NATIONAL AGRICULTURAL RESEARCH AND EXTENSION INSTITUTE

(NAREI)

ANNUAL REPORT 2018

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ANNUAL REPORT 2018

1.0 ABSTRACTS OF COMPLETED RESEARCH PROJECTS

(i) Evaluation of Yield and Morphological Characteristics of eight varieties of Quinoa (Chenopodium quinoa Willd.) at Mon Repos, East Coast Demerara

Premdat Beecham 1

Abstract

Due to its highly nutritive compounds, the demand for quinoa, a small grain originating from the Andean region of South America, increased rapidly over the last years. However, the main producing countries, Bolivia and Peru cannot cover the growing demand. Therefore, the interest of Guyanese farmers in cultivating quinoa as a profitable source of income gained prominence. The varieties originated from the United States and were chosen based on their variation in morphological and agronomic traits, and their potential for adaptation to the climate of Guyana. The objective of this study was to evaluate the stability and agronomic performance of eight quinoa cultivars. Field evaluations were conducted during 2018 cropping season at Mon Repos, East Coast Demerara, where eight genotypes of quinoa were tested using a randomized complete block design (RCBD) with eight treatments and three replicates. Plant height, number of branches, days to flowering, grain weight, and grain yield were recorded for each variety. Varieties four and five displayed greater adaptation compared with the others to local environmental conditions. Plant height was superior in variety five **(78.4cm)**, the number of branches was also higher in variety five **(13.0),** whilst the number of inflorescences was greater in varieties four and five with values **(7.6 and 9.4)** respectively. Days to flowering was significantly different in all the genotypes, whereas variety seven took longer to flower **(92 days)** when compared with variety five **(79 days).** Seed weight (g/1000) was greater in variety four **(2.0 g/1000 grains).** Yield was significantly different among all the varieties, however varieties four and five were superior with values of **(883 and 785 kg/ha)** respectively. While these results suggest that this Andean crop is able to grow in many different environments, social, and cultural considerations remain crucial regarding its possible introduction as a super food in new cropping systems around the country. The results also highlight the need to continue evaluating a diverse number of cultivars to select for genotypes adapted to specific agro-ecological areas and across seasons in Guyana.

Keywords: Chenopodium quinoa Willd. Diversification. Genotypes. Morphological

(ii) Evaluation of morphological characteristics and yield of five improved varieties of cassava at Parika, East Bank Demerara

Premdat Beecham 1

ABSTRACT

A study was carried out at a private farm in Salem, Parika, East Bank Essequibo with the following objectives i) To evaluate five cassava varieties for their field persistency and productivity on Farmer's field (ii) To assess the cassava stem characteristics for their suitability as planting material. (iii) To improve the capability of local farmers and make available improved planting materials. The experiment was factorial laid out in a randomized complete block design with five treatments and three replications. The treatments were the different varieties (NAREI 1, NAREI 2, Mmex, Smokey prolific and Uncle Mack [control]). The varieties had different growth characteristics, number of branches, canopy width and tuber yield when compared with the control variety. The highest tuber yield at 30 WAP was recorded by NAREI 1 (30t/ha) followed by NAREI 2 (29.0 t/ha), Mmex (26.4 t/ha), Smokey prolific (22.4 t/h), while Uncle Mack (Control) was the lowest at (21.3t/ha). The other parameters measured showed significant differences among the varieties during the later stages 30WAP. The highest Number of branches was recorded on the control variety Uncle Mack (2.8). NAREI 2 had the highest canopy width (113cm) whilst NAREI 1 recorded the highest plant height (185cm) and stem girth (3.9cm), respectively.

Key words: Cassava varieties; growth characteristics, yield.

(iii) ENERGY POTENTIAL OF THE BIOMASS OF COCONUT VARIETIES IN GUYANA

Bibi Nariefa Abrahim* and Oudho Homenauth

ABSTRACT

Guyana's growing coconut industry has great potential for the generation of renewable energy using its waste materials which are currently discarded unsustainably. This study sought to investigate the energy potential of the husks and shells of three common coconut varieties grown in Guyana. An experimental approach was applied in this research where samples of the coconut husks and shells were subjected to proximate, ultimate and calorific analyses. The analyses indicated that the energy value of the husks and shells of the tall and dwarf coconuts were high and confirmed to the findings presented in past studies. It was found that that the coconut shells have a higher energy content as opposed to the husk, mainly due to the presence of lignin and cellulose and a lower moisture content. The shell of one of the dwarf varieties (firmer and thinner) produced the greatest energy output. The coconut husks however, followed closely where the tall variety reported the greatest energy value. Based on the energy output of the waste materials, possible energy, power, carbon, diesel and price savings were determined if energy conversion is to be implemented. The analyses show substantial benefits for the country with respect to waste management, carbon emissions and costs and therefore indicate the need for energy generation from coconut waste. A proposed gasification-pyrolysis system was developed and provides a baseline for the utilisation of coconut biomass for energy generation in Guyana.

Keywords: coconut biomass, energy content, energy generation

(iv) EFFECTS OF COCO-PEAT, VERMICOMPOST AND PRO-MIX GROWTH MEDIA ON THE GROWTH AND DEVELOPMENT OF BOULANGER (SOLANUM MELONGENA) AND TOMATO (SOLANUM LYCOPERSICUM) SEEDLINGS: A COMPARATIVE STUDY

Lalita Gopaul*, Bibi Nariefa Abrahim & Dr. Oudho Homenauth

ABSTRACT

The use of suitable growth medium in nurseries is necessary for the production of seedlings of excellent qualities. In light of climate change and its effects, there is an urgent need for the replacement of synthetic growth media with organic alternatives. Currently the waste of Guyana's expanding coconut industry is posing a solid waste management issue; as such it can be converted and used as an organic growth medium in the form of cocopeat. This study sought to compare the effects of cocopeat, vermicompost, and promix growth medium on the growth and development of boulanger and tomato seedlings. Four treatments were evaluated using an experimental approach in a randomised complete block design. Data was obtained on the physical and chemical properties of the medium and the growth parameters of the seedlings. Results indicated that promix had the best bulk density and water holding capacity followed by cocopeat and then vermicompost. It was found that the mixture of vermicompost and cocopeat produced boulanger seedlings with the most leaves, widest leaves and highest fresh weight while vermicompost produced boulanger seedlings of the tallest shoots and longest leaves. On the other hand, the mixture of cocopeat and vermicompost produced tomato seedlings of the tallest shoots, longest leaves, and longest roots while vermicompost produced those with the most leaves and highest fresh weight. These were followed by the seedlings produced in cocopeat and then by those produced in promix for both boulanger and tomato. The results of this study concluded that the mixture of vermicompost and cocopeat at a 1:1 ratio is the ideal growth medium for boulanger and tomato seedling production as the vermicompost supplies the ready to use nutrients while cocopeat provides an ultimate environment for root development.

Keywords: growth medium, cocopeat, vermicompost, pro-mix, tomato, boulanger, seedlings

(v) Evaluation of Cost of Production for Bonta against Mickey Lee watermelon

Rebecca Narine, Simone Thomas (Research Technician), Michelle Washington (General Worker), Dr. Raghunath Chandranauth

ABSTRACT

Watermelon is an important agricultural commodity in Guyana, as well as worldwide. Only one cultivar of watermelon, Mickey Lee, is widely cultivated in Guyana which shows our lack of diversification. In the year 2017, varietal evaluations were done on new cultivars of watermelon in the Mahaica area. The results obtained from these studies concluded that one cultivar, Bonta, demonstrated qualities that were acceptable for production in Guyana. Its production factors were very similar to that of Mickey Lee and it was accepted into the local market. As a result of that study, this new study was done so that a detailed evaluation could be made on Bonta's cost of production in Guyana as compared to Mickey Lee. At the end of this research details were gathered on the cost effectiveness of producing Bonta to Mickylee. Watermelon seeds were manually sown at Mahaica using a randomized complete block design with three replicates with a total plot size of 64.6m x 5.5m. A seed density of 36,388 seeds/ha was used. General agronomic practices were done throughout the duration of this research. All inputs (labour, materials, machinery etc.) were recorded and were used to calculate the cost of production for the two varieties. Bonta produced larger fruits than the Mickylee. Bonta's average fruit weight was recorded at 5.02 kg while Mickylee's average fruit weight was 3.42 kg. The cost of production of both varieties was $788,000.ha. However, when it came to market prices, Mickylee fetched a slightly higher value since it was the variety that buyers were accustomed to seeing. Mickylee wholesaled at $77/kg while Bonta sold at approximately $70/kg. Bonta and Mickylee yielded 40,160 and 21,430 kg/ha, respectively.

Key words: Cost of production, diversification, Bonta, Mickey lee watermelon

(vi) Evaluating the combined use of chemical (Urea, Triple Super Phosphate and Muriate of Potash) and organic (chicken litter) fertilizers for increasing cabbage productivity

Rebecca Narine, Simone Thomas and Dr. R. Chandranauth

ABSTRACT

Cabbage, *Brassica oleracea*, belongs to the family Brassicaceae. It is a leafy vegetable that is used, in Guyana, cooked, pickled or as a salad. There are a few varieties grown locally with KK cross being one of the most popular. The KK cross variety is popular in tropical countries because of its high tolerance to heat and its resistance to *Xanthomonas*. Sustainable agriculture is of major importance to Guyana and the world in general. This research also showed that applying organic manure increased the soil bulk density and also its moisture retention capacity. This research will provide information that will aid in convincing farmers to try organic fertilizers and reduce the use of synthetic fertilizers. The research was done using a complete randomized block design with three replicates and three treatments (no fertilizer (T_1), inorganic fertilizer (T_2), and $^1/_3$ inorganic mixed with $^2/_3$ organic (T_3)) at NAREI's demonstration farm; it was done under the shade house. A sample of the poultry manure that was used was taken to GuySuCo's laboratory in order to determine its Nitrogen, Phosphorus, and Potassium content levels. Fertilizer was applied in two doses at 3 weeks and six weeks after transplant. Fertilizer was applied in kg/ha at N-P-K (125.8-103.6-59.2) for treatment two and N-P-K (40.7-33.3-20.35) along with chicken litter (7,849.55 kg/ha) for treatment three.

Fertilizer for treatment three was applied based on the results from the analysis done on the chicken litter. Pests and diseases management was done throughout the growth and production cycle of the cabbages. Other general agronomic practices were also done. Data were collected on the percentage of total marketable yield, head weight and head diameter for the cabbages.

Data were analyzed using the LSD to determine whether or not the means observed were significantly different from each other at p 0.05. After analysis, it was determined that there are no significant differences between cabbages cultivated with no fertilizer and those cultivated with inorganic fertilizer for the mean head weight and head diameter. However, those grown with the combination fertilizer produced significantly larger heads. Cabbages produced an average of 36,850, 29,700 and 27,500 kg/ha for the combination, inorganic and no fertilizer treatments, respectively. It can be concluded that growing cabbages with a combination of both organic and inorganic fertilizers is the better choice since the total marketable yield was 13 % and 17 % greater than those produced with inorganic and no fertilizers, respectively.

Keywords: Cabbage, Fertilizer, Inorganic, Organic, Chicken Litter

(vii) Evaluation of sweet potato varieties to sweet potato weevil susceptibility.

Aretha Peters and Simone Thomas

ABSTRACT

Sweet potato weevil (*Cylas formicarius*) is by far the most destructive pest of the sweet potato plant. Sweet potato production is often poor due to damage caused by the weevil. Varietal resistance is a built-in mechanism within the plant species to repel a particular insect from feeding. This project was conducted at NAREI Mon Repos, Field 17. A randomized complete block design was used for the trial with seven treatments (varieties) Beauregard, Amjad, professor No.1, zebra, vanilla, cogle and strong man. The treatments were replicated three times. Two pheromone traps were 'set up' to confirm the presence of *Cylas formicarius*. The parameters measured were: the number and weight of tubers, the number and percentage of damaged tubers. Results from the trial revealed that the varieties Strong Man and Beauregard had the highest numbers of tuber damaged by *Cylas formicarius* while the variety cogle had the least number of damaged tuber followed by professor.

Key Words: Sweet potato, weevil, Cylas formicarius, susceptibility, varieties, tubers

(viii) Evaluation of sprouts and stem cuttings for sweet potato production in Guyana.

Aretha Peters and Simone Thomas

ABSTRACT

The availability of good quality planting material is a major constraint of sweet potato production. Two types of planting materials are mainly used in sweet potato production (Stem cuttings and sprouts from tuberous roots). Studies from India have suggested that sprouts from tuberous roots can be superior to stem cuttings as a source of planting materials. In Guyana, farmers general use stem cuttings from established field that often accumulates insect pests and diseases leading to decline in the performance of cultivars. The trial was conducted in Field 17, Mon Repos. The two main types of planting materials (Sprouts and Stem cuttings (Treatments) were evaluated in a randomized complete block design with four replications. Two sweet potato varieties (Strong man and Beauregard) were evaluated for production potentials using the two types of planting materials. The analysis of data obtained from the trial revealed that there was significant differences in the number of tubers produced, weight of tubers, marketable and nonmarketable tubers for the Beauregard variety while, for the same parameters measured, there was no significant differences for the Strong man variety . The results from the research are indicating that the sprouts are the most appropriate planting material for sweet potato production.

Key Words – Sweet potato, sprouts, stem cuttings, Beauregard, Strong man, tubers and production

(ix) To evaluating the effects of different fertilizer rates on the yield of Rambutan

Indira Persaud and A. Mangar and S. Ramdowar

ABSTRACT

This study was undertaken to determine the best fertilizer rate for yield and quality of Rambutan *Nephelium lappaceum L.* It was conducted on a farmer's plot at Canal#1 over a two-year period. The experiment was laid out in Randomized Complete Block Design with three treatments and three replications: T_1:(375:375:375g NPK/tree/application), T_2:(500:500:500g NPK/tree/application), T_3: (225:225:225 NPK/tree/application (control)) Based on the results obtained from this investigation, it was observed that maximum yield/tree (38.65kg), ascorbic acid (58.1mg/100g) and Brix (19.4□) were recorded with the application of T_2 (500:500:500g NPK/tree/application).

Keywords: Yield, ascorbic acid, fertilizer

(x) Effect of integrated nutrient management on yield and quality of Limes (Citrus aurantifolia).

Vickram Persaud, Adrian Mangar and S. Ramdowar

ABSTRACT

This study was undertaken to determine the best treatment of integrated nutrient management for the growth, yield and quality of Citrus *aurantifolia*, Citrus *limon* and Citrus *reticulata*. It was carried out at two locations: Kairuni Nursery on the Soesdyke Linden Highway and NAREI Demonstration Farm Mon Repos. It was done over a two-year period. The experiment was laid out in Randomized Complete Block Design with five treatments and three replications: T_1: Control (Recommended Dosage of Fertilizer (RDF) 500: 300: 300g NPK per plant).), T_2: (Bio20 (100ml per plant), T_3:11kg/ plant chicken manure, T_4: 50% RDF + 50 % Bio20, T_5: 50% RDF + 50% chicken manure. Based on the results obtained from this investigation, it was observed that maximum fruit weight (152.63g), fruit diameter (6.2cm), ascorbic acid (33.74 mg/100g), canopy (3.93m), tree height (5.53m) and yield/tree (5.20 kg) were recorded with the application of T_5 (50%RDF+ 50% chicken manure) for Seedless limes and maximum tree height (3.61m) for West Indian limes at Kairuni Nursery. maximum fruit weight (152.63g), fruit diameter (6.2cm), ascorbic acid (33.74 mg/100g), canopy (3.93 m), tree height (5.53m) and yield/tree (5.20 kg) were recorded with the application of T_5 (50%RDF+ 50% chicken manure) Demonstration Farm, mixed results were obtained for Rangur and West Indian Limes. Maximum fruit weight (108g), fruit diameter (8.3cm), ascorbic acid (17.61 mg/100g), canopy (3.18m), tree height (4.38m), Brix (8%) and yield/tree (7.34 kg) were recorded with the application of T_5 (50%RDF+ 50% chicken manure) for Lemons and fruit weight (83g), fruit diameter (4.2cm), ascorbic acid (17.61 mg/100g), canopy (3.52), tree height (3.48m), Brix (8.8%) and yield/tree (4.43 kg) for Mandarin.

Keywords: Integrated nutrient management, ascorbic acid, manure

(xi) The response of the Moruga red hot pepper to various rates of of fertilizers

Rameshwar Raghunauth and Simone Thomas

ABSTRACT

The continuous use of chemical fertilizer has negative repercussions on the environment and human health. Organic fertilizer - inorganic fertilizer mixes are gaining acceptance and its use has been increasing globally because it is sustainable and safe for human consumption. A trial was conducted at NAREI Demonstration Farm, East Coast Demerara on the growth and yield of Moruga hot pepper using poultry manure, vermicompost and in combination with inorganic fertilizer. The plot was set out according to the Randomized Complete Block Design (RCBD) with four treatments (T1: 0kg/ha, T2: (0.5kg Poultry manure+ 0.5kg vermicompost/plant), T3: (15g NPK + 0.5kg Poultry manure /plant) and T4: (15g NPK+0.5kg vermicompost) were applied in split application at four weeks before planting, four weeks after planting and eight weeks after planting. Significantly higher total yield (18.1 t/ha), number of fruit per plant (124), yield per plant (1,537 g), yield per plot (18.5 kg), fruit length (5.13 cm), fruit width (4.41cm) plant height (59.52 cm) and plant spread (61.39 cm) were obtained from rate four (Vermicompost + NPK fertilizer) when compared to the other treatments. The second highest yield of 12.1 t/ha was achieved by rate three (Poultry manure + NPK fertilizer) that had notable differences from rate two and the control. Rate two (Vermicompost + Poultry manure) obtained the third highest yield of 7.3 t/ha which differs considerably from the control. The least yield (4.1 t/ha) was attained by the control (Rate 1). The result suggested that rate four (vermicompost + NPK fertilizer) increased yield performance of Moruga red hot pepper.

Keywords: Vernicompost, poultry manure, Moruga hot pepper, yield

(xii) The Response of Aristotle and Sunsation Varieties of Sweet pepper using fertilizers and manures to increase Production.

Rameshwar Raghunauth and Simone Thomas

ABSTRACT

The aim of this investigation was to increase sweet pepper production by reducing inorganic fertilizer usage and at the same time looking for sustainable nutrient source (manures and a combination of manure and fertilizer). The nutrients obtained from these sources are more rational for long term crop production. This study was carried out under NAREI Tunnel House, Mon Repos. The plot was arranged according to Strip plot design with two treatments [Aristotle (V1) and Sunsation (V2)] and four rates (R1: 0 g/plant), R2: (15 g NPK + 0.5kg vermicompost/plant), R3: (0.5kg Poultry manure+ 0.5kg vermicompost/plant), and R4: (15 g NPK+ 0.5kg Poultry manure) were applied in split application at four weeks before planting, four, eight and twelve week intervals after planting. Variety one (Aristotle) recorded significantly higher fruit weight (170.2 g) when compared to variety two (154.0g). The treatment combination R2 V1 obtained considerably heavier fruits (225.8 g) followed by R3 V1 (188.9 g) then R4 V1 (178.9 g). The highest fruit weight (195.8 g) for variety two was achieved by treatment combination R2 V2, however, it not notably different from the other treatments combination. Variety one recorded the highest total fruit yield (33.4 t) which was also significantly higher that the total yield (28.4 t) achieved Variety two. The treatment combination R2 V1 achieved notably higher total fruit yield (45.9 t) compared to other treatment combination. They were no considerably differences between treatment combinations R3 V1 (35.6 t) and R4 V1 (36.8 t) however, the latter attained higher yield. The treatments combination R2 V2 and R4 V2 achieved identical total fruit yield (34.7 t) hence they were not significantly different from one another. However, they were significanly different from the treatment combination R3 V2 (32.2 t) which obtained the third highest yield for variety two. The least total fruit yield was obtained from the control for variety one (15.3 t) and variety two (12.1 t). As such the Aristotle variety will be more lucrative to cultivate in Guyana under shaded conditions. The use of vermicompost + NPK fertilizer gave the highest yield which indicates it may be a more suitable nutrient source for sweet pepper production.

