MODIFICATION VEGETATIVE OF PLANT HEIGHT IN PADDY AFTER PBZ APPLICATION WITH RICE – OIL PALM PLANTING SYSTEM

BAMBANG SURYA ADJI SYAHPUTRA[1], MAIMUNAH SIREGAR[1], RUTH R. ATE TARIGAN[1], AND NUR JAMAY'AH BR KETAREN[2]
[1]Panca Budi University, Medan, North Sumatera
[2]Al-Azhar University, Medan, North Sumatera
bangsas@yahoo.com

ABSTRACT
Paclobutrazol (PBZ) is one of the hormone that acts by inhibiting activity of biosynthetic pathway of GAs, resulting in retardation if internodes in paddy. The aim of this experiment to find out concentration of Paclobutrazol (PBZ) suitable application in paddy with planting rice-oil palm system. This research was conducted using Split Plot Design factorial in four replicated which main plot were varieties IR 64, Mekongga, Inpari Sidenuk and Ciherang, whereas sub plot were used to concentration of PBZ with 0, 200, 400 and 600 ppm and was applied at panicle initiation (PI). Paddy varieties were planted with transplanting after 3 weeks in the seedling. Measuring plant height was conducted at three times, before application, two weeks after application and at harvesting. The result was shown that plant height before application was no signifant for among varieties and concentration, unlike plant height at two weeks after application and harvest time, following increase of concentration PBZ, plant height was decreased and significantly, respectively. The reduction of plant height with concentration PBZ at 400 ppm was found to be optimum as compare that ones. There was no interaction between varieties and concentrations of PBZ.
***Keywords*;** Concentration, Paddy, Rice-Oil Palm, Concentration, Paczlobutrazol, Panicle Initiation

A. INTRODUCTION

Paddy, one of the main source of carbohydrate for human life and can be grown in rainfed lowlands, rainfed uplands, mangroves, and others field due to this plant easily to adaptive with different environmental condition. In Indonesia, rice always planting with others plant is called integrated system such as "mina padi" (integrated paddy with fishes), rice-oil palm, and rice-rubber. It is assumed that around 40% of the population in the world consumes of rice and in Asia, more than 3 billion people depend on this crop (Smith and Dilday 2003). Currently, rice production is not parallel to population increase in most of the rice producing and consuming countries especially in Indonesia. On the other hand, Rice farming system is one of national food security and occupied around 20 million rural people in this field, so that its function to be very important and strategic. The prime purpose of rice planting is how to increase the yield for demand producing-consuming without compromising its quality.

The main objective in the Agriculture Ministry of Indonesia is to increase paddy yield due to self-sufficient through the optimum use of resources in the agricultural sector especially in rice field. To increase rice yield in square of land is needed some teknology like fertilizers, cultivation and farming system. One alternative to improve the programme is by adopting new agricultural technology by changing the existing monoculture system to diversified agricultural system such as the integrated rice-oil palm system. This system is easily implemented, increases the productivity of rice fields and efficiently minimizes the input cost. Integrated rice-oil palm system (IROS) has been recognizing since the farmers change the rice-field with comodity paddy to be oil palm plant. Currently, many rice farmers are transferring their land to plantation crops. The impact is very pronounced on farmers, namely their social life is increasing, but at the level of local and central government has a negative impact on food security. The loss of land for rice cultivation has resulted in a decline in rice production both at the farmer and regional levels. The main problem is the extent to which farmers understand the function of food security, especially for their own food self-sufficiency.

Although the change in the commodity of rice into oil palm can making unstable in food security, but several studies have suggested the strategy of integrated rice-oil palm system, namely between young oil palm (before fruiting) can be cultivated for intercrops (food crops) such as rice, corn and beans -defraction for 2 years (Lubis et al, 1999). Therefore, the land has changed to become an oil palm commodity, farmers can still planting rice among the oil palm plants. Rice planted in the middle of the palm is always low in production as compared to those grown at normal rice field. The problem is paddy plant has been modified for openly planted plants, but if this crop is planted in the shade it will return to habitat itself, resulting in perfect growth in the vegetative phase with low production (Ismail, 2015). One of the efforts to deal with the problem of rice grown under shade is to modify its vegetative growth to increase its production.

