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Sampling Technique in Rice Pest Management: A Tool for the Rice Growing Farmers at Buang Thong Lang Village in Lam Luk Ka Sub-district, Pathum Thani Province, Thailand

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ABSTRACT

Buang Thong Lang village at Lam Luk Ka sub-district, Pathum Thani province was the area where the experiments were conducted for two consecutive rice cropping seasons, February-May 2004 and July-November 2004. It was aimed to assess effectiveness of sampling tactics through visual counting of pests from randomly selected rice hills. Pesticide spraying schedule was administered through the determination of economic threshold of rice pests. The study comprised of four farmers' fields in a locality each of which was compared for grain yield, net returns taking into account the ecological aspects. The net economic benefits and presence of counts on natural enemies in an experimental plot were high which showed comparative advantages over the indecisive pesticide use driven traditional practices. It was concluded that the trends in present integrated pest management strategies designed for the farmers' situation needed timely and accurate information on identification of the key pests before drastic chemical actions are deployed.

Key words: rice, economic threshold, integrated pest management, sampling tactic, visual count

INTRODUCTION

Given the critical role to farmers in an integrated pest management (IPM) and the choice of sampling techniques, it remains essential, that farmers' capabilities to put IPM into practice are well understood. This calling is further raised due to growing concern that in spite of numerous IPM technologies being developed by the researchers and the allies, the vision for "Good Agricultural Practice" are yet being outdone by indiscriminate uses of pesticide in the wake of bridging the gap for more rice demand.

Various noble ideas on the IPM tactics were generated and defined by Smith and Reynolds (1966), and Robert *et al*. (2003) portrayed more of the theoretical aspects that remained inconsiderate as contrasted with its applicability in practicality. Wide ranges of sampling tactic recommended are still remaining dormant accounting to realized factors like lack of time in pest monitoring, labor shortage amid farmers' involvement in various other farm activities, the growing concern on hike in inputs' prices, and deprived of enough skills in pest management and sampling techniques. The presence of natural enemies in their *in situ* ecological niche continues to play as an important role in curbing pest menaces as biological control agents and other control tactics would do. But, biological control entities being unaffordable by

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the larger rural farming communities would still remain unrealized until the next few years or longer unless those are made accessible at lower prices. However, it is reported that the progressive extension of IPM would be accepted by most of crop growers in Thailand when the relevant packages involving less labor input can be demonstrated as simple (APO, 2000). The APO reported that in Thailand more than 50 percent of pesticides are applied for crop production. Thus, at the present study level, the IPM in rice pest management is directed to selecting, integrating and implementing pest control actions based on predicted ecological, economic and sociological consequences of the actions for the best by using economic threshold (ET).

Hence, this study was aimed to focus on selecting the most economic sampling technique, such as the visual count which would help to determine the ET of rice pests for the rice farmers of Buang Thong Lang village at Lam Luk Ka sub-district, Pathum Thani province. An attempt was made to evaluate and compare grain yields from the two consecutive rice planting seasons, February-May 2004 and July-November 2004, with respect to economic considerations which included ecological aspects of the IPM practices with that of farmers' traditional practices. Farmers' active involvement in executing successful implementation of the IPM with adaptable cost-effective technology, in turn, would perceive comparative advantages over their traditional practices in rice production.

MATERIALS AND METHODS

A total area of 20 rais (1 rai = 0.16 hectare) from 4 farmers were allocated each with a plot of 5 rais from different locations. Each plot was divided equally into two halves where one half was assigned for implementing IPM practices and the other half for undergoing farmers own traditional practices. Within each plot, an area of 1 rai each from all plots was demarcated with plastic ropes for the sampling purposes in order to avoid boundary interference between plots.

Suphanburi-I and Pathum Thani-I rice cultivars were used for the first and second rice planting seasons, respectively. The crop phenology on the growth and development of rice was studied and mapped out with respect to its growth and pest incidence.

