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Morphometric studies on white leafhopper (*Cofana spectra)* from rice fields in Tapanuli Region-North Sumatera-Indonesia

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Abstract
The present work emphasizes on the morphometric study of white leafhopper *Cofana spectra* at three districts in Tapanuli region-Indonesia. The research sample was taken from the rice fields located in Toba Samosir district (Tampubolon Sariburaja village), Samosir district (Sigaol Simbolon village), and Tapanuli Utara district (Simorangkir Julu village). The morphological traits that be meansured are body length, width body, head length, head width, stylet length, thorax length, abdomen length, wing length, wings width, leg length and ovipositor length. The morphometric features measuring were done by using sofware Carl Zeiss Imaging System Axio Vision LE Release 4.8.2 under Stereo Zeiss-Stemi 2000-C microscope. Morphometric differentiation of leafhopper between male and female in Tapanuli area was analyzed by using the Mann-Whitney test (U), Wilcoxon (W) and Z tests. Meanwhile among the three districts were analyzed by using Kruskal-Wallis test (X^2). The relationship among body length and other morphological traits be analyzed by stepwise multiple regression with the helping of Software IBM SPSS Statistics 22.The research result showed that the female size of white leafhopper *Cofana spectra* was very significantly larger ($p<0.01$) than in males. The male and female morphometric among the three districs were also very significantly different ($p<0.01$). The significant difference among males morphological traits at three districts were the body length, body width, head length, head width, thorax length, wings width and the leg length, whereas among females were body width, head width, stylet length, thorax length, abdomen length, wing length and the leg length. Further, in relationship among body length (Y) toward other morphological traits ($X_{2\text{-}10}$), the research result showed that the abdomen length has the highest contribution in male ($Y= 5.39 +0.52X_6$, $r^2=25.1\%$), meanwhile in female, it was the wing length ($Y=3.77+ 0.68X_7$, $r^2=38.4\%$).

Keywords: Morphometric features, *Cofana spectra*, Tapanuli-Sumatera

1. Introduction
The white leafhopper (WLH) *Cofana spectra* (Distant) is a pest of paddy, notably in upland rice fields, which suck sap from the leaves and results drying of leaf tips leading the leaf flip orange and curl [1]. The damaged of paddy is also caused of secondary infection of fungal and bacterial on the affected part. This species also has been reported could as vector of pathogenic viruses such as Rice yellow mottle virus (RYMV) that causes yield loss [2]. Therefore, based on its infestation on rice plant this hopper could be stated as minor pest and major pest [2-3].
The *Cofana spectra* is common within the rice fields and also on variety of economic grass species at a distance from rice fields. Its occurrence in Africa, Pacific, Australia and Asian countries as India, Indonesia, Malaysia, Philippines, Srilanka and Taiwan has been reported [3-4-5]. The presence of this species and also its abundance on rice field in Indonesia and especially in Tapanuli area has been reported [6].
The effective management of white leafhopper as pest or as a vector of virus on rice field depend on comprehensive comprehension of its bioecology. Information about its external biology traits or morphology is important for accurate identification. Furthermore, the data about its presence, abundance, distribution, population dynamic are needed in monitoring action in the field so that the disadvantage that shall be caused could be minimized.
Morphometric techniques has become one of the major tools for the study of population structures of insect vectors [7]. This techniques has contribution in insect systematics and also in medical entomology, especially in helping decision making in the development of vector control strategies [8].

There is no morphometric study of white leafohpper *Cofana spectra* that has been conducted until now in Indonesia, especially on white leafhopper that could be found in Tapanuli area. Therefore, in this study the morphometric approach has been used to examine the possible differences that may exist between different populations of white leafhopper species of Tapanuli-Indonesia.

The objective of this research was to apply morphometric analyses to check for size differences among populations of white leafhopper in three districts in Tapanuli area in Indonesia and also to find out the morphometrric traits that have significantly contribution in the prediction of the body length of both male and female white leafhoppers.

