomata

The treatment of varieties had a significant effect, while the treatment of various nutrient formulations and the interaction between the two did not significantly affect the parameter of the number of stomata on the leaves of melon plants based on the analysis of variance (Appendix 13). The number of stomata on the leaves of melon plants in various nutrient formulations and varieties can be seen in Table 10.

Number of Stomata on Melon Plant Leaves in Various Nutrient Formulations and Varieties

Nutrition	Varieties		Average
	Golden Aroma	New Century	
	----------stomata/mm^2----------		
Hoagland	234.67	164.33	199.50
Cooper	244.00	184.00	214.00
Steiner	227.67	176.00	201.83
Goodplant	219.00	186.00	202.50
Average	231.33^{a}	177.58^{b}	

Notes: Different superscripts on the average row indicate significant differences (P<0.05)

The Golden Aroma variety has an average number of stomata that is 30.27% significantly higher than New Century, presumably due to genetic and environmental factors (Table 10). According to Odabasioglu and Gursoz (2019), the frequency of stomata is directly influenced by genotype in plants, so different varieties have different stomatal frequencies. The number of stomata in a plant varies because the characters and traits of Golden Aroma and New Century varieties are different. According to Nurhaya *et al.* (2021), the number of stomata in each plant is different because they have different shapes and distribution of stomata. The higher number of stomata in the Golden Aroma variety indicates a better photosynthesis and transpiration process than the New Century variety. According to Anggraini *et al.* (2016), a greater number of stomata increases the rate of transpiration and absorption of $CO_2$for photosynthesis, thus producing sufficient assimilates that affect the quality and quantity of plants.

The treatment of various nutrient formulations did not have a significant effect on the number of stomata, presumably because the number of stomata is more influenced by genetic and environmental factors. According to Makin *et al*. (2022), the number of stomata is influenced by internal factors such as the genetic nature of the plant and external factors such as light intensity, air temperature, and soil pH. One of the environmental factors that can influence the number of stomata is temperature, where the average daytime temperature in the *greenhouse* is 36.$^{4°C}$and the highest temperature is 42.$^{5°C.}$According to Wilujeng *et al.* (2024), high air temperatures can increase the photosynthesis process, while a decrease in temperature affects the decrease in transpiration rate.

4.11. Time to Male Flower Emergence

The treatment of various nutrient formulations and varieties had a significant effect, while the interaction between the two had no significant effect on the parameter of time to appear male flowers on melon plants based on analysis of variance (Appendix 14). The time to appear male flowers of melon plants on various nutrient formulations and varieties can be seen in Table 11.

Time of Male Flower Emergence of Melon Plants on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	-------------HST-------------		
Hoagland	27.25	22.08	24.67^{ab}
Cooper	24.00	20.92	22.46^{a}
Steiner	28.17	22.25	25.21^{b}
Goodplant	25.08	21.17	23.13^{ab}
Average	26.13^{b}	21.60^{a}	

Notes: Different superscripts in the average row and average column indicate significant differences ($P < 0.05$).

The parameter of male flower emergence time showed that *Cooper* nutrient formulation was 1 day earlier than *Goodplant* and 2 days earlier than *Hoagland*, but not significantly different. The time for male flowers to appear on *Cooper* nutritional formulation showed a significantly earlier time than *Steiner*. This is thought to be due to the most optimal nitrogen (N) content in *Cooper* (Table 11). Nitrogen content in *Hoagland* (169.28 grams), *Cooper* (185.26 grams), *Steiner* (135.81 grams), and *Goodplant* (183.76 grams).

(Appendix 3). According to Novira *et al*. (2015), nitrogen (N) plays a role in flowering, but not directly; the element N helps increase the uptake of P, thus accelerating the time for flowers to appear. The treatment of *Cooper* and *Steiner* nutrient formulations on the average time for male flowers to appear showed that *Cooper* was 3 days earlier than *Steiner* nutrient formulations. It is suspected that the effect of phosphorus content in *Cooper (*47.10 grams), which is higher than *Steiner (*24.34 grams), accelerates the time of male flowers. According to Mauliyandani (2022), phosphorus is the main nutrient for flowering plants in general; it can spur the appearance of flowers and affect the quality of flowers in plants. The faster male flower emergence time is thought to be due to the nutrients P and K in the appropriate *Cooper* nutrient formulation. Burhan (2016) states that nutrients available in optimal and balanced amounts, especially phosphorus (P) and potassium (K), can help the flower formation process.

The treatment of varieties showed a significant difference, namely the average time of male flowers of the Golden Aroma variety was 5 days earlier than the New Century variety. This is in accordance with the opinion of Mauliyandani (2022) that the flowering age of cucumber plants is influenced by genetic and environmental factors, but genetic factors are more dominant in influencing the age of flower appearance. The time for male flowers to appear on melon plants is influenced by genetic factors, because the varieties used are different, namely Golden Aroma and New Century. According to Lakitan (2004) cited by Novira *et al.* (2015), plants will produce flowers if they have sufficient reserve substances and are determined by the nature of the plant and the variety used.

4.12. Time to Appear Female Flowers

The treatment of varieties has a significant effect, while the treatment of various nutritional formulations and the interaction between the two does not significantly affect the parameters of the time to appear female flowers of melon plants based on the analysis of variance (Appendix 15). The time to appear female flowers of melon plants on various nutrient formulations and varieties can be seen in Table 12.

Time to Emerge Female Flowers of Melon Plants on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	------------- HST -------------		
Hoagland	27.50	25.42	24.46
Cooper	26.58	24.92	25.75
Steiner	26.83	24.42	25.63
Goodplant	26.33	24.25	25.29
Average	26.81[b]	24.75[a]	

Notes: Different superscripts on the average row indicate significant differences ($P < 0.05$).

The treatment of varieties shows there is a significant difference in melon plants of Golden Aroma varieties with an average time of appearance of female flowers 2 days longer than New Century (Table 12). According to Mauliyandani (2022), the flowering age of cucumber plants (*Cucumis sativus*) is influenced by genetic and environmental factors, but genetic factors are more dominant in influencing the age of flower appearance. The difference in the time of appearance of female flowers between the Golden Aroma and New Century varieties is thought to be influenced by variations in flower emergence time characters. According to Amzeri *et al.* (2020), in 24 genotypes of hybrid melons

The results of flowering age characters have a high heritability value, which indicates that genetic factors are more influential than environmental factors.

The time for female flowers to appear on melon plants in the Golden Aroma variety is 2 days slower than in the New Century variety, presumably because there are differences in growth between the two varieties. According to Kartikasari *et al.* (2016), the length of the vegetative phase in different varieties can affect the flowering age and harvest age of a plant. The earlier female flowers appear on melon plants, the faster the harvest time. According to Jannah *et al.* (2017), plants with a shorter flowering age will have a shorter harvest age, so it can be an indicator of determining the early maturing age of a plant.

The various nutrient formulations did not affect the time of female flower emergence because one of the factors influencing the formation of the female flower phenotype is the presence of genes that regulate the activity of the hormone ethylene, which plays a role in determining the sex expression of flowers. According to Wang *et al.* (2022), the *CmCPR5* gene in melon plants interacts with the ethylene receptor *ETR1* and regulates ethylene signal transduction, thereby inhibiting stamen development and supporting the formation of female flowers. The time when female flowers appear is also influenced by the environment, such as the temperature in the *greenhouse*, which is too high, reaching 42.$^{5°C}$.According to Sugiarto *et al.* (2022), the optimal temperature for vegetative growth is$^{25°C}$-$^{30°C}$and for the flowering period is$^{30°C}$in melon plants.

4.13. Number of Male Flowers

The treatment of varieties had a significant effect, while the treatment of various nutrient formulations and the interaction between the two did not significantly affect the number of male flowers of melon plants based on the analysis of variance (Appendix 16). The number of male flowers of melon plants on various nutrient formulations and varieties can be seen in Table 13.

Number of Male Flowers of Melon Plants on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	--------- flowers/plant	-------------	
Hoagland	5.08	24.00	14.54
Cooper	7.42	24.08	15.75
Steiner	5.25	21.75	13.50
Goodplant	6.30	23.92	15.11
Average	6.01[b]	23.44[a]	

Notes: Different superscripts on the average row indicate significant differences ($P < 0.05$).

The number of male flowers of melon plants in the treatment of varieties shows a significant difference in the Golden Aroma variety with an average number of male flowers 74.36% significantly less than the New Century variety. According to Yulina *et al*. (2021), the variety factor has a significant effect on the number of flowers due to differences in the number of genotypes caused by genetic factors. The treatment of various nutrients had no significant effect, presumably because the influence of genetic factors is higher. According to Amzeri *et al.* (2020), the heritability of flowering characters, including the number of male flowers, tends to be high, so that genetic variations between varieties are more influential than nutritional treatments.

The treatment of different nutrient formulations did not have a significant effect on the number of male flowers, presumably due to the influence of temperature and light intensity. According to Marhaeni *et al*. (2018), high temperatures accompanied by low light intensity can increase the number of male flowers but reduce the number of female flowers. The difference in the number of male flowers in the two varieties is thought to be due to the different responses of each variety in receiving environmental factors such as light intensity. According to Annisa and Gustia (2017), high light intensity stimulates the formation of female flowers, while low light intensity can stimulate the formation of male flowers.

4.14. Number of Female Flowers

The treatment of varieties had a significant effect, while the treatment of various nutritional formulations and the interaction between the two did not significantly affect the parameters of the number of female flowers of melon plants based on the analysis of variance (Appendix 17). The number of female flowers of melon plants on various nutrient formulations and varieties can be seen in Table 14.

Number of Female Flowers of Melon Plants on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	--------- flowers/plant -------------		
Hoagland	2.50	3.75	3.13
Cooper	1.83	4.50	3.17
Steiner	2.08	4.75	3.42
Goodplant	2.58	5.50	4.04
Average	2.25^{b}	4.63^{a}	

Notes: Different superscripts on the average row indicate significant differences ($P < 0.05$).

The number of female flowers with variety treatment is significantly different in the Golden Aroma variety, which has an average number of female flowers 5.78% significantly less than New Century (Table 14). According to Hera *et al.* (2018), the difference in the number of female flowers on plants is because each variety has different genetic traits. Nutrient treatment has no significant effect on the number of female flowers, presumably due to the relatively small direct influence on flower formation. According to Rouphael *et al.* (2017), genetic factors have a greater effect on plant characteristics than nutritional treatments.

The difference in the number of female flowers in the Golden Aroma and New Century varieties can be influenced by pruning the lateral shoots of melon plants. According to Milania *et al.* (2022), pruning lateral shoots causes optimal sunlight to be received by the leaves so that flower formation is stimulated. The number of female flowers of plants, including low ones, is thought to be caused by high environmental temperature factors. According to Amarasinghe *et al.* (2021), high environmental temperatures favor the formation of male flowers, but inhibit the formation and cause the shedding of female flowers.

4.15. Fruit Diameter

The treatment of varieties and the interaction between the two had a significant effect, while the treatment of various nutrient formulations had no significant effect on the fruit diameter parameters of melon plants based on the analysis of variance (Appendix 18). The diameter of melon fruit on various nutrient formulations and varieties can be seen in Table 15.

Diameter of Melon Fruit on Various Nutrient Formulations and Varieties

Nutrients	VVarieties		Average
	Golden Aroma	New Century	
	------------ -cm- ------------		
Hoagland	15.38^{a}	14.06^{b}	14.72
Cooper	15.59^{a}	14.02^{b}	14.80
Steiner	14.81^{ab}	13.99^{b}	14.40
Goodplant	14.62^{ab}	14.67^{ab}	14.64
Average	15.10^{a}	14.18^{b}	

Notes: Different superscripts in the mean row and interaction matrix indicate significant differences ($P<0.05$)

Fruit diameter in Table 15 shows that there is a significant difference in the interaction between various nutrient formulations with Golden Aroma and New Century varieties on fruit diameter. Fruit diameter in Golden Aroma and New Century varieties showed responses that were not significantly different in all nutrient formulations given. *Hoagland* nutrient formulation treatment on Golden Aroma variety showed 9.39% significantly higher than New Century. *Cooper* nutrient formulation on Golden Aroma variety showed 11.20% significantly higher than New Century. Meanwhile, the *Steiner* and *Goodplant* nutrient formulations showed no significant difference between the two varieties.

This is thought to be because the *Hoagland* and *Cooper* nutrient formulations provide the most suitable content to increase the diameter of Golden Aroma fruit. According to Tome *et al*. (2023), hydroponics utilizes nutrient solutions as a source of nutrients, but the nutritional needs of each variety are different. The nitrogen (N) content in *Hoagland (*169.28 grams) and *Cooper (*185.26 grams) is thought to be suitable for increasing the diameter of melon fruit. According to Gardner *et al.* (1991) cited by Darwiyah *et al.* (2021), N has a function to increase assimilates such as melon fruit production.

N has a function to increase assimilates such as melon fruit production. The nutritional formulation of *Steiner* and *Goodplant* did not differ significantly between the two varieties, presumably due to the influence of elemental sulfur (S) on *Steiner* and *Goodplant*. The sulfur (S) content in *Hoagland* was 50.24 grams, *Cooper* was 53.38 grams, *Steiner* was 254.34 grams, and *Goodplant* was 105.98 grams. According to Aslotfi *et al.* (2021), the decrease in fruit size is caused by excessive S content, resulting in a decrease in the absorption of other nutrients by plants.

The Golden Aroma variety yielded significantly larger fruit diameters in each nutrient formulation compared to the New Century variety. According to Hardanto *et al.* (2023), genetic factors from each different fruit produce different fruit diameters. The average diameter of melon fruit in the Golden Aroma variety is 15.10 cm, while based on research by Sumartono *et al.* (2017), the Golden Aroma variety has a fruit diameter of 13.89 cm, which shows an increase in fruit diameter. The average fruit diameter of the New Century variety is 14.18 cm, while based on the description of the variety, it has a fruit diameter of ± 16 cm, indicating that the fruit diameter results do not reach their maximum potential. According to Hera *et al.* (2018), differences in varieties cause plants to respond differently to their environment.

4.16. Fruit Length

The treatment of various nutrient formulations, varieties, and the interaction between the two based on the analysis of variance significantly influenced the melon fruit length parameter (Appendix 19). The length of melon fruit on various nutrient formulations and melon varieties can be seen in Table 16.

Length of Melon Fruit on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	------------cm------------		
Hoagland	19.96^{b}	21.80^{a}	20.88^{a}
Cooper	19.53^{b}	22.00^{a}	20.76^{a}
Steiner	18.83^{bc}	21.57^{a}	20.20^{ab}
Goodplant	17.68^{c}	21.88^{a}	19.78^{b}
Average	19.00^{b}	21.81^{a}	

Notes: Different superscripts in the average row, average column, and interaction matrix indicate significant differences ($P < 0.05$).

The length of melon fruit in Table 16 shows that there is a significant difference in the treatment of various nutrient formulations, varieties, and the interaction between the two treatments. Fruit length of Golden Aroma variety was significantly smaller than New Century in all nutrient formulations. The provision of various nutritional formulations gave an effect that was not significantly different on the New Century variety. Whereas, in Golden Aroma variety, the provision of various nutritional formulations showed a real difference. *Hoagland* and *Cooper* nutrient formulations were significantly higher than *Goodplant* with a difference of 12.90% and 10.46% in Golden Aroma varieties. The provision of *Goodplant* nutrient formulation on Golden Aroma varieties is thought to be less appropriate in increasing the length of melon fruit.

The provision of various nutritional formulations on melon plant varieties is thought to have macro and micro nutrient content that can meet the basic needs of plants, so that the length of fruit on New Century varieties is uniform. According to Sembiring and Maghfoer (2018), plants can grow well if all the nutrients needed are fulfilled in sufficient and balanced amounts. However, in the Golden Aroma variety, the *Goodplant* nutrient formulation treatment produced significantly smaller fruit weight than *Hoagland* and *Cooper,* presumably because the response of each variety to nutrients is different. According to Tome *et al.* (2023), hydroponic cultivation utilizes nutrient solutions as a source of nutrients, but the nutritional needs of each variety are different.

The *Goodplant* nutrient formulation on the fruit length parameter of the Golden Aroma variety showed significantly different results, smaller than *Hoagland* and *Cooper*. Research by Chairudin *et al*. (2024) showed that the *Goodplant* formulation gave the lowest results on fruit size, presumably due to the influence of phosphorus nutrition.

The phosphorus content in *Goodplant* is thought to be too high, affecting fruit length. The phosphorus (P) content in *Hoagland* is 24.33 grams, *Cooper is* 47.10 grams, *Steiner* is 24.34 grams, and *Goodplant* is 69.08 grams. According to Paskalis *et al.* (2023), excessive phosphorus (P) nutrients can disrupt the balance of macronutrients such as nitrogen (N) and potassium (K). This is supported by Sirenden *et al.* (2015), who found that excessive phosphorus levels can result in a decrease in the quality and quantity of crop yields.

The results showed that there was a significant difference in melon fruit length in Golden Aroma and New Century, presumably due to genetic influences. According to Ipaulle and Kastono (2020), the size of the fruit produced is influenced by the genetic traits of the cultivar planted. The difference in melon fruit length in Golden Aroma and New Century is also influenced by various nutritional formulations. According to Sugiartini *et al.* (2022), melon fruit development involves the accumulation of nutrients and the addition of air cavities in the fruit.

4.17. Fruit Flesh Thickness

The treatment of varieties had a significant effect, while the treatment of various nutritional formulations and the interaction between the two did not significantly affect the parameters of melon fruit flesh thickness based on analysis of variance (Appendix 20). The thickness of melon flesh on various nutrient formulations and varieties can be seen in Table 17.

Thickness of Melon Fruit Flesh on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	------------cm------------		
Hoagland	4.66	3.85	4.25
Cooper	4.63	3.93	4.28
Steiner	4.58	4.13	4.35
Goodplant	4.42	4.20	4.31
Average	4.57[a]	4.03[b]	

Notes: Different superscripts on the average row indicate significant differences ($P < 0.05$).

