

RESEARCH ARTICLE | DECEMBER 23 2019

Mango off-season technology (MOST): Innovative, applicable, adaptive to climate change, and brings many positive impacts **FREE**

Zainuri ✉; Taslim Sjah; Nurrachman; Candra Ayu



AIP Conference Proceedings 2199, 040008 (2019)

<https://doi.org/10.1063/1.5141295>



CrossMark

AIP Advances

Why Publish With Us?

- 25 DAYS**
average time to 1st decision
- 740+ DOWNLOADS**
average per article
- INCLUSIVE**
scope

[Learn More](#)

Mango Off-Season Technology (MOST): Innovative, applicable, adaptive to climate change, and brings many positive impacts

Zainuri^{1,a)}, Taslim Sjah^{2,3}, Nurrachman² and Candra Ayu²

¹*Faculty of Food Technology and Agro Industry, University of Mataram, Indonesia*

²*Faculty of Agriculture, University of Mataram, Indonesia*

³*Study Program of Dryland Resource Management, Postgraduate Study, University of Mataram, Indonesia*

^{a)}Corresponding author: zainuri.ftp@unram.ac.id

Abstract. This paper presents the application of the new technology on production of mango fruits at out of its normal seasons, by using growth regulator in North Lombok, as well as presentation of its benefits and potentials for several aspects of mango production, mango producers, and the regions. Source of information for this paper was mainly obtained from authors own research and extension activities related to the introduction of the new technology for production of mango fruits in out of normal mango seasons. The information is also supplemented through reviews of related literatures. The paper concludes that mango off-season technology (MOST) with help from plant growth regulator or hormone, called paclobutrazol, has been recently applied to mangoes in Nusa Tenggara Barat (NTB). The technology is innovative, and adaptive to climate change occurred currently. Despite still not so many growers were convinced to apply for it so far, the technology is friendly to be applied. Its application to mangoes, called here as 'MOST' has evidenced that the technology is very useful as it brings many positive impacts. The application is potential to be scaled up to other regions, or to other crops in the same or different regions.

INTRODUCTION

Mango is one of the main horticultural products in Nusa Tenggara Barat (NTB) province as well as in Indonesia. Mango cultivation has been continued to develop in this province, indicated by increased production in recent years. For example, production in 2009 was 99,360 tons, and increased to 110,637 tons in 2013. In addition, mango is a fruit crop that has the highest production amongst fruit crops in the province [1]. In particular, mangoes from NTB has special quality in that its taste better (such as sweeter) than other regions, as mangoes in NTB are produced in relatively dry areas, such as mangoes from North Lombok Regency and Sumbawa Island [2].

Despite of its importance contribution to the region, mangoes are still (at least most of them) farmed in non-commercial way. They are farmed in traditional way, that is mango trees are planted, and then farmers just wait for several years for production, without applying agricultural intensification or new technology to the crop. The condition was coupled with traditional marketing that relies primarily on outside buyers who come with traditional low price offers [3]. As a result of all these practices is that there was not much improvement in mango grower's livelihood. Change to this situation needs interventions, one of which is called 'off-season technology'. As it is applied for the first time in mango, then this technology can be called 'Mango Off-Season Technology', abbreviated here as 'MOST'. This technology is not only foreseen to play role in technical aspect but also in its adaptation to climate change, market, and so on.

One of the strategies to reduce the negative impact of climate change is by bringing the fruiting season bit earlier so that the peak season does not fall in the rainy season. This may be done by manipulating or stimulating flowering process during off-season period. For that purpose, hormone use for stimulating and regulating mango flowering for expected periods outside normal flowering season become a strategy for adapting to the extreme climate. In addition to adaptation to climate, flowering stimulation using hormone can also extend the availability of fruit (such as mango) for the whole year round that overcome the problem of seasonal and regular production period. Mango in NTB is normally available for 3-4 months (from mid of September to the end of December or beginning of January) [2, 3].

This paper presents the application of the new technology on production of mango fruits at out of its normal seasons, by using growth regulator in North Lombok, as well as presentation of its benefits and potentials for several aspects of mango production, mango producers, and the regions.

MATERIALS AND METHODS

Source of information for this paper was mainly obtained from authors own research [2-6] and extension activities [2, 4, 7-9] related to the introduction of the new technology for production of mango fruits in out of normal mango seasons. The information is also supplemented through reviews of related literatures [10-14]. Results of this study are presented in the next sections. It is commenced with the description of the technology, followed by the technology application, benefits and its potentials for increasing livelihood of the growers and people in general.

