THE INFLUENCE OF PRUNING TIME OF TILLER AND COW MANURE DOSES ON GROWTH AND YIELD OF PADDY RICE (*Oryza sativa* L.) IN THE SRI METHOD

Sunadi[1)], Welly Herman[1)], dan Nita Yessirita[2]
[1)]Lecturer of Agrotechnology Departement, Agricuture Faculty, Universitas Tamansiswa, Padang, e-mail: sunnadi2@gmail.com
[2)]Lecturer of Agricultural Technology Departement, Agricuture Faculty, Universitas Ekasakti, Padang

ABSTRACT

The aim of the experiment was to determine the interaction effect of pruning time and cow manure doses on the growth and yield of paddy rice in the SRI method, carried out in April - July 2018 on the experimental land of Tamansiswa University, Ampang Village, Padang City at a height of 9 m above sea level. The treatment design are 2 factors. The first factor is the time of tiller pruning with 4 levels, namely: tillers are not pruned, tillers are pruned from the age of 30 DAS, starting at 40 DAS, and starting at 50 DAS. The second factor is cow manure doses with 3 levels, namely: 0, 0.8, and 1.6 kg polybag^{-1}. Then the experimental unit is placed in a completely randomized design with 3 replications. Observation data were analyzed by ANOVA and DNMRT test at the level of α = 0.01 and 0.05. The parameters observed were plant height, number of tillers, number of productive tillers, an age of panicle appearance, harvest age, panicle length, 1000 grain weight, grain production clump^{-1}, and harvest index. The pruning time and cow manure doses interacted with the number of productive tillers, grain weight clump^{-1} and harvest index. The single pruning time did not affect all growth and yield parameters of rice, whereas cow manure dose affected the number of tillers clump^{-1} and accelerated age appeared of panicles. The best pruning was obtained from the age of 30 DAS and the application of manure 0.8 kg polybag^{-1} with grain production of 76.96 g MDG clump^{-1} and harvest index 0.46.

Key words: tillers pruning, cow manure doses, rice, SRI method

INTRODUCTION

Efforts to build food security need to be continuously carried out through intensification, extension, and diversification of agriculture. Rice as the main food for the last 5 years continues to experience the dynamics of its availability, but generally, it is not fully safe, this is evident from the fact that the government's rice imports in 2014 reached 1.2 million tons (Quarterly, 2017). This condition is understandable because of the high level of rice consumption which reaches 139 kg capita^{-1} year^{-1} so that the problem of food security will always experience dynamics. National rice production in 2014 reached 70,846,465 tons and 75,397,000 tons in 2015 or an increase of 6.42%, while in West Sumatera rice

production was 2,519,020 tons in 2014 and 2,550,609 tons in 2015 (increased by 1,23%) (BPS, 2016). The grain production has increased very low and is not comparable with the national rice needs. So that to increase national rice production needs innovation by creating new cultivation techniques or by making modifications to existing cultivation techniques, for example by developing or modifying the System of Rice Intensification (SRI) method.

The SRI method is a system of rice cultivation that has high productivity and is sustainable today which is a system of rice management practices developed in Madagascar in the early 1980s by Hendri de Lauline. The basic principle of the SRI Method is the use of young seedlings which are 8-15 days old, planting one clump^{-1} seedling, wide spacing, not flooded, using organic fertilizers and periodic sowing (Uphoff, 2001). The advantages of the SRI method have been proven in Madagascar in some infertile soils where normal production of 2 t ha^{-1} can increase with SRI to be more than 8 t ha^{-1}, some even more than 20 t ha^{-1} (Berkelaar, 2001). In addition, the SRI method requires far fewer seeds, namely 5-10 kg ha^{-1}, compared to the general method which reaches 10 times more (Uphoff *et al*., 2002).

The SRI method is innovation in high-value agriculture with a concept that is proven to increase rice productivity and farmer income by minimizing water use and other inputs. The SRI method improves the growing environment of rice plants, above, and below the ground, by improving the management of plants, soil, water and nutrients, so that it can stimulate greater and better growth in the root system and can increase the activity of soil organisms. The SRI practice has been reported to use less water, produce higher yields and healthy grains that have a stronger aroma (Katambara *et al*., 2013). Based on the research conducted by Mutakin (2007), the SRI system is a rice cultivation technique that is able to increase rice productivity by changing the management of crops, soil, water and nutrients, proven to have succeeded in increasing rice productivity by 50%, even in some places reaching more from 100%.