The thickness of the fruit flesh in the Golden Aroma variety has an average of 13.39%, which is significantly higher than the New Century variety (Table 17). According to Aragão *et al*. (2013) cited by Amorim *et al*. (2022), the difference

The differences in the yield of fruit diameter, fruit flesh thickness, fruit weight, and sweetness level of melon varieties are caused by genetic factors, because they have a wide genetic diversity so that they have different variations. Nutritional formulations given to melon plants can meet the needs of plants in the process of fruit formation. According to Sugiartini *et al.* (2022), the formation of melon pulp can be influenced by nutrients absorbed by plants and transported by roots to all plant organs.

However, this study showed that the treatment of various nutritional formulations did not significantly affect the thickness of fruit flesh in the Golden Aroma and New Century varieties. According to Ariga *et al*. (2022), genetic factors can affect plant yields, because some plant varieties have genetic traits that cannot be changed even though they are planted in places with high fertility. The thickness of melon pulp can be affected by environmental conditions in the *greenhouse,* such as temperatures that are too high during the day reaching 36.4 ($^{o)}$ ^{C}and the highest temperature is 42.5 ($^{(o)}$ $^{C)}$ ·According to Christy (2020), high temperatures in plastic houses can interfere with fruit formation and pollination, so that fruit weight, which is influenced by the thickness of the pulp, decreases.

4.18. Fruit Weight

The treatment of various nutrient formulations, varieties, and the interaction between the two based on the analysis of variance significantly influenced the parameters of melon fruit weight (Appendix 21). Melon fruit weight on various nutrient formulations and varieties can be seen in Table 18.

Weight of Melon Fruit on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	------------kg------------		
Hoagland	2.09^{ab}	2.18^{a}	2.13^{a}
Cooper	1.98^{bc}	2.20^{a}	2.09^{ab}
Steiner	1.86^{cd}	2.14^{ab}	2.00^{bc}
Goodplant	1.77^{d}	2.17^{a}	1.97^{c}
Average	1.92^{b}	2.17^{a}	

Notes: Different superscripts in the mean row, mean column, and interaction matrix indicate significant differences ($P < 0.05$).

The melon fruit weight in Table 18 shows that there is a significant difference in the treatment of various nutrient formulations, varieties, and the interaction between the two treatments. The fruit weight of the Golden Aroma variety in the *Hoagland* and *Cooper* nutrient formulations was significantly higher than *Goodplant*, which was 18.08% and 11.86%. The *Hoagland* nutrient formulation produced fruit weight that was 12.37% significantly higher than *the Steiner formulation.* Fruit weight on New Century varieties showed no significant difference in various nutritional formulations. Fruit weight on the New Century variety was significantly higher than Golden Aroma on *the Cooper, Steiner,* and *Goodplant* nutrient formulations. The *Hoagland* nutrient formulation showed fruit weight that was not significantly different in both varieties. However, in the Golden Aroma variety, the *Hoagland* formulation produced the highest fruit weight.

The difference in fruit weight in the treatment of various nutritional formulations against Golden Aroma and New Century varieties is thought to be due to differences in the ability of each plant to absorb nutrients. According to Kurniawati *et al*. (2015), the generative phase, especially fruit weight, is strongly influenced by the absorption of macro and micro elements by plants. *Hoagland* nutrient formulation is thought to give the

Golden Aroma variety because the content of macro and micro elements (Appendix 3) is the most appropriate. According to Ayu *et al.* (2017), fruit development and ripening are supported by nutrients with balanced phosphorus (P), potassium (K), nitrogen (N), and calcium (Ca) content at the right time. Supported by Sugiartini *et al.* (2022), the element K plays a role in increasing fruit size and quality, the element P plays a role in the formation of flowers and fruit, and Ca plays a role in cell division and permeability so that optimal fruit development occurs. The *Goodplant* formulation significantly produced lower fruit weight than other nutritional formulations. Chairudin *et al.* (2024) stated that the *Goodplant* nutritional formulation produced the lowest results in fruit weight and size, presumably because it was less able to produce higher photosynthesis than other nutrients, resulting in lower fruit weight, which was mainly influenced by the P and K elements.

The melon fruit weight parameter in the New Century variety is significantly higher than the Golden Aroma variety, which is 2.17 kg. Based on research by Ngo-Hoang (2024), hami melon has the highest weight among the other three varieties, which is 2.8 kg. The average fruit weight in the Golden Aroma variety is 1.92 kg. Research by Hardanto *et al.* (2023) showed that the average fruit weight of Golden Aroma was 0.74 kg. The average weight of Golden Aroma fruit in research conducted by Minarni and Ulinnuha (2023) is 1.08 kg, while research conducted by Sumartono *et al.* (2017) showed the average fruit weight of Golden Aroma was 1.50 kg. The difference in fruit weight between Golden Aroma and New Century varieties is thought to be due to differences in the ability of varieties in the fruit enlargement process.

This is in accordance with the opinion of Sugiartini *et al*. (2022) that the metabolic ability of a plant is different depending on the physiological ability of each plant.

4.19. Fruit Sweetness Level

The treatment of varieties had a significant effect, while the treatment of various nutritional formulations and the interaction between the two did not have a significant effect on the parameters of melon fruit sweetness level based on analysis of variance (Appendix 22). The level of sweetness of melon fruit on various nutrient formulations and varieties can be seen in Table 19.

Level of Sweetness of Melon Fruit on Various Nutrient Formulations and Varieties

Nutrients	Variety		Average
	Golden Aroma	New Century	
	---------------------° Brix-----------------		
Hoagland	15.15	13.44	14.30
Cooper	14.93	13.33	14.13
Steiner	14.72	13.75	14.24
Goodplant	15.24	14.05	14.64
Average	15.01[a]	13.64[b]	

Notes: Different superscripts on the average row indicate significant differences (P<0.05)

The level of sweetness of melon fruit in the treatment of varieties showed a significant difference in the Golden Aroma variety with an average level of fruit sweetness of 10.04%, significantly higher than New Century (Table 19). According to Aragão *et al.* (2013) cited by Amorim *et al.* (2022), differences in the results of the level of fruit sweetness between melon varieties are caused by genetic factors, because it has a wide genetic diversity so that it has different variations. The results of the sweetness level of fruit in the Golden Aroma variety are

$15.^{01\circ}$Brix, which is still lower than the label description on the seed packaging according to PT Known You Seed, Golden Aroma F1, which reaches$^{16\circ}$Brix. The New Century variety showed a fruit sweetness level of $13.^{46\circ}$Brix, which was still lower than the variety description (Appendix 1), which reached$^{14\circ}$Brix. However, the fruit sweetness level of the Golden Aroma variety is higher than New Century, presumably because varietal differences affect production yield. According to Apung *et al.* (2023), the growth and production of melon plants are more influenced by genetics when plants are cultivated in optimal environmental conditions.

The treatment of various nutritional formulations did not result in a significantly different average fruit sweetness level. This is probably because the potassium (K) content in each nutritional formulation can fulfill the basic needs of melon plants. The potassium content in the *Hoagland* nutrient formulation is 183.82 grams, *Cooper* is 235.50 grams, *Steiner* is 218.41 grams, and *Goodplant* is 256.70 grams (Appendix 3). According to Preciado-Rangel *et al.* (2018), sugar transportation to the fruit is effective because potassium plays an important role in solute transportation. The appropriate K content can increase the sweetness of melon fruit. Low K element can reduce the quality of fruit production such as sugar content and fruit size (Bariyyah *et al.*, 2015). Excessive K application causes a decrease in fruit quality, because excess potassium cations will suppress the availability of other nutrients needed by plants (Bazaz *et al.*, 2022).

4.20. Vitamin C content

The treatment of various nutrient formulations, varieties, and the interaction between the two based on the analysis of variance did not significantly affect the parameters of vitamin C content in melon fruit (Appendix 23). Vitamin C content of melon fruit in various nutrient formulations and varieties can be seen in Table 20.

Vitamin C Content of Melon Fruit in Various Nutrient Formulations and Varieties

Nutrient	Variety		Average
	Golden Aroma	New Century	
	----------------mg/g-----------------		
Hoagland	0.51	0.47	0.49
Cooper	0.51	0.51	0.51
Steiner	0.47	0.51	0.49
Goodplant	0.47	0.54	0.50
Average	0.49	0.51	

The vitamin C content of melon fruit in the treatment of various nutrient formulations, varieties, and the interaction between the two did not give a significant effect (Table 20). The average vitamin C content in the treatment of various nutrient formulations and both varieties showed results of 0.49 mg/g and 0.51 mg/g. The content of vitamin C according to Prajnanta (2003) cited by Nerdy (2017) in melon fruit is 0.34 mg/g. Vitamin C content in melons can be influenced by genetic and environmental factors. Vitamin C content can be influenced by internal factors, namely genetics in different varieties, as well as external factors including temperature, humidity, season, sunlight, and availability of nutrients (Sandi and Hariyono, 2024).

The high and uniform vitamin C content in melon fruit is thought to be due to the nutrient content in the *Hoagland*, *Cooper*, *Steiner*, and Goodplant nutrient formulations that can fulfill the basic needs of plants.

Goodplant can meet the basic needs of plants, so that photosynthesis is optimal. According to Karamina *et al*. (2022), the provision of macro and micro nutrients in the fruit ripening phase causes optimal photosynthesis and the delivery of photosynthates to the fruit is maximized so as to increase secondary metabolites, one of which is ascorbic acid (vitamin C). The vitamin C content in melon fruit is also influenced by the level of fruit maturity. Presumably, the level of maturity of melon fruit at harvest time is appropriate so that the vitamin C content is quite high. According to Koubala *et al.* (2016), fruit maturity affects vitamin C content, with overripe fruit having low vitamin C content.

CHAPTER V

CONCLUSIONS AND SUGGESTIONS

5.1. Conclusion

The results showed that the Golden Aroma variety responded to increased growth and production of melon plants on *Hoagland* and *Cooper* nutrient formulations, but responded to decreased growth and production of melon plants on *Goodplant* nutrient formulations as shown in the parameters of fruit length and fruit weight. The New Century variety gave the same growth and production response to the application of *Hoagland*, *Cooper*, *Steiner*, and *Goodplant* nutrient formulations.

5.2. Suggestions

The suggestion is to conduct further research on the effect of nutrient concentration levels in nutrient formulations on various melon varieties. The next nutrient formulation treatment is expected to provide more optimal results for the growth and production of melon plants in various varieties.

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APPENDIX

Description of New Century Melon Variety

Plant origin	: Known You Seed Pte Ltd, Taiwan
Pedigree	: 99-4-4 (F) x 9901-7 (M)
Variety group	: Single cross hybrid
Plant type	: Vine
Stem shape	: Cylindrical
Stem diameter	: 0.58 - 0.65 cm
Stem color	: Green
Leaf shape	: Round (*orbicular*)
Leaf size	: ± 19.0 cm long ± 23.3 cm wide
Leaf edge	: Wavy
Leaf tip	: Blunt
Leaf color	: Green
Leaf surface	: Hairy Age at
flowering after sowing	: 23 - 28 days
Flower color	: Male and female flowers are yellow
Flower shape	: Rotate
Age of harvest	: 59 - 65 days after sowing
Fruit shape	: Oval (oblong round)
Fruit size	: Height ± 28 cm, diameter ± 16 cm
Skin color of young fruit	: Light yellow
Skin color of mature fruit	: Light yellow, slightly netted
Fruit flesh thickness	: 3.4 - 4.0 cm
Fruit flesh color	: Light orange
Texture of fruit flesh	: Firm, crunchy
Fruit flavor	: Sweet
Fruit aroma	: Medium
Sugar content	: 14%
Weight per fruit	: 1.8 - 2.7 kg
Yield	± 40 tons/ha
Shelf life of fruit at room temperature	: 7 days
Description	: Well adapted to low to medium altitudes with an altitude of 200 - 500 m above sea level, resistant to transportation.
Proposer	: Chang Kuang Hsien (Known You Seed Distribution (S.E.A) Pte. Ltd. Indonesia Representative Office)
Researcher	: Huang Kuang Hsien (Known You Seed Pte. Ltd.)

Appendix 2. Research Layout

V2U2
N2
N4
N1
N3

V2U3
N1
N3
N4
N2

V1U3
N1
N3
N2
N4

V1U1
N3
N2
N1
N4

V2U1
N4
N1
N3
N2

V1U2
N4
N2
N3
N1

Main Plots:
Melon Variety (V)
V1 : Golden Aroma
V2 : New Century

Subsidiary Plots:
Nutrient Formulation
(N) N1 :
Hoagland N2
: *Cooper*
N3 : *Steiner*
N4 : *Goodplant*

Each treatment has 3 replicates, namely U1, U2, and U3.

Preparation of nutrient solution

1. Modification of various nutrient formulations

The hydroponic nutrient formulation contained in Table 1 was used as a reference or basis in making the nutrients used during the study. However, there were modifications or changes to the nutrient formulations according to the availability of the materials used. The manufacture of nutrients was adjusted to the materials available, so adjustments were made to some of the formulation components. Modifications of the various nutrient formulations used can be seen in the table below:

Table of Modifications of Various Nutrient Formulations

Nutrient	*Hoagland*	*Cooper*	*Steiner*	*Goodplant*
	mg/L			
N	215.64	236.00	173.01	234.09
P	31.00	60.00	31.00	88.00
K	234.16	300.00	278.23	327.00
Ca	160.00	185.00	180.00	164.00
Mg	34.00	50.00	82.71	80.00
S	64.00	68.00	324.00	135.00
Fe	2.50	12.00	4.00	2.60
Cu	0.05	0.10	0.02	0.70
Zn	0.50	0.10	0.11	0.10
Mn	0.02	2.00	0.62	0.70
B	0.50	0.30	0.44	0.40
Mo	0.01	0.20	0.00	0.01
Total	742.38	913.70	1,074.14	1,032.60

2. Preparation of stock solutions

Preparation of stock solutions A and B was carried out in a 10 L capacity container by dissolving powder A and powder B each with 5 L of water, which was done separately to prevent interaction between components that might react, then stirred until dissolved and homogeneous. Raw water was then added back with 5 L of water in each container and stirred until homogeneous, so that the total volume of solution reached 10 L. The ingredients for making stock solutions A and B can be seen in the following table:

(Continued)

Table of Materials for Making Stock Solution A and B

Goal	Material	Percentage Nutrients	Rate (mg/L)			
			Hoagland	*Cooper*	*Steiner*	*Goodplant*
A	Calnit	(N 15.5%) (Approx. 18.6%)	860.22	994.62	483.87	881.72
A	Kalinitra	(N 13%) (K 38.2%)	512.18	590.71	0	569.84
A	Fe-EDTA	(Fe 13%)	19.23	92.30	30.77	20.00
A	$CaCl_2$	(Ca 36.03%)	0.00	0.00	249.80	0.00
B	MAG-S	(S 13%) (Mg 9.6%)	354.17	520.83	861.54	833.33
B	MKP	(K 28.2%) (P 22.7%)	136.56	264.32	136.56	528.17
B	Micro Zn	(Zn 15%)	0.33	0.67	0.73	0.67
B	Micro Mn	(Mn 13%)	3.84	15.38	4.77	5.38
B	Micro Cu	(Cu 15%)	0.13	0.67	0.13	14.00
B	Urea	(N 46%)	0.00	10.96	0.00	0.00
B	ZA	(N 21%) (S 24%)	74.83	0	466.67	111.12
B	Inabor	(N 0.40%) (B 31.43%)	1.59	0.95	1.40	1.27
B	Sodium Molybdate	(Mo 46%)	0.02	0.43	0.00	0.02
B	SOP	(K 43.2%) (S 18%)	0	0	555.55	0

3. Dilution of stock solution

Dilution of the stock solution is done by checking the raw water before use. The raw water used has a concentration of 200 ppm and a pH of 6.5 - 6.8. Dilution of the stock solution is done by putting stock solution A and stock B into a 50 L bucket in a ratio of 1: 1.

The addition of 100 ml of stock solution A and B to the *Hoagland* nutrient formulation in 50 L of water can increase the water concentration value by 500 - 600 ppm. Adding 100 ml of stock solutions A and B to the *Cooper* nutrient formulation in 50 L of water can increase the water concentration value by 600–700 ppm. Adding 100 ml of stock solutions A and B to the *Steiner* nutrient formulation in 50 L of water can increase the water concentration value by 600–700 ppm.

(Continued)

increase the water concentration value by 700 - 800 ppm. The addition of 100 ml of stock solutions A and B to the *Goodplant* nutrient formulation in 50 L of water can increase the water concentration value by 700 - 800 ppm. The dilution results of stock solutions A and B are then measured for pH and concentration. The pH measurement uses a pH meter, while the concentration measurement uses a TDS meter. The value of nutrient concentration after dilution can be confirmed again using a TDS meter to get accurate results. The pH measurement on the stock solution dilution results seen on the pH meter is 5.8 - 6.5. The results of the concentration measurement seen on the TDS meter can be described by the formula:

Raw Water Concentration + Nutrient Solution Concentration = TDS Measurement Result Based on the formula above, it shows that if the solution to be given to plants is 1000 - 1100 ppm, the TDS measurement result will be as follows

When given to plants at 1000 - 1100 ppm, the results that come out on the TDS meter are 1200 - 1300 ppm. So the calculation of nutrient dilution of stock solutions A and B at a capacity of 50 L of water is as follows:

a. Nutrient solution concentration of 1200 - 1300 ppm (vegetative phase):
   - *Hoagland*: 230 ml stock solution A + 230 ml stock solution B in 50 L water.
   - *Cooper*: 200 ml stock solution A + 200 ml stock solution B in 50 L of water
   - *Steiner*: 170 ml stock solution A + 170 ml stock solution B in 50 L of water
   - *Goodplant*: 180 ml stock solution A + 180 ml stock solution B in 50 L of water

b. Nutrient solution concentration 1400 - 1500 ppm (flowering phase):
   - *Hoagland*: 280 ml stock solution A + 280 ml stock solution B in 50 L of water
   - *Cooper*: 250 ml stock solution A + 250 ml stock solution B in 50 L of water.
   - *Steiner*: 220 ml stock solution A + 220 ml stock solution B in 50 L of water
   - *Goodplant*: 230 ml stock solution A + 230 ml stock solution B in 50 L of water

c. 1600 ppm concentration nutrient solution (fruit enlargement - harvest phase):
   - *Hoagland*: 320 ml stock solution A + 320 ml stock solution B in 50 L of water
   - *Cooper*: 280 ml stock solution A + 280 ml stock solution B in 50 L water
   - *Steiner*: 240 ml stock solution A + 240 ml stock solution B in 50 L water.
   - *Goodplant*: 250 ml stock solution A + 250 ml stock solution B in 50 L of water

Appendix 3 (continued)

Dilution of nutrient stock solutions A and B was carried out every time the nutrients ran out at each growth phase in a capacity of 50 L, so there were several dilutions during the research process. The total nutrients in each formulation used during one planting period for 24 plants was 785 liters.

