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Effects of Ripening Regulator on Rice Harvesting and Milling Quality

ศุภศักดิ์ ลิมปิติ [1/] *และ พรชัย เหลืองอาภาพงศ์* [1/]

Supasark Limpiti [1/] ***and Pornchai Lueang-a-papong*** [1/]

Abstract : Study on spraying Hom Mali 105 rice variety with dimethipin (2, 3 - dihydro - 5, 6 - dimethyl - 1, 4 - dithiin 1, 1, 4, 4 - tetraoxide) to accelerate ripening and reducing grain moisture content at harvest was carried out at Faculty of Agriculture, Chiang Mai University. Results of the study showed that the chemical could reduce grain moisture content significantly and rapidly. However, application it at 12 days before harvesting (12 DBH) resulted in grain yield reduction noticeably. Applying at 500 and 750 ml/ha at 8 and 4 DBH gave no effect on grain yield as compared to control. Spraying at 8 DBH with the rates 500 and 750 ml/ha gave no difference in term of moisture reduction and milling quality. In this experiment was found that % head rice of the sprayed plots was much superior to that of the unsprayed plots when the cut crop was milled without field drying. Spraying at 4 DBH with both rates gave the same results in grain yield and milling quality. Nonetheless, it was noted that when the unsprayed crop was field dried for 4 days after harvesting its milling quality improved greatly and statistically gave the same head rice percentage as those of the sprayed plots.

[1/] รองศาสตราจารย์ ภาควิชาพืชไร่ คณะเกษตรศาสตร์ มหาวิทยาลัยเชียงใหม่.

[1/] Associate professor, Department of Agronomy,Faculty of Agriculture, Chiang Mai University, Thailand 50200.

บทคัดย่อ : การใช้สาร dimethipin (2, 3 - dihydro - 5, 6 - dimethyl - 1, 4 - dithiin 1,1,4,4 - tetraoxide) พ่นข้าวหอมมะลิ 105 เพื่อเร่งการสุกแก่ และลดความชื้นเมล็ดก่อนการเก็บเกี่ยว ที่คณะเกษตรศาสตร์ มหาวิทยาลัยเชียงใหม่ ผลการศึกษาแสดงให้เห็นว่าสารเคมีชนิดนี้สามารถ ลดความชื้นของเมล็ดได้อย่างมากและรวดเร็ว อย่างไรก็ตาม การพ่นก่อนการเก็บเกี่ยว 12 วัน ทำให้ผลผลิตเมล็ดลดลงอย่างเห็นได้ชัด ส่วนการพ่นทั้งในอัตรา 500 และ 750 มล/เฮกตาร์ ในระยะ 8 และ 4 วันก่อนการเก็บเกี่ยวไม่ทำให้ผลผลิตลดลง การพ่นทั้งสองอัตราที่ 8 วันก่อนการเก็บเกี่ยวให้ผลในด้านการลดความชื้น และคุณภาพการสีไม่แตกต่างกัน ในการทดลองนี้พบว่า เมื่อนำข้าวไปสีทันทีโดยไม่ตาก คุณภาพการสีในแง่เปอร์เซ็นต์ต้นข้าวของแปลงที่พ่นสาร จะสูงกว่าแปลงที่ไม่มีการพ่นอย่างมาก สำหรับการพ่นสาร 4 วันก่อนการเก็บเกี่ยวพบว่าอัตราการพ่น 500 และ 750 มล./เฮกตาร์ให้ผลผลิตเมล็ดและคุณภาพการสี ไม่แตกต่างกันทั้งสองอัตราที่ใช้พ่น ส่วนในแปลงที่ไม่มีการพ่นสาร ถ้าตากข้าวที่เก็บเกี่ยวแล้วไว้ในแปลง 4 วัน คุณภาพการสีจะดีขึ้นมาก โดยผลลัพธ์จะไม่แตกต่างจากแปลงที่มีการพ่นสาร

Index words : ข้าว การสุกแก่ คุณภาพ การสี หอมมะลิ
Dimethipin, Rice, Hom Mali, Rice Quality, Ripening, Milling Quality

Introduction

The recent introduction of indigenous combine harvester to Thai agriculture for harvesting rice is aiming at solving labor shortage problem particularly in the central region and speed up harvesting and threshing process. Though the machine was proved to be technically feasible but it also inherited some problems. One of the major drawback is the crop has to be harvested and threshed at higher moisture level than usually done conventionally, since the crop would be threshed immediately after cutting without any field drying. Harvesting and threshing rice at unsuitable moisture content can cause harmful effect on milling yield (Araullo *et al.*, 1976).

