

Ozone-Mist Sterilization and Web-based Management for Greenhouse Agriculture

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Objectives : Ozone-mist sterilization

- Non-chemical ozone-mist sterilization for green house agriculture
- The sterilization rate of harmful insects(pests) using the ozone-mist treatment in greenhouse model chamber

Objectives :Web-based management

- Three colour channels (red, green, blue:R,G,B) to monitor plant growth using digital CCD camera
- On-site data acquisition and plant analysis at remote site
- Web-based management to sense plant state in a greenhouse and small-scale rural farms



Non-chemical greenhouse



(PecoShower ©Sanwa hi-tec Co.Ltd.)

Experimental systems and results

(1)Ozone-mist sterilization for pests

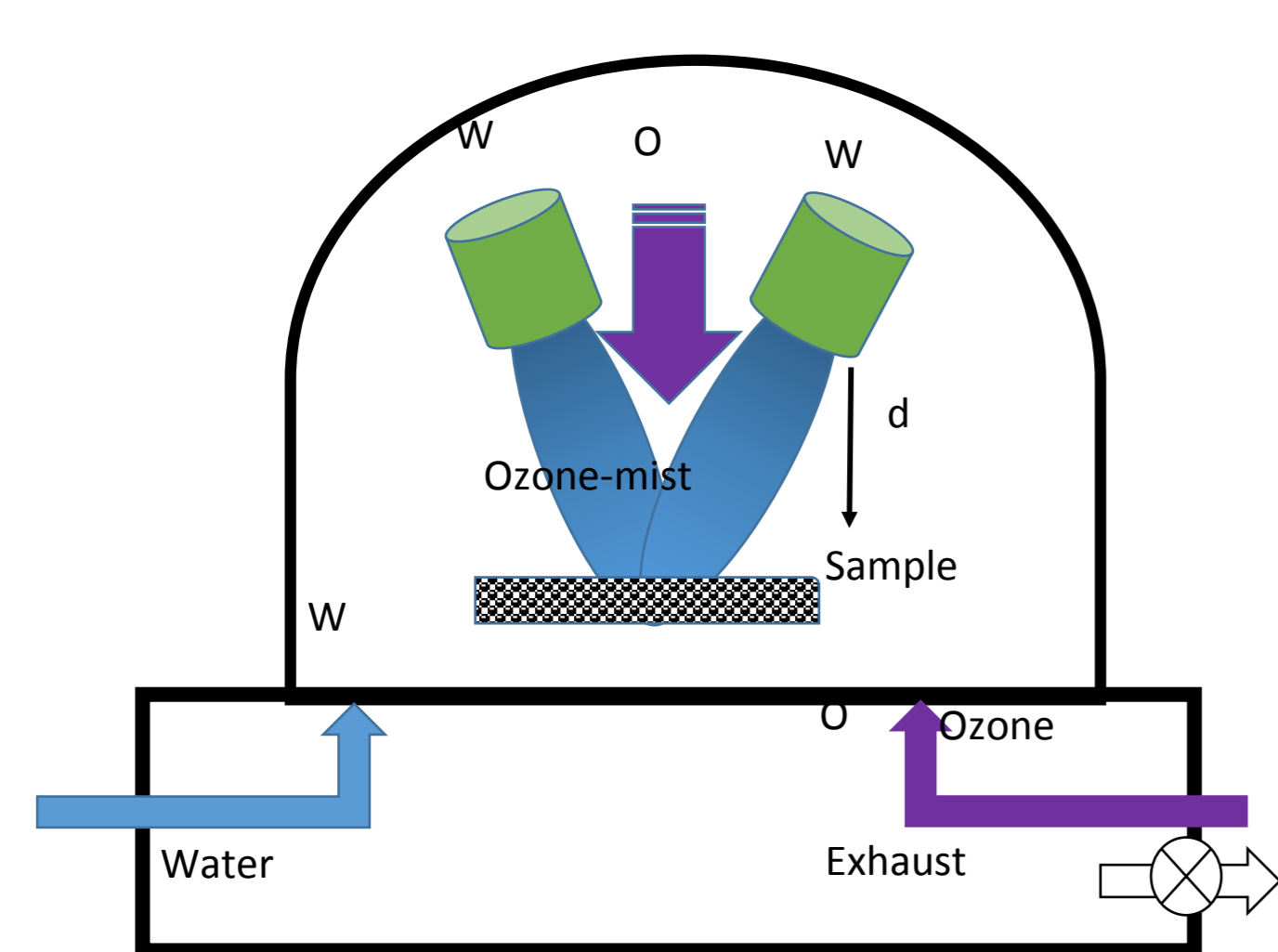


Fig. Ozone-mist generation in a closed chamber

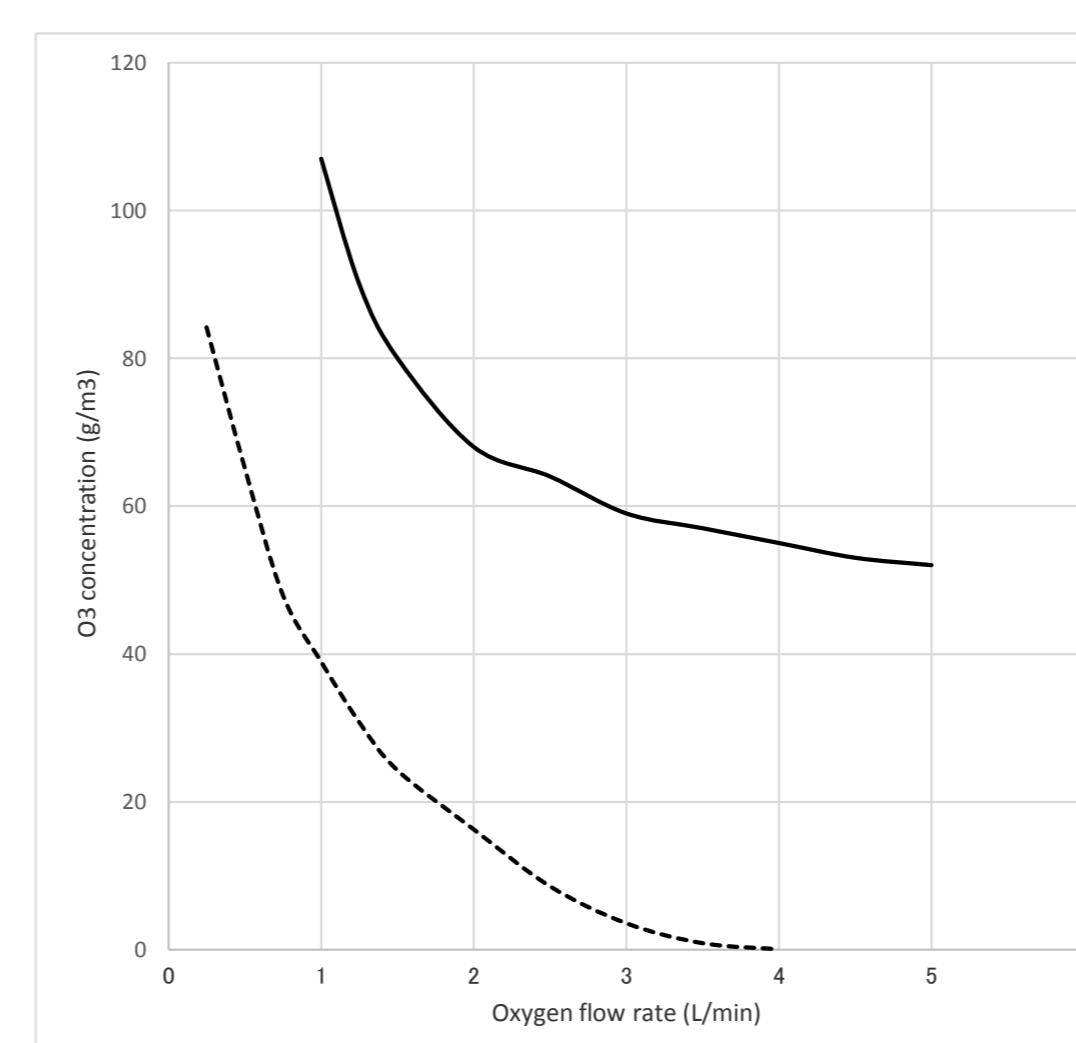


Fig. Ozone concentration of ozone generators

Table Ozone-mist sterilization rate of aphids

Method	Ozone-mist	Gaseous ozone	Water-mist	Chemical synthetics
Conditions	68gO ₃ /m ³ in 2L/minO ₂ Mist-water 330mL/min	68gO ₃ /m ³ in2L/minO ₂	330mL/min	Ortolan (1000-fold dilution)
Sterilization rate	90-100% for treatment time(T)=3min	50% T=2min 100% T=4min	0% T=2min	75% T=5s 90% T=10s

