PROCEEDING

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2016

"The Future of Tropical Horticulture"

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FOREWORD

The International Seminar on Tropical Horticulture 2016 was held in IPB International Convention Center, Bogor, Indonesia 28 – 29 November 2016. This seminar was organized by Center of Excellence for Tropical Horticulture Studies (PKHT), Center of Excellence in University (PUI-PT), Bogor Agricultural University (IPB), and supported by an excellent collaboration with International Tropical Fruits Network (TF Net).

We're very glad to know the fact that the seminar displayed a very wide discussion about tropical horticulture with delegates from 5 countries (Taiwan, Thailand, Malaysia, Japan and Indonesia) as keynote speech and participants. 24 papers were selected to be included in this proceeding from 28 oral and 31 poster presentation.

This proceeding is contained of three sub chapter, that is fruits, vegetables and miscellaneous. There are 9 papers of fruits chapter, 12 papers of vegetables chapter and 3 papers of miscellaneous chapter. We wish to thank Sanjeet Kumar, Ph.D, Prof. Sobir, Prof Masayoshi Shigyo, Dr. Mohd Desa Haji Hassim, Parson Saradhuldhat, Ph.D for being keynote speech at this international seminar and all participants for very lively atmosphere during and after the seminar.

Bogor, May 2017

Editor

Dr. Darda Efendi
Dr. Awang Maharijaya

SYMPOSIUM PROGRAM

28 November 2016

07.30 – 09.00	*Registration desk open and morning coffee*
09.00 – 09.30	Welcome addresses **Dr. Darda Efendi**, Director of Center for Tropical Horticulture Studies, Indonesia **Prof. Herry Suhardiyanto,** Rector of Bogor Agricultural University, Indonesia
09.30 – 12.00 (20 minutes presentation + 10 minutes discussion)	**Session 1: Introductory Topics** **Dr. Sanjeet Kumar,** World Vegetable Center, Taiwan *"Science and Art of Tropical Horticulture: Stories, Impacts and Prospects"* **Prof. Sobir,** Indonesian Center of Excellence for Tropical Horticulture *"Tropical Horticulture: Past, Present and Future"* **Gregori Hambali, MSc,** Mekarsari, Indonesia *"Managing Tropical Fruit Collection"*
12.00 – 13.00	*Lunch*
13.00 – 14.30 (20 minutes presentation + 10 minutes discussion)	**Session 2: Opportunity in Tropical Horticulture Industry** **Prof. Muhammad Firdaus,** Bogor Agricultural University *"Enhancing the Competitiveness of Tropical Horticulture Products"* **Dr. Mohd Desa Haji Hassim,** International Tropical Fruit Network, Selangor, Malaysia *"Issues and Challenges in The Global Tropical Fruit Market"* **Parson Saradhuldat, Ph.D,** Department of Horticulture, Kasestsart University, Thailand *"Tropical Horticulture Business in Thailand"*
14.30 – 16.00 (20 minutes presentation + 10 minutes discussion)	**Session 3: Quality of Horticultural Products** **Dr. Darda Efendi,** Center for Tropical Horticulture Studies, Indonesia *"Quality Issues in Tropical Horticultural Products"*

	Tatas H. P. Brotosudarmo, PhD, Ma Chung University *"*Non-optical and optical spectroscopy as metabolomics platforms for determining the quality of horticultural products*"* **Dr. Irmanida Batubara,** Tropical Biopharmaca Research Center *" Quality Control on Herbal Medicine"*

29 November 2016

07.30 – 08.30	*Registration desk open*	
08.30 – 10.15	**Parallel session 1**	**Parallel session 2**
10.15 – 10.30	*Coffee Break and Poster Session*	
10.30 – 12.15	**Parallel session 3**	**Parallel session 4**
12.15 – 13.00	*Lunch*	
13.00 – 15.00 (@20 minutes presentation + 10 minutes discussion)	**Session 4 : Technology Needs for Improving Horticulture in The Tropics** **Prof. Masayoshi Shigyo,** Yamaguchi University, Japan *"Proposal for a forwarding model in order to encourage social interaction among HRs and/or PGRs via platform operation based on research collaboration in Indonesian vegetable crops"* **Prof. Sri Hendrastuti Hidayat,** Department of Plant Protection. Faculty of Agriculture. Bogor Agricultural University *"Integrated Disease Management for Vegetable Crops: Concepts and Practices"* **Dr. Catur Hermanto,** Indonesian Vegetables Research Institute (IVEGRI) *"Pest And Disease Threats and Challenges For Future Vegetable In The Tropic*"	
15.00 – 16.00	*Concluding and Remarks*	
16.00 – 18.00	*Farewell Drink*	