RESULTS AND DISCUSSIONS

MOST: What is it?

This technology was designed from the principle that flowering and fruiting of trees can be stimulated in certain conditions and the conditions can be manipulated to suit to the growth of the trees. For example, flowering and fruiting can be stimulated with stressed conditions or with the use of hormone. Several research have been done to apply hormone to mangoes [2, 5, 15-18]. They found that a hormone or a growth regulator, called 'Paclobutrazol', or well known as 'Paclor', is effective to stimulate flowering and fruiting several varieties of mango. In market, there are many brand names for paclobutrazol, one of them is 'Coultar'. When this hormone is applied to crop, it stimulates flowering and then fruiting of the crop. In other words, mango farmers can decide timing of mango fruiting by applying paclor on accordance schedule. The application of the hormone adds production to the normal production season. Study by Zainuri [3] revealed that total production of mangoes from normal season and from outside of the normal season was increased by 30 %. Therefore, the use of the technology brings at least two benefits: one is increased total production, and another is increased mango price as the fruits are offered at the time of limited supply, while demand for mangoes is about the same.

How to Apply the Technology?

The application of paclobutrazol in mango trees is simple. It can be applied by infusing through stems or roots, spraying to leaves, or watering to the soil around the trees. Amongst these methods, the most effective one is the last mentioned one. The application of paclobutrazol can be started after the trees have reached the stage of flowering. Application before this stage will cause trees to be smaller than normally. It is best if applied at 5-6 years old trees, or at least the trees have fruited twice. The application of paclobutrazol at the same trees can be once year, with caution to reduce the amount up to $\frac{3}{4}$, since the previous application still leaves some amount for about 2 years. Growers should attempt to time the application of paclobutrazol such that the flowering time does not meet with lots of rainfalls, as that can drop the tree flowers. However, when flowering at time of bit too dry, then growers should make attempt to irrigate the trees sufficiently [16].

Watering method started with digging a whole of 10 cm depth rounding the tree in 20- 30 cm distance from the tree. Several days before putting the growth regulator into the soil, it is recommended to also put some amount of fertilizers to the tree. Depending on the need, organic or an organic fertilizer can be applied. The additional fertilizer application is required to support the growth of the trees, i.e. for flowering and fruiting, maintaining the mango trees to stay strong [16].

The use of paclobutrazol is reported to be applicable for crops other than mango. In general, trees having wood are good to receive paclobutrazol application [15, 19]. However, each crop or even each variety within a crop requires specific dozes, way, and time, since each has its own specific growth requirements. This growth requirements means more research are required to find those specific doze, way, and timing for more crops or varieties.

MOST is an Innovation

Mango fruits are traditionally produced during their own normal season or timing. The application of a growth regulator, such as paclobutrazol, can change the yearly traditional timing of flowering and fruiting of a crops [2, 3]. The hormone stimulates flowering and fruiting after about two months of its application. This application does not stop the flowering and fruiting of the crop at the normal timing. The crop still produces as previous years [15]. As a result, total production increases, since there is additional production from outside the normal season to the production of the normal season.

The technology can be said as an innovation. This technology is relatively new for Indonesia, and not much application has been practiced in Nusa Tenggara Barat. A few farmers who have applied the technology have been better off compared to others who do not apply. In this matter, extension work to disseminate information and particularly to convince farmers to adopt the technology is required, not only in terms of frequency but also in a method that effective for delivering.

MOST is Adaptive to Climate Change

The technology can be applied easily. It requires little amount of water, i.e. just for watering during the application, and watering is needed for the paclobutrazol and fertilizer. This water requirement is not much and can be done manually through the use pipeline or by carrying water in a container to the location of mango trees [3]. By this way of application, the use of paclobutrazol can be at any time during the year, both at rainy season or dry season, while growers keep controlling and adapting to condition of moisture availability. In other words, the application does not impede by the weather condition. If there is water from the season then that water is utilized and when there is insufficient water available naturally, then irrigation can be brought in to supply the need of water for the crop.

There is another advantage of paclobutrazol application that shows its adaption to climate variability. That is, the technology is applied at out of normal season, when usually there avails lots of rainfalls. At times of lots of rainfalls, diseases may attack more than at time of less rainfalls. So, the use of paclobutrazol at times of fewer rainfalls also means reduce the potential of disease attacks, and thus it requires less energy or cost to crop production.