The nutrient content of *Hoagland*, *Cooper*, *Steiner*, and *Goodplant* nutrient formulations based on the total nutrients used during one planting period for 24 melon plants can be seen in the table below:

Table of Element Content in Various Nutrient Formulations

Material	Total Elements (g)			
	Hoagland	*Cooper*	*Steiner*	*Goodplant*
N	169.28	185.26	135.81	183.76
P	24.33	47.10	24.34	69.08
K	183.82	235.50	218.41	256.70
Ca	125.60	145.23	141.30	128.74
Mg	26.69	39.25	64.93	62.80
S	50.24	53.38	254.34	105.98
Fe	1.96	9.42	3.14	2.04
Zn	0.04	0.08	0.02	0.55
Mn	0.39	0.08	0.09	0.08
Cu	0.02	1.57	0.49	0.55
B	0.39	0.24	0.35	0.31
Mo	0.01	0.16	0.00	0.01

Water and Nutrient Requirements of Melon per Plant

Watering is divided into two types, namely raw water watering and nutrient watering (AB mix fertilizer + raw water). Raw water watering on melon plants in the *greenhouse* uses drip irrigation, while nutrient watering is done by leaking. The water needs and nutrient concentrations of melon plants in each phase of growth are different. Raw water watering is divided into two times, namely morning (7:00 a.m. to 9:00 a.m.) and afternoon (3:00 p.m. to 5:00 p.m.). Additional watering can be done between 10:00 a.m. and
11:00 if the weather is hot and the planting medium is dry. The following are the details of nutrient and raw water irrigation, and their distribution in each phase of melon growth: Table of Irrigation and Fertigation Needs of Melon Plants

Plant Phase	Time Watering	Water Volume Raw (ml)	Volume Nutrition (ml)	Concentration Nutrient (ppm)
Vegetative Phase	Morning	900	300	
(1 - 14 HST)	Afternoon	-	-	12:00 PM - 1:00 PM
	Afternoon	9:00	-	
Flowering Phase	Morning	600	200	
(15 - 30 HST)	Afternoon	-	-	2:00 PM - 3:00 PM
	Afternoon	600	200	
Enlargement Phase	Morning	500	300	
Fruit	Day	-	-	1600
(31 - 54 HST)	Afternoon	500	200	
Gramation Phase -	Morning	300	200	
Harvest	Afternoon			1600

Temperature and Humidity in the Melon *Greenhouse*, Faculty of Animal Husbandry and Agriculture, Diponegoro University from April to July 2024

Date	Temperature (°C)			Average	Humidity (%)			Average
	Morning	Day	Afternoon		Morning	Day	Afternoon	
April 24, 2024	28.4	36.9	35.5	33.6	88	34	43	55.0
April 25, 2024	26.7	33.7	27.3	29.2	89	48	73	70.0
April 26, 2024	25.9	39.9	34.4	33.4	81	35	47	54.3
April 27, 2024	25.0	39.3	27.0	30.4	81	35	70	62.0
April 28, 2024	25.2	41.7	34.6	33.8	83	31	42	52.0
April 29, 2024	28.4	41.3	34.1	34.6	86	31	42	53.0
April 30, 2024	33.3	40.9	38.6	37.6	69	33	37	46.3
May 1, 2024	30.8	38.6	38.0	35.8	62	35	36	44.3
May 2, 2024	28.5	42.5	41.6	37.5	79	31	30	46.7
May 3, 2024	31.5	39.4	34.5	35.1	60	32	41	44.3
May 4, 2024	28.3	42.3	36.6	35.7	83	29	33	48.3
May 5, 2024	28.0	41.3	36.8	35.4	79	29	34	47.3
May 6, 2024	28.7	40.9	40.2	36.6	79	29	30	46.0
May 7, 2024	29.6	40.0	39.9	36.5	62	30	30	40.7
May 8, 2024	30.0	40.2	33.4	34.5	66	31	44	47.0
May 9, 2024	26.7	39.8	33.3	33.3	75	34	44	51.0
May 10, 2024	26.7	39.1	38.8	34.9	84	33	34	50.3
May 11, 2024	36.5	41.5	38.4	38.8	44	30	36	36.7
May 12, 2024	26.4	40.0	33.2	33.2	74	33	46	51.0
May 13, 2024	25.3	36.3	36.1	32.6	86	30	36	50.7
May 14, 2024	26.7	40.3	35.5	34.2	80	31	41	50.7
May 15, 2024	25.7	38.7	34.3	32.9	86	36	41	54.3
May 16, 2024	26.5	38.9	36.4	33.9	89	37	38	54.7
May 17, 2024	25.6	37.0	38.0	33.5	85	35	35	51.7
May 18, 2024	25.0	39.3	36.3	33.5	89	33	35	52.3
May 19, 2024	30.3	37.0	29.1	32.1	57	32	51	46.7
May 20, 2024	31.7	37.3	34.5	34.5	52	33	37	40.7
May 21, 2024	29.0	36.8	33.7	33.2	65	35	41	47.0
May 22, 2024	33.0	39.0	32.5	34.8	44	35	44	41.0
May 23, 2024	29.6	37.4	32.0	33.0	64	40	46	50.0
May 24, 2024	28.2	36.6	33.3	32.7	70	38	42	50.0
May 25, 2024	28.4	34.6	27.5	30.2	74	42	67	61.0
May 26, 2024	28.8	33.9	33.5	32.1	75	46	43	54.7
May 27, 2024	25.2	36.9	30.7	30.9	91	34	51	58.7
May 28, 2024	28.3	37.1	31.5	32.3	75	39	48	54.0
May 29, 2024	30.2	36.2	34.5	33.6	58	36	39	44.3
May 30, 2024	30.2	36.8	30.0	32.3	59	39	55	51.0
May 31, 2024	26.7	33.7	32.5	31.0	75	41	43	53.0

Appendix 5 (continued)

Date	Temperature (°C)			Average	Humidity (%)			Average
	Morning	Afternoon	Afternoon		Morning	Afternoon	Day	
June 01, 2024	29.9	34.9	32.2	32.3	61	44	49	51.3
June 2, 2024	28.6	34.2	31.7	31.5	75	50	56	60.3
June 3, 2024	31.3	33.6	32.0	32.3	63	51	53	55.7
June 4, 2024	28.2	35.0	30.2	31.1	77	40	52	56.3
June 5, 2024	29.7	36.5	31.0	32.4	60	35	45	46.7
June 6, 2024	29.9	34.5	32.4	32.3	56	40	38	44.7
June 7, 2024	30.0	37.1	30.7	32.6	60	32	51	47.7
June 8, 2024	28.6	34.0	33.7	32.1	71	38	44	51.0
June 9, 2024	27.5	34.0	33.3	31.6	79	43	41	54.3
June 10, 2024	30.6	35.1	30.6	32.1	55	39	48	47.3
June 11, 2024	27.8	33.7	34.1	31.9	75	43	40	52.7
June 12, 2024	29.6	33.0	30.3	31.0	66	58	57	60.3
June 13, 2024	27.5	33.8	28.3	29.9	76	41	61	59.3
June 14, 2024	30.1	34.3	30.9	31.8	60	40	51	50.3
June 15, 2024	28.1	32.9	26.7	29.2	82	47	74	67.7
June 16, 2024	28.5	33.8	33.1	31.8	80	39	40	53.0
June 17, 2024	31.1	32.5	31.7	31.8	47	42	41	43.3
June 18, 2024	32.0	34.2	30.7	32.3	50	43	39	44.0
June 19, 2024	29.1	33.0	31.4	31.2	56	40	36	44.0
June 20, 2024	29.1	34.4	31.5	31.7	51	41	39	43.7
June 21, 2024	27.9	34.3	28.6	30.3	73	40	41	51.3
June 22, 2024	29.1	31.8	31.3	30.7	49	37	34	40.0
June 23, 2024	27.1	33.4	29.9	30.1	54	37	47	46.0
June 24, 2024	31.7	33.3	30.2	31.7	47	41	48	45.3
June 25, 2024	29.0	35.5	31.6	32.0	86	36	42	54.7
June 26, 2024	31.4	35.2	31.2	32.6	48	36	43	42.3
June 27, 2024	29.0	37.7	31.1	32.6	60	32	49	47.0
June 28, 2024	31.9	35.2	33.2	33.4	75	35	51	53.7
June 29, 2024	29.1	36.1	32.1	32.4	86	33	41	53.3
39 June 2024	26.5	35.5	32.1	31.4	72	37	41	50.0
July 1, 2024	29.8	36.1	31.3	32.4	64	33	39	45.3
July 2, 2024	30.6	37.1	30.0	32.6	56	30	52	46.0
July 3, 2024	30.3	31.4	30.9	30.9	52	50	51	51.0
July 4, 2024	28.3	34.2	30.9	31.1	63	41	52	52.0
July 5, 2024	28.7	34.6	29.9	31.1	59	35	49	47.7
July 6, 2024	27.3	32.4	28.6	29.4	65	41	55	53.7
July 7, 2024	29.3	32.2	31.5	31.0	57	43	45	48.3
Average	28.8	36.4	32.8	32.7	68.9	37.3	44.8	50.3
Elementary	±2.1	±2.9	±3.2	±2.0	±12.9	±5.8	±9.2	±6.1

Analysis of Variance of Plant Height at 28 HST (cm)

Main Plot	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		-----------------	cm	---------------		
V1	N1	208.50	216.00	233.75	658.25	219.42
	N2	213.75	208.75	217.00	639.50	213.17
	N3	223.25	211.25	206.75	641.25	213.75
	N4	192.50	220.50	210.50	623.50	207.83
V2	N1	209.00	205.75	202.50	617.25	205.75
	N2	210.75	226.00	206.50	643.25	214.42
	N3	217.00	215.50	212.25	644.75	214.92
	N4	202.75	200.50	213.75	617.00	205.67
Total					5084.75	
Average					211.86	

1. Calculation of Free Degree (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y_{....}^2}{N \times G \times R} = \frac{(5084.75)^2}{2 \times 4 \times 3} = 1077278.44$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Yi_j^{\,2} - FK$$
$$= (208.50)^{(2}) + (213.75)^2 + (223.25)^{(2)} + \ldots + (213.75)^2 - 1077278.44$$
$$= 1773.25$$

Appendix 6 (Continued)

4. Sum of Squares of Variety Treatment (V)

JK(V) $= \sum_i \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(2562.50)^2 + (2522.25)^2}{4 \times 3} - (1077278.44)$

$= 67.50$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(838.00)^2 + (856.50)^2 + (868.00)^2 + \dots + (835.00)^2}{4} - (1077278.44) - (67.50)$

$= 135.45$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j..}^2}{N \times R} - FK$

$= \frac{(1275.50)^2 + (1282.75)^2 + (1286.00)^2 + (1240.50)^2}{2 \times 3} - (1077278.44)$

$= 218.90$

6. Sum of Squares of Interaction

FK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij.}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(658.25)^2 + (639.50)^2 + (641.25)^2 + \dots + (617.00)^2}{3} - (1077278.44) - (67.50) - (218.90)$

$= 224.09$

7. Sum of Error Squares

JKE $= JKT - JK(V) - JK(N) - JK(V \times N)$

$= 1773.25 - 67.50 - 218.90 - 224.09 = 1127.30$

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{67.50}{2 - 1} = 67.50$

KT(Error(V)) $= \frac{JK\ (Error\ V)}{V \times (R - 1)} = \frac{135.45}{2 \times (3 - 1)} = 33.86$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{218.90}{4 - 1} = 72.97$

10. Calculation of Interaction Center Squares

KT(V× N) $= \frac{JK\ (V \times N)}{(V - 1)(N - 1)} = \frac{224.09}{(2 - 1)(4 - 1)} = 74.70$

Appendix 6 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R-1)(V-1)} = \frac{1127.30}{2(3-1)(4-1)} = 93.94$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V))}{KT(Error\ V)} = \frac{67.50}{33.86} = 1.99$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{72.97}{93.94} = 0.78$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V\times N)}{KTE} = \frac{74.70}{93.94} = 0.80$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	67.50	67.50	1.99 ^{ns}	7.71	21.20
Error V	4	135.45	33.86			
Subsidiary Plots						
Nutrition (N)	3	218.90	72.97	0.78^{ns}	3.49	5.95
V × N	3	224.09	74.70	0.80^{ns}	3.49	5.95
N error	12	1127.30	93.94			
Total	23	1773.25				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{67.50}}{211.86} \times 100\% = 2.75\%$

KK(N) $= \frac{\sqrt{KT(Error(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{93.94}}{211.86} \times 100\% = 4.57\%$

Analysis of Variance of Number of Leaves at 28 HST (strands)

Main Plot	Subsidiary Plots	Repeat 1	2	3	Total	Average
		strands				
V1	N1	27.00	27.00	27.00	81.25	27.08
	N2	27.00	26.00	28.00	80.25	26.75
	N3	27.00	27.00	26.00	80.50	26.83
	N4	25.00	28.00	27.00	79.50	26.50
V2	N1	28.00	28.00	26.00	81.00	27
	N2	27.00	29	28.00	83.00	27.67
	N3	28.00	29.00	27.00	83.50	27.83
	N4	28.00	27.00	28.00	82.25	27.42
Total					651.25	
Average					27.14	

1. Calculation of Free Degree (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,,^2}{N \times G \times R} = \frac{(651.25)^2}{2 \times 4 \times 3} = 17671.94$$

3. Calculation of Total Square Sum (JK)

$$JKT = \sum Yi_j^{\,2} - FK$$
$$= (27.00)^{(2}) + (27.00)^2 + (27.00)^{(2)} + .. . + (28.00)^2 - 17671.94$$
$$= 14.25$$

Appendix 7 (Continued)

4. Number of Squares Treatment Variety (V)

JK(V) $= \sum_{i} \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(321.50)^2 + (329.75)^2}{4 \times 3} - 17671.94$

$= 2.48$

JK(Error V) $= \sum_{(i,k)} \left(\frac{Y_{i.k}^2}{G}\right) - FK - JK(V)$

$= \frac{(105.75)^2 + (108.00)^2 + (107.75)^2 + \cdots + (108.25)^2}{4} - 17671.94 - 2.48$

$= 1.93$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_{j} \frac{Y_{.j.}^2}{N \times R} - FK$

$= \frac{(162.25)^2 + (163.25)^2 + (164.00)^2 + (161.75)^2}{2 \times 3} - 17671.94$

$= 0.51$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij.}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(81.25)^2 + (80.25)^2 + (80.50)^2 + \ldots + (79.50)^2}{3} - 17671.94 - 2.84 - 0.51$

$= 1.20$

7. Sum of Error Squares

JKE $= JKT - JK(V) - JK(N) - JK(V \times N)$

$= 14.25 - 2.84 - 0.51 - 1.20 = 7.78$

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{2.84}{2 - 1} = 2.84$

KT(V Error) $= \frac{JK(\text{Error V})}{V \times (R - 1)} = \frac{1.93}{2 \times (3 - 1)} = 0.48$

9. Calculation of Center Square of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{0.51}{4 - 1} = 0.17$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{1.2}{(2 - 1)(4 - 1)} = 0.40$

Appendix 7 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R-1)(V-1)} = \frac{7.78}{2(3-1)(4-1)} = 0.65$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V))}{KT(Error\ V)} = \frac{2.84}{0.48} = 5.89$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{0.17}{0.65} = 0.26$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{0.40}{0.65} = 0.61$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	2.84	2.84	5.89 ns	7.71	21.20
V error	4	1.93	0.48			
Subsidiary Plots						
Nutrition (N)	3	0.51	0.17	0.26 ns	3.49	5.95
V × N	3	1.20	0.40	0.61ns	3.49	5.95
N error	12	7.78	0.65			
Total	23	14.25				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.48}}{27.14} \times 100\% = 2.56\%$

KK(N) $= \frac{\sqrt{KT(Error(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.65}}{27.14} \times 100\% = 2.97\%$

Analysis of Variance of Stem Diameter at 70 HST (mm)

Main Plots	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		---------------- mm --------------				
V1	N1	10.23	11.18	10.63	32.04	10.68
	N2	11.08	10.95	11.13	33.16	11.05
	N3	10.88	10.80	11.45	33.13	11.04
	N4	10.58	10.65	11.00	32.23	10.74
V2	N1	9.23	8.70	8.53	26.46	8.82
	N2	9.83	8.75	9.08	27.66	9.22
	N3	9.10	9.20	8.78	27.08	9.03
	N4	8.65	9.00	9.63	27.28	9.09
Total					239.04	
Average					9.96	

1. Calculation of Free Degree (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y\ldots_{,,}^2}{N \times G \times R} = \frac{(239.04)^2}{2 \times 4 \times 3} = 2380.84$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Yi_j^{\,2} - FK$$
$$= (10.23)^2 + (11.08)^2 + (10.88)^{(2)} + \cdot\ ..+ (9.63)^2 - 2380.84$$
$$= 23.20$$

Appendix 8 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(130.56)^2 + (108.48)^2}{4 \times 3} - (2380.84)$

$= 20.31$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(42.77)^2 + (43.58)^2 + (44.21)^2 + ... + (36.02)^2}{4} - (2380.84) - (20.31)$

$= 0.44$

5. Sum of Squares Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j..}^2}{N \times R} - FK$

$= \frac{(58.50)^2 + (60.82)^2 + (60.21)^2 + (59.51)^2}{2 \times 3} - (2380.84)$

$= 0.50$

6. Sum of Squares of Interaction

FK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij.}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(32.04)^2 + (33.16)^2 + (33.13)^2 + ... + (27.28)^2}{3} - (2380.84) - (20.31) - (0.50)$

$= 0.10$

7. Sum of Error Squares

JKE $= JKT - JK(V) - JK(N) - JK(V \times N)$

$= 23.20 - 20.31 - 0.50 - 0.10 = 1.86$

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{20.31}{2 - 1} = 20.31$

KT(Error V) $= \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{0.44}{2 \times (3 - 1)} = 0.11$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{0.50}{4 - 1} = 0.17$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{0.10}{(2 - 1)(4 - 1)} = 0.03$