2. Materials and methods

One sampling site at every district for three districts in Tapanuli area on non irrigated rice field have been set (Fig.1).The sampling sites were in Tapanuli Utara district (Simorangkir Julu village:N:2º02'93.62'';E:99º01'52.5"), Toba Samosir district (Tampubolon Sariburaja village: N:2º34'04.51''; E:99º08'75.6'') and in Samosir district (Sigaol Simbolon village: N:2º53'04.3"; E:98º74'58.7"). Leafhoppers sampling was done in August 2018 in conventional rice cultivation field. The hopper was catched by using standard sweeps net and done in the western, eastern and winward sides of the field [9-10]. Sampled hopper was dry preserved, labeled and transported to the lab for curation and identification. Species identification and confirmation were done under stereo binocular microscope in taxonomy laboratory of Biology Department of Universitas Negeri Medan and be based on Wilson & Claridge [4]and Meshram & Ramamurthy [5]. The identified leafhoppers were deposited in 70% alcohol in the Entomological Collection at Taxonomy Laboratory of Biology Department. Morphometric traits measurement were done until October 2018 and included body length, body width, head length, head width, thorax length, abdomen length, stylet length, fore wing length, fore wing width, hind leg length and ovipositor length. All measurement were done by using sofware Carl Zeiss Imaging System Axio Vision LE Release 4.8.2 under Stereo Zeiss-Stemi 2000-C microscope. 100 hoppers (50 specimens male, 50 specimens female) from every sampling site was measured their morphometric charachter. Morphometric differences between sexes was tested by using Mann-Whitney, Wilcoxon and Z tests, whereas among districts was conducted by using Kruskall-Wallis test. Furthermore, the relationship among body lenght and other morphological traits were done by using stepwise multiple regression [11] with the helping of Software IBM SPSS Statistics 22.

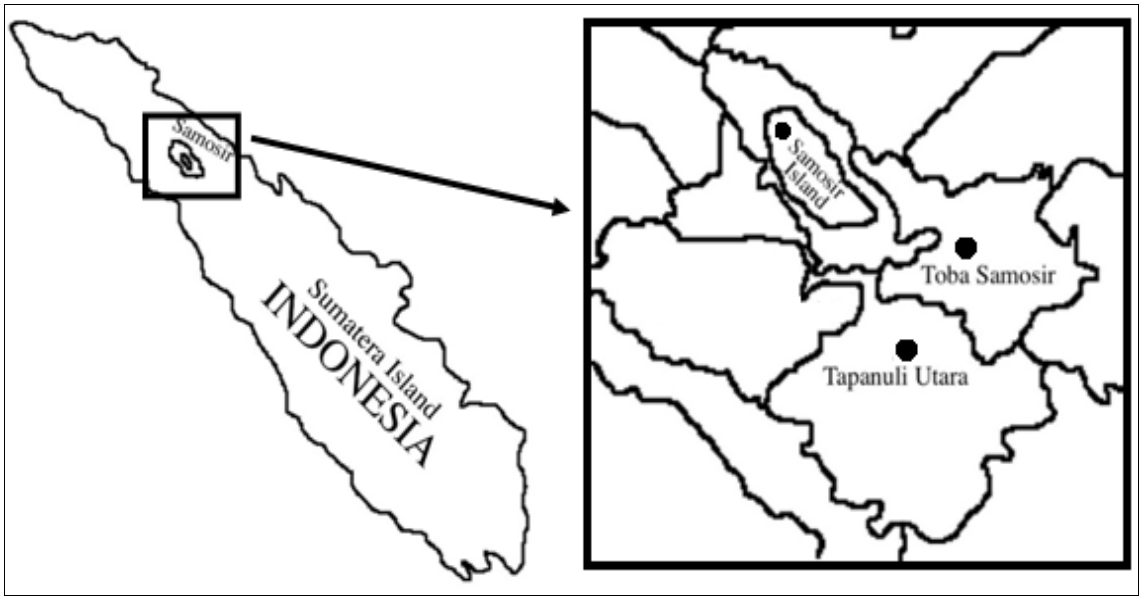

Fig 1: Sketch map of three sampling sites of white leafhopper *Cofana spectra* in Tapanuli area