Keywords: Variety, manure, fertilizer, yield and treatment combination

(xiii) An Assessment of the effects of Botanical Extracts on Insect Pests incidence and Tomato (Lycopersicon esculentum) and Boulanger (Solanum melongena) Production

Oceana O'Dean and Anesha Stephen

ABSTRACT

This project assessed the effectiveness of bio-pesticides on the major insect-pests affecting boulanger (aphids) and tomatoes (whiteflies). Four treatments were developed: *Treatment 1* – (25ml Ginger - 900ml water), *Treatment 2* – (25ml Chili pepper - 900ml water), *Treatment 3* – (25ml Garlic – 900ml water), *Treatment 4* – **(**25ml Turmeric – 900ml water) and *Control – (no treatment)*. Severity by Treatments for tomato showed that there was a significant difference (p=0.02) between treatments in the control of whiteflies. However, for boulanger, there no significant difference (p=0.07) between treatments in the control of aphids. The most effective treatments for controlling the aphids was *Treatment 3*. While in the control of whiteflies Treatments 2 was most effective. Additionally, the bio-pesticides had no effect on the weight or acidity of the fruit produced by each crop. Hence, it is suspected that these extracts can be used without fear of harming the plant or its produce. Further trials using garlic, ginger and chilli pepper will be done to ascertain its effect on other pests. Also, determining the correct concentrations for maximum effectiveness is extremely important.

Keywords: whiteflies, aphids, biopesticide, ginger, garlic, turmeric, chilli pepper

(xiv) Control of bacterial disease in watermelons using IPM approaches

Somwattie Pooran-DeSouza and Kimanda Pilgrim, Ariefa Hassan

ABSTRACT

Bacterial Fruit Blotch is one of the most devastating diseases affecting watermelons in Guyana. The sporadic outbreak during the rainy season has led to over 60% crop losses by Mahaica farmers. In 2018, three field trials were conducted: 1) to evaluate effects of BFB disease on two varieties of watermelon; 2) to evaluate the effects of nitrogen fertilizers on watermelon yields affected by BFB disease; and 3) to determine the effects of fungicides on the management of BFB in watermelon. Results obtained have shown that Bonta was more susceptible to BFB than Mickyelee but had higher yields (16%) and produces larger fruits compared to the Mickyelee variety. The use of nitrogen fertilizer at rates of 80kg/ha has resulted in an increase in watermelon yields by 27% compared to the control. Increased the nitrogen rates resulted in a reduction in BFB fruit severity but not BFB leaf severity. Fungicides did not had any significant effect on watermelon yields. However, Rizolex, Serenade and Bordeaux may be used in the management of BFB symptoms.

Key Words: Bacterial Fruit Blotch (BFB), Varieties, Fungicides, Nitrogen fertilizer rates, leaf and fruit severities

(xv) Performance of Macropropagated plantain plantlets treated with PGR's in open field conditions.

Vishan Persaud

ABSTRACT

The present study was conducted at Mahaicony, East Coast Demerara, Guyana to evaluate the effect of Benzylaminopurine (BAP) and auxin hormones on the growth and yield of macropropagated plantain plants. Agronomic data on plant height and number of leaves were collected monthly for a period of six months and yield data was collected on bunch weight and number of hands/bunch. Macropropagated plants treated with auxins produced the highest average number of leaves/plant; however, it was not significantly different from treatment with BAP and the control. Treatment with BAP significantly increased plant height by 44 % relative to treatment with auxins but did not significantly increase height as compared to the control. Yield data showed that there was no difference in bunch weight among the treatments relative to the control. Results of this study therefore show that treatments with hormones did not make a significant positive impact on the growth and yield of macropropagated plantain plants.

Key words: Macropropagation, BAP, auxin, plant height, leaf number, bunch weight

(xvi) Title: The Use of Charcoal as a Soil Amendment on Degraded Soils in Guyana.

Tracy Persaud and David B Fredericks.

ABSTRACT

Charcoal can be applied as biochar to acidic and infertile agricultural soils especially marginal and degraded soils where nutrient resources are scarce, as a valuable amendment for improving soil productivity and fertility. Although land degradation in Guyana is minimal, there are pockets of degraded areas around the country that are closely associated with mining land use. This project addresses post land-use challenges and hazard for reclaimed mine sites in Guyana. It implements sustainable techniques to re-establish natural vegetation and improve soil quality. To evaluate the use of charcoal as a soil amendment, four rates of charcoal (0, 10, 20 and 30 t/ha) were tested under shade house conditions with a blanket dose of inorganic fertilizers at rates of urea 652 kg/ha, triple super phosphate and muriate of potash at 180 kg/ha. The treatments were assessed for yield of Giant King Grass (Pennisetum purpureum*) and diagnostic characteristics for soil quality. After three cropping cycles the results obtained in this study reveal that the addition of charcoal to a mined out soil significantly improved the physical and chemical properties of the soil. There were significant increases in soil pH, organic matter, water holding capacity, cation exchange capacity and exchangeable cations and decrease bulk density for all charcoal amended treatments. There was a 21.79, 31.46 55.65% increase in yield between the application of charcoal at 20 t/ha and the control for first, second and third cropping cycles respectively. The control recorded the lowest yield in all the cropping cycles which suggests that the application of inorganic fertilizers alone could not sustain plant growth on degraded soils. The significant increase of cation exchange capacity, nitrogen, calcium and phosphorous levels at 20 t/ha applied charcoal correlated with significant increase of yields further enhancing the potential of charcoal use for increased production.*

Keywords: Charcoal, Soil Amendment, Mine Spoil, Giant King Grass.

(xvii) Glomus intraradices Responses to Charcoal in Tabela Sand using Lactuca sativa

Denisia Whyte, David Fredericks, Tracy Persaud

ABSTRACT

Agricultural crop production in the Hinterland Regions of Guyana is constrained by marginal quality sandy soils that limit their productivity. This present a challenge to farmers, and the government who are committed to expand agriculture into this vast land area. Improving and maintaining soil nutrient and microbiological quality using charcoal as an amendment is one way to alleviate this constraint. In this study, four charcoal application rates (0, 10, 20 and 30 t/ha) were used to amend a marginal soil Tabela Sand, to evaluate its effect on *Glomus intraradices* under shaded conditions, with *Lactuca sativa* (lettuce) as an indicator crop. Over four cropping cycles, it was found that root colonization and spores increased significantly, 93.78%, 124.85%, 124.29% for application rates 10, 20, 30t/ha respectively when compared to the control. Also, shoot fresh weight increased significantly, 20.60%, 66.43% and 53.99% at 10t/ha, 20t/ha and 30t/ha respectively across the four crop cycles relative to the control. In addition, there were significant increases in soil pH, organic carbon, organic matter, water holding capacity, yield and root length, and a decrease in soil bulk density.

Soil nutrients availability of P, Ca, Mg, Fe, Cu and Mn increased significantly across cropping cycles, as did nutrient levels in the plant tissue for K, Ca, Mg, Fe and Mn. Charcoal application rate at 20t/ha was found to be the optimum for *Glomus intraradices* and *Lactuca sativa* (lettuce) yield on this soil under shaded conditions.

Key words: Glomus intraradices, Lactuca sativa, Tabela Sand, marginal soils, soil amendment, charcoal

(xviii) Effect of synthetic fertilizer on the growth and yield of turmeric (Curcuma longa) on Onverwagt clay soil

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ABSTRACT

A field experiment was carried out at the National Agricultural Research & Extension Institute, NAREI, Mon Repos, East Coast Demerara, Guyana South America during 2017-2018 to study the effect of synthetic fertilizer on the growth and yield of turmeric (Curcuma longa) on Onverwagt clay soil. Turmeric is a common spice and a major ingredient in curry powder. Its primary active ingredients, curcuminoids, are yellow and used to color foods and cosmetics.

The experiment was carried out with the objectives to elucidate the effects of synthetic fertilizer on the growth and yield of turmeric and to ascertain the economic benefits of applying synthetic fertilizer on turmeric growing on Onverwagt clay soil.The experimental plot was laid out in a randomized complete block design (RCBD), with four treatments and five replicates. Treatments used were T1 No fertilizer (Control), T2 30kg N/ha, 25kg P2O5/ha, 60kg K2O/ha, T3 60kg N/ha, 50kg P2O5/ha, 120kg K2O/ha and T4 120kg N/ha, 100kg P2O5/ha, 240kg K2O/ha. Fertilizer was applied in three split applications: basal, 40 and 90 D.A.P. Statistical analyses could not detect any significant statistical differences among the fresh rhizomes weight obtained per 3m2 beds. The minimum and maximum weights recorded were 22kg and 25.46kg per 3m2 beds, respectively. No significant pairwise differences could not be detected among the treatment means with respect to length of leaves/plant, width of leaves/plant, number of leaves/plant, number of tillers/plant, plant height and weight of fresh turmeric rhizomes per 3m2 beds. There were, however, significant differences among the day interval means with respect to length of leaves/plant, width of leaves/plant, number of leaves/plant, number of tillers/plant and plant height. It was concluded that the different treatments did not have significant effect on the growth and yield of turmeric and it is not cost-effective to apply synthetic fertilizers at the aforementioned rate because turmeric yield were not significantly enhanced.

Key Words: Synthetic Fertilizers, Curcuma longa, Turmeric Growth and Yield

2.0 STATUS REPORTS OF WORK IN PROGRESS/ INITIATED

i. A COMPARATIVE STUDY OF THE USE OF CHAR DERIVED FROM COCONUT SHELL AND HUSK AS SOIL AMENDMENTS FOR CASH CROP PRODUCTION

Bibi Nariefa Abrahim* and Oudho Homenauth

PROJECT SUMMARY

Climate change and environmental degradation are two global concerns that greatly affect small developing nations like Guyana. With this in mind, the exploration and development of sustainable livelihoods and practices has since become crucial research areas with agricultural production being a focal point. In Guyana, the agricultural sector specifically the coconut industry has seen a vast increase in the demand and production levels over the past years. This has triggered various concerns relating to sustainable waste management of the industry's waste. Added to this is the increased usage of inorganic fertilisers for enhanced production resulting in concerns relating to soil health and environmental pollution. This study therefore seeks to assess the short-term effects of biochar in combination with organic and inorganic fertilisers on soil properties and plant yield. Biochar from coconut husks and shells were prepared in a pyrolyser. The organic fertiliser, vermicompost and inorganic fertiliser NPK 15:15:15 were selected for this research. The chemical, physical and biological properties of the coconut biochars were examined along with the organic fertiliser. Seven treatments were selected including control, organic and inorganic fertilisers and coconut husk and shell biochars combined with each fertiliser. The tested crop included pakchoi where two applications of fertilisers were done in two trial experiments. Production data of the pakchoi plants were recorded and analysed. The data revealed that the addition of biochar with 43.47% of inorganic fertiliser produces plants with comparable masses and leaves as 100% inorganic fertiliser. This observation is seen in both experiments where the coconut husk biochar added with the inorganic fertiliser produced plants with masses that are not significantly different from the synthetically fertilised plants. A 0.96% difference has been computed for the mass of plants of coconut husk biochar and inorganic fertilised plants. Following this trend is the coconut shell biochar plants with the inorganic fertiliser. In experiment one, it was found that this treatment produced plants with mass that is significantly different from the coconut husk biochar+inorganic fertiliser and the inorganic fertiliser alone; however in experiment two, this treatment recorded plants with similar weights as coconut husk biochar+ inorganic fertiliser and synthetic fertiliser alone. Treatment two (vermicompost only) followed after this, where a 27.44% difference from the coconut shell biochar+inorganic fertiliser was computed. The mass of the vermicompost fertilised plants were found to be significantly different from the coconut biochars+inorganic fertiliser and inorganic fertiliser only. The vermicompost+coconut husk biochar and vermicompost+coconut shell biochar were found to be significantly different from the inorganic fertiliser and inorganic fertiliser+coconut biochars; however when compared to the vermicomposts only, no significant difference was observed amongst the mass of the pak choi plants. For both experiments the control treatment recorded the least mass of plants.

ii. PAK CHOI PRODUCTION USING VERMICOMPOST, COCO-PEAT AND NPK (15:15:15): A COMPARATIVE STUDY

Vickram Persaud, Bibi Nariefa Abrahim* and Oudho Homenauth

PROJECT SUMMARY

The imbalanced usage of chemical fertilizer is a common practice for vegetable and crop production locally. Over time the yield of these crops decline due to depleted soil fertility and the residual effect chemical fertilizers poses on the soil. Organic wastes have been put to use in the preparation of enriched manure which has gained recognition in its usage as an alternative to synthetic fertilizers. Coco-peat, the dust from the coconut husk is an abundant organic waste with a high water holding capacity, excellent drainage, absence of weed seeds and pathogens, withstands compression, slow decomposition, easy wettability, gives good aeration to the root zone and acceptable levels of pH, cation exchange capacity and electron conductivity. Cow manure, another form of agricultural waste can be converted to an organic amendment in process known as vermicomposting. Vermicomposting is a biotechnological process whereby earthworms convert waste materials to a nutrient rich material. These earthworms consume organic waste and reduce its volume by 40-60%. Vermicompost is a peat like material rich in nitrogen, phosphorus, micronutrients, plant growth hormones, enzymes and various soil microbes.

The aim of this research is to compare production parameters of pak choi using the conventional method of fertilization versus using organic fertilizers. The design used for this project was the complete randomized block design (CRBD). Four treatments were used namely; control (T1), NPK (T2), vermicompost (T3) and coco-peat (T4), under shaded conditions, with each treatment replicated three times for a total of 12 beds. An initial soil sample was taken and sent for nutrient analysis at GuySuCo. Production data of pakchoi were recorded and analysed. The data obtained has shown that the treatment producing the highest average mass per plant was vermicompost at 160.39g. NPK fertilized plants had an average mass of 152.63g per plant, being slightly lower than the vermicompost fertilized plants. For this project vermicompost produced greater above ground fresh weight than NPK and there was no significant difference between these two treatments. The coco-peat fertilized plants had an average mass of 132.57g per plant, with the control having the lowest average mass of 108.94g per plant. Data analysis has revealed that there is significant difference in the average mass per plant between the vermicompost and NPK fertilized plants when compared to the coco-peat fertilized plants. It is also evident that there is significant difference between the average mass when comparing the cocopeat fertilized plants to the control. Furthermore, there is significant difference between the average mass for the vermicompost and NPK fertilized plants when compared to the control.

iii. A COMPARATIVE STUDY OF VERMICOMPOSTING USING VARIOUS TYPES OF ANIMAL MANURE

Vickram Persaud, Bibi Nariefa Abrahim*, Lauren Paddy and Oudho Homenauth

PROJECT SUMMARY

Environmental degradation has always been an area of concern as it relates to the proliferated use of synthetic fertilizers. The use of organic fertilzers are seen as a way to mitigate the impacts the use of synthetic fertilizers pose on the environment and at the sametime remediate the soil. This research seeks to invetigate the use of different types of animal manure (pig, cow and sheep/ goat and a combination) for the production of vermicompost and using the vermicompost for the planting of pak choi. This research lends support to the drive towards the greening of Guyana's economy by making better use of materials, that are more than often considered waste, and often problematic to dispose of. In so doing it will allow for farmers to diversify their operations and produce foods that are organic and more wholesome for consumption.

Three treatments were selected with treatment 1 being cow manure, treatment 2 as sheep/goat manure and treatment 3 as a combination of the sheep/goat and cow manures. A bin was divided into three sections and each filled with the respective manures. The California Red Earthworms were then placed on this layer followed by a layer of organic waste. The bins were then left for the process of vermicomposting to occur where regular monitoring and watering are done. At this point, two of the bins, treatment 1 and 3, were harvested. The weight of vermicomposts, composting time and number of worms were recorded. Two hundred and sixty worms and fifteen worms were found in the treatment 1 and 3 respectively. The weights of vermicomposts produced were recorded as 100kg for treatment 1 and 75kg for treatment 3. Monitoring of treatment 2 will continue until it ready for harvesting. Nutrient analysis of the vermicomposts from each treatment will be done so as to assess the variations in the nutrients levels.

iv. Agronomic characterization of local coconut varieties.

Adrian Mangar, Satyanand Ramdowar and Indira Persaud

Coconut has been found distributed in many parts of the world including central and South America. Dissemination was achieved by seeds floating in sea currents and subsequent germination on the shore, followed by further human dispersal. Geographic isolation, introgressive hybridization, mutation and selection are the most likely causes of population differentiation of coconut.

In Guyana, there are approximately 12,000 ha cultivated with coconut across seven regions. Coconuts also dominate the export market with a value of 11,674,572 USD in 2017.There are many different varieties of coconuts grown in Guyana, majority of which are tall varieties. However very little agronomic traits are known as such this investigation aimed to complile information about two main varieties cultivated here, the panama tall brown and the Suriname brown dwarf is becoming very popular.

In this study some data was collected on a monthly basis and others bianually. The agronomic traits measured for both varieties were length of petiole of leaves, thichness of petiole, width of petiole, number of leaflet ½, width of leaflet,lenght of leaflet, length of rachis, number of leaves, number of fruits on a bunch, number of bunches for each variety, average weight of mature fruit and water content of tender nut.

Results obtained demonstrated that both varieties had similar values in the traits measured such as rachis and petiole length but the suriname brown variety have more bunches per palm and number of nuts per bunch which is a indicator of higher productivity. Meanwhile the panama tall brown showed more leaflets per branch (an indicator of a larger photosyntetic area).

v. Agronomic and morphological characterization of breadfruit

Indira Persaud and Roberto Mendez Peligrin

Breadfruit trees are as diverse as they are vital. Trees produce fruit that look completely different when compared to another cultivar, in terms of colour, shape and size of fruit and leaves. Cultivars not only differ in appearance; they also vary in flavor, texture, nutritional composition, timing of fruit production, tree size and shape, and suitability to various growing conditions. The objectives of this study are to differentiate and characterize morphologically the different varieties of breadfruit in Guyana

Samples were collected from sixteen homeowners/farmers from regions# 4 and 5 and the following parameters were evaluated: **fruit**: weight, length, colour of flesh, core length, core diameter, shape; **skin:** texture, colour; **leaf:** length, width, number of lobes; **inflorescence:** length, width and seasonality of the crop.

Breadfruit is not produced on a large scale in Guyana. The major period of production is May to August, with a smaller crop between December and February. In Region 4, the breadfruit trees are growing on clay soils, whereas in Region 5, they are grown on sandy loam soil. The trees in Region 4 had a higher incidence of disease and pests.

It was determined there are two types of breadfruit based on the fruit characteristics found in the two regions:

Type 1 the fruits were oblong with slightly rough skin texture and light green to yellow-green skin colour at maturity. The flesh of immature fruits was white, but became cream to light yellow as the fruit matured.