Appendix 8 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R-1)(V-1)} = \frac{1.86}{2(3-1)(4-1)} = 0.15$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V)}{KT(Error\ V)} = \frac{20.31}{0.11} = 186.32$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{0.17}{0.15} = 1.07$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{0.03}{0.15} = 0.22$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab	
					0.05	0.01
Main Plots						
Variety (V)	1	20.31	20.31	186.32**	7.71	21.20
V error	4	0.44	0.11			
Subsidiary Plots						
Nutrition (N)	3	0.50	0.17	1.07 ns	3.49	5.95
V × N	3	0.10	0.03	0.22ns	3.49	5.95
N error	12	1.86	0.15			
Total	23	23.20				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.11}}{9.96} \times 100\% = 3.32\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.15}}{9.96} \times 100\% = 3.95\%$

Appendix 8 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.11}{3 \times 4}} = 0.10$$

$HSD_{(0.05)}$ = q (0.05, 2, 4)

= 3.93 × 0.10 = 0.37

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Value Center	Difference		Notation
		V1	V2	
		10.88	9.04	
V1	10.88	0.00		a
V2	9.04	1.84	0.00	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

Analysis of Variance of Leaf Greenness at 28 HST (SPAD)

Main Plot	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		----------------SPAD-------------				
V1	N1	38.70	37.97	37.87	114.54	38.18
	N2	38.77	38.97	38.73	116.47	38.82
	N3	36.43	37.40	36.40	110.23	36.74
	N4	39.07	37.40	37.73	114.20	38.07
V2	N1	36.17	37.13	37.57	110.87	36.96
	N2	36.67	36.83	37.53	111.03	37.01
	N3	32.87	35.13	35.43	103.43	34.48
	N4	37.03	38.87	37.77	113.67	37.89
Total					894.44	
Average					37.27	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
Number of Errors V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrients (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y_{...,}^{2}}{N \times G \times R} = \frac{(894.44)^2}{2 \times 4 \times 3} = 33334.29$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}^{(2)} - FK$$
$$= (38.70)^2 + (38.77)^2 + (36.43)^{(2)} + .. . + (37.77)^2 - 33334.29$$
$$= 47.25$$

Appendix 9 (continued)

4. Sum of Squares Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(455.44)^2 + (439.00)^2}{4 \times 3} - 33334.29$

$= 11.26$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(152.97)^2 + (151.74)^2 + (150.73)^2 + \ldots + (148.30)^2}{4} - 33334.29 - 11.26$

$= 1.37$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j..}^2}{N \times R} - FK$

$= \frac{(225.41)^2 + (227.50)^2 + (213.66)^2 + (227.87)^2}{2 \times 3} - 33334.29$

$= 22.59$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(114.54)^2 + (116.47)^2 + (110.23)^2 + \ldots + (113.67)^2}{3} - 33334.29 - 11.26 - 22.59$

$= 3.67$

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 47.25 - 11.26 - 22.59 - 3.67= 4.24

8. Calculation of Center Squares of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V-1} = \frac{11.26}{2-1} = 11.26$

KT(V Error) $= \frac{JK(Error\ V)}{V \times (R-1)} = \frac{5.49}{2 \times (3-1)} = 1.37$

9. Calculation of Center Square of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N-1} = \frac{22.59}{4-1} = 7.53$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V-1)(N-1)} = \frac{3.67}{(2-1)(4-1)} = 1.22$

Appendix 9 (continued)

11. Calculation of Central Square of Error

KTE $= \frac{JKE}{V(R-1)(V-1)} = \frac{4.24}{2(3-1)(4-1)} = 0.35$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V))}{KT(Error\ V)} = \frac{11.26}{1.37} = 8.21$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{7.53}{0.35} = 21.29$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{1.22}{0.35} = 3.46$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	11.26	11.26	8.21*	7.71	21.20
V error	4	5.49	1.37			
Subsidiary Plots						
Nutrition (N)	3	22.59	7.53	21.29**	3.49	5.95
V × N	3	3.67	1.22	3.46 tn	3.49	5.95
Error N	12	4.24	0.35			
Total	23	47.25				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{5.17}}{37.27} \times 100\% = 3.14\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{3.54}}{37.27} \times 100\% = 1.60\%$

Appendix 9 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{1.37}{3\times4}} = 0.34$$

$$HSD_{(0.05)} = q\,(0.05, 2, 4)$$
$$= 3.93 \times 0.34 = 1.33$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		37.95	36.58	
V1	37.95	0.00		a
V2	36.58	1.37	0.00	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

19. Further Test Analysis BNJ (0.05) (Nutrient Treatment)

$$Sd= \sqrt{\frac{\text{KT Error (N)}}{R \times V}} = \sqrt{\frac{1.2}{3\times2}} = 0.24$$

$$HSD_{(0.05)} = q\,(0.05, 4, 12)$$
$$= 4.2 \times 0.24 = 1.02$$

20. Mean Value Matrix Table (Nutrient Treatment)

Treatment	Center Value	Difference				Notation
		N4	N2	N1	N3	
		37.98	37.92	37.57	35.61	
N4	37.98	0.00				a
N2	37.92	0.06	0.00			a
N1	37.57	0.41	0.35	0.00		a
N3	35.61	2.37	2.31	1.96	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Analysis of Variance of Total Leaf Chlorophyll Content (mg/g)

a. Analysis of Variance of Leaf Chlorophyll A Level (mg/g)

Main Plots	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		- - - - - - - - - mg/g - - - - - - -				
V1	N1	11.77	10.45	11.07	33.29	11.10
	N2	11.29	12.17	12.02	35.48	11.83
	N3	11.09	10.83	11.85	33.77	11.26
	N4	10.63	9.38	10.21	30.22	10.07
V2	N1	9.94	7.99	9.03	26.96	8.99
	N2	9.59	10.41	10.12	30.12	10.04
	N3	7.89	8.65	8.84	25.38	8.46
	N4	7.9	9.83	8.68	26.41	8.80
Total					241.63	
Average					10.07	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y_{...}^2}{N \times G \times R} = \frac{(241.63)^2}{2 \times 4 \times 3} = 2432.71$$

3. Calculation of Total Square Sum (JK)

$$JKT = \sum Y_{(i)(j)}^2 - FK$$
$$= (11.77)^2 + (11.29)^2 + (11.09)^2 + \ldots + (8.68)^2 - 2432.71$$
$$= 40.08$$

Appendix 10 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(132.76)^2 + (108.87)^2}{4 \times 3} - (2432.71)$

$= 23.78$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G}$ - FK - JK(V)

$= \frac{(44.78)^2 + (42.83)^2 + (45.15)^2 + ... + (36.67)^2}{4} - (2432.71) - (23.78)$

$= 1.14$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(60.25)^2 + (65.60)^2 + (59.15)^2 + (56.63)^2}{2 \times 3} - (2432.71)$

$= 7.14$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right)$ - FK - JK(V) - JK(N)

$= \frac{(33.29)^2 + (35.48)^2 + (33.77)^2 + ... + (26.41)^2}{3} - (2432.71) - (23.78) - (7.14)$

$= 1.84$

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 40.08 - 23.78 - 7.14 - 1.84 = 6.19

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{23.78}{2 - 1} = 23.78$

KT(V Error) $= \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{1.14}{2 \times (3 - 1)} = 0.28$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{7.14}{4 - 1} = 2.38$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{1.84}{(2 - 1)(4 - 1)} = 0.61$

Appendix 10.

11. Calculation of Central Square of Error

KTE $= \frac{JKE}{V(R - 1)(V - 1)} = \frac{6.19}{2(3 - 1)(4 - 1)} = 0.52$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V)}{KT(Error\ V)} = \frac{23.78}{0.28} = 83.80$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{2.38}{0.52} = 4.61$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V\times N)}{KTE} = \frac{0.61}{0.52} = 1.19$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	23.78	23.78	83.80**	7.71	21.20
Error V	4	1.14	0.28			
Subsidiary Plots						
Nutrition (N)	3	7.14	2.38	4.61*	3.49	5.95
V × N	3	1.84	0.61	1.19ns	3.49	5.95
N error	12	6.19	0.52			
Total	23	40.08				

Notes: ** = very real, * = real, ns = non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.28}}{10.07} \times 100\% = 5.29\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.52}}{10.07} \times 100\% = 7.13\%$

Appendix 10 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.28}{3\times4}} = 0.15$$

$HSD_{(0.05)}$ = q (0.05, 2, 4)

= 3.93 × 0.15 = 0.60

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		11.06	9.07	
V1	11.06	0.00		a
V2	9.07	1.99	0	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

19. Further Test Analysis BNJ (0.05) (Nutrient Treatment)

$$Sd= \sqrt{\frac{\text{KT Error (N)}}{R \times V}} = \sqrt{\frac{0.52}{3\times2}} = 0.29$$

$HSD_{(0.05)}$ = q (0.05, 4, 12)

= 4.2 × 0.29 = 1.23

20. Center Value Matrix Table (Nutritional Treatment)

Treatment	Center Value	Difference				Notation
		N2	N1	N3	N4	
		10.93	10.04	9.86	9.44	
N2	10.93	0.00				a
N1	10.04	0.89	0			ab
N3	9.86	1.08	0.18	0.00		ab
N4	9.44	1.50	0.60	0.42	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Appendix 10 (Continued)

b. Analysis of Variance of Leaf Chlorophyll B Level (mg/g)

Main Plots	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		--------- mg/g -------				
V1	N1	4.62	4.27	4.27	13.16	4.39
	N2	4.53	4.72	4.72	13.97	4.66
	N3	4.21	4.36	4.36	12.93	4.31
	N4	4.31	3.73	3.73	11.77	3.92
V2	N1	4.19	3.4	3.4	10.99	3.66
	N2	3.98	4.23	4.23	12.44	4.15
	N3	3.24	3.42	3.42	10.08	3.36
	N4	2.88	4.01	4.01	10.90	3.63
Total					96.24	
Average					4.01	

1. Calculation of Degrees of

   Freedom (df) R (Repeat) = 3
   V (Variety) = 2
   N (Nutrient) = 6
   db Variety (V) = V - 1 = 2 - 1 = 1
   db Error V = V(R - 1) = 2 × (3 - 1) = 4
   db Nutrient (N) = N - 1 = 4 - 1 = 3
   db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
   db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
   db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

   FK $= \frac{Y_{...,}^{2}}{N \times G \times R} = \frac{(96.24)^2}{2 \times 4 \times 3} = 385.92$

3. Calculation of Total Squared Sum (JK)

   JKT $= \sum Y_{(i)(j)}{}^{(2)} - FK$
   $= (4.62)^{(2)} + (4.53)^2 + (4.21)^{(2)} + \dots + (4.01)^2 - 385.92$
   $= 5.76$

Appendix 10 (Continued)

4. Sum of Squares of Treatment Variety (V)

$$JK(V) = \sum_i \frac{Y_{i..}^2}{G \times R} - FK$$

$$= \frac{(51.83)^2 + (44.41)^2}{4 \times 3} - 385.92$$

$$= 2.29$$

$$JK(Error\ V) = \sum_{(i,k)} \frac{Y_{i.k}^2}{G} - FK - JK(V)$$

$$= \frac{(17.67)^2 + (17.08)^2 + (17.08)^2 + ... + (15.06)^2}{4} - 385.92 - 2.29$$

$$= 0.16$$

5. Sum of Squares of Nutrient Treatment (N)

$$JK(N) = \sum_j \frac{Y_{.j.}^2}{N \times R} - FK$$

$$= \frac{(24.15)^2 + (26.41)^2 + (23.01)^2 + (22.67)^2}{2 \times 3} - 385.92$$

$$= 1.43$$

6. Sum of Squares of Interaction

$$JK(V \times N) = \sum_{(i,j)} \left(\frac{Y_{ij.}^2}{R}\right) - FK - JK(V) - JK(N)$$

$$= \frac{(13.16)^2 + (13.97)^2 + (12.93)^2 + ... + (10.90)^2}{3} - 385.92 - 2.29 - 1.43$$

$$= 0.36$$

7. Sum of Squares of Error

$$JKE = JKT - JK(V) - JK(N) - JK(V \times N)$$

$$= 5.76 - 2.29 - 1.43 - 0.36 = 1.52$$

8. Calculation of Center Square of Variety Treatment

$$(V)\ KT(V) = \frac{JK(V)}{V - 1} = \frac{2.29}{2 - 1} = 2.29$$

$$KT(V\ Error) = \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{0.16}{2 \times (3 - 1)} = 0.04$$

9. Calculation of Center Squares of Nutrient Treatment

$$(N)\ KT(N) = \frac{JK(N)}{N - 1} = \frac{1.43}{4 - 1} = 0.48$$

10. Calculation of Interaction Means

$$KT(V \times N) = \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{0.36}{(2 - 1)(4 - 1)} = 0.12$$

Appendix 10 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R-1)(V-1)} = \frac{1.52}{2(3-1)(4-1)} = 0.13$

12. F-Count of Variety Treatment (V)

F-Count (V) ()) $= \frac{(K)\,(T(V)}{KT(Error\ V)} = \frac{2.29}{0.04} = 58.51$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{0.48}{0.13} = 3.76$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V\times N)}{KTE} = \frac{0.12}{0.52} = 0.95$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab	
					0.05	0.01
Main Plots						
Variety (V)	1	2.29	2.29	58.51^{**}	7.71	21.20
V error	4	0.16	0.04			
Subsidiary Plots						
Nutrition (N)	3	1.43	0.48	3.76^{*}	3.49	5.95
V × N	3	0.36	0.12	0.95^{ns}	3.49	5.95
N error	12	1.52	0.13			
Total	23	5.76				

Notes: ** = very real, * = real, ns = non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.04}}{4.01} \times 100\% = 4.94\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.13}}{4.01} \times 100\% = 8.87\%$

Appendix 10.

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.04}{3\times4}} = 0.06$$

$HSD_{(0.05)}$ = q (0.05, 2, 4)

= 3.93 × 0.06 = 0.22

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference V1	Difference V2	Notation
		4.32	3.70	
V1	4.32	0.00		a
V2	3.70	0.62	0.00	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

19. Further Test Analysis BNJ (0.05) (Nutrient Treatment)

$$Sd = \sqrt{\frac{\text{KT Error (N)}}{R \times V}} = \sqrt{\frac{0.13}{3\times2}} = 0.15$$

$HSD_{(0.05)}$ = q (0.05, 4, 12)

= 4.2 × 0.15 = 0.61

20. Table of Matrix of Mean Values (Nutrient Treatment)

Treatment	Center Value	Difference N2	Difference N1	Difference N3	Difference N4	Notation
		4.40	4.03	3.84	3.78	
N2	4.40	0.00				a
N1	4.03	0.38	0.00			ab
N3	3.84	0.57	0.19	0.00		ab
N4	3.78	0.62	0.25	0.06	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), tn : (|µ1-µ2|< HSD0.05)

Appendix 10 (Continued)

c. Analysis of Variance of Total Leaf Chlorophyll Content (mg/g)

Main Plots	Child Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		- - - - - - - - - mg/g - - - - - - -				
V1	N1	21.43	19.1	20.27	60.80	20.27
	N2	20.60	22.13	21.89	64.62	21.54
	N3	20.13	19.76	21.61	61.50	20.50
	N4	19.41	17.09	18.69	55.19	18.40
V2	N1	18.23	14.67	16.44	49.34	16.45
	N2	17.56	19.01	18.4	54.97	18.32
	N3	14.43	15.75	16.18	46.36	15.45
	N4	14.28	17.96	15.92	48.16	16.05
Total					440.94	
Average					18.37	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,^2}{N \times G \times R} = \frac{(440.94)^2}{2 \times 4 \times 3} = 8101.17$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}^{(2)} - FK$$
$$= (21.43)^{(2)} + (20.60)^2 + (20.13)^{(2)} + \ldots + (15.92)^2 - 8101.17$$
$$= 76.45$$

Appendix 10 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(242.11)^2 + (198.83)^2}{4 \times 3} - (8101.17)$

$= 78.05$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \left(\frac{(81.57)^2 + (78.08)^2 + (82.46)^2 + \ldots + (66.94)^2}{4}\right) - (8101.17) - (78.05)$

$= 3.89$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j..}^2}{N \times R} - FK$

$= \frac{(110.14)^2 + (119.59)^2 + (107.86)^2 + (103.35)^2}{2 \times 3} - (8101.17)$

$= 23.43$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(60.80)^2 + (64.62)^2 + (61.50)^2 + \ldots + (48.16)^2}{3} - (8101.17) - (78.05) - (23.43)$

$= 5.80$

7. Sum of Error Squares

JKE $= JKT - JK(V) - JK(N) - JK(V \times N)$

$= 131.94 - 78.05 - 23.43 - 5.80 = 20.77$

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{78.05}{2 - 1} = 78.05$

KT(V Error) $= \frac{JK(\text{Error } V)}{V \times (R - 1)} = \frac{3.89}{2 \times (3 - 1)} = 0.97$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{23.43}{4 - 1} = 7.81$

10. Calculation of Interaction Mean Square

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{5.80}{(2 - 1)(4 - 1)} = 1.93$

Appendix 10 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R - 1)(V - 1)} = \frac{20.77}{2(3 - 1)(4 - 1)} = 1.73$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V)())}{KT(Error\ V)} = \frac{78.05}{0.97} = 80.28$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{7.81}{1.73} = 4.51$

14. F-Count Treatment Interaction

F-Count (V×N) $= \frac{KT(V\times N)}{KTE} = \frac{1.93}{1.73} = 1.12$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	78.05	78.05	80.28^{**}	7.71	21.20
V error	4	3.89	0.97			
Subsidiary Plots						
Nutrition (N)	3	23.43	7.81	4.51^{*}	3.49	5.95
V × N	3	5.80	1.93	1.12^{ns}	3.49	5.95
N error	12	20.77	1.73			
Total	23	131.94				

Notes: ** = very real, * = real, ns = non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.97}}{18.37} \times 100\% = 5.37\%$

KK(N) $= \frac{\sqrt{KT(Error(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{1.73}}{18.37} \times 100\% = 7.16\%$

Appendix 10 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.97}{3 \times 4}} = 0.28$$

$HSD_{(0.05)}$ = q (0.05, 2, 4)