(3) Web-based management for a green house

On-site data acquisition (Greenhouse)

- Monitoring (Plant images)
- Measuring (Plant growth)

Digital CCD Camera with Wi-Fi Sensors(Plant, Environment)



Wi-Fi transmission



Plant analysis at remote site

- Image analysis (GIMP) R,G,B: Greenindex
- Plant growth (leaf area, stem height etc)

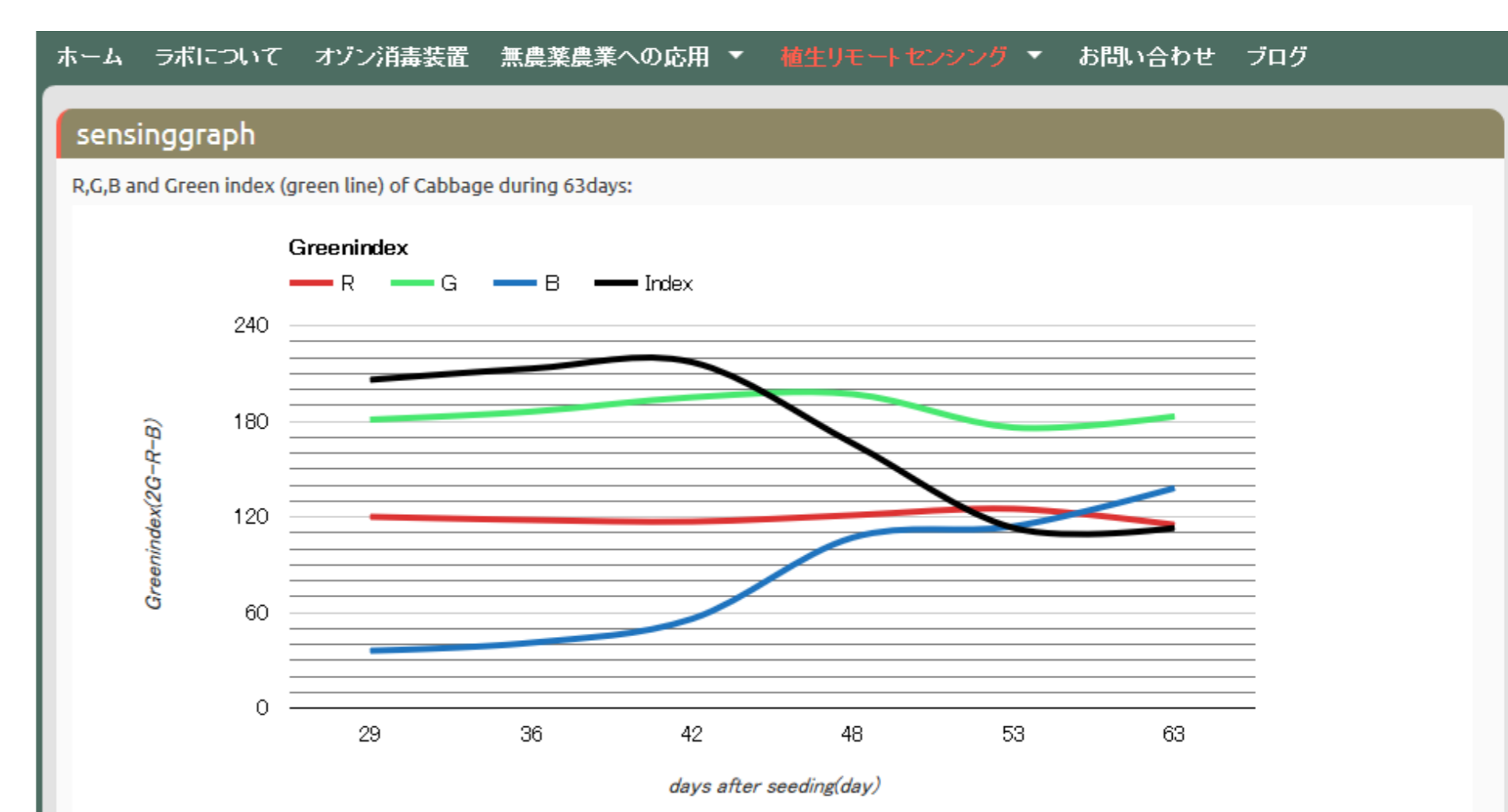
Internet

Web-server
• Wordpress (PHP,HTML)
• Database (MySQL)



