

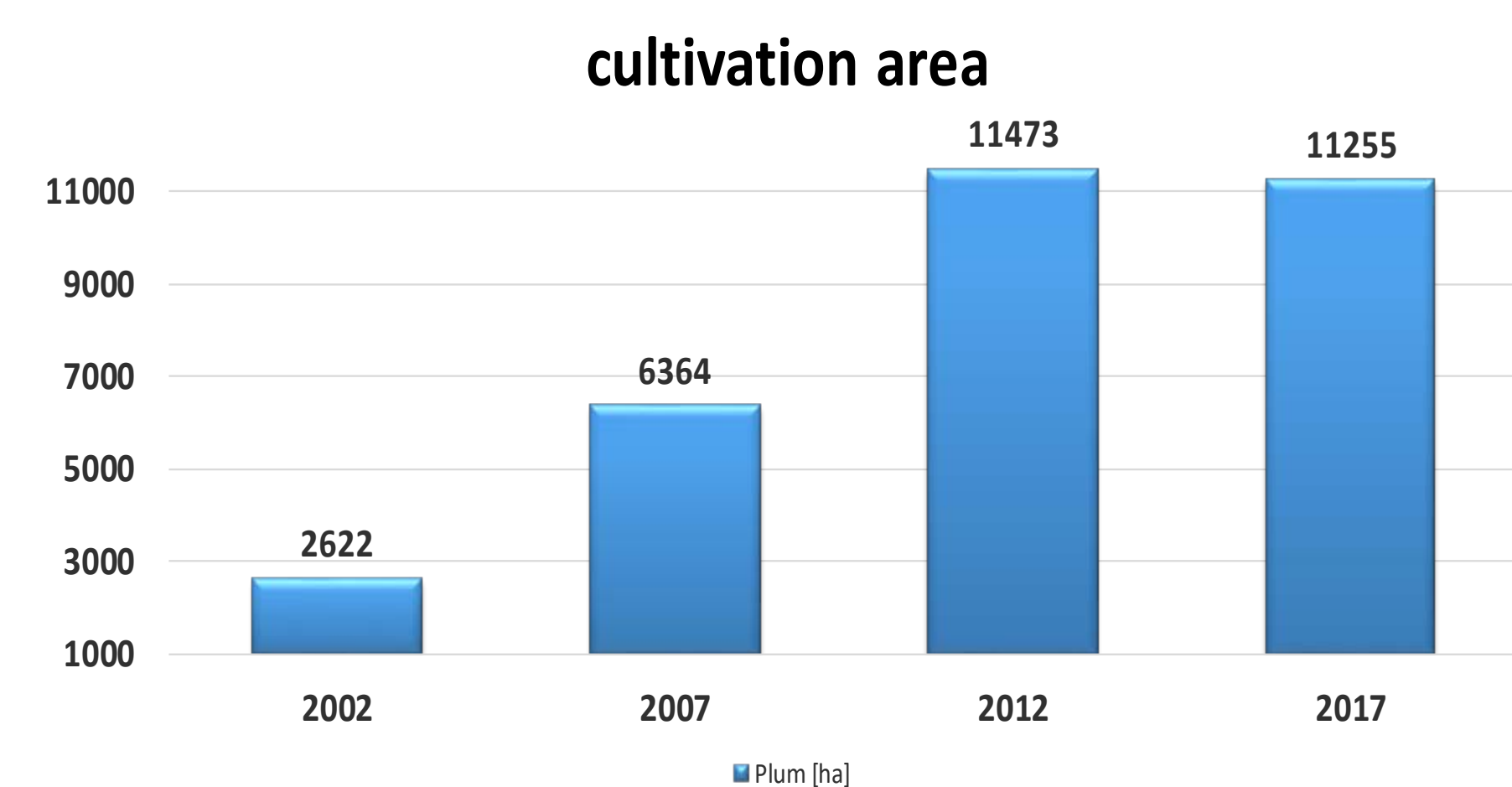
