International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Supplementation of Naturally Fermented Solutions (NFS) to Production Management of Strawberry (*Fragaria X Ananassa*) Grown in Isabela, Philippines

Suetos, Jemmarie G

Department of Agricultural Sciences, Faculty, Mariano Marcos State University, Philippines

ABSTRACT

Strawberry production in Benguet is highly dependent on inorganic fertilizers which added to its high production cost. Cost cost-cutting strategy is imperative to elevate income and reduce the chemical substance added to the soil. To promote environmentally-friendly crop nutrients, supplementation of Naturally Fermented Solutions (NFS) to production management strawberries was conducted in Cabagan, Isabela from October 2021 to April 2022. Specifically, it aimed to determine which among the Naturally Fermented Solutions would yield the highest; determine the best Naturally Fermented Solutions that would give a quality fruit of strawberry; determine which among the Naturally Fermented Solutions gives the sweetest fruit of the strawberry; and determine the profitability of using NFS to strawberry production. Treatments were set following the split-plot statistical design and analysis. Treatments used were as follows: T_1 (2 tbsp Vermitea), T_2 (Kuhol Amino Acid + 2 tbsp/L vermitea), T_3(2 tbsp/L Fermented Plant Juice + Calcium applied at flowering), T_4 (2 tbsp/L Kuhol Amino Acid + 2 tbsp/L FFJ applied at flowering), T_5 (2 tbsp/L Kuhol Amino Acid + Calcium applied at flowering), T_6 (2 tbps/L Combinations of FPJ, FFJ, KAA, and Calcium), T_7 (Control no application). The study revealed that vermitea added with NFS increases strawberry production. Among the 7 treatments evaluated, the highest yield (1,720.00 kg) was recorded by T_1 using the Sweet Charlie variety. This treatment remarkably gave the highest of ROI of 248.18%. On contrary, T_1 yielded 831.11 kg under the Japanese Shoga variety having a return of investment of 68.24%. Further, strawberries supplemented with NFS can yield comparable to those plants applied with inorganic fertilizers.

Keywords: Naturally Fermented Solutions (NFS), Kuhol Amino Acid (KAA), Strawberry, Vermitea

INTRODUCTION Background of the Study

Nutrient deficiency is a major threat to strawberry plant growth and development. There are lots of commercially available granular and foliar fertilizers in the market which are known to be effective in supplementing the soil with the macro and micro elements needed to attain high yield in strawberry production.

Foliar application using the different Naturally Fermented Solutions (NFS) is one of the promising solutions to conserve our environment. NFS is a plant food supplements from indigenous materials that

had undergone series of fermentation process which includes; Indigenous Microorganisms (IMO), Fermented Plant Juice (FPJ), Fermented Fruit Juice (FFJ), Fish Amino Acid (FAA), Kuhol Amino Acid (KAA), Oriental Herb Nutrient (OHN), Calcium (eggshell), Calcium phosphate (bone meal), Lactic Acid Bacteria Serum (LABS), and Seaweed Extract. It has been used to other crops like solanaceous crops and found effective in nutrient supplementation of organically grown crops in region 02 (Department of Agriculture, 2019).

Ling (2002) stated that foliar fertilization is widely used to practice correct nutritional deficiencies in plants caused by improper supply of nutrients to roots. He also stated that Calcium (Ca) and Boron (B) which are immobile in the plant should be applied in small amounts at high frequency rather in one application for correcting temporary deficiencies in vegetables or fruits like strawberries.

Organic food contributes to better health through reduced synthetic chemical exposure for all and increased crop nutritional quality. Foliar fertilization using chemical-free substances like NFS will help to conserve our environment and enhance crop quality with ensuring health safety.

Objectives of the Study

Generally, the study aims to evaluate the effect of Naturally Fermented Solutions (NFS) as supplement in the production of strawberry.

Specifically, it aims to:

1. Determine which among of the Naturally Fermented Solutions would yield the highest;
2. Determine the best Naturally Fermented Solutions that would give a quality fruit of strawberry;
3. Determine which among the Naturally Fermented Solutions gives the sweetest fruit of the strawberry; and
4. Determine the profitability of using NFS to strawberry production.

Significance of the Study

Strawberry is commonly grown with the application of synthetic fertilizers which are expensive and can cause environmental pollution, eventually, affecting human health. Nowadays, due to the high risk of unpredicted health issues, human well-being is the number one priority of consumers. The utilization of available local materials such as Kuhol, eggshells, banana sheath, papaya, and vermicompost which undergo fermentation process can help our environment to solve the insensitive use of chemicals in conventional farming practices. The result of the study will help growers to grow strawberries in Isabela using the Naturally Fermented Solution which promotes productivity and quality produced.

METHODOLOGY

The study was established in the organic experimental area of Isabela State University located at Garita Heights, Cabagan, Isabela (17.4079ºN, and 121.8050ºE) from October 2, 2021 to Aprril 28, 2022.

Source and Characteristics of Strawberry Varieties Tested

Variety Type	Yield (MT/ ha)	Plant Height (cm)	Plant characteristic	Fruit shape, color, texture and taste	Disease resistance
Planting Material Source: Siguiran, Abulug, Cagayan					
JAPANESE SHOGA VARIETY					
June-bearing	18-21 MT/ha in 2019 (Lapniten, 2019).	23.78cm to 26.56cm	Vigorous plant; long stems for fruit allow efficient picking.	Elongated, medium size, external color: light to dark red, internal color: pinkish to reddish, sweet-sour flavor	Resistant to angular leaf spot
SWEET CHARLIE VARIETY					
June-bearing	18-21 MT/ha in 2019 (Lapniten, 2019).	19.22cm to 27.67cm	Vigorous plant; fruit allow efficient picking. tolerate gentle shipping over short distances.	Medium sized, deep red mature strawberry; moderately acidic but excellent flavor.	Resistant to crown rot caused by *Collectotrichum acutatum* and slightly more susceptible to *Phomopsis* fruit rot

Data Sources:

a. *Chandler, C.K., Legard, D.E., Dunigan, D.D., Crocker,T.E. and Sims,C.A.2000.@Strawberry Festival' Strawberry". HortScience 35(7):1366-1367.*

b. *La Trinidad and other parts of Baguio City produced highly production of strawberry with an average yield of 15.8 tons/ ha in an enclosed condition and also, reported that Hawaiian Festival variety of strawberry is one of the prominent varieties in terms of growth adaptability in Abucay, Bataan, Philippines (Mainen et. al).*

The experimental area was thoroughly prepared to get rid of plant stubbles. This was plowed and harrowed twice to obtain good soil tilt. The soil was elevated (plot) and levelled measuring 0.5m width at 37 meters length.