Weekly visual counts of pests and natural enemies from 20 randomly selected rice's hills were done through stratified random sampling method by walking across the field diagonally starting from 7 days after emergence (DAE) till the 14^{th} week of matured grain stage. The insects' counts were recorded in the prototype sampling sheet based on the ET suggested by Reissig *et al*. (1986) and KAU (2002) for insect pests and Ou (1972, 1973) for diseases were used as the basis for chemical control decision as shown in Table 1.

Overnight incubated seeds at the rate of 20 kg/rai were broadcasted onto the well prepared land in every plot followed by application of herbicide, petrilachlor @ 0.048 kg a.i./rai. Ammonium phosphate 16-20-0 @ 30 kg/rai at 21 days after sowing as first fertilizer application and urea 46-0-0 @ 10 kg/rai each as topdressing at 42 DAE and 56 DAE were applied to each plot and irrigated as needed. Suitable selective pesticides were prepared for combating the pest outbreak. No chemical seed treatments were performed.

A total of 5 random crop-cut samples from 2 ¥ 5 meter square area from each plot were taken for yield assessment. The harvested grains were sun dried for 4 days, thrashed and weighed with a weighing balance at 12 % moisture content and finally computed for harvestable yield comparisons. Counts on number of natural enemies, both parasites and predators were also recorded. Individual farmer's records on expenses incurred for each crop season both in IPM and farmer's field were maintained. Independent variable samples t-Test at 0.05 level in SPSS program were used for the comparative analysis.

RESULTS

Pest monitoring and surveillance

First season crop (Suphanburi-I variety) was encountered with severe infection of brown spot disease, *Helminthosporium oryzae* in every plot of rice which made the farmers to spray propiconazole + diphenoconazole @ 0.75 ml in one liter water along with an insecticide fipronil @ 0.024 kg a.i./rai, while the disease in IPM plots was controlled by the application of propiconazole + diphenoconazole alone.

Insecticides were applied for controlling thrips, *Baliothrips biformis* infestation in all except one plot where infestation was caused by whorl maggot, *Hydrellia spp.* during the second season crop. When the insect population reached the ET, carbofuran @ 0.16 kg a.i./rai and dimethoate @ 0.064 kg a.i./rai were sprayed for whorl maggot and thrips infestation, respectively.

In general, more insect pests, diseases, and snails were observed in farmers' fields than in IPM plots (Table 2) though not significantly high except the rice bug, stem borers, and zigzag leafhopper which showed significant difference in the first planting season.

The counts of natural enemies in the IPM plots (Figure 1 & 2) were found to be significantly high in the first season. However, the difference in counts on insects, diseases, and natural enemies in the second planting season was found to be insignificant.

Grain yield and economic returns

The harvestable grain yield between IPM and farmers' fields for the first planting season with 1.51 percent difference did not show significant difference due to severe infestation from brown spot disease but only had significant difference in the second planting season crop with the percentage differences in yield of 21.74 (Table 3).

The returns from both IPM and farmers' practices were analyzed. The difference in average returns from IPM practices in the first planting season (Table 4) was not significant but the second planting season showed a significant difference with a net return of 847.04 Thai baht per rai (Table 5). It also presented the added returns and benefit cost ratio in both farmers' and IPM plots showing that ET treatment was only one that would be economically viable.

DISCUSSION

Stratified random sampling method and visual count sampling technique with a sample unit as the rice hill for pest surveillance can be used as a simple technique by the field practical farmers, although weekly monitoring may not be possible. The economic analysis showed that on the average, with only the lowest level of application, the ET treatment (IPM fields) was economically profitable for the rice growing farmers. The results obtained also showed that the ET treatments anticipated the monetary loss of 318.00 Thai baht per rai in the first crop (Table 4) and 847.04 Thai baht per rai in the second crop (Table 5) which illustrated the advantages in saving farmers' money, conserving natural enemies, thereby reducing the potential for environmental problems and reducing the likelihood of insects developing resistance to pesticides.

