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ANNUAL DIVERSITIES CHANGES OF PESTS THAT CAUGHT ON THE LIGHT TRAP IN RELATIONSHIP WITH PESTS COMMUNITY IN THE RICE CROP

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ABSTRACT

Research of annual diversities changes of pests that caught in the light trap in relationship with the pest's community in the rice crop was carried out at the Sukamandi Research Station of Indonesian Center for Rice Research (ICRR) from 2000 to 2013. The results showed that the annual abundance of yellow stem borer (YSB), brown planthopper (BPH) and rice black bug (RBB) on the light trap were always high compared to the other rice pests. Abundance of BPH and YSB on the light trap had signaled high population of both pests in the rice crop, this is due to the flights of both pest originated from the outbreak pests area. Abundance of RBB on the light trap did not signaled of high RBB pest populations in the rice crop, because although the populations RBB as the highest that caught on the light trap did not caused outbreak in the rice crops. RBB population did not originate from rice cultivation, but coming from the surrounding environment including herbaceous vegetation. In accordance with the passage of time from 2000 to 2013, the diversity index of pests and natural enemies decreased from moderate to low diversity, and the evenness index declined from balanced community stability to the distressed communities. Similarities index of insects community that caught in the light trap did not increased, due to increasing of rarity of species and the other hand species richness declined. Instability of the community that caught in the light trap was signaled by low diversity index, evenness index declined, high of species rarity, low of species richness as a consequently of pests explosion in the rice field.

Keywords: light trap, pests and natural enemies, diversity, evenness, rarity, richness, similarity.

INTRODUCTION

The light trap as a monitoring tool to determine the economic status, pests abundance, and kind of pests and natural enemies as a first information suspected how can to reduce the pests population density. In the new integrated pest management (IPM), the pests caught on the light trap can be used in the early warning system and number of pests caught determines the economic threshold (Baehaki, 2011). The light trap data determine a new economic threshold (ET) of rice stem borer, whereas the decision making control of insecticides is done on 4 days after the moth caught in the light trap, because after 4 days since the moth landing, that eggs mass were laid to begin to hatch (Baehaki, 2013). Light trap as an insect pest control device is a non-chemical that can reliably to capture the insect pests either at the beginning rice crop as pests immigrants or at the mid rice crop as pests emigrants who have developed in rice crop. Indonesian Center for Rice Research (ICRR) has been used an electric light trap with incandescent lamp of 25 watt since the 1970s, followed since 2008 using light traps BSE-G3 electric models with a 160 watt mercury lamp (Baehaki *et al*., 2016).

Insects are actively captured or driven into the trap with a white or bluish light, however, mercury or ultraviolet lamp (black light) is the best. The effectiveness of the trap can be increased if the wavelength of light is adjusted to pests interests. Collection of pests and natural enemies in the light trap provide significant clues to the diversity of insects are active at night. Identification of pests and natural enemies on light trap are very important before executing of pest control. Pests and natural enemies that caught in the light trap can be used to determine the level of population in is going develop on rice.

Information on trap models, types of lights, light colors and wavelengths can be utilized for the detection and control of insects in agriculture. Therefore the light traps have been used widely to sample insect abundance and diversity, but their performance for sampling scarab beetles in tropical forests based on light source type (López *et al*., 2011). Light trap not only used to determine the diversity of pests in agriculture, but also used in forestry land and used to collect aquatic insects. Most aquatic insects and especially caddisflies (Trichoptera) are commonly attracted to lights, especially ultraviolet or black light, the exception being the few diurnal caddisfly species, e.g., *Phylloicus* sp. Müller (Calamoceratidae) (Calor and Mariano, 2012).

The diversity of pests and natural enemies that are closely related to biodiversity of plants in an ecosystem had very important role to preserve the stability of the ecosystem. Information of biodiversity can give a way to look for alternative pest control with the factors that affect the pest itself. Insects are highly responsive to environmental changes, including those resulting from anthropogenic activity to agriculture fields. This case is important that diversity of insect species represents an equivalent variety of adaptations to variable environmental conditions (Belamkar and Jadesh, 2014).

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Reduction of pest abundance is significant in the dry season especially in the long dry season in tropics area so that become a phenomenon limiting factor to development of pest. In connection with the changes of environment, the research aims to update the information of community diversity changes, similarity, rarity and richness of species that caught in the light trap. Likewise, pests abundance in the light trap is expected to provide information of pest population in relation to rice damage.