The study was laid out following the Split-Plot in Randomized Complete Block Design (RCBD) with three replications. The treatments used were as follows:

Factor A: Varieties

A1 – Japanese Shoga

A2 – Sweet Charlie

Factor B: Naturally Fermented Solutions (NFS)

T_1 - Vermitea

T_2 - Kuhol Amino Acid (KAA) + Vermitea

T_3 - Fermented Plant Juice (FPJ) + Calcium

T_4 - Kuhol Amino Acid (KAA) + FFJ

T_5 - KAA + Calcium (eggshell)

T_6 - Combinations of FPJ, FFJ, KAA and Calcium

T7 - Control (No application)

Naturally Fermented Solutions (NFS) Production Processes

A. Fermented Plant Juice (FPJ) – Materials needed include plastic pail, 1kg molasses, manila paper, string, 2 kilo sweet potato tops. Harvest 2 kg of the desired plant before sunrise to preserve its energy. Do not
B. wash the plant and shred it as finely as possible. Place molasses & plant material (1:2 ratio) in the pail, and mix well. Fill the container up to ¾ full only. Cover the pail with paper, tie it, and place in a cool dry place. Label accordingly. Indicate the starting date and date of harvest. Ferment for 7 days. To harvest, strain, and transfer in a clean container.
C. Wait until the tiny bubbles disappear then close the container not too tightly. Label the container with the date of harvest.
D. Fermented Fruit Juice (FFJ) – Materials needed include plastic pail, 1kg molasses, manila paper, string, and 1 kilo ripe papaya. Slice the whole fruit meat. Place the sliced fruit in a plastic pail, add 1 kg molasses, and mix thoroughly. Cover the pail with clean paper, tie it with string, and place in a cool dry place. Label the pail properly and indicate starting date and date of harvest. Ferment for 7 days.
E. Kuhol Amino Acid (KAA) – Materials needed include plastic pail, 1kg molasses, manila paper, string, and 1 kilo Golden Apple Snail (GAS). Mash very well 1 kg kuhol (and eggs if available) and mix with 1 kg molasses. Place the mixture inside a plastic pail, cover it with manila paper, and tie it with string. Label accordingly. Place the pail in a dry cool place Ferment for 14 days.
F. Calcium (eggshell) – Materials needed include plastic pail, 0.5 kg molasses, manila paper, string, 1 kilo eggshells, and white pure coconut vinegar. Take out the inside peel of the eggshells and wash them very well. Pan-fry until brown and crisp. Crush and allow to cool. Measure about equal volume of eggshells and vinegar. Used rice straw as stopper. After five to six (6) Hours 80% of the eggshell will float. Wash the eggshell very well with running water or you will end up having a rotten egg. Place eggshells first then the vinegar and wait until the bubbles disappear. Ferment for 20 days. Filter and pour into proper containers up to the brim and seal for longer shelf life. Store in a cool place out of direct sunlight.
G. Vermitea - Materials needed include plastic pail, manila paper, string, 1 kilo vermicompost, and 1L water. Soaked vermicompost in water for 7 days. Strain. It is now ready to use.

Crop Establishment

Strawberry runners were transplanted 18 days after cutting from its mother plant. One seedling/runner per hill was planted distanced at 25cm x 30cm. Transplanting was done late in the afternoon to avoid transplanting shock. The crown was ensured not to be too deep or too shallow for a higher survival rate. The soil in the experimental area has 5.75 soil pH with a total of 31.17% NPK.

Crop Care and Maintenance

A. Fertilizer Management – Fertilizer application was based on treatments. Based on analysis the Kuhol Amino Acid (KAA) used contains a total of 4.51 % NPK, Fermented Fruit Juice (FFJ) has a total of 4.33% NPK, Fermented Plant Juice (FPJ) has a total of 3.43% NPK and Vermitea has analysis of 0.6%

NPK, respectively (Figure 4). Blanket application of vermicompost was undertaken, vermicompost used contains 0.42 % macronutrients and 1,209
% micronutrients (Figure 2).

A. Water Management – Watering was based on a sufficient amount of water. A tool was used to determine it. It was done before and after watering to ensure the necessity of watering.

B. Pest and Disease Management – Integrated Pest Management (IPM) was employed to manage the pest incidence.

c.1. Insects – To prevent the occurrence of pests (insects), weekly application of *green* muscardine *(Metharizium anisopliae)* was employed. It was done early in the morning during the vegetative and reproductive stages of the plant.

c.2. Weeds – Removing of weeds that appeared per pot was done by uprooting. This was done once in two weeks.

c. 3. Diseases – Sanitation in the area was maintained to prevent disease infestation.

Harvesting

Harvesting was done 90 days after transplanting. When harvesting berries pigment turned red, and fruit harvesting was done by gently twisting it. Harvesting is usually done every other week early; it is done early in the morning. Strawberries are the sweetest when they are fully ripened on the plant. During harvest proper care was observed to avoid fruit injury, using plastic cups and baskets to properly ensure its quality.

Fruit Quality Evaluation Through Total Soluble solids ^{0}Brix

The sweetness quality of the strawberry fruit was measured through Brix reading. Five sample fruits per treatment were presented each treatment. To read the degree of sweetness the juice was placed on the prism of the refractometer, covered with a lens, and was read after 20 seconds. Brix percentage was varied from 8.6-11.0% in Bangladesh (Islam et al., 2013). While all the potential varieties are quite sweet with sugar content ranging from
9.23-9.93 deg. Brix indicating their suitability for fresh fruit consumption in Benguet (Padua et al (2011).

Data gathered

For the vegetative growth parameters, the data gathered includes plant height, crown size. On the other hand, reproductive growth parameters include, fruit yield (kg), fruit quantity, fruit size, fruit setting and fruit quality (^{o}brix). Other relevant data were gathered such as soil and vermicompost aggregate components and agro-climatic data were also recorded.

Data Analysis

Statistical Analysis – All data gathered was consolidated, tabulated, and analysed using a computer program called Statistical Tool for Agricultural Research (STAR). The Least Significant Difference (LSD) was used to compare the differences among the treatment means. To further analysis of data with significant results of ANOVA. A pairwise mean of comparison using the Tukey's Honest Significant Differences (THSD) was used to compare the differences among the treatments means.

Profitability Analysis – The computation of profitability in growing strawberries includes the cost of production, gross income and net to determine the return on investment.

