American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-6, Issue-3, pp-188-196
www.ajer.org
Research Paper Open Access

The Filtering of Rice Resistance and Population Buildup to Determine Antibiosis and Tolerance as Characteristics of Rice Resistance to Brown Planthopper Biotype 3

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ABSTRACT: *Control to rice brown planthopper (BPH) using resistance rice varieties is an economically way, although to obtain the rice resistant needed four stages those are seedbox mass screening, filtering of resistant lines, population buildup of BPH, and field test of resistant lines. The research of filtering of resistant lines/varieties and population buildup of BPH were conducted at the screen house of Indonesian Center for Rice Research (ICRR). The result of filtering activity showed that BP4724-1f-Kn-15-2-2*B, BP 4724-1f-Kn-15-3-2*B, BP4138-5f-Kn-23-3-3*B, BP 4920F-BB8-2-BB4 (DHP-MT1-08-38), PK68 (SH133), Barumun, Rathu Heenati, PTB33, and Pokkali were moderately resistant to BPH biotype 3, whereas ASD7 and TN1 were susceptible and highly susceptible respectively. In the population buildup activity showed that BPH biotype 3 population was quite high on BP-15-2-2 4724-1f-Kn*B and susceptible variety TN1, while on BP4138-5f-Kn-23-3-3*B, PK68, DHP-MT1-08-38, Pokkali, and Barumun were low population. BP4138-5f-Kn-23-3-3*B and DHP-MT1-08-38 have antibiosis, but tolerance absent to BPH biotype 3. Pokkali and Barumun have both antibiosis and tolerance to BPH biotype 3. The lines of BP4724-1f-Kn-15-3-2*B, BP4724-1f-Kn-15-2-2*B, and PK68 did not had resistance of antibiosis, but tolerance present to BPH biotype 3. In the other hand TN1 and ASD7 absent both antibiosis and tolerance to BPH biotype 3. All lines resistant by antibiosis, tolerance or both can be continued for the proposed to release resistant rice varieties to BPH biotype 3, after was equipped by the others properties such as productivity, rice quality, and the data morphological rice performance.*

Keywords: *Antibiosis, brown planthopper, filtering test, population buildup, rice, tolerance*.

I. INTRODUCTION

The rice brown planthopper (BPH) evolved follows the pattern of biological clock that breed and damaging to rice crops due to well matched to the environment of both rainy and the dry season. In Indonesia before 1994 the BPH as an insect in rainy season, but after 1994 move to insect that attacks the rice crop in the both rainy and dry season. BPH has a high genetic plasticity that is able to adapt to various environments in a relatively short time. This is evident with the emergence of biotypes / new population that can overcome resistance properties of rice or pests are becoming resistant to insecticides. The emergence of BPH biotypes is a challenge that will not be easily to overcome.

In 1967, Indonesian goverment introduced high yielding rice varieties IR5 and IR8 with no resistance gene against BPH. Baehaki (2012) [1] had reported chronology of released varieties and occurred BPH outbreak in 1971 due to the BPH changes to biotype 1 from biotype 0 since 1930. In 1975, to overcome the BPH biotype 1 was introduced IR26 variety that carrying resistant genes Bph1, but in 1976 was occured outbreak of BPH due to the BPH population had changed from biotype 1 to biotype 2. In 1980, to overcome the BPH biotype 2 was introduced IR42 variety (bph2), but in 1981 was occurred outbreak in Simalungun, North Sumatra and some other areas, because the BPH population had changed from biotype 2 to biotype 3. To overcome the BPH biotype 3, in 1983 was introduced IR56 (Bph3)and in 1986 was introduced IR64 ($Bph1^+$). Alam and Cohen (1998) [2] reported a total of seven QTLs associated with resistance were identified, located on 6 of the 12 rice chromosomes of IR64. In 1991 the IR74 (Bph3) was distributed. In 2006, resistance gene for BPH population in IR64 had broken down, due to BPH population had changed to biotype 4.