MATERIALS AND METHODS

Diversity and evenness of rice pests and natural enemies

Research diversity of rice pests and natural enemies that caught in the light trap conducted in Sukamandi Experimental Farm of Indonesian Center for Rice Research ICRR began in 2000 up to 2013. The Experimental Farm is located in Ciasem sub-district, Subang-West Java- Indonesia surrounded rice areas from three sub districts of Pabuaran, Patokbeusi, and Blanakan

In 2000 to 2007, had used the electric light trap with Philips incandescent lamp of 25 watts, was equipped container box for collecting pests with solution of soapy water. In 2008 to 2013, using electric light trap of mercury (ML-160 watt) BSE-G3 model was 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 (Baehaki *et al*., 2016). 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 trap installed in the experimental garden at a height of 150 cm from the ground. Electric light trap is turned manually during 11-12 hours starting at 18:00 pm until 5:00 am.

Pests collected in the morning by taking the container box or bag pests' collector from all electric light trap and sprayed by Baygon to killing pests that still life. All dead pests transferred into a plastic tray for processed further. Separated pests and predators to identified on the orders, families and species. Calculated pests and predators number of each species and then the data of pests and predators inserted into an excel program for cumulative data in one year. Index of insect's diversity is determined by the Shannon-Wiener formula in Krebs (1978) as follows:

$$H = -\sum_{i=1}^{s} (p_i)(\log_2 p_i)$$

H = index of species diversity
S = number of species
p_i = proportion of total sample belonging to i^{th} species

Classification values diversity index of Shannon-Wiener divided into three levels, namely H> 3 indicate that a high diversity, the distribution of the number of individuals of each species are high and high stability of communities, H = 1-3 shows that diversity is moderate, the distribution of the number of individuals of each species are moderate and moderate stability of community, and H <1 indicates that low diversity, the distribution of the low number of individuals of each species and low stability of community (Magurran, 1988).

Evenness of species (J) or equitability (E) or the stability is calculated from Shannon index by dividing H with H_{max} as follows:

$$H_{max} = - S\left(\frac{1}{S}\right)\left(\log_2 \frac{1}{S}\right) = \log_2 S_i$$

$$E = \frac{H}{H_{max}}, \text{ E range from 0-1}$$

H_{max} = maximum species diversity
S = number of species in community
E = equitability

Evenness index of Shannon-Wiener with the value range from 0 <E <0.5 indicates a community is in under pressure and low balanced, value from 0.5 <E <0.75 indicates a community is in moderately balanced and value from 0.75 <E <1 indicates a community is in high balanced (Ludwig and Reynolds, 1988). The evenness index measures how evenly species are distributed in a sample. The evenness assumes a value between 0 and 1, with 1 being complete evenness i.e., a situation in which all species are equally abundant.

Calculation of changes and diversity of pests during the observation can be seen in the development curve between pests and natural enemy's diversity (H), maximum diversity (H_{max}), and evenness of pests (E) each year. The relationship showed by the regression equation between diversity as independent variable and stability as dependent variable.

Simpson's diversity index (Rarity species index)

Simpson's diversity index expressed in λ or D was used to determine which sample has more rare species (Asghar, 2010). It is a simple mathematical measure that characterizes species diversity (rarity) in a community as:

$$D = \lambda = \sum_{i=1}^{s} p_i^2$$

where pi is the proportional abundance of the i^{th} species and is given by pi= ni/N, i= 1,2 ,3,…….S, whereas ni is the number of individuals of i^{th} species and N is the known total number of individuals for all S species in the population.

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In the other hand species richness = R in Balakrishnan (2014) is calculated base on *Simpson's diversity index* as follow:

$$R = 1 - \sum_{i=1}^{s} p_i^2 = 1 - D$$

where pi is the proportional abundance of the i^{th} species and is given by pi= ni/N, i= 1, 2 , 3,…….S, whereas ni is the number of individuals of i^{th} species and N is the known total number of individuals for all S species in the population.

Simpson's index varies from 0 to 1 and gives the probability that two individuals drawn at random from an infinitely large population belong to the different species. Likewise, the richness index of number of species S varies between 0 and 1. For a given species richness (R), evenness (E) increases as D decreases, and for a given evenness, D decreases as richness increases.

Sorensen similarity index

The Sorensen index (Sorensen, 1948) also known as Sorensen's similarity coefficient, was used for comparing the similarity of two samples (sites) (Janson and Vegelius, 1981). The short hand version of the formula, as applied to qualitative data, is CS = 2C/A+B where CS is similarity coefficient**,** A and B are the species numbers in sample A and B, respectively and C is the number of species shared by the two samples. The value for this index always ranges between 0 to 1. Where 0 means completely different and 1 means completely similar samples (Asghar, 2010).

RESULTS AND DISCUSSIONS

Diversity and evenness of rice pests and natural enemies

Pests and natural enemies that caught in the light trap at Sukamandi in the 2000 to 2013 were the fly insect's imago comprised four orders pests of 9 families. There are the order Lepidoptera (Pyralidae and Noctuidae), Hemiptera (Pentatomidae, Alydidae, Cicadellidae and Delphacidae), Orthoptera (Gryllotalpidae) and Diptera (Muscidae and Ephydridae). At the same time were acquired natural enemies of two order with 4 families, namely the Coleoptera (Coccinellidae, Staphylinidae, Carabidae) and the order Hemiptera (Miridae).