ORAL PRESENTATION SCHEDULE

Tuesday, November 29th 2016

Paralel 1

TIME	PRESENTER NAME	CODE	TITLE
08.30 – 08.45	Slamet Susanto	OP 1	Prolong Shelflife of Seedless Pummelo (*Citrus maxima* (L.) Osbeck) Fruit During Storage
08.45 – 09.00	Dini Hervani	OP 2	Cryopreservation of Long-term Plant Germplasm Storage
09.00 – 09.15	Sulassih	OP 3	Variability of Jackfruit Based on Morphology and Molecular ISSR
09.15 – 09.30	Ahmad Solikin	OP 4	Characterization of Local Durian Varieties In Central Java Using Molecular Markers Inter Simple Sequence Repeats (ISSR)
09.30 – 09.45	Nelinda	OP 5	Packaging Design and Postharvest Treatment to Maintain the Quality of Rambutan (*Nephelium Lappaceum* L.) in Distribution System
09.45 – 10.00	Maxmilyand Leiwakabessy	OP 6	Disease Incidence and Molecular Analysis of Banana Bunchy Top Virus in Bogor, West Java
10.00 – 10.15	Ajmir Akmal	OP 7	Transpiration rate of relationship fruit with Gamboge of Mangosteen (*Garcinia mangostana* L.)

Paralel 2

TIME	PRESENTER NAME	CODE	TITLE
08.30 – 08.45	Juang Gema Kartika	OP 8	Growth and Production of Some *Moringa oleifera* Lam. Accession at Several Harvesting Interval
08.45 – 09.00	Lutfi Izhar	OP 9	Conservation Agriculture with Soil Health: Optimal Fosfor Fertilizer Rate for Tomato (*Lycopersicon esculentum* Mill. L) on Inceptisols
09.00 – 09.15	Adhitya Mahendra K	OP 10	Stakeholders Analysis in Seed Provision System Development Originated from True Seed of Shallot
09.15 – 09.30	Endro Gunawan	OP 11	Policy Analysis on Shallot Stock Seed Program Though The Botanical Seed (*True Shallot Seed*) TSS
09.30 – 09.45	Ali Asgar	OP 12	Integrating Understanding of Indigenous Vegetable Nutrients and Benefits
09.45 – 10.00	Marlin	OP 13	Metabolite Changes in Shallot (*Allium cepa* var *aggregatum*) during Vernalization
10.00 – 10.15	Suhesti Kusuma Dewi	OP 14	The Effects of Vernalization and Photoperiod on Flowering of Shallot (*Allium cepa* var. *ascalonicum* Baker) in Lowland Area

Paralel 3

TIME	PRESENTER NAME	CODE	TITLE
10.30 – 10.45	Satriyas Ilyas	OP 15	Study of Phenology and Determination of Seed Physiological Maturity of Long Bean (*Vigna sinensis* L.) Based on Heat Unit
10.45 – 11.00	Endah Retno Palupi	OP 16	Chromosome Number Estimation of Diploid, Autotetraploid and Triploid Hybrid 'Rejang' Banana Using Protoplast from Male Flower (anther)
11.00 – 11.15	Yudiwanti Wahyu	OP 17	Performance of Some First Generation Corn Populations derived from Selfing and Sibbing for Developing Baby Corn Varieties
11.15 – 11.30	Ady Daryanto	OP 18	Inheritance of Chili Pepper Resistance Against Infestation of *Aphis gossypii* Glover (Hemiptera: Aphididae)
11.30 – 11.45	Edi Santosa	OP 19	Variation in Floral Morphology of Agamosporous *Amorphophallus Muelleri* Blume of Natural and Gibberellins Treatment
11.45 – 12.00	Kusuma Darma	OP 20	The Eco-Friendly Technology to Control Pests and Diseases of Shallot
12.00 – 12.15	Filemon Yusuf	OP 21	Phylogenetic Study of Indigenous Pulses Based on Morphological and Inter Simple Sequence Repeat (ISSR) Markers