OBSERVATIONS AND DISCUSSION OF RESULTS General Appearance of the Plant

Two strawberry varieties were used to grow vigorously which was indicated by the crown size recorded which measured 9.91mm-10.97mm in Sweet Charlie and 8.68mm to 15mm in Japanese Shoga.

Runner Appearance and Clipping

Runners (daughter plants) were observed to appear from 22 to 45 days after transplanting. The runner produced a major runner which also produced sub-runners in every node of the stolon then produce spontaneously thereafter. Runners tend to creep and grow anywhere that's why clipping was done to ensure the stability of the daughter plant to grow and for efficient reproduction management. Clipping was done 8-15 days after the runner's appearance using a paper clip. Runners were detached from the mother plant to grow independently 20-60 days after runner emergence. Separated runners were transplanted for reproduction purposes. Two strawberry varieties were used to grow vigorously which was indicated by the crown size recorded which measured 9.91mm-10.97mm in Sweet Charlie and 8.68mm to 15mm in Japanese Shoga.

Pest Infestation and Management

Occurrences of pest and disease were monitored and managed weekly to ensure plant growth.

A. Insect Pest Occurrence

The most damaging insect pest observed during the vegetative and reproductive phase was the armyworm *(Spodoptera ornithogalli).* Spraying of green muscadine (*Metarhizium anisopliae*) at the rate of 5 packs/16 L of water was used to control the occurrence of pests.

B. Disease Present

An angular leaf spot (*Xanthomonas fragariae*) disease was observed. Infected leaves were removed and were disposed in the area far from the experimental area to prevent spread of the disease.

Agro-meteorological Data

The data shown in Figure 2 present the Agro-meteorological data retrieved from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), Isabela from July 2021 to April 2022. It was observed that since planting, the precipitation received during the strawberry runner production is very low ranging from 1.23 mm to 9.20 mm amount of rainfall which is far beyond the normal climatological annual rainfall in the Philippines from 1991 to 2020 which is 31.5mm or 282.9 mm (PAGASA Cagayan, 2020). Relative humidity ranged from 59.3% to 91.5%.

Moreover, the temperature recorded was at 23.3°C to 31.0°C However, the temperature recorded in Cagayan ranged from 23.38°C to 28.98°C. Having a rainfall of 0.76mm to 4.49mm, and a relative humidity ranged from 75.75% to 85.74% (Figure 3). On the other hand, temperature in Benguet ranged from 14.00°C to 18.00°C, having a relative humidity of 84% to 98% and a rainfall of 101mm to 779mm (Figure 4).Comparing the three (3) rovinces, it was observed that though Benguet has more favorable weather condition than Isabela and Cagayan, it was noted that strawberry production in Isabela is feasible despite the drought experienced during the conduct of the study. Thus, the strawberry plant was proven adaptive in Isabela weather condition.

Table 1. Comparison of Agro-meteorological Data in Isabela, Cagayan and Benguet, Philippine Atmospheric Geophysical and Astronomical Services Administration

	Isabela	Cagayan	Benguet
Temperature (°C)	23.3 to 31.0	23.33 to 28.98	14.00 to 18.00
Rainfall (mm)	1.23 to 9.20	0.76 to 4.49	101.00 to 779.00
Relative Humidity (%)	59.03 to 91.05	75.75 to 85.74	84.00 to 98.00

Plant Height (cm)

Variety. It can be observed that the plant stature of Sweet Charlie variety had a mean of 18.29 cm while Japanese Shoga had a mean of 22.95 cm (Table 1). The analysis of variance (Appendix Table 1) showed that the varieties did not differ significantly in terms of plant height.

Table 2. Varietal Response on the Mean Plant Height (cm) at Maturity to the Naturally Fermented Solutions (NFS)

Main Plot (Variety)	
Japanese Shoga	
Sweet Charlie	
ANOVA RESULT	ns
C.V. (a)	18.53%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Naturally Fermented Solutions (NFS). As shown in Table 1a, the application of T6 - (Combined Fermented Plant Juice, Fermented Fruit Juice, Kuhol Amino Acid and Calcium) gave the tallest plant stature of 22.67 cm. This was followed by the application of T5 (Kuhol Amino Acid + Calcium), T2 - (Kuhol Amino Acid + Vermitea), T4 - (Kuhol Amino Acid + Fermented Fruit Juice), T1 -(Vermitea), T3 - (Fermented Plant Juice + Calcium) and T7 – (Control (No Application) which have a means of 22.33 cm, 21.50 cm, 21.17 cm, 20.00 cm,
19.50 cm, and 18.17 cm, respectively. Effect on the height of the plants applied with Naturally Fermented Solutions did not show any significant differences as shown by the ANOVA (Appendix Table 1a).

Table 2.a. Effect of Naturally Fermented Solutions on the Variety mean of Plant Height (cm)

Sub-plot (Naturally Fermented Solutions)	
T1 – 2 tbsp vermitea	
T2 – 2 tbsp/L KAA + 2tbsp/L vermitea	
T3 – 2 tbsp/L FPJ + Calcium (applied at flowering)	
T4 – 2 tbsp/L KAA + 2 tbsp/L FFJ (applied at flowering)	
T5 – 2 tbsp/L KAA + Calcium (applied at flowering)	
T6 – 2 tbsp/L Combinations of FPJ, FFJ, KAA and calcium	
T7 – Control (No application)	

ANOVA Result	ns
C.V. (b)	12.85%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the Same letter are not significantly different*

Variety vs. Naturally Fermented Solutions (NFS). Table 1b present the data on plant height as affected by the combined variety and NFS. It was observed that the T12 had the tallest plant stature of 26.33cm. This was followed by T13, T8, T10, T9, T11, T2, T6, T7, T5, T4, T14, T1 and T3 with a means of 25.00cm, 24.00cm, 23.33cm, 22.33cm, 22.33cm, 20.67cm, 20.33cm, 19.00cm, 18.33cm, 18.00cm, 17.33cm 16.00cm, 15.67cm, respectively. Furthermore, the result of Tukey's Honest Significant Differences (HSD) Test showed that it varies on the mean of every variety. Under the Sweet Charlie variety, plant height, it did not differ significantly among one another. Similarly, the plant height of Japanese Shoga variety did not show significant differences on the parameter measured.