Pests that often caught were rice yellow stem borer (*Scirpophaga incertulas*), rice pink borer (*Sesamia inferences*), leaf folder (*Cnaphalocrosis medinalis*), case worm (*Nymphula depunctalis*), mole cricket (*Gryllotalpa africana*), rice black bug (*Scotinophara coarctata*), rice stink bug (*Leptocorisa oratorius*), brown planthopper (*Nilaparvata lugens*), and white backed planthopper (*Sogatella furcifera*). The high abundance pests during the years of 2000-2013 only three species those are rice yellow stem borer (YSB), brown planthopper (BPH) and rice black bug (RBB), while the other pests caught were in very small amounts (Figure-1).

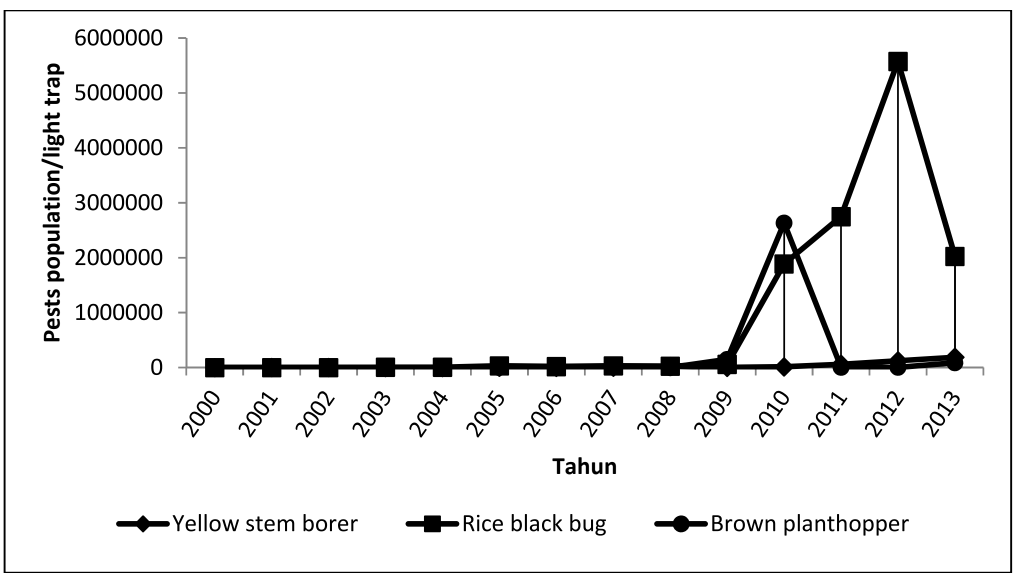

Figure-1. Annualy three major pests abundance that caught in the light trap.

Characters of BPH abundance in the light trap was accordance with the pest in rice cropping. The BPH that caught in trap light between years of 2000 to 2008 is very low, but in 2009 and 2010 BPH caught in the trap light was high enough, because at the same time there was an explosion in the rice cropping areas. Observations brown plant hopper in the field in the 2011 were 2462 BPH/hill, and were 17123 BPH/30 hills on the WS 2012/2013. In 2010 the BPH attacks rice plantation in the sub district of Ciasem, Pabuaran, Patokbeusi and Blanakan were 850; 1,719; 1,577 and 663 ha respectively. The BPH outbreak up to hopperburn were 395 ha divided 120 ha in

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Ciasem, 270 ha in Patokbeusi and 5 ha in Pabuaran (http://saungurip.blogspot.co.id/2010_05_01_archive.html).

Characters of YSB abundance in the light trap was accordance with the pest in rice cropping. YSB was very low in the 2000 and gradually to increase in high population, especially reached to peak population in 2013, this was due in 2012-2013 at the rice cropping area near the light trap attacked by YSB. In the observations of borer attacks at Ciasem rice cropping showed that 30.2% white heads.

The character of RBB abundance in light trap did not depended upon RBB population in the rice cropping, because throughout the years of pest abundance is always high, although there did not explosion of RBB in the rice cropping. RBB is still regarded as secondary pests despite its abundance was very high, this RBB mainly still breed in the vegetation of grasses. The RBB catches was higher than BPH and YSB. This indicates that there was an abundance process of RBB will gradually become a major pest, leading to succession to shift the BPH and YSB.

Natural enemies that often caught in the light trap only four species, namely *Ophionea nigrofasciata*, *Coccinella* sp, *Paederus fuscipes, and Cyrtorhinus lividipennis*, while spiders as pests predators has never been found in light trap catches. In Japan insects catches in light trap reaches 12 order consists of 52 families of insects divided to class of Thysanoptera, Hemiptera, heteroptera, Coleoptera, Diptera and Lepidoptera and members of non-pest is Ephemeroptera, Odonata, Psocoptera, Strepsiptera, Hymenoptera, and Trichoptera (Morita *et al*., 2009).