The stability of BPH biotype 0 had survived for 41 years before changes to BPH biotype 1. BPH biotype 1 to BPH biotype 2 took just four years, and changes of BPH biotype 2 to BPH biotype 3 required of only 5 years. Stability of BPH biotype 3 during 24 years since 1981 up to 2005. The existence of BPH biotype 3 was quite long times, due to the double genes resistant on variety IR64 (Bph1+7QTLs) as a durable resitant variety which resulted in a sustainable rice productivity. The acting of IR4 as a buffer variety against the changes in BPH to more higher biotype. To stabilize of BPH biotype, various strategies were recommended, including varietal rotations to prevent a directional selection against new BPH biotype [1]. The long age distribution of IR64 in the field is very interesting, compared with the other national popular varieties like Fatmawati, Ciherang, Rokan, and other local varieties were attacked by the BPH in relatively short age distribution.

To overcome the changes BPH biotypes must be genes for genes resistant, although very difficult because must be known level of biotype and gene of rice varieties. As it is known the Indonesian released variety since 1943-2016, no one at all varieties were identified of resistance genes about major (Bph/bph) and minor genes (QTLs).

In the research Institute to determination of the resistance rice varieties on brown planthopper biotypes through seedbox mass screening and a little activity determine the resistance rice varieties base on tolerant and antibiosis. Host plant resistance that important to covered insect has been classified to three mechanism that are non preference, antibiosis, and tolerance [3], but Kogan and Ortman (1978) [4] proposed that term non preference should be replaced by antixenosis because the former describes a pest reaction and not a plant characteristic. Plant resistance to insects is generally differentiated in (1) antibiosis, a quality that reduces insect survival, growth rate, or reproduction following the ingestion of host tissue (2) tolerance, a capacity to produce a crop of high quality and yield despite insect infestation, and (3) antixenosis, a quality that repels or disturbs insects, causing a reduction in colonization or oviposition [5,2]. The resistance mechanism are believed to associated with the minor genes [6]. However the resistance type of most BPH resistance genes identified remains largely unknown. Therefore, it is necessary to identify the level the antibiosis and tolerance in rice varieties carrying BPH-resistance genes, which would favor resistance breeding in rice.

The Indonesian Center for Rice Research (ICRR) have an experience with relied on seedbox mass screening as the basis for the release varieties was very risky, because many new varieties released only lasted for one season already broken its resistance to BPH in the field. This is due to mass screening products can not be relied upon to release varieties, because the mass screening products are still preliminary and rough or raw and coarse screening.

Screening of lines resistant to BPH through mass screening, filtering of resistant lines and the population buildup of BPH are essential for the release of resistant rice varieties. In addition, the stages of the endurance are important in determining the stability of resistance, as well as the type of resistant [7]. The solution of release varieties of ICRR was done with crash program in 2006, which establishes four stages to obtain the resistance rice varieties to brown planthopper as the basis for release varieties as follows:

1. The first stage is seedbox mass screening as the initial test of choice feeding that selects up to hundreds of lines per one batch screening. BPH were infested between 5-10 nymphs/seedling with gently tapping the pots with the insect colonies to uniformly scatter a large number of insects on the test plants.
2. The second stage is a filtering of resistant lines as a special selection which is still the choice feeding. Filtering of resistant lines is done to some lines that are already resistant in mass screening with the exactly infestation of BPH were 8 nymph/seedling.
3. The third stage is the population buildup of BPH with no choice feeding method. Population buildup is limited to the lines which is resistant on the filtering test. Data population buildup must be analyzed to determine the stability of the resistance mechanism based on antibiosis and tolerance of resistant lines.
4. The fourth stage is field test to lines that had been known the resistance mechanisms. The field test to see resistance of lines to BPH-field as a candidate of rice varieties .

The objective of this study are the first to filtering lines that has been resistant to BPH biotype 3 in the mass screening, and second to get information of antibiosis and tolerance of lines that has been resistant on filtering through the population built up.

II. MATERIALS AND METHODS

1. Filtering lines resistance to BPH biotype 3

Mass rearing of the BPH biotype 3 on the rice variety IR42 (bph2) on 30 days old after transplanted. This BPH biotype 3 has been maintained since 1994 on IR42 in the screen house. As the tightening of screening at ICRR, the filtering of resistant lines starts from seedbox mass screening. In the seedbox mass screening of 200 accessions were infested by gently tapping the pots with the insect colonies to uniformly scatter a large number of insects on the test plants. An average of 5-10/seedling of second-third instar BPH nymphs. Seedbox mass screening was produced 24 lines and one varieties with rating moderately resistant. The 24 lines and one variety was used in filtering rice resistant added with differential variety TN1(none BPH-gene resistant), Mudgo (Bph1), ASD7 (bph2), Pokkali (Bph9), Rathu Heenati (Bph3+Bph17), and PTB33 (Bph3+bph2) (Table 1).