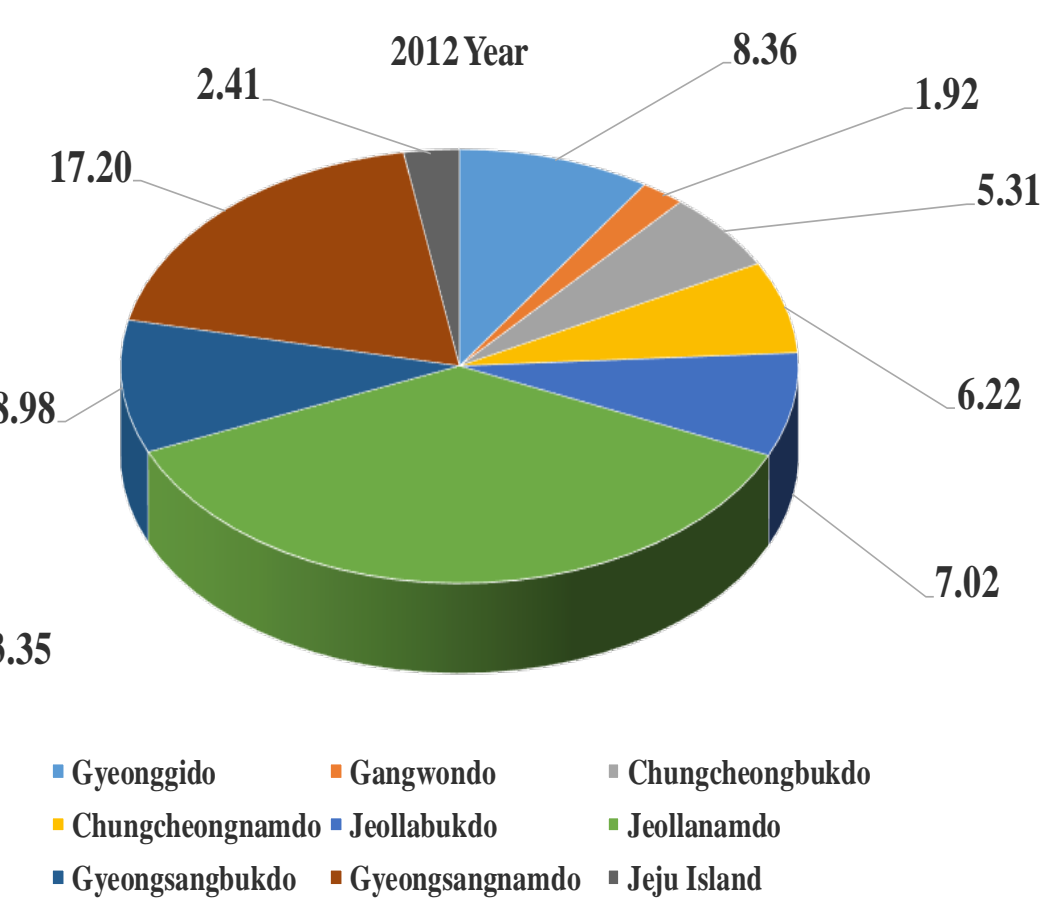