Type 2 the fruits were round with slightly rough to smooth, light green skin at maturity. The flesh colour was white but might become cream or light yellow with maturity.

vi. Investigation into the response of five tomato varieties to three fertilizer regimes under shaded and open field conditions.

Tomato is one of the more important economical vegetables in Guyana. It has significantly contributed to the agricultural wellbeing of the country (NAREI's Farmers Manual, 2011). It can be consumed raw or cooked and serves as a key ingredient to the food processing industry. Products from tomatoes consumed in Guyana include ketchup, jam, sauces, and tomato paste and tomato powder. Tomatoes are important constituents of human diets.

The varieties that were used to carry out this experiment were Gem Pride which was grown for its lower water content so as to be a better option for tomato paste making. This variety is high yielding and is suitable for field conditions and it is resistant to TYLC (Seminis), Heat Master a determinate hybrid produces well in warmer conditions, produces medium size fruits. This variety is resistant ToMV, Aal, Verticillium (V), and DRD8539 hybrid with a round shape, excellent foliar coverage that provides high productivity of large and uniform fruits. This variety is resistant to Tomato Yellow Leaf Curl Virus (TYLCV). Its fruits have an extraordinary quality, long shelf life and can be easily commercialized in the local and export markets (Seminis). SV8579TE hybrid with an oval shape. It is resistant to three races of *Fusarium oxysporonf.sp*. Lycopersici races (Fol 1, Fol 2, Fol 3), Tomato Torrado Virus (ToTV), and *Verticillium wilt (Verticillium albo-atrum, Va, Vd)* Its fruits have an extraordinary quality, long shelf life and can be easily commercialized in the local and export markets (Seminis). Mongol F1 adapts well to hot and tropical conditions, withstand temperatures over 42-45ºC (110 F). (Determinate growth for field production). High yields, round slightly flat- shaped fruits with green shoulder before maturity and bright red color at full maturity are characteristics of this variety. It displays both high heat tolerance and good resistance to diseases, especially bacterial wilt (*Pseudomonas solanacearum*), fusarium, verticillium, and powdery mildew.

The objectives of this project were to determine the best fertilizer package to be used on the different tomato varieties to get high yields also to find out whether the tomatoes would perform any differently under shaded conditions.

The experiment was laid-out in a split-split plot design due to the fact that two factors were being evaluated.

Project was modified and continues in 2019. This was because of the prolonged dry weather and lack of water.

vii. Evaluating the performance of two new varieties of breadfruit in Guyana.

Breadfruit, *Artocarpus altilis*, grow easily in a wide range of ecological conditions with minimal input of labor or materials and require little attention or care. Breadfruit contributes to sustainable food security, diversified sustainable agriculture and agroforestry, improved soil conditions and watersheds, and valuable environmental benefits including reduction of CO2, thus is has been identified as a tree for life for a hungry planet (National Geographic Society, 2014).

Due of the status of this crop and promotion for the increase in production of breadfruit and the lack of planting materials, the introduction of new varieties will help contribute to alleviate this problem.

The varieties were distributed to farmers in the regions that breadfruit is predominantly grown and that have different soil types. The main objective is to determine how the trees adapt to the different conditions in terms of growth and production. The following parameters are being measured: time of first bearing, number of fruits, weight of fruits, colour, shape, and height of tree, pest and diseases.

viii. Root cutting method of propagation of breadfruit.

Traditionally the only method of breadfruit propagation was through scarring a surface root and waiting for a sucker (young tree) to emerge. Once it reached a large enough size (1-2 years), the sucker was severed from the parent tree and replanted. This new young plant might take 5-7 years to begin producing fruit. The success rate in this method of propagation varies widely.

The use of root cuttings is the most suitable method that is currently available for commercial production of young breadfruit plants. Root cuttings can be used to produce young breadfruit plants because they can be induced to produce adventitious shoots. (Nkrumah, 2012) The objectives of this research are to determine the success rate and the most economically feasible method of propagationof breadfruit. This trial is being conducted at NAREI Plant Nursery.

ix. The use of trellises to enhance cross pollination for the production of virus free planting materials in sweet potato production.

The sweet potato plant is an indeterminate perennial, but it is grown as an annual. It is produced by vegetative propagation using vine cuttings from production fields. This method may accumulate pathogens, particularly viruses, in the planting stock resulting in decline in yield and sometimes quality. This project is a collaboration between the University of Arkansas, NAREI and University of Guyana with funding from the University of Arkansas.

The decline of farmers producing sweet potato is largely due to rising production cost including pesticides, fertilizers and cultural practices. Secondly, commercial and small acreage producers in Guyana lack adequate information to determine which varieties have tolerance pests, drought and yield well under minimum cultural conditions. The research is based on selection of sweet potato genotypes for tolerance to environmental stresses grown under minimum cultural conditions in Guyana and participates in the National Sweet Potato Collaborators Group to evaluate regional standard entries and advanced breeding lines.

The purpose of this study is to collect information on yield and performance of commercially available varieties and advanced genotypes when grown in Guyana. Performance rating from 1-10 will be based on insect damage, tuber appearances, and dry matter content and soluble solids. Seven local and five USA sweet potato accessions or genotypes are being used and experiments conducted at the Agricultural Research Demonstration Farm at NAREI, Mon Repos and University of Arkansas at Pine Bluff for yields and quality characteristics. During 2018, 448 sweet potato

seedlings were screened for continuous assessments at the plant nursery, Mon Repos. These includes seedlings that were crossed from accessions grown on trellis- vanilla, strong man, professor, Amjad, zebra, cogle, beauregard and five USA accession- PB 11, PB 12, PB 18, PB 19 and PB 21. Thirty seven sweet potato seedlings were selected for continuous assessments in the field. First, second and third field evaluations were completed for selected accessions. Four accessions were selected for continuous assessment after second field evaluations. These includes Amjad1, Amjad 2, PB 19 and PB 21.

x. Comparison of Performance of Tomatoes with Roots Developed in Line and 90^0 to Main Stem.

It was observed that tomato plant roots became exposed above the soil when cultivated in shallow grow boxes. The challenge of mounding the soil to cover exposed roots was recognized, and planting tomato seedlings with root system at a 90 degrees angle to the main stem was explored. The productivity of tomato plants transplanted at 90 degrees planting angle was compared to those planted at a 180 degrees planting angle (root system in line with the main stem or traditional method). Results showed that plants with roots at 90 degrees planting angle came into fruiting 7-14 days earlier, has a longer root length (33cm longer), and give twice the yield over the traditional method. It is hypothesized that this new method of planting encourages enhanced root development, which optimizes root function by enhancing accessibility to essential plant nutrients.

xi. Production of Leafy and Fruit Type Vegetables Using Hydroponics and Shade-house Facilities

Production of Leafy Vegetables Using Hydroponics and Shade-house Facilities: Soil and water substrates were used to cultivate lettuce under shaded and hydroponic conditions. Indicative results show that head size produced under hydroponic conditions is approximately 74% greater than with the soil substrate (150g c.f. 69g). Lettuce produced under hydroponic conditions matured in three weeks for harvest compared to six weeks under shade house (soil substrate) conditions.

After several adjustments to the hydroponics structure and change in nutrient solution to achieve production, the first cycle of Mongal tomato is in progress.

xii. Tomato Production on Clay Raised Beds with Plough Layer Developed under Wet, Dry and Bare Grass Cover.

First cropping cycle completed in 2018. Indicative results show production on plough layer developed under wet grass cover had: greater number of fruits, average fruit weight, and yield; and 100 fruit weight of 7.1kg compared to 5.8kg for bare and dry grass treatments.

xiii. Geographic Information System

Map inventory and the addition of regional identifiers to maps and the catalogue were completed. Maps were produced to show breadfruit trails in regions 4 and 5 and soil map for 150 acres of land at Ithaca (RAID) project. Digitizing of existing analogue maps has commenced with sheets 1and 3 Ebini Ituni Kakwani completed.

xiv. Mangrove

Restoration of coastal mangrove ecosystems: Mangrove restoration activities completed during 2018 focused on mangrove seedling planting and coastal infrastructure as interventions to promote and encourage sedimentation and natural regeneration. 2018 restoration projects included the completion of 700m brushwood dam field at Aberdeen and Columbia and planting 14,876 *Avicennia germinans* seedlings along 300m at Walton Hall, Essequibo Coast, Region No. 2.

The completed brushwood dams at Aberdeen and Columbia are expected to support restoration of 1,000 meters of mangroves parallel to the shoreline. The structures are expected trap sediments and increase shoreline elevation to achieve the minimum optimal elevation of 2.3m above CD that is suitable for the natural regeneration of *Avicennia germinas* within the first 2 years after construction.

Mangrove protection and monitoring activities completed during the year resulted in enhanced monitoring capacity with the procurement of one DJI Phantom 4 Advance UAV and the installation of permanent graduated monitoring gauges in Region 2 and 4. An analysis of available updated imagery on restored sites indicates that approximately 500hectares of mangroves have been restored as at the end of 2018.

Community involvement continued to play a critical role in the success of restoration activates. During the year the Department worked to members of the volunteer groups (Village Mangrove Action Committees) to implement a series of community awareness and activities and continued to engage NDCs on mangrove conservation and management issues.

The public awareness and education programme resulted in 538 visitors to the mangrove Heritage Trail Tour, 640 students reached through school presentations, 121 youths engaged through Easter and summer camps and completed of Mangrove Photo and Quiz competitions as part of NAREI's celebration of International Mangrove Day 2018.

xv. Evaluation of botanical extracts on Acoushi ant activity in Guyana.

A Study was done on the Evaluation of botanical extracts and a fumigant on Acoushi ant activity in Guyana. The experiment was conducted at Canal #1 and Linden. Two trials were carried out using the completely randomized design at each location which consisted of four treatments (T1- Colour + Citrus + Fipronil, T2- Colour + Fipronil, T3- NAREI bait (a.i Fipronil) and T4 Aluminum Phosphide (fumigant); each treatment was replicated three times. Data collected from this experiment would have reflected which bait formulation was accepted by the leaf cutting ants. Additionally, the potential of fumigant to manage the pest was evaluated. Data was analyzed at a 95% confidence interval to determine the significant means. Results obtained from this experiment with respect to baiting showed a fluctuation in bait preference by the ants. The fumigation method was 100% successful in Linden; and in Canal #1 it was 17% successful.
Further trials will be conducted to determine the acceptability of the bait and preference of the ants.

xvi. Evaluation of botanical extracts and fumigant on Acoushi ant activity in Guyana.

A Study was done to evaluate botanical extracts and a fumigant on Acoushi ant activity in Guyana. The experiment was conducted at Canal #1 and Linden. There were four treatments (T1- Colour + Citrus + Fipronil, T2- Colour + Fipronil, T3- NAREI bait (a.i Fipronil) and T4 Aluminium Phosphide (fumigant); each treatment was replicated three times. Preliminary result shows that baiting in Canal #1 resulted in no significant difference among the treatments during Trial 1, while in Trial 2 there were significant differences among the different treatments. The ants displayed a higher preference for T1 and the least was T2. The two trials done in Linden showed no significant differences among treatments. During the fumigation exercise, two trials were conducted in Canal #1 and Linden. The trial in Linden showed that after fumigation all nests were declared inactive in both trials, while in Canal #1, one nest was deemed in active. Further trials will be done in 2019 to assess the reaction of ants to both bait ant fumigant.

xvii. Evaluation of entomopathogenic fungi for the control of Red Palm Mite (Raoiella indica)

The red palm mite, *Raoiella indica* (RPM), is a predominant and invasive pest of coconut (*Cocos nucifera* L.). It causes coconut plants to turn yellow with grey stippled patterns and in severe cases the plants become necrotic with defoliation occurring. This research aims at evaluating the efficacy of existing biocontrol strains of *Beauveria spp* against Red palm mite.

A total of 80% of the project has been completed. Three trials using the product has been completed and the data has been analysed. Base on the LSD analysis, the product significantly reduced the population of the red palm mite approximately 100%. For the pure culture, two out of three trials have been completed. Based on the LSD analysis, it was found that there was a significant difference among the treatments for trial two however, there was no significant difference among the treatments for trial one.

The *Beauveria sp.* cultures have been frequently contaminated. Consequently, the project was stated and has been extended beyond scheduled time. As such, the third trial using the pure culture is on pause until a pure culture is obtained. Despite of the challenges, the project is expected to be completed by the first quarter of 2019.

xiv. Use of exclusion bags to manage Soursop pest

At NAREI research station at Kairuni a research trial was initiated to evaluate the ability of exclusion bags to protect soursop fruit during its early growth and development stages against the soursop wasp (Brephatelloides sp.). Soursop fruits where placed in exclusion bags when they are approximately 2 cm in length and 3 cm in width coinciding with the period just prior to when the wasp oviposit its eggs into the fruits. Bags will be removed when fruits are more than 6 cm long, coinciding with the stage of fruit development when the wasp is not known to oviposit its eggs into the fruit (Ramkhelawan, 2008). Before bagging fruits, pest such as aphids, whiteflies, mealybugs or scales where removed with the aid of a soft bristle brush.

There was a total of 15 treatments in a 3 x 5 design: Three bags types made of different materials × bags dipped in four solutions (dipped in pyrethrins, dipped in neem, dipped in cedar oil and not dipped) plus a control (no exclusion bag). The experiment was setup in a factorial design of three blocks and three replicates. Each cultivar was a block. The research initiated in the 2018 November fruiting period.

The research was not mounted at NAREI research stations at Mon Repos and Ebini and at a farmer's plot at Naamryck (Parika), East Bank Essequibo because fruits had developed beyond two centimetre as prescribed for the study. However, at NAREI research station at Kairuni enough fruits with less than two centimetres diameter were present to initiate the study. Amidst the challenges, the progress of the project is considered to be a success. Now that the team can easily mitigate the known challenges the expansion of the project to the other locations should be prompt.

As the fruits mature evaluation will be done on the effectiveness of treatments by counting the number of infected fruits and the number of insect holes on the fruits. The damaged fruits will be collected and taken to the bio-control laboratory of NAREI to allow the emergence of insects for identification purposes. Additionally, all other insects found when removing the bag will be collected and take to the laboratory to be identified.

xv. Effects of Botanical Extracts on Black Sigatoka Disease.

Mycosphaerella fijiensis causes black Sigatoka disease (BSD) is a major leaf spot disease affecting the *Musa* species It affects the overall yield and quality of the fruit. Since there are few fungicides available for use in Guyana, there is a high possibility of fungicide resistance. The main challenge in disease management is to ensure that the plant survives and produce a viable economic return. Thus plant (botanical) extracts as well as bacteria and fungi isolated from the rhizosphere of plantain control this economically important disease in laboratory conditions (University of Copenhagen & Makerere University). This experiment was carried out using three treatments (Garlic Extract, Pepper Extract, Control) and a Randomized Completely Block Design to analyse data such as the Youngest Leave Spot, Number of Leaves, Disease Severity (Infection Index) and also the Weight and Number of Bunches. In addition, the objective of this work was to determine the effects of Sigatoka Disease on plantain quality attributes.

Thus far, this study showed that the pepper extract was the least effective in controlling Black Sigatoka Disease while there was no significant difference between the disease severity of the control and garlic extracts. Additionally, neither of the extracts has shown any major distinction in antifungal activity thus far. This project will be continued in 2019 and will be repeated at least twice.

xvi. An Assessment of the effects of Botanical Extracts on Insect Pests incidence and a Tomato (Lycopersicon esculentum) and Boulanger (Solanum melongena) Production

Solanaceae are very nutritious and provide good quantities of vitamins A and important components of daily diets consumed both fresh and processed in many cooking recipes (FAOSTAT 2013). Since the demand for these crops is high it is necessary to produce healthy crops to supply to the market. Chemical-based pesticides have been used to control pests affecting these crops but they are dangerous to the environment and health of farmers and consumers. Additionally, these pesticides are expensive. As such, pesticides that are environmentally friendly and inexpensive are needed.
Bio-pesticides pose less threat to the environment and to human health. They have considerable benefits since they are less harmful, biodegradable and only target pests and closely related organisms. As such, the used of botanicals to control the pests was considered.

Two trials have been completed of which different botanicals were used and the most effective where chosen for further trials. Preliminary results showed that turmeric and garlic seem to work well in controlling pest. However, further trials are still to be carried out. In 2019, the plan is to evaluate of the effectiveness of these botanicals under shaded and non-shaded conditions. Additionally, to find the most effective concentration at which the botanicals will work. While in 2020, the best performing botanical agents and concentrations will be compared against a synthetic pesticide.

xvii. Control of bacterial diseases affecting watermelon

Watermelon is an important cash crop earner for many small farmers in Guyana. In little Biaboo, Mahaica this crop is affected by bacterial fruit blotch (BFB) caused by *Acidovorax avenae* subsp*. citrulli*. This bacterial disease can result in 60-80% yield losses if not managed properly. Currently, there is no single control option available for this disease. Therefore, an integrated approach is needed which must include the use of seed treatment, proper fertilizer application, sanitation, resistant varieties and the use of biological and fungicidal control for this disease. This project will evaluate a number of control options available to manage the disease.

Results obtained from previous trials have shown that Bonta was more susceptible to BFB than Mickyelee but had higher yields (16%) and produces larger fruits compared to the Mickyelee variety. The use of nitrogen fertilizer at rates of 80kg/ha has resulted in an increase in watermelon yields by 27% compared to the control. Increased in nitrogen rates

resulted in a reduction in BFB fruit severity but not BFB leaf severity. Fungicides did not have any significant effect on watermelon yields. However, Rizolex Serenade and Bordeaux may be used in the management of BFB symptoms. These trials are to be repeated in 2019.

xviii. Identification and control of white mold affecting Musa species in Guyana

White mold are common soil pathogens found in agricultural soils. This fungus has a wide host range and is responsible for wilting, lodging and death of field crops. In 2015, white mold was observed affecting the pseudostem of banana plants at Mon Repos, Guyana. The fungus caused the pseudostem to become soft and soggy, resulting in them breaking midway. This can have a negative impact on crop yields. There is currently no report on white mold affecting Musa and control options are limited thus warranting this research.

The project will continue in 2019 with the reactivation of the pathogen, sub-culturing, and working on Koch's postulate for all isolates– Inoculating banana and plantain cultivars with the pathogen and screening approved fungicides for controlling white mold under laboratory conditions are to be done.

xix. Efficacy of Trichoderma for the control of BSD

Trichoderma can be used as a biological agent for the control of many plant pathogens (Cavero, Hanada, Gasparotto, Coelho Neto, & Souza, 2015). Black sigatoka disease (BSD) caused by the fungus *Mycosphaerella fijiensis* is of major economic importance in the plantain industry, damaging the foliar parts of plants, significantly reducing yield. As such an experiment was set up to test the effects of *T. harzianum* on the control of BSD. The experiment consisted of two levels of *Trichoderma harzianum* spore concentrations and a control (water) applied to the foliar parts of plantain suckers. Data was collected on the disease severity, number of leaves, and plant yield (weight of bunches).

Preliminary analysis of data showed that there were no significant differences ($p > .05$) in disease severity among the treatments relative to the control. Results on plant yield are not available since, data collection on bunch weight has recently begun. Suckers were planted at the end of December 2017, as such data collection should have been completed by Oct-Nov 2018. However, due to the plants delayed maturation and un-uniform fruiting harvesting could not have been completed during the projected time.

xx. Project: Evaluation of Onions and Irish Potatoes in Open Field Conditions.

