Preface

With the improvement in the living standards of country, consumers are becoming more anxious about their health, safety and quality of life, and change their eating habits from food sufficiency to eat well and a healthy diet. As such, following the agricultural policies of the Council of Agriculture (COA), Executive Yuan, Taiwan Agricultural Research Institute (TARI) is committed to the agricultural research, in areas of genetics and breeding, cultivation and physiology, environmental ecology, industrial development and marketing, aimed at maintaining natural resources and farming safety so as to take into account food security, economic development, and innovative applications of value-added agricultural products that build Taiwan into a modern agriculture with technological innovation sharing, ecological sustainability and international market orientation. Through our continued efforts and endeavors, there are considerable achievements have been made in 2019, and are summarized as the followings.

Agricultural Crops

Rice crop: Research was conducted to construct chromosome segment substitution lines (CSSLs) ,which were used as the important genetic stocks for identifying favorable alleles from wild rice germplasm. A brown planthopper (BPH) resistant gene *Bph31(t)* was identified from wild rice species *Oryza nivara*. It had stable resistance through a bioassay by different BPH populations. Eleven lines with persistently resistant to sheath blight have been selected using the rice stalk inoculation method in the field. Two japonica lines ('TNG77-GIC' and 'TNG77-GIL') carrying high amylose content and soft gel have been derived through marker-assisted backcross approach to meet the requirement of low GI.

(Chiayi Agricultural Experiment Branch) The objectives of breeding programs were aimed at selecting good eating quality and resistance to pests and diseases of rice, sweet potato and potato. Research activities were also carried out to provide improved cultivation practices for farmers and preserve germplasm of root crops. In cooperation with other district agricultural research and extension stations under COA on rice breeding, Chiayi Branch is continually working on detection of rice resistance/tolerance to blast and BPH and the derived new varieties and practices can be used for improving cultivation management, extension service and applying plant variety right.

Dryland and special crops: Research activities this year were to develop maize marker assisted selection platform, pyramid the Opaque(o2) gene into elite field corn inbred lines, use maize double haploid techniques to develop quality protein maize (QPM) population, and provide 60 QPM inbred lines adapted to dense planting and local climatic conditions to the National Plant Genetic Resources Center (NPGRC) of Taiwan. Based on breeding goals of high oleic acid content, pod yield and 100-pods weight, 9 peanut lines were selected from line trial accordingly.

Crop and stress physiology: A number of integrated crop production modules and their operation technologies have been developed for agrivoltaic farming. For examples, the experimental results showed that yields of Chinese white cabbage, pak-choi and water convolvulus grown under 50% shading rate can reach 70% yield values of control plots with the developed adaptive practices. Based on results of sink and source study of rice in the first cropping season in 2013 and 2014, it suggests that application of the developed sink-source management protocol could improve the balance of sink-source relationship in rice. The regression curve between SPAD value and photosynthesis rate can be an approach to acquire physiological signals that be used to optimize fertilization management for better grain quality and yield production in rice.

Biostatistics and bioinformatics: The Common Information Platform (CIP) that incorporate the Open Application Programming Interface (Open API) to connect with a range of existing application databases has been developed. Within it, the common agricultural consumption/service platform is an excellent application tool connecting the supply chain of agricultural produce (food) between farmers and consumers. It also can be used to establish a traceability food chain management between the sources of produce and schools. The risks and reaction time of food safety incident can also be reduced to improve the trust of all stakeholders on food safety. The "Plant Protection Network Platform" intended for plant protection experts in Taiwan to jointly conduct pest diagnostic appraisal research has been built for facilitating information integration (including weather information and crop distribution), and sharing and working on value-added applications among the research units through platform usages. The platform will be used to provide more multi-faceted services and reduce problems of information exchange and integration in the future.

Horticultural Crops

In fruit research, SSR markers were used to screen grape hybrids for downy mildew resistance. About half of the leaves from selected populations had less than 25% infected area. The breeding program and traits evaluation of pear, loquat and grapes to break dormancy in different ways were investigated. Improvement of varieties and cultivation techniques in litchi, pineapple, citrus and avocado were also continued, including organic farming, disaster prevention and reduction, post-harvest handling on pineapple, preservation and utilization of fruit tree species, and production under agrophotovoltaic facility/system. The results found that the LcFT1 gene could be used as a molecular marker for screening litchi varieties during the flowering period. The pineapple strain C93-312 is rich in flavor, sour and sweet, and is suitable for consumers who like sour fruit.