Delay of harvesting to let the standing crop drying in the field can caused shattering loss and lodging for high yielding variety. Study made by Chinsuwan *et al.* (1996) showed various losses during harvesting and threshing using Thai combine harvester. The study emphasized the need for harvesting and threshing at appropriate moisture content to reduce such losses.

As natural drying of grain takes several days after ripening and the process of field drying is omitted by using combine harvester some mean to reduce moisture content of the grain at harvest is required. Report of using chemical for accelerating ripening of rice was presented by Lacodie (1987). The chemical used was dimethipin which was marketed as a ripening regulator under brand name "Harvade".

Use of dimethipin with rice was reported to caused the crop to ripe with rapid reduction of grain moisture content (Benyak,1987). However, there are some question to be answered if the dimethipin is to be used with Thai rice, they are: 1) when to applied the chemical without causing

reduction of yield, 2) what is appropriate application rate, 3) would the dimethipin cause any milling quality problem and 4) will there be any harmful residues in the milled rice.

The objectives of this study were to find the appropriate application rate and time for using dimethipin (2, 3 - dihydro - 5, 6 - dimethyl - 1, 4 - dithiin 1, 1, 4, 4 - tetraoxide) to reduce grain moisture content of Hom Mali 105 rice variety. And to examine effect of dimethipin on milled rice quality.

Material and Methods

General practice

Sowing of Hom Mali 105 rice variety in seedling plot was done on July 10, 1996. The seedlings were transplanted one month later at Faculty of Agriculture, Chiang Mai University experimental field. The plant spacing were 0.25 x 0.25 m. The 16-20-0 fertilizer at 94 kg/ha was applied on the day of transplanting. It was applied again one month later on September 10, 1996. The crop was harvested on December 3, 1996 which was 115 days after transplanting.

Experimental design

The two dimethipin spraying rates used in the experiment were 500 ml/ha and 750 ml/ha. Size of the experimental plot was 5 x 5 m. the plots were laid out in RCBD with 3 replications. The chemical was applied at 12, 8 and 4 days before harvesting using the two assigned rates. Three plots were kept as control (no spraying). Data collected from the control plots was used for comparison with the treated plots. Detail of treatments was shown in Table 1.

Table 1 Detail of treatments used in the experiment.

Treatment	Time of spraying	Spraying rate (ml/ha)	Date
Control	no spraying	-	-
1	12 DBH *	500	21/11/96
2	12 DBH	750	21/11/96
3	8 DBH	500	25/11/96
4	8 DBH	750	25/11/96
5	4 DBH	500	29/11/96
6	4 DBH	750	29/11/96

* DBH means Day Before Harvest

Data collection

Moisture content of filled grain was recorded on the day of spraying the dimethipin and every 2 days after that until harvest. Percentage of filled grain was as well determined.

The harvested crop was manually threshed and divided into 2 groups. One group was milled promptly after harvest. The other was dried in the field for 4 days before milling. The milling machine used was a laboratory mill which required 250 grams of sample for each test.

Results and Discussion

1. Grain Moisture reduction

1.1 Spraying at 12 DBH

Visual reduction of moisture content of filled grain is shown in Figure 1. The initial moisture content of the grain at 12 DBH was 69-71% (Table 2). In the first 2 days after spraying moisture content of grain in the control plots decreased 7.7% as compared to 48.4 and 51.5% for grain sprayed with dimethipin at 500 and 750 ml/ha respectively (Table 3).