Species diversity index of pests and natural enemies in 2000 and 2001 were H = 2.92 and 2.90 respectively. In 2002 reach H = 2.61 and continued to decline in the next year and in 2012 the diversity index of pests and natural enemies reached the lowest point of H = 0.22 and in 2013 go up to H = 0.72.

The diversity index of pests and natural enemies that caught in the light trap is a representation of pests and natural enemies in the crop. Therefore, the diversity index of pests and natural enemies that caught in the light trap from 2000 to 2010 ranged between H = 1.15- 2.92 had indicated that the diversity index and distribute of individuals number of each species in the rice crop including to the moderately category and also the stability of the community including to moderately category. The diversity index of pests and natural enemies that caught in the light trap in 2011 to 2013 with H = 0.22 to 0.72 indicates that diversity and distribution of individuals number of each species, including to the low category as well as the stability of the community including the low category. In the lowest diversity index due to one or more pests had dominated, that signaled outbreak in the rice field by YSB and BPH that was informed above. The maximum species diversity (H_{max}) at the high stability in 2000 only reached H_{max} = 3.58. In the following years until 2013, the maximum diversity index did not many changes between H_{max} = 3.46-4.09 the display data showed that an index of maximum diversity is quite low. This is caused by the presence of species that caught in the light trap very little only 12 species in 2000 and 13-18 species between 2001-2012, even in the 2013 only 11 species (Table-1).

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Table-1. Pests and natural enemies that caught in the light trap per year.

Ordo/Famili	Spesies	Number individual pests and natural enemies that caught on the light trap per year													
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Lepidoptera:															
Pyralidae	*T. iinnotata*	0	135	19	24	16	34	4	11	0	0	0	0	0	0
	S. incertulas	167	1139	2735	2499	1969	6203	5287	7426	22034	3552	13832	59276	122939	187349
	C.suppressalis	429	211	18	7	4	15	9	30	0	8	0	3	0	0
	C.medinalis	6	54	378	514	179	221	293	396	379	494	325	455	1788	1833
	N.depunctalis	0	0	5	0	86	29	90	139	82	84	62	59	2	24
Noctuidae	*S.inferens*	335	292	267	503	267	333	497	932	874	1767	3951	1275	1601	942
	M.separata	0	0	0	0	0	0	0	0	101	177	622	2	0	0
Orthoptera:															
Gryllotalpidae	*G. africana*	105	217	208	283	213	345	460	676	547	571	2862	3056	2130	1588
Hemiptera:															
Pentatomidae	*S.coarctata*	0	6	75	7158	6185	32685	18414	33100	27313	58477	1887523	2019650	5574998	2024033
Alydidae	*L.oratorius*	118	208	88	285	165	251	143	257	97	145	238	280	462	189
Miridae	*C. lividipennis*	89	78	10	30	32	111	324	586	225	15075	18485	3425	7	0
Cicadellidae	*Nephotettix sp*	16	4	334	604	235	207	136	138	131	171	5	0	0	0
Delphacidae	*N. lugens*	234	18	116	116	32	94	710	2112	402	149855	1791542	4792	3341	87824
	S. furcifera	24	12	164	96	5	36	416	1212	283	978	79	41	3	0
Coleoptera:															
Coccinellidae	*Coccinella sp*	0	62	271	644	409	609	827	1708	811	1838	1920	827	1175	424
Staphylinidae	*P. fuscifes*	415	586	449	789	473	674	872	1523	636	1200	21193	33859	30615	16849
Carabidae	*O.nigrofasciata*	0	86	52	89	75	174	91	110	198	540	1795	14051	973	834
Diptera:															
Muscidae	*A. exigua*	0	0	0	1	2	0	49	27	5	14	1	0	0	0
Ephydridae	*Hydrellia sp*	3	8	33	9	53	4	7	0	0	0	0	0	0	0
Number of species		12	16	17	17	18	17	18	17	16	17	16	15	13	11
Total of individual insects		1941	3116	5222	13651	10400	42025	28629	50383	54118	234946	3744435	2141051	5740034	2321889
H		2.92	2.90	2.61	2.37	2.08	1.21	1.87	1.88	1.63	1.52	1.15	0.42	0.22	0.72
Hmax		3.58	4.00	4.09	4.09	4.17	4.09	4.17	4.09	4.00	4.09	4.00	3.91	3.70	3.46
E		0.81	0.73	0.64	0.58	0.50	0.30	0.45	0.46	0.41	0.37	0.29	0.11	0.06	0.21

