

แนวโน้มความเข้มข้นของไฮโดรเจนเปอร์ออกไซด์ในรอบวันและฤดูกาล

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Measurement of Ambient Gas-Phase Hydrogen Peroxide at Farmland in Kasetsart University,
Kamphaeng Saen Campus

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บทคัดย่อ

การทดลองครั้งนี้เป็นการวัดความเข้มข้นของก๊าซไฮโดรเจนเปอร์ออกไซด์ในพื้นที่การเกษตรของมหาวิทยาลัยเกษตรศาสตร์ วิทยาเขตกำแพงแสน เพื่อศึกษาการเปลี่ยนแปลงความเข้มข้นในรอบวันและตลอดฤดูกาล โดยตรวจวัดตั้งแต่เดือนสิงหาคม พ.ศ. 2553 ถึงเดือนพฤษภาคม พ.ศ. 2554 จากผลการศึกษาพบว่าความเข้มข้นของก๊าซไฮโดรเจนเปอร์ออกไซด์มีความแตกต่างกันในแต่ละเดือน และความเข้มข้นของก๊าซไฮโดรเจนเปอร์ออกไซด์ในรอบวันมีแนวโน้มเพิ่มขึ้นเล็กน้อยตั้งแต่เช้าและมีความเข้มข้นสูงสุดประมาณบ่ายถึงบ่ายสองโมง หลังจากนั้นความเข้มข้นค่อย ๆ ลดลง สำหรับการเปลี่ยนแปลงในแต่ละเดือนนั้นปรากฏว่า ความเข้มข้นของก๊าซไฮโดรเจนเปอร์ออกไซด์มีแนวโน้มลดลงเรื่อย ๆ ตั้งแต่เดือนสิงหาคม พ.ศ. 2553 จนถึงเดือนพฤษภาคม พ.ศ. 2554 โดยเดือนสิงหาคม พ.ศ. 2553 มีค่าความเข้มข้นของก๊าซไฮโดรเจนเปอร์ออกไซด์สูงที่สุด 5.33 ppmv ขณะที่เดือน พฤษภาคม พ.ศ. 2554 มีค่าความเข้มข้นของก๊าซไฮโดรเจนเปอร์ออกไซด์ต่ำที่สุด 1.41 ppmv

ABSTRACT

The aim of this experiment was to measure the collecting the concentration of H_2O_2 at the agricultural field of Kasetsart University, Kamphaeng Saen Campus. The experiment was started from August, 2010 to May, 2011. The result showed that the different of H_2O_2 concentration in each month was found. The diurnal trend of H_2O_2 concentration was slightly increased in the morning and reached the maximum in the afternoon around 13:00-14:00 pm. Then the concentration gradually decreased. Moreover, seasonal trend of H_2O_2 concentration was highest (5.33 ppmv) in August, 2010 and after that the concentration was decreased to 1.41 ppmv in May, 2011.

Key words: Hydrogen Peroxide

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INTRODUCTION

From the agricultural perspective, peroxides are very harmful to plants especially when combined with O_3 (Chen *et al.*, 2005; Chen *et al.*, 2010). The examples of visible injury of birch and beech after exposed by peroxides (Chen *et al.*, 2010) are shown in figures 1 and 2. Peroxides can damage DNA, lipids, proteins and plasma membrane in plants, and highly impact to growth by effecting source and sink strength, reducing photosynthetic capacity, inhibiting assimilate translocation and declining yield accumulation (Terry *et al.*, 1995). Chen *et al.*, (2010) demonstrated that only 2-3 ppbv peroxides combined with 50 ppbv O_3 caused more severe damage to Japanese radish than 100 ppbv O_3 . Moreover, H_2O_2 associated with forest decline (Hatakeyama *et al.*, 1993; Takami *et al.*, 2003). Therefore observation data of H_2O_2 in the field is very important for agriculture and terrestrial ecosystems. The information of ambient H_2O_2 concentration, especially for long period, is limited in Thailand. Hence the objective of the research was to accumulate data of H_2O_2 concentration for long period in Kasetsart University, Kamphaeng Saen Campus between 2010 and 2011.

MATERIALS AND METHODS

1. Site description

Measurement site was located at Agronomy Department field, Kasetsart University Kamphaeng Saen Campus, Kamphaeng Saen City, Nakhon Pathom Province (latitude 14.0 °N, longitude 100.0 °E). This measurement site was located in mixed areas of resident and crop production areas in the central part of Thailand. It locates around 80 km from Bangkok and 30 km from downtown Nakhon Pathom Province, and is surrounded by industrial areas of Ayutthaya Province with the distance of 70 km and Saraburi Province with the distance of 120 km (Figure 1). The pollutants emitted by these industrial areas may affect measurement sites in the dry season from November to January due to the steady prevailing wind of north east. The industrial areas of Rachaburi Province locates about 45 km south west from the measurement site, and the emitted pollutants may affect the measurement site by the steady prevailing wind of South West Monsoon in the rainy season (May to October).