The SRI method produces many tillers so production is high but the percentage of productive tillers is still low. Sunadi *et al.* (2006) reported the results of the modified SRI method were able to produce a number of tillers

reaching 73 clumps^{-1} but the number of productive tillers was around 59%, so the opportunity to increase their productivity was still open such as through the provision of organic fertilizers such as manure and optimization of tillers through pruning tillers.

Continuous cultivation of lowland rice using artificial fertilizers needs to be revisited, especially for the loss of N and saturation of P fertilizers, because besides being inefficient it also has a negative impact on the environment (Saraswati, 2009). Excessive use of artificial fertilizers without being balanced with the provision of organic materials can result in soil degradation. To overcome these problems, it can be done by adding organic matter to the cowshed.

Cow manure can improve the soil both physically, chemically and biologically. The cows manure come from cattle pens, both in the form of solid dung mixed with food waste and urine. Cows contain N 2.33%, P2O5 0.61%, K2O 1.58%, Ca 1.04%, Mg 0.33%, Mn 179 ppm and Zn 70.5 ppm (Wiryanta and Bernardinus, 2002). Nutrients contained in cow manure can be used by plants for their growth so they can increase plant productivity.

Pruning is to remove puppies that appear in certain phyllochron periods. It is expected that the pruning arrangement will be able to increase the productivity of rice plants. Pruning on rice plants aims to regulate the number of tillers in rice plants so as not to overdo them by removing saplings that grow at a predetermined time. Pruning controls the number of tillers that grow so that the remaining chicks can grow optimally. Pruning will reduce the parasitic saplings consuming photosynthate so that photosynthate accumulation to grain decreases which will result in reduced number of productive tillers and low weight of grain produced, but it is not known when the pruning time is right.

The aim of the experiment was to determine the interaction effect of pruning time and doses of cow manure on the growth and yield of paddy rice in the SRI method.

MATERIASL METHODS

This research was carried out on the experimental field of the Faculty of Agriculture, Tamansiswa University, Ampang Village, Padang City at a height of

9 m above sea level, April - August 2018. Experiments using rice varieties IR 44, paddy fields, cow manure, Urea fertilizer , SP-36, KCl, and polybag, hoes, machetes, meters, rulers, measuring instruments, analytical scales, rubber bands, masking tape, wareng, paper, bamboo blades, wood battens, water hoses, cameras, string, and stationery.

The experiment used factorial Randomized Complete Design with 3 replications. Factor I is the pruning time for tillers which consist of 4 levels, namely tillers are not pruning, tillers are pruned every time appearing starting 30 days after planting (DAS), 40 DAS, and 50 DAS. The second factor is the doses of cow manure consists of 3 levels, namely 0 kg, 0.8 kg, and 1.6 kg polybag^{-1}, thus 12 treatment combinations and 36 experimental units. Data were analyzed by ANOVA and DNMRT tests at the level of 5% and/or 1% using SPSS 16.0. The variables observed were plant height, total number of tillers clump^{-1}, number of productive tillers^{-1}, flowering age, harvest age, panicle number clump^{-1}, number of spikelet panicle^{-1}, grain weight clump^{-1}, weight of 1000 grains, and Harvest Index.

RESULTS AND DISCUSSION

Plant Height

The growth of rice plant age aged 1-10 MST showed that paddy rice at the age of 1 - 5 weeks after pruning had an increase in relatively the same plant height, and at weeks 6-9 MST after pruning there was an increase in rice plant height growth (Figure 1), but at the end of vegetative growth (age 10 MST) the rice plant height was not different from the treatment of pruning and application of cow manure dose (Table 1).