Paralel 4

TIME	PRESENTER NAME	CODE	TITLE
10.30 – 10.45	Ririh Sekar Mardisiwi	OP 22	Growth and Production of Black Cumin (*Nigela sativa* L.) at Several Composition Media and Watering Interval
10.45 – 11.00	Evi Setiawati	OP 23	Growth and Production of Black Cumin (*Nigela sativa* L.) at Shade Levels and Nitrogen Doses
11.00 – 11.15	Tatik Raisawati	OP 24	The Nutritional Value and Total Flavonoid Content of *Sonchus arvensis* L. Leave
11.15 – 11.30	Dewi Sukma	OP 25	Diversity Analysis of Phalaenopsis by Using SNAP Marker
11.30 – 11.45	Widya Sari	OP 26	Morphological, Molecular Charactheristics and Pathogenicity of *Fusarium* spp. from Some Cultivars of Banana
11.45 – 12.00	Juwartina Ida Royani	OP 27	In Vitro Shoots Multiplication of Sapodilla (*Manilkara zapotta* Van Royen) with Modified MS Media
12.00 – 12.15	Willy B. Suwarno	OP 28	Melon Breeding: Past Experience and Future Challenge

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Melon Breeding: Past Experiences and Future Challenges

Willy B. Suwarno[1,2*], Sobir[1,2], and Endang Gunawan[2]

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Abstract

Melon (*Cucumis melo* L.) is a species with the largest genetic diversity among others in the Cucurbitaceae family, and therefore providing opportunities for plant breeders to develop new, improved varieties. C. *melo* var reticulatus (North American cantaloupes), C. *melo* var inodorus (honeydews), and C. *melo* var cantalupensis (European cantaloupes) are the most widely known among at least eight cultivar groups. Melon is a cross pollinated species where most of pollination events are performed by bees. F_1 hybrid is the most common type of varieties could be found in the market today. Some important fruit traits in melon include: fruit weight, sugar content, flesh color and texture, rind appearance and hardness, and shelf-life. An ideotype of large fruit with an attracting orange or green, sweet and crisp flesh are more demanded nowadays for Indonesian market. Additionally, obtaining varieties resistant to main pests and diseases are of importance as well. We have been conducting a melon breeding program aimed for quality fruits at the Center for Tropical Horticulture Studies, Bogor Agricultural University (IPB), and two honeydew varieties has been released. Recetly we identified a melon genotype (IPB Meta 9) exhibiting good resistance to downy mildew and can be utilized in a breeding program. Future challenges include shifts in consumer preferences, for example, small-size fruits may be more preferred for personal or small family consumptions.

Keywords: breeding, fruit quality, melon

1. Genetic diversity of melon

Melon (*Cucumis melo* L.) is a cross-pollinated diploid species (2n=2x=24) with the largest genetic diversity among other species in the Cucurbitaceae family (Dutt and Saran, 1994; Nayar and Singh, 1994). Wild species of *Cucumis* occur in Africa. Secondary centers of diversity include Persia, Southern Russia, Iran, Afghanistan, India, and China. Cucumber (*Cucumis sativus* L.) is known as a close relative to melon based on combined chloroplast and nuclear data (Renner *et al.* 2007). The C. *melo* species has at least eight cultivar groups or botanical varieties, i.e. *C. melo* var. reticulatus (North American cantaloupe or muskmelon), *C. melo* var. inodorus (honeydew), *C. melo* var. cantalupensis (European cantaloupe), *C. melo* var. makuwa (oriental melon), *C. melo* var. flexosus (snake melon), *C. melo* var. conomon, *C. melo* var. chito, and *C. melo* var. dudaim (Robinson and Decker-Walters, 1999). Reticulatus, inodorus, and cantalupensis are the most widely known cultivar groups in many countries including in Indonesia. Reticulatus melons typically have thick, netted rind, moderate shelf-life, green or orange thick flesh with firm texture, and mature fruit slips from the stem. Inodorus melon generally have smooth (non-netted) rind, long shelf-life, flesh color of white, green, or orange, crisp flesh texture, and mature fruits does not slip from the stem. Catalupensis melons typically have strong aroma, short shelf-life, juicy flesh, and vertical sections in the rind.