Evenness index (E) kinds of pests and natural enemies as a proportion H/H_{max} for year of 2000 was E = 0.81. In 2001 the evenness of pests and natural enemies reach E = 0.73, it decreased by 9.9%. In 2002 reached E = 0.64 and continued to decline in the next year. In 2012 the evenness of pests and natural enemies reached the lowest point was E = 0.06 and in 2013 rose again up to E = 0.21. Evenness index based on index Shannon-Wiener in 2000 between 0.75 <E <1 indicates the community in the rice crop was balanced situation. Evenness index from 2001 to 2004 between 0.5 <E <0.75 indicates the community in the rice crop is rather balanced. Evenness index in the year of 2005 up to 2013 between 0 <E <0.5 indicates the community in the crop is in under stresses. Likewise, the diversity of pests and natural enemies in the light trap of SRI cultivation in Malaysia is obtained 34 species representing 21 families and 8 orders of insects was recorded comprising Homoptera, Hymenoptera, Coleoptera, Orthoptera, Odonata, Hemiptera, Lepidoptera and Diptera. For the total sampling period, the Shannon-Wiener diversity index (H) was 1.17 and evenness index (E) was 0.89 (Norela *et al*., 2013). When all species in a sample are equally abundant will give the evenness index at maximum, decreasing towards to zero as the relative abundance of the species diverges away from evenness (Sebastian *et al*., 2005). The value Evenness index between 0 and 1 thus the value 1 being perfect evenness that the situation of all species are equally abundant.

Development curves of diversity index of pests and natural enemies (H), maximum diversity (H_{max}), and evenness of pests (E) of each year shown in Figure-2. The curve shows that fluctuation of the diversity of pests and natural enemies decreased from 2000 to 2013. Similarly, fluctuations in evenness of pests and natural enemies decreased from 2000 to 2013. On the other hand, the maximum diversity curve did not fluctuate, because almost all at the flat line.

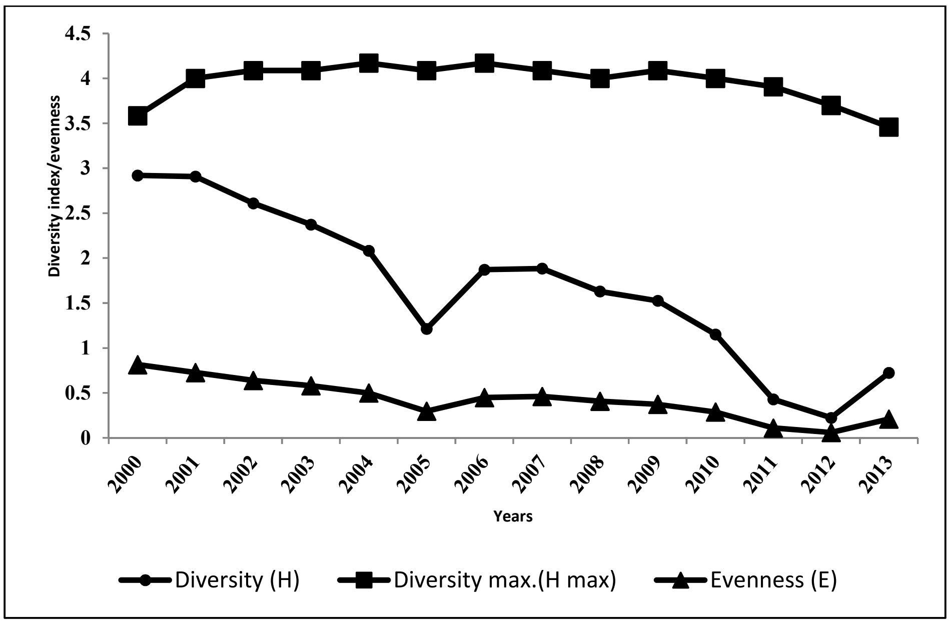

Figure-2. Changes diversities and evenness annual of pest insects that caught in the light trap.

Performance of diversity curve will be followed by fluctuations in aligned of evenness. Therefore, the linear equation between the diversity index (H) and evenness index (E) was E = -0.0042 + 0.2537 H positively correlated was r = 0.992 with a coefficient of determination $R^2 = 0.9856$ and Adj. $R^2 = 0.9844$. Adj. R^2 is R^2 corrected with the degree of freedom as an indicator measuring the goodness of high-value models. This showed that R^2 and Adj. R^2 did not different, therefore the evenness (E) determined by diversity (H) amounted to 98.44% (Figure-3). The relationship in accordance with the stability of arthropods that closely related to the diversity of arthropod community in an agroecological zone (AEZ) and arthropods stability much more explained by its diversity (Baehaki and Mejaya, 2012).

