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Light Traps Abilities of Mercury (ML-160 Watt) BSE Models and Light Traps of Solar Cell (CFL-20 Watt) to Capture of Pests in the Rice Field

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ABSTRACT: *Research light traps abilities of mercury (ML-160 watt) BSE models and solar cell light traps (CFL-20 watt) to capture rice pests was carried out in Sukamandi-Subang and Sepat Kerep-Karawang of West Java on the WS 2013. Pests caught on the electric light traps of mercury (ML-160 watt) BSE-G3 model were compared to the light trap of mercury (ML-160 watt) BSE-G4 model and mercury (ML-160 watt) BSE-Giant model and also compared to solar cell light traps (CFL-20 watt) of Sainindo and Hariff models. The Results showed that abilities of light trap of mercury (ML-160 watt) BSE-G3, BSE-G4, and BSE-Giant models were higher capture of pests compared to the light trap of solar cell (CFL-20 Watt). The rice pests that caught on the light trap with higher power capacity at 160 watt and light intensity at 3150 lm were higher than in the lower power capacity at 20 watt and low light intensity between 1200-1250 lm. In the other hand, number of pests that caught in mercury lamp were higher than CFL. Pests were caught in the light traps of mercury (ML-160 watt) BSE-G3 and BSE-G4 models with the top of the funnel collector pests are 60 cm in diameter less than the pest was caught the light traps of mercury (ML-160 watt) BSE-Giant with the top of the funnel collector pests is 100 cm in diameter. In the other hand almost all of pests attractive to light trap of mercury (ML-160 watt) BSE-G3, BSE-G4 and BSE-Giant models compared to the light trap of solar cell (CFL-20 watt). Light trap of solar cell (CFL-20 watt) used for monitoring of immigrant and emigrant pests, whereas electric light trap of mercury (ML-160 watt) BSE-G3, of BSE-G4 model, and BSE-Giant models used for monitoring and reducing of immigrant and emigrant pests.*

Keywords: *Electric light trap of mercury, forecasting, monitoring, pests, reducing, solar cell of CFL.*

I. INTRODUCTION

Rice production business will be successful when the presence of pests can be early detected. Pests that did not early detected will develop unnoticed and will cause damage and difficult to control. One tool to determine the presence of insect pests in rice crops using light traps. The light trap can be used as a method of non-chemical pest control that has been widely used in some developing countries such as China [1], Japan [2], also in Brazil [3]. At the Indonesian Center of Rice Research (ICRR) since 2008 using light traps electric of mercury (ML-160 watt) BSE-G3 models, however, the appropriate light trap and standards are still rarely found in a rice field in each province, district or city.

The light trap placed in the rice farm on the edge of the embankment or other places that adjusted to the condition of the land, because the electric light trap requires a source of power and a long wire. Light trap can attract pests at night by the light it emits. Nocturnal insects are often attracted to light sources that emit large amounts of UV radiation, and devices that exploit this behavior, such as light traps for forecasting pest outbreaks, and electric insect killers, have been developed [4]. In free-flying preference experiments using light-emitting diodes (LEDs) of five different peak wavelengths (373, 444, 464, 534 and 583 nm), both male and female adults green stink bug, *Nezara viridula* strongly preferred the ultraviolet light (373 nm) among five LEDs. Among all other four, adults preferred blue region light (444 nm and 464 nm) to 534 nm and 583 nm [2].