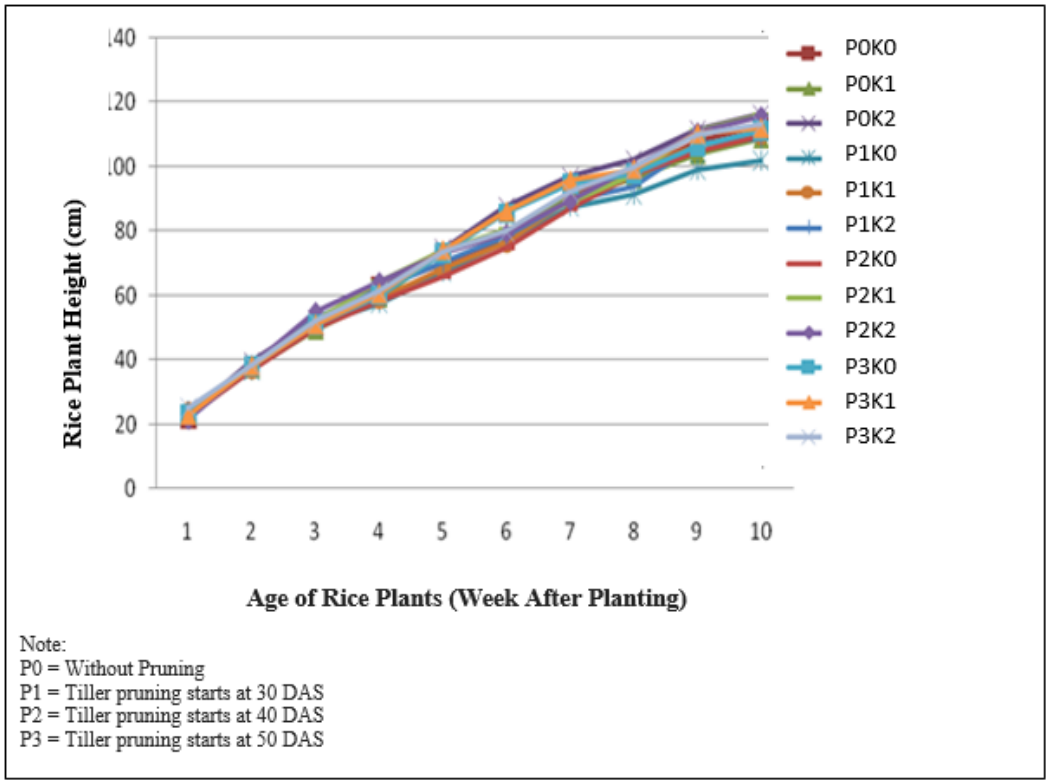

Figure 1. Graph of development of rice plants height aged 1-10 weeks after planting in the SRI method with pruning time and cow manure dose treatment.

Table 1. Rice plant height in the SRI method with pruning time and cow manure dose treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
	..... cm			
Without Pruning	113,00	108,83	116,33	112,72
30	102,00	110,00	109,00	107,00
40	109,67	116,00	115,83	113,83
50	111,33	112,17	113,17	112,22
Average	109,00	111,75	113,58	
CV=6,56 %				

Table 1 above shows that the time and doses of cow manure do not produce different rice plants pruning treatment on tillers produces plant height between 107.00 cm to 113.83 cm as well as giving cow manure until the doses of 1.6 kg polybag^{-1} does not produce different plant heights, which is between 109.00 cm to 113.58 cm.

Total Tiller and Productive Tiller Clump^{-1}

The total number of tillers clump^{-1} of paddy rice was influenced by the doses of cow manure but was not influenced by the time of pruning. Total tiller number clump^{-1} of paddy rice as influenced by pruning time and cow manure doses presented in Table 2.

Table 2. The total number of tillers clump^{-1} of rice plant in the SRI method with the pruning time and cow manure doses treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
	.....tiller clump^{-1}.....			
Without Pruning	34,00	33,00	48,00	38,33
30	34,00	47,33	55,33	45,33
40	34,67	46,00	50,67	43,78
50	35,33	37,67	53,67	42,22
Average	34,50C	41,00B	51,91A	
CV=10,16 %				

Inline numbers followed by the same letters are not significantly different according to the DNMRT at the level of 5%.