3. Results and discussion

3.1 Morphometric traits of male and female leafhopper

The data of ten morphometric features for male and female of white leafhopper *Cofana spectra* from Tapanuli area followed by their statistic test are presented in Table 1. Based on this data, nine morphological traits in female are very significantly higher ($p<0.01$) than in male and therefore indicated that female was larger than male. This research finding confirmed the existence of dimorphism in this hopper. The presence of dimorphism on other hopper spesies both on leaf-and planthoppers have been written by Wilson and Claridge [4]. The finding in this research, furthermore can also indicated the occuring of genetic variability for *Cofana spectra* species, especially between female and male [12]. The occurence of dimorphism and the higher value of morphometric features in female than in male on white leafhopper in this research was in line with work by Mitra *et al* at West Bengal-India [3] and also by Faruq *et al* at Dumki Upazila-Bangladesh [13]. In contrast, the value of morphological features in this research were lower compared to the hopper that be found at Dumki Upazila-Bangladesh but it was higher as compared to the hopper at West Bengal-India. Mitra *et al.* [3] have reported that body length, wing length and leg length on male at West Bengal-India were 7.29±0.42 mm, 5.62±0.49 mm and 6.65±0.58 mm, respectively and on female were 7.93±0.5 mm, 6.61±0.58 mm and 6.93±0.35 mm. Meanwhile, Faruq *et al.* [13] reported that body length and fore wing length in male at Dumki Upazila-Bangladesh were 8.5-11.8 mm and 7.5-10.5 mm and in female 8.3-13.00 mm and 7.2-12.00 mm. The morphological differences of white hopper among Indonesia, India and Bangladesh may be could be caused several factors such as ecological differences, geographical distances and differences of food availability in the field.

Table 1: The result of Mann-Whitney, Wilcoxon and Z tests on morphological traits of male and female of white leafhopper *Cofana spectra* on rice field in Tapanuli area

Morphological features	Male (mm) Mean ± SD n=150	Female (mm) Mean ± SD n=150	Mann-Whitney U	Wilcoxon W	Z	Asymp.Sig.
Body length-BL (Y)	7.35 ± 0.36	9.11 ± 0.35	61.000	11386.000	-14.924	0.00 **
Body width-BW (X_1)	2.04 ± 0.20	1.96 ± 0.21	9491.000	20186.000	-2.350	0.01 *
Head length-HL (X_2)	0.45 ± 0,07	0.68 ± 0.06	1140.000	12465.000	-13.763	0.00 **
Head width-HW (X_3)	1.75 ± 0,23	2.09 ± 0.10	1709.500	13034.500	-12.865	0.00 **
Stylet length-SL (X_4)	0.56 ± 0,07	0.69 ± 0.10	4788.000	16113.000	-8.883	0.00 **
Thorax length-TL(X_5)	2.11 ± 0.21	2.33 ± 0.18	5096.500	6421.500	-8.271	0.00 **
Abdomen length-AL (X_6)	3.72 ± 0.34	2.31 ± 0.35	70.000	11395.000	-14.924	0.00 **
Wing length-WL (X_7)	5.97 ± 4.89	7.75 ± 0.34	155.500	1148.500	-14.788	0.00 **
Wing width-WW (X_8)	1.28 ± 0.16	1.38 ± 0.06	5190.000	16515.000	-8.167	0.00 **
Leg length-LL (X_9)	6.64 ± 0.32	7.58 ± 0.34	624.000	11949.000	-14.161	0.00 **

Notes: Morphological feature is significantly different when Asymp. Sig. value smaller than 0.05 (*) and very significantly different when smaller than 0.01 (**)

Table 2: The result of Kruskall-Wallis test on morphological traits of male white leafhopper *Cofana spectra* on rice field of three districts in Tapanuli area

Morphological features (in mm)	Toba Samosir Mean ± SD n=50	Samosir Mean ± SD n=50	Tapanuli Utara Mean ± SD n=50	Kruskall-Wallis X^2	Asymp. Sig.
Body length-BL (Y)	7.54 ± 0.41	7.27 ± 0.32	7.24 ± 0.32	17.710	0.00 **
Body width-BW (X_1)	2.08 ± 0.20	1.98 ± 0.17	2.02 ± 0.22	10.044	0.00 **
Head length-HL (X_2)	0.54 ± 0.96	0.43 ± 0.04	0.44 ± 0.02	47.032	0.00 **
Head width-HW (X_3)	1.74 ± 0.24	1.67 ± 0.21	1.89 ± 0.12	27.874	0.00 **
Stylet length-SL (X_4)	0.54 ± 0.06	0.57 ± 0.08	0.58 ± 0.86	5.087	0.07
Thorax length-TL(X_5)	2.06 ± 0.22	2.07 ± 0.21	2.15 ± 0.13	6.054	0.04*
Abdomen length-AL (X_6)	3.77 ± 0.37	3.68 ± 0.38	3.68 ± 0.27	1.573	0.45
Wing length-WL (X_7)	5.98 ± 0.48	5.32 ± 0.26	5.41 ± 0.24	47.418	0.00 **
Wing width-WW (X_8)	1.42 ± 0.15	1.2 ± 0.08	1.23 ± 0.05	59.011	0.00 **
Leg length-LL (X_9)	6.52 ± 0,32	6.64 ± 0.31	6.72 ± 0.33	8.854	0.01 *