Light trap data is needed to be used as a data of dispersal, distribution of pests and anticipation of pest outbreak either at country or beyond countries, it is proved by the existence collaborative of some countries as members of the Asian Food and Agriculture Cooperation initiative (Afaci) must report the pests caught in the light trap at any time. Light trap data from Indonesia, Vietnam, Korea, Thailand, Bangladesh, Nepal, Laos, Cambodia, the Philippines, Myanmar, Japan, and China are reported through the Asian Migratory Insects And Viruses Surveillance System (AMIVS) directly managed by Afaci South Korea [5]. In Indonesia the one BSE-G3 light trap be used as a detector to control an area of 200-500 ha, but when it is used to reduce pest as much needed for one light trap covered 50 ha rice plantation [6]. Light trap is very important to monitor pest immigrants that first arrived at the nursery or rice planted. Pests caught in the light trap can determine the decision making to start and delay nursery and planting, control with insecticides recommended, and forecasting. The data is used as early warning of kind and numbers of pests immigrants who came to rice crop, especially determine the economic threshold [5]. The aim of this research to analyze the ability of each light trap models about kind of lamp, light intensity, power capacity and also establish base of technology pests capture as monitoring, reducing, and forecasting pest populations in rice crops.

II. MATERIALS AND METHODS

The study was conducted at the Sukamandi rice research station of Indonesian Center for Rice Research (ICRR) at Ciasem- Subang district and in farmers field Sepat Kerep, Cilamaya-Karawang district of West Java in the WS of 2013. The research in Sukamandi using electric light traps of mercury (ML-160 watt) BSE-G3 model were compared to mercury (ML-160 watt) BSE-G4 model, mercury (ML-160 watt) BSE-Giant model, and solar cell light traps (CFL-20 watt) of Sainindo. Research in Sepat Kerep-Karawang using light trap of mercury (ML-160 watt) BSE-G3 model compared to solar cell light traps (CFL-20 watt) of Hariff model. Light traps of mercury (ML-160 watt) BSE-G3 model is a electric light trap equipped with mercury lamp ML160 W, funnel pests collector with the upper and lower part are 60 and 7 cm in diameter respectively, the cylinder bag pests collector with 31 cm in diameter and 80 cm in height, the rectangular roof to protect the lamp and pests catches especially from rain water (Fig.1). Description of ML160W (Mercury Lamp, Philips) colored cool daylight white light, luminance of 3150 lm, the voltage of 220-230 V, and the power capacity is 160 Watts.

Light traps of mercury (ML-160 watt) BSE-G4 model (Fig. 2) is a electric light trap knock down equipped as the light traps of mercury (ML-160 watt) BSE-G3 model but the roof is cylindrical was 90 cm in diameter . Light trap BSE-Giant model is equipped as the light traps of mercury (ML-160 watt) BSE-G3 model but the funnel pests collector in the upper and lower part are 100 and 7 cm in diameter.Solar cell light trap (CFL-20 watt) of Sainindo model is equipped *compact fluorescent lamp* (CFL) bulbs, container box for collecting pests with a solution of soapy water. Description of CFL bulbs is cool daylight in color, luminance of 1200 lm, long life rays for 10 hours, the voltage of 220-240 VAC, and the power capacity is 20 Watt (Figure 3). Light trap solar cell Hariff model is equipped CFL-i & Extra Bright and container box for collecting pests with solution of soapy water. Description of CFL-i & Extra Bright, cool daylight in color, luminance of 1250 lm, the long life rays of 10 hours, the voltage of 220-240 VAC, and the power capacity is 20 Watt.

All light trap installed in the rice fields at a height of 150-250 cm from ground level to the distance between the light trap are100-200 m. Electric light trap is turned manually during 11-12 hours starting on 18.00 pm until 5:00 am, while the flame of solar light trap turned automatically when the sun was sinking.

Fig. 1. Light traps of mercury (ML-160 watt) BSE-G3

Fig. 2. Light traps of mercury (ML-160 watt) BSE-G4

Fig. 3. Solar cell light trap (CFL-20 watt) of Sainindo

Pests collected in the morning by taking the bag pests collector from all electric light trap and sprayed by Baygon to killing pest that still life. All dead pests transferred into a plastic tray for processed further. On the other side of solar cell light trap, pests was collected from container box, sprayed by Baygon to killing pest is still life, and all dead pests transferred into a plastic tray to processed as follows:

a. Separated pests and predators to identified on the orders, families and species.
b. Calculated pests and predators number of each species
c. Data of pests and predators inserted into an excel program for cumulative weekly.
d. Differences abilities of pests and predators catches of light trap using analytical paired observation by t-test between two light traps.