MOST brings many Positive Impacts

There are many positive impacts brought by the innovation. The impacts are in the aspects of mango production, price, trade, income, workforce, and economic improvement. The technology causes production increases. The increase sources from additional production at times of paclobutrazol application, and this adds to the normal production as to without paclobutrazol application. The total production becomes more than production without pacbutzaol application. The study counted about 30 % increase of production from the non- application of the technology [3].

Furthermore, the price of mango fruits are higher due to its availability at out of normal season, when supply is limited to only from those who apply the technology. This follows price theory that states when supply is limited under other factors unchanged, such as constant demand, then the price will be increased [20-23]. As an illustration here, a study by Zainuri [3] reported that the price per kg at the farm gate at the normal season was about Rp 1.000 – Rp 2.0000 at the normal season, and this was very low comparatively to prices of outside the normal season, when prices were about Rp 5.000 – Rp 7.000. Consequently, from the increase of both production and price, income also increases. Although there is additional cost for the application of the hormone, additional fertilizer, maintenance and labour, yet these all are accumulated only relatively a little.

The application of technology also needs additional work. As a result more workers are involved. The involvement of workers not only adds on farm activities but also off-farm activities (such as in mango processing to be new products, which have longer life storage), or non-farms activities (such as in trading of mangoes, mango products, or mango inputs). Therefore, this technology helps the region in general in reducing unemployment and poverty, since there are jobs for new workers, or additional works for the already existed workers. The region also be helped with retribution or tax paid to the government from activities related to mango businesses in general.

Scaling Up Possibility

It has been evidenced the technology of using growth regulator or hormone, called ‘paclobutrazol’ (be nick named as ‘paclo’) has been applied successfully in mango. It was also reported to give satisfactory production in other crops. It is believed that to trees with wood within its structure can be applied and be expected to give positive impact.

The application of the technology has not been wide enough. Only a few crops to which the technology have been applied. In Nusa Tenggara Barat, the application has been only to mango, and that is only by a few growers in North Lombok. Even to those few growers, they applied it to limited trees, not all trees that they have [3]. There are more other crops to which the technology is possible to be applied, in addition to more mango trees of the

same growers. As well as that there are other regions within NTB or outside NTB, where this new technology can be applied to mangoes or other crops that grow in there.

Accordingly, there exists a huge potential to apply the innovative technology. The challenges, amongst other, are how to disseminate this technology to other growers or to other regions in an effective way that can convince the would applicants, in NTB or outside, in mango or non-mango crops.

CONCLUSIONS

Mango off-season technology (MOST) with help from plant growth regulator or hormone, called paclobutrazol, has been recently applied to mangoes in Nusa Tenggara Barat (NTB). The technology is innovative, and adaptive to climate change occurred currently. Despite still not so many growers were convinced to apply for it so far, the technology is friendly to be applied. Its application to mangoes, called here as 'MOST' has evidenced that the technology is very useful as it brings many positive impacts on economic, social, and environment. The application is potential to be scaled up to other regions, or to other crops in the same or different regions.

ACKNOWLEDGEMENT

We express our sincere thanks to any person or body who has contributed this paper in one way or another. Special thank goes to the funding body for this research, ACIAR, who funded most parts of thi activity.