Table 2 shows the total number of pruning time influences not significantly by giving cow manure doses, where without pruning the number of total tillers on cow manure 38.33 tiller clump^{-1}, on pruning 30 DAS 45.33 tiller clump^{-1}, on pruning 40 DAS, and on pruning 50 DAS is 42.22 tiller clump^{-1} where pruning and cow manure application have not been able to give the results of the total number of tillers in the number of different tillers.

Table 2 also shows the giving of cow manure with different dose to the total number of tillers in pruning showed a significant effect on the total number of tillers at the doses manure 0 kg polybag^{-1} produced a total number of tillers of 34.50, in the application of cow manure 0.8 kg polybag^{-1} produces a total number of tillers of 41.00 which is much different from dose of cow manure 1.6 kg polybag^{-1}.

Number of Productive Tillers

The number of productive tillers is influenced by the pruning time and dose of cow manure. The results of the average number of productive tillers are presented in Table 3.

Table 3. The number of productive tillers clump^{-1} of rice plants in the SRI method with pruning time and cow manure doses treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
	.....tiller clump^{-1}.....			
Without Pruning	30,33Cc	37,33Aa	37,67Aa	35,11
30	31,67Cb	33,00Bb	35,00Ac	32,22
40	31,00Cb	33,00Bb	36,33Ab	33,44
50	31,00Cb	33,00Bb	35,33Ac	33,11

CV=3,38%

Inline numbers followed by the same uppercase letters and column numbers followed by the same lowercase letters were not significantly different according to the DNMRT at the level of 5%.

Table 3 shows the pruning time at the number of productive tillers at without pruning and cow manure doses 0 kg polybag^{-1} which is 30.33 tiller clump^{-1}. At cow manure dose 0.8 kg polybag^{-1} produced pruning time of 37.33 tiller clump^{-1} and at dose of cow manure 1.6 kg polybag^{-1} produced a number of productive tillers 37.67 tiller clump^{-1}. When pruning 30 DAS at cow manure dose 0 kg polybag^{-1} produced a number of productive tillers of 31.67 tiller clump^{-1}, at dose of cow manure 0.8 kg polybag^{-1} produced a productive number of tillers 33.00 tiller clump^{-1}, whereas at dose of cow dung 1.6 kg polybag^{-1} number of tillers is slow pruning which is 35.00 tiller clump^{-1}.

At pruning 40 DAS with fertilizer dose sometimes 0 kg polybag^{-1} cows produce a number of productive tillers 31,00 tiller clump^{-1}, which is different from cow manure 0,8 kg polybag^{-1} that is 33,00 tiller clump^{-1} which is different from cow manure doses 1,6 kg polybag^{-1} with pruning 40 produced a slower number of productive tillers, which was 36.33 tiller clump^{-1}. At pruning 50 DAS at cow manure doses 0 kg polybag^{-1} produced the number of productive tillers with age 31.00 tiller clump^{-1}, at cow manure 0.8 kg polybag^{-1} produced the number of productive tillers which was 33.00 tiller clump^{-1} and at the latest time pruning on the number of productive tillers, namely at 1.6 kg polybag^{-1} cow manure doses which is 35.33 tiller clump^{-1}.

The number of productive tillers shows that the higher the provision of cow manure the faster the number of productive tillers. This is because the larger the doses of cow manure is given, the more nutrient content available for plant

growth. Nutrients are used as an assimilation process in the plant body, assimilate produced in the form of carbohydrates which are used as energy by plants.

One nutrient that affects the growth of productive tillers is the element P. Harran (2005) states that the P element absorbed by plants plays a role in cell division activities. The formation of cells will help paddy seedlings, so by increasing the absorption of P by the rice plants contributed by each organic material it has the same effect on the formation of the number of productive tillers of rice plants.

Age Appears Panicle and Harvest Age

The age of appearance of panicles is influenced by the doses of manure but is not influenced by the time of pruning and its interaction with the dose of manure. The age at which panicles appears is accelerated by increasing dose to 1.6 kg polybag^{-1} (Table 4), while harvest age is not affected by pruning time and manure dose (Table 5).

Table 4. Age of rice panicles appear in the SRI method with pruning treatment and cow manure doses.