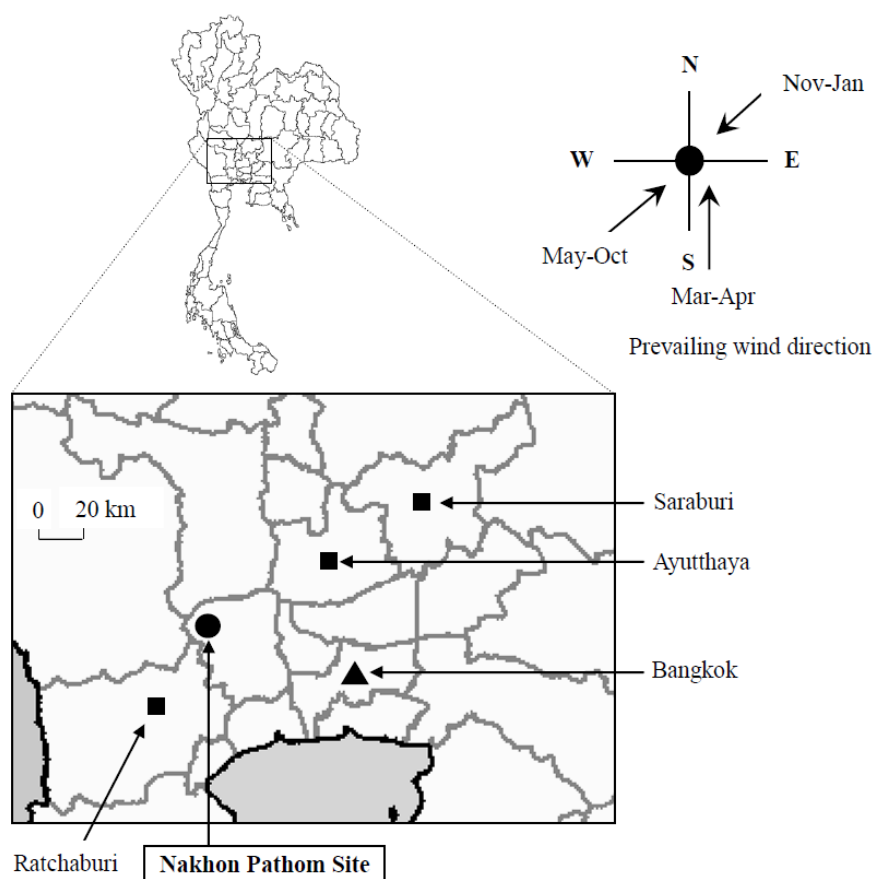


Figure 1 Location of Nakhon Pathom site, Kasetsart University surrounded big city and their industrial areas

2. Measurement of gaseous H_2O_2

Gaseous H_2O_2 in the air was sampled for 30-60 min with a Pyrex glass mist chamber (Cofer *et al.*, 1985) filled with about 5 ml of distilled water. The mist chamber was placed 2 m above ground. In order to prevent photolysis of peroxides during sampling, the mist chamber was shielded with aluminum foil. A Teflon filter with a pore size of $1 \mu m$ was mounted at the sample air inlet of the mist chamber to eliminate dust. Samples were collected basically four days a month and three to five times a day in the morning, afternoon and evening from 2010 to 2011. Samples were analyzed using a portable RQflex 10 reflectometer (MERECK KGaA, Darmstadt, Germany), which measures the difference in the intensity of emitted and reflected light and allows a quantitative determination of the concentration of H_2O_2 . This equipment is a reliable way to measure H_2O_2 concentration as shown in Figure 2.