Our previous study evaluating a diverse collection consisting of 30 melon genotypes (13 F_1 hybrid varieties, 4 F_2 populations, 6 open pollinated varieties, and 7 inbred lines) indicated a good opportunity for breeding new, improved varieties. These genotypes can be classified into the reticulatus (12 genotypes), inodorus (8 genotypes), and makuwa (3 genotype) groups; however we found some reticulatus genotypes with some cantalupensis group's characteristics (e.g. stronger aroma, shorter shelf-life, juicier flesh), and therefore we put those into the 'cantalupensis-like' group (7 genotypes). Fruit appearance of some of the genotypes are shown in Figure 1. F_1 hybrids selected based on fruit weight and sugar content are: Action, Autumn Favor, and Monami Red from the reticulatus group; Jade Flower from the inodorus group, and Hales' Best from the cantalupensis-like group.

Figure 1. Genetic diversity of fruit appearance among melon genotypes

2. Flower types and pollination

Most cantaloupes and honeydews cultivars are andromonocious, i.e. has both male and hermaphrodite flowers in one plant (Robinson and Decker-Walters, 1999). Male flowers appear on the main and secondary branches, whereas hermaphrodite flowers appear on the secondary or higher order branches. Monoecious cultivars (having male and female flowers in one plant) are less common, although are more desirable for hybrid seed production because emasculation (removing anthers) from the female plants would not be required. Monoecious is dominant to andromonocious and the difference among these are controlled by a pair of alleles (More and Seshadri, 1994).

Main pollinating agent for melon plants is honey bees and the outcrossing amount is 5 – 70%. Higher fruit set (98%) occured under natural pollination as compared to hand pollination

(68%) (Munshi and Alvarez, 2005). From a study of melon pollination in an area containing two cantaloupe genotypes, greater number of bee moves between the two strains were observed than that within the same strain (Foster and Levin, 1967).

Steps involved in making crosses among melon genotypes are described in Figure 2. Emasculation of hermaphrodite flowers of an andromonicous parent should be performed one day before anthesis. Both male and hermaphrodite flowers need to be covered. Hand pollination should be done in early morning (e.g. by about 6 AM in Bogor, Indonesia) to avoid undesireable pollen contaminations by bees.