III. RESULTS AND DISCUSSION

1. Performance Lights Trap in Sukamandi-Subang

Insect pests activities that flight in the evening was stimulated by light intensity of light trap. The main rice pests and predators that caught in the light trap in Sukamandi at WS 2013 were 4 orders of pest insects consist of 7 families and 8 species, as well one order of predator consists of 3 families and 3 species (Table 1). Insect pests caught were adults wing pests from order of Lepidoptera (*Scirpophaga* (*Tryporyza*) *incertulas*, *Sesamia inferens*, and *Cnaphalocrosis medinalis*), Hemiptera- sub Ordo Heteroptera (*Scotinophara coarctata* and *Leptocorisa oratorius* rice), Hemiptera- sub Ordo Auchenorrhyncha (*Nilaparvata lugens* and *Nephotettix* sp), and Orthoptera (*Gryllotalpa africana*). Order Coleoptera captured as adults predator wing form of *Ophionea nigrofasciata*, *Micraspis crosea* and *Paederus fuscipes*.

Table 1. Kind of main rice pests and predators caught on the light trap of mercury (ML-160 watt) BSE models. Sukamandi, WS 2013

Order	Family	Species	Common name
Orthoptera	Gryllotalpidae	*Gryllotalpa africana*	Mole cricket
Hemiptera (Heteroptera)	Pentatomidae	*Scotinophara coarctata*	Rice black bug
	Alydidae	*Leptocorisa oratorius*	Rice stink bug
Hemiptera (Auchenorrhyncha)	Cicadellidae	*Nephotettix* sp	Gren leafhopper
	Delphacidae	*Nilaparvata lugens*	Brown planthopper
Lepidoptera	Pyralidae	*Scirpophaga (Tryporyza) incertulas*	Yellow stem borer
		Cnaphalocrosis medinalis	Leaf foder
	Noctuidae	*Sesamia inferens*	Pink stem borer
Coleoptera	Coccinellidae	*Micraspis crosea*	Lady beetle
	Carabidae	*Ophionea nigrofasciata*	Ground beetle
	Staphylinidae	*Paederus fuscipes*	Rove beetle

Some pests did not found in the light trap were white stem borer, black headed stem borer, army worm, leaf roller, seed flies, whiteback planthoppers and the natural enemies of spider and *Cyrtorihnus lividipennis*, even though the white stem borer did not caught by light traps since 2008. In the 1990s, the population of white stem borer dominance catches on the electric light trap, because at that time there was an explosion of white stem borer in northern coastal of West Java along Bekasi up to West Cirebon district [7]. In Japan pests catches in the light trap reaches 12 order consists of 52 families of insects divided from the class of pests Thysanoptera, Hemiptera, heteroptera, Coleoptera, Diptera and Lepidoptera and members of non-pest is Ephemeroptera, Odonata, Psocoptera, Strepsiptera, Hymenoptera, and Trichoptera [8].

In the 2013, the pests that dominate the light trap catch were *S. incertulas* (yellow stem borer = YSB), *S. coarctata* (rice black bug =RBB) and *N. lugens* (brown planthopper =BPH), while the second rank that low population were *S. Inferens* (pink stem borer =PSB), *C. medinalis* (leaf foder =LF), *L. oratorius* (rice stink bug =RSB), *Nephotettix* sp (gren leafhopper = GLH) and *G. africana* (mole cricket =MC) (Table 2).
Abundance of YSB and BPH aligned with the considerable rice damage. On the other hand RBB did not found any serious damage to the rice crop, even though the population is very high exceeding the population of YSB and BPH. The RBB behavior is very strange because the abundance of population in light trap did not followed by an explosion. However, this pest needs to be monitored, because it is expected to gradually become a major pest as the succession of the main pest that exist today.