Development of Data Acquisition System for Plum (*Prunus mume*) Growth Monitoring

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Research Background

- Plum plantation expanded nationwide
- In 2002, the total area of cultivated plums nationwide is 2,622 ha but In 2012, 11,473ha. (KOSIS: National Statistics Portal)
- The plum price is continuously decreasing, which resulting in lower farm income
- Therefore, smart technology to increase the productivity and quality of plum is needed



Materials and Methods (Cont.)

Fruit quality measurement

- The sugar content of fruit flesh was measured by using Reflex Sugar Meter.
- Ascorbic acid and citric acid was analyzed by Centrifugation (30 min, 15,000 rpm).
- pH was measured by using pH meter.
- Acidity was measured by the following Equation:

$$\text{Acidity} = \frac{0.1\text{N-NaOH Consumption} \times \text{g} \times \text{F} \times \text{DF}}{\text{Sample Volume (mL)}} \times 100$$

- Data of 2 kinds of plums are gathered from 2 places of farm in Suncheon city in Korea.
 - Name of places : Gyewol, Haeryong
 - Plum variety : Nam-go, Chun-go, Aeng-suk

Results and Discussion

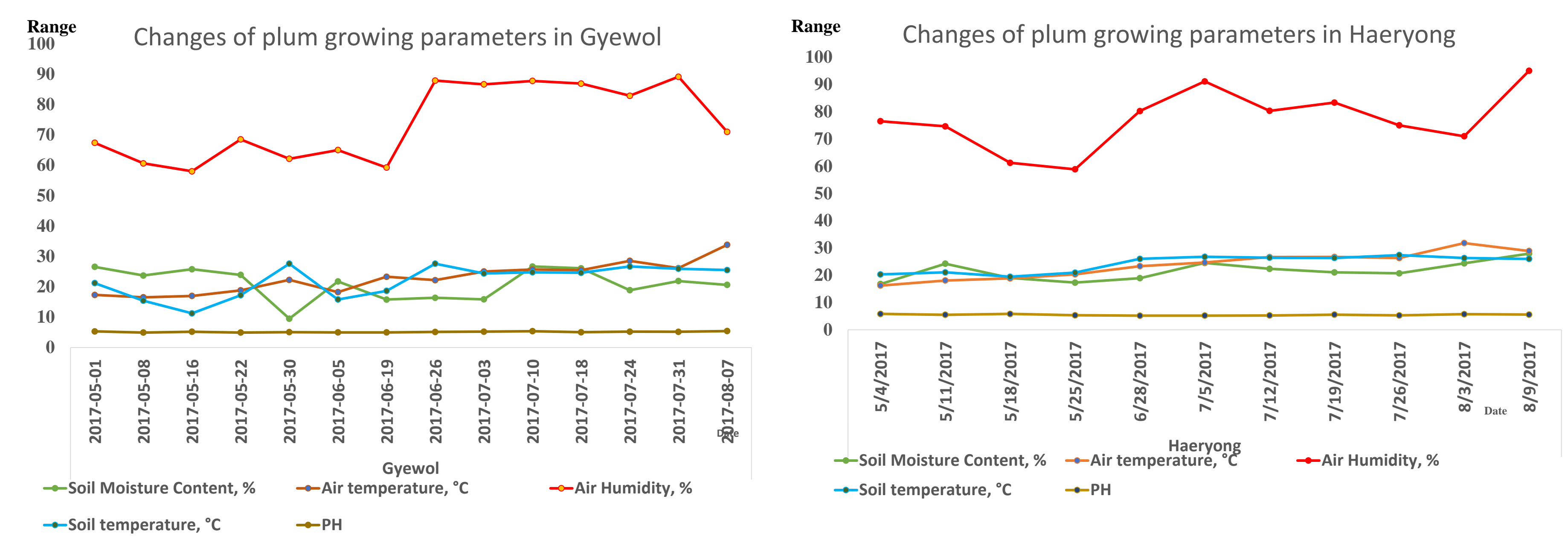
Data acquisition results

Cultivation condition	Start to grow	Middle April	Cultivation condition	Start to grow	Middle April
	Growth period	65 Days		Growth period	70 Days
Gyewol Area	Atmospheric temperature	25 ~ 32 °C	Haeryong Area	Atmospheric temperature	25 ~ 39 °C
	Relative Humidity	55 ~ 86 % (Rh)		Relative Humidity	47 ~ 95 % (Rh)
	Soil pH	4.97 ~ 5.13		Soil pH	5.16 ~ 5.24
	Soil water content	15 ~ 21% (w.b.)		Soil water content	19 ~ 22% (w.b.)
	Soil density	0.79 ~ 0.83 g/cm ³		Soil density	0.77 ~ 0.81 g/cm ³
	Soil Electrical Conductivity	0.29-0.44 ds/m		Average weight of plums	16.8 g
	Average weight of plums	13.9 g		Soil Electrical Conductivity	0.12-0.36 ds/m