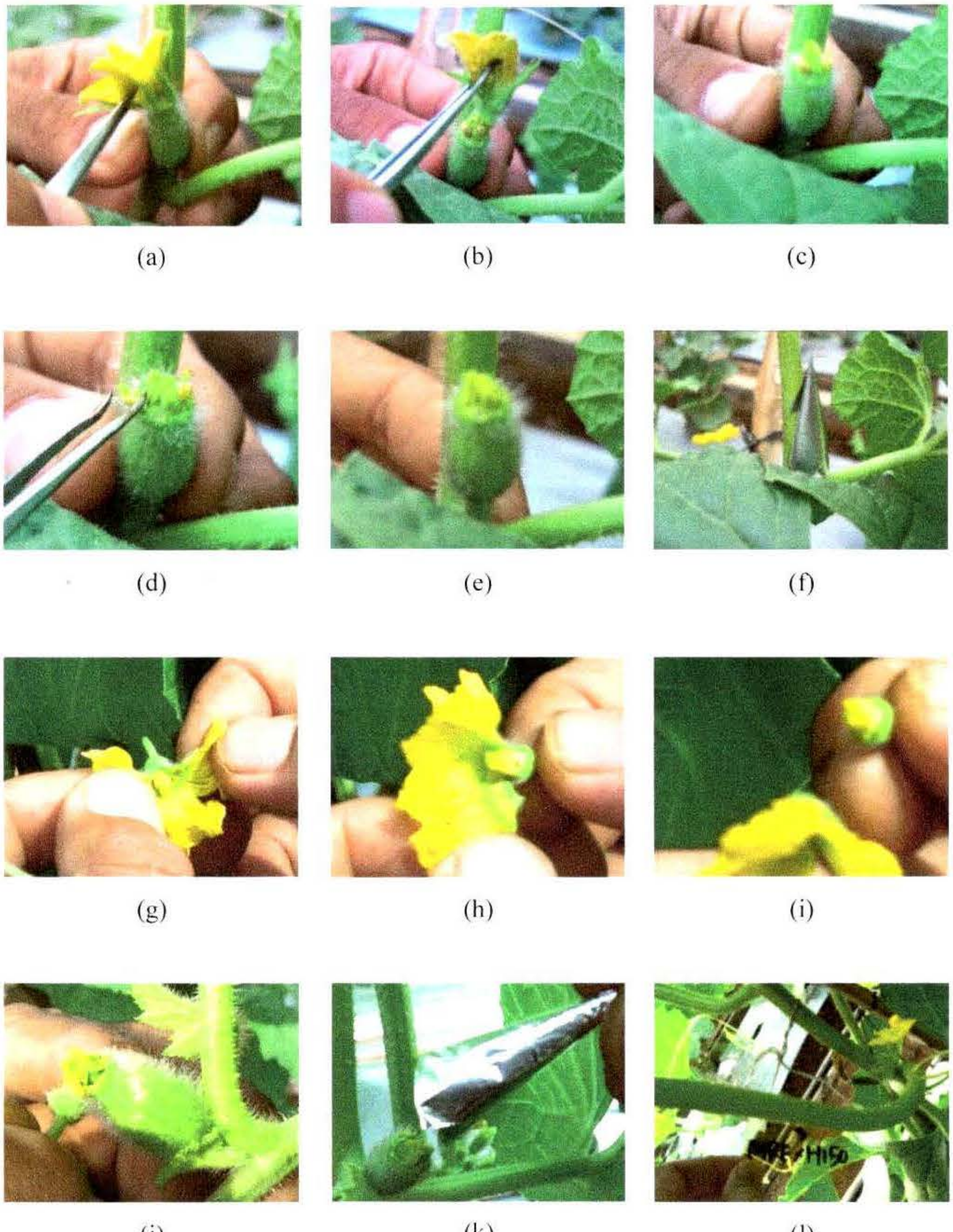

Figure 2. Steps involved in making a controlled crossing among melon genotypes: emasculation of a hermaphrodite flower on a female parent plant, before anthesis (a-f), pollination, performed the next morning (g-j), covering (k), and labelling (l).

3. Breeding objectives and methods

Ideally, breeding objectives are set to meet a melon ideotype demanded by consumers. The other less ideal practice is, the objectives may be set by the breeders and later the new released varieties will be advertized to the consumers. Fruit traits could be of most importance for consumers, and therefore the breeders should put considerable efforts into them. Some important fruit traits are: high sugar content, high yield, thick flesh, crisp flesh texture, attractive flesh color (usually green or orange), no unpleasant after-taste, hard rind for transportations, long shelf life, and good-looking dense net (for cantaloupes). No less important are breeding for pest and disease resistance. Important diseases in tropical regions include powdery mildew, downy mildew, bacterial wilt, and viruses. Additionally, breeding for adaptation to marginal environments, for example, drought tolerance, acid soil tolerance, or salinity tolerance could be of important considerations as well.

Because melon is a cross-pollinated species, its breeding programs could be targeted for developing improved open-pollinated varieties (OPVs) or hybrid varieties. Hybrid varieties are more common nowadays than OPVs eventhough their seed price are more expensive. Most melon hybrids available in the market are single crosses resulting from controlled mating of two inbred lines. Three-way cross and double cross varieties of melon hybrids are rarely available. An advantage of the single cross hybrid is theoretically more uniform than the other type of hybrids and the OPVs. Additionally, a hybrid melon variety may posess a specific combination of desirable traits (in our example, flesh and rind color) from its female and male parents. Characterizations of the traits may utilize a well developed descriptor such as from (IPGRI, 2003).