Table 1. Materials of filtering test that was moderately resistant in seedbox mass screening to BPH biotype 3

No.	No. Entry	Origin	Lines/varieties
1	3	85	BP4214-7f-1-1-1*B-1-1*B
2	4	94	BP4218-2f-9-2-1*B-1-1*B
3	20	129	BP4884f-2-1*B-3-1*B
4	21	163	BP4222-1f-7-2*B-1-1*B
5	22	164	BP4222-1f-7-2*B-2-1*B
6	23	165	BP4222-1f-7-2*B-3-1*B
7	49	130	BP3350-3e-Kn-5-2-5*B
8	84	5871	BP4618-3f-5-2-3*B
9	85	5968	BP4924f-16-2-3*B
10	93	6023	BP 4112-4f-Kn-14-3-3*B
11	94	6184	BP 4718-5f-Kn-9-3*B
12	95	6386	BP5088-5f-152*B
13	96	6527	BP 4700-2f-Kn-21-3-2*B
14	97	6557	BP 4716-2f-Kn-2-1-2*B
15	98	6653	BP 4722-5f-Kn-3-3-2*B
16	99	6666	BP 4724-1f-Kn-15-2-2*B
17	100	6667	BP 4724-1f-Kn-15-3-2*B
18	103	6133	BP4132-6f-Kn-13-3-3*B
19	104	6144	BP4138-5f-Kn-23-3-3*B
20	143		Barumun
21	74	BP 4920F-BB8-2-BB4	DHP-MT1-08-38
22	75	BP 4920F-BB8-13-BB4	DHP-MT1-08-39
23	79	BP 10618F-BB8-13-BB4	DHP-MT1-08-43
24	123	SH123	PK58
25	133	SH133	PK68
26			Pokkali
27			TN1
28			Mudgo
29			ASD7
30			Rathu Heenati
31			PTB33

In filtering method, all 31 accessions planted in one box 80cm x 60 cm x 10 cm size by containing Lembang's soil (three replication). Soil in a box divided to many row in furrow of 20 cm. Each accession sown 25-30 seeds at 20 cm long row. In edges row placed susceptible rice varieties TN1 to prevent escape from the BPH attack. Differential resistant varieties placed in middle row as the focus of the BPH pressure. On the other hand the other lines/varieties are placed randomly between the susceptible varieties.

At 5 days old seedling the tested lines/varieties are thinned to remains 20 seedlings per row. Then the each seedling were infested by 8 BPH of 2-3 instar nymphs of BPH biotypes 3. The infested BPH nymphs must be counted exactly, therefore the number of nymphs were infested depending on the numbers of seedling in box screening, and evenly distributed to all of seedlings in box. Scoring damage is done at 7-10 days after 90% of susceptible check variety TN1 died. Scores based on the Standard Evaluation System for Rice (SES) [8] and [9] (Table 2), and the rating based on Seshu and Kauffman (1980) [10].

Table 2. Scoring and rating of rice resistant to brown planthopper

Score	Symptom of SES (IRRI, 2002)	Modus rating rice resistant of 3 replications
0	No damage	HR = highly resistant
1	Very slight damage of a few plants with yellowing on leaves tip less than 1%	R = resistant
3	First and 2nd leaves of most plants partially yellowing	MR = moderately resistant
5	Pronounced yellowing and stunting or about 10 to 25% of the plants wilting	MS = moderately susceptible
7	More than half of the plants wilting or dead and remaining plants severely stunted or dying	S = susceptible
9	All plants dead	HS = highly susceptible

Determination of the final score and resistance level rice accessions to BPH was based on the value of the modus of three replications. If the value of the modus score was 0, the accession was highly resistant (HR) level. If the value of the modus score was 1, the accession was resistant (R). If the value of the modus score was 3, the accession was moderately resistant (MR). If the value of the modus score was 5, the accession was moderately susceptible (MS). If the value of the modus score was 7, the accession was susceptible (S), and if the value of the modus score was 9, the accession was highly susceptible (HS).