The reason farmers still grow rice is because for their own consumption, in addition to utilizing the land optimally. Even though rice production in united areas is still low, farmers still continue to grow rice in the middle of the oil palm. There are already studies on suitable varieties planted in the integration, such as Inpari 10 varieties planted under stands of oil palm plants with different planting systems found results that are not significantly different (Manto, 2015). This fact shows that the rice planting system does not affect the conditions under the shade, meaning that the Inpari 10 variety if planted in integration with oil palm can use a different cropping system.

Paclobutrazol (PBZ) is one type of hormone in the ABA (Abscisic Acid) group whose working system is to inhibit plant growth through inhibition of geberellin acid biosynthesis (GA) (Rademacher, 2000). PBZ, better known as PP333 and commercially available on the market with trade names include Bonzi, Downsize, Paczol, Piccolo, Clipper, Cultar, and Parlay (Lever et al., 1982; Barrett and Bartuska, 1982). Plant growth inhibiting hormones with the mechanism of action of these hormones do not reduce the size of the plant, but reduce the average growth of a plant and if applied can cause plants to be shorter than usual (Latimer et al., 2001 and Davies et al., 1988).

Paclobutrazol (PBZ) is a type of hormone whose work system inhibits the activity of Giberellin Acid (GA), where GA is a hormone whose function is to stimulate the elongated growth of cells which results in higher plants. With the inhibition of the GA work, the plant will experience a high inhibition of the plants and plants become shorter than usual. At a concentration of 200 ppm PBZ applied to rice plants have shown the results of a decrease in the concentration of GA3 on rice plants and the results were statistically significant compared to control (Syahputra et al, 2013). PBZ applications can also increase rice production up to 15% compared to PBZ applications (Syahputra, 2013).

PBZ application to be increase of chlorophyll in flag leaf area so that the result of phosinthetic higher than usual and the yield of rice up to with more fill in the grains. Integrated paddy with oil palm always production of rice below as compare than planting paddy in the rice field. Reducing of paddy yield because ligh intensity is poor and to influence of photosinthetic in rice. Increasing chlorophill after aplication PBZ can be increase photosintetic rate in rice. This experiment was important because resulting of yield can be increase following the reduce of plant height and transportation photosinthetic or sour and sink to be shoother.

B. MATERIAL AND METHOD

This field trial was carried out at the Kota Rantang village, Kecamatan Hamparan Perak, Kabupaten Deli Serdang, Sumatera Utara, from May 2018 until September 2018. It is used to assess the effect of the plant growth retardant paclobutrazol with several concentrate as foliar spray on the growth and yield in the rice-oil palm system. The environmental condition was recorded to get better understanding of the field conditions. A square of land around 0,5 hectare was divided into 48 subplots of 2,5 m x 2,5 m, and the experiment was done in three replicates at split plot design with main plot were varieties and concentration was sub plot. The field was flooded when the paddy plant was about one week after transplanting, and the water in the field was maintained at about 5-15 cm deep. Subplots were separated with wood's stick and rope. The variety of paddy used was Ciherang, Mekongga, IR 64 and Inpari Sidenuk and the planting system was used transplanting after 3 week in seedling. PBZ application was applied at panicle initiation (PI). We applied inorganic fertilizer to the rice at normal rates, 120 kg N, 50 kg P_2O_5 and 60 kg K_2O per hectare. Weeding, control pest and diseases were done based on the standard practice for paddy planting in Indonesia with pesticides when necessary to eliminate enemy in the rice-oil palm system. The plant height was measured three time namely; before application, two weeks after application and at harvesting. All results were combined and subjected to analysis of variance (ANOVA) and followed by a comparison, the statements made in the text are based on differences that were statistically significant using DMRT test at $p < 0.05$ level.

C. RESULT AND DISCUSSION

Result

In this experiment focus how to modification on vegetative especially in rice plant and a decline plant height due to chemical paclobutrazol as foliar application with four Indonesia varieties; Inpari Sidenuk, IR 64, Mekongga and Ciherang. Characteristic of the two varieties (Ciherang and Sidenuk) are similar with harvest time at 105-110 days and plant height around 104-110 cm. Unlike others varieties (Mekongga and IR 64) with plant height 110-120 cm and harvesting 110-120 days after sowing.For this field experiment, the average plant height of varieties before application was similary and statistically no significant among them both varieties and PBZ concentration (Table. 1). At two weeks after application, the plant height was reduced following the increase of PBZ concentration to 95,26 cm, 91,20 cm, 88,28 cm and 87,26 cm for PBZ concentration of 0, 200, 400 and 600 ppm, respectively.