Notes: Morphological feature is significantly different when Asymp. Sig. value smaller than 0.05 (*) and very significantly different when smaller than 0.01 (**)

Table 3: The result of Kruskall-Wallis test on morphological traits of female white leafhopper *Cofana spectra* on rice field of three districts in Tapanuli area

Morphological features (in mm)	Toba Samosir Mean ± SD n=50	Samosir Mean ± SD n=50	Tapanuli Utara Mean ± SD n=50	Kruskall-Wallis X^2	Asymp. Sig
Body length-BL (Y)	9.07 ± 0.37	9.08 ± 0.38	9.17 ± 0.31	4.125	0.12
Body width-BW (X_1)	1.92 ± 0.25	1.86 ± 0.11	2.11 ± 0.16	41.592	0.00 **
Head length-HL (X_2)	0.69 ± 0.06	0.67 ± 0.06	0.66 ± 0.06	1.475	0.47
Head width-HW (X_3)	2.08 ± 0.11	2.10 ± 0.10	2.05 ± 0.12	8.079	0.01 *
Stylet length-SL (X_4)	0.67 ± 0.08	0.69 ± 0.13	0.72 ± 0.11	5.929	0.05
Thorax length-TL(X_5)	2.36 ± 0.22	2.27 ± 0.22	2.36 ± 0.11	10.996	0.00**
Abdomen length-AL (X_6)	2.22 ± 0.31	2.28 ± 0.36	2.38 ± 0.38	6.873	0.03*
Wing length-WL (X_7)	7.81 ± 0.31	7.81 ± 0.36	7.62 ± 0.28	16.693	0.00**
Wing width-WW (X_8)	1.36 ± 0.06	1.41 ± 0.82	1.35 ± 0.05	3.506	0.17
Leg length-LL (X_9)	7.51 ± 0.37	7.52 ± 0.45	7.73 ± 0.28	7.829	0.02*
Ovipositor length-OL (X_{10})	2.77 ± 0.20	2.71 ± 0.21	2.70 ± 0.21	2.239	0.32

Notes: Morphological feature is significantly different when Asymp. Sig. value smaller than 0.05 (*) and very significantly different when smaller than 0.01(**)

The morphometric features in male of white leafhopper *Cofana spectra* on three districts in Tapanuli area followed by their statistic test were displayed in Table 2. There was eight morphological features that significantly (p<0.05) different among males. Toba Samosir white leafhopper belongs to largest hopper compared to Samosir and Tapanuli Utara. Based on this finding, could be stated that there was population variation among males of hopper in three districts of Tapanuli. Regarding into this finding, geographic isolation, geographical distances and ecological differences among three districts may be have contributed on the creating of morphometric traits variation on male.

Further, the morphometric features in female of hopper on three districts in Tapanuli area followed by their statistic test were displayed in Table 3. In comparison into male, however, there was only six from the ten morphometric traits that be significant different (p<0.05) among females. Contrast in to male, female hopper Tapanuli Utara was largest compared to Toba Samosir and Samosir. This finding also revealed that there was population variation among females of hopper that occuring at three districts in Tapanuli region. This finding revealed that geographic isolation and geographical distances among districts in Tapanuli area have contributed in the creating of population variation among female hoppers.

The occuring of population variation on other hopper species in Indonesia, in this case on brown planthopper *Nilaparvata lugens* has been reported by Wijayanti *et al* [14] and on species green leafhopper has been written by Supriyadi & Wijayanti [15-16].

The finding of population variation both in male and female of white leafhopper *Cofana spectra* at three districts in Tapanuli area as in this research, at molecular level revealed the existence of nucleotide sequence variation in that hopper. The presence of nucleotide sequence variation on white leafhopper *Cofana spectra* has been reported by Sreejith & Sebastian [1]. In this case based on COI sequence, there was nucleotide sequence differences between Kerala-India species and Australia species.