Varietie improvement of tropical fruit trees: In order to improve existing varieties of dragon fruit, 205 seedling lines out of 1,000 cultivated lines by budding were investigated and 19 lines were selected with good character traits initially. For newly-introduced 'golden fruit' lines of durian, A2 line was selected due to its big fruit size, high total soluble solids (TSS), excellent flavor and white flesh (not easy to browning). All lines had good performance in flowering and fruiting this year, especially lines 2-3 and 3-6 which had more than 50 fruits per plant and characterized by inconsistency in flowering period. Local jackfruit variety 'Excellent' was collected along with several introduced trial varieties such as "Malaysia Red", "Kind of Thailand", "Jiao-he" and "Hong-niang". The common characters of these varieties are less latex, easy-to-peel flesh, golden or red flesh color and high TSS. For wax apple 'Tainung No. 3 (Sugar Barbie)', one specialized farming group with a planting area of 1.8 ha has been granted plant variety rights in 2019, making the total non-exclusive authorized production area of 51 ha. In litchi, one case of plant variety right of litchi 'Tainung No. 6' has been renewed with 300 seedlings, and strains E17 and E09 with superior characters, such as high edible rate and low acidity, were selected for further trial. The fruit weight was in the range of 22-35 g and the coke nucleation rate was about 60%. In jujube research, 3 non-exclusive cases of plant variety rights for 'Tainung No. 13 (Shirley)' and 2 cases for 'Tainung No. 12 (Water Honey) have been granted. The Jujube 'Tainung No. 13' is characterized by fine flesh, juicy, sweet and sour, low astringency, good flavor, stable quality, waxy and bright skin, with no brown spots and average fruit weight of 135-145 g. As to mango breeding, an orchard has been built for comparing seven promising lines in their early generations. Among them, line W-2-23 was found to have the potential to apply for plant variety rights.

Improvement of tropical fruit tree cultivation technology: In Yuhebao litchi, spraying fertilizer containing magnesium compound to trees of low vigor in flowering stage and young fruit stage would significantly increase

the amount of fruit and the content of soluble solids. In pearl guava, the symptom of non-pathogen red spot surface would become more serious in the face of low temperatures and poor field management. Poorly managed orchards with low tree vigor have the highest incidence of erythema. If the soil is acidic and insufficient in calcium content, increase of calcium fertilizer application could improve the occurrence of red spot on the guava fruit surface. Planting of passion fruit 'Taiung No. 1' was carried out in countries in Southeast Asia to evaluate the most suitable cultivation mode for the local climate. For instance, in Chiang Mai of Thailand, wall-hedge cultivation is the traditional practice for growing passion fruit. In considering environment and climate in the cultivation areas of Chiang Mai, the horizontal scaffolding cultivation practice has been suggested to Thai farmers to replace the traditional practice because of the conditions of high solar radiation, large farm size and long growing period. With such change, it greatly increased the amount of yield and achieved the goal of annual production. The average weight of 'Tainung No. 1' fruit reached 60-70 g with TSS went up to 16-18 °Brix.

Vegetables: For vegetable research this year, the tomato fruit characteristics of 290 core selection lines and 17 new hybrid combinations were evaluated, respectively, which can be used as the basis for subsequent breeding program. And SNP molecular markers were used to assist transferring male infertility trait into cauliflower doubled haploid (DH) lines. A single plant with 92% genomic recovery rate was selected from the BC_1 population.

Edible and medicinal mushrooms: The labor-saving and high-efficiency manufacturing and application of high-quality compost were studied for the button mushroom cultivation. The technologies of napier grass bag production of mushroom, mushroom by-products as animal feed additives, three-dimensional mushroom cultivation, recycling mushroom remaining materials for mushroom production, mushroom production in facilities, key pest identification and control for flagship crop mushrooms were developed.

Floriculture: Energy-saving cultivation practice of *Oncidium* cut flowers in the facility was improved. A method of using coconut fiber, sphagnum moss and rock wool to replace the traditional three-point crushed stone in the facility for cut flower production was derived. These materials are superior to gravel in water retention and porosity that can effectively maintain the supply of water and fertilizer and save the labor cost. Moreover, the formation rate of the pseudo-bulb is accelerated and its diameter can be increased by 11% relative to that of three-point crushed stone cultivation.