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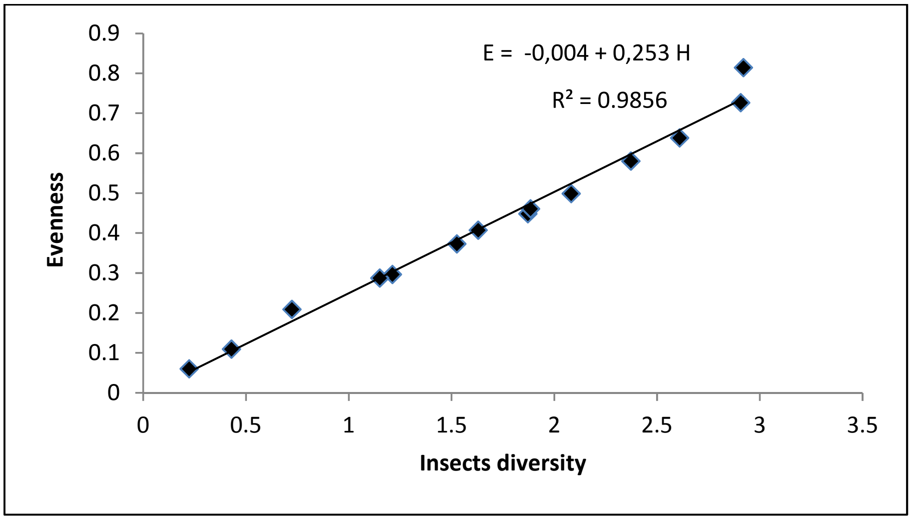

Figure-3. Relationship between insects diversity and Evenness.

Light trap will facilitate the development of a control strategy that more comprehensive with the appropriate light trap as operational optimize pest control. The development of more comprehensive trapping strategies by adjusting when during a night a light trap is operational with the objective of optimizing the conflicting requirements of using these traps for controlling pest insects and the need to reduce the numbers of beneficial insects caught by these traps in various agricultural ecosystems (Ma and Ma, 2012).

Ramamurthy *et al*. (2010) 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 relation to the changes in meteorological factors (Sharma *et al*., 2004). Differences of insects caught in the light trap are also different for each 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. The hourly numbers of predatory insects caught by light traps were evenly distributed throughout the night (Ma and Ma, 2012). A model was developed to describe the relationships between the cumulative proportions of insects caught and time of night. The model accurately describes the flight activity of insects that were mainly caught before midnight, after midnight and evenly throughout a night by using different parameters for the three different insect groups. Ma *et al*. (2012) reported that white light emitted from mercury lamps attracted significantly more *Oryctes agamemnon arabicus* (Coleoptera) adults compared with the other tested light colors. 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. Light trap catches of each region will be different as well as catch insects from Baghdad obtained 593 specimens there are 12 species of 10 genera representing three families were diagnosed: Pentatomidae, Reduviidae and Coreidae (Order; Hemiptera) and the species of *Oncocephalus pilicornis* Reuter (fam., Reduviidae) (Augul *et al*., 2015). The composition of faunal species of insects are attracted to light traps in Maharashtra, India in the year 2011-2012 dan 2012-2013 revealed that order Coleoptera showed a rich population were 41.81% and 35.10%, followed by Hemiptera were 16.86% and 21.77% and Lepidoptera were 12.96% and 12.89%, respectively (Dadmal and Khadakkar, 2014). The highest number of insects was observed in container placed under black light (ultraviolet light), while the lowest in that of red light. Similarly, the common insect orders frequented among all color lights were Diptera, Coleoptera and Lepidoptera respectively. The experimental results indicated that insects are attracted in more number on lights with short wavelengths and high frequencies and vice a versa (Ashfaq *et al*., 2005).

Simpson's diversity index (Rarity species index)

The rarity species index (D) on year of 2000 and 2001 very low were D= 0.15524 and D= 0.19567, and then the rarity species more increase was D=0.30006-0.39544 for 2002-2004. In the year 2005, the rarity species most increase with D=0.6274 but then turn to decrease in 2006-2010 to D= 0.45125-0.48309. In 2012 the rarity reach peak was D=0.94381 and then in 2013 turn to decrease was D=0.76788 (Figure 4).

Based on the formula R = 1-D, then the species richness index (R) was the inverse of the rarity species index. In 2000 the rarity species index was very low (D= 0.15524) resulting in very high species richness reached with R = 0.84476, and then began to decline in 2001 with R = 0.80433. In the years 2002-2004 the species richness were between R = 0.60456-0.69994 and in 2005 the species richness index decreased reaching R = 0.3726. In

2006-2010, the species richness was between R = 0.51691-0.54875 and in 2011 the species richness decreased reaching R = 0.10912. In 2012 the species richness reached the lowest point of R was 0.05619, then rose again in 2013 with R = 0.23212 (Figure-4).