3.2. The relationship among body length with other morphometric traits

The relationship among body length (Y) of white leafhopper *Cofana spectra* with other its morphological traits (X_2 to X_{10}) in regression equation are presented in Table 4, 5 and 6. Based on data in Table 4, it was found that there were eight morphological traits that contributed on the determination of body length of the leafhopper, namely: Head length, leg length, head width, thorax length, abdoment length, wing width and body width ($Y = -0.04 + 2.11X_2 + 0.54X_9 + 0.46X_3 + 0.47X_5 + 0.21X_6 + 0.74X_8 + 0.30X_1 + 0.43X_4$, R^2=84.5%, Table 4). In general, the morphological trait that has highest contribution on the prediction of hopper body length was head length ($Y = 4.87 + 5.89X_2$, r^2=65.1%, Table 4). In contrast to this finding, abdoment length variable ($Y=5.39+0.52X_6$, r^2=25.1%, Table 5) was morphomemetric feature that has highhest contribution in prediction of male body length, whereas on the female body length was wing length ($Y = 3.77 + 0.68X_7$, r^2=38.4%, Table 6). In difference to the approach that has been used in this research, Mitra *et al*[3] have described the regression equation using wing length as explanatory variable for leg length and aedeagus length in male, leg length and ovipositor length in females of *C.spectra*. It was found that there was significant contribution of wing length on leg length, aedeagus length and ovipositor length.

Table 4: Regression equation and determinant coefficient of some morphological traits on body length of white leafhopper *Cofana spectra* in Tapanuli area

No	Regression equation	Determinant coefficient (R^2)
1	$Y = 4.87 + 5.89X_2$	65.1%
2	$Y = 0.61 + 3.78X_2 + 0.76X_9$	78.8%
3	$Y = 0.07 + 3.18X_2 + 0.69X_9 + 0.74X_3$	80.9%
4	$Y = -0.59 + 2.96X_2 + 0.64X_9 + 0.64X_3 + 0.59X_5$	82.3%
5	$Y = 1.01 + 2.62X_2 + 0.55X_9 + 0.53X_3 + 0.57X_5 + 0.17X_6$	83.1%
6	$Y = 0.29 + 2.22X_2 + 0.57X_9 + 0.49X_3 + 0.57X_5 + 0.19X_6 + 0.72X_8$	83.8%
7	$Y = -0{,}04 + 2.16X_2 + 0.57X_9 + 0.47X_3 + 0.50X_5 + 0.22X_6 + 0.73X_8 + 0.31X_1$	84.2%
8	$Y = -0.04 + 2.11X_2 + 0.54X_9 + 0.46X_3 + 0.47X_5 + 0.21X_6 + 0.74X_8 + 0.30X_1 + 0.43X_4$	84.5%

Table 5: Regression equation and determinant coefficient of some morphological traits on body length of male white leafhopper *Cofana spectra* in Tapanuli area

No	Regression equation	Determinant coefficient (R^2)
1	$Y = 5.39 + 0.52X_6$	25.1%
2	$Y = 4.79 + 0.48X_6 + 1.64X_2$	38.8%
3	$Y = 4.07 + 0.46X_6 + 1.61X_2 + 0.37X_5$	42.8%
4	$Y = 2.98 + 0.45X_6 + 1.74X_2 + 0.32X_5 + 0.17X_9$	45.2%
5	$Y = 2.67 + 0.42X_6 + 1.65X_2 + 0.28X_5 + 0.18X_9 + 0.24X_1$	46.9%
6	$Y = 2.28 + 0.39X_6 + 1.28X_2 + 0.29X_5 + 0.20X_9 + 0.25X_1 + 0.38X_8$	48.5%

Table 6: Regression equation and determinant coefficient of some morphological traits on body length of female white leafhopper *Cofana spectra* in Tapanuli area

No	Regression equation	Determinant coefficient (R^2)
1	$Y = 3.77 + 0.68X_7$	38.4%
2	$Y = 2.67 + 0.68X_7 + 0.57X_1$	50.2%
3	$Y = 1.73 + 0.64X_7 + 0.56X_1 + 0.47X_{10}$	57.8%
4	$Y = 1.37 + 0.59X_7 + 0.47X_1 + 0.44X_{10} + 0.43X_5$	62.2%
5	$Y = 1.08 + 0.57X_7 + 0.43X_1 + 0.47X_{10} + 0.46X_5 + 0.16X_6$	64.7%

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5. References.