Postharvest handling: In the post-harvest handling research, storage experiments were conducted on different varieties of Indian jujube, Abiu, Chinese jujube, dragon fruit and pineapple with various pre-cooling conditions, storage temperatures, package materials and 1-MCP treatment. In addition, the management and storage conditions for export of dragon fruit has been established. Experimental results showed that Indian jujube variety 'golden peach' had better storage ability, Abiu was more sensitive to ethylene, the chilling injury threshold for Chinese jujube was around -0.2 to 0.8℃. Pineapple performed better with precooling at 10℃ or 15℃followed by low temperature storage for 2 days before export.

Biotechnology

Tissue Culture: Doubled haploid (DH) rates of microspore culture using various cabbages were around 67-78% with 94% acclimation rate, and a total of 31 DH lines were produced for breeding selection. The best result for in vitro ginger proliferation was found by culturing *in vitro* rhizomes in a liquid medium for 6 wks before 8 wks on a solid medium by using the uncut shoot-buds directly from the liquid culture. It was found that blue-purple *Phalaenopsis* tetraploid had better flower traits than that of diploid, and single plant selection was made afterwards. Protocorm growth of miniature Phalaenopsis was found different in the medium containing active charcoal. A

28% stalk induction rate was obtained using age of 6-month-old flask plants of miniature Phalaenopsis at 26℃for duration of 22-24 days.

Molecular Genetics: The resistance genes of rice bacterial blight and melon powdery mildew were mapped and introduced to cultivar 'TSC10' and melon lines by marker-assisted backcrossing (MABC), respectively. The transgenic lines with high resistant starch content were obtained by editing the *sbe3* gene through the *CRISPR/Cas9* technique. Besides, the transformation of *Capsicum* was also developed by pollen electroporation in cooperation with National Chiao Tung University. Additionally, we have finished the genetic diversity analysis of 49 accessions of pepper germplasm (*Capsicum* spp.). These results can be used as the basis for the developments of fast-forwarding genetic gain platforms for rice, melon and peppers.

Biosafety: Field assessment of nitrogen use efficiency was studied by regulating nitrogen-related genes in rice. The result showed that the yield of Q-5 transgenic line was significantly higher than that of the control group. The presence of transgenic phytase gene in rice did not cause changes in microbial populations, soil enzyme activities or functional diversity of soil microbial communities in the rhizosphere. The present results indicated the classification between GM and non-GM soybean events reach a satisfactory accuracy. The linear classification model is able to distinguish GM and non-GM soybean events with nearly 100% accuracy.

Bioproduct Development: Results showed that seeds of *Sacha inchi* were not easy to germinate because of its thick and tough seed coat. The hot-water treatment combined with scarification effectively increased the germination rate to 60% on the 20th day of treatment. To develop a processing technology of whole-soybean tempeh products, the degree of fermentation was determined by a color spectrophotometer, showing the fermentation level 1.18 times better than that of the control. A functional component of longan was revealed by a computer simulation algorithm, and its flower extracts exhibited the efficacies of relaxation and bioactivities confirmed by animal tests.

Plant Germplasm

Three research projects were executed in Plant Germplasm Division in this year, namely, 'Crop Genetic Resources Conservation', 'Management of National Plant Genetic Resource Center (NPGRC)', and 'The Application of Core Collection in Tomato'. These projects were to continue maintaining the seed storage facilities and conserving plant germplasms in NPGRC. The mission of NPGRC includes collection, introduction, distribution and exchange of germplasm, as well as the development of conservation and identification technologies. Furthermore, 292 accessions of tomato germplasm that conserved in NPGRC are also selected as a core collection by the analysis of Single Nucleotide Polymorphism (SNP) genotype from next generation sequencing (NGS).

Agricultural Chemistry

Soil resources investigation and environmental monitoring: The multi-source telemetry image analysis technology was applied to estimate harvested area and provide early warning information. The use of agricultural spatial information analysis and the drawing of agricultural land cover and soil themes maps were exploited to agricultural land production, land use planning and environmental monitoring management. A standard operating procedure for natural disaster investigation of large-scale farmland was established by drone survey for local governments.

Soil and crop fertilization management: Research on the design of a new three crops-harvested farming system was carried out in the southwest coastal area and the environmental restoration technology was derived to study the impact of non-agricultural photovoltaic facility. Large area labor-saving management, organic vegetable cultivation techniques, coated fertilizers and microbial fertilizers were developed to sustain environmental integrity.

The efficiency of crop, soil and plant nutrition diagnosis services was improved for farm management. The annual production model of asparagus was set up in protected cultivation. Disaster indicators and mitigation adjustment technologies were identified for passion fruit production.