= 3.93 × 0.28 = 1.12

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		20.18	16.57	
V1	20.18	0.00		a
V2	16.57	3.61	0.00	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

19. Further Test Analysis BNJ (0.05) (Nutrient Treatment)

$$Sd = \sqrt{\frac{\text{KT Error (N)}}{R \times V}} = \sqrt{\frac{1.93}{3 \times 2}} = 0.54$$

$HSD_{(0.05)}$ = q (0.05, 4, 12)

= 4.2 × 0.54 = 2.26

20. Matrix Table of Mean Values (Nutrient Treatment)

Treatment	Center Value	Difference				Notation
		N2	N1	N3	N4	
		19.93	18.36	17.98	17.23	
N2	v	0.00				a
N1	14.15	1.57	0			ab
N3	13.80	1.95	0.38	0.00		ab
N4	13.25	2.70	1.13	0.75	0.00	b

Notes: *: real (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Analysis of Variance of Leaf Carotenoid Content (mg/g)

Main Plots	Child Plots	Repeat			Total	Average
		1	2	3		
		---------mg/g-------				
V1	N1	47.48	44.48	46.12	138.08	46.03
	N2	48.62	49.00	46.26	143.88	47.96
	N3	44.61	45.41	47.97	137.99	46.00
	N4	43.76	39.34	42.21	125.31	41.77
V2	N1	42.78	34.03	36.95	113.76	37.92
	N2	41.68	43.78	41.55	127.01	42.34
	N3	34.18	38.14	39.01	111.33	37.11
	N4	31.43	42.62	36.49	110.54	36.85
Total					1007.90	
Average					42.00	

1. Calculation of Free Degree (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

FK $= \frac{Y...,,^2}{N \times G \times R} = \frac{(1007.90)^2}{2 \times 4 \times 3} = 42327.60$

3. Calculation of Total Squared Sum (JK)

JKT $= \sum Y_{(i)\,(j}\,)\,(_2{}^) - FK$
$= (47.48)^2 + (48.62)^2 + {}^{((}44.61)^{(2)+..}) + (36.49)^2 - 42327.60$
$= 548.99$

Appendix 11 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(545.26)^2 + (462.64)^2}{4 \times 3} - 42327.60$

= 284.42

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G}$ - FK - JK(V)

$= \frac{(184.47)^2 + (178.23)^2 + (182.56)^2 + ... + (154.00)^2}{4} - (42327.60) - (284.42)$

= 14.16

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(251.84)^2 + (270.89)^2 + (249.32)^2 + (235.85)^2}{2 \times 3} - 42327.60$

= 104.14

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right)$ - FK - JK(V) - JK(N)

$= \frac{(138.08)^2 + (143.88)^2 + (137.99)^2 + ... + (110.54)^2}{3} - 42327.60 - 284.42) - 104.14$

= 16.41

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 548.99 - 284.42 - 104.14 - 16.41 = 129.86

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{284.42}{2 - 1}$ = 284.42

KT(V Error) $= \frac{JK(Error V)}{V \times (R - 1)} = \frac{14.16}{2 \times (3 - 1)}$ = 3.54

9. Calculation of Center Square of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{104.14}{4 - 1}$ = 34.71

Appendix 11 (Continued)

10. Calculation of Interaction Means

$$KT(V \times N) = \frac{(JK)((V)\times(N))}{(V-1)(N-1)} = \frac{16.41}{(2-1)(4-1)} = 5.47$$

11. Calculation of Central Square of Error

$$KTE = \frac{MSE}{V(R-1)(V-1)} = \frac{129.86}{2(3-1)(4-1)} = 10.82$$

12. F-Count of Variety Treatment (V)

$$\text{F-Count}(V) = \frac{(K)(T(V))}{KT(\text{Error } V)} = \frac{284.42}{3.54} = 80.35$$

13. F-Count of Nutrient Treatment (N)

$$\text{F-Count}(N) = \frac{KT(N)}{KTE} = \frac{34.71}{10.82} = 3.21$$

14. F-Count of Interaction Treatment

$$\text{F-Count}(V \times N) = \frac{(K)(T(V)(\times N))}{KTE} = \frac{}{10.82} = 0.51$$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	284.42	284.42	80.35**	7.71	21.20
V error	4	14.16	3.54			
Subsidiary Plots						
Nutrition (N)	3	104.14	34.71	3.21 ns	3.49	5.95
V × N	3	16.41	5.47	0.51ns	3.49	5.95
N error	12	129.86	10.82			
Total	23	548.99				

Description: ** = very real, * = real, ns = non-real

16. Coefficient of Variance (CoW)

$$KK(V) = \frac{\sqrt{KT(\text{Error}(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{3.54}}{42.00} \times 100\% = 4.48\%$$

$$KK(N) = \frac{\sqrt{KT(\text{Error}(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{5.47}}{42.00} \times 100\% = 7.83\%$$

Appendix 11 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{3.54}{3{\times}4}} = 0.54$$

$HSD_{(0.05)}$ = q (0.05, 2, 4)

= 3.93 × 0.54 = 2.13

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		45.44	38.55	
V1	45.44	0.00		a
V2	38.55	6.89	0	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

Analysis of Variance of Nitrate Reductase Activity (μmol $NO_{(2)-}$. g^{-1} . $h^{(-)(1)}$)

Main Plots	Child Plot	Repeat 1	Repeat 2	Repeat 3	Total	Average
		---μmol NO_2^- . g^{-1} hour^{-1} —				
V1	N1	5064.8	3629.32	920.87	9614.99	3205.00
	N2	2,958.98	5,254.39	1,401.62	9,614.99	3,205.00
	N3	3,724.12	2132.9	2,505.32	8362.34	2787.45
	N4	2,938.67	4082.99	3,385.56	10,407.22	3,469.07
V2	N1	1523.5	5,708.06	4,875.21	12,106.77	4035.59
	N2	3236.6	1340.68	1503.19	6080.47	2026.82
	N3	907.33	2,986.07	2,437.61	6331.01	2110.34
	N4	3,818.92	3236.6	3940.8	10,996.32	3,665.44
Total					73,514.11	
Average					3063.09	

1. Calculation of Degrees of

Freedom (df) R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y_{...,}^2}{N \times G \times R} = \frac{(73514.11)^2}{2 \times 4 \times 3} = 225180182.05$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}{}^{(2)} - FK$$
$$= (5064.80)^2 + (2958.98)^2 + (3724.12)^{(2)} + .. + (3940.80)^2 - 225{,}180{,}182.05$$
$$= 43{,}758{,}958.27$$

Appendix 12 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(37999.54)^2 + (35514.57)^{(2)}}{4 \times 3} - (225180182.05)$

$= 257{,}294.83$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(14686.57)^{(2)} + (15099.60)^{(2)} + (8213.37)^{(2)} + ... + (12756.81)^{(2)}}{4} - 38059.16) (-)$

257,294.83

= 9565039.72

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(21721.76)^{(2)} + (15695.46)^{(2)} + (14693.35)^{(2)} + (21403.54)^{(2)}}{2 \times 3} - (225180182.05)$

= 6851214.77

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(9614.99)^{(2)} + (9614.99)^{(2)} + (8362.34)^{(2)} + ... + (10996.32)^{(2)}}{3} - 225180182.05) (-)$

257,294.83 - 6,851,214.77

= 3,605,228.43

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 43,758,958.27 - 257,294.83 - 6,851,214.77 - 3,605,228.43

= 23,480,180.52

8. Calculation of Center Squares of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{257{,}294.83}{2 - 1} = 257{,}294.83$

KT(Error V) $= \frac{JK(\text{Error } V)}{V \times (R - 1)} = \frac{9{,}565{,}039.72}{2 \times (3 - 1)} = 2{,}391{,}259.93$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{6851214.77}{4 - 1} = 2283738.26$

Appendix 12 (Continued)

10. Calculation of Interaction Mean Square

$$KT(V \times N) = \frac{SS(V \times N)}{(V-1)(N-1)} = \frac{3{,}605{,}228.43}{(2-1)(4-1)} = 1{,}201{,}742.81$$

11. Calculation of Central Square of Error

$$KTE = \frac{CSE}{V(R-1)(V-1)} = \frac{3968.67}{2(3-1)(4-1)} = 1{,}956{,}681.71$$

12. F-Count of Variety Treatment (V)

$$\text{F-Count}(V) = \frac{KT(V)}{KT(\text{Error } V)} = \frac{257294.83}{2391259.93} = 0.11$$

13. F-Count of Nutrient Treatment (N)

$$\text{F-Count}(N) = \frac{KT(N)}{KTE} = \frac{2{,}283{,}738.26}{1{,}956{,}681.71} = 1.17$$

14. F-Count of Interaction Treatment

$$\text{F-Count}(V \times N) = \frac{KT(V \times N)}{KTE} = \frac{1201742.81}{1956681.71} = 0.61$$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	257,294.83	257,294.83	0.11^{ns}	7.71	21.20
Error V	4	9565039.72	2,391,259.93			
Subsidiary Plots						
Nutrition (N)	3	6,851,214.77	2,283,738.26	1.17^{ns}	3.49	5.95
V × N	3	3605228.43	1201742.81	0.61^{ns}	3.49	5.95
Error N	12	23480180.52	1,956,681.71			
Total	23	43,758,958.27				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

$$KK(V) = \frac{\sqrt{KT(\text{Error}(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{2391259.93}}{30633.09} \times 100\% = 50.48\%$$

$$KK(N) = \frac{\sqrt{KT(\text{Error}(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{1956681.71}}{30633.09} \times 100\% = 45.67\%$$

Appendix 12.

Data Transformation of Nitrate Reductase Activity with Formula ($\sqrt[3]{x}$)

Main Plots	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		---µmol NO^-_2. g^{-1} . h^{-1} ---				
V1	N1	61.62	54.85	34.53	151.00	50.33
	N2	51.46	62.29	39.95	153.70	51.23
	N3	55.52	46.04	48.75	150.31	50.10
	N4	51.46	56.88	53.49	161.83	53.94
V2	N1	41.3	63.65	60.94	165.89	55.30
	N2	52.81	39.27	41.3	133.38	44.46
	N3	34.53	51.46	48.08	134.07	44.69
	N4	56.2	52.81	56.2	165.21	55.07
Total					1215.39	
Average					50.64	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrition) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

FK $= \frac{Y...,^2}{N \times G \times R} = \frac{(1215.39)^2}{2 \times 4 \times 3} = 61548.87$

3. Calculation of Total Square Sum (JK)

JKT $= \sum Y_{(i)(j)}{}^{(2)} - FK$
$= (61.62)^{(2)} + (51.46)^2 + (55.52)^{(2)} + ... + (56.2)^2 - 61548.87$
$= 1661.87$

Appendix 12 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(616.84)^2 + (598.55)^{(2)} (-) (}{4 \times 3}$ 61548.87)

= 13.94

JK(Error V) $= \sum_{(i,k)} (\frac{Y_{i,k}^2}{G}) - FK - JK(V)$

$= \frac{(220.06)^{(2)} + (220.06)^{(2)} + (176.72)^{(2)} + ... + (206.52)^{(2)} (-) (}{4}$ 61548.87) (-) () () (13.94))

= 393.89

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$(=) \frac{(316.89)^{(2)} + (287.08)^{(2)} + (284.38)^{(2)} + (327.04)^{(2)} (-) (}{2 \times 3}$ 61548.87)

= 228.02

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} (\frac{Y_{ij..}^2}{R}) - FK - JK(V) - JK(N)$

$= \frac{(151.00)^{(2)} + (153.70)^{(2)} + (150.31)^{(2)} + ... + (165.21)^{(2)} (-) (}{3}$ 61548.87) (-) (13.94) (-) ())

228.02

= 137.69

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 1661.87 - 13.94 - 228.02 - 137.69 = 888.32

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{(JK)((V))}{V - 1} = \frac{(13.94)}{2 - 1} = 13.94$

KT(V Error) $= \frac{(JK)(Error (V))}{V \times (R - 1)} = \frac{393.89}{2 \times (3 - 1)} = 98.47$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{(JK)((N))}{N - 1} = \frac{(228.02)}{4 - 1} = 76.01$

Appendix 12 (continued)

10. Calculation of Interaction Means

$$KT(V \times N) \quad \frac{(JK)((V) \times (N))}{(V-1)(N-1)} = \frac{137.69}{(2-1)(4-1)} = 45.90$$

11. Calculation of Central Square of Error

$$KTE = \frac{MSE}{V(R-1)(V-1)} = \frac{888.32}{2(3-1)(4-1)} = 74.03$$

12. F-Count of Variety Treatment (V)

$$\text{F-Count (V)} = \frac{(K)(T(V))}{KT(\text{Error } V)} = \frac{13.94}{98.47} = 0.14$$

13. F-Count of Nutrient Treatment (N)

$$\text{F-Count (N)} = \frac{KT(N)}{KTE} = \frac{76.01}{74.03} = 1.03$$

14. Interaction Treatment F-Count

$$\text{F-Count } (V \times N) = \frac{KT(V \times N)}{KTE} = \frac{45.90}{74.03} = 0.62$$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab	
					0.05	0.01
Main Plots						
Variety (V)	1	13.94	13.94	0.14 ns	7.71	21.20
V error	4	393.89	98.47			
Subsidiary Plots						
Nutrition (N)	3	228.02	76.01	1.03 ns	3.49	5.95
V × N	3	137.69	45.90	0.62ns	3.49	5.95
N error	12	888.32	74.03			
Total	23	1661.87				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

$$KK(V) = \frac{\sqrt{KT(\text{Error}(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{98.47}}{50.64} \times 100\% = 19.60\%$$

$$KK(N) = \frac{\sqrt{KT(\text{Error}(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{74.03}}{50.64} \times 100\% = 16.99\%$$

Appendix 13. Analysis of Variance of Number of Stomata (Stomata/mm^2)

Main Plots	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		---------Stomata/mm^2 -------				
V1	N1	244	198	262	704.00	234.67
	N2	189	255	288	732.00	244.00
	N3	187	272	224	683.00	227.67
	N4	240	181	236	657.00	219.00
V2	N1	177	135	181	493.00	164.33
	N2	186	237	129	552.00	184.00
	N3	203	166	159	528.00	176.00
	N4	178	160	220	558.00	186.00
Total					4907.00	
Average					204.46	

1. Calculation of Free Degree (db)

   R (Repeat) = 3
   V (Variety) = 2
   N (Nutrient) = 6
   db Variety (V) = V - 1 = 2 - 1 = 1
   db Error V = V(R - 1) = 2 × (3 - 1) = 4
   db Nutrient (N) = N - 1 = 4 - 1 = 3
   db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
   db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
   db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

   FK $= \frac{Y...,,^2}{N \times G \times R} = \frac{(4907.00)^2}{2 \times 4 \times 3} = 1003277.04$

3. Calculation of Total Squared Sum (JK)

   JKT $= \sum Y_{(i)\,(j}\,)\,(_2)$ - FK
   $= (244)^{(2}\,) + (189)^2 + (187)^{(2)} + ..\,. + (220)^2 - 1003277.04$
   = 42433.96

Appendix 13 (Continued)

4. Sum of Squares of Variety Treatment (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(2776)^2 + (2131)^2}{4 \times 3} - (1003277.04)$

= 17,334.38

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(860)^2 + (906)^2 + (1010)^2 + ... + (689)^2}{4} - (1003277.04) - (17334.38)$

= 3387.83

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(1197)^2 + (1284)^2 + (1211)^2 + (1215)^2}{2 \times 3} - (1003277.04)$

= 758.13

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(704)^2 + (732)^2 + (683)^2 + ... + (558)^2}{3} - 1003277.04 - 17334.38 - 758.13$

= 1123.46

7. Sum of Squares of Error

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 42433.96 - 17334.38 - 758.13 - 1123.46= 19830.17

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{17334.38}{2 - 1} = 17334.38$

KT(Error V) $= \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{3387.83}{2 \times (3 - 1)} = 846.96$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{758.13}{4 - 1} = 252.71$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{1123.46}{(2 - 1)(4 - 1)} = 374.49$

Appendix 13 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R-1)(V-1)} = \frac{19830.17}{2(3-1)(4-1)} = 1652.51$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)\ (T(V)}{KT(Error\ V)} = \frac{17334.38}{846.96} = 20.47$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{252.71}{1652.51} = 0.15$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V\times N)}{KTE} = \frac{374.49}{1652.52} = 0.23$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-hit	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	17334.38	17,334.38	20.47^{*}	7.71	21.20
V error	4	3387.83	846.96			
Subsidiary Plots						
Nutrition (N)	3	758.13	252.71	0.15^{ns}	3.49	5.95
V × N	3	1123.46	374.49	0.23^{ns}	3.49	5.95
N error	12	19,830.17	1652.51			
Total	23	42,433.96				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{846.96}}{204.46} \times 100\% = 14.23\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{1652.51}}{204.46} \times 100\% = 19.88\%$

Appendix 13 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{846.96}{3\times 4}} = 8.40$$

$$HSD_{0.05} = q\,(0.05, 2, 4)$$

$$= 3.93 \times 8.40 = 33.02$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		231.33	177.58	
V1	231.33	0.00		a
V2	177.58	53.75	0	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

Variety Analysis of Male Flower Emergence Time (HST)

Main Plot	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		----------------HST-------------				
V1	N1	28	24	30	82	27.25
	N2	23	25	24	72	24.00
	N3	27	29	29	85	28.17
	N4	26	24	25	75	25.08
V2	N1	23	22	22	66	22.08
	N2	21	21	21	63	20.92
	N3	22	22	23	67	22.25
	N4	21	21	22	64	21.17
Total					572.75	
Average					23.86	

1. Calculation of Free Degrees (db)

   R (Repeat) = 3
   V (Variety) = 2
   N (Nutrient) = 6
   db Variety (V) = V - 1 = 2 - 1 = 1
   db Error V = V(R - 1) = 2 × (3 - 1) = 4
   db Nutrient (N) = N - 1 = 4 - 1 = 3
   db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
   db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
   db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

   FK $= \frac{Y_{...}^2}{N \times G \times R} = \frac{(572.75)^2}{2 \times 4 \times 3} = 13668.44$

3. Calculation of Total Squared Sum (JK)

   JKT $= \sum Y_{(i)(j)}^{(2)} - FK$
   $= (28)^{(2)} + (23)^{(2)} + (27)^{(2)} + \ldots + (22)^2 - 13668.44$
   $= 187.50$