Breeding improved melon varieties involves four important practical steps: (1) development of base populations, (2) development of inbred lines, (3) generation of hybrids through controlled mating among inbred lines, (4) evaluation of the hybrids. A base population is a segregating popoulation that can be derived from a controlled mating among two genotypes (for example, see (Zuniga *et al.* 1999)), or from a topcross. Inbred lines can be developed from base populations following the pedigree breeding method (Robinson, 2000). In our example illustrated in Figure 3, we have two F_2 base populations named A and B. Manual self-pollinations (selfing) were conducted in selected plants from each populations, and the resulting fruit would contain S_1 seeds. The S_1 seeds from each fruit were kept separately and planted in groups in the following season. Selections were made among and within gorups, and the selected S_1 plants were selfed to produce S_2 seeds. In a practical breeding program for fruit traits, we selfed a number of plants and then perform selection based fruits performance later. These processes continue until at least S_7 generation. The S_7s or more advanced generations have homozygous genotypes in most of the loci, and hence can be considered as inbred lines. Genetic diversity within an inbred line theoretically are small, among lines derived from the same base population are larger, and among lines from different base populations are even larger. The hybrids, therefore, are suggested to be produced by crossing the lines derived from different base populations for obtaining aimed combinations of the traits as well as some amount of heterosis. Studies reported positive heterosis for fruit shape in melon (Fernandez-Silva *et al.* 2009; Jose *et al.* 2005).

Inbreeding depression are a phenomena typically observed during development of inbred lines of a cross pollinated species. We observed somewhat higher inbreeding depression level for fruit weight in reticulatus (netted) groups than in inodorus; whereas for sugar content, we did not notice a considerable level of such a depression.