Table 2. Pest populations caught light traps. Sukamandi, 2013

Light traps	Pests caught in the light trap/week							
	YSB	PSB	LF	RBB	BPH	GLH	MC	RSB
Model BSE-G3	4,709.1	43.8	38.4	25,847.2	5,407.1	0.3	45.2	0.2
Model BSE-G4	6,633.8	21.8	23.0	23,787.6	9,742.3	0	18.3	0.1
Model BSE-Giant	11,751.3	59.9	68.9	43,718.4	6,505.2	0	63.9	0
Solar cell Sainindo	248.9	19.1	46.7	709.1	799.0	0	1.3	0
Total	23,343.1	144.6	177	94,062.3	22,453.6	0.3	128,7	0.3

Remarks: YSB= yellow stem borer, PSB= pink stem borer, LF=leaf folder, RBB= rice black bug, WC = brown planthopper, GLH= green leafhopper, MC= mole cricket, RSB= rice stink bug

The light trap of mercury (ML-160 watt) BSE-G3, BSE-G4 and BSE-Giant models catches pests very much booth in early planting immigrants pests and in old crop as emigrants pests who have grown in paddy crop. The light trap of mercury (ML-160 watt) BSE-G3, BSE-G4 and BSE-Giant models catches YSB were 4,709.1, 6,633.8 and 11,751.3 YSB/week/unit respectively, as well capturing the RBB were 25,847.2, 23,787.6 and 43,718.4 head /week /unit respectively. Light trap of mercury (ML-160 watt) BSE-G3, BSE-G4 and BSE-Giant models catches BPH were 5,407.1, 9,742.3 and 6,505.2 BPH /week /unit respectively (Table 2). On the other light trap of solar cell (CFL-25 watt) catches of YSB, RBB, and BPH were very low.

Differentiation performance of light trap in Sukamandi rice research station showed that of the four kinds of light traps provide different pests catches. YSB catches on the light trap of mercury (ML-160 watt) BSE-G3 model differ substantially smaller than the light trap BSE-G4 model with a t-test is negative (t_h = -8.261), as well as BPH catches in the light trap of mercury (ML-160 watt) BSE-G3 model differ substantially smaller than the light trap BSE-G4 model with t_h = -7.056 (Table 3). In the other hand PSB, LF, RBB, GLH, MC, and RSB in light trap model of light trap of mercury (ML-160 watt) BSE-G3 model differ significantly larger than the light trap model of BSE-G4 with t-test is positive (Table 3). Pests catches of YSB, PSB, LF, RBB, and MC in the light trap of mercury (ML-160 watt) BSE-G3 model differ substantially smaller than the light trap of BSE Giant model by t-test is negative, but GLH and RSB catches in the light trap of mercury (ML-160 watt) BSE-G3 model significantly different and larger than the catches on the BSE-Giant model, while BPH insignificantly different (Table 3).

Abundance of YSB, PSB, BPH, GLH, MC, and RSB in the light trap of mercury (ML-160 watt) BSE-G3 model significantly and higher than light trap CFL model Sainindo by t-test positive value. The number of YSB, PSB, LF, RBB, and MC in the light trap of mercury (ML-160 watt) BSE-G4 model significantly and smaller than light trap of BSE-Giant model by t-test is negative value. The numbers of YSB, RBB, BPH, RSB, and MC in the light trap of mercury (ML-160 watt) BSE-G4 model significantly and higher than the light trap solar cell (CFL) with t-test is positive value. In the other hand number of YSB, PSB, LF, RBB, BPH, and MC in the light trap of mercury (ML-160 watt) BSE-Giant models significantly and higher than the light trap solar cell (CFL) with t-test is positive value (Table 3).