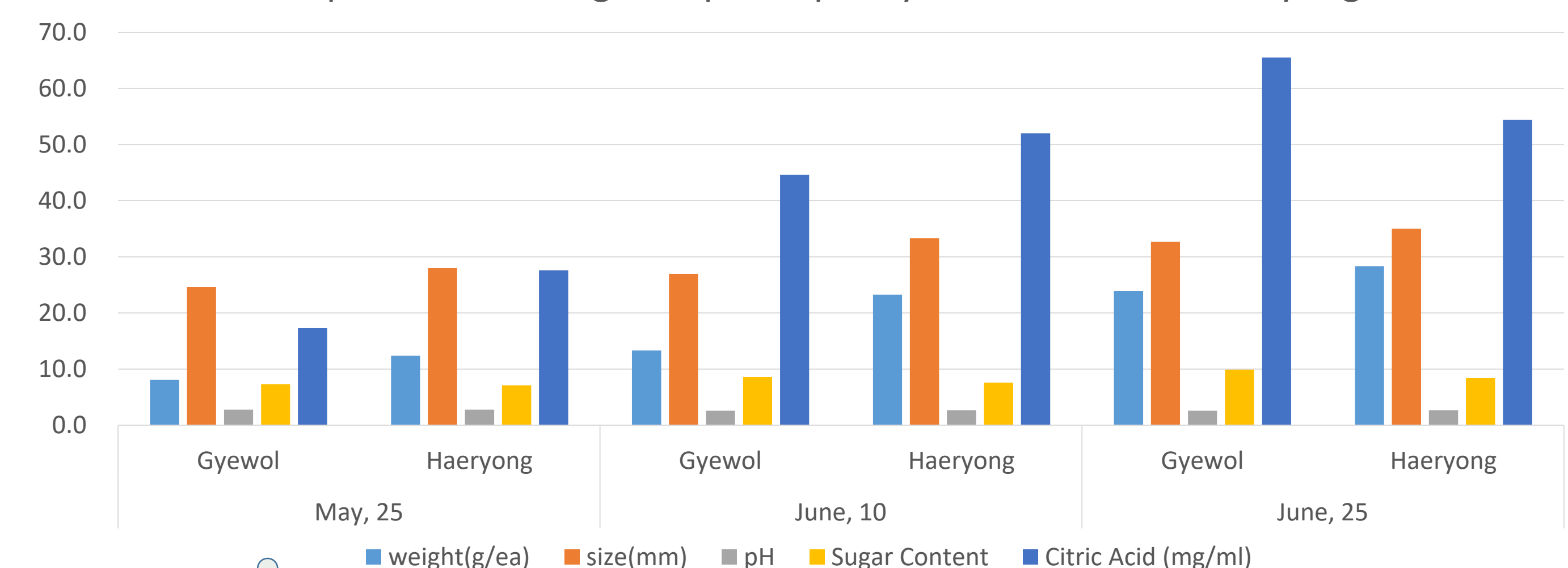
Plum quality test results

	Gyewol			Haeryong		
	May, 25	June, 10	June, 25	May, 25	June, 10	June, 25
weight(g/ea)	8.1	13.3	24.0	12.4	23.3	28.3
size(mm)	24.7	27.0	32.7	28.0	33.3	35.0
pH	2.8	2.6	2.6	2.8	2.7	2.7
Sugar Content	7.3	8.6	9.9	7.1	7.6	8.4
Citric Acid (mg/ml)	17.3	44.6	65.5	27.6	52.0	54.4

