

Agricultural Soil Ozonation by Dielectric Barrier Discharge Plasma (aimed for pesticides and fertilizers)



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1. Introduction

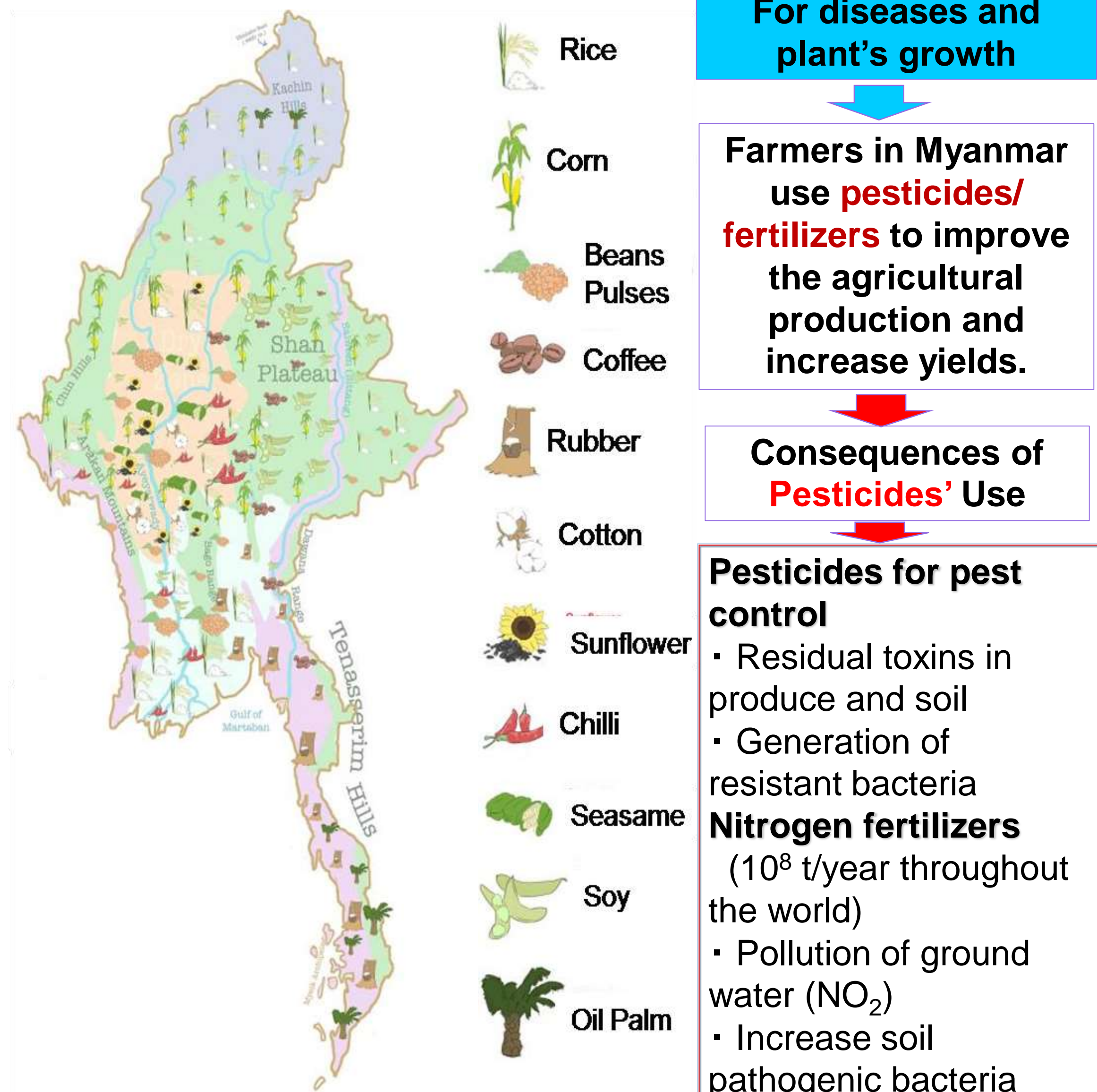


Fig. 1 Myanmar's agricultural crops.

- Myanmar has a largely agriculture-based economy.
- About 70% of the population is actively engaged in **agriculture**, which contributes about 50% of the national Gross Domestic Product.

Figure Source: <https://frontieryanmar.net/en/myanmar-agriculture-101>

What is OZONE?