Table 2.b. Interaction Effect of the Variety and Naturally Fermented Solutions to Plant Height (cm)

Treatments	Sweet Charlie		Treatments		Japanese Shoga
T1	16		T8		24
T2	20.67		T9		22.33
T3	15.67		T10		23.33
T4	18		T11		22.33
T5	18.33		T12		26.33
T6	20.33		T13		25
T7	19		T14		17.33
ANOVA Result ns					
C.V. (a) 18.53%					
C.V.(b) 12.85%					

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Fruit Setting/Priming (no)

Variety. It can be gleaned in Table 2 that Sweet Charlie variety registered a mean of 15 fruit setting while Japanese Shoga variety had a mean of 6 fruit setting. Results of the analysis of variance (Appendix Table 2) showed that the two varieties vary significantly with each other. This implied that Japanese Shoga variety set a higher fruit than Sweet Charlie variety.

Table 3. Varietal Response on the Mean Fruit Setting/Priming (no) at Maturity to the Naturally Fermented Solutions

Main Plot (Variety)		
Japanese Shoga	15	
Sweet Charlie	6	
ANOVA Result		**
C.V. (a)		**19.13%**

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Naturally Fermented Solutions (NFS). As shown in the Table 2a the highest to set fruit was attained by the application of T1 with a mean of 14 fruit setting. This was followed by the use of T7, T6, T4, T2 , T3, and T5 with means of 12, 11,11, 10, 10, 14, and 6 fruit, respectively. Result of the analysis variance (Appendix Table 2a) revealed a significant effect of the NFS application.

Result showed that T1 vary significantly among the rest of the treatments. On the other hand, T7, T6, T2, T3 and T4 did not vary significantly with one another but vary significantly with T5. This clearly indicates that the application of vermitea influenced the flowers of strawberry plant. According to the study of (Sundararasu and Jeyasankar, 2014) Vermitea can be economically, productivity suitable for healthy plant growth, can increase the fruit quality, yield and for enhancement of the soil environment.

Table 3.a. Effect of Naturally Fermented Solutions on the Variety Mean of Fruits Setting/Priming (no)

Sub-plot (Naturally Fermented Solutions)	Mean
T_1 – 2 tbsp vermitea	14^a
T_2 – 2 tbsp/L KAA + 2tbsp/L vermitea	11^b
T_3 – 2 tbsp/L FPJ + Calcium (applied at flowering)	10^b
T_4 – 2 tbsp/L KAA + 2 tbsp/L FFJ (applied at flowering)	10^b
T_5 – 2 tbsp/L KAA + Calcium (applied at flowering)	6^c
T_6 – 2 tbsp/L Combinations of FPJ, FFJ, KAA and calcium	11^b
T_7 – Control (No application)	12^b
ANOVA Result	**
C.V. (b)	**13.%**

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Variety vs Naturally Fermented Solutions (NFS). It can be observed that strawberry fruit sets from 5 to 20 in Sweet Charlie variety while 4 to 8 only in Japanese Shoga variety. The analysis of variance revealed a highly significant effect on the combined variety and NFS treatment (Appendix Table 2b). Fruit setting in Sweet Charlie variety showed that T1 did not vary significant with T7 and T6 but varied significantly among the rest of the treatments. On the other hand, T4 did not vary significantly with T3 and T2 but vary significantly with T5. On the contrary fruit setting using Japanese Shoga variety vary showed that T1 significantly obtained the highest fruit setting while T4 significantly gave the lowest. However, no significant differences were observed among the treatments. Result indicate that the fruit setting was influenced by the application of NFS. This revealed that vermitea application can increase the fruit settings of strawberry.

Vermitea is a rich source of vitamins, hormones, enzymes, macro nutrients and micronutrients when applied to plants and help in efficient growth. Vermitea increases the uptake of the nutrients of the plants resulting to a higher growth (Verma, 2018). Vermicompost is an organic material broken down by interactions between earthworms and microorganisms in a mesophilic process to produce fully stabilized organic soil amendments with low c. It can be used as a supplement or alternative and help concentrate fertility and microorganisms so that the compost treated plants increase fruit yield. Moreover, the biochemical qualities of the fruits grown in vermiwash and vermicompost indicated higher nutrient quality, which may be attributed to the presence of plant growth promoters like gibberellins, cytokinin and auxins (Ansari and Sukhraj, 2010). Similarly, Edwards *et al.* (2004) has also observed increase in quality of fruit with the application of vermitea.

Table 3.b. Interaction Effect of the Variety and Naturally Fermented Solutions to Fruit Setting/Priming (no)

Treatments	Sweet Charlie	Treatments	Japanese Shoga
T_1	20^{a}	T_8	8^{a}
T_2	14^{cd}	T_9	7^{ab}
T_3	14^{d}	T_{10}	7^{ab}
T_4	15^{bcd}	T_{11}	4^{b}
T_5	5^{e}	T_{12}	6^{ab}
T_6	17^{abc}	T_{13}	5^{ab}
T_7	18^{ab}	T_7	6^{ab}
ANOVA Result	**		
C.V. (a)	19.13%		
C.V. (b)	13.21%		

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Fruit Quantity (no)

Variety. It can be gleaned in Table 3 that Sweet Charlie variety registered a mean of 190 fruits while Japanese Shoga variety had a mean of 97 fruits only. Results of the analysis of variance (Appendix Table 3) showed that the two varieties vary significantly with each other. This implies that Sweet Charlie variety produced more fruit than the Japanese Shoga variety.

Table 4. Varietal Response on the Mean Fruit Quantity (no) at Maturity to th		**e**
Main Plot (Variety)	**Mean**	
Japanese Shoga	97	
Sweet Charlie	190	
ANOVA Result		*
C.V. (a)		5.07%

*ns = not significant, * = significant at 5%level, ** = highly significant at 1% level Means with the same letter are not significantly different*

Naturally Fermented Solutions. As shown in (Table 3a), the highest fruit produced was attained by the application of T3 with a mean of 185 fruits. This was followed by the use of T1, T2, T6, T4, T5, and T7 having means of 172, 168, 127, 125, 118 and 110 fruits respectively. Analysis of variance showed that the strawberries grown with the Naturally Fermented Solutions showed a highly significant differences among the treatment used (Appendix Table 3a). It can be observed that the plants applied with T2 gave a significant higher fruits number than the rest of the treatments. Subsequently, T1, and T2 did not vary significantly with one another but vary significantly with T6, T4, T5 and T7.

On the contrary, the least number of produced fruits was observed T7. Results clearly indicated that the two varieties were affected favorably by the different Naturally Fermented Solutions.