2. Population buildup

The series of screening, the filtering test and population buildup using Baehaki and Abdullah method (2006). Lines/varieties resistant to moderately resistant (score of 0-3) resulted from the filtering test as a materials for population buildup. Population buildup itself is defined as the development of pest populations on resistant lines/varieties that reared in mylar cages as as no choice feeding. In the population buildup, the source of seeds taken from lines / varieties that are resistant in filtering test, plus a variety of differential Pokkali, ASD7, and TN1 (susceptible check).

In population buildup, one of 21-days-old seedlings were transplanted in a pot diameter of 20 cm, and then were covered with a 18 cm x 80 cm mylar cage with fine-mesh-screened in the top and windows in two sides left-right. Pots arranged in RBD and each five replications. After the rice crop in cage was one month old, the 3 replications first infested by 5 pairs of brachypterous BPH biotype 3, the exposure time for 5 days for replaced BPH dies with a same age. On the other hand two replications again as the controls are not infested by BPH.

Observations were made on the BPH 1st generation. Collected all nymphs and adults with a large plastic bag as high as 1 m, and sprayed by Baygon to killing pest that still life. All the BPH calculated under binocular microscope. Each BPH of rice treatment that has been calculated put in a paper bag and dried at 60 ^{o}C for 48 h, and weighed on a mg sensitivity balance. Rice plants of each variety cut off at the basal stem, put on a paper bag and then put into oven at 75^{o}C for 60 h [11]. Then the plant dry weight calculated from infested and uninfested BPH for the calculated of functional plant loss index (FPLI) with Panda dan Heinrichs formula (1983) as follows:

$$FPLI = 1 - \left(\frac{\text{Dry weight of infested rice tested}}{\text{Dry weight of uninfested rice tested}}\right)\left(1 - \frac{\text{Damage rating rice tested}}{9}\right) \times 100$$

The tolerance index based on the dry weight ratio of BPH reared on the test plants as compared with the dry weight of the BPH in rice susceptible (Panda and Heinrichs, 1983) as follows:

$$\text{Tolerance index} = \frac{\text{Brown planthopper dry weight on rice variety tested}}{\text{Brown planthopper dry weight on susceptible rice variety}}$$

Antibiosis index = 1- tolerance index

III. RESULTS AND DISCUSSIONS

1. Filtering test on lines mass screening-resistant to BPH biotype 3

In the filtering test against BPH biotype 3 obtained 5 (=20%) lines and one (=4%) varieties moderately resistant of 25 accessions of mass screening resistant to BPH biotype 3, and 3 (=50%) differential varieties were moderately resistant of 6 varieties-tested. Lines that passed filtering test were BP4724-1f-Kn-15-2-2*B, BP4724-1f-Kn-15-3-2*B, BP4138-5f-Kn-23-3- 3*B, BP-4920F-BB8-2 BB4 (DHP-MT1-08-38), and PK68 (SH133), and rice varieties that moderately resistant were Barumun, Pokkali, Rathu Heenati, and PTB33 (Table

3). The lines were resistant in the mass screening did not guaranteed resistant stable in the filtering test, even lines that were resistant in the mass screening almost 80% changes to susceptible in the filtering test. This shows that the mass screening with tapping BPH intake is still coarse and raw.

Something similar was reported by Baehaki and Munawar (2013) [7], that the lines and varieties were moderately resistant in the filtering test was only 22.2% of the 18 accessions were moderately resistant in the mass screening. In the other hand PTB33, Rathu Heenati, and Pokkali but same reaction moderately resistant to BPH biotype 3, while Mudgo was moderately susceptible and ASD7 was susceptible [7].

Tabel 3. Filtering rice screening that were resistant on mass screening to brown planthopper biotype 3