Internet

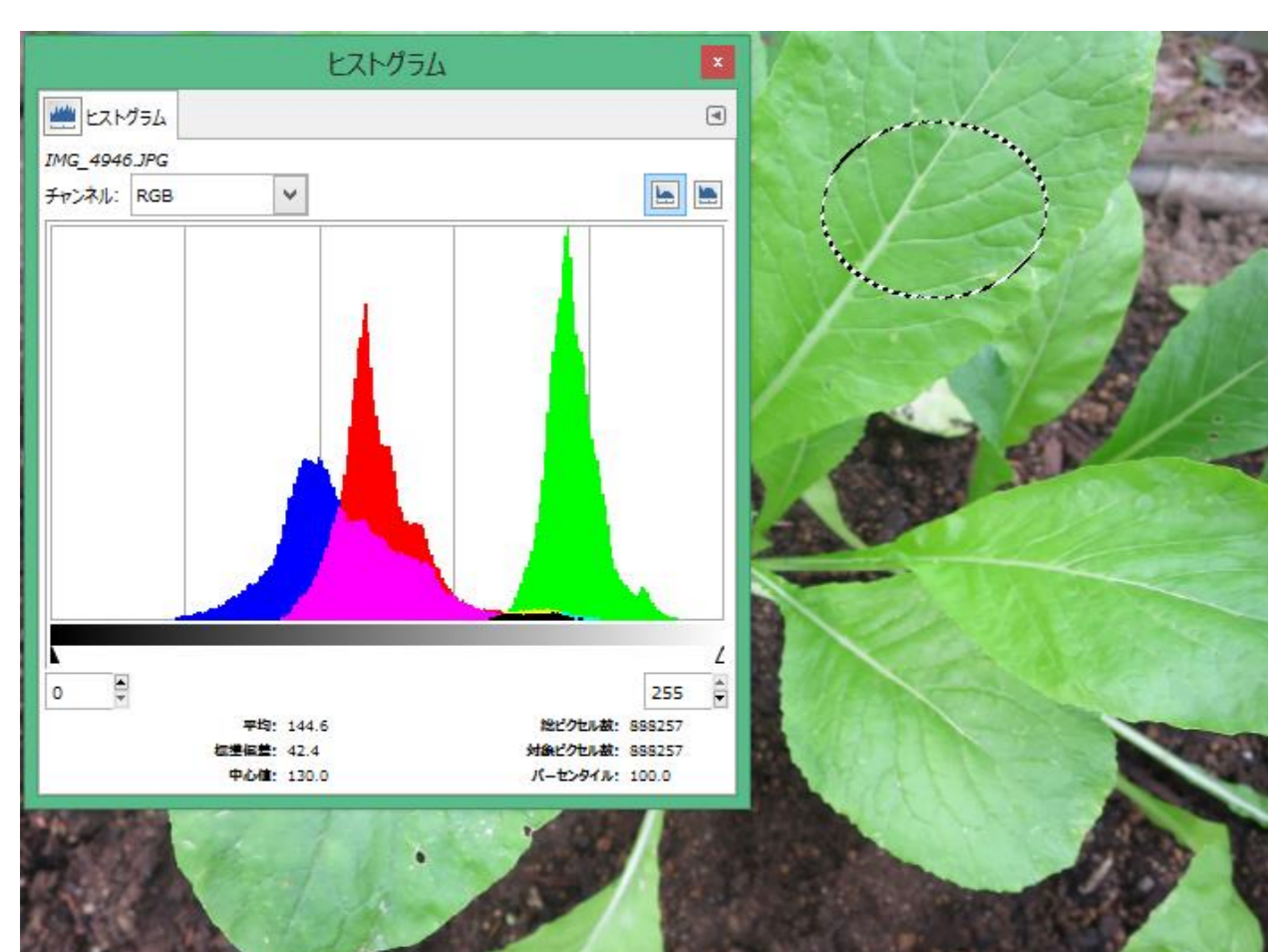
Web-browser



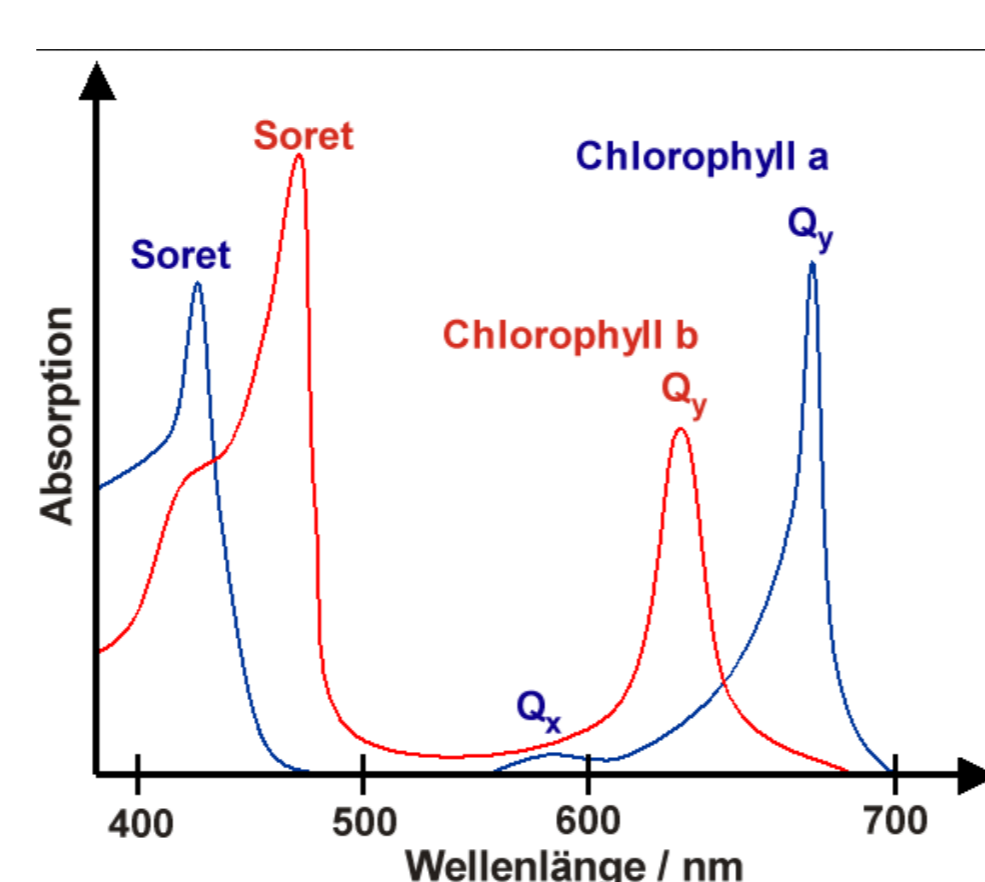
Photosynthetic activity display via the web
<http://environment-lab.com/wp/>

(2) Greenindex(2G-R-B) and Plant Growth

R:red, G:green, B:blue
Greenindex=2G-R-B



Histogram of leaf-images of cabbage after 45 days after seeding.