Appendix 14 (Continued)

4. Sum of Squares of Variety Treatment (V)

$$JK(V) = \sum_i \frac{Y_{i..}^2}{G \times R} - FK$$

$$= \frac{(313.50)^2 + (259.25)^2}{4 \times 3} - 13668.44$$

$$= 122.63$$

$$JK(Error\ V) = \sum_{(i,k)} \frac{Y_{i,k}^2}{G} - FK - JK(V)$$

$$= \frac{(104.00)^2 + (101.25)^2 + (108.25)^2 + ... + (87.00)^2}{4} - 13668.44 - 122.63$$

$$= 6.73$$

5. Sum of Squares of Nutrient Treatment (N)

$$JK(N) = \sum_j \frac{Y_{j..}^2}{N \times R} - FK$$

$$= \frac{(148.00)^2 + (134.75)^2 + (151.25)^2 + (138.75)^2}{2 \times 3} - 13668.44$$

$$= 29.84$$

6. Sum of Squares of Interaction

$$JK(V \times N) = \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$$

$$= \frac{(81.75)^2 + (72.00)^2 + (84.50)^2 + ... + (63.50)^2}{3} - 13668.44 - 122.63 - 29.84$$

$$= 7.20$$

7. Sum of Squares of Error

$$JKE = JKT - JK(V) - JK(N) - JK(V \times N)$$

$$= 187.50 - 122.63 - 9.95 - 7.20 = 21.10$$

8. Calculation of Center Square of Variety Treatment

$$(V)\ KT(V) = \frac{JK(V)}{V - 1} = \frac{122.63}{2 - 1} = 122.63$$

$$KT(V\ Error) = \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{6.73}{2 \times (3 - 1)} = 1.68$$

9. Calculation of Center Squares of Nutrient Treatment

$$(N)\ KT(N) = \frac{JK(N)}{N - 1} = \frac{29.84}{4 - 1} = 9.95$$

10. Calculation of Interaction Means

$$KT(V \times N) = \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{7.20}{(2 - 1)(4 - 1)} = 2.40$$

Appendix 14 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R-1)(V-1)} = \frac{21.10}{2(3-1)(4-1)} = 1.76$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)\,(T(V)}{KT(Error\ V)} = \frac{122.63}{1.68} = 72.89$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{9.95}{1.76} = 5.66$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{2.40}{1.76} = 1.36$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab	
					0.05	0.01
Main Plots						
Variety (V)	1	122.63	122.63	72.89^{**}	7.71	21.20
V error	4	6.73	1.68			
Subsidiary Plots						
Nutrition (N)	3	29.84	9.95	5.66^{*}	3.49	5.95
V × N	3	7.20	2.40	1.36^{ns}	3.49	5.95
N error	12	21.10	1.76			
Total	23	187.50				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{1.68}}{23.86} \times 100\% = 5.43\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{1.76}}{23.86} \times 100\% = 5.56\%$

Appendix 14 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{1.68}{3 \times 4}} = 0.37$$

$$HSD_{(0.05)} = q\,(0.05, 2, 4)$$
$$= 3.93 \times 0.37 = 1.47$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference V1 26.13	Difference V2 21.60	Notation
V1	26.13	0.00		a
V2	21.60	4.53	0	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

19. Further Test Analysis BNJ (0.05) (Nutrient Treatment)

$$Sd = \sqrt{\frac{\text{KT Error (N)}}{R \times V}} = \sqrt{\frac{1.76}{3 \times 2}} = 0.54$$

$$HSD_{(0.05)} = q\,(0.05, 4, 12)$$
$$= 4.2 \times 0.54 = 2.27$$

20. Matrix Table of Mean Values (Nutrient Treatment)

Treatment	Center Value	Difference N3 25.21	Difference N1 24.67	Difference N4 23.13	Difference N2 22.46	Notation
N3	25.21	0.00				a
N1	24.67	0.54	0.00			ab
N4	23.13	2.08	1.54	0.00		ab
N2	22.46	2.75	2.21	0.67	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Analysis of Variance of Female Flower Emergence Time (HST)

Main Plot	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		----------------HST-------------				
V1	N1	28	27	27	82.50	27.50
	N2	27	26	27	79.75	26.58
	N3	26	28	27	80.50	26.83
	N4	26	26	27	79.00	26.33
V2	N1	26	26	25	76.25	25.42
	N2	25	25	25	74.75	24.92
	N3	25	25	24	73.25	24.42
	N4	24	25	24	72.75	24.25
Total					618	
Average					25.78	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

FK $= \frac{Y\ldots,,^2}{N \times G \times R} = \frac{(618.75)^2}{2 \times 4 \times 3} = 15952.15$

3. Calculation of Total Squared Sum (JK)

JKT $= \sum Y_{(i)\,(j\,)}\ (_2{}^) $ - FK
$= (28^{)(2}\ ) + (27)^{(2)\,+}\ (26)^{(2)\,+..}\ . + (24)^2 - 15952.15$
= 36.41

Appendix 15 (Continued)

4. Sum of Squares of Variety Treatment (V)

JK(V) $= \sum_i \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(321.75)^2 + (297.00)^2}{4 \times 3} - 15952.15$

$= 25.52$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{i.k}^2}{G} - FK - JK(V)$

$= \frac{(107.00)^2 + (106.75)^2 + (108.00)^2 + ... + (97.75)^2}{4} - 15952.15 - 25.52$

$= 1.00$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{.j.}^2}{N \times R} - FK$

$= \frac{(158.75)^2 + (154.50)^2 + (153.75)^2 + (151.75)^2}{2 \times 3} - 15952.15$

$= 4.34$

6. Sum of Squares of Interaction

FK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij.}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(82.50)^2 + (79.75)^2 + (80.50)^2 + ... + (72.75)^2}{3} - 15952.15 - 25.52 - 4.34$

$= 0.42$

7. Sum of Error Squares

JKE $= JKT - JK(V) - JK(N) - JK(V \times N)$

$= 36.41 - 25.52 - 4.34 - 0.42 = 5.13$

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{25.52}{2 - 1} = 25.52$

KT(V Error) $= \frac{JK(\text{Error } V)}{V \times (R - 1)} = \frac{1.00}{2 \times (3 - 1)} = 0.25$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{4.34}{4 - 1} = 1.45$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{0.42}{(2 - 1)(4 - 1)} = 0.14$

Appendix 15.

11. Calculation of Central Square of Error

$$KTE = \frac{JKE}{V(R-1)(V-1)} = \frac{5.13}{2(3-1)(4-1)} = 0.43$$

12. F-Count of Variety Treatment (V)

$$\text{F-Count (V)} = \frac{(K)\ (T(V)}{KT(\text{Error V})} = \frac{25.52}{0.25} = 102.09$$

())

13. F-Count of Nutrient Treatment (N)

$$\text{F-Count (N)} = \frac{KT(N)}{KTE} = \frac{1.45}{0.43} = 3.39$$

14. F-Count of Interaction Treatment

$$\text{F-Count (V×N)} = \frac{KT(V\times N)}{KTE} = \frac{0.14}{0.43} = 0.33$$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	25.52	25.52	102.09**	7.71	21.20
Error V	4	1.00	0.25			
Subsidiary Plots						
Nutrition (N)	3	4.34	1.45	3.39 ns	3.49	5.95
V × N	3	0.42	0.14	0.33ns	3.49	5.95
N error	12	5.13	0.43			
Total	23	36.41				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

$$KK(V) = \frac{\sqrt{KT(\text{Error (V)})}}{\bar{X}} \times 100\% = \frac{\sqrt{0.25}}{25.78} \times 100\% = 1.94\%$$

$$KK(N) = \frac{\sqrt{KT(\text{Error (N)})}}{\bar{X}} \times 100\% = \frac{\sqrt{0.43}}{25.78} \times 100\% = 2.53\%$$

Appendix 15 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.25}{3\times 4}} = 0.14$$

$HSD_{(0.05)}$ $= q\ (0.05, 2, 4)$

$= 3.93 \times 0.14 = 0.57$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		26.81	24.57	
V1	26.81	0.00		a
V2	24.57	2.24	0	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

Analysis of Variance of Number of Male Flowers (Flower/Plant)

Main Plots	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		--------Bunga/Tanaman-----				
V1	N1	6	6	3	15.25	5.08
	N2	7	7	8	22.25	7.42
	N3	7	4	5	15.75	5.25
	N4	6	5	7	18.90	6.30
V2	N1	21	25	26	72.00	24.00
	N2	23	22	28	72.25	24.08
	N3	23	21	22	65.25	21.75
	N4	24	23	25	71.75	23.92
Total					353.40	
Average					14.73	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,,^2}{N \times G \times R} = \frac{(353.40)^2}{2 \times 4 \times 3} = 5203.82$$

3. Calculation of Total Square Sum (JK)

JKT $= \sum Y_{(i)\,(j}\,)\,(^{2)}$ - FK
$= (6)^{(2)}) + (7)^2 + (7)^{(2)}) + \cdot.. + (25)^2 - 5203.82$
= 1894.95

Appendix 16 (Continued)

4. Sum of Squares of Treatment Variety (V)

$$JK(V) = \sum_i \frac{Y_{i..}^2}{G \times R} - FK$$

$$= \frac{(72.15)^2 + (281.25)^2}{4 \times 3} - (5203.82)$$

$= 1821.78$

$$JK(Error\ V) = \sum_{(i,k)} \frac{Y_{i.k}^2}{G} - FK - JK(V)$$

$$= \frac{(25.75)^2 + (22.75)^2 + (23.65)^2 + ... + (101.00)^2}{4} - (5203.82) - (1821.78)$$

$= 20.97$

5. Sum of Squares of Nutrient Treatment (N)

$$JK(N) = \sum_j \frac{Y_{.j.}^2}{N \times R} - FK$$

$$= \frac{(87.25)^2 + (94.50)^2 + (81.00)^2 + (90.65)^2}{2 \times 3} - (5203.82)$$

$= 16.39$

6. Sum of Squares of Interaction

$$JK(V \times N) = \sum_{(i,j)} \left(\frac{Y_{ij.}^2}{R}\right) - FK - JK(V) - JK(N)$$

$$= \frac{(15.25)^2 + (22.25)^2 + (15.75)^2 + ... + (71.75)^2}{3} - (5203.82) - (1821.78) - (16.39)$$

$= 5.54$

7. Sum of Squares of Error

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 1894.95 - 1821.78 - 16.39 - 5.54 = 30.27

8. Calculation of Center Square of Variety Treatment

$$(V)\ KT(V) = \frac{JK(V)}{V - 1} = \frac{1821.78}{2 - 1} = 1821.78$$

$$KT(V\ Error) = \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{20.97}{2 \times (3 - 1)} = 5.24$$

9. Calculation of Center Squares of Nutrient Treatment

$$(N)\ KT(N) = \frac{JK(N)}{N - 1} = \frac{16.39}{4 - 1} = 5.46$$

10. Calculation of Interaction Means

$$KT(V \times N) = \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{5.54}{(2 - 1)(4 - 1)} = 1.85$$

Appendix 16 (continued)

11. Calculation of Central Square of Error

KTE $= \frac{JKE}{V(R - 1)(V - 1)} = \frac{30.27}{2(3 - 1)(4 - 1)} = 2.52$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)\,(T(V)\,())}{KT(Error\ V)} = \frac{1821.78}{5.24} = 347.57$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{5.46}{2.52} = 2.17$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V\times N)}{KTE} = \frac{1.85}{2.52} = 0.73$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	1821.78	1821.78	347.57**	7.71	21.20
V error	4	20.97	5.24			
Subsidiary Plots						
Nutrition (N)	3	16.39	5.46	2.17 ns	3.49	5.95
V × N	3	5.54	1.85	0.73ns	3.49	5.95
N error	12	30.27	2.52			
Total	23	1894.95				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{5.24}}{14.73} \times 100\% = 15.55\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{2.52}}{14.73} \times 100\% = 10.79\%$

Appendix 16 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{5.24}{3\times4}} = 0.66$$

$$HSD_{(0.05)} = q\,(0.05, 2, 4)$$
$$= 3.93 \times 0.66 = 2.60$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V2	V1	
		23.44	6.01	
V2	23.44	0.00		a
V1	6.01	17.43	0	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

Appendix 17. Analysis of Variance Number of Female Flowers (Flower/Plant)

Main Plot	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		--------Bunga/Tanaman-----				
V1	N1	3	2	3	7.50	2.50
	N2	2	2	2	5.50	1.83
	N3	3	2	2	6.25	2.08
	N4	3	3	2	7.75	2.58
V2	N1	4	4	3	11.25	3.75
	N2	5	5	4	13.50	4.50
	N3	5	6	4	14.25	4.75
	N4	6	4	6	16.50	5.50
Total					82.50	
Average					3.44	

1. Calculation of Free Degree (db)

   R (Repeat) = 3
   V (Variety) = 2
   N (Nutrient) = 6
   db Variety (V) = V - 1 = 2 - 1 = 1
   db Error V = V(R - 1) = 2 × (3 - 1) = 4
   db Nutrition (N) = N - 1 = 4 - 1 = 3
   db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
   db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
   db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

   FK $= \frac{Y...,,^2}{N \times G \times R} = \frac{(82.50)^2}{2 \times 4 \times 3} = 283.59$

3. Calculation of Total Squared Sum (JK)

   JKT $= \sum Y_{(i)\,(j}\,)\,(_2{}^{)}$ - FK
   $= (3)^{)(2}\,) + (2)^2 + (3)^{(2}\,)+\cdot .. + (6)^2 - 283.59$
   = 50.28

Appendix 17 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(27.00)^2 + (55.50)^2}{4 \times 3} - 283.59$

$= 33.84$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(11.00)^2 + (7.75)^2 + (8.25)^2 + ... + (17.00)^2}{4} - 283.59 - 33.84$

$= 2.50$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j..}^2}{N \times R} - FK$

$= \frac{(18.75)^2 + (19.00)^2 + (20.50)^2 + (24.25)^2}{2 \times 3} - 283.59$

$= 3.22$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(7.50)^2 + (5.50)^2 + (6.25)^2 + ... + (16.50)^2}{3} - 283.59 - 33.84 - 3.22$

$= 2.59$

7. Sum of Error Squares

JKE $= JKT - JK(V) - JK(N) - JK(V \times N)$

$= 283.59 - 33.84 - 3.22 - 2.59 = 8.13$

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{33.84}{2 - 1} = 33.84$

KT(V Error) $= \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{2.50}{2 \times (3 - 1)} = 0.63$

9. Calculation of Center Square of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{3.22}{4 - 1} = 1.07$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{2.59}{(2 - 1)(4 - 1)} = 0.86$

Appendix 17 (continued)

11. Calculation of Central Square of Error

KTE $= \frac{JKE}{V(R-1)(V-1)} = \frac{8.13}{2(3-1)(4-1)} = 0.68$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V))}{KT(Error\ V)} = \frac{33.84}{0.63} = 54.15$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{1.07}{0.68} = 1.58$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{0.86}{0.68} = 1.28$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	33.84	33.84	54.15**	7.71	21.20
V error	4	2.50	0.63			
Subsidiary Plots						
Nutrition (N)	3	3.22	1.07	1.58 ns	3.49	5.95
V × N	3	2.59	0.86	1.28ns	3.49	5.95
N error	12	8.13	0.68			
Total	23	50.28				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.63}}{3.44} \times 100\% = 23.00\%$

KK(N) $= \frac{\sqrt{KT(Error(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{2.52}}{3.44} \times 100\% = 23.95\%$

Appendix 17 (Continued)

Transformation of Female Flower Count Data with Formula ($\sqrt{x^2}$)

Main Plots	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		--------Bunga/Tanaman-----				
V1	N1	2	1	2	4.57	1.52
	N2	1	1	1	3.96	1.32
	N3	2	1	1	4.20	1.40
	N4	2	2	1	4.64	1.55
V2	N1	2	2	2	5.58	1.86
	N2	2	2	2	6.28	2.09
	N3	2	2	2	6.46	2.15
	N4	2	2	2	6.87	2.29
Total					42.56	
Average					1.77	

1. Calculation of Free Degrees (db)

   R (Repeat) = 3
   V (Variety) = 2
   N (Nutrient) = 6
   db Variety (V) = V - 1 = 2 - 1 = 1
   db Error V = V(R - 1) = 2 × (3 - 1) = 4
   db Nutrient (N) = N - 1 = 4 - 1 = 3
   db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
   db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
   db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

   $$FK = \frac{Y...,^2}{N \times G \times R} = \frac{(42.56)^2}{2 \times 4 \times 3} = 75.47$$

3. Calculation of Total Square Sum (JK)

   JKT $= \sum Y_{(i)(j)}{}^{(2)} - FK$
   $= (2)^{(2)} + (1)^{(2)} + (2)^{(2)} + \cdots + (2)^2 - 75.47$
   $= 3.74$

Appendix 17 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(17.37)^2 + (25.19)^2}{4 \times 3} - 75.47$

= 2.55

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G}$ - FK - JK(V)

$= \frac{(6.44)^2 + (5.34)^2 + (5.59)^2 + ... + (8.06)^2}{4} - 75.47 - 2{,}55$

= 0.23

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(10.15)^2 + (10.24)^2 + (10.66)^2 + (11.51)^2}{2 \times 3} - 75.47$

= 0.19

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right)$ - FK - JK(V) - JK(N)

$= \frac{(4.57)^2 + (3.96)^2 + (4.20)^2 + ... + (6.87)^2}{3} - 75.47 - 2.55 - 0{,}19$

= 0.20

7. Sum of Squares of Error

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 3.74 - 2.55 - 0.19 - 0.20 = 0.57

8. Calculation of Center Square of Variety Treatment (V)

KT(V) $= \frac{JK(V)}{V - 1} = \frac{2.5}{2 - 1} = 2.55$

KT(V Error) $= \frac{JK\ (Error\ V)}{V \times (R - 1)} = \frac{0.23}{2 \times (3 - 1)} = 0.06$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK\ (N)}{N - 1} = \frac{0.19}{4 - 1} = 0.06$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK\ (V \times N)}{(V - 1)(N - 1)} = \frac{0.2}{(2 - 1)(4 - 1)} = 0.07$

Appendix 17 (continued)