Table 4.a. Effect of Naturally Fermented Solutions on the Variety Mean of Fruit Quantity (no)	
Sub-plot (Naturally Fermented Solutions)	**Mean**
T1 – 2 tbsp vermitea	172^{b}
T2 – 2 tbsp/L KAA + 2tbsp/L vermitea	168^{b}
T3 – 2 tbsp/L FPJ + Calcium (applied at flowering)	185^{a}
T4 – 2 tbsp/L KAA + 2 tbsp/L FFJ (applied at flowering)	125^{c}
T5 – 2 tbsp/L KAA + Calcium (applied at flowering)	118^{cd}
T6 – 2 tbsp/L Combinations of FPJ, FFJ, KAA and calcium	127^{c}
T7 – Control (No application)	110^{e}
ANOVA Result	**
C.V. (b)	8.33%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Variety vs Naturally Fermented Solutions. Table 3b presents the interaction effect of the variety and NFS to produced fruit. The highest fruit produced using the Sweet Charlie variety was attained by the application of T2. This was followed by T1, T3, T4, T6, T5 and T7 having means of 237, 237, 217, 130, 127 and 123, respectively. Moreover, the Sweet Charlie variety had lower fruit production of only 33 to 133 fruits. Based on the results of ANOVA, the combined variety and NFS significantly influenced the quantity of fruit produced. It can be noted that under Sweet Charlie variety T2, T1 and T3 did not vary significantly with one another but vary significantly with the rest of the treatments. On the other hand, quality produced in Japanese Shoga variety showed that the application of T10 did not vary significantly with T13, T12 and T8. Contrarily, least quantity was produced using T9 which significantly varied with the rest of the treatments except for T8 and T14. The result showed that the application of FPJ combined with calcium influenced the quantity of fruit produced.

Table 4.b. Interaction Effect of the Variety and Naturally Fermented Solutions to Fruit Quantity (no)

Treatments	Sweet Charlie	Treatments	Japanese Shoga
T1	237^{ab}	T8	107^{abc}
T2	237^{ab}	T2	77^{c}
T3	260^{a}	T10	133^{a}
T4	217^{b}	T11	33^{d}
T5	127^{c}	T12	110^{ab}
T6	130^{c}	T13	123^{ab}
T7	123^{c}	T14	97^{bc}
ANOVA Result **			
C.V. (a) 15.07%			
C.V. (b) 8.33%			

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the*

same letter are not significantly different

Fruit Size (mm)

Variety. With regards to the size of fruit Japanese Shoga attained a size of 399.13 mm while Sweet Charlie variety had 386.95 mm (Table 4). Result of the analysis of variance showed that the two varieties did not vary significant with each other (Appendix Table 4).

Table 5. Varietal Response on the Mean Fruit Size (mm) at Maturity to the Naturally Fermented Solutions

Main Plot (Variety)	Mean	
Japanese Shoga	386.95	
Sweet Charlie	399.13	
ANOVA Result		ns
C.V. (a)		6.37%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Naturally Fermented Solutions (NFS). It can be noted in Table 4a that the fruit size had a mean ranging from 378.51mm to 418.23mm. The analysis of variance result showed that the fruit size was significantly affected by the application of Naturally Fermented Solutions (Appendix Table 4a). Further, test of comparison among the treatment means using the Tukey's Honest Significant Difference (HSD) Test revealed that application of T_2 vary significantly among the rest of the treatments. Meanwhile, the quantity produced by T_7, T_6 and T_3 were comparable from one another. However, this was varied significantly of T_1, T_4 and T_5. Result of the study implies that the two varieties respond differently to the application of Naturally Fermented Solutions.

Table 5.a. Effect of Naturally Fermented Solutions on the Variety Mean of Fruit Size (mm)

Sub-plot (Naturally Fermented Solutions)	Mean	
T_1 – 2 tbsp vermitea	378.51	
T_2 - 2 tbsp/L KAA + 2tbsp/L vermitea	418.23	
T_3 – 2 tbsp/L FPJ + Calcium (applied at flowering)	409.69	
T_4 – 2 tbsp/L KAA + 2 tbsp/L FFJ (applied at flowering)	362.07	
T_5 – 2 tbsp/L KAA + Calcium (applied at flowering)	357.55	
T_6 – 2 tbsp/L Combinations of FPJ, FFJ, KAA and calcium	412.34	
T_7 – Control (No application)	412.91	
ANOVA Result		**
C.V. (b)		5.7%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Variety vs Naturally Fermented Solutions (NFS). The interaction effect of the variety and NFS to fruit size were presented in Table 4b. The fruit size of Sweet Charlie variety measures 353.51mm to 423.49mm while Japanese Shoga variety's fruit sizes measured 337. 30mm to 448.54mm. From the result of ANOVA (Appendix Table 4b) the significant effect was observed. Treatment 2 significantly registered the biggest fruit size in Sweet Charlie variety which varied significantly with T_7. Other treatments did

not vary significantly among one another. Moreover, the fruit size produced by Japanese Shoga variety T2 did not vary significantly with T6, T1, T5 and T7 but varied significantly with T3 and T4. Based on the result, the fruit size was affected significantly by the application of T2 for both varieties (KAA + Vermitea).

Table 5.b. Interaction Effect of the Variety and Naturally Fermented Solutions to Fruit Size (mm)

Treatments	Sweet Charlie	Treatments	Japanese Shoga
T_1	353.51^{b}	T_8	403.50^{a}
T_2	423.49^{a}	T_2	448.54^{a}
T_3	380.02^{ab}	T_{10}	439.36^{d}
T_4	386.84^{ab}	T_{11}	337.30^{cd}
T_5	365.15^{ab}	T_{12}	349.95^{ab}
T_6	411.75^{ab}	T_{13}	412.92^{abc}
T_7	387.92^{ab}	T_{14}	402.34^{bcd}
ANOVA Result **			
C.V. (a) 6.37%			
C.V. (b) 5.7%			

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Converted Fruit Yield (kg/ha)

Variety. As shown in Table 5, Sweet Charlie variety obtained a fruit weight of 1309.84 while Japanese Shoga variety produced a mean of 573.97. The analysis of variance showed a highly significant differences on the number of fruit weight of the two varieties.

Table 6. Varietal Response on the Mean Converted Fruit Yield (kg/ha) at

Main Plot (Variety)	Mean	
Japanese Shoga	1309.84	
Sweet Charlie	573.97	
ANOVA Result		**
C.V. (a)		16.51 %

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Naturally Fermented Solutions (NFS). As shown in Table 5a the highest yield was attained by application of T1 with a mean of 1275.56. This was followed by the application of T7, T2, T3, T4, T6 and T5 with means of 1122.22, 1020.00, 986.67, 882.22, 717.78 and 729 respectively.