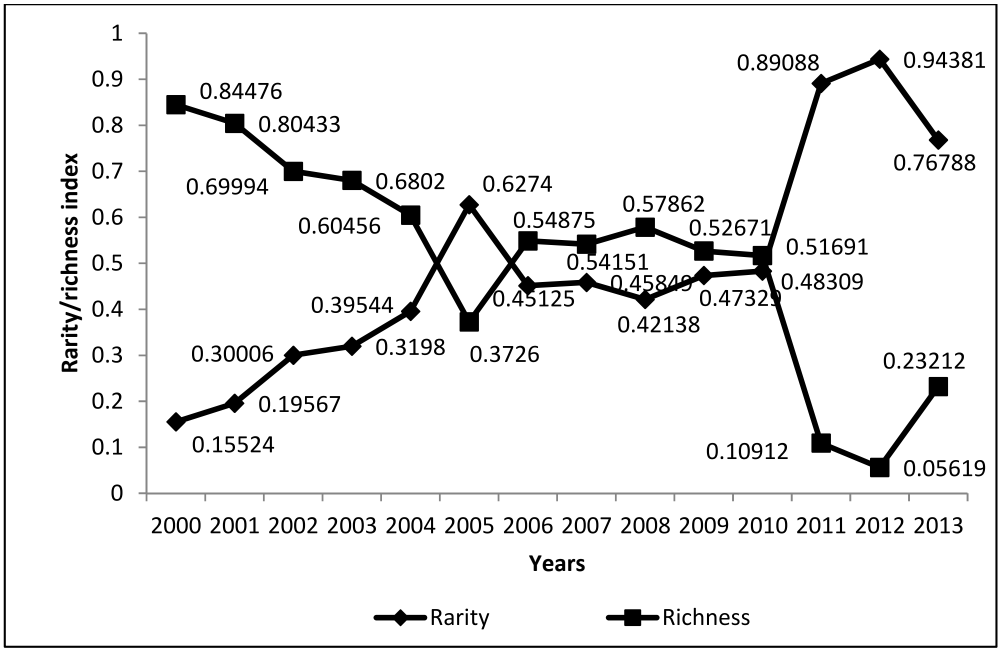

Figure-4. The annually rarity species index and species richness index that caught in the light trap.

The insect richness in rice crop may change from time to time depending on the situation of agroecosystem. The overall insect diversity and richness decreased in tandem with the growth phase of the paddy plant, and Although the overall population abundance of insects Increased with the growth and development of the paddy plants, there were no significant difference recorded between plots and sampling visits (p > 0.05) (Norela *et al*., 2013).

Sorensen similarity index

Sorensen similarity index (Cs) ranges between 0 and 1, and then to understand the similarity insects from the year 2000-2013, the index of similarity can be categorized into five levels of similarity index, namely: Index = 0 (0%) = differences was perfect or no similarity at all, index> 0-0.5 (> 0-50%) = rather similar, index> 0.5-0.75 (> 50-75%) = similar, index> 0.75 - <1 (> 75-<100%) = very similar, index = 1 (100%) = a perfect similarity.

Based on the Sorensen similarity level above, the community of insect similarity index that caught in the trap light in 2000 compared to the light catches in 2001, 2002, 2003, 2004, 2005, 2006, 2007, and 2009 were very similar for Cs = 76-83%. Community of insect similarity index that caught in the trap light in 2000 was similar to the light catches in 2008, 2010, 2011, 2012, and 2013 with an index of similarity of Cs = 61-71% (Table-2).

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Table-2. Sorensen similarity index between years in the community of insects caught in the trap light.

Years	Years													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2000	1.00	0.79	0.83	0.83	0.80	0.83	0.80	0.76	0.71	0.76	0.71	0.74	0.72	0.61
2001		1.00	0.97	0.97	0.94	0.97	0.94	0.91	0.81	0.79	0.81	0.84	0.83	0.74
2002			1.00	0.94	0.97	1.00	0.97	0.49	0.85	0.88	0.85	0.88	0.87	0.79
2003				1.00	0.97	0.94	0.97	0.94	0.85	0.82	0.85	0..81	0.80	0.71
2004					1.00	0.97	1.00	0.97	0.88	0.86	0.88	0.85	0.84	0.76
2005						1.00	0.97	0.94	0.85	0.88	0.85	0.88	0.87	0.79
2006							1.00	0.97	0.88	0.91	0.88	0.85	0.84	0.76
2007								1.00	0.91	0.94	0.91	0.88	0.87	0.79
2008									1.00	0.97	0.94	0.90	0.90	0.81
2009										1.00	0.97	0.88	0.87	0.79
2010											1.00	0.90	0.90	0.81
2011												1.00	0.93	0.85
2012													1.00	0.92
2013														1.00

Community of insect similarity index that caught in the trap light in 2001 was very similar to the insects catches in 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2011, and 2012 with a value of Cs = 79-97%, while the index community of insect similarity caught in the light traps in 2013 similar to the insects caught in the light trap in 2001 with value of Cs was 74%.