Changes of all parameters during May ~ July, 2017



Comparison of changes of plum quality of Gyewol and Haeryong

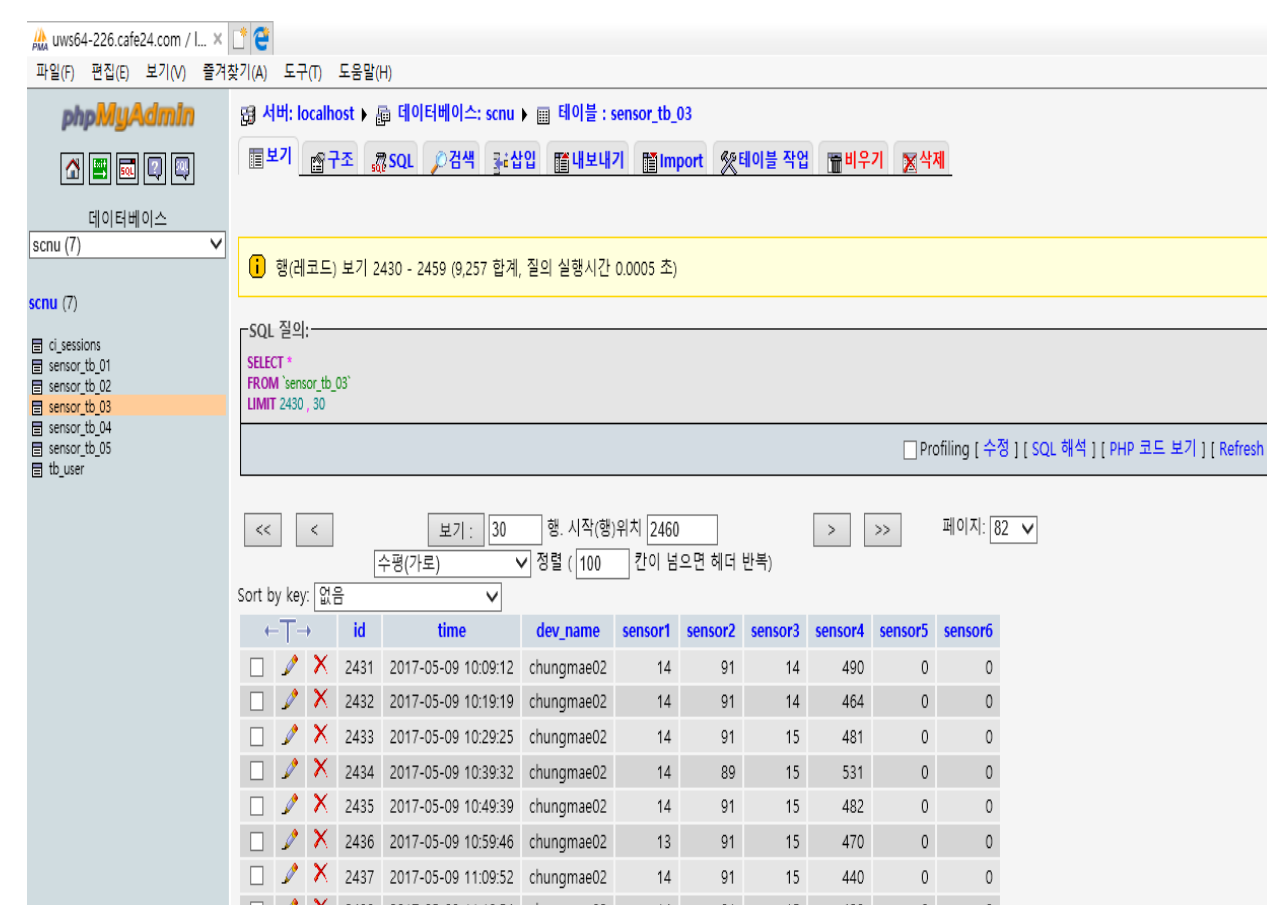
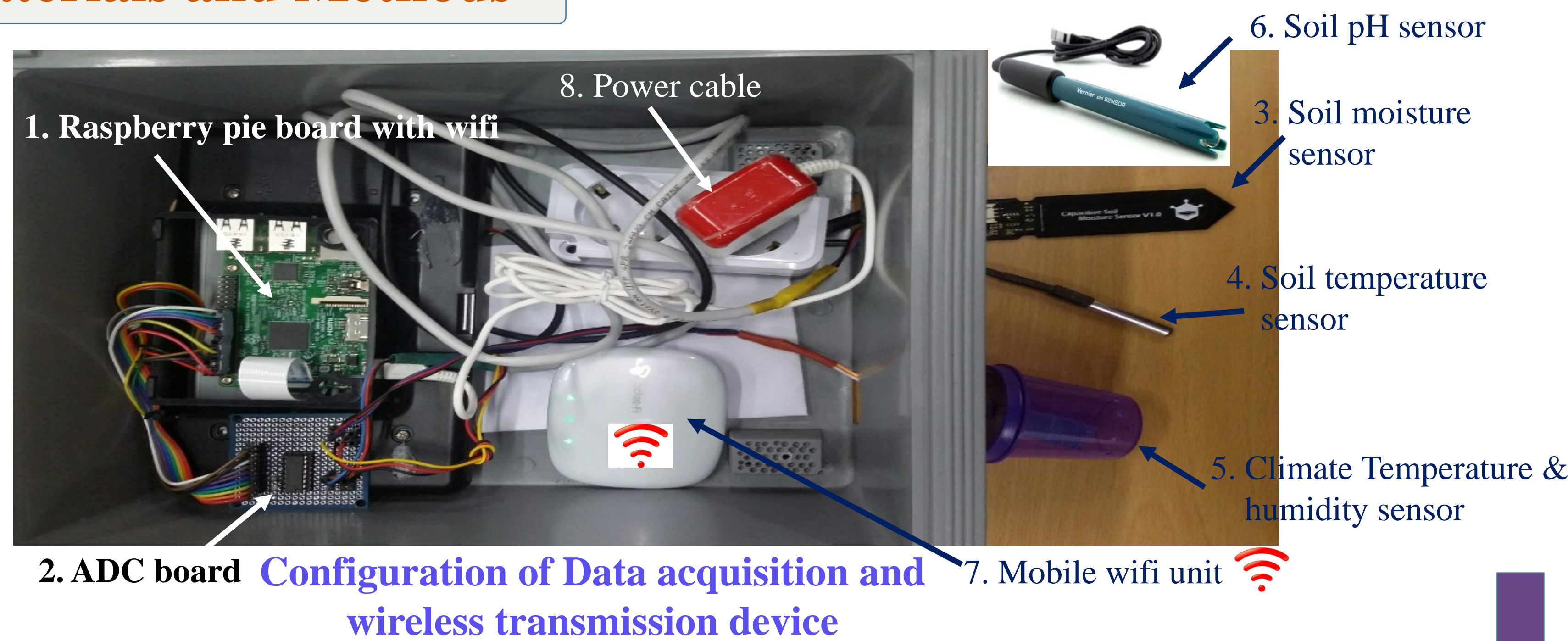


Research Objectives

- To improve the productivity and quality of plums for increasing the farm income
- A monitoring system for gathering and analyzing the big data related plum growing was developed. Also, a low cost Data Acquisition system using Raspberry pi board with wireless network.
- With developed system, some parameters including climate temperature and humidity, soil moisture and temperature, pH information are collected and transmitted to web server.