No. Entry	Lines/varieties	Score				Rating
		I	II	III	Final	
1	BP4214-7f-1-1-1*B-1-1*B	5	5	5	5	MS
2	BP4218-2f-9-2-1*B-1-1*B	5	5	5	5	MS
3	BP4884f-2-1*B-3-1*B	5	5	5	5	MS
4	BP4222-1f-7-2*B-1-1*B	3	5	5	5	MS
5	BP4222-1f-7-2*B-2-1*B	5	5	5	5	MS
6	BP4222-1f-7-2*B-3-1*B	5	5	5	5	MS
7	BP3350-3e-Kn-5-2-5*B	5	5	5	5	MS
8	BP4618-3f-5-2-3*B	5	5	5	5	MS
9	BP4924f-16-2-3*B	5	5	5	5	MS
10	BP 4112-4f-Kn-14-3-3*B	5	5	5	5	MS
11	BP 4718-5f-Kn-9-3*B	5	5	5	5	MS
12	BP5088-5f-152*B	5	5	5	5	MS
13	BP 4700-2f-Kn-21-3-2*B	5	5	5	5	MS
14	BP 4716-2f-Kn-2-1-2*B	5	5	5	5	MS
15	BP 4722-5f-Kn-3-3-2*B	5	5	5	5	MS
16	BP 4724-1f-Kn-15-2-2*B	3	5	3	3	MR
17	BP 4724-1f-Kn-15-3-2*B	3	3	3	3	MR
18	BP4132-6f-Kn-13-3-3*B	3	5	5	5	MS
19	BP4138-5f-Kn-23-3-3*B	3	3	5	3	MR
20	DHP-MT1-08-38	3	3	5	3	MR
21	DHP-MT1-08-39	5	5	5	5	MS
22	DHP-MT1-08-43	5	5	5	5	MS
23	PK58	5	5	5	5	MS
24	PK68	3	3	5	3	MR
25	Barumun	3	3	5	3	MR
26	Pokkali	3	3	5	3	MR
27	TN1	9	9	9	9	HS
28	Mudgo	5	5	5	5	MS
29	ASD7	7	7	5	7	S
30	Rathu Heenati	3	3	3	3	MR
31	PTB33	1	3	3	3	MR

Remarks: 0= highly resistant (HR), 1= resistant (R), 3= moderately resistant (MR), 5= moderately susceptible(MS), 7= susceptible (S), 9= highly susceptible (HS).

2. Population Buildup

In the population buildup used all lines resistant in the filtering test plus Barumun, Pokkali, ASD7 and TNI (susceptible check). Those lines were 4724-1f BP-15-2-2-Kn * B, BP 4724-1f-Kn-15-3-2 * B, BP4138-5f-Kn-23-3-3 * B, BP 4920F- BB8-2-BB4 (DHP-MT1-08-38), PK68 (SH133), and varieties were Barumun, Pokkali, ASD7, and TN1.

The population buildup of BPH 1st generation showed that on TN1 was the highest and not significantly different from the BPH population on ASD7 and BP 4724-1f-Kn-15-2-2*B. The lowest BPH population on BP4138-5f -Kn-23-3-3 * B and did not significantly different from the BPH on DHP-MT1-08-38, Pokkali and Barumun. BPH populations on PK68 was lower and significantly than BPH on TN1 (Table 4).

Table 4. Population buildup of BPH on lines resistant

No. Entry	Origin	Lines/varieties	Population (BPH)/hill	Dry weight of BPH (gr)
100	6667	BP 4724-1f-Kn-15-3-2*B	466.33 bc	0.11713 ab
104	6144	BP4138-5f-Kn-23-3-3*B	208.00 d	0.04907 d
74	BP 4920F-BB8-2-BB4	DHP-MT1-08-38	290.00 cd	0.06918 cd
133	SH133	PK68	449.00 bc	0.11385 ab
99	6666	BP 4724-1f-Kn-15-2-2*B	523.33 ab	0.09755 bc
143		Barumun	237.00 d	0.05927 d
		Pokkali	304.00 cd	0.07945 cd
		ASD7	622.00 ab	0.13416 a
		TN1	700.00 a	0.12740 ab

Value in a column followed by the seem letter are not significantly different by DMRT at 5% level

The dry weight of the BPH on TN1was highest and did not significantly different from the BPH population on ASD7, BP 4724-1f-Kn-15-3-2 * B and PK68. The dry weight of the BPH from fourth accessions was significantly different from the dry weight of BPH on BP4138-5f-Kn-23-3-3*B, DHP-MT1-08-38, Pokkali, and Barumun. The dry weight of the BPH that growing on BP4138-5f-Kn-23-3-3*B was the lowest, followed BPH dry weight on Barumun.