The evaluation of white and red onions continued in 2018 with emphasis on open field cultivation. Two cropping cycles of onions were initiated in the last quarter of 2018 and will be completed in the first quarter of 2019. Planting was done in Phillipi East Berbice on a farmer's plot in support of commercial production. The varieties being evaluated are: white

onions (Mercedes, Yellow F1 Granex, Early Texas Grano) and red onions (Red Creole and SV7030NS). Research will continue in 2019 using additional varieties.

One of the major challenges in the storage of Irish potato planting materials was the lack of a storage facility. A cold storage facility was purchased and installed for this purpose. In 2019 focus will be placed on acquiring planting materials and observational trials in coastal and hinterland areas.

xxi. Soil Chemistry Laboratory

The department continues to provide critical soil analytical service to the agricultural community of Guyana. In 2018, 1453 soil samples were received from various stakeholders (farmers, researchers, mangrove department, RAID project areas, UG students). All samples were processed for analyses and fertilizers, limestone and organic matter recommended as required. Training on the operation and optimization of the AAS was facilitated in an effort in improving the efficiency of services offered to farmers, researchers and other stakeholders.

xxii. Rural Agricultural Infrastructure Development (RAID)

RAID is geared towards the development of Small Scale Farming Communities in Regions 4 and 5 (Ithaca, Buxton/Friendship, BV/Triumph and Mocha Arcadia). It focuses on the rehabilitation of drainage and irrigation systems, clearing access dams and farm lands in these areas. During 2018 a total of 79 farmers where visited in the four project areas. These farmers were given the necessary technical support and advice in good agricultural practices, climate smart agriculture, diversification and intensification. Farmers were advised on proper field sanitation, judicious use of chemicals, home remedies for control of pest, proper record keeping, use of raised beds to reduce risk of flooding, mulching, crop rotation, compost production and management etc. A total of 31 soil samples, 13 tissue samples and 4 water samples were analyzed. A total 380 acres were cleared between Ithaca, Buxton and Mocha. Soil surveys were completed for Mocha and Buxton and a soil map produced for Ithaca.

xxiii. The use of Mycorrhiza as a Bio-stimulant for Crop Production in Marginal Soils

Tabela Sand, chicken litter, vermicompost, fresh paddy hull and rice husk biochar were used in various proportions to create a local potting mixture as an alternate to imported PROMIX. 105 combinations inputs were treated with mycorrhiza to create a soil substrate for vegetable seedling production. Three substrate mixes were selected after evaluation for comparable chemical and physical properties of PROMIX, and used to sow Bell pepper (California Wonder) seedlings. After one cycle, indicative results are showing that all substrate mixes produced greater seedling bio-mass than PROMIX (>1g/plant c.f. <0.5g/plant).

xxiv. The Use of Rhizobium Inoculant in Legume Production

In an effort to produce new strains of rhizobium bacteria, four (4) strains were isolated from Jack bean, Sunn hemp, Sesbania White Stem, and Sesbania Red Stem and used to make inoculant. After three cultivation cycles using feijou as the indicator crop, indicative results show that Jack Bean, Sunn hemp and Sesbania White Stem was comparable in nodule production, efficacy, 100 seed weight and yield to the established rhizobia strain 178. These new strains will be maintained and added to NAREI's collection.

xxvi. Hinterland Agricultural Programme - Field Research: Kairuni Research Station

Cassava Core Genebank

The core collection of local landrace accessions of cassava was established with currently 105 accessions sown to 385 field plots. During the reporting year nine accessions were added from St Ignatius-Kumu communities, 6 from Kato, 3 donated from the Ministry of Indigenous People Affairs, and one each from Salem-Parika Community, Queenstown Village-Essequibo Coast, and Georgetown. Characterization data were taken for 16 morphological traits from 150 plots comprising 72 accessions. Seventy four (74) accessions were regenerated in 138 newly planted plots towards the end of December. Data generated were subjected to a pre-emptive analysis and results were used to allot accessions to a number of putative Specialty Subset Collections. The Drought-tolerant Specialty Subset Collection was expanded from 16 to 23. New Specialty Subsets collections were indicative for Superior Sprouting Vigour (22), Superior sprouting Rate (16), Superior Leaf Retention (27), favourable petiole orientation (40), erect growth habit (27), favourable branching canopy (38). Several accessions could be allotted to combination specialty sub-sets groups. No harvesting could be done; this activity remaining behind schedule. Towards mid - December, 79 accessions were migrated to Ebini research station as part of a strategy to duplicate the Kairuni Core Gene Bank.

Field evaluation trials

From six field trials in 2017 an additional 13 were added for 2018. Twenty four selected accessions are under advanced genetic and agronomic evaluations. The current 19 field experiments, comprising almost 1000 plots are under evaluation to confirm growth vigour, sprouting rate, canopy convergence rate and specifically yield and yield components interrelationship under agronomic pressures of planting density (3 levels), foliage clipping frequency (3 levels), planting method (3 methods), manure application rates (5 levels) and timing of manure application (2 levels). Yield and yield component data for only 36 of the 518 plots ready for harvested were taken; harvesting remaining far behind schedule.

Kairuni (General)

An integrated planting routine that has rapid 'seed-cutting' regeneration as its focus has been established. The routine's main feature is forced canopy cover to suppress the aggressive nature of on-station weedy sedges. Weed suppression was 100% successful; need for use of weedicides completely eliminated. Notwithstanding, this very efficient regeneration of 'seed cuttings' has inadvertently created a contentious planting expansion bottle-neck; poor administrative logistics and

absent on-station coordination being considerable deterrents. No 'seed cutting' was lost or wasted and there remains a large quantity of available 'seed-cutting' material for currently more than a guestimated 50 acres; planting density considering.

Ebini Research Station

Horticulturals

Emergency interventions were carried out at the old citrus nursery (pruning) and coconut gene bank (fertilizing). Efforts at the old citrus nursery were effective but interventions at the coconut gene bank are still slow in coming through and more efforts on this gene bank are continuing. Favourable weather supported the progress of establishment at the new orchard block. Weed management and pruning further helped to maintain healthy tree stands.

Open row field crops

In corn, efforts were successfully initiated to purify the lone open-pollinated corn variety, CARDI 1. More than 300 single-ear selections were made. Remnants of these selections were bulked into more than 12 composites. Ear selections were mainly for Tasseling-silking interval (TSI), and about 10 ears were selection from plants with early flowering. Towards mid-December these see lots were being planting out in-field.

Good seed recovery was obtained from the lone peanut variety, AK 62. Because of the urgency to harvest the crop at an otherwise very busy on-station schedule, single plant selections could not be carried out. Efforts were however, successful in obtaining three lots of bulked graded seeds stock. More than 60% of the harvested seed lot was replanted during mid-December.

With the loss of seed stocks of Blackeye and Minica 4 seeds. No on-station plantings could be done with these crops. Towards mid-December efforts were successful to acquire approved seed remnants from farmers at Molsen Creek at the Lower Corentyne Coast.

Towards mid-December as a safety measure, efforts were successful to migrate 79 accessions of cassava landrace varieties in the Core Gene Bank at Kairuni Research Station to the Ebini Research Station. The Core gene bank, currently under establishment, is sown to 253 plots inter-cropped in the new mixed orchard. And data on sprouting rate and growth vigour is already being generated.

Hinterland Cassava Community Seed Banks (CSBs)

In collaboration with the local FAO Guyana Office a project to established cassava community seed banks (CSB) was initiated. Two hinterland communities, Wowetta in the North Rupununi and Kato in Region 7, have so far benefitted. In these efforts NAREI donated 5 drought tolerant varieties to the Wowetta CSB and 6 to the Kato CSB. Follow up visits by FAO project personnel reported very good progress from Kato, but some follow up interventions were required at the Wowetta CSB. As of last August, no further invitations were received by NAREI to continue in the project.

FAO, Rome Engagements

From 25 to 27 July 2018, Guyana was represented, through NAREI as national focal point, at the 9th Session of the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture (Working Group) and at an Informal Dialogue on "Building Linkages to Strengthen On-Farm Management of Farmer's Varieties/Landraces: Community Seed Banks" at FAO Headquarters, Rome, Italy. The main focus of the ensuing discussions were to apprise members of their reporting obligations to the PGRFA Secretariat on the status of implementation of the Global Plant of Action on PGRFA. The informal dialogue gave renewed importance of safeguarding farmers' varieties and their sustainable on farm management. With NAREIs already programme of establishing Community Cassava Seed Banks in the country, the Collaboration with the local FAO Office on these efforts were already bearing fruits.

Later from the 30th October to 1st November, 2018, the Secretariat of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) with the African Union Commission, co-organized a Regional Workshop on the Preparation of the National Reports on the Implementation of the International Treaty in Addis Ababa, Ethiopia. The National Focal Point for the preparation of this report is the GRDB through its research arm, Burma Rice Research Station (BRRS). Guyana was represented by NAREI at this workshop. Within two weeks NAREI had completed and submitted this report to the Secretariat of the ITPGRFA.

It must be noted that with NAREI as the national focal point for matters relating to PGRFA in the country, Guyana stands out as one of the 79 (out of 191 countries) that that has always fulfilled its reporting obligations to the FAO.

xxviii. SPICES

Four spices viz. black pepper, turmeric, ginger and nutmeg were targeted under the spices program in 2018.

Turmeric (Curcuma longa)

1. A total of 165.2kg of turmeric planting materials were distributed to 21 farmers of Region 4, 5, 6 &10. These planting materials were used to expand turmeric cultivation in Guyana. Farmers were able to expand their acreages and supply the factory with fresh turmeric rhizomes. Farmers benefitted financially from the sale of these fresh turmeric rhizomes.
2. Data collected from turmeric experiment established in 2017 and completed in 2018 at NAREI, Mon Repos was statistically analyzed and presented at the Research conference held at the Plant Science Building, G.S.A Compound (October 22-23, 2018) with the theme: Agriculture: Guyana's Pathway to a Green Economy. Statistical analysis indicated that:

- The different fertilizer treatments did not have significant effect on the growth and yield of turmeric and it is not cost-effective to apply synthetic fertilizer at the aforementioned rate because turmeric yield were not significantly enhanced.
- Statistical analyses revealed that there were no significant differences among the fresh rhizomes weight obtained/3m^2 beds.

There was no significant pairwise difference among the treatment means with respect to length of leaves/plant, width of leaves/plant, number of leaves/plant, number of tillers/ plant, plant height and weight of fresh turmeric rhizomes/3m^2 beds.

It was recommended that in order to confirm these results, the experiment must be repeated in different locations. Further study is required to assess an increase level of N:P_2O_5:K_2O on the growth and yield of turmeric on Onverwagt clay soil.

Turmeric Factory:

First batch of fresh turmeric rhizomes was successfully processed between the 6^{th} -14^{th} of March 2018 at the turmeric factory located at Hosororo. To date the factory processed 8,313 kg of fresh turmeric rhizomes purchased from farmers of Region #1. The processed turmeric was sold to E.B.Beharry & sons Co. Ltd. This factory has a boiler with two cookers, hot air generator (furnace), dryer with a conveyor belt and a polisher. Each cooker has a capacity of 320 kg, the dryer has a capacity of one ton and the polisher has a capacity of 500kg. A tractor and trailer was added to the turmeric factory for transporting fresh turmeric rhizomes purchased from farmers and fuel for the factory.

Solar Dryer:

The solar dryer at Hosororo, Region #1 will be completed by the end of January 2019 and it is expected to reduce the cost of production. It will also be equip with galvanize pipes which conduct heat to dry the boiled turmeric rhizomes. The 22ft x 52ft solar dryer is expected to dry 1000kg of boiled turmeric rhizomes in seven days.

Ginger (Zingiber officinale)

A scientific experiment of ginger was established at NAREI, Mon Repos with the title: "Effect of synthetic fertilizers on the growth and yield of ginger (*Zingiber officinale*) on Onverwagt clay soil". Parameters such as number of leaves per plant (Total # of leaves of first 2-3 main tillers), width of leaves, length of leaves, plant height and number of tillers are currently being evaluated. It was observed that ginger was affected by rhizome rot (soft rot) caused by fungi. Soft rot manifested by September-October. Drenching with carbendazim at a rate of 2ml/L was effective against the malady. Disease free and healthy rhizomes are the ideal planting materials which will prevent against soft rot. This scientific experiment will be completed by April-May of 2019 and is to be repeated in May-June of 2019 when planting materials become available and the climatic conditions are suitable for cultivation.

A total of 53.2kg of ginger planting materials were distributed to eight farmers of Region 4, 5, 6 &10. These planting materials were used to expand ginger cultivation in Guyana.

Turmeric and ginger germplasm

Turmeric and ginger accessions in the Ex - situ germplasm conservatory at NAREI, Mon Repos were harvested, treated and stored. Some of the treated rhizomes were used as planting materials for continuous preservation and conservation of these germplasm materials. The turmeric and ginger accessions yielded 36.40kg and 31.81kg respectively.

Black pepper (Piper nigrum L.)

A total of 2,310 and 1,123 black pepper cuttings were generated in the nurseries at NAREI, Mon Repos and Hosororo, Region #1 using the serpentine method of multiplication. These cuttings were used by NAREI to expand black pepper cultivation at Hosororo, Region # 1 and also distributed to interested farmers. A total of forty one black pepper cuttings were sold to eight farmers of Region 3, 4, 6 & 10 and 78 cuttings were distributed to seven farmers of Region 2, 4, 5 & 6. At NAREI's demonstration plot located at Hosororo, 1.6ha were planted with black pepper cuttings.

Nutmeg (Myristica fragrans)

At Hosororo nursery, 810 nutmeg seedlings were generated of which 370 seedlings were used to expand nutmeg cultivation. At NAREI's demonstration plot, 2.43ha were cleared of trees and bushes and planted with nutmeg seedlings. Most of these seedlings were growing vigorously with a few affected with leaf spot disease which was controlled by spraying carbendazim and triazophos at 2ml/L and 1ml/L respectively.

The production of seedlings of the various nurseries is shown below:

2018 Production Report

Nursery	**Target**	**Achieved**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Bartica	3,500	3,164	-	-	-	600	-	2421	89	54	-	-	-	-
Benab	17,000	16,562	-	-	2569	-	2634	2270	506	1084	738	3601	-	3160
Charity	18,000	7035	-	144	660	-	-	-	3552	1921	-	758	-	-
Hosoror	11,000	3717	-	-	-	-	-	1056	2661	-	-	-	-	-
Mon Repos	30,000	26161	-	541	1081	8519	1484	919	4650	1186	2824	1989	366	2602
Pouderoyen	21,000	25092	-	753	-	6401	3085	2960	4360	796	1417	1525	2583	1212
St.Ignatius	9,000	4239	-	-	-	-	-	-	-	2177	2062	-	-	-
Timehri	38,000	23557	-	761	-	5867	4863	2353	2298	802	2695	1247	-	2671
Fort Wellington	2,500	2393	-	392	275	313	-	766	-	-	-	-	249	398
TOTAL	**150,000**	**111,920**		**2,199**	**4,702**	**21,662**	**12,379**	**11,979**	**18,882**	**8,020**	**9,736**	**9,120**	**3198**	**10,043**

2018 Sales Report

Nursery	**Target ($)**	**Jan ($)**	**Feb ($)**	**Mar ($)**	**Apr ($)**	**May ($)**	**June ($)**	**July ($)**	**Aug ($)**	**Sept ($)**	**Oct ($)**	**Nov ($)**	**Dec ($)**	**Total Sale ($)**
Bartica	600,000	14,900	33,520	39,250	28,370	18,200	10,810	17,850	10,500	13,880	17,480	34,800	Nil	**239,560**
Benab	1,845,000	137,750	166,000	198,850	355,800	67,600	128,275	117,200	151,100	101,100	189,900	329,525	217,250	**2,160,350**
Charity	1,985,000	150,025	224,000	216,150	235,100	206,700	208,000	189,725	60,100	74,700	78,450	243,725	111,650	**1,998,325**
Hosororo	900,000	306,650	139,450	104,600	6,300	22,100	20,900	1,000	1000	3,200	4,800	180,900	80,350	**871,250**

Mon Repos	7,910,000	590,615	582,775	903,350	792,800	732,050	514,775	518,625	561,425	499,650	1,234,310	580,450	538,100	**8,048,925**
Pouderoyen	3,000,000	264,255	522,525	365,925	421,225	678,500	326,880	249,750	122,425	461,450	213,055	542,210	926,775	**5,094,975**
St.Ignatius	840,000	27,175	26,725	64,450	32,450	106,250	121,350	54,900	41,325	26,450	73,100	24,125	106,250	**704,550**
Timehri	5,000,000	149,600	771,800	228,450	480,675	807,250	756,500	248,150	297,050	275,725	121,900	194,250	359,350	**4,690,700**
Fort Wellington	420,000	24,050	17,000	51,800	59,000	51,100	30,700	30,000	47,800	48,100	35,600	34,400	30,500	**460,050**
TOTAL	**22,500,000**	**1,665,020**	**2,483,795**	**2,172,825**	**2,411,720**	**2,689,750**	**2,118,190**	**1,427,200**	**1,292,725**	**1,504,255**	**1,968,595**	**2,164,385**	**2,370,225**	**24,268,685**

CROP PRODUCTION

Data collection on crop production was done on a monthly basis and presented on quarterly bases: Appendix 1 shows the crop production data for selected crops for 2018.

3.0 EXTENSION AND TRAINING

3.1 Farm Visits

The total targeted number of farm/field visits/Region is shown in Table 1 and illustrated in Figures 1 & 2

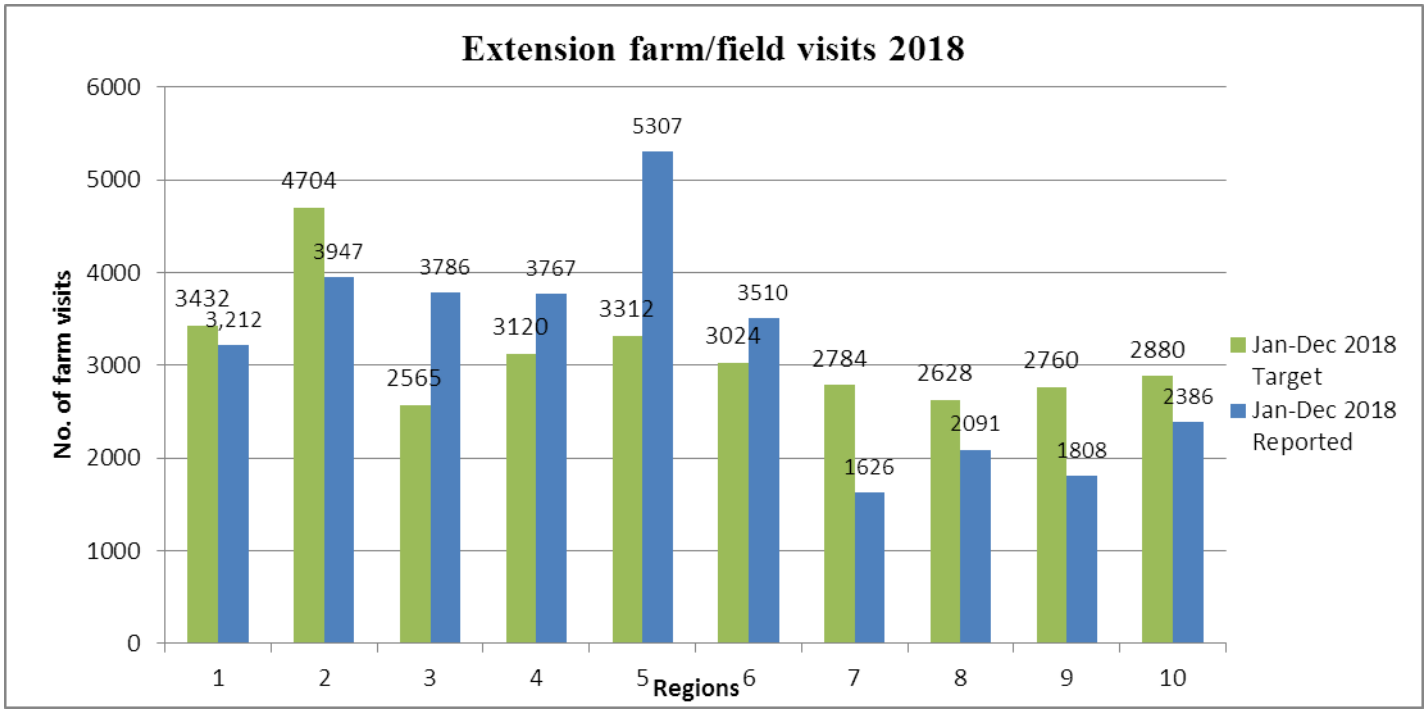

Figure 1: This bar chart illustrates the number of field visits targeted vs. the number reported per region for the period January - December 2018. Region five reported the greatest number of field visits, with 5307 visits reported for 2018, with an achievement rate of 160% of the targeted 3312 visits. Region two, which projected the largest target of 4704 visits for 2018 (approximately 1272 visits more than the next highest target set by region one of 3432 visits), achieved an accomplishment rate of 84%. Region 7 reported the lowest visits in 2018 with 1626 of their 2784 targeted visits achieved; an accomplishment rate of 58.4%.