Light absorption of chlorophyll-a and -b

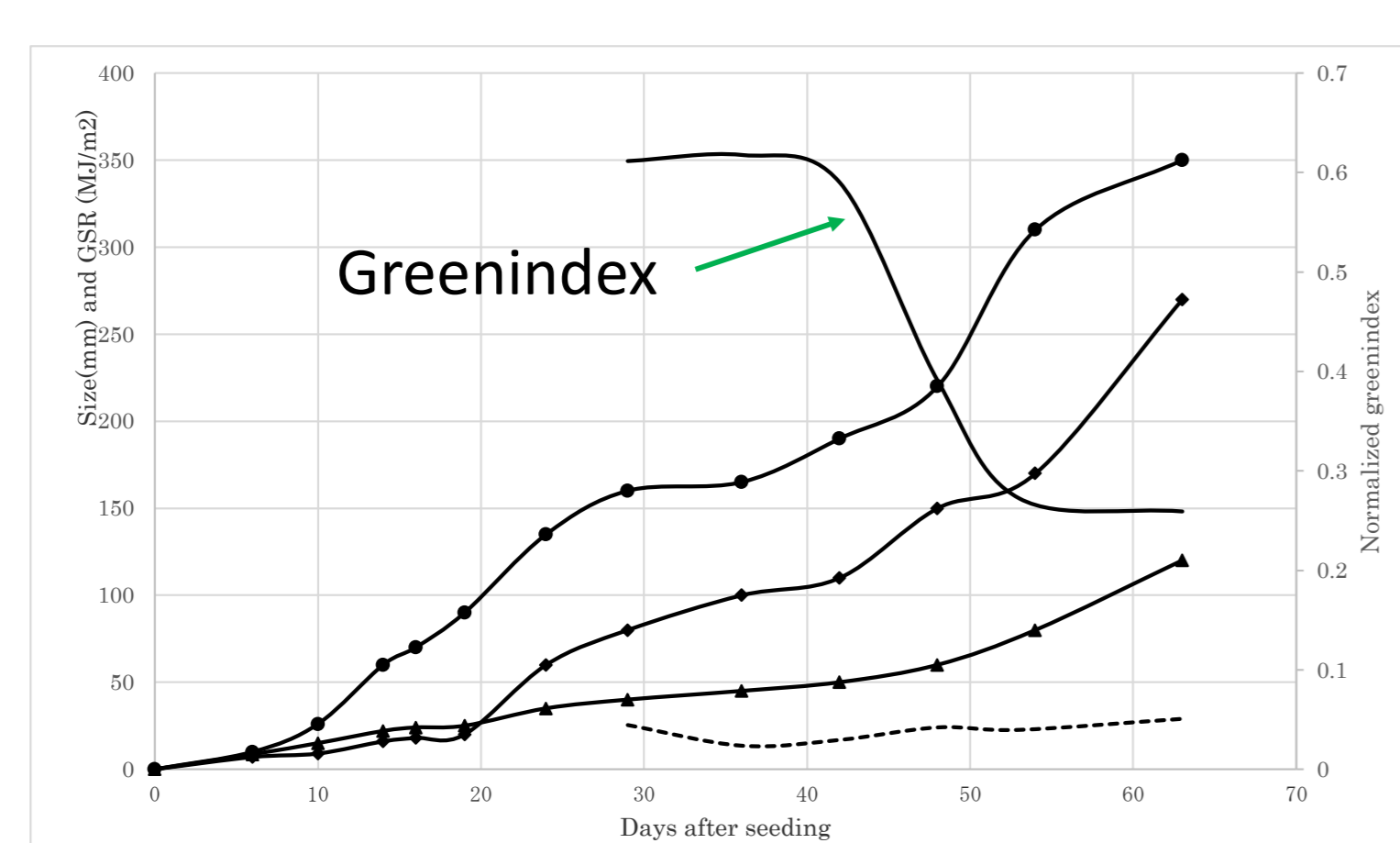


Fig.7 Relationship between normalized greenindex and plant growth of cabbage.

Normalized greenindex(—), height(—●—), length(—◆—), width(—▲—), GSR: global solar radiation(---)

Conclusion

- Ozone-mist sterilization for aphids in modeled greenhouse gives death rate of 100% for the 4min treatment.
- The greenindex(2G-R-B) reflects the chlorophyll production enhancing plant growth.
- The web-based greenhouse management system proposed here has the potential of sensing plant state and offers an inexpensive tool for small scale rural farms. .

• <http://environment-lab.com>

• Supported by the Ministry of Economy, Trade and Industry of Japan