- Ozone is tri-atomic form of oxygen.
- Most powerful commercial oxidizing agent.
- Kills bacteria 3,125 times faster than chlorine.
- Unstable- must be generated and used onsite.

Dielectric Barrier Discharge (DBD) Plasma

DBD is the electrical discharge between two electrodes separated by an insulating dielectric barrier.

DBD plasma can be used for

- Ozone generation
- Pollution control
- Surface treatment, etc.

DBD plasma's Advantages

- Low gas temperature
- Simple system \Rightarrow low cost
- Production of reactive species

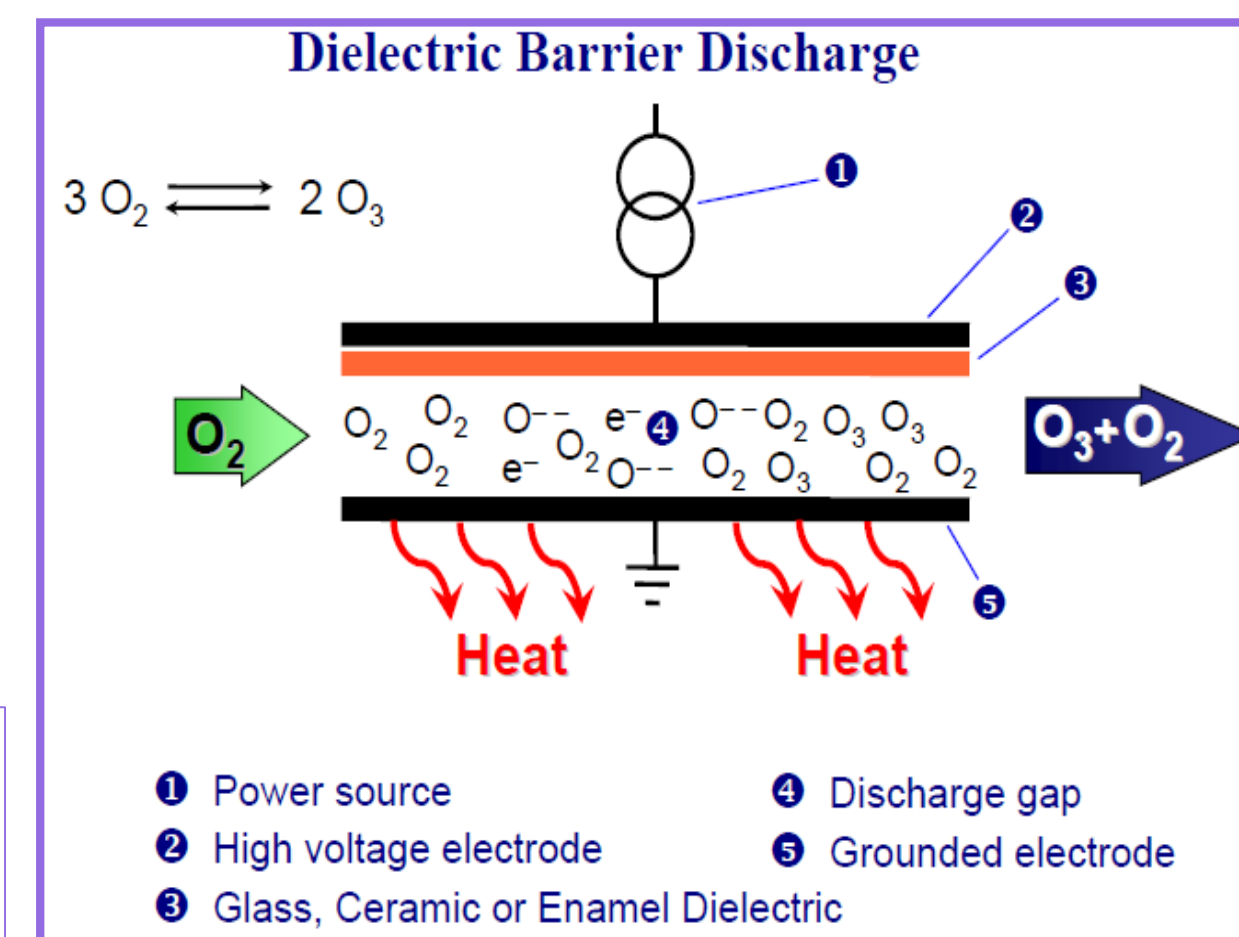
Purpose of this study

Purposes of this research are

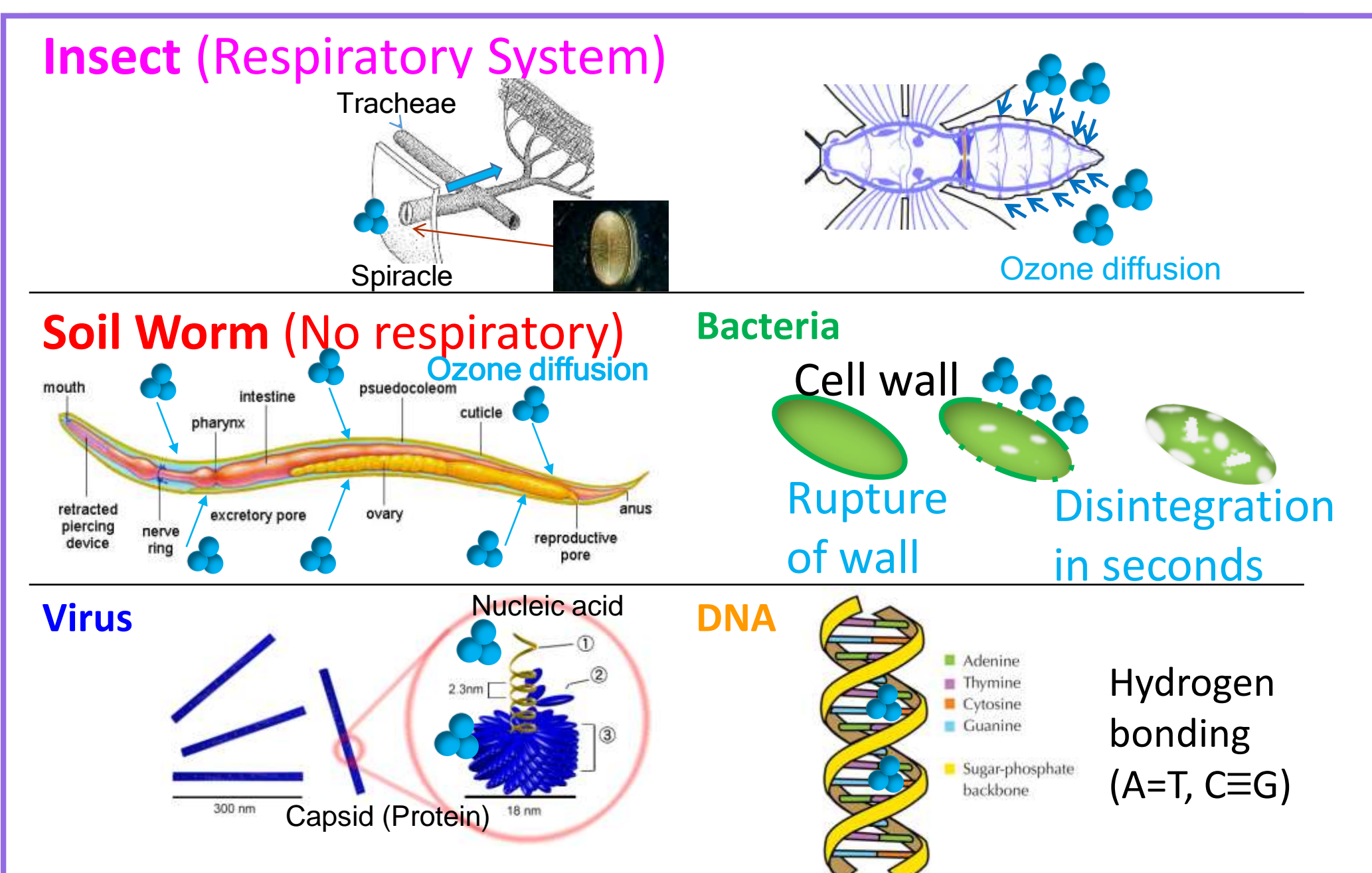
- to adopt non-thermal plasma technology to agriculture in order to improve the production yield without negative health and environmental impacts in Myanmar,
- to generate cheap and efficient ozone by dielectric barrier discharge (DBD) plasma providing sufficient reactive region spatially and temporally.

2. Generation of Ozone and Plasma

How Do We Make Ozone??