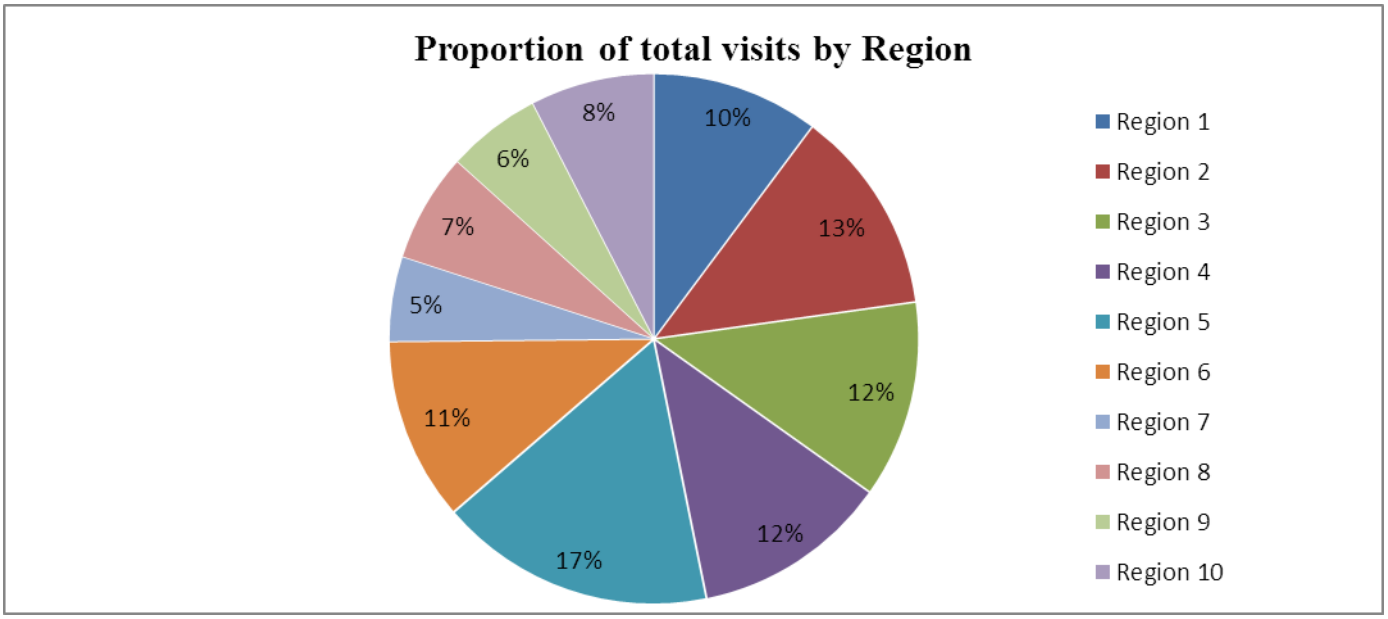

Figure 2: The Extension department reported a total of 31,440 farm visits for 2018. This pie chart illustrates each region's contribution to the total reported visits. Region five contributed the largest proportion to this figure with 5307 visits (17%). The second largest contributor was region two with 3947 visits which represented 13% of the total visits. Regions three and four each contributed 12% with 3786 and 3767 visits respectively. Regions nine and seven contributed the smallest shares at 6% (1808) and 5% (1626) visits respectively.

Regional Accomplishments January –December 2018

Regions	**Jan-Dec 2018 Target**	**Jan-Dec 2018 Reported**	**% Accomplishment Jan-Dec 2018**	**Proportion of total visits by Region**
Region 1	3432	3212	94%	10%
Region 2	4704	3947	84%	13%
Region 3	2565	3786	148%	12%
Region 4	3120	3767	121%	12%
Region 5	3312	5307	160%	17%
Region 6	3024	3510	116%	11%

Region 7	2784	1626	58%	5%
Region 8	2628	2091	80%	7%
Region 9	2760	1808	66%	6%
Region 10	2880	2386	83%	8%
Total	**31,209**	**31,440**	**100.7%**	**100%**

Table 1: Highlights the field visit accomplishment rate of the Extension Department for the period January –December 2018. Of the 31,209 visits targeted for this period, 31,440 visits have been reported; representing a 101% accomplishment rate. Four coastal regions recorded greater than 100% accomplishment with region five achieving 160%, region three 148%, region four 121% and region 6 recording 116% accomplishment of their 2018 targets. Regions one, two, ten and eight all recorded accomplishments of 80% and above their 2018 targeted number of field visits, with 94%, 84%, 83% and 80% respectively. No region fell below 50% accomplishment of their target, with regions nine and seven reporting rates of 66% and 58% respectively.

3.2 Demonstration Plots

Coastland Demonstration plots

The use of the Demonstration Method was one of the most important group techniques used during the period under review for extension purposes. The reason for using this method was to prove that a particular new practice is superior to the ones being used currently, to convince and motivate farmers to try and where necessary adopt a new practice, and to set up long-term teaching-learning situation. Due to its practical nature, it has proven to be a useful method to introduce new technology and practice to a large group of interested farmers. Demonstration plots being more practical and easy to understand has been more lucrative than other extension methods to farmers in that its proven excellent results and good impacts on yields, acreage cultivated and the amount of farmers adopting the methodology increased significantly.

A total of fifty one (51) farmers benefited directly with input (resources) that were provided as assistance for all DEMO plot. For example the following outputs/ assistance were provided; establishment of two shade houses, one in Region Two at Mr. Hansraj and one in Region Ten at Mr. Filber Bowling farm, cultivation of approximately twenty two acres of nontraditional high value crops (Cauliflower, Broccoli and Purple Cabbage), throughout all six region of the coastland, revitalization of five acres of citrus orchard and coconut plantation and establishment of a compost bin.

These interventions had a positive impact on production and productivity especially for the following crops:

Onion: - farmers who participated in the demonstration are now cultivating the crop for local consumption and have been marketing this product at several local supermarkets. The two main varieties cultivated were Red Creole and **Taxes Early Grano**, One farmer in Region 6 has expressed an interest to expand his cultivation as he incorporate Onion as his principle crop.

Radish: - Farmers in Region 3 continued the production of Radish after the demonstration was completed, since this particular produce is easily marketed.

Spices: - with the introduction of Ginger in Regions # 2, 3, 4 and 10, it is expected that importation will decline as farmers adopt the recently introduced tech pack for this crop. Many farmers have expressed their interest in venturing into larger scale production of ginger as they see its production as lucrative and easy to manage.

Papaya:-the production of the **Red Lady** has increased as farmers have adopted the the cultivation methodologies as demonstrated.

Bora: - the use of inoculum as part of the cultivation practice for bora production has seen a steady rise in usage amongst farmers especially in Region 3 in Parka back. The request for inoculum has grown throughout the farming communities in this region.

Plantain: - as a direct result of the Demo intervention plantain bunch sizes has increased especially in Region 2; (Jacklow, Pomona); region 3 - (Parika Back, Leguan); region 5 - (Blairmont - Biaboo) and in region 6 - (East Bank Berbice) and has seen widespread adaptation of the tech pack for Black Sigatoka Management and Good Agricultural Practice by farmers.

Passion Fruit:- the cultivation of this crop was successfully introduced and adopted in the remote Community of Moraikoba, Region 5, while in Laluni, Region 4, the acreage cultivated has increased as farmers welcomed the new cultivation technique that were demonstrated. Good Agricultural Practices (crop rotation, crop diversification and integrated pest management) techniques have been adopted by 112 farmers throughout the coastland for the production of Sweet peppers Cole crops, Citrus and Coconut.

Hinterland Demonstration plot

In 2018 there were executed 31 DEMO projects within the hinterland regions. Of this number, 26 were completed. These projects were conducted in regions # 1, 7 8 and 9. The focus was on the introduction and expansion of the non-traditional crops. These crops included onion, carrot, cabbage, pepper, red beans, ginger tomato, cassava and peanut. There were five cabbage projects that were completed in Shulinab, Mabaruma, Parmakatoi, Waramuri, Mabaruma and Kamarang. Favourable results were achieved with an average weight of 1.8kg in comparison to the baseline date which was recorded at 1kg. Subsequently, based on the results, farmers are now willing to adapt the new cropping techniques demonstrated by the DEOMO projects.

Two tomato projects were completed in Sand Creek and Parmakatoi. More importantly the tomato project in Parmakatoi was done in collaboration with IAST, where NAREI produced and distributed approximately thirty thousand (30,000) tomato seedlings in Parmakatoi and surrounding communities. This resulted in a total of seventy five (75) farmers benefiting. In comparison to 2017 which saw the production of 7,000 lbs of fresh tomato, the harvest in 2018 was 18,000 lbs.

There were four onion projects. These projects were executed at Waramadong, Bartica, St. Ignatius and Mabaruma. In 2019 it is expected that these projects will be expanded to enhance production of this commodity.

Hot pepper demo project in St. Igantious was successfully completed with favorable results, with an average of eight peppers weighting 0.4kg. There will be further expansion of these technologies to other communities in 2019.

Peanut and Minica IV demos were also completed in Region # 1, 7 and 9. The Carrot Demo project was conducted in region # 1, but failed due to possible weather conditions. The Cassava and ginger demo projects are still on going in Region 9.

3.3 Training

The major training activities conducted in 2018 are shown in Table 2 below:

Month	**Programme**	**# Of Training Programme**	**# Of Persons Trained**	**Objective**	**Location**	**Achievement**	**Output**
January	Extension Methods Launching of F. A. O. Project in Regions 5&6.	Five	Staff: 32, Farmers: 92	Staff to become more acquainted with teaching techniques used in Extension training.	Now or Never; Lovely Lass; # 4 Village; DeEdwards and Fryish.	Staff and farmers in these communities listed under location were invited to be a part of this training to make them aware of some of the activities they were to be involved in.	For every training activity executed, extension staff for that location were present, thus benefited from the interventions.

February. October	Acoushi ant control.	Two	68	Farmers know to control Acoushi ant using baits or swing-fog machine.	Santa Mission:37, Kakaru: 31	Seventy five farmers were involved in these training activities. They were involved in both baiting and using of swing-fog machine.	Sixty eight farmers were involved in either baiting or fogging, e.g. baiting, 30 of the fifty that received baits and ten did fogging. Thirty, 30% of the farmers involved can control Acoushi ant, using baits or swing fog machine.
February, March & April	Growing Coconuts in Guyana.	Four	57	To introduce to farmers new technology practices that are used in the coconut industry to increase production and productivity.	Guysuco's Boardroom: 07; NAREI's Boardroom: 27; Charity Extension Centre: 23.	Fifty seven farmers were involved in these training activities. This training was provided to Guysuco exemployee as a means of sustaining their livelihood. For the other farmers it was to provide them with the skills necessary to rehabilitate their plantation.	For the ex-employees of Guysuco; nil. For the plantation owners, 22 of them rehabilitated their plantation, e.g. cleared their plantation of grass, clean out drains and fertilized the trees.

							Output: 44%.
February	Growing citrus in Guyana.	One	17	To introduce to ex-employees of Guysuco new technological practices associated with citrus production.	Guysuco Boardroom: 17	Seventeen ex- employees of Guysuco were exposed to this training. The intension was to provide the basic management skills needed in citrus production to provide livelihood to the ex-employees.	Nil. The ex-employees were not interested.
March	Post-harvest treatment of onions	One	12	Farmers to know that once onions are harvested and processed properly, they can have a self-life of about 105 days.	Hague: 12	Twelve farmers were involved in this exercise. This was Propel sponsored training where selected farmers were exposed to F. F. S. activities in growing onions, i.e. from land preparation to storing.	

March	Testing soil pH	One	37	Farmers should be able to take simple soil samples and to explain the importance of soil sampling.	Aishalton: 37	Thirty seven farmers were involved in this training exercise. These farmers are now using artificial fertilizers, thus the need to know the status of the soil, as it relates to acidity and plant growth. Farmers were exposed to the simple hand testing devise used for testing soil pH.	Ten farmers can now use this simple devise to read off soil Ph. Impact 1o farmers can read soil pH, or 27% of the farmers trained.
April	New rice varietal trial and vermi-composting. F.A.O. joint field day activity.	1	62	Rice farmers were exposed to a new varietal variety of rice that shows great promise for the future; whilst, other farmers were exposed to the making of compost using California Earth	For the rice experience, 52 farmers were involved at Fairfield and at Now Or Never for the vermi-composting, (10) farmers.	Sixty two farmers were involved in these two exercises. This was a joint exercise to show that rice, livestock and crops can be integrated into farming to help households to be resilience after a hazard/disaster.	This would be determining after these initiatives are put into practice.

				Worms.			
April	Conducting research in Guyana.	1	29	To expose young scientist in the procedure of selecting, conducting and writing up research proposals.	NAREI Boardroom.	This training was geared towards assisting young research assistants to be better able to carry out research activities.	Trainees are showing positive behavioral changes towards the information received. Further monitoring and feedbacks are being observed.

April	Good Agricultural Practices.	1	10	Farmers should know that Agriculture is not a hit and miss affair but has specific ways and means of doing things to obtain maximum returns.	Farmers' resident Wakapau.	These farmers experience adverse weather conditions during both dry and wet periods. Thus, farmers were exposed to, good drainage systems, irrigation systems, good agronomic practices, e.g. weeding, fertilizing pruning, etc. This activity took the form of a field day.	All the farmers exposed to the different practices adapted them, hence there was an improvement in quality and quantity of produce. 100%

May, June	Shade House Agronomy.	Three	84	To get farmers to adapt to a technology whereby they can produce crops throughout the year irrespective of climatic conditions.	Belladrum: (17), B. B. P.: (23), Lovely Lass: (7), and De. Edwards: 37	Farmers suffer losses to their crops due to changing climatic conditions; however, shade house technology will allow them to grow crops in a semi intensive environment on raised beds with good water management practices, thus, allowing them to produce vegetables throughout the year.	To date eight farmers have shade houses, i.e. one at Belladrum; three at B.B.P. and four at Lovely Lass. Output 17% of farmers trained have adapted this technology.
May	Climate Smart Agriculture; (growing vegetables in plastic bags).	Two	14	Farmers should be able to adapt this climate smart practice in order to save their crops from flooding.	Lovely Lass: (7) and # 4 Village: (7).	Lovely Lass and # 4 Villages are prune to flooding, thus, by growing plants in large plastic bags, they can be easily moved to higher grounds during flooding.	Lovely Lass Village adapted this technology whereby two hundred bags were purchased and distributed to group members.

May	Mixing Potting mixtures for shade house beds and large plastic bags.	Eight	49	Farmers should be able to mix soils with soil additives in the correct proportion to be used in planting boxes and large plastic bags.	Lovely LASS: (7) and # 4 Village: (7). De Edwards Village: (12) and Fyrish Village: (23).	Soil is the natural habitat for plant growth, thus, good healthy plant growth require that the soil should contain most nutrients in the right proportion for good yields.	This initiative was a part of FAO. Farmers' resilience to farmers of regions' five and six. Thirty two of these farmers have since have since used mixed potting soils in their climate smart technology. In shade house boxes or in large plastic bags, 65%
May, June & July.	Safe use of pesticides; Proper storage of pesticide containers; and safe disposal of pesticide containers.	Five	244	Farmers know that pesticides are dangerous chemicals, thus, care must be taken when using, storing or disposing of containers.	Black Bush Polder: (23); Enterprise: (70); Friendship: (23); St. Cuthbert Mission: (23); and Bartica:	These training activities were conducted by P.T.C.C.B. and were facilitate by N.A.R.E.I. Farmers were exposed to techniques used for storing and disposing of pesticides and their containers. They were exposed to the proper	

					(94).	gears to use when applying pesticides.	
June	Budding and Grafting.	One	34	To develop in farmers the skills needed to produce their own orchard seedlings.	Wisroc: (34).	This activity took the form of a group discussion followed by a practical session. Ten CSEC. Students and twenty three farmers were exposed to budding and grafting. A group discussion held explaining the importance of budding and grafting and how it is done. A practical demonstration was done by a propagator from NAREI. Three students and three farmers were given the opportunity to perform same.	Three students and three farmers were able to successfully perform the budding and grafting task. Output 18%.

June	Growing pineapples in Guyana.	One	23	To expose farmers to new technological practices involved in the growing of pineapples.	Guysuco Training Centre, L.B.I. Estate.	Ex-employees of Guysuco are being trained in a number of crop production systems that would enable them to maintain their livelihood. Training is being provided by NAREI. GLDA. And NGMC.	Output, (nil). Thought farmers attended the training, they are not willing to take up farming as a career.
July	Insect pest of coconuts.	One	37	Farmers should be able to identify and treat common pest and diseases of coconut palms.	Charity Extension Office, Charity.	Over the years coconut plantations have been allowed to be ravaged by pest and diseases, however due to the rejuvenation of the industry, efforts are being made by C.A.R.D.I., to use first tier and second tier plantation owners to become trainers to owners of run down plantations to rejuvenate their plantations by weeding, replanting treating for diseases and	

						pest, fertilizing, etc.	
July	The use of lures in controlling Sweet Potato Weevil.	One	23	To expose farmers to a cheap means of controlling sweet potato weevil, (cost effective).	Friendship Resident	Farmers find lures very cost effective in controlling the sweet potato weevil. Previously pronto was being used to control this pest which was very costly.	All twenty three farmers present were given five packs of lures each. All have initiated the use of the lures 100%
July	Growing onions on a large scale	One	57	To expose all the observer farmers who were involved in the field school demonstration to grow onions on their own.	Corentyne, Kildonon, Phillipi, # 58, Canje Creek and Adventure.	Previously all the onions used by households in Region #6 were imported; however, many farmers are now producing onions at the subsistence level.	Fifty seven farmers produced over two thousand pounds of onions.
August	Setting up of vermi composting bin at Fryish.	One	6	To expose farmers to constructing and setting up of vermi composting bin.	Fryish.	If farmers can produce compost on a fairly large scale it would greatly reduce their use of synthetic fertilizers, thus,	To date six bins have been established in regions 5&6. One in Fyrish, three in #

						reduce expenditure and increase profitability.	4 village and two in Now Or Never.
September.	Land preparation using farm implements.	One	48	To demonstrate to farmers how some motorized farm implements are operated	Eversham.	Farming tools and implements were given to the Regional Crops Extension Officer, by Food For The Poor to be distributed to farming groups in the Upper Corentyne Area. These tools and implements will enable farmers to become more efficient in their farming activities. Also, more work will be done in a shorter time span.	Farming activities will be monitored by Extension staff to determine efficiency in using implements.

