2015 International Award for Young Agricultural Researchers

Mechanism, potency and practical application
of heat shock-induced resistance

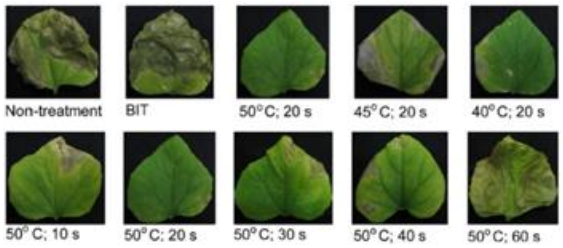
Dr. Ani WIDIASTUTI
Lecturer
Gadjah Mada University (UGM), Indonesia

Reason for the Award

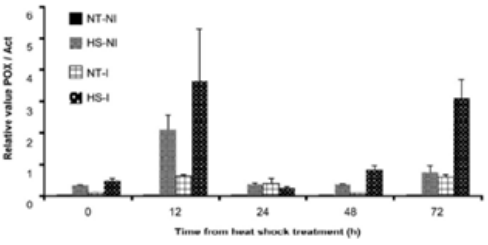
Dr. Widiastuti's research on disease resistance in crops induced by heat shock treatment of seedlings shows promise for reducing pesticide use. Her consistent approach, from basic research through various applications, was based on a unique idea and has been highly evaluated. Dr. Widiastuti is also actively involved in programs that make significant contributions to local communities, including the dissemination of this technique, which shows promise for further developments in this domain, to farmers in Indonesia.

Outline of Research Achievements

One potential solution to reduce excessive use of pesticides is to utilize the defense mechanisms of plants through the application of technologies to induce resistance. Heat shock treatment (50°C for 20s) in melon and strawberry seedlings was effective in reducing gray mold (*Botrytis cinerea*) and crown rot (*Colletotrichum gloeosporioides*) infection under a mechanism that influences heat shock-induced resistance (HSIR). In melon, peroxidase (POX) and chitinase1 (CHI1) gene expression increased at 12 and 72h after heat shock treatment, whereas in strawberry, chitinase2-1 (CHI2-1) expression increased 2 days after treatment. HSIR also covered the treated leaves (locally) and untreated leaves (systemically). In melon, salicylic acid (SA) accumulation increased after the first peak of POX and CHI gene expression. This study proposed that the HSIR mechanism included two different pathways that functioned simultaneously. The first pathway is the bypass pathway and the second pathway occurs upstream of SA and leads to SA accumulation. This idea was first disseminated during the Cucurbit Working Group Meeting of the Japanese Society for Horticultural Science in 2010. Recently, this idea was also disseminated for farmers group in Indonesia due to concerns over the consequences of intensive pesticide use.



Effect of heat shock treatment in melon leaves



Change of peroxidase gene expression over time in melon seedlings

Main Publications:

(1) **Ani Widiastuti**, M. Yoshino, H. Saito, K. Maejima, S. Zhou, H. Odani, K. Narisawa, M. Hasegawa, Y. Nitta, T. Sato. 2013. Heat shock-induced resistance in strawberry against crown rot fungus Colletotrichum gloeosporioides. Physiol. and Mol. of Plant Pathol. 84 : 86 – 91.

(2) **Ani Widiastuti**, M Yoshino, M Hasegawa, Y Nitta. T Sato. 2013. Heat shock-induced resistance increases chitinase-1 gene expression and stimulates salicylic acid production in melon (Cucumis melo L.). Physiol. and Mol. of Plant Pathol. 82 (2): 51 – 55.

(3) **Ani Widiastuti**, A., M. Yoshino, H. Saito, K. Maejima, S. Zhou, H. Odani, M. Hasegawa, Y. Nitta, & T. Sato. 2011. Induction of disease resistance against Botrytis cinerea by heat shock treatment in melon (Cucumis melo L.). Physiol. and Mol. of Plant Pathol. 75 (4): 157 – 162.

2015 International Award for Young Agricultural Researchers

Development and utilization of silage technique
and agro-industrial by-products for cattle feed
for the promotion of sustainable livestock agriculture in Laos

Dr. Viengsakoun NAPASIRTH
Head of Livestock Division
National University of Laos (NUOL), Lao PDR

Reason for the Award

Dr. Napasirth was the first to introduce silage to the farmers of Laos. Since then, he has worked on improving silage techniques by processing (ensiling) cassava residues into fodder, and by collecting and analyzing bacterial strains to be used for silage production in this region. These techniques are effective in solving the problem of fodder shortage during the dry season in Laos, thereby significantly contributing to the development of sustainable farming. Moreover, these techniques have promising applications in developing countries in Southeast Asia and Africa.

Outline of Research Achievements

Cattle production in tropical countries such as Laos has been managed under free-range condition in natural fields, meaning, the nutritional condition of the livestock heavily depends on natural environmental condition. In particular, the shortage of cattle feed in dry season is a common problem and it needs to be addressed. Dr. Napasirth has been working on improving the quality and availability of cattle feed in Laos by fully utilizing local feed resources in Laos.