Materials and Methods

Installation of DAQ system



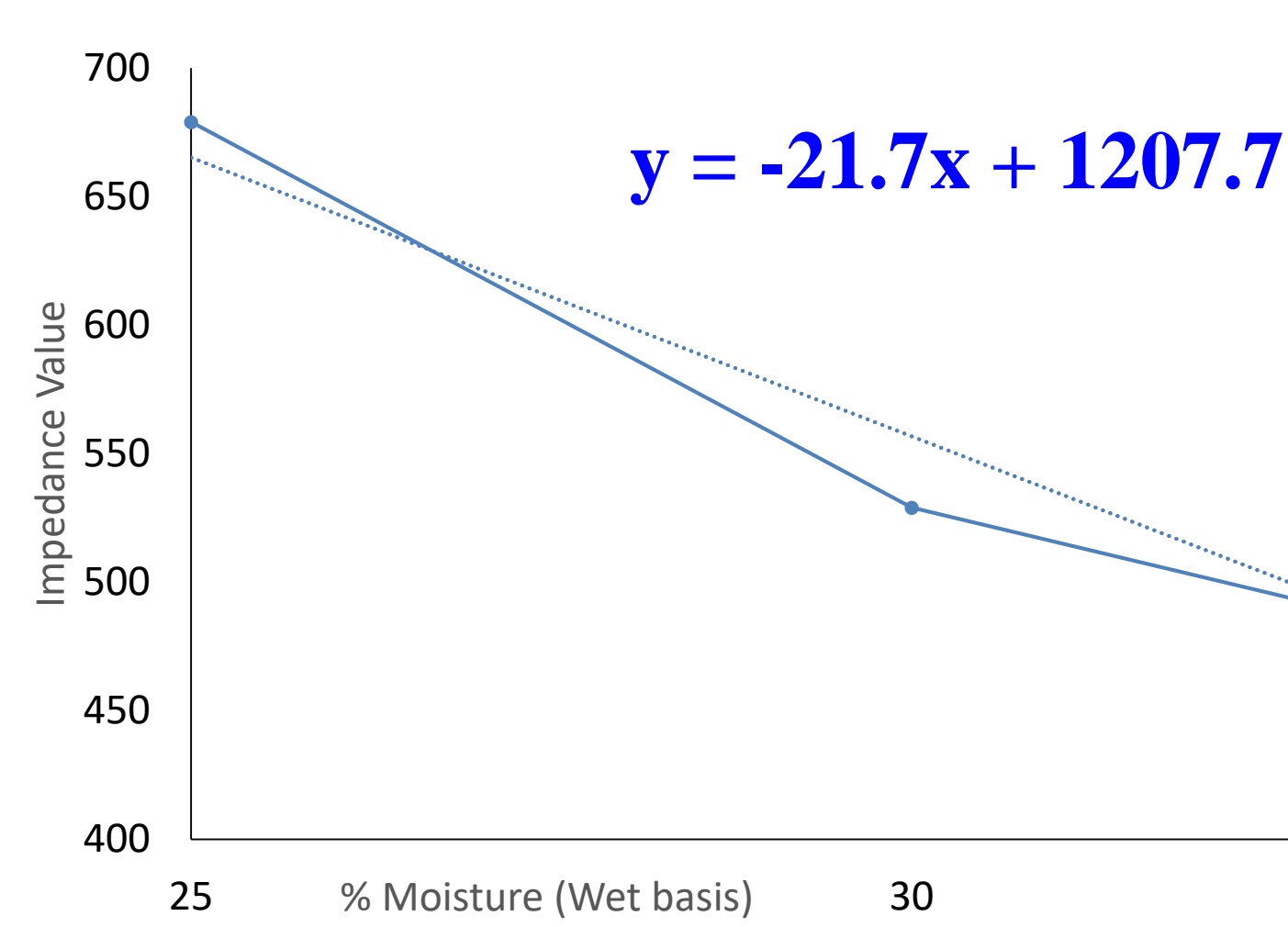
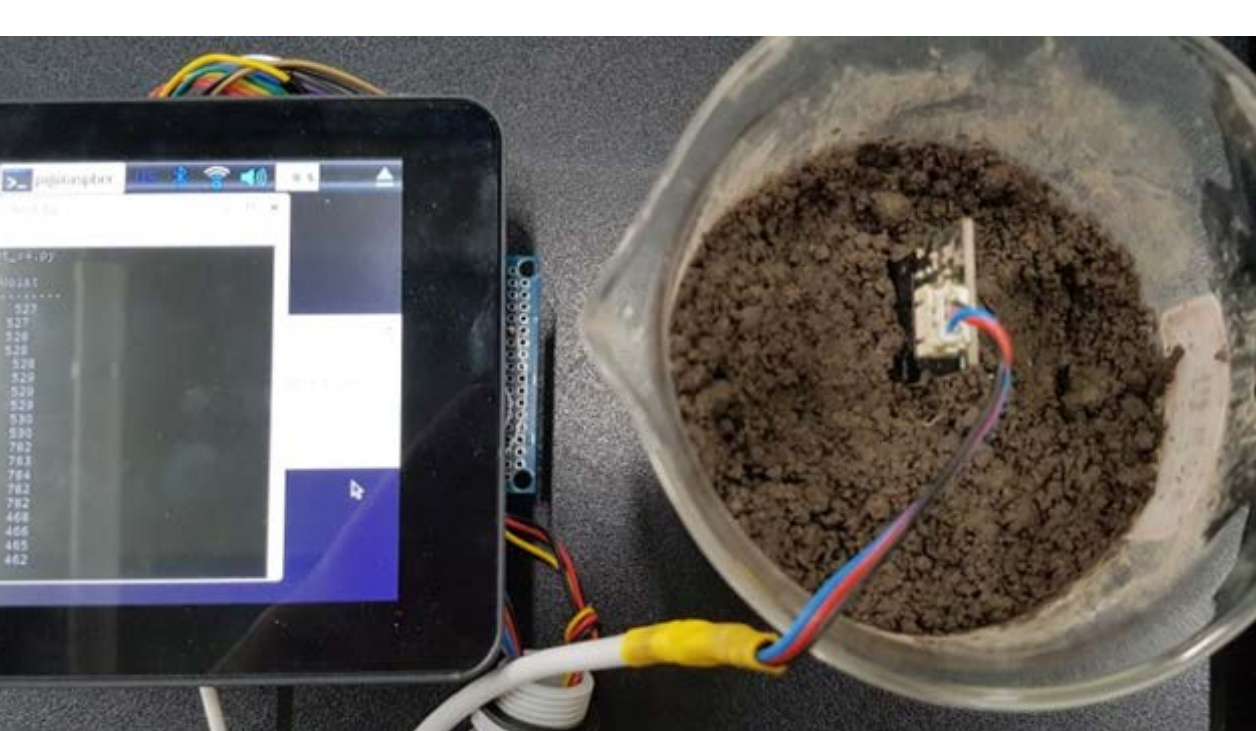
Web server Data Base