The five major types of insect pests: defoliators, *Spodoptera litura, etc*, whorl maggot, *Hydrellia spp.*, thrips, *Baliothrips biformis*, planthoppers, *Nilaparvata lugens* (Stal), *Nephotettix spp.*, stem borers, *Tryporyza spp.*, *Chilo supressalis*, and bugs, *Scotinophara coarctata*, *Leptocorisa oratorius* including golden apple snail, *Pomacea spp.*, and blast disease, *Pyricularia oryzae* monitored in the study had been identified being those mainly responsible for the damage to the rice paddy fields in the Lam Luk Ka sub-district, Pathum Thani province. However, only brown spot disease in the first crop was found to be severe while insect pests like whorl maggot and thrips were found in high numbers reaching

ET to cause damage to the crop. Stem borers and plant hoppers were also identified, but not in sufficiently high numbers to cause any real damage. The presence of golden apple snail menace was still observed as a major problem to the rice growers. Due to rapid infestation and reproductive characteristics, the pest dominates and damages the young rice plants in a short time. Use of toxic chemicals to eliminate the snails has been shown to have very little effect in the control treatment

Table 1 A sample of prototype sampling sheet showing ET for rice insect pests and diseases used for weekly pest surveillance.

Name of the pests	ET at different crop stages per hill	Stages pests observed	No. of	Decision stage	Crop	Remarks
Black bug	1 bug, 5 % damage leaves					
Brown planthopper	15 nymphs, 5 adults, 5% hopper burn					
Caseworm	15% leaf damage					
Green leafhopper	15 nymphs, 5 adults, 5% hopper burn					
Leaf folder	5 % leaf damage, 1 larva					
Other defoliators	10 leaves damage, 1 larva					
Rice bug	1 bug, 5 % damage leaves					
Rice hispa	10% leaf damage, 4 adults					
Stem borers	10 % damage,1 dead heart or 1 white head,1egg mass					
Thrips	10 leaf damage, 1 adult					
White leafhopper	15 nymphs					
Whorl maggot	10 % leaves damage, 1 egg mass, 1 adult					
Zigzag leafhopper	15 nymphs, 5 adults, 5% hopper burn					
Blast	5-10 % severity					
Brown spot	2-5 % severity					

Table 2 Average numbers of insect pest, snail and disease per hill observed during 14 weeks in both IPM and farmers' fields during the two rice planting seasons in Buang Thong Lang, Pathum Thani, 2004.

Pests	First season crop (Suphanburi-I)				Second season crop (Pathum Thani-I)			
	Average		Difference	% Difference	Average		Difference	% Difference
	IPM (i)	Farmer (f)	(i – f)	(i-f)/f	IPM (i)	Farmer (f)	(i – f)	(i-f)/f
Black bug	0.002	0.002	0	0	0.082	0.082	0	0
Brown plant hopper	0.357	0.383	-0.026	-6.79	0.874	0.991	-0.117	-11.81
Caseworm	0.003	0.003	0	0	0.271	0.357	-0.086	-24.09
Green leafhopper	0.264	0.285	-0.021	-7.37	0.634	0.697	-0.063	-9.04
Leaf folder	0.191	0.199	-0.008	-4.02	0.237	0.256	-0.019	-7.42
Other defoliators	0.416	0.433	-0.017	-3.93	0.303	0.379	-0.076	-20.05
Rice bug	0.169	0.21	-0.041	-19.52	0.143	0.158	-0.015	-9.49
Stem borers	0.144	0.154	-0.01	-6.49	0.432	0.457	-0.025	-5.47
Thrips	-	-	-	-	0.27	0.322	-0.052	-16.15
White leafhopper	0.023	0.052	-0.029	-55.77	0.314	0.36	-0.046	-12.78
Whorl maggot	0.007	0.008	-0.001	-12.5	0.232	0.269	-0.037	-13.75
Zigzag leafhopper	0.031	0.052	-0.021	-40.38	0.172	0.196	-0.024	-12.24
Snails	0.041	0.042	-0.001	-2.38	0.319	0.378	-0.059	-15.61
Blast	1.107	1.19	-0.083	-6.97	-	-	-	-
Bacterial blight	0.041	0.048	-0.007	-14.58	-	-	-	-
Brown spot	4.147	4.418	-0.271	-6.13	0.008	0.008	0	0