In addition to evaluating chemical composition and nutritional values of natural forages in the country, he introduced a silage technology to Laos, and evaluated the chemical composition and fermentation characteristics. Moreover, two lactic acid bacteria species showing high tolerance to acid stress and high lactic acid productivity were isolated from silage made in Laos as possible candidates for silage fermentation starter. These selected strains are expected to be useful towards producing silage with higher quality and longer storage stability.

Currently, utilization of cassava residues for livestock diets is highly desirable in reducing the risk of environmental pollution caused by rotten cassava residues neglected in factories in Laos. Dr. Napasirth demonstrated that cassava residues contained abundant nutritional contents as well as lactic acid bacteria for silage fermentation, and the silage technique could be useful in preserving the quality of cassava residues in good condition for the livestock diets. Based on these research achievements, the demonstration farm has begun testing the effectiveness of using cassava-industrial by-products as feed for the native beef cattle in Laos.

Main Publications:

(1) **Napasirth Viengsakoun**, Napasirth Pattaya, Sulinthone Tue, Phommachanh Kham, and Cai Yimin. Microbial population, chemical composition and silage fermentation of cassava residues. Animal Science Journal, 86 (9): 842-848. (2015).
(2) **Napasirth Viengsakoun**, Wanapat Metha, and Berg Jan. Assessment of urea and/or lime treatment on rice straw quality using in vitro gas fermentation technique. Journal of Veterinary Advance, 11 (2): 295-299. (2012).
(3) Vongsamphanh Phanthavong, **Napasirth Viengsakoun**, Inthapanya Sangkhom, and Preston Thomas Reg. Cassava pulp as livestock feed; effects of storage in an open pit. Livestock Research for Rural Development, 26 (9): (2014),

2015 International Award for Young Agricultural Researchers

Development of a cost-effective raisedbed machine for small-scale farms to improve land and water productivity in the Nile Delta

Dr. Atef SWELAM
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International Center for Agricultural Research in Dry Areas (ICARDA), Lebanon

Reason for the Award

The machine developed by Dr. Swelam for raisedbed planting has remarkable effects on reducing irrigation water use and preventing waterlogging. Manual planting on raisedbeds is extremely time- and effort-intensive for farmers; the introduction of this machine would therefore lead to improved efficiency and significantly increased income for farmers. Mechanization of farming is a very practical approach for small-scale farmers in this region, and it has potential applications in neighboring countries, leading to advances in the field.

Outline of Research Achievements

The cost-effective raisedbed machine for small-sized lands was innovated in Egypt with a goal of making land preparing and sowing on raisedbed convenient for the resource-poor smallholders in Nile Delta, so as to encourage water and land conservation practices in the intensively farmed region. The machine is fashioned after a prototype tested and refined through trials on wheat fields with participating farmers. The resulting technology offers farming accuracy and allows sowing of different crops with easy maintenance and adjustable seed rates. After long-term calibration and validation of the new prototype, the technology has been adopted and is being scaled out with a local manufacturer.

Mechanized raisedbed planting has demonstrated multiple benefits (e.g., water savings, greater efficiency in agricultural practices and increased crop yields) on wheat, maize and sugarbeet. It also reduced waterlogging with better drainage of excess water from the active root zone of the crop. The good results achieved promoted the adoption of raisedbed technology in cultivated wheat areas from 1,670 hectares to a phenomenal 45,000 hectares over three years (2011-2014).

The uptake of mechanized raisedbed planting is spreading all over Egypt, as well as to other countries in the region such as Ethiopia, Eritrea, Iraq, Jordan, Morocco, Nigeria, Uzbekistan and Sudan. The machine is being used flexibly, both for intensive crops (such as wheat, berseem and rice) and interspaced crops (such as corn, sugarbeet and faba bean).

Impacts (on average): This machine achieved remarkable results and enabled the growers to 1) save irrigation water by 25%, 2) reduce seed rate by 50%, 3) decrease farming costs by 25%, 4) increase fertilizer use efficiency by 30%, 5) increase crop yields by 15-25%, 6) provide a good opportunity for local investment for fresh graduates.

Main Patent and Publications:

(1) Patent for invention on innovative raisedbed machine for agricultural water saving at ASRT, Egypt, March 2012 ICARDA-ARC) ID: 4072012.
(2) Ghazouani, W.; Molle, F.; **Swelam, A.**; Rap, E.; Abdo, A. (2015) Understanding farmers' adaptation to water scarcity: a case study from the western Nile Delta, Egypt. Colombo, Sri Lanka: International Water Management Institute (IWMI). 31p. (IWMI Research Report 160). doi: 10.5337/2015.200. SSN 1026-0862, ISBN 978-92-9090-810-4
(3) **Atef Swelam** and Y. Atta, (2012) Improve Water Saving and Water Productivity by New Approach of Farm Management under Surface Irrigation. Mi. J. Ag. Eng., 29 (2):745-762.