3. Oxidative effect of Ozone



4. Developed Soil Ozonation System

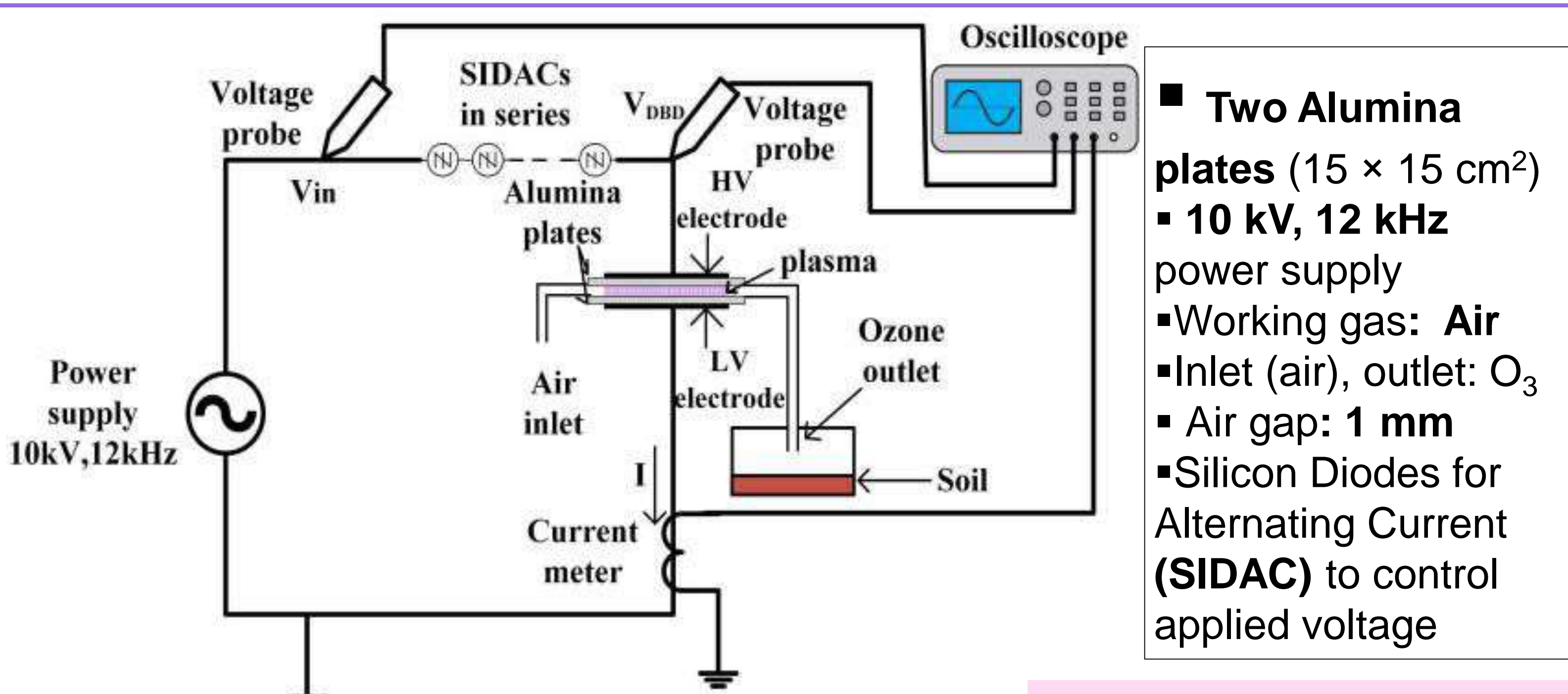


Fig: experimental setup of soil ozonation system

To control the **sufficient ozone** generation by the electrical properties using the N-series of silicon diodes for alternating current. (SIDAC: its breakover voltage, $V_{BO} = 400 \text{ V}$)

SIDAC is used as a simple high voltage power source with rapid voltage change for the reason of cost effective.

The sample **soil** was 100 g (Red brown forest soil, livestock and animal wastes, rice husk) and treatment time was 30 mins.