Environmental protection for agriculture: The methane emission coefficient was revised in paddy rice field for the national GHG emission inventory of the agricultural sector. The environmental impact/benefits of applying bio-char and the reuse of livestock wastewater were evaluated in the arable land. The cost of data collection has been reduced and the expenses of analysis of the ecosystem services were reduced by installing the wireless sensor network. Technique of unmanned aerial vehicles (UAV) image discriminations was deployed in the natural disaster damage investigation for the use in banana plantation insurance.

Soil analysis service laboratory: The second analysis performance test for the Soil and Plant Analysis Laboratory among the Asia-Pacific region has been executed to promote the technologies exchange of soil and plant tissue analysis. The quality of commercially available fertilizers has been inspected to revise inspection regulations. The guidelines for improving the safety management of farmland crops by the potential risks of cadmium and lead pollution were developed to supplement the missing samples of grid survey data. The farming field management system has been modified and transferred to the control management of *Spodoptera frugiperda* (JE Smith). A crop growth model has been applied to the traceability information system.

Processing and chemistry of agricultural products: The production process to optimize banana starch was developed, the purity and heat resistance to increase the applicability were improved and the function of banana starch was confirmed in this year. New processes for peel de-bittering, formulating seasonings, and drying fruit of pomelo have also been developed.

Applied microbiology: The co-digestion technology of agricultural production by-products, pig manure and urine was developed to improve the biogas output. The straw-paste was used to develop a decomposable pineapple packing material for replacing plastic material to pack vegetable and fruit sets. Technologies for producing single-cell protein and fermentation of bio-polymer and transformation of poor-quality sweet potato were developed.

Aboriginal agriculture: Mission-oriented activities have been carried out to provide the application counseling of chicken-manure-grained fertilizer in growing red quinoa and cabbage in the aboriginal regions for improving environmental hygiene and rational fertilization locally. The needs of agricultural management training were assessed in the aboriginal tribes in Central Taiwan as the basis for preparing subsequent education and training plans in the near future.

Plant Pathology

In viral disease, *Chinese yam necrotic mosaic virus* on *Dioscorea japonica* var. *pseudojaponica* was identified, *Plumeria mosaic virus* on desert rose were identified, and the viroid infection in solanaceous crops were investigated. Phylogenetic analysis and the molecular detection technology of *Telosma* mosaic virus isolates of passion fruit were studied. In fungal diseases, pesticide reduction in integrated management of papaya diseases and insect pests was demonstrated. A passion fruit safety production system and integrated guava pest management technology in facilities were developed. *Phytophthora* blight of green onion and fig in Taiwan were studied. The relationship between the resistance of *Oryza sativa* and the pathotype of *Pyricularia oryzae* was tested. The susceptibility of bud age to leaf fleck spot disease of *Cymbidium* was assessed. In bacterial diseases, phylogenetic of different Pseudomonas viridiflava isolates was analyzed. The relationship between *Xanthomonas campestris* pv. *oryzae* pathotype and rice resistance in Taiwan was evaluated. In nematode diseases, the distribution of *Aphelenchus*

avenae in mushroom farms was surveyed and the microorganisms were screened for control. In biological control, the materials for enhancing induced resistance to vegetable diseases were developed.

Applied Zoology

Insect taxonomic identification and monitoring: Taxonomic revisions of five species in the genus *Pyrrhalta* from Taiwan were completed. Biological information of these species were also provided. To enhance the ability of Taiwanese entomologists in *Cicadomorpha* and *Fulgoromorpha* identification, Dr. Chris. H. Dietrich from the Biodiversity Research Center of University of Illinois, USA was invited to co-organize a training course on identification of *Cicadomorpha* and *Fulgoromorpha* at Taiwan Agricultural Research Institute, using the limited resources provided by the government to achieve a sustainable international cooperation in agricultural science and technology. These cooperation opportunities are expected to enhance the overall research in the economically important pest leafhoppers in Taiwan, including identification, classification, disease transmission tests, control technology R&D, etc.

Biological control: *Mallada basalis* is an important natural enemy used to control agricultural pests in Taiwan. In order to solve the problems in transporting, packaging, time-consuming and manpower for releasing lacewing eggs, different protective materials for the egg transportation were compared, in addition to development of an egg retrieval equipment that has been completed earlier. Results showed that wet sawdust treatment has the highest egg hatching rate and can be used as a lacewing eggs transportation medium in the future.