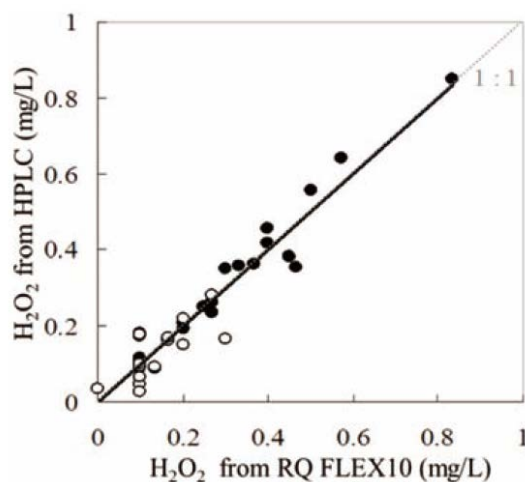


Figure 2 Calibration of H_2O_2 concentrations from RQFLEX 10 versus HPLC system (LCSS-905; JASCO). Different symbols refer to different measurement series

RESULTS AND DISCUSSION

1. Monthly concentration of H_2O_2

Samples of H_2O_2 concentration were collected basically four days a month and three to five times a day in the morning, afternoon and evening from 2010 to 2011. The distributions of H_2O_2 concentration in each month were shown in Figure 3. The results, the H_2O_2 concentration was high in August to December, 2010. High concentration in this period might be due to the wind direction come from the north east and wind from this direction passed through industrial areas of Ayutthaya Province with the distance of 70 km and Saraburi Province with the distance of 120 km (Figure 1). During the period, the monthly average H_2O_2 concentration was ranged from 3.43 to 5.50 ppbv. On the other hand, the data showed lower concentration in January-May, 2011 which might be due to the wind direction changed to south west. The wind from this direction come with the rainy season in Thailand, it means the H_2O_2 concentration in the air might be dropped or lower by the rain. During the period, the monthly average H_2O_2 concentration ranged from 1.27 to 4.33 ppbv. The ambient H_2O_2 concentration depends on several environmental factors such as air temperature, humidity, solar radiation, seasons and areas (Gunz and Hoffmann, 1990). High temperature might be the cause of H_2O_2 concentration decreased in May due to high evaporates to the atmosphere.