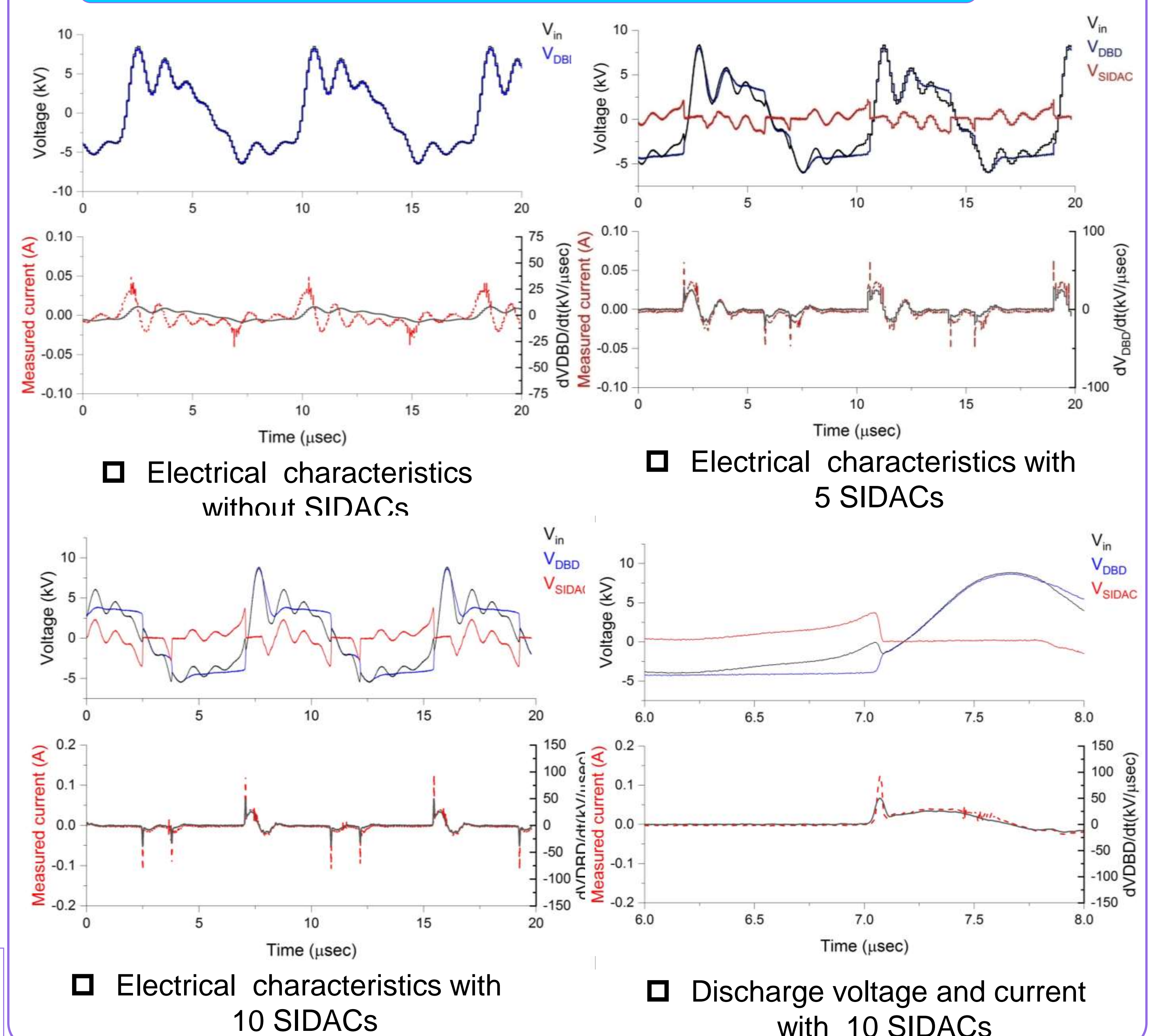
Changes in Acidity and Nitrogen nutrient of Organic Soil after ozone treatment

Conditions	pH (H_2O)	$\text{NO}_3\text{-N}$ (mg/kg)
Control	9.34	175
Without SIDACs	8.93	375
5 SIDACs	8.63	225
10 SIDACs	8.83	325

- pH levels of treated soil decreased after treatment because of the decomposition of organic substances that increases acids.
- $\text{NO}_3\text{-N}$ content** increased throughout all treated soil compared to control soil by two times.
- Such increases in acids and nitrogen nutrient provide enhanced effect on the growth of plant.

5. Results and Discussion

Electrical Properties of DBD plasma



Acknowledgments

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6. Conclusions and future plan

- We have developed the soil ozonation system by dielectric barrier discharge plasma.
- Controlling of applied voltages by SIDACs, making changes in a plasma properties and ozone generation.
- Investigation on acidity and nitrogen nutrient showed that after treatment, nitrogen nutrient increased significantly, and pH level was decreased because of the decomposition of organic substances that increases acids.
- However, power consumption, heat property, and durability of the sources for this application are under investigation.
- The number of SIDACs is needed to be optimized to get the efficient ozone generation.
- The plants' cultivations growing in Myanmar's soil to compare Japan's soil will be compared.

References

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