Rapid reduction of 35.2% grain moisture in the control plot occurred between 10 DBH-8 DBH while moisture of the grain in treatment 1 and 2 decrease 7 and 5.1% respectively (Table 3). Drying rate of grain in control plots was high during 12 DBH to 4 DBH because the grain still had moisture content more than 20%. The rate decreased after that. Average moisture content of the grain in control plots at harvest was 15.4% which was significantly higher than that of the grain in the sprayed plots. For Treatment 1 and 2, highest drying rate occurred at 2 days after spraying. The rates were still high at 4 days after spraying (Table 3) however, at 6 DBH the moisture content of the grain in this two treatments had become as low as 13.1-13.3%. Therefore, drying rate after that was very low. Slight increase of moisture content happened between 4 DBH and 2 DBH due to high equilibrium relative humidity of the surrounding air. Harvesting moisture content of grain in treatment 1 and treatment 2 were 13.6%. From Table 2 it is clear that there was no different in moisture reduction between the application rate of 500 and 750 ml/ha when the chemical was sprayed at 12 DBH. The grain moisture content began to be lower than 14% at 6 days after spraying while the grain moisture content in control plots was as high as 21.4%. This means that the sprayed plots can be harvested 6 days faster than naturally dried plots. Earlier harvest will be very beneficial during wet season.

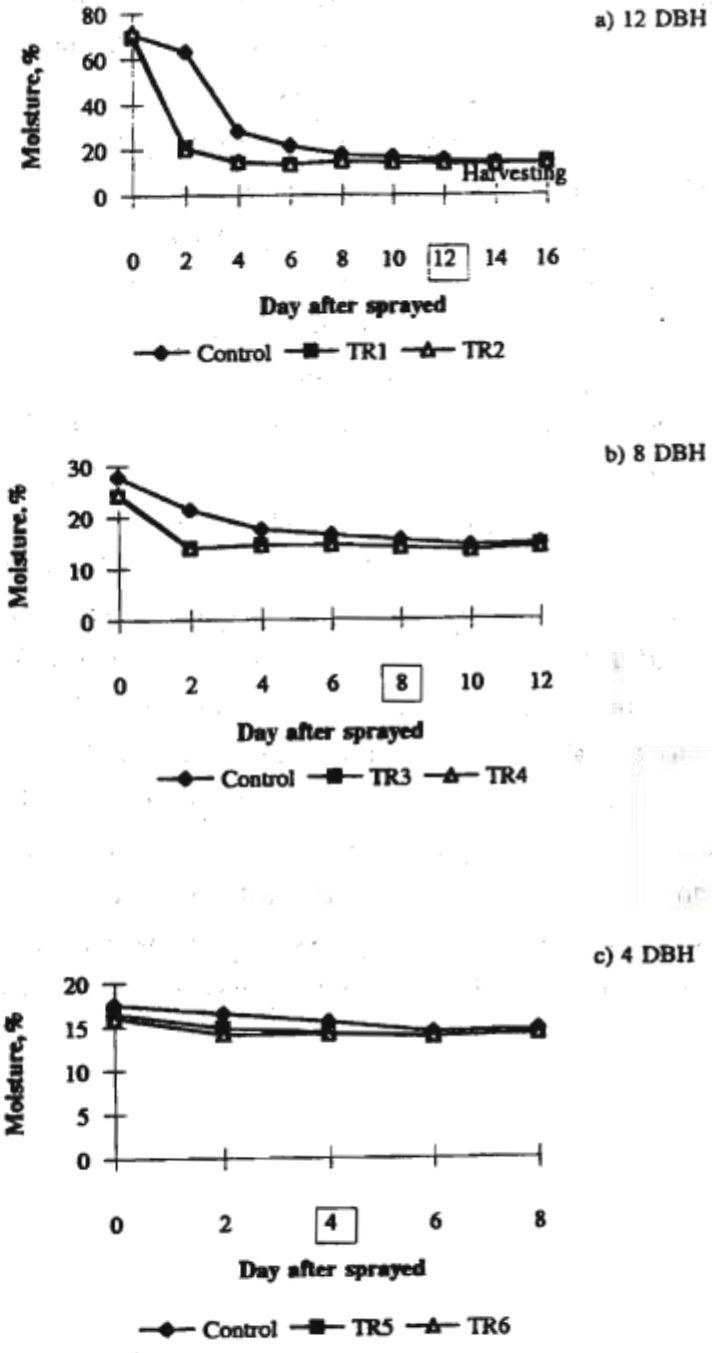

Figure 1 Reduction of grain moisture content after spraying with dimethipin. a) at 12 DBH. b) at 8 DBH. c) at 4 DBH. The small box on X-axis represents the day of harvesting.