11. Calculation of Central Square of Error

KTE $= \frac{JKE}{V(R-1)(V-1)} = \frac{0.57}{2(3-1)(4-1)} = 0.05$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V))}{KT(Error\ V)} = \frac{2.55}{0.06} = 44.36$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{0.06}{0.05} = 1.36$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{0.07}{0.05} = 1.40$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	2.55	2.55	44.36**	7.71	21.20
V error	4	0.23	0.06			
Subsidiary Plots						
Nutrition (N)	3	0.19	0.06	1.36 ns	3.49	5.95
V × N	3	0.20	0.07	1.40ns	3.49	5.95
N error	12	0.57	0.05			
Total	23	3.74				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.06}}{1.77} \times 100\% = 13.52\%$

KK(N) $= \frac{\sqrt{KT(Error(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.05}}{1.77} \times 100\% = 12.27\%$

Appendix 17 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.06}{3\times 4}} = 0.07$$

$$HSD_{(0.05)} = q\ (0.05, 2, 4)$$

$$= 3.93 \times 0.07 = 0.27$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference V2	Difference V1	Notation
		2.10	1.45	
V2	2.10	0.00		a
V1	1.45	0.65	0	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

Appendix 18. Analysis of Variance of Fruit Diameter (cm)

Main Plot	Subplots	Repeat			Total	Average
		1	2	3		
		----------------	cm	-------------		
V1	N1	15.53	15.40	15.22	46.15	15.38
	N2	15.43	15.84	15.49	46.76	15.59
	N3	14.46	14.44	15.52	44.42	14.81
	N4	14.57	14.54	14.75	43.86	14.62
V2	N1	14.20	13.81	14.19	42.19	14.06
	N2	14.29	13.88	13.88	42.05	14.02
	N3	14.33	14.09	13.54	41.96	13.99
	N4	14.16	14.56	15.27	44.00	14.67
Total					351.39	
Average					14.64	

1. Calculation of Free Degree (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,^2}{N \times G \times R} = \frac{(351.39)^2}{2 \times 4 \times 3} = 5144.79$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}{}^{(2)} - FK$$
$$= (15.53)^{(2)} + (15.43)^2 + (14.46)^{(2)} + \ldots + (15.27)^2 - 5144.79$$
$$= 9.98$$

Appendix 18 (Continued)

4. Sum of Squares of Treatment Variety (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(181.19)^2 + (170.20)^{(2)}}{4 \times 3} (-) (5144.79)$

$= 5.03$

FK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(59.99)^{(2)} + (60.22)^{(2)} + (60.99)^{(2)} + ... + (56.88)^{(2)}}{4} (-) (5144.79) (-(5) (,03))$

$= 0.20$

5. Sum of Squares Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(88.34)^{(2)} + (88.81)^{(2)} + (86.38)^{(2)} + (87.86)^{(2)}}{2 \times 3} (-) (5144.79)$

$= 0.55$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} (\frac{Y_{ij..}^2}{R}) - FK - JK(V) - JK(N)$

$= \frac{(46.15)^{(2)} + (46.76)^{(2)} + (44.42)^{(2)} + ... + (44.00)^{(2)}}{3} (-) (5144.79) (-) (5.03) (-) (0) (,) (55))$

$= 2.29$

7. Sum of Error Squares

JKE $= JKT - JK(V) - JK(N) - JK(V \times N)$

$= 9.98 - 5.03 - 0.55 - 2.29 = 1.90$

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{(JK)(V)}{V - 1} = \frac{5.03}{2 - 1} = 5.03$

KT(Error V) $= \frac{(JK)(Error\ V)}{V \times (R - 1)} = \frac{0.20}{2 \times (3 - 1)} = 0.05$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{(JK)(N)}{N - 1} = \frac{0.55}{4 - 1} = 0.18$

10. Calculation of Interaction Means

KT(V× N) $= \frac{(JK)(V \times N)}{(V - 1)(N - 1)} = \frac{2.29}{(2 - 1)(4 - 1)} = 0.76$

Appendix 18 (continued)

11. Calculation of Central Square of Error

$$\text{CSE} = \frac{\text{JKE}}{\text{V(R - 1)(V - 1)}} = \frac{1.90}{2(3 - 1)(4 - 1)} = 0.16$$

12. F-Count of Variety Treatment (V)

$$\text{F-Count (V)} = \frac{\text{(K) (T(V))}}{\text{KT(Error V)}} = \frac{5.03}{0.05} = 101.62$$

13. F-Count of Nutrient Treatment (N)

$$\text{F-Count (N)} = \frac{\text{KT(N)}}{\text{KTE}} = \frac{0.18}{0.16} = 1.16$$

14. F-Count of Interaction Treatment

$$\text{F-Count (V×N)} = \frac{\text{KT(V×N)}}{\text{KTE}} = \frac{0.76}{0.16} = 4.81$$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-hit	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	5.03	5.03	101.62**	7.71	21.20
V error	4	0.20	0.05			
Subsidiary Plots						
Nutrients (N)	3	0.55	0.18	1.16 ns	3.49	5.95
V × N	3	2.29	0.76	4.81*	3.49	5.95
N error	12	1.90	0.16			
Total	23	9.98				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

$$\text{KK(V)} = \frac{\sqrt{\text{KT(Error (V))}}}{\bar{X}} \times 100\% = \frac{\sqrt{0.05}}{14.64} \times 100\% = 1.52\%$$

$$\text{KK(N)} = \frac{\sqrt{\text{KT(Error (N))}}}{\bar{X}} \times 100\% = \frac{\sqrt{0.16}}{14.64} \times 100\% = 2.72\%$$

Appendix 18 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.05}{3 \times 4}} = 0.06$$

$HSD_{(0.05)}$ $= q\,(0.05, 2, 4)$

$= 3.93 \times 0.06 = 0.25$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		15.10	14.18	
V1	15.10	0.00		a
V2	14.18	0.92	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

Appendix 18 (Continued)

19. Analysis of BNJ Further Test (0.05) (Interaction Treatment)

$$Sd = \sqrt{\frac{KTE}{R}} = \sqrt{\frac{0.16}{3}} = 0.23$$

$$HSD_{(0.05)} = q(0.05, 8, 12)$$
$$= 5.12 \times 0.23 = 1.18$$

20. Table of Mean Value Matrix (Interaction Treatment)

Treatment	Value Center	V1N2	V1N1	V1N3	V2N4	V1N4	V2N1	V2N2	V2N3	Notation
					Cell isih					
		15.59	15.38	14.81	14.67	14.62	14.06	14.02	13.99	
V1N2	15.59	0.00								a
V1N1	15.38	0.21	0							a
V1N3	14.81	0.78	0.57	0.00						ab
V2N4	14.67	0.92	0.71	0.14	0.00					ab
V1N4	14.62	0.97	0.76	0.19	0.05	0.00				ab
V2N1	14.06	1.53	1.32	0.75	0.61	0.56	0.00			b
V2N2	14.02	1.57	1.36	0.79	0.65	0.60	0.04	0.00		b
V2N3	13.99	1.60	1.39	0.82	0.68	0.63	0.07	0.03	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), tn : (|µ1-µ2|< HSD0.05)

Analysis of Variance Fruit Length (cm)

Main Plot	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		----------------cm-------------				
V1	N1	20	19.88	20	59.88	19.96
	N2	19	20.33	19.25	58.58	19.53
	N3	18.5	18	20	56.50	18.83
	N4	17.17	17.88	18	53.05	17.68
V2	N1	21.8	22.67	20.93	65.40	21.80
	N2	22.05	22.45	21.5	66.00	22.00
	N3	21.3	22	21.4	64.70	21.57
	N4	21.48	22.67	21.5	65.65	21.88
Total					489.76	
Average					20.41	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,^2}{N \times G \times R} = \frac{(489.76)^2}{2 \times 4 \times 3} = 9994.37$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}{}^{(2)} - FK$$
$$= (20.00)^{(2)} + (19.00)^2 + (18.50)^{(2)} + \dots + (21.50)^2 - 9994.37$$
$$= 63.38$$

Appendix 19 (Continued)

4. Sum of Squares of Variety Treatment (V)

JK(V) $= \sum_{i} \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(228.01)^2 + (261.75)^{(2)}}{4 \times 3}$ (-) (9994.37)

= 47.43

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G}$ - FK - JK(V)

$= \frac{(74.67)^{(2)} + (76.09)^{(2)} + (77.25)^{(2)} + ... + (85.33)^{(2)}}{4}$ (-) (9994.37) (-) (47.43)

= 3.47

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_{j} \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(125.28)^{(2)} + (124.58)^{(2)} + (121.20)^{(2)} + (118.70)^{(2)}}{2 \times 3}$ (-) (9994.37)

= 4.70

6. Sum of Squares of Interaction

FK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right)$ - FK - JK(V) - JK(N)

$= \frac{(59.88)^{(2)} + (58.58)^{(2)} + (56.50)^{(2)} + ... + (65.65)^{(2)}}{3}$ (-) (9994.37) (-) (47.43) (-) (4.70)

= 4.49

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 63.38 - 47.43 - 4.70 - 4.49 = 3.30

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{4.73}{2 - 1}$ = 47.43

KT(V Error) $= \frac{JK(\text{Error } V)}{V \times (R - 1)} = \frac{3.47}{2 \times (3 - 1)}$ = 0.87

9. Calculation of Center Squares of Nutrient

Treatments (N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{4.70}{4 - 1}$ = 1.57

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{4.49}{(2 - 1)(4 - 1)}$ = 1.50

Appendix 19.

11. Calculation of Central Square of Error

KTE $= \frac{JKE}{V(R-1)(V-1)} = \frac{3.30}{2(3-1)(4-1)} = 0.27$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V)())}{KT(Error\ V)} = \frac{47.43}{0.87} = 54.75$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{1.57}{0.27} = 5.70$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{1.50}{0.27} = 5.45$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab	
					0.05	0.01
Main Plots						
Variety (V)	1	47.43	47.43	54.75**	7.71	21.20
Error V	4	3.47	0.87			
Subsidiary Plots						
Nutrition (N)	3	4.70	1.57	5.70*	3.49	5.95
V × N	3	4.49	1.50	5.45*	3.49	5.95
N error	12	3.30	0.27			
Total	23	63.38				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error\ (V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.87}}{20.41} \times 100\% = 4.56\%$

KK(N) $= \frac{\sqrt{KT(Error\ (N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.27}}{20.41} \times 100\% = 2.57\%$

Appendix 19 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{KT\ Error\ (V)}{R \times N}} = \sqrt{\frac{0.87}{3\times4}} = 0.27$$

$$HSD_{(0.05)} = q\,(0.05, 2, 4)$$

$$= 3.93 \times 0.27 = 1.06$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V2	V1	
		21.81	19.00	
V2	21.81	0.00		a
V1	19.00	2.81	0	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

19. Further Test Analysis BNJ (0.05) (Nutrient Treatment)

$$Sd = \sqrt{\frac{KT\ Error\ (N)}{R \times V}} = \sqrt{\frac{0.27}{3\times2}} = 0.21$$

$$HSD_{(0.05)} = q\,(0.05, 4, 12)$$

$$= 4.2 \times 0.21 = 0.90$$

20. Center Value Matrix Table (Nutritional Treatment)

Treatment	Center Value	Difference				Notation
		N1	N2	N3	N4	
		20.88	20.76	20.20	19.78	
N1	20.88	0.00				a
N2	20.76	0.12	0			a
N3	20.20	0.68	0.56	0.00		ab
N4	19.78	1.10	0.98	0.42	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Appendix 19 (Continued)

21. Analysis of BNJ Further Test (0.05) (Interaction Treatment)

$$Sd = \sqrt{\frac{KTE}{R}} = \sqrt{\frac{0.27}{3}} = 0.30$$

$$HSD_{(0.05)} = q(0.05, 8, 12)$$
$$= 5.12 \times 0.30 = 1.55$$

22. Center Value Matrix Table (Interaction Treatment)

Treatment	Value Center	Cell isih								Notation
		V2N2	V2N4	V2N1	V2N3	V1N1	V1N2	V1N3	V1N4	
		22	21.88	21.80	21.57	19.96	19.53	18.83	17.68	
V2N2	22.00	0.00								a
V2N4	21.88	0.12	0							a
V2N1	21.80	0.20	0.08	0						a
V2N3	21.57	0.43	0.31	0.23	0.00					a
V1N1	19.96	2.04	1.92	1.84	1.61	0.00				b
V1N2	19.53	2.47	2.35	2.27	2.04	0.43	0.00			b
V1N3	18.83	3.17	3.05	2.97	2.74	1.13	0.70	0.00		bc
V1N4	17.68	4.32	4.20	4.12	3.89	2.28	1.85	1.15	0.00	c

Notes: *: real (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Analysis of Variance of Fruit Flesh Thickness (cm)

Main Plot	Subsidiary Plots	Repeat			Total	Average
		1	2	3		
		---------------- cm -------------				
V1	N1	4.27	4.70	5.00	13.97	4.66
	N2	4.40	4.75	4.73	13.88	4.63
	N3	4.30	4.50	4.93	13.73	4.58
	N4	4.33	4.63	4.30	13.26	4.42
V2	N1	4.17	4.00	3.37	11.54	3.85
	N2	3.67	4.15	3.97	11.79	3.93
	N3	4.18	4.07	4.13	12.38	4.13
	N4	4.25	4.03	4.33	12.61	4.20
Total					103.16	
Average					4.30	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,,^2}{N \times G \times R} = \frac{(103.16)^{(2)}}{2 \times 4 \times 3} = 443.42$$

3. Calculation of Total Square Sum (JK)

$$JKT = \sum Y_{(i)(j)}^{(2)} - FK$$
$$= (4.27)^{(2)} + (4.40)^2 + (4.30)^{(2)} + \cdots + (4.33)^2 - 443.42$$
$$= 3.27$$

Appendix 20 (Continued)

4. Sum of Squares of Variety Treatment (V)

JK(V) $= \sum_i \frac{Y_{i...}^2}{G \times R} - FK$

$= \frac{(54.84)^2 + (48.32)^2}{4 \times 3} - 443.42$

$= 1.77$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{(i,k)}^2}{G} - FK - JK(V)$

$= \frac{(17.30)^2 + (18.58)^2 + (18.96)^2 + ... + (15.80)^2}{4} - 443.42 - 1.77$

$= 0.41$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{j...}^2}{N \times R} - FK$

$= \frac{(25.51)^2 + (25.67)^2 + (26.11)^2 + (25.87)^2}{2 \times 3} - 443.42$

$= 0.03$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(13.97)^2 + (13.88)^2 + (13.73)^2 + ... + (13.26)^2}{3} - 443.42 - 1.77 - 0.03$

$= 0.32$

7. Sum of Squares of Error

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 3.27 - 1.77 - 0.03 - 0.32 = 0.73

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{1.77}{2 - 1} = 1.77$

KT(V Error) $= \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{0.41}{2 \times (3 - 1)} = 0.10$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{0.03}{4 - 1} = 0.01$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{0.32}{(2 - 1)(4 - 1)} = 0.11$

Appendix 20 (continued)

11. Calculation of Central Square of Error

$$CSE = \frac{JKE}{V(R-1)(V-1)} = \frac{0.73}{2(3-1)(4-1)} = 0.0613$$

12. F-Count of Variety Treatment (V)

$$\text{F-Count (V)} = \frac{(K)(T(V))}{KT(\text{Error V})} = \frac{1.77}{0.10} = 17.13$$

13. F-Count of Nutrient Treatment (N)

$$\text{F-Count (N)} = \frac{KT(N)}{KTE} = \frac{0.01}{0.06} = 0.18$$

14. F-Count of Interaction Treatment

$$\text{F-Count (V×N)} = \frac{KT(V \times N)}{KTE} = \frac{0.11}{0.06} = 1.72$$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	1.77	1.77	17.13*	7.71	21.20
V error	4	0.41	0.10			
Subsidiary Plots						
Nutrition (N)	3	0.03	0.01	0.18 ns	3.49	5.95
V × N	3	0.32	0.11	1.72ns	3.49	5.95
N error	12	0.73	0.06			
Total	23	3.27				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

$$KK(V) = \frac{\sqrt{KT(\text{Error}(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.10}}{4.30} \times 100\% = 7.48\%$$

$$KK(N) = \frac{\sqrt{KT(\text{Error}(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.06}}{4.30} \times 100\% = 5.75\%$$

Appendix 20.

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.1}{3\times4}} = 0.09$$

$HSD_{(0.05)}$ = q (0.05, 2, 4)

= 3.93 × 0.09 = 0.36

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V2	V1	
		4.57	4.03	
V2	4.57	0.00		a
V1	4.03	0.54	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

Analysis of Variance of Fruit Weight (kg)

Main Plot	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		---------------- kg -------------				
V1	N1	2.00	1.99	2.27	6.26	2.09
	N2	1.90	2.03	2.00	5.93	1.98
	N3	1.85	1.80	1.93	5.58	1.86
	N4	1.72	1.79	1.80	5.31	1.77
V2	N1	2.18	2.27	2.09	6.54	2.18
	N2	2.21	2.25	2.15	6.60	2.20
	N3	2.13	2.15	2.14	6.42	2.14
	N4	2.15	2.20	2.15	6.50	2.17
Total					49.13	
Average					2.05	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,,^2}{N \times G \times R} = \frac{(49.13)^{(2)}}{2 \times 4 \times 3} = 100.56$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}^{(2)} - FK$$
$$= (2.00)^{(2)} + (1.90)^2 + (1.85)^{(2)} + \ldots + (2.15)^2 - 100.56$$
$$= 0.64$$

Appendix 21 (Continued)

4. Sum of Squares of Variety Treatment (V)

JK(V) $= \sum_i \frac{Y_{i..}^2}{G \times R} - FK$

$= \frac{(23.07)^2 + (26.06)^2}{4 \times 3} - 100.56$

$= 0.37$

JK(Error V) $= \sum_{(i,k)} \frac{Y_{i.k}^2}{G} - FK - JK(V)$

$= \frac{(7.47)^2 + (7.61)^2 + (7.99)^2 + ... + (8.53)^2}{4} - 100.56 - 0.37$

$= 0.05$

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y_{.j.}^2}{N \times R} - FK$

$= \frac{(12.80)^2 + (12.53)^2 + (12.00)^2 + (11.80)^2}{2 \times 3} - 100.56$

$= 0.11$

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} \left(\frac{Y_{ij.}^2}{R}\right) - FK - JK(V) - JK(N)$

$= \frac{(6.26)^2 + (5.93)^2 + (5.58)^2 + ... + (6.50)^2}{3} - 100.56 - 0.37 - 0.11$

$= 0.07$

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 0.64 - 0.37 - 0.11 - 0.07= 0.04

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{JK(V)}{V - 1} = \frac{0.37}{2 - 1} = 0.37$

KT(V Error) $= \frac{JK(Error\ V)}{V \times (R - 1)} = \frac{0.05}{2 \times (3 - 1)} = 0.01$

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{JK(N)}{N - 1} = \frac{0.11}{4 - 1} = 0.04$

10. Calculation of Interaction Means

KT(V× N) $= \frac{JK(V \times N)}{(V - 1)(N - 1)} = \frac{0.07}{(2 - 1)(4 - 1)} = 0.02$

Appendix 21.