REFERENCES

1. BPS NTB, *Nusa Tenggara Barat Dalam Angka 2014 (West Nusa Tenggara in Figures 2014)*, Badan Pusat Statistik Nusa Tenggara Barat (Central Body of Statistics of West Nusa Tenggara), Mataram, 2015.
2. Zainuri, H. Suheri, A. Daly, I. Baker, B. Thistleton, A. McLennan, M. Rahayu, Mursal, *Kualitas Mangga dan Upaya Perbaikannya Dalam Menunjang Agribisnis Mangga di Nusa Tenggara Barat (Mango Quality dan Its Improvement Effort to Support Mango Agribusiness in Nusa Tenggara Barat)*, in: Seminar Dalam Rangka Dies Natalis Fakultas Pertanian Universitas Mataram, Fakultas Pertanian Universitas Mataram, Mataram, 2009.
3. Zainuri, T. Sjah, Nurrachman, C. Ayu, *Adaptation to climate for gaining higher economic value of mangoes in the Regency of North Lombok*, Climate Change Adaptation Project, Mataram, 2012.
4. Zainuri, Nurrachman, T. Sjah, C. Ayu, *Adaptation to climate for gaining higher economic value of mangoes in the regency of North Lombok*, Universitas Mataram, Mataram, 2013.
5. M. Rahayu, N. Hidayah, S. Qureshi, B. Thistleton, Zainuri, M. Yusuf, Nurrachman, *Harvesting period through flowering modification system in North Lombok Indonesia*, in: The 9th International Mango Symposium, Sanya, China, 2010.
6. Zainuri, T. Sjah, *Survei kualitas mangga dalam rantai pemasaran mangga*, Universitas Mataram, Mataram, 2018.
7. Zainuri, T. Sjah, A. Sauqi, Jayaputra, *Pengembangan Agrowisata Melalui Sistem Agribisnis dan Agroindustri Terpadu Untuk Mendukung Pariwisata dan Ekonomi Desa Gumantar Kabupaten Lombok Utara (Developing Agrotourism Through Integrated System of Agribusiness for Supporting Tourism and Economic of Gumantar, North Lombok)*, in, Lembaga Penelitian Universitas Mataram (Research Institution of University of Mataram), Mataram, 2016.
8. Zainuri, B.R. Handayani, W. Werdiningsih, W. Widyasari, *Modul pelatihan pengolahan hasil pertanian untuk meningkatkan ekonomi perempuan di Kabupaten Lombok Utara*, Konsorsium Karya Terpadu-MCAI, Mataram, 2017.
9. Zainuri, T. Sjah, A. Sauqi, Jayaputra, 'Agro-tourism Development in North Lombok, Indonesia, Stimulates New Crops and Technology Adaptation, and Farming Becomes Profitable', *Asian Academic Research Journal of Multidisciplinary*, 4 (2017) 1-8.
10. T. Sjah, *Metodologi Penelitian Sosial Ekonomi*, Mataram University Press, Mataram, 2011.
11. E. Babbie, *Survey research methods*, Wadworth Publishing Company, Belmont, California, 2004.
12. M.Q. Patton, *Qualitative research and evaluation methods*, 3 ed., Sage Publications, Thousand Oaks, California, 2002.
13. W.L. Neuman, *Social research methods: Qualitative and quantitative approaches*, Allyn and Bacon, Massachusetts, 1994.

14. K. Kumar, 'An overview of rapid appraisal methods in development settings', in: K. Kumar (Ed.) *Rapid Appraisal Methods*, World Bank, Regional and Sectoral Studies, Washington, D.C., 1993, pp. 8-22.
15. O. Untung, *Agar Tanaman Berbuah di Luar Musim*, Penebar Swadaya, Jakarta, 2010.
16. D. Cahyana, *Cara Aman Pakai Zat Pengatur Tumbuh*, in: Trubus, 2007.
17. S. Yuniastuti, Suhardjo, Handoko, Hanafi, M. Ghozali, *Pengaruh Cara Aplikasi dan Dosis Paclobutrazol Terhadap Pembungaan dan Pembuahan Mangga Arumanis*, in: Seminar Teknologi Pertanian untuk Mendukung Agribisnis dalam Pengembangan Ekonomi Wilayah dan ketahanan Pangan, Jakarta, 2000, pp. 147-150.
18. V. Kulkarni, D. Hamilton, G. McMahon, *Flowering and Fruiting in Mangoes in the Top End with Paclobutrazol*, in: *Crops, Forestry and Horticulture*, Darwin, 2006.
19. R. Purwanto, H. Inoue, 'Pengaruh paclobutrazol terhadap pertumbuhan dan pembungaan jeruk Satsuma Mandarin pada beberapa kondisi suhu', *Jurnal Agronomi Indonesia*, 22 (1994).
20. W.D. Seitz, G.C. Nelson, H.G. Halcrow, *Economics of resources, agriculture, and food*, 2 ed., McGraw-Hill, New York, 2002.
21. G.L. Cramer, C.W. Jensen, D.D.J. Southgate, *Agricultural Economics and Agribusiness*, 8th ed., John Wiley & Sons, New York, 2001.
22. K.L. Casavant, C.L. Infanger, D.E. Bridges, *Agricultural economics and management*, Prentice Hall, Upper Saddle River, New Jersey, 1999.
23. T. Sjah, *Ekonomi Pertanian (Agricultural Economics)*, Mataram University Press, Mataram, 2010.