From the result of ANOVA (Appendix Table 5a) it showed that the strawberries grown with the application of Naturally Fermented Solutions showed a highly significant differences among the treatment used. It can be noted that T1 and T7 did not vary significantly with one another but varied significantly with the rest of the treatments. Meanwhile, T2 did not vary significantly with T3 but vary significantly with T4, T6 and T5. Results implied that the NFS significantly affected the fruit yield of strawberry.

Table 6.a. Effect of Naturally Fermented Solutions on the Variety Mean of Converted Fruit Yield (kg/ha)

Sub-plot (Naturally Fermented Solutions)	Mean	
T_1 – 2 tbsp vermitea	1275.56	
T_2 – 2 tbsp/L KAA + 2tbsp/L vermitea	1020.00	
T_3 – 2 tbsp/L FPJ + Calcium (applied at flowering)	986.67	
T_4 – 2 tbsp/L KAA + 2 tbsp/L FFJ (applied at flowering)	882.22	
T_5 – 2 tbsp/L KAA + Calcium (applied at flowering)	588.89	
T_6 – 2 tbsp/L Combinations of FPJ, FFJ, KAA and calcium	717.78	
T_7 – Control (No application) 1122.22		
ANOVA Result		**
C.V. (b)		5.48%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Variety vs Naturally Fermented Solutions. Table 5b presents the interaction of variety and NFS. The Sweet Charlie variety attained a yield of ranging from 728.89 kg to 1720 kg while Japanese Shoga variety had a lower yield ranging from only 297.78 kg to 831. 11kg, respectively. Result of the ANOVA (Appendix Table 5b) showed a highly significant differences among the treatment means. It can be noted that T_1 and T_7 had comparable yield. Likewise, T_2 and T_4 did not vary significantly with one another but differ significantly with T_3, T_6 and T_5. Furthermore, T_3 and T_1 did not vary significantly with one another but vary significantly with the rest of the treatments. On the other hand, T_7, T_2, T_5, and T_6 did not vary significantly with one another but vary significantly with T_4. Result of the study showed that the application of T_2 (KAA + Vermitea) significantly attributes to the high yield obtained by the strawberry. Vermitea application comes from the vermicompost extract, application of aqueous extract of vermicompost (vermi-tea) has been shown to improve plant health, crop yield and nutritive quality (Gamaley *et al.* 2001). According to Ismail (2005) reported that the foliar spray of vermiwash/vermitea improved okra growth and yield. Vermitea can be economically, productivity suitable for healthy plant growth, increased the fruit quality, yield and for enhancement of the soil environment (Gandhi *et al.*, 2012; Sundararasu *et al*, 2014 and Belliturk *et al.*, 2017 and Soraya *et al.*, 2020). This reported that, significant increases in growth and yield of treated plants with vermitea, due to high available amounts of macro and micro- elements in vermitea.

Table 6.b. Interaction Effect of the Variety and Naturally Fermented Solutions to Converted Fruit Yield (kg/ha)

Treatments		Sweet Charlie	Treatments	Japanese Shoga
T_1		1720.00^a	T_8	831.11^a
T_2		1475.56^b	T_2	813.33^a
T_3		1160.00^c	T_{10}	564.44^{bc}
T_4		1466.67^b	T_{11}	297.78^d
T_5		728.89^e	T_{12}	448.89^c
T_6		991.11^d	T_{13}	444.44^c
T_7		1626.67^a	T_{14}	617.78^b
ANOVA Result	**			
C.V. (a)	16.51%			
C.V. (b)	5.48 %			

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Total Soluble Solids (^{0}Brix)

Variety. It can be observed that the sweetness of Japanese Shoga variety registered a mean of 8.61% while Sweet Charlie variety had a mean of 7.85 % (Table 6). The analysis of variance (Appendix Table 6) showed that the varieties planted were not affected by its degree of sweetness.

Table 7. Varietal Response on the Mean Total Soluble Solids (^{0}Brix) at	
Main Plot (Variety)	**Mean**
Japanese Shoga	7.85
Sweet Charlie	8.61
ANOVA Result	ns
C.V. (a)	11.2%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Naturally Fermented Solution. As shown in the Table 6a the application of T6 gave brix of sweetness fruit juice (9.39%). This was followed by the application of T7, T4, T1, T3, T2, and T5 having means of 8.16%, 8.07%, 8.04%, 8.00%, 7.99% and 7.96%, respectively. Effect on the sweetness fruit juice of the plants at applied with Naturally Fermented Solutions did not show any significant differences as shown by the analysis of variance (Appendix Table 6a). Result clearly indicates that the strawberry sweetness was not affected by the application of NFS.

Table 7.a. Effect of Naturally Fermented Solutions (NFS) on the Variety Mean of Total Soluble Solids (^{0}Brix)

Sub-plot (Naturally Fermented Solutions)	
T1 – 2 tbsp vermitea	
T2 – 2 tbsp/L KAA + 2tbsp/L vermitea	
T3 – 2 tbsp/L FPJ + Calcium (applied at flowering)	
T4 – 2 tbsp/L KAA + 2 tbsp/L FFJ (applied at flowering)	
T5 – 2 tbsp/L KAA + Calcium (applied at flowering)	
T6 – 2 tbsp/L Combinations of FPJ, FFJ, KAA and calcium	
T7 – Control (No application)	
ANOVA Result	ns
C.V. (b)	12.62%

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Variety vs. Naturally Fermented Solutions (NFS). It can be gleaned in Table 6b that the sweetness of Japanese Shoga varieties obtained a mean ranging from 6.71% to 9.31% with T6 as the sweetest while T2 as the least. On the other hand, the sweetness produced by Sweet Charlie variety had a mean ranging from 8.00% to 9.48%. Analysis of variance (Appendix Table 6b) showed a non-significant effect on the combination of variety and application of the Naturally Fermented Solutions. From the results of the study, it is evident that the combination of the variety and Naturally Fermented Solutions did not affect the sweetness of the strawberries

Table 7.b. Interaction Effect of the Variety and Naturally Fermented Solutions (NFS) to Total Soluble Solids (^{0}Brix)

Treatments	Sweet Charlie	Treatments	Japanese Shoga
T1	7.5	T8	8.59
T2	7.74	T2	8.2
T3	8.01	T10	8
T4	7.8	T11	8.33
T5	6.71	T12	9.22
T6	9.31	T13	9.48
T7	7.89	T14	8.43
ANOVA Result ns			
C.V. (a) 11.25 %			
C.V. (b) 12.62 %			

** = significant at 0.05, ** = highly significant at 0.01, ns = not significant means with the same letter are not significantly different*

Comparison of Fruit Quality.