Pruning (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
	.....DAS.....			
Without Pruning	73,67	72,67	71,00	72,44
30	74,00	70,00	70,33	71,44
40	74,00	73,33	71,67	73,00
50	75,00	72,00	71,00	72,66
Average	74,16A	72,00AB	71,00B	
CV=3,33%				

Inline numbers followed by the same letters are not significantly different according to the DNMRT at the level of 5%.

Tabel 5. Rice harvest age in the SRI method with pruning and cow manure doses treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0	0,8	1,6	
	.....DAS.....			
0	107,67	106,33	107,67	107,22
30	108,33	107,00	107,00	107,44
40	108,33	108,33	105,67	107,44
50	107,00	109,00	109,00	108,33
Average	107,83	107,66	107,33	
CV=1,43%				

Panicle Length

The pruning time and cow manure doses had no significant effect on panicle length (Table 6).

Table 6. Panicle length of rice plants in the SRI method with pruning and dose of cow manure doses treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
	.....cm.....			
Without Pruning	28,00	27,00	27,67	27,55
30	28,00	28,33	28,33	28,22
40	27,67	28,67	29,17	28,50
50	27,67	27,50	27,83	27,66
Average	27,83	27,87	28,25	
CV=3,78%				

Table 6 shows that panicle length is not different from the difference in pruning time and cow manure doses. Panicle length with different pruning times ranged from 27.55 - 28.5 cm, while the difference in cow manure dose produced panicle lengths of 27.83 - 28.25 cm.

1000 Grain Weight, Grain Weight Clump^{-1} and Harvest Index

The pruning time and cow manure doses had no effect on 1000 grain weight (Table 7), but resulted in different grain weight clump^{-1} and harvest index (IP) in rice plants cultivated by the SRI method (Table 8 and Table 9).

Increased dose of 1.6 kg polybag^{-1} over the all pruning time (without pruning, with pruning from the ages of 30, 40 and 50 DAS) able to inreased production of grain weight clump^{-1}. Aplication of cow manure dose of 0.8 kg polybag^{-1} yields the highest grain weight on pruning starting at 30 DAS, while pruning without cow manure and giving manure 1.8 kg polybag^{-1} does not increase grain weight. Overall the highest grain yield was obtained at 1.6 kg polybag^{-1} manure dose, both pruning and without pruning, ie between 76.82 - 81.39 g MDG clump^{-1}, but the pruning time and optimal manure dose were at pruning from 30 DAS and giving manure 0.8 kg polybag^{-1} with grain production of 76.96 g MDG clump^{-1} (Table 8).

Table 7. 1000 grain weight of rice plants in the SRI method with pruning and cow manure doses treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
		g MDG		
Without Pruning	21.10	20.60	18.90	20.20
30	19.42	20.95	21.83	20.73
40	19.48	19.98	20.57	20.01
50	18.70	19.62	21.62	19.91
Average	26.23	27.05	27.57	
CV = 8.45%				

MDG = milled dry grain

Table 8. Grain weights clump^{-1} of rice in the SRI method with pruning and cow manure doses treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
		g MDG / clump^{-1}		
Without Pruning	62.01Ba	69.71Bb	81.39Aa	71.04
30	61.62Ba	76.96Aa	76.82Aa	71.80
40	60.67Ba	67.17Bbc	78.35Aa	68.73
50	64.02Ba	61.45Bc	77.88Aa	67.78
Average	62.08	68.82	78.61	
CV = 1,59%				

Inline numbers followed by the same uppercase letters and column numbers followed by the same lowercase letters were not significantly different according to the DNMRT at the level of 1%.

The increased dose of cow manure until 1.6 kg polybag^{-1} without pruning, and with pruning from the ages of 30, 40, and 50 DAS able to increase harvest index (HI). Providing manure dose 0.8 kg polybag^{-1} resulted in the highest HI on pruning from 30 DAS, while pruning without manure and giving manure 1.8 kg polybag^{-1} did not increase HI. Overall the highest HI was obtained at manure dose 1.6 kg polybag^{-1}, both pruning and without pruning, ie HI between 0.43 to 0.49, but the pruning time and optimal manure doses was on pruning from 30 DAS and giving manure 0.8 kg polybag^{-1} with HI 0.46 and pruning starting 40 DAS by giving manure 1.8 kg polybag^{-1} with HI 0.49 (Table 9).