Development of insect pest control materials: A new type of emulsified soybean oil was developed as plant protection material. Tests on aphid control efficacy on melon in the facility showed that 1% soybean oil emulsion spraying 2 to 3 times at intervals of 3 days had a similar effect as that with 10% fluniamine water dispersible granule at the concentration of 4,000 x. However, more studies are needed to confirm its control efficacy stability. In regard to the important pests and diseases of chili, 12 kinds of non-chemical materials, such as herb extract, lime sulphur solution, Bordeaux mixture etc., were tested for their inhibition effect on the spore germination of anthracnose. Results showed that the herb extract worked the best among all tested materials. Soaking of the seedlings was a very important step. By monitoring the occurrence of pests from the early detection and adjust the control measures in a timely manner, the above-mentioned non-chemical plant protection materials could display their control efficacy more effectively, and might have the opportunity to achieve the complete elimination as that of chemical pesticides.

Insect ecology and control: The ingestion probing behavior of *Kolla paulula* on healthy grapes was recorded by using the third-generation AC-DC EPG monitor. The main purpose was to establish an EPG waveform database for quick identification of this specie. Based on the established basic information of pests in response to the impact of climate change, the fitness of the melon fly population distribution analyzed by CLIMEX expressed great reference value. On the basis of the degree days of western flower thrips and applying the CLIMEX model to analyze its eco-climatic index, the suitable areas for western flower thrips survival and occurrence in Taiwan were also evaluated to establish the necessary early warning information that would improve the effectiveness of the detection system. A specified work plan to verify the greenhouse works for the export of *Phalaenopsis* media to the United States has been passed. The major pests of *Phalaenopsis* and their annual population dynamics were investigated. A pest image identification system for the surveillance of greenhouse pests was also developed. Using the image of watershed model can automatically identify more than 88% of the insect species. It will take only 40 seconds to finish the identification for one sticky trap, 20 times more efficient than with manual microscopy. Automated pests monitoring

technology, visualizing lettuce pests for identification, and a management service system were under development. Constructing an automated cloud to drive the pest warning function and establishing an intelligent pest management model were also conducted. An intelligent pest management decision-making system for agriculture can have two functions: one is to help the farmers in identification and control of the pests during their cultivation process; another one is to help researchers in the information management and extension. Besides, all latest information can be posted on the platform in a timely manner.

Pesticide research: Based on mite specimens collected from the wood ear, the identification and classification technology of the wood ear mites has been initially established. In addition, selected pesticides and materials for the *Luciaphorus* mites have been tested. Among these reagents, 7 insecticides/acaricides and one material elicited the mortality rates of 85.0-100.0% in the female adult *Luciaphorus* mites within 48 hours. Their application in the mushroom cultivation can be evaluated in the future. For the major pest fungus gnats, a total of 19 chemical pesticides, 3 types of *Bacillus thuringiensis* microbial pesticides, and the hypochlorous acid water were tested for their effects in controlling the fungus gnat larvae. Among them, chlorpyrifos had the highest control efficacy, followed by clonidine. In the future, the maximum residue level will be established to provide a necessary reference for the pesticide registration and application. Results of studies using unmanned aerial vehicles spraying on demonstrated pests and diseases controls, including the target pests and diseases - planthoppers, rice leaffolder, rice blast, and sheath blight approved the expected control effectiveness. Furthermore, using the unmanned aerial vehicles with a hyperspectral module for large-area rice disease monitoring and early warning, the goals of saving manpower, time spending, amount of water use and pesticides have been achieved. It also improved the efficiency in precise agricultural management.

Agricultural Engineering

In 2019, the execution of 46 cases of machinery performance test was completed, and 6 test methods and regulations were revised. In the studies on smart agriculture, the R&D and applications of technologies developed in agricultural facilities on pilot industrial programs have been completed, and a number of smart detection and environmental control technology developments have been done. In addition, in terms of industrial utilization and promotion, the smart agriculture industry analysis, smart financial layout and operation model planning and establishment have also been accomplished. The assistance to smart agriculture alliance for promoting and deploying the developed smart agriculture technologies has successfully fulfilled the expectations. Field machinery R&D on engine-powered self-propelled electric leaf cutting machine has carried through in good shape. The agricultural meteorological observation and disaster risk assessment plan provided important meteorological data and disaster prevention information, which are of great help in reducing damages from natural disasters and improving crop cultivation.