Base on the result of this study it was found out that producing strawberry in areas with high temperature like Isabela condition produces sweeter fruit as reflected by the Total Soluble Solids (ºBrix) reading of 7.96% to 9.39% compared to other studies conducted in Benguet and Bangladesh

Table 8. Comparison of fruit quality of Strawberry

	BANGLADESH	BENGUET 1	BENGUET 2	ISABELA
Authors	Islam *et al (2013)*	Padua *et al (2011*	Milagros *et al (2019)*	Callueng and Guiuo (2022) (This study result)
Study	*Evaluation of growth and yield of four strawberry genotypes in Bangladesh*	Strawberry Variety Improvement in the PhiSslippines	Field performance of strawberry varieties grown from different sub-cultured tissue culture meristem in La Trinidad, Benguet	*Growth and Yield performance of strawberry under naturally fermented solutions*
Total Soluble Solids (ºBrix)(sweetness)	8.6 to 11.00	9.23 to 9.93	7.72 to 9.25	7.96 to 9.39

Profitability

The computation of profitability in growing strawberry using the natural fermented solutions include the cost of production, gross income, and net income to determine the return on investment. The ROI in 10 plants basis was computed differently according to varieties because they produced fruits as regard to their yield differently. In the study, using of Sweet Charlie variety gave a higher return on investment than Japanese Shoga variety. The used of Vermitea remarkably gave the highest ROI of 248.18% using the Sweet Charlie variety. The cost of production is Php 24,700.00 having Php 86,000.00 gross income and Php 61,300.00 net income per production of 10 plants per treatments. Other treatment used attained a 100% ROI which indicated that application of naturally fermented solutions in SC variety gives plentiful of yield (Table 7). This was followed by the used of T7 with a notable ROI of 243.18%. Spending Php 23,700.00 gives a return of Php 81,333.50 gross income with Php 57,633.50. The rest of the treatments used have a return on investment of
47.07% to 196.30% only.

On the other hand, the ROI using the Japanese Shoga variety was noted with a highest return of investment of 68.24% with the vermitea having a cost of Php 24,700.00 a gross income of Php 41,555.5 and a net income of Php 16,855.5 this was followed by T2, T4 and T7 having a 59.48%, 39.84% and 30.33% of return of investment.

Further, using of this variety did not gave favorable return on investment which was cause by the low yield produced. Treatments 3, 6, and 5 used have an ROI of -9.42% to 13.89% only and having a negative ROI using of T5 and T6 (KAA + Calcium), and Combinations of (FPJ, FFJ, KAA, and Calcium.

Table 9. Return on Investment (ROI) of strawberry production applied with Naturally Fermented Solutions (NFS)

Treatments	Converted Yield	Gross Income	Net Income	ROI
T1 – 2 tbsp vermitea	1720	86,000.00	49,150.00	133.38
T2 – 2 tbsp/L KAA + 2tbsp/L vermitea	1475.56	73,778.00	36,928.00	100.21
T3 – 2 tbsp/L FPJ + Calcium	1160	58,000.00	18,150.00	45.55
T4 – 2 tbsp/L KAA + 2 tbsp/L FFJ	1466.67	73,333.50	49,123.50	202.91
T5 – 2 tbsp/L KAA + Calcium	728.89	36,444.50	12,234.50	50.53
T6 – 2 tbsp/L Combinations of FPJ, FFJ,	991.11	49,555.50	25,345.50	104.69
T7 – Control (No application)	1626.67	81,333.50	57,923.50	247.43
T8 – 2 tbsp vermitea	831.11	41,555.50	4,705.50	12.77
T9 – 2 tbsp/L KAA + 2tbsp/L vermitea	564.44	40,666.50	3,816.50	10.36
T10 – 2 tbsp/L FPJ + Calcium	813.33	28,222.00	-11,628	-29.18
T11 – 2 tbsp/L KAA + 2 tbsp/L FFJ	297.78	14,889.00	-9,321.00	-38.5
T12 – 2 tbsp/L KAA + Calcium	448.89	22,444.50	-1,765.50	-7.29
T13 – 2 tbsp/L Combinations of FPJ, FFJ,	444.44	22,222.00	-1,988.00	-8.21
T14 – Control	617.78	30,889.00	7,479.00	31.95

Summary

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This research on **"Supplementation of Naturally Fermented Solutions (NFS) to the Production Management of Strawberry *(Fragaria x ananassa)* in Isabela, Philippines"** was conducted to evaluate the two strawberry varieties under a chemical-free production system in Cabagan, Isabela. Specifically, it aimed to determine which among of the Naturally Fermented Solutions would yield the highest, determine the best Naturally Fermented Solutions that would give a quality fruit strawberry, determine which among the Naturally Fermented Solutions gives the sweetest fruit of the strawberry, and determine the profitability of using NFS to strawberry production. The study was conducted in a chemical-free crop production area of Isabela State University located at Garita Heights, Cabagan, Isabela (17.4079ºN, and 121.8050ºE) from October 2021 to April 2022. This study was laid out following the split-plot in Randomized Complete Block Design (RCBD) and replicated three times. Study 1 and Study 2 treatments were as follows: T_1 - 2 tbsp Vermitea, T_2 - 2 tbsp/L Kuhol Amino Acid (KAA) + 2 tbsp/L Vermitea, T_3 -2 tbsp/L Fermented Plant Juice (FPJ) + Calcium (applied at flowering) T_4 -2 tbsp/L Kuhol Amino Acid (KAA) + FFJ (applied at flowering), T_5 - 2 tbsp/L Kuhol Amino Acid (KAA) + Calcium (applied at flowering), T_6 – 2 tbsp/ L Combinations of FPJ, FFJ , KAA and Calcium. T_7- Control (no application). All data gathered were consolidated, tabulated and analysed using the process in Statistical Tool for Agricultural Research (STAR). The Least Significant Difference (LSD) were used to compare the differences among the treatment means. To further analyse the data with significant results of ANOVA, a pairwise mean comparison in post hoc analysis was used to test the differences among treatment means using Tukey's Honest Significant Difference (THSD) Test.

Results of the study showed that among all the treatments used, application of Kuhol Amino Acid + vermitea is very effective which gave the highest produce the fruit production in strawberries. The study indicates that the use of Kuhol Amino Acid + vermitea in strawberry production significantly gave the highest fruit setting, produce fruit and had the tallest fruit yield.