September.	Pest and Disease management.	One	70	Farmers should be able to identify and treat simple pest and diseases affecting their major crops in the region.	Aishalton.	Farming is the major economic activity in this community, thus, producing quality fruits and vegetables is of utmost importance.	
September.	Integrated approach to Climate Smart Agriculture.	One	60	Farmers should be able to integrate rice production, paddy shell, and rice straw, to make silage for livestock feeding and the paddy shell along with kitchen waste to produce compost for plant nutrient.	Bushlot	Farmers suffer immensely during disaster, so by producing silage, which can be made and stored for future use to feed animals, whilst the compost can be used to improve soil structure and fertility.	Staff will work with farmers to implement these initiatives.

October	Interviewing farmers, (suitability for small loans.	One	61	To determine the capability of farmers to implement interventions provided by F.A.O. in combatting disasters.	Fryish, De, Edwards and Lovely Lass village.	Many of these farmers do farming at the subsistence level, thus would find it difficult to meet the cost of constructing a shade house or a vermi composting bin, thus the interviews.	To be determine by F.A.O.
November and December.	Pisca use in Agriculture.	Two	60	Farmers should be able to plan their farming activities in accordance with known hazard periods.	Region # 6 Extension Office.	Farmers need to have a chart showing periods where climatic hazards are more likely to occur, thus plan their growing season to avoid these hazards.	To be implemented and monitored by Extension Field Staff.
December	Shade house construction	One	32	Farmers need to know how to construct simple shade houses.	Region # 9, Yupakari.	This community usually experience prolonged dry periods. Farmers constructing and growing vegetables under shaded cultivation would be able to grow crops throughout the year.	

4. National Plant Protection Organization

The National Plant Protection Unit conducted surveillance activities in keeping with International Standards for Phytosanitary Measure (ISPM) 6[1] and other appropriate ISPMs when necessary. ISPM describes the components for effective and efficient survey and monitoring programmes that are essential for pest detection and the supply of information for use in pest risk analyses, the establishments of pest free areas/areas of low pest prevalence, and in some cases, the preparation of national pest list.

For the year in review, specific pest surveys were carried out for four quarantine pests, namely: the Carambola fruit fly, Mediterranean fruit fly, Red Palm mite and the Red Palm weevil. While host surveys were conducted for Carambola, Mediterranean and *Anastrepha* species of Fruit flies.

1.1 Pest Surveys

1.1.1 Carambola Fruit Fly

Scientific name: *Bactrocera carambolae* (Drew & Hancock) (Insecta: *Diptera: Tephritidae*)

The carambola fruit fly is known to be polyphagous and causes tremendous economic losses of fruit crop (Koswanudin, et al., 2018); with its reintroduction and spread into Guyana has resulted in embargoes, yield and production *inter alia*. During the period under review, six of the ten (10) administrative regions were monitoring and control activities were conducted in seven, namely: Regions # 2, 3, 4, 5, 9, and 10. Based on results obtain through the monitoring component of the program, the Unit recognized the need to implement Control measures in areas highly infested with CFF with the aim of reducing the population.

A major challenge was the unavailability of adequate resources to effect eradication efforts. Hence, execution of baiting activities was limited to region 9 (Culvert City) where a new and isolated incidence occurred. However, for other affected areas, farmers and residents were advised on simple ways of management such as bagging and good sanitation.

According to updated detection and delimiting CFF surveys, the Carambola Fruit Fly is confirmed present within Regions; 2, 3, 4, 6, 8, 9 and 10. According to ongoing trap servicing Region 5 is negative of this Quarantine pest. Regions 1 and 7 are unknown.

Additionally, the unit conducted (2) Two In-house refresher CFF training conducted for the CDSS staff: (i) Coastal Coordinators, and the other for staff of region 9. There was also a CFF Sensitization Workshop hosted between NAREI and Inter-American Institute for Cooperation on Agriculture (IICA), where a plethora of stakeholders were informed and

[1] ISPM 6: Guidelines for Surveillance, is an internationally accepted reference standard formulated and adopted by the IPPC of the Food and Agriculture Organization (FAO)

engaged in dialogue in relational to the pest and the upcoming Joint Initiative for the Control and Eradication of CFF between Guyana, Suriname and Brazil.

1.1.2 Mediterranean Fruit Fly

Scientific name: *Ceratitis capitata* (Wiedemann) (Insecta: Diptera: Tephritidae)

The Mediterranean fruit fly is considered one of the most destructive of the fruit flies in the tropics and subtropics due to its high dispersive ability, extensive host range (more the 200 host species inclusive of fruits and vegetables), and tolerance to a wide temperature range. This pest has its origin in Sub-Saharan Africa, and has spread to a number of territories in almost all the continents (CABI, 2014). Notable mentions of those affected in Latin America and the Caribbean include our geographical neighbours (Brazil and Venezuela), USA, Jamaica, the Netherland Antilles, and Belize; given Guyana's proximity and susceptibility to this pest, the unit has embarked on an active survey and monitoring programme to determine the country's pest status and to maintain surveillance activity to in an effort to ensure early detection and effect regulatory actions if necessary.

Active surveillance for the Mediterranean fruit fly entailed the use of Multi-lure traps impregnated with an organic pheromone (Trimedlure[2]) distributed in "high priority areas." These sites were monitored every other month, and the results indicate that Guyana remains free from this pest.

1.1.3 Red Palm Mite

Scientific name: *Raoiella indica*

The Red Palm Mite is an economic pest of the palms, *Musa spp* and Heliconicas, and was discovered in the late 2013 on the island of Wakenaam, Guyana and since its introduction the NAREI has embarked on a concerted effort to monitor and control the spread, with the eventual aim of eradication.

The NPPO in 2018 carried out one surveillance activity for the RPM along the Lower and Upper Pomeroon River, Region 2. This resulted in a total of 17 Villages/Grants were visited during surveillance activities, collecting 147 random leaflet samples which were transport to the laboratory for diagnosis. This resulted in a total of 57 visited and a positive identification of 0.64.

Internal Quarantine continues to be an important aspect in the efforts to contain the spread of RPM to unaffected areas. Measures were implemented on Wakenaam Island, Region 3. This area accounts for a significant percentage of Guyana's coconut export production and coconut by-products. Here, chemical treatment of host materials was conducted with aluminum phosphide (tablets) destined to leave infected areas, along with treatment of palms with systemic insecticides.

[2] The IUPAC name for Trimedlure is tert-Butyl-2-methyl-4-chlorocyclohexanecarboxylate

The implementation of internal quarantine measures resulted in a total of 32,852 brooms and 1,947,035 dry coconuts being fumigated with phostoxin tablets, 29,315 water coconuts washed in bleach solution and 13,549 coconut palms treated with Monocrotopus, Abamectin and triazophos.

The Second phase for the distribution of chemical concluded in 2018 for the control of Red Palm Mite, where 715 Farmers benefited from 3860.7 liters of Chemicals (Monocrotophos, Abamectin and Triazophos). Areas targeted for treatment were the Pomeroon River, Wakenaam, Leguan, and Hogg Island.

Public Awareness also played an integral role, information was disseminated via sessions with 1,470 farmers, residents and other concerned parties about the threat of RPM and how to deal with same. These sessions took the form of one on one conservations, Group discussions, and distribution of Brochures.

1.1.4 Red Palm Weevil

Scientific name: *Rhynchophorus ferrugineus* (Oliver)

The red palm weevil originated in tropical Asia but has spread through the Middle East and the Mediterranean where it has severely damaged commercial and ornamental palm trees (Faleiro, 2006). In 2009 this destructive palm pest was first reported in the Caribbean islands of Aruba and Curacao (Brochert, 2009), by 2014 it had further spread to the Netherland Antilles (CABI, 2018); given the high pest population in Curacao, coupled with the increased trade of fresh agricultural produce by smallholder boats between Curacao and Venezuela, there is an increased risk for its introduction and spread into the Caribbean and South America (Roda, et al., 2011). Hence, the Plant Protection Unit has established an official survey and monitoring programme in major coconut producing areas to determine the pest status of defined areas in Guyana.

The areas under surveillance include Pomeroon and Lower Essequibo Coast (Region 2), Lancaster and North Bygeval (Region 4), Farm, Fellowship and Letter T (Region 5). There are presently forty-eight (48) traps within Region two (2), Fifteen (15) traps in region four (4) and twenty-seven (27) traps in Region five (5) resulting in a total distribution of 90 red palm weevil traps.

The surveillance methodology entailed the use red palm weevil pheromone (Ferrolure[3]) traps placed along the plantations within the survey sites. These traps were serviced with the change of lures quarterly. To date, no red palm weevil was detected in any of the traps.

1.1.5 Pink Hibiscus Mealybug

Scientific name: *Maconellicoccus hirsutus* (Green)

Passive countrywide surveillance conducted throughout the year has indicated that both the Pink Hibiscus Mealybug and Papaya Mealybug remain below the economic threshold.

This low population count remains in check due to the presence of the biological control agents (*Anagyrus Kamali, Cryptolaemus montrouzieri*) that were released during PMB Control and Management Programme. Passive surveillance continues countrywide.

1.2 Host Surveys

1.2.1 ***Tephritidae*** (Genus: Anastrepha, Bactrocera, Ceratitis and any emerging fruit flies)

For the period 2018; the surveillance team embarked on the strategic regional surveillance of Carambola Fruit Fly via fruit sampling. This methodology was employed to establish an organized way of assessing the status and geographic distribution of fruit flies across Guyana.

During this period, surveys were conducted within administrative region 3 to achieve the aforementioned objective. The laboratory saw a total of 15 batches submitted that resulted in the examination of 263 individual fruit samples. Fruits that were investigated included: *Persea americana, Bligia sapida, Averrhoa bilimbi, Averrhoa carambola, Anacardium occidentale, Anacardium spp., Prunus avium, Eugenia uniflora, Ziziphus mauritiana, Chrysobalanus icaco, Aegle marmelos, Ribes uva-crispa, Psidium guajava, Syzgium cumini , Citrus aurantifolia, Citrus limon, Mammea americana, Mangifera indica, Citrus sinensis, Carica papaya, Passiflora.*

[3] Ferrolure contains active ingredients of 4-methyl-5-nonanol and 4-methyl-5-nonanone, in a ratio of 9:1. The compound has a purity of >98%

5.0 MANGROVE MANAGEMENT/RESTORATION

This report covers the period of 12 months from January 1, 2018 through to December 31, 2018 and provides a review of the activities which were implemented by the NAREI Mangrove Restoration and Management Department during the period.

Restoration of coastal mangrove ecosystems: Mangrove restoration activities completed during 2018 focused on mangrove seedling planting and coastal infrastructure as interventions to promote and encourage sedimentation and natural regeneration. 2018 restoration projects included the completion of 700m brushwood dam field at Aberdeen and Columbia and planting 14,876 Avicennia germinans seedlings along 300m at Walton Hall, Essequibo Coast, Region No. 2.

The completed brushwood dams at Aberdeen and Columbia are expected to support restoration of 1,000 meters of mangroves parallel to the shoreline. The structures are expected trap sediments and increase shoreline elevation to achieve the minimum optimal elevation of 2.3m above CD that is suitable for the natural regeneration of Avicennia germinas within the first 2 years after construction.

Mangrove protection and monitoring activities completed during the year resulted in enhanced monitoring capacity with the procurement of one DJI Phantom 4 Advance UAV and the installation of permanent graduated monitoring gauges in Region 2 and 4. An analysis of available updated imagery on restored sites indicates that approximately 500hectares of mangroves have been restored as at the end of 2018.

Community involvement continued to play a critical role in the success of restoration activates. During the year the Department worked to members of the volunteer groups (Village Mangrove Action Committees) to implement a series of community awareness and activities and continued to engage NDCs on mangrove conservation and management issues.

The public awareness and education programme resulted in 538 visitors to the mangrove Heritage Trail Tour, 640 students reached through school presentations, 121 youths engaged through Easter and summer camps and completed of Mangrove Photo and Quiz competitions as part of NAREI's celebration of International Mangrove Day 2018.

6.0 HUMAN RESOURCES DEPARTMENT, 2018

1. **RECRUITMENT – Twenty-eight (28) persons were recruited in 2018 as follows:**

A. CROP DEVELOPMENT AND SUPPORT SERVICES

Name	Designation	Date of Employment
1. *Trevor Matheson	Extension Agent	2018-09-01
2. Jameraquai Haley	Crop Extension Assistant	2018-10-01
3. Leana Stuart	Crop Extension Assistant	2018-10-01
4. Lashawn Knight	Crop Extension Officer	2018-12-03
5. Taseka Blair	Crop Extension Officer	2018-12-03

B. GENERAL ADMINISTRATION AND FINANCE

Name	Designation	Date of Employment
1. Collin Morgan	Driver/Boat Operator	2018-01-15
2. Joy Lyte	General Worker	2018-01-17
3. Dwayn Lachish	Security Guard	2018-02-01
4. Shiv Rampersaud	Security Guard	2018-02-01
5. Samuel Jordan	Security Guard	2018-02-01
6. Romila Boodram	Special Projects Officer	2018-03-05
7. David Debideen	General Worker	2018-03-05
8. Owen James	General Worker	2018-03-05.
9. Gilbert Hernandez	General Worker	2018-04-03.
10. Keron Kertzious	General Worker	2018-05-07.
11. Shelly Gonsalves	General Worker	2018-05-28
12. Vishraj Singh	Internal Auditor	2018-07-03
13. Towanda Clarke	Corporate Secretary	2018-08-02
14. Gem Worrell	General Worker	2018-08-06
15. Annie Hinds	General Worker	2018-08-06

16. Britney Lall	Secretarial Assistant	2018-09-06

C. NATIONAL PLANT PROTECTION ORGANIZATION

Name	Designation	Date of Employment
1. Alpha Harcourt	Quarantine Inspector	2018-10-01

D. RESEARCH AND DEVELOPMENT

Name	Designation	Date of Employment
1. Somwattie Pooran- DeSouza	Research Scientist	2018-02-12
2. Daniel Chand	Nursery Supervisor	2018-03-19
3. Kellon Phillips	GIS Technician	2018-04-03.
4. Andrew Carter	Research Assistant	2018-08-02
5. Vernon Duncan	GIS Technician	2018-08-02
6. Faron Pearson	Research Assistant	2018-10-01

2. **RESIGNATION – Two (2) persons tendered their resignations as follows:**

A. RESEARCH AND DEVELOPMENT

Name	Designation	Date of Resignation
1. Ray Imhoff	Research Assistant	2018-08-25
2. Komal Wahab	Research Technician	2018-10-01

3. **DISMISSAL – Seven (7) persons were dismissed as follows:**

A. GENERAL ADMINISTRATION AND FINANCE

Name	Designation	Date of Dismissal
1. Omar Ramlall	General Worker	2018-02-01
2. Kishan Daniels	General Worker	2018-06-29
3. Nankumar Gopal	General Worker	2018-04-09
4. Cleveland Atkinson	General Worker (Boat Operator)	2018-08-01

B. RESEARCH AND DEVELOPMENT

Name	Designation	Date of Dismissal
1. Kellon Phillips	GIS Technician	2018-08-01
2. Rachel Carew	Research Assistant	2018-09-24
3. Vickram Persaud	Research Assistant	2018-10-01

4. **NON RENEWAL OF CONTRACTS – Twelve (12) persons' contracts have not been renewed as follows:**

A. GENERAL ADMINISTRATION AND FINANCE

Name	Designation	Effective Date
1. Harripaul Arjoon	Security Guard	2018-02-01
2. Sahadeo Behari	Security Guard	2018-02-01
3. *Romila Boodram	Communications Officer	2018-03-01
4. Roxanne James	General Worker	2018-04-01
5. Jonathan Rodney	General Worker	2018-05-01
6. Colin Hercules	General Worker	2018-05-01
7. Ryan Paul	Accounts Clerk	2018-05-01
8. Loaknauth	General Worker	2018-11-01

B. NATIONAL PLANT PROTECTION ORGANIZATION

Name	Designation	Effective Date
1. Ramsingh Tajbally	Plant Quarantine Officer	2018-09-12

C. RESEARCH AND DEVELOPMENT

Name	Designation	Effective Date
1. Faron Pearson	Research Assistant	2018-08-17
2. Lancelyn Sucre	Research Assistant	2018-09-02
3. Lalita Gopaul	Research Assistant	2018-11-01

5. **PROMOTION – Eleven (11) persons were promoted as follows:**

A. CROP DEVELOPMENT AND SUPPORT SERVICES

Name	Designation	Effective Date
1. Trisha Williams	Snr. Crop Ext. Asst.	2018-01-01

B. GENERAL ADMINISTRATION AND FINANCE

Name	Designation	Effective Date
1. Deoranie Outar	Snr. Secretarial Assistant	2018-08-01
2. Sharon Boyer	Nursery Supervisor	2018-08-02

C. MANGROVE

Name	Designation	Effective Date
1. Luan Gooding	Monitoring Asst.	2018-01-01

D. NATIONAL PLANT PROTECTION ORGANIZATION

Name	Designation	Effective Date
1. Adele Pierre	Snr. Plant Protection Officer	2018-03-01
2. Andre Marks	Snr Quarantine Insp.	2018-09-01
3. Zareefa Bacchus	Snr. Pl. Quar. & Pest Risk Officer	2018-10-01
4. Brian Sears	Deputy CEO (Crop Prot. & Ext.)	2018-12-01

E. RESEARCH AND DEVELOPMENT

Name	Designation	Effective Date
1. David Fredericks	Senior Research Scientist	2018-05-15
2. Cleveland Paul	Senior Research Scientist	2018-06-01
3. Raghunath Chandranauth	Senior Research Scientist	2018-06-01
4. David Fredericks	Deputy CEO (Research)	2018-12-01

6. **RE-DESIGNATION –Two (2) persons were re-designated as follows:**

A. RESEARCH AND DEVELOPMENT

Name	Designation	Effective Date
1. Analesa Skeete	Research Scientist	2018-09-03
2. Howard London	Research Scientist	2018-09-12

7. **TRANSFER – Seven (7) persons were transferred as follows:**

A. CROP DEVELOPMENT AND SUPPORT SERVICES

Name	Designation	Effective Date
1. Chevy Bissessar	District Crop Ext. Officer	2018-01-01
2. Quincy Bentinck	District Crop Ext. Officer	2018-01-01
3. Erena Torres	Crop Ext. Assistant	2018-01-01

B. NATIONAL PLANT PROTECTION ORGANIZATION

Name	Designation	Effective Date
1. Loressa McDonald	Quarantine Inspector	2018-07-01
2. Shalona Joaquin	Quarantine Inspector	2018-07-01
3. Peter Davson	Quarantine Inspector	2018-07-01
4. Dorret Jones	Quarantine Inspector	2018-07-01

8. **DEATH: One (1) person died as follows:**

A. GENERAL ADMINISTRATION AND FINANCE

Name	Designation	Effective Date
1. Diane Younge	General Worker	2018-03-28

9. **TRAINING**

A. **OVERSEAS**

1. **Mr. Brian Sears, Deputy Chief Executive Officer**, participated in the **Consultation and Validation Workshop - programme for the Strengthening of Agricultural Health Systems - Prevention, Surveillance and Control of Pets and Diseases (livestock, fisheries, aquaculture, forestry and crops) in the Latin America and Caribbean Region,** held in Panama City, during the period April 5-6, 2018.