Table 1 : Average plant height before application PBZ

	Sidenuk	IR 64	Mekongga	Ciherang	Average
P 0 (0 ppm)	84,90	87,29167	87,17	85,88	86,31
P 2 (200 ppm)	86,49	88,33333	88,34	86,91	87,52
P 4 (400 ppm)	84,59	87,14667	86,65	85,57	85,99
P 6 (600 ppm)	84,16	87,18667	84,85	84,34	85,13
Average	85,03	87,48958	86,75	85,67	**86,24**

Furthermore, the average plant height among the varieties were statically siginificant at $p<0.05$ between variety IR 64 with Sidenuk, Mekongga and Ciherang. Unlike among three varieties (Mekongga, Ciherang and Sidenuk) no significant difference at plant height, respectively both for two weeks after application and harvest time.

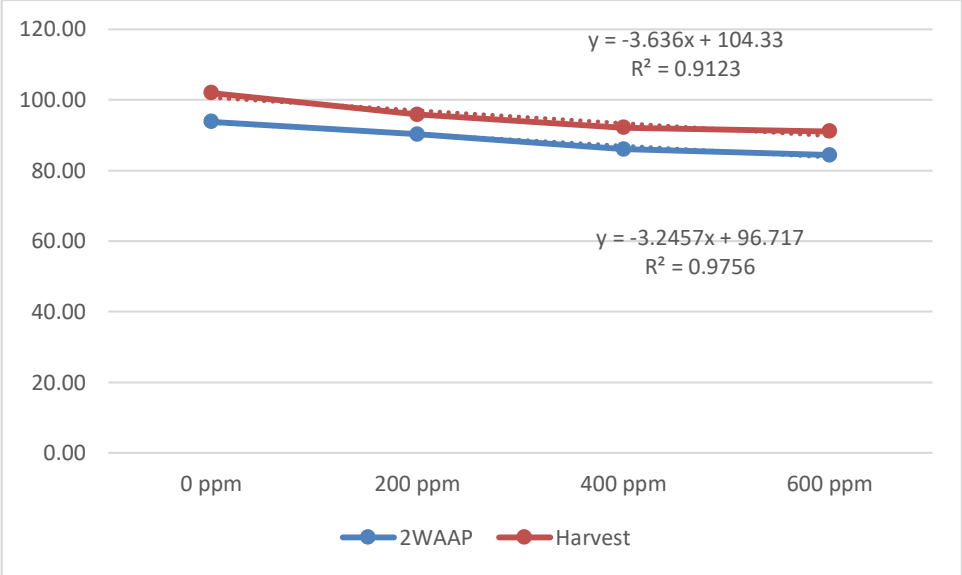

Figure 1: Effect of different PBZ concentration in plant height on two week after application (blue color) and at harvesting (red color)

The paddy crops were harvested after 90% of the grains yellowing. The plant height at harvesting was also decrease their average height decreased to 104,53 cm, 97,77 cm, 93,49 cm and 92,12 cm for PBZ concentration 0, 200, 400 and 600 ppm (Figure 1), respectively. The ANOVA test showed that there was statistically significantly different both PBZ concentrationlevels and among varieties. The measured parameter plant height at two week after application and harvesting showed that the trent of two different time measuring it cought be result similary (Figure.1).

Discussion

The retardation in vegetative growth especially plant height by altering relative sink strengths within plant had an indirect consequence of allowing a greater partition of the assimilates to reproductive growth, fruit formation, fruit growth and grains filling. It possible PBZ appears to be a promising means of controlling the balance between modification vegetative to the generative development.

Statistics analysis showed that there was siginifant different between untreated plant with PBZ applied. However, among the treatment plant was showed that no significant different between PBZ concentration 200 ppm with 400 ppm and 400 ppm with 600 ppm, but 200 ppm with 600 ppm significant difference, respectively (Figure.1). Similirally result with Syahputra et al (2016) and Sinniah et al (2012) showed that application PBZ at panicle initiation at different concentration was reduced palnt height, culm length and internode length. Application PBZ at concentration 400 ppm and applied at panicle initiation as optimum concentration and can reduce GA3 in rice crop and also reduced plant height (Syahputra et al, 2013). Application PBZ at various concentration and combined with silicon it preferred for provide multitude effect in rice plant (Dorairaj and Ismail, 2017).