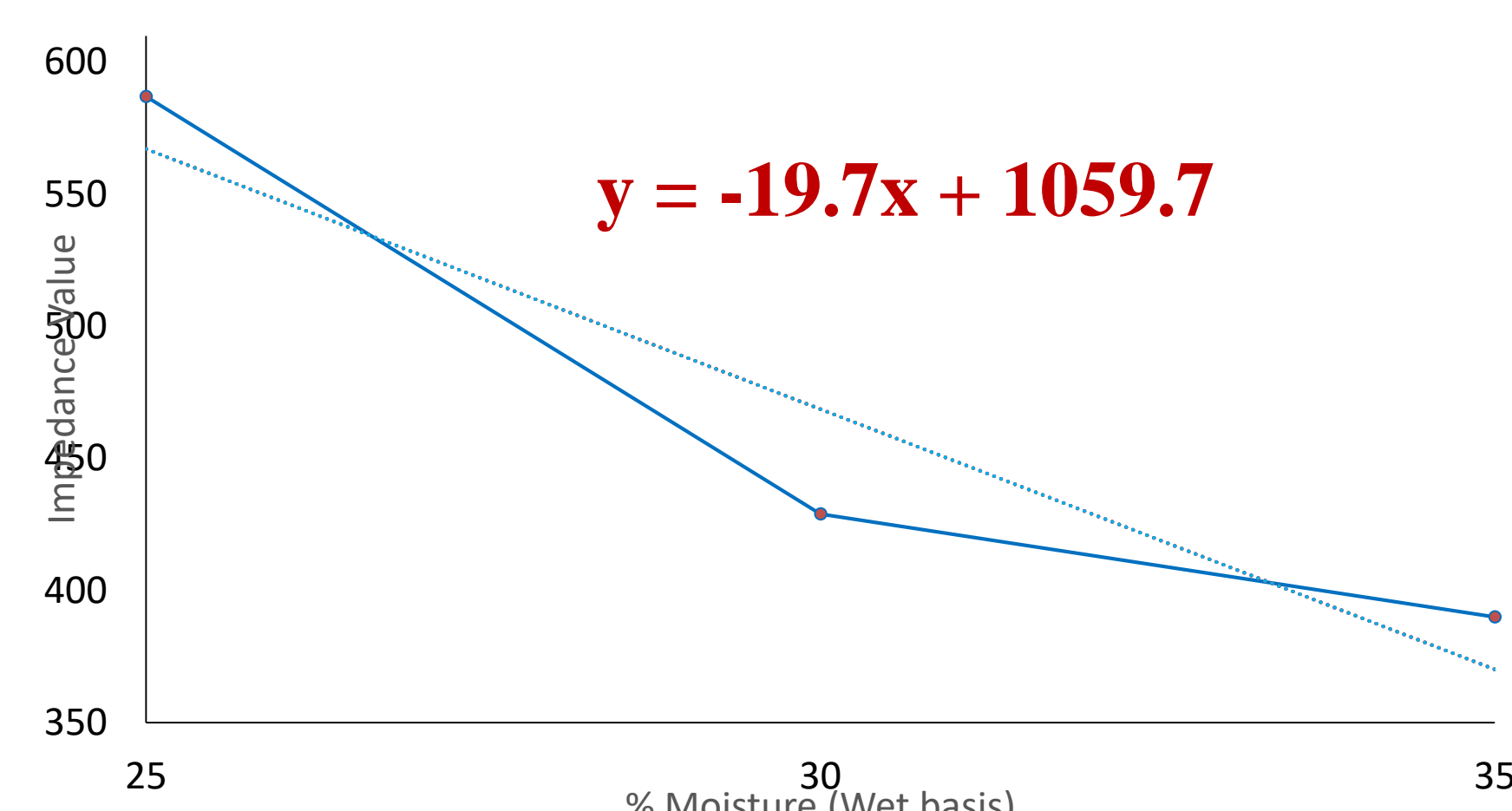
Installation of DAQ on the plum field

- Soil samples collection from Gyewol and Haeryong Plum Farm, the oven is dried at 105 °C for 24 hours.
- Dried soil is produced in 25%, 30% and 35% moisture content at intervals of 30 seconds

Sensor Calibration



Gyewol Plum Farm Soil: Sensor Calibration



Haeryong Plum Farm Soil: Sensor Calibration

Conclusions

- The data acquisition system wirelessly linked to the web server storing various field data was developed and operated for about 3 months successfully.
- As a result of data collection in Haeryong area adjacent seaside and Gyewol area which is a mountainous area, the temperature and humidity of soil, moisture and temperature were lower in the Gyewol area. The pH of the soil was lower in Haeryong area. Soil EC value was higher in the Gyewol area.
- On the other hand, citric acid, which is a functional substance, was continuously increased in all cultivars. However, increase pattern by region is different. Considering the functionality, it can be seen that harvesting time according to the region is different from that of productivity.
- As a result of short-term observation in this study, it is difficult to identify the correlation between growth and quality as a result of monitoring various factors. We intend to continuously improve productivity and quality of plums through continuous monitoring and sharing the data with experts and farmers using the developed system.

Acknowledgements

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Division	Specifications
Soil moisture content sensor	<ul style="list-style-type: none"> ➤ Moisture range : 0~65% ➤ Output voltage : 0~3.0 VDC ➤ Model : Dfrobot, SEN0193
Soil temperature sensor	<ul style="list-style-type: none"> ➤ Temperature range : -10~85°C ➤ Temperature error : ±0.5°C ➤ Model : Dfrobot, DS18B20
Temperature & Humidity Sensor	<ul style="list-style-type: none"> ➤ Temperature error : ±2°C ➤ Temperature range : -40~80°C ➤ Humidity range : 20~90% RH ➤ Humidity error : ±5% RH ➤ Model : Dfrobot, DHT11

Specification of sensors in DAQ system