Agricultural Economics

In addition to the advancement of agricultural production technologies, smart cultivation and market research are also essential in the development of agriculture. In the training of advanced farmers and agricultural talents, as well as to develop the industries in rural communities and support the rural talents for diversified techniques learning, we reviewed the standardized curriculums and established the training materials of common curriculums in this year. There were 26 materials and curriculums completed, such as the curriculums of healthcare plants, seedling production…etc. In addition, in response to the needs of training course from different ethnic groups raised by the National Agricultural Conference, a grouping and hierarchical system of agricultural counselling and

training should be planned to attract diverse new farmers into agricultural work. The differences of the effectiveness between grouped and non-grouped special training courses were assessed. Activities to assist farmers' association to incorporate business thinking into farming were held, and the guidebook and course of agricultural business model were continued to be improved. There were 3 workshops held for product promotion.

In the agricultural market research part, it can be roughly divided into domestic and international markets. The domestic market research on dragon fruit was conducted this year to solve the imbalance of production and sales in 2018, with the focal points on wholesale market, agricultural associations and it's downstream to make relevant recommendations. For international markets, extensive data collection is required in the early stages of expanding the international market for increasing the sensitivity of the international market. To make up the lack of long-term data accumulation and reduce the obstacles of sharing information of industry and market research, an analysis platform was established. It is expected to provide market potential analysis modules and aggregate and accommodate various types of market information, which can be used as the basis for decision-making of export issues for government, industries and research study.

Agricultural Technical Service

Agriculture extension and public relationship: There were 72 visits paid by foreign guests, 142 academic speeches given by TARI researchers, and 5 international academic symposiums held in 2019. Additionally there were 6 events of technical training, personnel exchange and expert visit with collaborated international organizations. For improving farmers' skill, 19 training courses in areas of agronomy, horticulture and mushroom cultivation were provided, with farming levels from new comers, experienced farmers to management and a total of 489 attendees. The library has collected 37,336 books, 857 journals, and 8 electronic databases (i.e., BioOne Complete, CAB Abstracts, ProQuest Biological Science Database, ProQuest Earth, Atmospheric & Aquatic Science Database, ProQuest Biological Review, CEPS, Wanfang-Chinese Journal Full-text Database, and Crop Protection Compendium to enhance researchers' proficiency). As to interlibrary cooperation, TARI sent 21 applications to other libraries, and received 12 applicants vice versa. The publications in TARI in 2019, including Journal of Taiwan Agricultural Research (Volume 68), Technical Services Quarterly (No.117-120, Volume 30), and 10 special issues. Crop cultivation and management, pest diagnosis and control advice service were provided for free. TARI received samples of soil (2,794), plant (2), irrigation water (499), solid fertilizer (18), liquefied organic fertilizer (62) and growth media (25) from farmers for examination tests and yielded 2,385 diagnosis reports in this year. There were also 528 plant disease samples and 2,751 pest samples analyzed by TARI researchers.

Technology management and information service: In 2019, there were 3 enterprises applying for enrollment to the Innovation and Incubation Center at TARI, while 1 for extended residency and 5 dismissed. The center also held one technology achievement presentation and business matchmaking, one joint graduation presentation, and 2 joint industry-academia exhibitions. There were 226 agricultural technology projects in 2019, including 2 industry-academia collaboration projects, 14 academia collaboration projects cooperated with National Chung Hsing University or National Taiwan University, and 5 projects received subsidy by the Ministry of Science and Technology. The plant variety rights of cherry blossom 'Tainung No. 2' and jujube 'Tainung No. 13' were successfully granted in the year. As to agricultural information service, there were 2,786,299 visits to the official website of TARI. TARI also obtained one patent, transferred 39 agricultural technologies, and registered 6 NCBI gene cases.

As a leading official institution in crop science under COA, TARI is always clinging to the problem-solving innovation, tracking the demand of consumers and markets, and following up the principles of research ethics. After a century of research and development and accumulation of experience, it has not only gradually developed into an influential and renowned institute in the agricultural community but also greatly improved the utilization of agricultural technologies by farmers. It is hoped that under the supervision of COA and the guidance of the agricultural policies, researchers in TARI will bear in mind their original intention of the research, strive to face challenges and look to the future. Efforts should also be placed on strengthening cooperation and collaboration with domestic and international research institutions to pursue continued success and prosperity.

The above-mentioned important research results, findings and achievements are attributed to the expertise and efforts of my colleagues and their fully support to the administration. I would like to take this opportunity to express my deep gratitude for their hard work throughout the year and look forward to continue working together and moving forward.



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August 30, 2020