Functional plant loss index (FPLI) of each lines due to an attack by the BPH compared to TN1as a susceptible rice variety. FPLI on TN1 varieties was the highest TN1 equal 100% significantly different compared to all FPLI of the varieties/lines, except to FPLI of ASD7 (84.4%) insignificantly. FPLI of the tested line between 47-55%, except DHP-MT1-08-38 was higher by 56.4%. Likewise, the FPLI The lowest FPLI was Barumun only 40.8% but insignificantly compared to BP 4724-1f-Kn-15-3-2*B, BP4138-5f-Kn-23-3-3*B, DHP-MT1-08-38, PK68, BP 4724-1f-Kn-15-2-2*B, and Pokkali (Table 5). This shows that all the lines or varieties with FPLI more than 50% indicate when lines or varieties attack by BPH will more than 50% yield decrease.

Table 5. Characteristics of lines/varieties resistance to BPH biotype 3

No. Entry	Origin	Lines/varieties	FPLI (%)	Tolerance index	Antibiosis index
100	6667	BP 4724-1f-Kn-15-3-2*B	53.701 b	0.9573 ab	0.0427 cd
104	6144	BP4138-5f-Kn-23-3-3*B	53.578 b	0.4028 d	0.5972 a
74	BP 4920F-BB8-2-BB4	DHP-MT1-08-38	56.405 b	0.5809 cd	0.4191 ab
133	SH133	PK68	47.006 b	0.9420 ab	0.0580 cd
99	6666	BP 4724-1f-Kn-15-2-2*B	48.453 b	0.8081 bc	0.1919 bc
143		Barumun	40.801 b	0.4873 d	0.5127 a
		Pokkali	44.524 b	0.6485 cd	0.3515 ab
		ASD7	84.423 a	1.1235 a	-0.1235 d
		TN1	100.000 a	1.0000 ab	0 cd

Value in a column followed by the seem letter are not significantly different by DMRT at 5% level

Tolerance index (IT) as a comparison between the varieties tested with the differential varieties TN1 as a susceptible rice variety to BPH showed insignificantly compared to BP4724-1f-Kn-15-3-2*B, PK68, and ASD7 varieties. This means that the two lines and one differential varieties are less resistant against BPH biotype 3, while another lines that is BP4138-5f-Kn-23-3-3 * B, DHP-MT1-08-38, and BP 4724-1f-Kn-15-2-2 * B more tolerance to BPH. Similarly, the differential varieties Pokkali and Barumun more tolerance to BPH (Table 5).

Based on the Panda and Heinrich (1983) that the tolerance index was = (BPH dry weight on rice variety tested)/(BPH dry weight on susceptible rice variety) showed that susceptible varieties TN1 had tolerance index was 1 = (BPH dry weight on rice tested variety TN1) / (BPH dry weight on susceptible rice variety TN1). In the other word the variety more higher of tolerance index will be more susceptible, whereas varieties with low tolerance index has a power tolerance as Pokkali and Barumun, BP4138-5f-Kn-23- 3-3 * B, DHP-MT1-08-38 and BP 4724-1f-Kn-15-2-2.

Antibiosis index (IB) from line BP4138-5f-Kn-23-3-3 B was the highest insignificantly different compared IB of DHP-MT1-08-38, Barumun, and Pokkali varieties. While IB of TN1 varieties was the lowest insignificantly different compared IB of ASD7, PK68, and BP 4724-1f-Kn-15-3-2 * B. The lines and varieties with high IB values can sustain the brown plant hopper attacks since their antibiosis substances. The above description indicates that varieties with high antibiosis has a high power antibiosis such as Pokkali and Barumun, BP4138-5f-Kn-23-3-3 * B and DHP-MT1-08-38, whereas the other lines and differential varieties had the power low of antibiosis.

The ralationship with the value of IT and IB separately would be very difficult to combine the two properties antibiosis and tolerance resistance of lines/varieties. Therefore, to see the combination of IT and IB which causes resistance is needed relationship between FPLI (y) and the dry weight of the BPH (x) of each of the lines or varieties and the regression arithmetic combination were calculated of all lines and varieties. The combined regression equation is y = 0.3258x + 25 251 with R^2 = 0.2878 (r_{df29} = 0.52**) were significantly different that enables the distribution of varieties have various combinations of antibiosis and tolerance (Figure 1). The average value of the independent variable, the dry weight of the BPH (x) = 94.9 mg is computed and a vertical line is drawn from the top down so that it intersects the regression line equation makes four Quadrant by four category combinations. Resistance mechanisms of varieties/lines are determined by the distribution point coordinates (x, y) in four categories combined.