D. CONCLUSION

The use of Paclobutrazol changed plant architecture to become shorter and stouter with various concentration. Thus the improved plant stature was able to enhance or modification vegetative growth to be generative development. It was found that plants treated with Paclobutrazol were able to withstand strong wind due to shorter and stouter of the stem. However, the further experiment will be conducted to examine the effect of PBZ at different time application, at which PBZ can effectively retard the endogenous GA biosynthesis.

AKNOLEDGEMENT

We gratefully acknowledge the financial support funded by Government of Indonesia through Kementerian Riset dan teknologi, Direktorat Jenderal Pendidikan Tinggi, for the project Applied Research wit title “Modifikasi Vegetatif Dengan Paclobutrazol Untuk Meningkatkan Produksi Tanaman Padi Dalam Sistem Integrasi Padi Dengan Kelapa Sawit”.

REFERENCE

Barrett, J.E. and Bartuska, C.A. 1982. PP333 effects on stem elongation dependent on ite of application. *Hortscience*, Vol. 17; No. 5, p737-738.

Davies, T. D., Steffens, G. L. and Sankhla, N. 1988. Triazole plant growth regulators. *Hort. Rev.* 10: 63-105.Ismail, M.R., 2015. Crop Improvement Strategies in Rice production Under Stressfull

Environment. *Seminar pangan dengan tema "Food Security and Climate Change Challenge".* Fakultas Pertanian UMSU, Medan 1 Juni 2015. (prosiding Nasional).

Latimer,J.G., Scoggins, H.L. and Banko, T.J. 2000. Using plant growth regulators on containerized herbaceous perennials. *Virginia Tech. Publication* No. 430. Blacksburg, VA, USA.

Lever, B.G., Shearing, S.J., and Batch, J.J. 1982. PP333 a new broad spectrum growth retardant. *In Proceedings of the 1982 Brithis Crops protection Conference – Weeds,* Vol 1, pp 3-10. Croydon; BCPC publication.

Lubis, E. Suwarno, & M. Bustaman. 1999. Genetik Ketahanan Beberapa Varietas Lokal Padi Gogo terhadap Penyakit Blas. *Balai Penelitian Tanaman Padi Sukamandi. Penelitian Pertanian Tanaman pangan* V. 18:2:1999. Puslitbangtan.

Manto, 2015. Pengaruh Sistem Tanam Terhadap Pertumbuhan dan Produksi Padi (*Oryza sativa* L.) pada varietas Inpari 10 di bawah Tegakan Kelapa Sawit. Universitas Muhammdiyah Sumatera Utara, Medan. Final Proyect, *Unpublished*.

Rademacher, W. 2000. Growth retardants: effects on gibberellin biosynthesis and other metabolic pathways. *Ann. Rev. Plant Physiol. Plant Molec. Biol.* 51: 501-531.

Dorairaj, D and Ismail MR, 2017. Distribution of Silicified Microstructures, Regulation of Cinnamyl Alcohol Dehydrogenase and Lodging Resistance in Silicon and Paclobutrazol Mediated *Oryza sativa*. Front. Physiol. 8:491.

Smith, C.W and Dilday, R.H. 2003. Rice: Origin, History, Technology and Production, *John Wiley & Sons, Inc.*

Sinniah, U. R., Wahyuni, S., Syahputra, B. S. A. and Gantait, S. 2012. A potential retardant for lodging resistance in direct seeded rice (*Oryza sativa* L.). *Canadian Journal of Plant Science*, Vol.92, No. 1, pages 13-19.

Syahputra, B.S.A. 2013. effect of paclobutazol on lodging resistance, growth and yield of direct seeded rice. *Ph.D Theses, Universiti Putra Malaysia (UPM),* Serdang, Selangor, Malaysia. (Unpublished).

Syahputra, B.S.A., Sinniah, U.R., Rastan, S.S.O. and Ismail, M.R. 2013. Changes in Gibberellic Acid (GA_3) content in *Oryza sativa* due to Paclobutrazol treatment. *Journal of Food and Pharmaceutical Science*. Vol.1, No.1 pages 14-17

Syahputra, B.S.A., Sinniah, U.R., Ismail, M.R. and Malappa, K.S. 2016b. Optimization of paclobutrazol Concentration and Application Time for Increased Lodging Resistance and Yield in Field-growth Rice. *The Philippine Agriculture Science(PAS),* Vol. 9, No. 33.