Table 9. Rice crop harvest index in the SRI method with pruning and cow manure doses treatment.

Pruning Time (DAS)	Cow Manure Doses (kg polybag^{-1})			Average
	0.0	0,8	1,6	
Without Pruning	0,43Ba	0,45Ba	0,48Aab	0,45
30	0,44Ba	0,46Aba	0,47Ab	0,46
40	0,45Bab	0,46Ba	0,49Aa	0,47
50	0,47Bb	0,46Ba	0,47Bb	0,47
Average	0,45	0,46	0,48	

CV = 9,72%

Inline numbers followed by the same uppercase letters and column numbers followed by the same lowercase letters were not significantly different according to the DNMRT at the level of 1%.

CONCLUSIONS

The time of pruning and cow feed on rice plants in the SRI method influences interactively on the number of productive tillers, grain production clump^{-1}and harvest index, but does not interact with other growth and yields parameters. The single pruning time does not affect the growth and yield components of rice in the SRI method. A single increase in cow manure dose can increase the number of tillers clump^{-1} and accelerate the appearance of panicles. The best pruning is obtained from the age of 30 DAS and giving cow manure doses 0.8 kg polybag^{-1} with grain production of 76.96 g MDG clump^{-1} and harvest index 0.46.

ACKNOWLEDGEMENTS

This study was supported by the Tamansiswa University through permission to use the research land of the Faculty of Agriculture in Ampang Village, Padang City, and other facilities so that this research can be completed. The authors are highly grateful to the Rector, Dean of Agriculture Faculty and Head of the LPPM Tamansiswa University.

REFERENCES

Berkelaar, D. 2001. Sistem Intensifikasi Padi (*The System of Rice Intensification-SRI*): Sedikit Dapat Memberi Lebih Banyak. Buletin ECHO Development Notes, Januari 2001. ECHO Inc. 17391 Durrance Rd. North Ft. Myers Fl.33917 USA.pp.1-6.

BPS. 2016. Statistik Indonesia 2016. Badan Pusat Statistik, Jakarta. (In Indonesia)

Harran, 2005. Uji Daya Tembus Akar Untuk Seleksi Somaklon Toleran Padi IR 64. Penelitian Tanaman Pangan 24(2) : 97-103.

Katambara, Z., F.C. Kahimba, H.F. Mahoo, W.B. Mbungu, F.Mhenga, P.Reuben, M. Maugo, and A. Nyarubamba. 2013. Adopting the system of rice intensification (SRI) in Tanzania: A review. Agricultural Sciences. 4(6):369-375.

Mutakin, J. 2008. Budidaya dan keunggulan padi organik budidaya S.R.I. http://www.garutkab.go.id/downloadfiles/artikel%20S.R.I..pdf.[diakses 11 Februari 2009]. (In Indonesia)

Sunadi, M. Kasim, A. Syarif, dan N. Akhir. 2006. Pertumbuhan dan hasil padi sawah dalam metode SRI dengan pengaturan jumlah bibit per rumpun sistem tanam satu-satu. Gakuryoku 12 (1), 120 – 123. (In Indonesia)

Triwulanan. 2017. Pedoman Bercocok Tanam Padi Palawija Sayur-sayuran. Departemen Pertanian Satuan Pengendalian BIMAS. Jakarta .125p. (In Indonesia)

Uphoff, N. 2001. The System of Rice Intensification: Agricultural Opportunities for Small Farmers. ILEIA Newsletter.

Uphoff, N., K.S.Yang, P.Gypmantasiri, K.Prinz, and H.Kabir. 2002. The System of Rice Intensification (SRI) and its relevance for food security and natural resource management in Southeast Asia. International Symposium Sustaining Food Security and Managing Natural Resources in Southeast Asia, Challenges for the 21st Century, January 8-11,2002 at Chiang Mai, Thailand.

Wiryanta, W dan T. Bernardinus 2002. Bertanam Cabai Pada Musim Hujan. Agromedia Pustaka. Jakarta. (In Indonesia)