Lines of BP4138-5f-Kn-23-3-3*B and DHP-MT1-08-38 in Quadrant I (Q1) there were that lines had defense with their antibiosis present, but tolerance absent to BPH biotype 3 (Figure 1). Therefore this lines can be continued for the proposed release of varieties resistant to BPH biotype 3. Pokkali and varieties Barumun in Quadrant II (Q2) there were the varieties had defense with the antibiosis present and tolerance present to BPH biotype 3. The lines BP4724-1f-Kn-15-3-2*B, BP4724-1f-Kn-15-2-2*B, and PK68 were in Quadrant III (Q3), This lines did not had antibiosis defense, but the tolerance present to BPH biotype 3, and this lines can be continued for the proposed to release as varieties that resistant to BPH biotype 3. Usually the release variety after equipped of other properties such as ability of rice production, rice quality, and the performance of rice variety. Varieties TN1 and ASD7 are in Quadrant IV (Q4), showed that antibiosis absent and tolerance absent. This meaning varieties TN1 and ASD7 did not have defense antibiosis and tolerance to BPH biotype 3 (Figure 1).

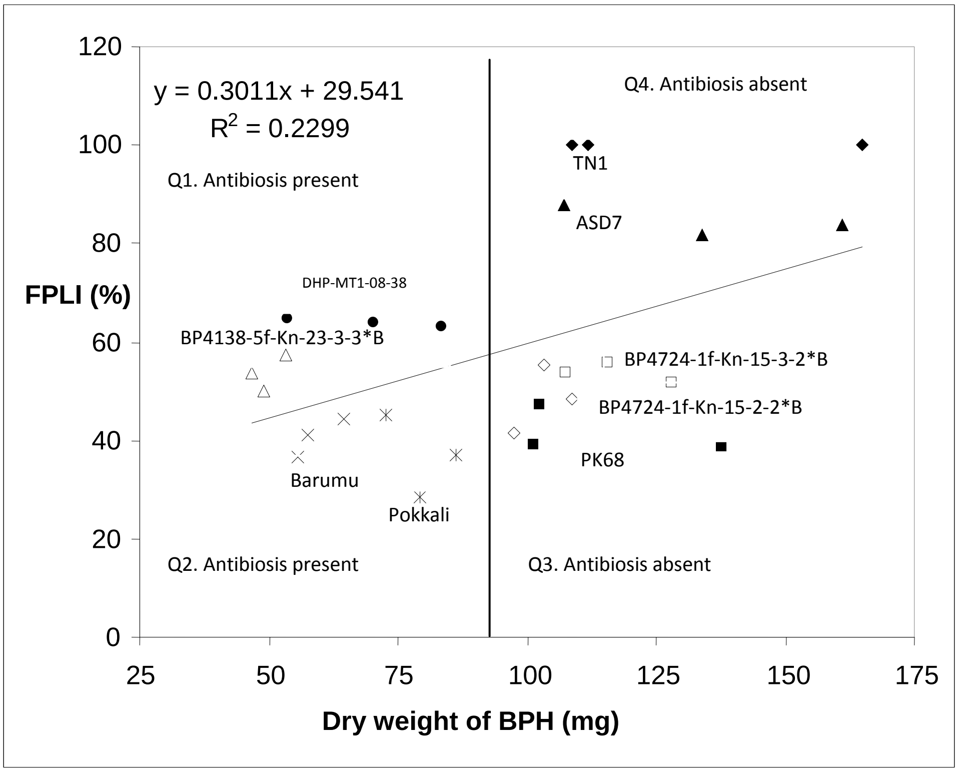

Figure1. Identification of rice resistant componen to BPH biotype 3.

Pokkali (Bph9) reacts moderately resistant to BPH biotype 3 in Mass Screening and filtering tests. In population buildup BPH biotype 3 on Pokkali variety were low of BPH population, low BPH dry weight, low of tolerance Index low and high on antibiosis. Pokkali was resistant due to antibiosis and tolerance, likewise Barumun defense on antibiosis and tolerance. The lines BP4138-5f-Kn-23-3-3*B and DHP-MT1-08-38 resistant due to antibiosis, but he lines BP4724-1f-Kn-15-3-2 * B, BP4724-1f-Kn-15-2-2 * B, and PK68 were resistant due to tolerant. Resistance of Pokkali by antibiosis and tolerance is suspected conferred by these major resistance genes Bph9. Alam & Cohen (1998) [2] investigated that QTLs to be predominantly associated with antixenosis and tolerance in IR64 which carried the major resistance gene Bph1.