compared to the duck-rice-fish treatment (Men *et al*., 2002). Hence, periodic draining of the water combated their menace although introduction of ducks during flooding time would have helped snail population to reduce further. The ET treatments not only gave better returns but also favored conserving many species of natural enemies, the exception being application of pre-emergence herbicide used to control weeds, fungicide used to control brown spot disease caused by *Helminthosporium oryzae* fungi, and insecticides used to control thrips and whorl maggots.

Weeds were also found as a major problem for the rice growing farmers. Pre-emergence application of herbicide was a necessity where in its establishment at later stages dominated the rice fields thereby bringing about reduction in yield. The rice's major weeds locally called as "phagpot", *Sphenoclea zeylanica* (Gaertn.) and "yahkhaonok", *Echinochloa sp.* were widely spread in rice growing areas. Those weeds including other noxious weed

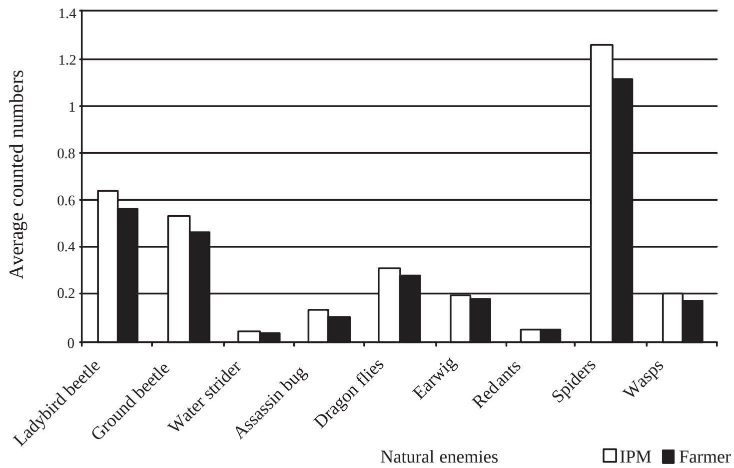

Figure 1 Average numbers of natural enemy per hill observed during 14 weeks in IPM and farmers' fields. Data were taken from the first season crop in Buang Thong Lang, Pathum Thani, 2004.

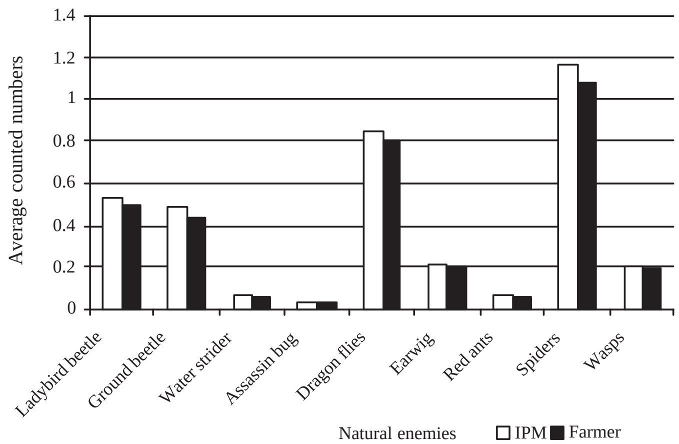

Figure 2 Average numbers of natural enemy per hill observed during 14 weeks in IPM and farmers' fields. Data were taken from the second season crop in Buang Thong Lang, Pathum Thani, 2004.

Table 3 Average harvestable grain yields per rai obtained from both IPM and farmers' fields during the two cropping seasons in Buang Thong Lang, Pathum Thani, 2004.