Table 3. Differentiation caught pests in the light trap. Sukamandi, 2013

Kind of pests	Significant Difference Test ($T_{calculate}$) between light trap (pests/weeks)					
	BSEG3-BSE G4	BSE-G3: BSE Giant	BSE-G3: CFL	BSE-G4: BSE Giant	BSE-G4: CFL	BSE Giant: CFL
Yellow stem borer	-8.261**	-9.032**	12.432**	-4.527**	8.567**	19.956**
Pink stem borer	28.172**	-5.071**	9.153**	-18.604**	1.394^{tn}	20.735**
Leaf folder	23.859**	-13.222**	-2.683*	-16.822**	-7.136**	9.958**
Rice black bug	1.513^{tn}	-2.632*	8.721**	-2.632**	5.863**	9.394**
Brown planthopper	-7.056**	-0.717^{tn}	5.261**	1.171^{tn}	4.394**	6.717**
Green leafhopper	16.664**	3.691**	4.624**	0	0	0
Mole cricket	28.752**	-4.405**	15.927**	-14.033**	10.092**	24.976**
Rice sting bug	3.742**	2.984*	3.737**	2.436*	3.737**	0

*Significance, **highly significance, T table: $T_{05\text{-}db26}$ = 2.056 and $T_{01\text{-}db26}$ = 2.779

The presence of predators caught in the light trap related with pest caught on the tool, although insignificant (Baehaki et al., 2016) [9]. However, the relationship is slightly due to prey and predator winged adults as food. The relationship of the food chain due to the character of each predator. *O. nigrofasciata* beetles prey on the BPH, WBPH, GLH, and LF larvae. *M. crosea* beetles are polyphage predators to prey on the BPH as its main prey and predators of LF eggs much better than *Synharmonia octomaculata*, as well *P. fuscipes* prey on BPH and newly hatched of rice stem borer larvae. The information using light trap as a tool of Integrated Pest Management against insect pests of vegetables and other crops. The trap catch data also provide valuable information on bio control agents (predatory) active in vegetable ecosystem [10].

Paederus sp. or tomcat beside as a predator, also has a negative effect that cause irritation to the skin is called Paederus dermatitis (dermatitis linear) is a peculiar irritant contact dermatitis characterized by erythematous and bullous lesions of sudden onset on exposed areas of the body[11]. Some symptom of dermatitis linear as linear erythematous patches with central blisters, Stellate patch of erythema with central blisters, two small patches of erythema with erosions [12]. This beetle does not bite or sting, but accidental brushing against or crushing the beetle over the skin provokes the release of its coelomic fluid which contains paederin, a potent vesicant. Toxins released not by Paederus bite, because of the beetle hit, push or harassed. The toxin is not produced by Paederus itself but is produced by bacterial endosymbiont suspected of Pseudomonas species (http://upikke.staff.ipb.ac.id/2012/03/20/fenomena-tomcat-atau-dermatitis-paederus/). In the 2012 part of people in Surabaya was attack by tomcat caused the skin irritation from contact with pederin

($C_{25}H_{45}NO_9$) in the form of toxic amide hemolymph of beetle genus Paederus cause red spots that develop into blisters.

2. Performance Light Trap in Sepat Kerep –Karawang

Rice pests caught in the light trap in Karawang WS 2013 were four orders of insect pests consists of six families and 7 species. Orders Lepidoptera were YSB, PSB, and LF. Order Hemiptera were BB, RSB, and BPH and Orthoptera were MC. Also found the Order Coleoptera in very low quantities in the form of predator pests that *O. nigrofasciata*, *M. crosea* and *P. fuscipes* The pests number catches in the light trap of mercury (ML-160 watt) BSE-G3 model highly significant compared pests caught in the light trap solar cell (CFL-25 watt) Hariff model (Table 4). The YSB caught was 814.4 YSB / week significantly different than in the light trap solar cell (CFL-25 watt) Hariff model only catch was 51.4 YSB/ week. The RBB caught was 314.3 RBB/ week in the light trap of mercury (ML-160 watt) BSE-G3 model highly significant compared pests caught in the light trap solar cell (CFL-25 watt) Hariff model (25 RBB / week).