Zhao et al., (2016) [12] reported that the near-isogenic line NIL-BPH9 (Pokkali (Bph9) introgressed into the highyielding indica variety 9311-BPH susceptible, through successive back-crossing) showed strong resistance to BPH at the seedling, tillering, and mature stages, resistance to BPH biotypes 1, 2, and 3, and the two-host choice test showed that BPH insects preferred to settle on 9311 than on NIL-BPH9 plants;, thus BPH9, had an antixenosis effect. Furthermore Zhao et al., (2016) [12] reported that BPH insects fed on NIL-BPH9 plants showed significantly lower survival rate, body weight gain, and honeydew excretion (which is an indirect measure of phloem consumption) than those on 9311 plants thus, Bph9 also exhibited antibiosis effects.

Varieties TN1 was highly susceptible and the differential varieties ASD7 (bph2) was moderately resistant on filtering test against BPH biotype 3 and absent of antibiosis and tolerance resistance. This result was similarity to Panda and Heinrichs, 1983[13] that rice varieties carrying the gene bph1 (IR26) displayed resistance to BPH biotype 1, but they were highly susceptible to BPH biotype 2 and lacked antibiosis or tolerance. The susceptible varieties IR26 (Bph1) and IR36 (bph2) to BPH-field generally is low of antibiosis, but Cisadane variety although include to susceptible rice variety have more antibiosis value [11]. Of the population buildup test, the dry weight of the BPH was the highest in susceptible variety TN1. This suited with the ability to BPH biotype 3 feed on susceptible due to dry weight will be higher [14]. In the other hand The deferential varieties Rathu Heenati, PTB33, Swarnalata had antibiosis and tolerant mechanism resistant to BPH.

The implications of the research are identified varieties Barumun (antibiosis+tolerance) and differential Pokkali (BPH9+antiboisi+tolerance) as germplasm can be reliable to assemble new superior varieties that are resistant to BPH. BPH-resistance genes have been identified in germplasm and some are used in resistant rice breeding programs [15, 16, 17, and 18]. The lines BP 4724-1f-Kn-15-3-2*B, BP4138-5f-Kn-23-3-3*B, DHP-MT1-08-38, PK68, BP 4724-1f-Kn-15-2-2*B can be continued for the release varieties that were moderately resistant to BPH biotype 3, after through the multi-location test and equipped by rice quality. Similarity studies produce 1 strain BP3448E-4-8 has antibiosis and tolerance resistance and then two strains were not stable BP1356-IG-KN-4 and BP205D-KN-78-1-8 [14] released successively as Inpari 3, Inpari 2, and Inpari 6 Jete. The lines that did not stable in population buildup can be released after repaired by breeder [7].

IV. CONCLUSIONS

In the filtering activity showed that BP 4724-1f-Kn-15-2-2*B, BP 4724-1f-Kn-15-3-2*B, BP4138-5f-Kn-23-3-3*B, BP 4920F-BB8-2-BB4 (DHP-MT1-08-38), PK68 (SH133), Barumun, Rathu Heenati, PTB33, and Pokkali were moderately resistant to BPH qualify for population buildup. In the other hand ASD7 and TN1 were susceptible and highly susceptible respectively.

In the population buildup showed that BPH biotype 3 population was quite high in BP-15-2-2 4724-1f-Kn*B is equal to that developed in the susceptible variety TN1, while in BP4138-5f-Kn-23-3-3 * B, PK68 and DHP-MT1-08-38 as well as on the varieties and Pokkali, Barumun was relatively low BPH. BP4138-5f-Kn-23-3-3*B and DHP-MT1-08-38 have antibiosis, but tolerance absent to BPH biotype 3. Pokkali and varieties Barumun have antibiosis and present of tolerance to BPH biotype 3. The lines of BP4724-1f-Kn-15-3-2*B, BP4724-1f-Kn-15-2-2*B, and PK68 did not had resistant of antibiosis, but toleran present to BPH biotype 3. In the other hand TN1 dan ASD7 absent of both antibiosis and tolerance to BPH biotype 3.

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