1.2 Spraying at 8 DBH

Initial moisture content of grain in the control plots at 8 DBH was 27.8% while moisture content of grain at the beginning of spray in treatment 3 and 4 were 24 and 24.5% respectively (Table 2). In the first 2 days rapid reduction of moisture content in the two treatments occurred at the rate 10.1-10.6% and moisture content of the sprayed crop had dropped to below 14%. The result showed that if the dimethipin was applied at 8 DBH the crop could be harvested within 2 days.

1.3 Spraying at 4 DBH

At 4 days before harvesting moisture content of grain in the untreated plots was 17.5%, which was not significantly differed from moisture content of the grain in treatment 5 and 6. From Table 3 it can be seen that drying rate of grain in the control plots and in treatment 5 and treatment 6 was only 1.1, 1.7 and 1.9% respectively. Nonetheless, statistically, the dimethipin still could reduce the moisture of the grain faster than natural drying of the crop until the day of harvest.

At harvesting moisture content of grain in control plot was 15.4% which was significantly higher than the grain sprayed with dimethipin at the two application rates. The time of application i.e. 12 DBH, 8 DBH and 4 DBH gave no difference in term of grain moisture content at the day of harvest.

Table 2 Grain moisture content after spraying with dimethipin, % (wb)

Days Before Harvest	Control	Treatment					
		1	2	3	4	5	6
12	70.7	69.3	71.5				
10	63.0a	20.9b	20.9b				
8	27.8a	13.9b	14.9b	24.0c	24.5c		
6	21.4a	13.1b	13.3b	13.9b	13.9b		
4	17.5a	14.9bc	14.6c	14.4c	14.4c	16.5ab	16.0ab
2	16.4a	14.1b	13.9b	14.5b	14.4b	14.8b	14.1b
0	15.4a	13.6b	13.6b	13.9b	13.9b	14.2b	14.0b
-2	14.3	13.5	13.3	13.3	13.3	13.8	13.7
-4	14.6	14.1	13.9	14.3	13.9	14.0	14.1

Numbers in the same row follow by the same letter are not significantly different at P > 0.95

Table 3 Drying rate of grain after spraying with dimethipin, % per 2 days

Days Before Harvest	Control	Treatment					
		1	2	3	4	5	6
12	-	-	-				
10	7.7	48.4	51.1				
8	35.2	7.0	5.1				
6	6.4	0.8	1.6	10.1	10.6		
4	3.9	-1.8	-1.3	-0.5	-0.5		
2	1.1	0.8	0.7	-0.1	0	1.7	1.9
0	1.0	0.5	0.3	0.6	0.5	0.6	0.1
-2	1.1	0.1	0.3	0.6	0.6	0.4	0.3

2. Percent filled grain

One important aspect of using ripening regulator is whether it affects the yield of the crop. Applying the chemical too early may result in reduction of yield. In this experiment, percent filled grain was used to represent effect of dimethipin on grain yield. Result of percent filled grain is given in Table 4.

From Table 4, it was shown that applying dimethipin at 12 DBH resulted in significant decrease of percent filled grain from the beginning until harvesting. The low percentage of filled grain was caused by the chemical accelerating the ripening process at the stage where the grain kernel had not fully developed. Percentage of filled grain of treatment 1 and 2 were 16 and 14.7% lower than that of the control plots respectively.

Applying dimethipin at 8 DBH and 4 DBH at both 500 and 750 ml/ha showed no significant difference of grain filling percentage from the control plots at harvesting except in treatment 4 (sprayed at 8 DBH with 750 ml/ha) where the filled grain percentage was statistically lower than that of the control plots.