The similarity index of insect community that caught in the trap light in 2002 was very similar to the insects caught in 2003, 2004, 2006, 2008, 2009, 201, 2012, and 2013, with the value of Cs = 79-97%, even the perfect similarity of Cs = 100% to insects caught in 2005, however, in 2007 value of Cs was only 49%. The similarity index of insect community that caught in the trap light in 2003 was very similar to the insects caught in 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, and 2012 with value of Cs = 80-97%, while the similarity index of insect community that caught in the trap light in 2003 was similar to the insects caught in 2013 with value of Cs = 71%. The similarity index of insect community that caught in the light traps in 2004 was very similar to the insect caught in 2005, 2007, 2008, 2009, 2010, 2011, 2012, and 2013, with the value of Cs = 76-97%, while the similarity index of insect community that caught in the light trap in 2004 have perfect similarity with CS = 100% to insects caught in 2006.

The similarity index of insect Community that caught in the light trap in 2005 was very similar to the insects caught in 2006, 2007, 2008, 2009, 2010, 2011, 2012, and 2013 with value of Cs = 79-97%. The similarity index of insect community that caught in the trap light in 2006 was very similar to the light catches in 2007, 2008, 2009, 2010, 2011, 2012, and 2013, with the value of Cs = 76-97%. Similarity index of insect community that caught in the trap light in 2007 was very similar to the light catches in 2008, 2009, 2010, 2011, 2012, and 2013, with the value of Cs = 79-94%.

Similarity index of insect community that caught in the trap light in 2008 was very similar to the insects caught in 2009, 2010, 2011, 2012, and 2013, with the value of Cs = 81-94%. Similarity index of insect community that caught in the trap light in 2009 was very similar to the insects caught in 2010, 2011, 2012, and 2013 with a value of Cs = 79-97%. Similarity index of insect community that caught in the trap light in 2010 was very similar to the insects caught in 2011, 2012, and 2013, with the value of Cs = 81-90%. Similarity index of insect community that caught in the trap light in 2011 was very similar to the light catches in 2012 and 2013 with value of Cs = 85-93%. Similarity index of insect community that caught in the trap light in 2012 was very similar to the insects caught in 2013 with a value of Cs = 92% (Table-2).

In 2000-2001 the insect community that caught in the light trap more diverse than in the following years, although the diversity of insects community in 2000 to 2010 showed the moderate diversity and in 2011 to 2013 showed low diversity. In the two early years the rarity species were smaller than in the following years; in the others hand the catches insects of its years more equally among species compared to next years.

In accordance with the data of diversity, rarity and species evenness, the community of insects that caught in the light trap in 2000-2001 was quite rich compared to insects catches in the next year, especially in 2013. From discussion above shows that in rice field of North Coastal of West Java, particularly in the rice field of Ciasem- Subang district there were gradients in the diversity decreased, evenness decreased, richness decreased, but had gradient increased in species rarity. The similarities of insects catches did not increase, because the rarity of species declined.

The results also showed that the agro-ecosystem of rice field still considered to have a diversity of fauna of insects, but the diversity more narrowed that toward to the instability of the community, so it is always upheavals pests that could potentially toward to pests explosion.

In one agroecosystem expected the kinds and distribution of insects is quite high, in order the insect have much contributed to the welfare of ecology and insects conservation is an important part of sustainable life, as a response to the crisis of the ecosystem. The further research study on the insect biodiversity and taxonomy mush be continued, in order to get better and comprehensive information on those aspects to be documented for future reference (Belamkar and Jadesh, 2014). Balakrishnan *et al*. (2014) gives reviews that biodiversity is one of the important cornerstones of sustainable development and represents the biological wealth of a nation. The world is currently facing its greatest ever biodiversity crisis. Insects and plants are becoming extinct because of habitat loss, over exploitation, pollution, over population, and the threat of global climatic changes.

CONCLUSIONS

Pests and natural enemies that caught in the light trap during the years 2000-2013 consists of 4 orders with 9 families of pests and 2 orders with 4 families of natural enemies. Pests in the high abundance during the years were YSB, BPH and RBB, while the other pests that caught in very small amounts.

Abundance of BPH and YSB in light trap were cues the high population of these pests in the rice crop. This is an indication the relationship between the pests abundance that caught in the light trap with pests outbreak in rice field. In the other hand abundance of RBB that caught in the light trap did not given cue the high pest population in the rice field, because although the populations RBB the highest that caught on the light trap did not caused outbreak in the rice crops. RBB population did not originate from rice cultivation, but coming from the surrounding environment including herbaceous vegetation

The diversity of pests and natural enemies that caught in the light trap in 2000 to 2010 showed the moderate diversity category and in 2011 to 2013 showed the low diversity category. Evenness index in 2000 was between 0.75 <E <1 that indicates a community in the crop in high balanced, but evenness index from 2001 to 2004 moderately balanced. Evenness index in the year 2005 up to 2013 showed that the community in the rice crop under stressed. The similarities of insects community did not increased, due to increasing of rarity of species and the species richness declined, signaled to the instability of the community, so it is always insects upheavals that could potentially toward to an outbreak of pests in the rice crop.

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