The BPH pests caught was is 524.7 BPH/ week in the light trap of mercury (ML-160 watt) BSE-G3 model significantly different than in the light trap solar cell (CFL-25 watt) Hariff model only catch was 8.1 BPH/ week. The MC pests caught was is 3.6 MC/week in the light trap of mercury (ML-160 watt) BSE-G3 model significantly different than in the light trap solar cell (CFL-25 watt) Hariff model only catch was 1.4 MC/week. The SB pests caught was is 11 RSB/ week s in the light trap of mercury (ML-160 watt) BSE-G3 model ignificantly different than in the light trap solar cell (CFL-25 watt) Hariff model only catch was 2.5 RSB/ week. On the other hand light trap of mercury (ML-160 watt) BSE-G3 model caught of PSB was 17 PSB/week and LF was 12.5 LF/week, whereas in the light trap solar cell (CFL-25 watt) Hariff model are not caught. Comparison pests caught in the light trap of mercury (ML-160 watt) BSE-G3 model was higher than in the light trap solar cell (CFL-25 watt) Hariff model. Abundance of BPH, YSB, and RBB were 65.0, 15.8, 12.6-fold respectively in the light trap of mercury (ML-160 watt) BSE-G3 model compared to the light trap solar cell (CFL-25 watt) Hariff model. In the other hand MC and RSB were 2.6 and 4.4-fold respectively in the light trap of mercury (ML-160 watt) BSE-G3 model compared in the light trap solar cell (CFL-25 watt) Hariff model.

Table 4. Differentiation caught pests in the light trap of mercury (ML-160 watt) BSE-G3 and light trap of solar cell (CFL) Hariff. Sepat Kerep, 2013

Pests			Light trap per week		$T_{calculate}$
Order	Family	Spesies	BSE-G3 model	CFL Hariff	
Orthoptera	Gryllotalpidae	*Gryllotalpa africana* (MC)	3.6	1.4	64.83**
Hemiptera	Pentatomidae	*Scotinophara coarctata* (RBB)	314.3	25.0	30.82**
	Alydidae	*Leptocorisa oratorius* (RSB)	11.0	2.5	69.22**
	Delphacidae	*Nilaparvata lugens* (BPH)	524.7	8.1	14.79**
Lepidoptera	Pyralidae	*Scirpophaga incertulas* (YSB)	814.4	51.4	38.18**
		Cnaphalocrosis medinalis (LF)	12.5	0	32.77**
	Noctuidae	*Sesamia inferens* (PSB)	17.0	0	96.97**

**highly significance between pests catches in the light trap of mercury (ML-160 watt) BSE-G3 and solar Cell (CFL) Hariff on significant difference test t-test, 1% . $T_{05\text{-}db26}$= 2.056 and $T_{01\text{-}db26}$= 2.779

The performance light trap of mercury (ML-160 watt) BSE-G3 model, BSE-G4 and BSE-Giant in Sukamandi-Subang shows that pests catches were higher than the light trap of solar cell (CFL-25 watt) Sainindo model. In the other hand the performance light trap of mercury (ML-160 watt) BSE-G3 model in Sepat Kerep-Karawang shows that pests catches were higher than the light trap of solar cell (CFL-25 watt) Hariff model. The data from two location show that the numbers pests catches were determined by power capacity lamp, light intensity or luminance lamp, kind diameter of funnel. The light trap with height power capacity (160 watt) and luminance of 3150 lm show that were higher pests numbers than in 20 watt power capacity with luminance of 1200-1250 lm. In the other hand pests numbers that caught in mercury lamp was higher than CFL. Performance light trap that catches pests also is determined by the diameter of the funnel light trap.

Pests were caught in the light traps of mercury (ML-160 watt) BSE-G3 and BSE-G4 models less than the pest was caught in the BSE-G4 model, because the top of the funnel collector pests on light traps of mercury (ML-160 watt) BSE-G3 and BSE-G4 models are only 60 cm compared to 100 cm at the light traps of mercury (ML-160 watt) BSE-Giant. In the other hand almost all of pests attractive to light trap of mercury (ML-160 watt) BSE-G3 model, BSE-G4 and BSE-Giant compared to the light trap of solar cell (CFL-20 watt).