3. Grain milling Quality.

3.1 With no field drying after harvesting

It was found that milling quality of grain from of the control plots was very poor when the grain was milled immediately after harvest although its moisture content was only 15.4% which was not too high (Table 5). the head rice yield of the control plots was as low as 16.2% while the percentage of broken rice was 83.4%. Khush *et al* (1982) stated that in good milling the milled rice should have at least 50% head rice. Percentages of head rice of the sprayed plots were very much higher than that of

the control. The lowest % head rice was 66% in treatment 1. However, there was significant difference of head rice yield among the treated plots. In general the plots sprayed at earlier stage i.e. 12 DBH gave lower % head rice together with higher % broken rice. But spraying at 8 DBH and 4 DBH resulted in no difference of both head rice and broken rice percentages.

3.2 With 4 days drying in the field after harvesting

When the cut crop was left to be sun dried in the field for 4 days it was noted that the milling quality of the grain from the unsprayed plots had improved vastly. The head rice yield increased from 16.2% to 70% while the head rice percentage of the sprayed plots dropped down slightly particularly for those plots sprayed at 12 DBH. The result in Table 5 suggested that the drying process can improved milling quality of rice significantly. This result agreed with the report of Limpiti and Changrue (1993) in studying the drying of Japanese rice. They found that milling quality of Japanese rice was improved after mechanical drying with hot air.

Table 4 Percentage of filled grain after spraying with dimethipin.

Days Before Harvest	Control	Treatment					
		1	2	3	4	5	6
12	61.4	60.8	58.9				
10	68.4a	64.3b	62.4b				
8	81.6a	71.3b	71.2b	81.5a	82.1a		
6	86.1a	74.3b	72.6b	86.7a	83.8a		
4	87.4a	72.9b	74.0b	84.4a	83.8a	86.6a	87.4a
2	85.7ab	74.1c	74.5c	83.2b	83.3b	87.5a	86.4a
0	87.0a	73.1c	74.2c	84.8ab	81.6b	86.6ab	87.9a
diff.from control	0	16.0	14.7	2.5	6.2	0.5	-1.0

Numbers in the same row follow by the same letter are not significantly different at P > 0.95

Table 5 Milling quality of Hom Mali 105 in each treatment

Treatment	Without field drying after harvest			With 4 days field drying after harvest		
	Grain moisture,%	% Head rice	%Broken rice	Grain moisture,%	% Head rice	% Broken rice
Control	15.4	16.2a	83.4a	12.9	70.0a	29.8a
1	13.6	66.0b	33.8b	12.5	54.5b	45.4b
2	13.6	69.4bc	30.5bc	12.7	53.5b	46.4b
3	13.9	74.9cd	25.0cd	13.1	66.9a	32.9a
4	13.9	78.4d	21.4d	12.2	69.8a	30.2a
5	14.2	76.3d	23.7d	12.1	66.2a	33.7a
6	14.0	73.7cd	26.1cd	12.3	68.8a	31.1a

Numbers in the same column follow by the same letter are not significantly different at P > 0.95

Conclusion

The following points may be concluded from this study :

1. Spraying rice with dimethipin can accelerate ripening process and reduce grain moisture content rapidly.
2. Applying dimethipin earlier than 8 DBH is not recommended since it could lower grain yield as much as 14-16% .
3. At 8 DBH, using the rates of 500 and 750 ml/ha gave no difference in both grain yield and milling quality.
4. When applying dimethipin at 4 DBH the higher rate (750 ml/ha) gave the same effect to the crop as the lower rate (500 ml/ha)
5. If field drying is practicable there is no need for using the dimethipin since natural process of drying after cutting will improved the milling quality of the grain. Nonetheless, for wet season rice it is unlikely that the crop will be sufficiently sun dried without the risk of rewetting.
6. For combine harvester which skip the field drying process before threshing, and in other circumstances where the time is the major constraint for harvesting, use of dimethipin can be a promising alternatives.

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