1. Sreejith K, Sebastian CD. Molecular evolutionary analysis of paddy pest, *Cofana spectra* (Distant) (Hemiptera: Cicadellidae) using partial DNA sequence of cytochrome oxidase subunit I (COI) gene. International Journal of Applied and Natural Sciences. 2014; 3(2):135-140.
2. Mitra S, Rupa H, Niladri H, Abhijit M. An assessment of the relative abundance of normal and parasitized white leafhopper *Cofana spectra* (Homoptera: Cicadellidae) affecting the paddy plants in West Bengal, India. International Journal of Tropical Insect Science. 2014; 34(1):14-21.
3. Mitra S, Rupa H, Niladri H, Abhijit M. Estimation of Fitness of Normal and Stylopized Paddy Pest, White Leafhopper *Cofana spectra* (Distant) (Hemiptera: Cicadellidae), in West Bengal, India through Correlation of Life History Traits. International Journal of Insect Science. 2014; 6:33-42.
4. Wilson MR, Claridge MF. Handbook for Identification of Leafhoppers and Planthoppers of rice. CAB

Internasional: Wallinford-UK, 1991.
5. Meshram NM, Ramamurthy VV. A new species of *Cofana* associated with grasses from India (Hemiptera: Cicadellidae: Cicadellinae). Acta Entomologica Musei Nationalis Pragae. 2014; 54(1):57-64.
6. Manurung B, Prastowo P, Daulae AH. Community structure of leaf-and plant hoppers (Auchenorrhyncha: Hemiptera) on rice ecosystem in Samosir Island-Sumatera-Indonesia. International Journal of Science and Research. 2017; 6(9):1412-1416.
7. Vignon M, Sasal P. The use of geometric morphometrics in understanding shape variability of sclerotized haptoral structures of monogeneans (Platyhelminthes) with insights into biogeographic variability. Parasitology International. 2010; 59:183-191.
8. Camara M, Caro Riano H, Ravel S, Dujardin JP, Hervouet JP, de Meeus T *et al*. Genetic and mophometric evidence for isolation of a tsetse (Diptera: Glossinidae) population (Loos islands, Guinea). Journal of Medical Entomology. 2006; 43(5):853-860.
9. Manurung B, Witsack W, Mehner S, Gruentzig M, Fuchs E. The epidemiology of wheat dwarf virus in relation to occurrence of the leafhopper *Psammotettix alienus* in Middle-Germany. Virus Research. 2004; 100(1):109-113.
10. Manurung B, Witsack W, Mehner S, Gruentzig M, Fuchs E. Studies on biology and population dynamics of the leafhopper *Psammotettix alienus* Dahlb. (Homoptera: Auchenorrhyncha) as vector of wheat dwarf virus (WDV) in Saxony-Anhalt, Germany. J Plant. Dis. Protec. 2005; 112(5):497-507.
11. Zar JH. Biostatistical Analysis. 5th Edition. New Jersey: Prentice – Hall Inc, 2010.
12. Sharmila BN, Prasad NG, Mallikarjun S, Joshi A. Correlated of sexual dimorphism for dry weight and development time on five species of *Drosophila*. J Zool. 2004; 264:87-95.
13. Faruq MO, Khan MMH, Rahman MA. The new records of cicadellid leafhoppers (Hemiptera: Cicadellidae) in rice ecosystem at Dumki Upazila of Bangladesh. Int. J Innov. Res. 2017; 2(1):25-32.
14. Wijayanti R, Supriyadi, Hidayat P, Maryana N. Keragaman Populasi Wereng Coklat *Nilavarpata lugens* (Homoptera: Delphacidae) berasal dari beberapa sentra padi. Seminar Nasional Perlindungan Tanaman. 2009, 159-169.
15. Supriyadi, Wijayanti R. Karakterisasi individu wereng hijau *Nephotettix virescens* Distant penular aktif virus tungro padi. J HPT Tropika. 2010; 10(2):116-122.
16. Supriyadi, Wijayanti R. Genetic variation of leafhopper, *Nephotettix virescens* Distant active transmitter from endemic and non endemic area of rice tungro disease based on RAPD marker. J HPT Tropika. 2014; 14(1):25-31.