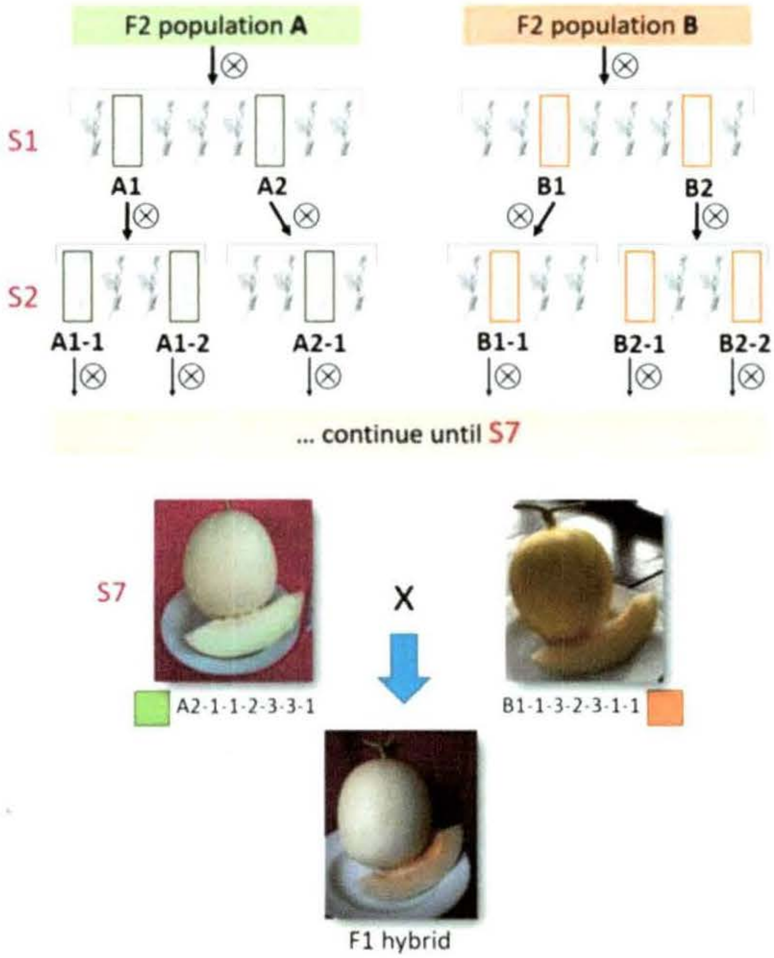

Figure 3. Illustration of steps involved in hybrids melon breeding

Our previous study evaluating 29 melon genotypes showed that fruit weight was positively correlated with fruit diameter ($r=0.96$, $P<0.01$), flesh thickness ($r=0.82$, $P<0.01$), fruit length ($r=0.67$, $P<0.01$), and rind thickness ($r=0.49$, $P<0.01$). We performed a path analysis for partitioning the correlation coefficients into direct and indrect effects, using fruit weight as an independent variable (Y), and stem diameter, days to harvest, fruit length, fruit perimeter, rind thickness, and flesh thickness as dependent variables (X). The direct effects of fruit perimeter on fruit weight were positive and large (0.83), while the indirect effects through the other X's are negligible. Altogether, these six X traits could explain 96% of the total variability of fruit weight.

4. Future challenges

The demand for melon fruits implies the necessity of quality seeds production of improved varieties. Changes on consumer perferences need to be anticipated through development of new, unique varieties with excellent tasting quality. Small-size melon cultivars will perhaps be popular for small family or personal consumptions.

Planting melon in tropical regions faces the challenges on dealing with pest and diseases. Downy mildews and viruses, among other diseases, are regarded as very important melon diseases leading to considerable economic loses, and hence breeding melon varieties resistant to these diseases could be among the top priorities. The 'IPB Meta 9' melon genotype from our breeding program showed moderate resistance to downy mildew (Huda and Suwarno, 2016). Its fruits, however, are small (less than 500 g on average) with thin and sweet white flesh. This implies that subsequent breeding activities are needed to introduce the resistance to another genotypes, and/or to 'fix' some undesireable characteristics posessed by this genotypes.

Our breeding experience suggested that breeding reticulatus (cantaloupe; netted) melons are more challenging somewhat than breeding inodorus (honeydew; non-netted) melons in terms of achieving uniformity of the lines. The cantaloupes unfortunately are still more popular than the honeydews in Indonesia, and therefore varieties from both groups need to be bred still. Large-size cantaloupes with sweet, orange thick flesh, and strong rind are on market demand at present and also in near future, we predict. Breeding honeydews could be aimed for obtaining fruits with thick, sweet and crisp flesh, along with unique rind appearance. Additionally, breeding for nutritions could also be an interesting option as melon is a good source of vitamin C. We recently observed a considerable range of genetic diversity for vitamin C concentrations among several melon genotypes in our breeding program.

Finding genes controlling a trait of interest is simply challenging; however genotyping tools are becoming more available recently. Marker-assisted selection could be an option for accelerating the breeding process, especially for traits that are controlled by single or few genes. Gene-finding approaches such as QTL or associaton mapping requires both genotypic and phenotypic data. Several recent studies have been conducted for studying QTL controlling important traits in melon, for example fruit traits (Monforte *et al.* 2004; Ramamurthy and Waters, 2015; Wang *et al.* 2016), fruit ripening and fruit softening (Moreno *et al.* 2008, Vegas *et al.* 2013), yield-related traits (Zalapa *et al.* 2007), powdery mildew resistance (Fukino et al. 2008; Wang *et al.* 2016), cucumber mosaic cucumovirus resistance (Dogimont *et al.* 2000), aphids and whiteflies resistance (Boissot *et al.* 2010).

Phenotyping of low-heritability, polygenic quantitative traits unfortunately are typically difficult. Measuring tolerance to abiotic stresses are not simple because a relatively small shift on the stress level may lead to a dramatic change on the phenotype. Even more difficult is that, another stress (e.g. heat) can be confounded with the stress-of-interest (e.g. drought) if the experiment is not controlled properly. Utilization of computer-aided, precision phenotyping which are becoming more popular could be a good opportunity for obtaining more accurate phenotypic data. Some of the tools are not very expensive (for example, using scanner and/or computer imaging devices along with a relevant software for quantifying color components as RGB) and could be of practical use in a breeding program.

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