Expt	First crop season (Suphanburi I)			Second crop season (Pathim Thani I)		
	RPM Kg/rai (r)	Farmer Kg/rai (f)	% diff (r - f)/f	RPM Kg/rai (r)	Farmer Kg/rai (f)	% diff (r - f)/f
Plot I	627.20	624.96	0.36	686.72	576.00	19.22
Plot II	419.20	409.60	2.34	733.44	625.92	17.18
Plot III	579.20	576.00	0.56	752.64	597.76	25.91
Plot IV	473.60	460.80	2.78	728.32	584.32	24.64
Average	524.80	517.84	1.51	725.28	596.00	21.74
T-test result between IPM and farmer			ns			*

ns = not significant different, * Significant different at P£0.05

Table 4 Cost benefit analysis in Thai baht on net return and benefit cost ratio per rai in both IPM and farmers' fields for the first season crop in Buang Thong Lang, Pathum Thani, 2004.

Expt	Cost assessment for first planting season (Suphanburi-I)						
	IPM (i)			Farmer (f)			Difference in
	Total cost	Net return	BCR	Total cost	Net return	BCR	Net return (i-f)
Plot I	1762.25	1373.75	0.78	1824.75	1300.05	0.71	73.70
Plot II	2286.35	-64.59	-0.03	2944.90	-774.02	-0.26	-709.43
Plot III	1546.06	1349.94	0.87	1824.75	1170.45	0.64	179.49
Plot IV	1487.24	880.76	0.59	1824.75	571.41	0.31	309.35
Average	1770.47	884.97	0.55	2104.79	566.97	0.35	318.00
T-test result between IPM and farmer							ns

BCR=Benefit cost ratio (Net return/total cost), ns = not significant different

Table 5 Cost benefit analysis in Thai baht on net return and benefit cost ratio per rai in both IPM and farmers' fields for the second season crop in Buang Thong Lang, Pathum Thani, 2004.

Expt	Cost assessment for second planting season (Pathum Thani I)						
	IPM (i)			Farmer (f)			Difference in
	Total cost	Net return	BCR	Total cost	Net return	BCR	Net return (i-f)
Plot I	1690.98	1742.62	1.03	1762.25	1117.75	0.63	624.87
Plot II	2247.38	1639.85	0.73	2819.90	497.47	0.18	1142.38
Plot III	1611.85	2151.35	1.33	1720.58	1387.77	0.81	763.58
Plot IV	1508.07	2133.53	1.41	1762.25	1276.21	0.72	857.32
Ave	1764.57	1916.84	1.13	2016.25	1069.80	0.59	847.04
T-test result between IPM and farmer							*

BCR=Benefit cost ratio (Net return/total cost), * Significant different at P£0.05

species seen were practically removed by hand weeding in the first season crop.

Farmers in these investigation areas can easily apply such simple IPM practices provided that more knowledge and skills on ET for pests' surveillance, especially in identifying key pests, are imparted through regular training programs. The sampling technique which was applied here, without having to incur extra expenses unlike other tactics, could be easily picked up by the farmers. Even though they may not realize higher income at par with that of productions through indiscriminate use of chemical pesticide, it is highly advisable that they exert concerted efforts to put into practice the ET applications, as is already noticed in this study. Given the potentiality of the farmers and with the availability of resources, not only their net incomes that will be gradually increased for a better quality of life but also contribute to reducing potential damages to the environment and its consequent hazards to the human health.

CONCLUSION

An intended research study brought into light the potential sustainability of using a simple sampling techniques that was comfortable and practicable for the farmers' situation whereby ET application remained as a prime importance in rice production. Regular pest surveillance to judicious and/or no use of pesticides assured the improved environmental conditions and so did incomes or benefits for resource-poor farmers of Thailand and other parts of the world.

The study confirmed that grain yields from rice through ET based decisions increased by around 1.51 to 21.74% as compared with traditional chemicals-based rice farming systems. Likewise, the net profit was also pointed out in between 318.00 to 847.04 Thai baht per rai**.** Besides, economic benefits and its potentiality to international market exposure, the reduction or elimination of agricultural chemicals usage would result in substantial environmental benefits, especially with respect to pesticides and herbicides, overuse of which causes serious health problems to mankind and other living organisms in rice paddy field agro-ecosystem.

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