11. Calculation of Central Square of Error

KTE $= \frac{JKE}{V(R-1)(V-1)} = \frac{0.04}{2(3-1)(4-1)} = 0.0035$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V)())}{KT(Error\ V)} = \frac{0.37}{0.01} = 29.45$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{(K)(T(N)())}{KTE} = \frac{(O)(,0)(4)}{0.0035} = 10.05$

14. F-Count Treatment Interaction

F-Count (V×N) $= \frac{(K)(T(V)(\times N)())}{KTE} = \frac{(O)(,0)(4)}{0.0035} = 6.75$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	0.37	0.37	29.45**	7.71	21.20
V error	4	0.05	0.01			
Subsidiary Plots						
Nutrition (N)	3	0.13	0.04	33.56**	3.49	5.95
V × N	3	0.07	0.02	6.75**	3.49	5.95
N error	12	0.02	0.0013			
Total	23	0.64				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.37}}{2.05} \times 100\% = 5.49\%$

KK(N) $= \frac{\sqrt{KT(Error(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.0035}}{2.05} \times 100\% = 2.90\%$

Appendix 21 (continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d\ \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.01}{3\times4}} = 0.03$$

$$HSD_{(0.05)} = q\,(0.05, 2, 4)$$
$$= 3.93 \times 0.03 = 0.13$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V2	V1	
		2.17	1.92	
V2	2.17	0.00		a
V1	1.92	0.25	0.00	b

Notes: *: real (|µ1-µ2|> HSD0.05), ns: (|µ1-µ2|< HSD0.05)

19. Further Test Analysis BNJ (0.05) (Nutrient Treatment)

$$Sd= \sqrt{\frac{\text{KT Error (N)}}{R \times V}} = \sqrt{\frac{0.0035}{3\times2}} = 0.02$$

$$HSD_{(0.05)} = q\,(0.05, 4, 12)$$
$$= 4.2 \times 0.02 = 0.10$$

20. Table of Matrix of Mean Values (Nutrient Treatment)

Treatment	Center Value	Difference				Notation
		N1	N2	N3	N4	
		2.13	2.09	2.00	1.97	
N1	2.13	0.00				a
N2	2.09	0.04	0.00			ab
N3	2.00	0.13	0.09	0.00		bc
N4	1.97	0.16	0.12	0.03	0.00	c

Notes: *: significant (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Appendix 21 (Continued)

21. Analysis of BNJ Further Test (0.05) (Interaction Treatment)

$$Sd = \sqrt{\frac{KTE}{R}} = \sqrt{\frac{0.0035}{3}} = 0.03$$

$$HSD_{(0.05)} = q(0.05, 8, 12)$$
$$= 5.12 \times 0.03 = 0.18$$

22. Table of Mean Value Matrix (Interaction Treatment)

Treatment	Value Center	V2N2	V2N1	V2N4	V2N3	V1N1	V1N2	V1N3	V1N4	Notation
					Cell isih					
		2.2	2.18	2.17	2.14	2.09	1.98	1.86	1.77	
V2N2	2.20	0.00								a
V2N1	2.18	0.02	0.00							a
V2N4	2.17	0.03	0.01	0.00						a
V2N3	2.14	0.06	0.04	0.03	0.00					ab
V1N1	2.09	0.11	0.09	0.08	0.05	0.00				ab
V1N2	1.98	0.22	0.20	0.19	0.16	0.11	0.00			bc
V1N3	1.86	0.34	0.32	0.31	0.28	0.23	0.12	0.00		cd
V1N4	1.77	0.43	0.41	0.40	0.37	0.32	0.21	0.09	0.00	d

Notes: *: real (|µ1-µ2|> HSD0.05), tn: (|µ1-µ2|< HSD0.05)

Analysis of Variance of Fruit Sweetness Level (°Brix)

Main Plots	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		---°Brix---				
V1	N1	15.50	15.63	14.33	45.46	15.15
	N2	14.50	15.67	14.63	44.80	14.93
	N3	14.67	14.67	14.83	44.17	14.72
	N4	14.83	14.88	16.00	45.71	15.24
V2	N1	13.33	13.5	13.5	40.33	13.44
	N2	13.33	14.00	12.67	40.00	13.33
	N3	13.00	14.75	13.5	41.25	13.75
	N4	14.38	13.63	14.13	42.14	14.05
Total					343.86	
Average					14.30	

1. Calculation of Free Degree (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,^2}{N \times G \times R} = \frac{(343.86)^2}{2 \times 4 \times 3} = 4926.65$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}^{(2)} - FK$$
$$= (15.50)^2 + (14.50)^2 + (14.67)^2 + \ldots + (14.13)^2 - 4926.65$$
$$= 18.20$$

Appendix 22 (Continued)

4. Sum of Squares of Treatment Variety (V)

$$JK(V) = \sum_i \frac{Y_{i...}^2}{G \times R} - FK$$

$$= \frac{(180.14)^2 + (163.72)^2}{4 \times 3} - (4926.65)$$

$$= 11.23$$

$$JK(Error\ V) = \sum_{(i,k)} \left(\frac{Y_{i,k}^2}{G}\right) - FK - JK(V)$$

$$= \frac{(59.50)^2 + (60.85)^2 + (59.79)^2 + ... + (53.80)^2}{4} - (4926.65) - (11.23)$$

$$= 0.90$$

5. Sum of Squares of Nutrient Treatment (N)

$$JK(N) = \sum_j \frac{Y_{j...}^2}{N \times R} - FK$$

$$= \frac{(85.79)^2 + (84.80)^2 + (85.42)^2 + (87.85)^2}{2 \times 3} - (4926.65)$$

$$= 0.87$$

6. Sum of Squares of Interaction

$$JK\ (V \times N) = \sum_{(i,j)} \left(\frac{Y_{ij..}^2}{R}\right) - FK - JK(V) - JK(N)$$

$$= \frac{(45.46)^2 + (44.80)^2 + (44.17)^2 + ... + (42.14)^2}{3} - (4926.65) - (11.23) - (0.87)$$

$$= 0.54$$

7. Sum of Squares of Error

$$JKE = JKT - JK(V) - JK(N) - JK(V \times N)$$

$$= 18.20 - 11.23 - 0.87 - 0.54 = 4.66$$

8. Calculation of Center Squares of Variety Treatment

$$(V)\ KT(V) = \frac{JK(V)}{V - 1} = \frac{11.23}{2 - 1} = 11.23$$

$$KT(V\ Error) = \frac{JK\ (Error\ V)}{V \times (R - 1)} = \frac{0.90}{2 \times (3 - 1)} = 0.22$$

9. Calculation of Center Squares of Nutrient Treatment

$$(N)\ KT(N) = \frac{JK(N)}{N - 1} = \frac{0.87}{4 - 1} = 0.29$$

10. Calculation of Interaction Means

$$KT(V \times N) = \frac{JK\ (V \times N)}{(V - 1)(N - 1)} = \frac{0.54}{(2 - 1)(4 - 1)} = 0.18$$

Appendix 22 (continued)

11. Calculation of Central Square of Error

CSE $= \frac{JKE}{V(R-1)(V-1)} = \frac{4.66}{2(3-1)(4-1)} = 0.39$

12. F-Count of Variety Treatment (V)

F-Count (V) $= \frac{(K)(T(V))}{KT(Error\ V)} = \frac{11.23}{0.22} = 49.93$

13. F-Count of Nutrient Treatment (N)

F-Count (N) $= \frac{KT(N)}{KTE} = \frac{0.29}{0.39} = 0.75$

14. F-Count of Interaction Treatment

F-Count (V×N) $= \frac{KT(V \times N)}{KTE} = \frac{0.18}{0.39} = 0.46$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	11.23	11.23	49.93**	7.71	21.20
V error	4	0.90	0.22			
Subsidiary Plots						
Nutrition (N)	3	0.87	0.29	0.75 ns	3.49	5.95
V × N	3	0.54	0.18	0.46ns	3.49	5.95
N error	12	4.66	0.39			
Total	23	18.20				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

KK(V) $= \frac{\sqrt{KT(Error(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.22}}{14.30} \times 100\% = 3.31\%$

KK(N) $= \frac{\sqrt{KT(Error(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.39}}{14.30} \times 100\% = 4.35\%$

Appendix 22 (Continued)

17. Further Test Analysis BNJ (0.05) (Variety Treatment)

$$S\,d \quad \sqrt{\frac{\text{KT Error (V)}}{R \times N}} = \sqrt{\frac{0.2}{3 \times 4}} = 0.14$$

$$HSD_{(0.05)} = q\,(0.05, 2, 4)$$

$$= 3.93 \times 0.14 = 0.54$$

18. Table of Matrix of Mean Values (Variety Treatment)

Treatment	Center Value	Difference		Notation
		V1	V2	
		15.01	13.64	
V1	15.01	0.00		a
V2	13.64	1.37	0.00	b

Notes: * : significant (|µ1-µ2|> HSD0.05), ns : (|µ1-µ2|< HSD0.05)

Analysis of Variance of Vitamin C Content (mg/g)

Main Plot	Subsidiary Plots	Repeat 1	Repeat 2	Repeat 3	Total	Average
		----------------mg/g---------------				
V1	N1	0.56	0.49	0.49	1.54	0.51
	N2	0.56	0.56	0.42	1.54	0.51
	N3	0.56	0.42	0.42	1.40	0.47
	N4	0.49	0.49	0.42	1.40	0.47
V2	N1	0.56	0.42	0.42	1.40	0.47
	N2	0.49	0.56	0.49	1.54	0.51
	N3	0.63	0.42	0.49	1.54	0.51
	N4	0.49	0.56	0.56	1.61	0.54
Total					11.97	
Average					0.50	

1. Calculation of Free Degrees (db)

R (Repeat) = 3
V (Variety) = 2
N (Nutrient) = 6
db Variety (V) = V - 1 = 2 - 1 = 1
db Error V = V(R - 1) = 2 × (3 - 1) = 4
db Nutrient (N) = N - 1 = 4 - 1 = 3
db Interaction (V×N) = (N - 1)(N - 1) = (2 - 1)(3 - 1) = 1 × 3 = 3
db Error N = V (R - 1)(N - 1) = 2 × (3 - 1)(4 - 1)= 2 × 2 × 3 = 12
db Total = VNR - 1 = 2 × 4 × 3 - 1 = 23

2. Correction Factor (FK)

$$FK = \frac{Y...,^2}{N \times G \times R} = \frac{(11.97)^2}{2 \times 4 \times 3} = 5.97$$

3. Calculation of Total Squared Sum (JK)

$$JKT = \sum Y_{(i)(j)}^{(2)} - FK$$
$$= (0.56)^{(2)} + (0.49)^2 + (0.42)^{(2)} + \ldots + (0.56)^{(2)} - 5.97$$
$$= 0.09$$

Appendix 23 (Continued)

4. Sum of Squares of Variety Treatment (V)

JK(V) $= \sum_i \frac{Y^2_{i...}}{G \times R} - FK$

$= \frac{(5.88)^2 + (6.09)^{(2)} (-}{4 \times 3}) (5,97)$

= 0.002

JK (Error V) $= \sum_{(i,k)} \frac{Y^2_{(i,k)}}{G}$ - FK - JK(V)

$= \frac{(2.17)^{(2)} + (1.96)^{(2)} + (1.75)^{(2)} + ... + (1.96)^{(2)}}{4} (-)(5.97) (-) (0.002)$

= 0.029

5. Sum of Squares of Nutrient Treatment (N)

JK(N) $= \sum_j \frac{Y^2_{j...}}{N \times R} - FK$

$= \frac{(2.94)^{(2)} + (3.08)^{(2)} + (2.94)^{(2)} + (3.01)^{(2)}}{2 \times 3} (-) (5,97)$

= 0.002

6. Sum of Squares of Interaction

JK (V×N) $= \sum_{(i,j)} (\frac{Y^2_{ij..}}{R})$ - FK - JK(V) - JK(N)

$= \frac{(1.54)^{(2)} + (1.54)^{(2)} + (1.40)^{(2)} + ... + (1.61)^{(2)}}{3} (-) (5.97) (-) (0.002) (-) (0.002)$

= 0.012

7. Sum of Error Squares

JKE = JKT - JK(V) - JK(N) - JK(V×N)

= 0.09 - 0.002 - 0.002 - 0.012 = 0.046

8. Calculation of Center Square of Variety Treatment

(V) KT(V) $= \frac{(JK)(V)}{V - 1} = \frac{(0.002)}{2 - 1}$ = 0.002

KT(V Error) $= \frac{(JK)(Error V)}{V \times (R - 1)} = \frac{(0.029)}{2 \times (3 - 1)}$ = 0.007

9. Calculation of Center Squares of Nutrient Treatment

(N) KT(N) $= \frac{(JK)(N)}{N - 1} = \frac{(0.002)}{4 - 1}$ = 0.001

10. Calculation of Interaction Means

KT(V× N) $= \frac{(JK)(V \times N)}{(V - 1)(N - 1)} = \frac{0.012}{(2 - 1)(4 - 1)}$ = 0.04

Appendix 23.

11. Calculation of Central Square of Error

$$KTE = \frac{JKE}{V(R-1)(V-1)} = \frac{0.046}{2(3-1)(4-1)} = 0.004$$

12. F-Count of Variety Treatment (V)

$$\text{F-Count (V)} = \frac{(K)(T(V)}{KT(\text{Error V})} = \frac{0.002}{0.007} = 0.25$$

13. F-Count of Nutrient Treatment (N)

$$\text{F-Count (N)} = \frac{KT(N)}{KTE} = \frac{0.001}{0.004} = 0.20$$

14. F-Count of Interaction Treatment

$$\text{F-Count (V×N)} = \frac{KT(V \times N)}{KTE} = \frac{0.004}{0.004} = 1.05$$

15. ANOVA Table

Source of Variance	DB	JK	KT	F-value	F-tab 0.05	F-tab 0.01
Main Plots						
Variety (V)	1	0.002	0.002	0.25^{ns}	7.71	21.20
Error V	4	0.029	0.007			
Subsidiary Plots						
Nutrition (N)	3	0.002	0.001	0.20^{ns}	3.49	5.95
V × N	3	0.012	0.004	1.05^{ns}	3.49	5.95
N error	12	0.046	0.004			
Total	23	0.091				

Notes: ** = very real, *= real, ns= non real

16. Coefficient of Variance (CoW)

$$KK(V) = \frac{\sqrt{KT(\text{Error}(V))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.007}}{0.50} \times 100\% = 17.19\%$$

$$KK(N) = \frac{\sqrt{KT(\text{Error}(N))}}{\bar{X}} \times 100\% = \frac{\sqrt{0.004}}{0.50} \times 100\% = 12.38\%$$

Appendix 24. Research Documentation


Preparation of Planting Media


Cleaning *Greenhouse*


Greenhouse Sterilization


Drip Hose Checking


Transplanting


VariousFormulations Nutrients


Checking pH and nutrient density


Plant Propagation


Pesticide Spraying


Installing *Yellow Sticky Traps*


Cutting of Early Lateral Shoots


Watering the nutrient solution

Appendix 24 (Continued)


Pollination


Chlorophyll and Carotenoid Test


ANR Test


Leaf Greenness Measurement with SPAD


Fruit Selection


Shoot Pruning


Lower Leaf Pruning


Stomata Sampling


Harvest


Fruit Data Collection


DataCollection Fruit Sweetness

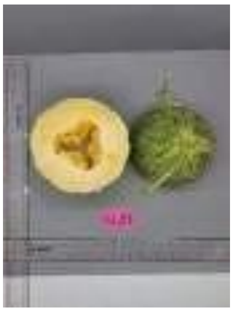

Vitamin C Test

Documentation of Melon Fruit Research Results

N / V	*Hoagland*	*Cooper*	*Steiner*	*Goodplant*
GA				
NC				

Description: N= Nutrition, V= Varieties, GA= Golden Aroma, NC= New Century

Appendix **171** . Documentation of N-split Research Melon Fruit

N / V	*Hoagland*	*Cooper*	*Steiner*	*Goodplant*
GA				
NC				

Description: N= Nutrition, V= Variety, GA= Golden Aroma, NC= New Century

LIFE HISTORY

The author's full name is Almira Livia, born in Salatiga on February 24, 2002. The author is the second child of Mr. Didik Suprihadi (deceased) and Mrs. Nunuk Samiasih. The author studied at SDI Al-Azhar 22 Salatiga, graduating in 2014, SMP Negeri 1 Salatiga graduating in 2017, and SMA Negeri 1 Ungaran graduating in 2020. The author continued

his education in the Agroecotechnology Undergraduate Study Program, Department of Agriculture, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Semarang.

During his studies, the author actively participated in student activities, namely as a *Design and Public Relations* staff member at the *International Association of Students in Agricultural and Related Sciences* (IAAS) *Local Committee* Diponegoro University student activity unit from 2020 to 2022. He also became a Climatology Course assistant in the odd semesters of 2021/2022 and 2022/2023. The author participated in *a student exchange* at the *Winter Program* at Asia University, Taiwan in 2021 and *a student exchange* at the *New Southbound Policy Elite Study Program* at National Pingtung University of Science and Technology, Taiwan in 2023. The author has carried out Field Work Practices with the title "Application of Tissue Culture Techniques in Procuring Sugarcane Seeds (*Saccharum officinarum L.*) at the Central Java Province Plantation Seed Center". Currently, the author is still actively enrolled as an undergraduate student of Agroecotechnology, Department of Agriculture, Faculty of Animal Husbandry and Agriculture, Diponegoro University.