The light trap of mercury (ML-160 watt) BSE-G3 model, BSE-G4, and BSE-Giant can be used for monitoring and reducing pests that come to rice cropping and coming out of rice crop breeding sites, while the light trap of solar cell (CFL-25 watt) only suitable for monitoring pests. This situation also has been reported that light trap of mercury (ML-160 watt) BSE-G3 model reduced pest populations of immigrants or emigrants pests. In the height pest population the light trap of mercury (ML-160 watt) BSE-G3 model catches BPH as many as 491,922 BPH/night /unit, YSB moth as many as 10,690 YSB/night /unit and RBB and as much as 504,000 RBB/night/unit (Baehaki, 2013) [5].

Ramamurthy *et al*. (2010) [13] reported that the mercury light was more efficient for Lepidoptera, Hemiptera, Hymenoptera, Odonata, and Diptera and black light was more efficient for Coleoptera, Orthoptera, Isoptera, and Dictyoptera. However, the abundance of pest species also depends on the time of the catch and the time of planting in connection with changes in meteorological factors [14]. The pests catches also differently in every hour. The highest numbers of Coleoptera were caught between 20:00 and 22:00 h and of most Lepidoptera between 02:00 and 04:00 h, while the hourly numbers of predatory insects caught by light traps were evenly distributed throughout the night [1]. Ma *et al*. (2012) [15] reported that white light emitted from mercury lamps attracted significantly more *Oryctes agamemnon arabicus* adults compared with the other tested light colours. Increasing the wattage of mercury lamps from 160 to 250 watt did not significantly increase the number of collected insects. The results demonstrated that light traps equipped with 160-watt mercury lamps emitting white light collected significantly the highest number of this insect among the other tested lamps.

Population dynamics of YSB as the other pest fluctuate according to dynamic environmental conditions [16]. Quantification of pests mortality factor to be important, both by biotic and abiotic as the mainstay estimate the insect population. Light trap as a reliable tools for warning and monitoring are dispensable for pests management, especially in predictive model to prevention of pests explosion and avoid yield loss due to pests. Forecasting of pest outbreak can be determined by pests catches from light trap by making the monthly curves of pest population as dynamics model. Forecasting models using light traps to BPH and WBPH also has been developed in China involving the Plant Protection Agency with various organizations [17]. In Japan the BPH and WBPH immigrants pests has been monitored using light trap, nets trap and field survey.

IV. CONCLUSION

Abilities of light trap of mercury (ML-160 watt) BSE-G3, BSE-G4, and BSE-Giant models were higher capture of pests compared to the light trap of solar cell (CFL-20 Watt). The rice pests that caught in the light trap was higher in the high power capacity at 160 watt and light intensity at 3150 lm than on the lower power capacity at 20 watt and low light intensity between 1200-1250 lm. In the other hand, number of pests that caught in mercury lamp was higher than CFL. Performance light trap that catches pests also is determined by the diameter of the funnel light trap. Pests were caught in the light traps of mercury (ML-160 watt) BSE-G3 and BSE-G4 models less than the pest was caught in the BSE-G4 model, because the top of the funnel collector pests on light traps of mercury (ML-160 watt) BSE-G3 and BSE-G4 models are only 60 cm compared to 100 cm at the light traps of mercury (ML-160 watt) BSE-Giant. In the other hand almost all of pests attractive to light trap of mercury (ML-160 watt) BSE-G3 model, BSE-G4 and BSE-Giant compared to the light trap of solar cell (CFL-20 watt).

Light trap of solar cell (CFL-20 watt) used for monitoring of immigrants and emigrants pest, whereas electric light trap of mercury (ML-160 watt) BSE-G3 model, of BSE-G4 model, and BSE-Giant model used for the monitoring and reducing of immigrant and emigrants pests.

REFERENCES

[1]. G. Ma and C. S. Ma. Differences in the nocturnal flight activity of insect pests and beneficial predatory insects recorded by light traps: Possible use of a beneficial-friendly trapping strategy for controlling insect pests. *Eur. J. Entomol, 109*,2012,395–401.