2. **Ms. Luandra Jack, Engineer**, participated in the **Coastal Ecosystems of the Guianas Workshop,** held in Suriname on April 16, 2018.

3. **Ms. Samantha Brotherson, Research Scientist**, participated in a **Regional workshop on coconut tissue culture and seed nut germination**, held in Mexico during the period May 14-18, 2018.

4. **Mr. Satyanand Ramdowar, Research Assistant**, participated in the **Caribbean Agricultural and Research Development Institute (CARDI) Regional forum on the implementation of the Regional Coconut Industry Development Project**, held in Trinidad &Tobago, during the period 3-7 June, 2018.

5. **Ms. Adele Pierre, Senior Plant Protection Officer**, participated in the **Advance Thematic Course on Sanitary and Phytosanitary (SPS),** held in Geneva, Switzerland, during the period July 4-13, 2018.

6. **Ms. Oceana O'Dean, Research Scientist**, participated in the **Identification, Monitoring and Management of Economically Important Pest Insects in Agriculture, held at the Florida Agricultural and Mechanical University, USA**, during the period 2-30, July, 2018.

7. **Mr. Ramnarace Sukhna, Research Scientist**, participated in **a Regional Workshop on Legumes: Conservation and Protection of Agro resources Cochabamba**, held in Bolivia, during the period July 23-27, 2018.

8. **Mr. Premdat Beecham, Research Assistant**, participated in a training course on **High-Yield Cultivation Technology Intensification for Developing Countries**. Changsha, Hunan Province, China, during the period 15 July, 2018 to 2 September, 2018.

9. **Mr. Cleveland Paul, Senior Research Scientist**, participated in a training course on **Building Linkages to strengthen on-farm management of Farmers varieties/landraces,** held at FAO HQ, Rome, Italy, during the period 24-27 July, 2018.

10. **Ms. Kendra Belgrave-Smartt, Plant Quarantine Officer**, participated in a training course on **Plant Quarantine Principles and Procedures**, held in Trinidad & Tobago, during the period 6-17 August, 2018.

11. **Ms. Kimanda Pilgrim and Ms. Adrianna Wellington, Research Assistants**, participated in a training course on **Ecological and Circulatory Agriculture for Foreign Officials under Belt and Road,** held in China, during the period 10-30 October, 2018.

12. **Ms. Maleka Russell, Crop Extension Assistant**, participated in a training course on **Greenhouse Vegetable Cultivation Techniques for Developing Countries**, held in China, during the period 10 October, 2018 to November 03, 2018.

13. **Mr. David Fredericks, Deputy Chief Executive Officer (Research)**, participated in the **First Global Conference on the sustainable Blue Economy**, held in Nairobi, Kenya during the period 26-28 November, 2018.

14. **Ramnarace Sukhna, Research Scientist**, participated in a training programme on **Regionally Relevant Cocoa Equipment Project,** held in Trinidad and Tobago during the period December 3-8, 2018.

B. **LOCAL**

1. **Ms. Adele Pierre, Senior Plant Protection Officer** and **Ms. JoAnn Griffith-Nedd, Research Assistant**, participated in a training programme on **Principles of Supervisor Management Module 1**, held at Ministry of the Presidency, Department of Public Service, Training Division during the period March 5-9, 2018.

2. The following persons participated in a **NIS workshop**, held at NAREI on April 18, 2018:

	Name		**Designation**
i.	Ms. Samantha Maraj	-	Finance Manager
ii.	Ms. Sharon Blair	-	Senior Human Resources Officer
iii.	Ms. Natasha Seeratan	-	Human Resources Officer
iv.	Ms. June Eastman	-	Senior Human Resources Clerk
v.	Ms. Liloutie Persaud	-	Accountant
vi.	Ms. Shirley Primo	-	Accounts Clerk
vii.	Ms. Schedelia Hodge	-	Accounts Clerk
viii.	Ms. Dennecia Goddette	-	Accounts Clerk

3. **Ms. Adele Pierre, Senior Plant Protection Officer** and **Ms. JoAnn Griffith-Nedd, Research Assistants**, participated in a training programme on **Principles of Supervisor Management Module 11**, held at Ministry of the Presidency, Department of Public Service, Training Division during the period May 7-11, 2018.

4. **Ms. Adele Pierre, Senior Plant Protection Officer** and **Ms. JoAnn Griffith-Nedd, Research Assistants**, participated in a training programme on **Monitoring and Evaluation**, held at Ministry of the Presidency, Department of Public Service, Training Division during the period 11-15 June, 2018.

5. The following persons participated in a training course on **Records Management and Archives**, held at Ministry of Agriculture Boardroom on 24-25 July, 2018.

	Name		**Designation**
i.	Selina Lepps	-	Administrative Assistant
ii.	Kevin Paltoo	-	Administrative Assistant
iii.	Terance Ram	-	Human Resources Officer
iv.	Devica Singh	-	Research Technician

6. Ms. Samantha Maraj, Finance Manager, participated in a training workshop on **IIA Standards, Code of Ethics, Audit Reports, Risk Management, Internal Auditing** during the period 26-27 September, 2018.

7. The following persons participated in the **Mini-International Programme for Development Evaluation Training** at the Arthur Chung Convention Centre during the period 29 October, 2018 to 02 November, 2018:

	Name	**Designation**
i.	Denisia Whyte	Research Assistant
ii.	Evan Willabus	Research Assistant
iii.	Cleveland Paul,	Senior Research Scientist
iv.	Aaron Ramroop	Hinterland Crop Extension Coordinator (ag)
v.	Vishraj Singh	Internal Auditor
vi.	Howard London	Research Scientist
vii.	Indira Persaud	Research Assistant

viii.	Premdat Beecham	Research Assistant
ix.	Ramnarace Sukhna	Research Scientist
x.	Nariefa Abrahim	Research Scientist
xi.	Samantha Maraj	Finance Manager

8. The following persons participated in the **Mini-International Programme for Development Evaluation Training** at the Arthur Chung Convention Centre during the period 27 November, 2018 to 30 November, 2018:

	Name	**Designation**
i.	Aretha Peters	Research Assistant
ii.	Rebecca Narine	Research Assistant

STAFFING AT NAREI

Categories	**No. of Positions**	**Positions Filled**	**Position Vacant**
Crop Extension Services	98	*99	14
General Admin. & Finance	244	*185	60
National Plant Protection Office	52	*35	29
Research and Development	95	62	33
Mangrove	18	14	4
Total	**507**	**395**	**140**

*** Represents overlapping of Seven (7) District Crop Extension Officers, eight (8) Crop Extension Assistants, one (1) Confidential Secretary, and twelve (12) Plant Quarantine Officers which is reflected under staffing at CDSS, GA&F and NPPO.**

NON CONTRACTED EMPLOYEES

Extension Agents 21

STAFFING IN THE CROP DEVELOPMENT AND SUPPORT SERVICES DEPARTMENT

Category	**Authorized Positions**	**Positions Filled**	**Vacant Post**
Deputy Chief Executive Officer/Crop Protection and Extension Services	1	1	0
National Crop Extension & Training Coordinator	1	0	1
Training Manager	1	1	0
Regional Crop Extension Officer	12	6	6
District Crop Extension Officer	30	*37	0
Senior Crop Extension Assistant	13	6	7
Crop Extension Assistant	40	*48	0
Total	**98**	**99**	**14**

*represents overlapping of Seven (7) District Crop Extension Officers and eight (8) Crop Extension Assistants

The Hinterland and the Coastal Coordinators are reflected as Regional Crop Extension Officers, hence their current positions are not stated.

STAFFING IN THE GENERAL ADMINISTRATION AND FINANCE DEPARTMENT

Category	Authorized Positions	Positions Filled	Vacant Post
Human Resources Manager	1	0	1
Administrative Manager	1	1	0
Finance Manager	1	1	0
Corporate Secretary	1	1	0
Internal Auditor	1	1	0
Projects/PRO	1	1	0
Senior Human Resources Officer	1	1	0
Librarian	1	0	1
Special Projects Officer	1	1	0
Accountant	2	1	1
Human Resources Officer	2	2	0
Administrative Officer	1	1	0
Communications Officer	1	1	0
Farm Manager	3	2	1
Administrative Assistant	2	2	0
Security Supervisor	1	1	0
Assistant Librarian	2	1	1
Storekeeper	4	2	2
Senior Human Resources Clerk	2	2	0
Confidential Secretary	2	*3	0
Information Technology Technician	2	1	1
Senior Secretarial Assistant	1	1	0
Cashier	3	0	3
Accounts Clerk	6	5	1
Secretarial Assistant	6	3	3
Human Resources Clerk	2	0	2
Data Entry Clerk	2	1	1
Library Assistant	2	0	2
Heavy Duty Operator	10	4	6

Drivers/Office Assistants	20	9	11
Well Operator	1	1	0
Welder	1	0	1
General Workers	125	114	11
Senior Security Guard	2	2	0
Security Guard	30	19	11
Total	**244**	**185**	**60**

* Represents overlapping of one (1) confidential Secretary.

STAFFING IN THE NATIONAL PLANT PROTECTION ORGANISATION

Category	Authorized Positions	Positions Filled	Vacant Post
Assistant Chief Executive Officer/Chief Plant Protection Officer	1	0	1
Senior Plant Protection Officer	1	1	0
Senior Quarantine and Pest Risk Officer	1	1	0
Plant Protection Officer	5	1	4
Plant Quarantine Officer	5	*17	0
Senior Plant Quarantine inspector	5	1	4
Senior Plant Protection Assistant	4	0	4
Plant Protection Assistant	10	0	10
Plant Quarantine Inspector	20	14	6
Total	**52**	**35**	**29**

* represents overlapping of twelve (12) Plant Quarantine Officers

STAFFING IN THE GUYANA MANGROVE MANAGEMENT DEPARTMENT

Category	Authorized Positions	Positions Filled	Vacant Post
Project Coordinator	1	1	0
Monitoring Officer	1	1	0
Monitoring Assistant	1	1	0
Community Dev. Officer	1	1	0
Monitoring Officer/GIS Technician	1	1	0
Engineer	1	1	0
Ranger	12	8	4
Total	**18**	**14**	**4**

STAFFING IN THE RESEARCH AND DEVELOPMENT DEPARTMENT

Category	**Authorized Positions**	**Positions Filled**	**Vacant Post**
Chief Executive Officer	1	1	0
Deputy Chief Executive Officer (Research)	1	1	0
Assistant Chief Executive Officer/Chief Research Scientist	1	0	1
Head, Fruits, Vegetables and Other Crops (Senior Research Scientist)	1	1	0
Head, Entomology, Pathology and Weed Science (Senior Research Scientist)	1	0	1
Head, Biotechnology and Seed Technology (Senior Research Scientist)	1	1	0
Head, Soils and Farm Mechanization (Senior Research Scientist)	1	0	1
Head, Bio Energy (Senior Research Scientist)	1	0	1
Horticulturist	1	0	1
Research Scientist	15	9	6
Monitoring & Evaluation Officer	1	1	0
Monitoring & Evaluation Assistant	1	1	0
Nurseries Manager	1	0	1
Research Assistant	30	24	6
Nursery Supervisor	5	3	2
GIS Technician	1	1	0
Senior Research Technician	6	1	5
Research Technician	16	13	3
Laboratory Attendant	10	5	5
Total	**95**	**62**	**33**

S. Blair

Snr. HRO

7.0 FINANCIAL REPORTS 2017- UNAUDITED STATEMENT

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE
STATEMENT OF FINANCIAL POSITION
AS AT 31 DECEMBER, 2018

	Note	31.12.2018	31.12.2017
		$	$
Assets			
Non-Current Assets			
Property, Plant & Equipment	2	453,310,492	421,366,605
Total Non-Current Assets		453,310,492	421,366,605
Current Assets			
Inventory	3	168,825,761	202,609,391
Receivables	4	6,806,694	10,756,416
Cash and Cash Equivalents	5	119,036,655	198,961,922
Total Current Assets		294,669,110	412,327,729
Total Assets		747,979,602	833,694,334

DRAFT ACCOUNTS

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE

STATEMENT OF FINANCIAL POSITION

AS AT 31 DECEMBER, 2018

	Note	31.12.2017	31.12.2017
		$	$
Equity & Liabilities			
Equity			
Grant from Foreign Sources	6	51,897,479	51,897,479
Government for Guyana Contribution	7	1,064,135,417	1,043,062,088
Revaluation of Stock		341,781	341,781
Accumulative Surplus/(Deficit)		(435,410,989)	(329,847,587)
Total Equity		680,963,688	736,997,818
Liabilities			
Non-Current Liabilities			
Ministry of Public Works	8	5,606,815	5,606,815
Total Non-Current Liabilities		5,606,815	5,606,815
Current Liabilities			
Payables	9	61,409,099	91,089,701
Total Current Liabilities		61,409,099	91,089,701
Total Equity & Liabilities		747,979,602	833,694,334

The accompanying notes form an integral part of these financial statements. These financial statements were signed on the ……by:

DRAFT ACCOUNTS

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE

STATEMENT OF COMPREHENSIVE INCOME

FOR THE YEAR ENDED 31 DECEMBER, 2018

	Note	31.12.2018	31.12.2017
		$	$
REVENUE			
Government of Guyana Subvention	10	988,447,408	885,928,417
Income from Operations	11	26,686,515	29,057,978
Other Income	12	9,324,360	14,454,230
Interest Earned	13	149,458	210,803
Gain on disposal of Motor Vehicles		-	-
Income Adjustment under IAS 20	14	-	-
Write off of Bad debts		-	9,000
Capital Expenditure/Income		-	-
Total Revenue for the Year		1,024,607,741	929,660,428
Expenditure			
Wages & Salaries		705,651,844	627,821,822
Overhead Expenditure		102,111,691	90,820,001
Material, Equipment & Supplies		32,579,994	15,841,699
Fuel & Lubricant		21,688,391	14,813,312
Rental & Maintenance of Buildings		19,105,857	10,349,885
Maintenance of Infrastructure		7,982,912	1,760,124
Transport, Travel & Postages		38,641,810	33,902,145
Utility Charges		39,439,684	40,432,483
Other Goods & Services		37,231,867	36,291,128
Other Operating Expenses		19,061,580	17,678,070
Education Subvention & Training		1,323,298	1,609,759

Old Age Pension		1,024,313	1,023,747
Severance Payment		183,080	835,515
Red Palm Mite		-	3,769,220
Project expenses		5,345,834	1,406,809
Capital expenses		17,159,385	4,710,152
Write off of inventory			-
Loss on disposal of property, plant & equipment		11,799,632	-
Depreciation	2	71,571,000	63,125,000
Total Expenditure for the year		1,131,902,172	966,190,871
(Deficit)/Surplus		(107,294,431)	(36,530,443)

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE

STATEMENT OF CHANGES IN EQUITY

FOR THE YEAR ENDED 31 DECEMBER, 2018

	Grants from Foreign Sources	**Government of Guyana Contribution**	**Revaluation of Stock**	**Accumulated Surplus/ (Deficit)**	**Total**
	$	**$**	**$**	**$**	**$**
Balance as at 01.01.2017	51,897,479	958,594,722	341,781	(279,674,050)	731,159,932
Unrestricted net assets				-	-
Deficit as at 31.12.2017				(50,173,537)	(50,173,537)
Capital Contribution		94,000,000			94,000,000
Capital Contribution adjustment		(9,532,634)			(20,926,671)
Balance as at 31.12.2017					

	51,897,479	1,043,062,088	341,781	(329,847,587)	754,059,724
Balance as at 01.01.2018	51,897,479	1,043,062,088	341,781	(329,847,587)	765,453,761
Unrestricted net assets				-	-
Deficit as at 31.12.2018				(107,294,431)	(107,294,431)
Capital Contribution		42,000,000			42,000,000
Capital Contribution adjustment		(20,926,671)		1,731,029	(19,195,642)
Balance as at 31.12.2018	51,897,479	1,064,135,417	341,781	(435,410,989)	680,963,688

DRAFT ACCOUNTS

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE

STATEMENT OF CASH FLOW

FOR THE YEAR ENDED 31 DECEMBER, 2018

	Note		31.12.2018		31.12.2017
OPERATING ACTIVITIES					
Net Surplus/(Deficit) for the year			(107,294,431)		(50,173,537)
Adjusted for:					
Depreciation		71,571,000		63,125,000	
Loss/(gain) on disposal of property, plant and equipment		11,799,632		(3,722,064)	
Adjustment		77,640		-	
Government of Guyana subvention		-		1,751,584	
			83,448,272		61,154,520
Operating Surplus/(Deficit) before changes in working Capital			**(23,846,159)**		**10,980,983**
(Increase)/Decrease in Inventories					

		22,632,207		1,160,377	
(Increase)/Decrease in Accounts Receivable		1,459,918		(3,466,766)	
Increase/(Decrease) in Accounts Payable		(29,684,214)		44,755,148	
			(5,592,089)		**42,448,759**
Net Cash Inflow/(Outflow) from					
Operating Activities			(29,438,248)		53,429,742
Cash flows from Investing Activities					
Purchase of property, plant and equipment	2	(92,487,000)		(106,283,211)	
Net Cash Inflow/(Outflow) from Investing Activities			**(92,487,000)**		**(106,283,211)**
Financing Activities					
Government of Guyana subvention		42,000,000		73,073,329	
General reserve					
Net Cash Inflow/(Outflow) from					
Financing Activities			42,000,000		73,073,329
Net increase in cash and cash equivalents					

	(79,925,248)	20,219,860
Cash & Cash Equivalent as at 1 January	198,961,903	178,742,043
Cash & Cash Equivalent as at 31 December	119,036,655	198,961,903

DRAFT ACCOUNTS

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE

NOTES ON THE FINANCIAL STATEMENTS

FOR THE YEAR ENDED 31 DECEMBER, 2018

	31.12.2018	**31.12.2017**
	$	**$**

Note 2

Non-Current Assets (See page 15)

Note 3

Inventory

Inventory is valued in accordance with IAS 2 and is issued on a first in first out basis.