Conclusion

Based on the result of the study, it can be concluded that treatment 1 (Vermitea), and Treatment 2 (2 tbsp/L Kuhol amino acid (KAA) + Vermitea) produced the best result on fruit yield and fruit quality produced. The yield of Sweet Charlie variety was highest than the Japanese Shoga variety.

Recommendations

From the result of the study, it is recommended to:

1. The Sweet Charlie Variety is recommended for mass production as it was found more adaption to Isabela weather condition.
2. Apply Vermitea and Kuhol Amino Acid as it gives higher production of fruit quality produced and fruit yield.
3. Apply Vermitea, KAA, FPJ, FFJ and Calcium (eggshell) as supplement for the production of the strawberry following the recommended dilution rate of 2 tbsp/L.

LITERATURE CITED

1. Alam, Md. Amirul. 2017. Effects of fermented plant juice and fruit on growth and yield of tomato for sustainable practices. Bangladesh Journal of Botany. 46. 405-412

2. Ansari, AA, Sukhraj K. 2010. Effect of vermiwash and vermicompost on soil parameters and productivity of okra (Abelmoschus esculentus) in Guyana. African Journal of Agricultural Research. 5(14):1794-1798
3. Bakshi, Parshant, M. Singh, AK Singh, Vishaw Vikas, JN Srivatava, Vijay kumar and Vishal Gupta., 2018. Organic production of strawberry: A review. Department of Agriculture, 2019. Production of Natural Farming Inputs (NFS). Unpublished technology guide.
4. Belliturk, K., S. Adiloglu, Y. Solmaz, A. Zahmacioglu and A. Adiloglu. 2017. Effects of increasing does of vermicompost applications on P and K contents of pepper (*Capsicum annum*, L.) and eggplant (*Solanum melongena*, L.). J. of Agric. Tech. 4(4):372- 375.
5. Edwards, CA, Domínguez J, Arancon NQ, 2004. The influence of vermin composts on plant Growth and pest incidence. In, S.H Shakir and W.Z.A. Mikhaïl, (Eds. Soil Zoology for Sustainable Development in the 21st century, 397-420.
6. Fathima M, Sekar M. 2014. Studies on Growth Promoting effects of Vermiwash on the Germination of Vegetable Crops. International Journal of Current Microbiology and Applied Sciences. 3(6):564-570.
7. Gamaley, A. V., Nadporoshkaya, M. A,Popov, A. I.,Gromova OA., 2001. Non root nutrition with vermicompost extracts as the way of ecological optimization: Plant nutrition, food security and sustainable agro- ecosystem through basic and appl;ied research. Fourteenth Internatil Plant NutritionColloqium., Springer Netherlands, Hannover, Germany.,, pp.862- 863.
8. Gandhi, and U.S. Sundari. 2012. Effect of vermicompost prepared from aquatic weeds on growth and yield of eggplant (*Solanum melongena*, L.). Biofertilizers & Biopesticides. 3(5): PP. 100 – 128.
9. Gorakh, N., K. Singh and D.K .Singh. 2009. Chemical Analysis of vermiwash of different combination of animal, agro and kitchen wastes. Aus.J Bas. & Appl. Sci.2009.
10. Ismail, S.A. 2005. The Earthworm Book. Ausa, Goa: Other India Press. Pp. 101.
11. Khalid, S., K. M Qureshi, I. A Hafiz, K. S Khan and U. S Qureshi 2013. Effect of Organic Amendments on Vegetative Growth, Fruit and Yield Quality of Strawberry. Pakistan Journal of Agricultural Research. Vol. 26 No. 2, 2013. Retrieved from https://www.cabi.org/GARA/FullTextPDF/2013/20133358759.pdf on February 10, 2021.
12. Kuepper, G., Foliar fertilization, The National Sustainable Agriculture Information Service, 2003, www.attra.ncat.org.
13. Ling, Fan and M. Silberbush. 2002. Response of maize to foliar vs. soil application of nitrogen-phosphorus-potassium fertilizers. Journal of Plant Nutrition 25(11):2333- 2342. DOI:10.1081/PLN-120014698
14. Naz, F, Haq IU, Asghar S, Shah AS and Rahman A 2011. Studies on growth, yield and nutritional composition of different tomato cultivars in Battal valley of district Mansehra, Khyber Pakhtunkhwa, Pakistan. Sarhad J. Agric.27: 569-571.
15. Nigam, SN, Aruna R, Giri DY, Ranga Rao GV and Reddy AGS. 2006. Obtaining Sustainable Higher Groundnut Yields: Principles and Practices of Cultivation. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 48 pp. ISBN 92-9066-484-3
16. Racoma, A. Detorio and Beato and L. Lovino. 2017. Growth and Yield Performance of Hot Pepper (Capsicum frutescens) Fertilizer with Fermented Plant Materials. International Journal of Advance Research. Article DOI: 10.21474/IJAR01/5503. DOI URL: http://dx.doi.org/10.21474/IJAR01/5503

17. Raoul, A. 2008. Organic farming,https://www.britannica.com Strawberry thrives in Camarines Sur. Inquirer Southern Luzon. https://newsinfo.inquirer.net/390933/strawberry-thrives-even-in-camsur
18. Kumar, R. and Gehlot, R. 2018. Traditional Fermented Products of India. Int.J.Curr.Microbiol.App.Sci. 7(04): 1873-1883doi: https://doi.org/10.20546/ijcmas.2018.704.214
19. Seleiman, M.F. Khalid F. Almutairi, M. Alotaibi, Ashwag Shami Bushra Ahmed Alhammad and Martin Leonardo Battagli*l*. 2020. Nano-Fertilizers as an emerging fertization Techniques: Why can modern agriculture benefits from its use. Plants; 10(1):2.https://doi.org/10.3390/plants 10010002
20. Soraya, I., C.Sulaiman, P. Mohamad. 2020. The use of Vermiwash and Vermicompost Extract in the Plant Disease and Pest Control. Natural Remedies for Pest, Disease and Weed Control. 187-201
21. Sundararasu, K. and A. Jeyasankar. 2014. Effect of vermiwash on growth and yield of brinjal (*Solanum melongena,* L.). Asian J. of Sci. and Tech. 5(3): 171-173.
22. Verma, S, Babu A, Patel A, Singh Sk, Pradhan SS, Singh Jp, and Singh RK 2018IUI Significance of vermiwash on crop production: A review. J Pharmacognosy Phytochem 7(2): 297-301. www.phytojournal.com