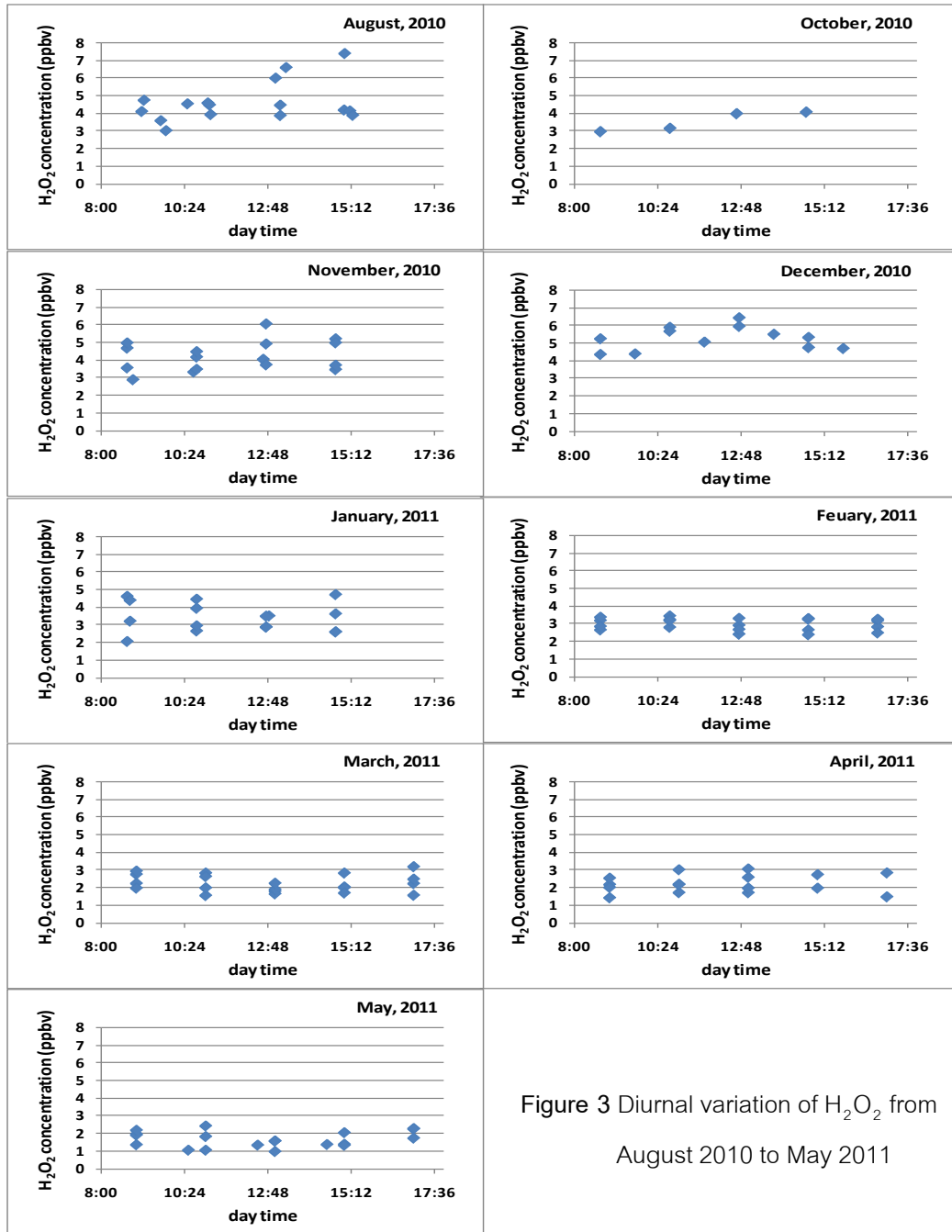


Figure 3 Diurnal variation of H_2O_2 from August 2010 to May 2011

2. Diurnal trend

The diurnal trend of H_2O_2 concentration during 8:00-18:00 was shown in Figure 4. The result showed that the H_2O_2 concentration slightly increased in the morning and reached its highest in the afternoon. The high levels were similar to levels in farmland in Claremont and Riverside, CA, USA, which showed strong diurnal variation (Kok *et al.*, 1978).

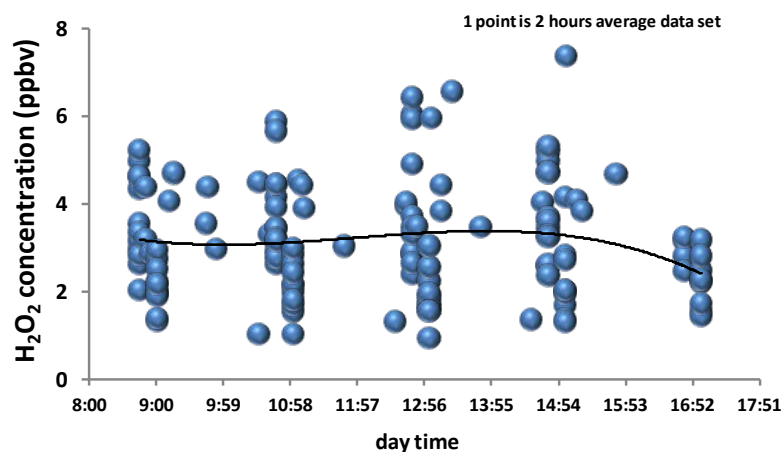


Figure 4 Diurnal trend of H_2O_2 concentration (ppbv) from experiment field of Agronomy Department Kamphaeng Saen Campus, Thailand. One point show the data every 2 hours from August, 2010 to May, 2011

3 Seasonal trend

Figure 5 Showed seasonal trend of H_2O_2 concentration which measured from August, 2010 to May, 2011. The H_2O_2 concentration showed highest in August, 2010 then gradually decreased until May, 2011.

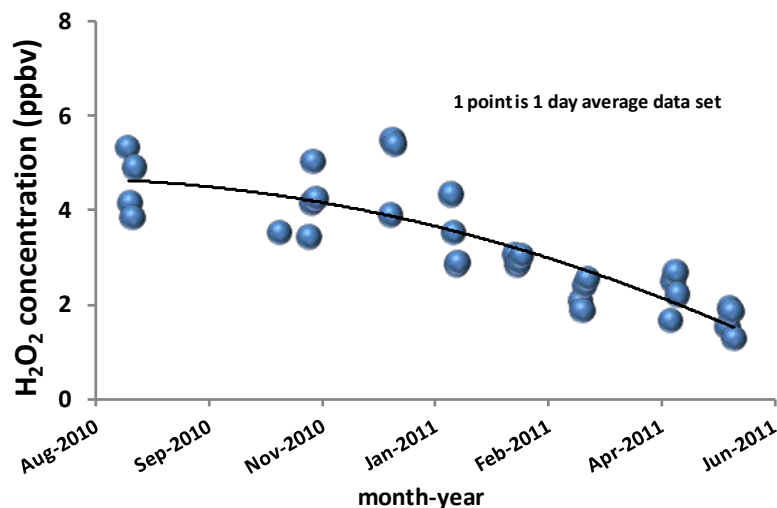


Figure 5 Seasonal trend of H_2O_2 concentration (ppbv) from experiment field of Agronomy Department Kamphaeng Saen Campus, Thailand

CONCLUSIONS

1. The highest H_2O_2 concentration was conducted in the afternoon.
2. The H_2O_2 concentration was fluctuation and difference in each month throughout experiment.
3. The highest H_2O_2 concentration was found in August 2010 while the lowest H_2O_2 concentration was found in April 2011.

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