[2]. N. Endo, M. Wakakuwa, K. Arikawa and M. Hironaka. Spectral preference in a free-flying condition of the southern green stink bug, *Nezara viridula* (Heteroptera: Pentatomidae). *Jpn. J. Appl. Entomol. Zool. 58,* 2014, 23–28.

[3]. A.C. Oliveira, V.R. Veloso, R.G. Barros, P.M. Fernandes, and E.R. Souza. Capture of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) with light trap in tomato crop. *Pesq. Agropec. Trop. 38*, 2008, 153–157 [in Portuguese, English abstr.].

[4]. M. Shimoda and K. Honda Insect reactions to light and its applications to pest management. *Appl Entomol Zoo, 48*, 2013. 413–421.

[5]. Baehaki, S.E. Rice Stem Borer and Its Control Techniques. *IPTEK Tanaman Pangan 8(1),* 2013, 1-14. Abstract in English.

[6]. Baehaki, S.E. Strategi fundamental pengendalian hama wereng batang coklat dalam pengamanan produksi padi nasional. *Pengembangan Inovasi Pertanian 4(1)*, 2011, 63-75.

[7]. Baehaki, S.E. Pengendalian penggerek batang padi putih pada berbagai ambang kendali pada 3 varietas. *Pros. Symp. Penerapan PHT. Sukamandi,* 1994, 84-88.

[8]. S. Morita, K. Tanabe, Y. Tabaru, M. Hirao and Y. Kitashima. Evaluation of insect invasion indoors using indoor and outdoor light traps. *Jpn. J. Appl. Entomol. Zool, 53*, 2009, 147–155.

[9]. Baehaki.S.E, Tita Rustiati, Eko Hari Iswanto, dan Nono Sumaryono. The influence of meteorological factors on the rice pests flight that catched in the light traps of mercury lamp and CFL. *Agrotrop 5(2),* 2015, 122 – 138. Abstract in English.

[10]. A.K .Sharma and U. K. Bisen. Taxonomic documentation of insect pest fauna of vegetable ecosystem collected in light trap. International Journal of Environmental Science: *Development and Monitoring (IJESDM), 4(3),* 2013, 4-11.

[11]. G. Singh and S. Y. Ali. "Paederus dermatitis". *Indian Journal of Dermatology, Venereology and Leprology,* ***73*** *(1),* 2007, 13–15. doi:10.4103/0378-6323.30644

[12]. J.J. Mammino. Paederus Dermatitis an outbreak on a medical mission boat in the Amazon. *J Clin Aesthet Dermatol. 4(11)*, 2011, 44–46.
[13]. V. V. Ramamurthy, M. S Akhtar, N. V Patankar, P. Menon, R. Kumar, S. K Singh, S. Ayri, S. Parveen, and V. Mittal. Efficiency of different light sources in light traps in monitoring insect diversity. *Munis Entomology and Zoology 5(1)*, 2010, 109-114
[14]. M.K. Sharma, V. Pandey, R.S. Singh and R.A. Singh. A study on light trap catches of some rice pests in relation to meteorological factors. *Ethiop. J. Sci. 27(2),* 2004, 165–170.
[15]. A.D. Ma, S.T. Mahmoud, and E.M. Sharif . Use of light traps and differing light color to investigate seasonal abundance of the date palm pest, *Oryctes agamemnon arabicus* (Coleoptera: Scarabaeidae). *J Econ Entomol. 105(6)*, 2012, 2062-2067.
[16]. A. Khaliq, , M. Javed, M. Sohail and M. Sagheer. Environmental effects on insects and their population dynamics. *Journal of Entomology and Zoology studies 2(*2), 2014, 1–7.
[17]. X.H. Yan, H. Liu, J.J. Wang, Z. M. Zhao, F. Huang, and D. F. Cheng. Population forecasting model of *Nilaparvata lugens* and *Sogatella furcifera* (Homoptera: Delphacidae) based on Markov Chain theory. *Environmental Entomology 39(6)*, 2010, 1737-1743.