Note 4

Receivables

Other Debtors	1,767,000	6,540,000
Prepayments	-	-
Purchase Advance	2,321,845	4,286,436
Salary Advance	437,849	(70,020)
Loan	-	-

Less provision for bad debts	2,280,000	
	6,806,694	10,756,416

Note 5

Cash and Cash Equivalents

Short Term investment	5,511,245	5,511,265
Petty Cash	489,023	604,853
Cash in Hand	304,753	200,162
Bank AC 670-386-2	73,455	75,755
Bank AC 688-602-2	48,463,145	91,172,985
Bank AC 688-610-5	3,773,409	66,061,845
Bank AC 145-712-6	45,634,874	20,518,769
Bank AC 1-975-2	14,786,750	14,816,288
	119,036,654	198,961,922

Note 6

Grant from Foreign Sources

Brought Forward from previous years

Note 7

Government of Guyana Contribution

Balance as at 1.1.2018

	963,957,974	963,957,974
Contribution for period	42,000,000	
IAS 20 Adjustment for Depreciation	-	-
Other Operating Income	-	-
Balance as at 31.12.2017	1,005,957,974	963,957,974

DRAFT ACCOUNTS

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE

NOTES ON THE FINANCIAL STATEMENTS

FOR THE YEAR ENDED 31 DECEMBER, 2018

	31.12.2018	**31.12.2017**
	$	**$**
Note 8		
Non-Current Liabilities - Ministry of Public Works	5,606,815	5,606,815
Note 9		
Current Liabilities - Payables		
Other Creditors	4,468,286	(4,756,229)
Accounts Payable	10,130,634	19,275,723
Accrued Expenses	46,808,388	76,570,206
Statutory deductions 2%	1,791	-
	61,409,099	91,089,700
Note 10		
Subvention	988,447,408	885,928,417

Note 11

Income from Operation

Sale of Plant	21,770,675	23,390,300
Acoushi Ants Bait	127,500	137,400
Other Agri Produce	223,872	143,140
Rental of Houses	2,311,200	4,136,000
Sale of Seeds	128,550	50,500
Technical Services	2,018,218	1,017,438
Tender Documents	106,500	115,700
Sanitation & Maintenance Fee	-	67,500
Total Income from Operation	26,686,515	29,057,978

Note 12

Other Income

Miscellaneous	9,324,360	14,454,230
Write off of Bad debts	-	9,000
Gain on Sale of Fixed Assets	-	-

Note 13

Interest Earned

Interest	149,458	210,803
Fixed Deposit	-	-
	149,458	210,803
TOTAL INCOME	1,024,607,741	929,660,428

Note 14

Disposal/Accumulated Depreciation

Two vehicles were disposed during the year. Total costs and accumulated depreciation were removed from the Fixed Asset Register.

DRAFT ACCOUNTS

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE BOARD

NOTES TO THE FINANCIAL STATEMENTS

DEPRECIATION SCHEDULE

AS AT DECEMBER 2018.

NOTE 2	**Buildings G$'000**	**Machinery, Equipment & Motor Vehicle G$'000**	**Furniture, Fittings & Office Equipment G$'000**	**Laboratory Equipment G$'000**	**Library Books G$'000**	**Total G$'000**
Percentage	5%	20%	20%	20%	15%	
Cost						
At December 31, 2017	592,736	386,376	96,166	82,591	2,262	1,160,131
Additions	24,770	56,883	6,080	4,754	-	92,487
Disposal	(35,345)	(51,474)	(55,570)	(45,512)		(187,901)
At December 31, 2018	582,161	391,785	46,676	41,833	2,262	1,064,717
Accumulated depreciation						
At December 31,						

2017	271,781	278,143	83,391	79,811	2,262	715,388
Charge for the year	27,726	38,388	4,758	699	-	71,571
Written back on disposal	(23,596)	(51,424)	(55,570)	(45,512)		(176,102)
At December 31, 2018	275,911	265,107	32,579	34,998	2,262	610,857
Net Book Values						
At December 31, 2018	306,250	126,678	14,097	6,835	-	453,860
At January 1, 2018	320,955	108,233	12,775	2,780	-	444,743

Appendices

APPENDIX 1

Production (MT) of Non- Traditional Crops by Quarter: 2018															
	Q 1 2018			**Q 2 2018**			**Q3 2018**			**Q4 2018**			**2018 Total Production**	**2017 Production**	**% Change 2018-2017**
Crops	**Total Acreage**	**Yield/ ac**	**Production**	**Total Acreage**	**Yield/ ac**	**Production**	**Total Acreage**	**Yield/ ac**	**Production**	**Total Acreage**	**Yield/ ac**	**Production**			
Banana	1,000.9	10.5	**3,503.1**	1,259.0	10.5	**4,410.7**	1,604.7	10.6	**4,252.6**	1409.74	10.6	**4,635.8**	**16,802.2**	**15,596.5**	8
Beans	120.1	0.8	**100.9**	115.9	0.8	**97.3**	191.1	0.8	**149.1**	191.12	0.8	**186.3**	**533.7**	**472.1**	13
Bitter cassava	1,401.1	12.9	**6,024.5**	1,333.1	12.9	**4,292.4**	1,392.1	12.9	**4,482.4**	1400.05	12.9	**11,016.3**	**25,815.7**	**22,742.1**	14
Bora	878.8	8.5	**7,469.9**	873.8	8.5	**7,427.4**	880.8	7.8	**6,826.3**	880.81	7.8	**8,532.9**	**30,256.5**	**27,943.8**	8
Boulanger	741.7	16.4	**12,134.5**	734.7	16.4	**12,019.9**	731.6	16.4	**11,968.9**	731.60	16.4	**11,868.9**	**47,992.3**	**47,933.5**	0
Bread Fruit	22.0	9.0	**198.3**	22.0	9.0	**198.3**	24.0	9.0	**216.1**	24.98	9.0	**225.1**	**837.8**	**805.6**	4

Breadnut	13.5	5.3	**71.1**	13.5	5.3	**71.1**	13.5	5.3	**71.1**	13.49	5.3	**53.3**	**266.6**	**231.9**	15
Broccoli	2.5	9.9	**24.8**	2.5	9.9	**24.8**	5.9	9.9	**58.5**	4.90	9.9	**48.6**	**156.6**	**72.9**	115
Butternut Squash	2.0	10.0	**20.0**	2.0	10.0	**20.0**	2.0	10.0	**20.0**	0.00	-	**-**	**60.0**	**58.0**	3
Cabbages	323.8	15.2	**4,927.5**	323.8	12.7	**2,927.5**	203.7	13.3	**2,712.7**	203.65	13.3	**2,812.7**	**13,380.4**	**8,414.1**	59
Callaloo	93.0	26.7	**2,486.6**	95.0	26.7	**2,540.1**	97.0	27.3	**2,652.0**	86.00	27.3	**2,351.2**	**10,029.9**	**8,999.0**	11
Carambola	129.2	17.1	**1,438.5**	123.2	17.1	**1,438.5**	126.2	16.4	**2,067.3**	126.21	16.4	**2,067.3**	**7,011.7**	**8,280.3**	-15
Carilla	230.4	8.5	**1,967.4**	246.4	8.5	**2,104.0**	244.3	8.5	**2,086.5**	397.23	8.5	**3,392.4**	**9,550.3**	**9,097.1**	5
Carrot	2.3	3.2	**7.5**	2.3	3.2	**7.5**	4.5	3.2	**14.5**	0.41	3.2	**1.3**	**30.9**	**21.0**	47
Cashew (Malaka)	51.6	15.3	**791.4**	51.6	15.3	**791.4**	51.6	15.3	**791.4**	51.62	15.3	**791.4**	**3,165.5**	**3,157.3**	0
Cassava	1,824.6	12.3	**5,793.1**	1,824.6	12.3	**5,596.9**	1,822.0	12.3	**5,589.0**	2019.69	12.3	**16,390.8**	**33,369.8**	**30,999.9**	8

Cauliflower	2.8	4.8	**13.7**	4.8	4.8	**23.4**	3.0	5.2	**15.6**	3.98	5.2	**20.8**	**73.5**	**30.4**	142
Celery	94.2	26.1	**2,458.6**	112.2	26.1	**2,928.4**	110.2	26.1	**2,876.2**	121.20	27.0	**3,272.4**	**11,535.7**	**11,249.6**	3
Cherry	140.2	4.1	**574.9**	140.2	4.1	**574.9**	142.2	4.1	**583.1**	142.23	4.4	**625.8**	**2,358.8**	**2,700.7**	-13
Cocoa	40.0	1.0	**1,218.2**	40.0	1.0	**40.0**	22.1	8.3	**184.3**	22.10	8.3	**184.3**	**1,626.8**	**1,941.9**	-16
Coconut	28,408.5	440.0	**3,409**	28,408.5	270.0	**4,183.6**	28,408.5	440.0	**2,660.5**	28408.50	440.00	**3624.09**	**13,877.3**	**136,603.0**	-90
Coconut water		715.0	**3,438**			**6,275.4**		715.0	**2,808.9**		715.00	**4607.18**	**17,129.8**	**21,274.4**	-19
Coffee	45.7	4.1	**188.7**	45.7	4.1	**188.7**	9.3	3.8	**35.6**	19.30	3.8	**61.6**	**474.5**	**248.3**	91
Corn	200.2	3.7	**1.0**	211.2	3.7	**781.6**	269.2	3.7	**996.2**	269.24	3.7	**498.1**	**2,276.9**	**3,160.8**	-28
Cucumber	98.3	7.2	**705.9**	94.3	7.2	**677.1**	99.3	7.2	**713.0**	123.31	7.2	**885.4**	**2,981.4**	**2,922.3**	2
Dasheen	80.1	6.2	**496.3**	83.3	6.2	**516.3**	81.4	6.2	**504.4**	75.19	6.2	**466.2**	**1,983.2**	**2,129.1**	-7
Eddoes	341.9	6.2	**2,120.0**	347.0	6.2	**2,151.2**	345.9	6.2	**2,144.8**	379.61	6.2		**8,769.6**	**8,613.1**	2

											2,353.6			
Eshallot	60.7	9.1	**552.6**	69.7	9.1	**634.5**	61.8	9.7	**601.7**	83.64	9.7	**813.8**	**2,602.6**	**2,270.7**	15
Ginger	299.1	29.4	**8,785.9**	248.1	20.6	**7,287.9**	209.1	26.1	**5,456.2**	246.40	26.1	**6,428.7**	**27,958.7**	**26,150.4**	7
Golden Apple	22.8	1.3	**29.7**	22.8	1.3	**29.7**	22.8	1.3	**29.7**	22.83	1.3	**44.7**	**133.7**	**119.6**	12
Goose Berry	5.1	4.1	**20.9**	5.1	4.1	**20.9**	4.4	4.1	**18.0**	4.40	4.1	**18.0**	**77.9**	**35.6**	119
Granadilla	5.6	1.3	**7.3**	5.6	1.3	**7.3**	5.6	1.3	**7.3**	5.58	1.3	**7.3**	**29.0**	**30.3**	-4
Grape Fruit	230.6	0.9	**207.6**	227.6	0.9	**204.9**	227.6	0.9	**204.9**	227.61	0.9	**204.9**	**822.1**	**811.6**	1
Guava	38.8	4.3	**166.8**	38.8	4.3	**166.8**	39.8	4.3	**171.1**	53.80	4.3	**231.3**	**736.2**	**664.2**	11
Lemon	97.0	4.8	**465.8**	98.0	4.8	**470.6**	98.0	4.8	**470.6**	98.04	4.8	**470.6**	**1,877.5**	**1,096.5**	71
Lettuce	88.2	9.7	**855.4**	88.2	9.7	**855.4**	81.7	9.7	**792.8**	64.63	9.7	**626.9**	**3,130.6**	**3,186.8**	-2
Limes	356.1	3.1	**1,103.9**	372.1	3.1	**1,153.5**	372.1	3.1	**1,153.5**	372.10	3.1		**4,564.4**	**3,843.2**	19

											1,153.5			
Mamee Apple	9.9	4.8	**47.8**	10.9	4.8	**52.6**	10.9	4.8	**52.6**	10.91	4.8	**52.6**	**205.6**	**122.4**	68
Mangoes	466.8	4.3	**2,002.7**	484.8	4.3	**2,079.9**	484.8	4.3	**2,079.9**	484.82	4.3	**1,039.9**	**7,202.5**	**8,368.1**	-14
Married man	12.6	11.0	**138.5**	12.6	11.0	**138.5**	12.6	11.0	**138.5**	12.59	11.0	**138.5**	**554.1**	**562.2**	-1
Musk Melon	14.9	7.5	**111.9**	22.5	7.5	**169.2**	4.0	7.6	**30.4**	3.00	7.6	**22.8**	**334.3**	**465.0**	-28
Mustard	0.7	6.6	**4.7**	1.6	6.6	**10.3**	0.9	6.6	**5.9**	0.21	6.6	**1.4**	**22.4**	**18.7**	20
Ochro	498.3	9.6	**4,764.1**	498.3	9.6	**4,764.1**	339.7	9.6	**3,247.9**	307.53	9.6	**2,940.0**	**15,716.0**	**15,963.9**	-2
Onion	5.1	3.4	**17.3**	5.3	1.4	**18.2**	0.9	3.4	**3.2**	2.94	3.4	**10.0**	**48.7**	**67.0**	-27
Oranges	867.4	5.4	**4,620.0**	867.4	5.4	**4,666.5**	868.4	5.4	**4,671.8**	868.37	9.0	**7,815.3**	**21,773.6**	**8,064.3**	170
Pakchoi	120.4	13.2	**1,586.2**	120.4	13.2	**1,586.2**	97.8	13.2	**1,288.6**	67.84	13.2	**893.5**	**5,354.6**	**5,203.4**	3
Papaw	561.7	30.7	**17,232.2**	565.7	30.7	**17,354.9**	558.7	30.7	**17,140.1**	558.67	30.7		**68,867.2**	**69,051.9**	0

											17,140.1			
Parsley	4.6	21.8	**99.8**	4.6	21.8	**99.8**	0.0	22.9	**0.7**	0.03	22.9	**0.7**	**201.0**	**292.6**	-31
Passionfruit	109.5	15.0	**1,642.6**	109.5	15.0	**1,642.6**	111.5	15.0	**1,672.6**	110.51	15.0	**1,657.6**	**6,615.5**	**4,645.2**	42
Peach	1.1	1.6	**1.8**	1.1	1.8	**1.8**	1.1	1.6	**1.8**	1.11	1.6	**1.8**	**7.2**	**7.6**	-5
Peanuts	82.0	1.3	**106.5**	83.0	1.2	**107.8**	29.0	1.0	**29.0**	29.96	1.0	**30.0**	**273.3**	**397.7**	-31
Pears	449.3	6.3	**2,830.7**	449.3	6.3	**4.0**	449.3	6.4	**2,875.6**	449.32	6.4	**2,875.6**	**8,586.0**	**5,873.6**	46
Hot Peppers	513.8	6.4	**3,268.0**	517.8	6.4	**3,293.4**	514.3	6.4	**3,307.1**	531.38	6.5	**6,908.0**	**16,776.5**	**14,853.0**	13
Pigeon Peas	16.2	1.2	**20.1**	16.2	1.2	**20.1**	16.2	1.2	**20.1**	16.21	1.2	**20.1**	**80.4**	**79.1**	2
Pineapples	2,498.4	7.3	**18,138.6**	2,498.4	7.3	**4,535.0**	2,453.4	7.3	**4,453.0**	2133.94	7.3	**7,746.2**	**34,872.8**	**16,930.5**	106
Plantain	8,190.2	15.3	**21,327.6**	8,187.2	15.3	**21,316.8**	7,097.2	15.3	**27,146.8**	7097.21	15.3	**60,293.7**	**130,084.9**	**102,504.0**	27
Pomegranat	4.0	8.0	**32.1**	4.4	8.0	**35.5**	4.0	7.0	**28.1**	4.01	7.0		**123.7**	**112.2**	10

e												**28.1**			
Potato	0.0	9.5	**0.0**	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.00	-	-	**0.0**	**362.2**	-100
Psydium	1.6	7.8	**12.6**	1.6	7.8	**12.6**	1.6	7.8	**12.6**	1.62	7.8	**12.6**	**50.5**	**43.8**	15
Pumpkin	1,352.0	11.2	**15,155.9**	1,352.0	11.2	**15,155.9**	1,151.0	8.5	**9,760.5**	1235.82	8.5	**13,841.2**	**53,913.5**	**41,278.3**	31
Raddish	0.5	5.1	**2.6**	0.5	5.1	**2.6**	0.4	3.8	**1.5**	0.40	3.8	**1.5**	**8.1**	**0.3**	2613
Ramboutan	3.9	6.4	**25.0**	3.9	6.4	**25.0**	3.0	6.4	**19.2**	3.00	6.4	**19.2**	**88.3**	**247.1**	-64
Saeme	91.1	27.9	**2,541.7**	91.1	27.9	**2,541.7**	91.1	27.9	**2,541.7**	117.00	27.9	**3,264.3**	**10,889.4**	**10,263.1**	6
Sapadilla	49.9	3.1	**155.1**	47.9	3.1	**148.9**	49.9	2.1	**104.7**	49.86	2.1	**104.7**	**513.4**	**459.0**	12
Sorrel	79.0	2.8	**221.2**	79.0	2.8	**221.2**	76.0	2.8	**212.8**	84.50	2.8	**236.6**	**891.8**	**933.0**	-4
Sour sop	167.7	4.0	**677.5**	168.7	4.0	**681.5**	168.7	3.1	**522.9**	168.69	3.1	**522.9**	**2,404.9**	**1,694.4**	42
Spinach	4.4	4.6	**20.2**	4.4	4.6	**20.2**	0.9	4.6	**4.1**	1.00	5.6	**5.6**	**50.1**	**144.3**	-65

Squash	237.5	5.8	**1,377.5**	250.5	5.8	**1,452.9**	241.5	5.8	**1,400.7**	211.10	5.8	**1,224.4**	**5,455.5**	**5,814.5**	-6
Star apples	8.3	3.4	**28.1**	8.3	3.4	**28.1**	8.3	3.4	**28.1**	8.25	3.4	**28.1**	**112.3**	**158.4**	-29
Sugar apple	7.4	1.7	**12.6**	7.4	1.7	**12.6**	7.4	1.7	**12.6**	7.39	1.7	**12.6**	**50.2**	**95.6**	-47
Sweet Peppers	346.6	19.4	**6,721.5**	346.6	19.4	**4,585.4**	281.7	19.4	**2,731.5**	523.01	19.4	**7,070.6**	**21,109.0**	**16,965.6**	24
Sweet Potatoes	590.3	9.7	**5,725.6**	590.3	9.7	**5,725.6**	590.0	9.7	**715.4**	346.03	9.7	**2,803.3**	**14,969.9**	**14,681.4**	2
Tangarine	462.0	4.3	**1,986.6**	462.0	4.3	**1,986.6**	380.0	4.3	**1,634.0**	481.00	12.0	**6,018.8**	**11,626.0**	**4,027.0**	189
Tannia	1.9	6.4	**12.1**	1.9	6.4	**12.1**	24.4	6.3	**152.9**	24.40	6.3	**152.9**	**330.0**	**92.4**	257
THYME	91.0	7.4	**673.4**	118.0	7.4	**873.2**	121.4	7.4	**898.4**	101.30	7.4	**749.6**	**3,194.6**	**3,355.0**	-5
Tomatoes	618.0	17.1	**10,555.4**	612.0	17.1	**10,453.0**	398.6	17.1	**6,807.8**	629.22	17.1	**10,747.1**	**38,563.2**	**28,479.5**	35
Turmeric	27.0	17.0	**459.0**	27.0	17.0	**459.0**	31.0	17.0	**527.0**	31.00	17.0	**527.0**	**1,972.1**	**1,652.2**	19

Water Melon	605.0	7.9	**4,755.3**	605.0	7.9	**4,755.3**	807.0	8.2	**6,617.4**	610.75	8.2	**8,611.6**	**24,739.6**	**31,049.8**	-20
Yam	47.8	7.7	368.2	41.6	7.7	**301.0**	75.0	7.7	**577.5**	43.26	7.7	**333.1**	**1,579.8**	**1,979.6**	-20.2
Total	**56,713.4**		**203,259.9**	**56,967.5**		**184,491.6**	**55,573.0**		**169,863.9**			**256,877.2**	**814,492.6**	**831,266.8**	**-2.0**

Note: There is a new methodology of calculating coconut production

Source: NAREI