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Preliminary Trial of 11 New Hybrid Maize Genotype to the Resistance on Java Downy Mildew (*Peronosclerospora maydis*)

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***Abstract*— Maize or corn (*Zea mays* L.) belongs to the family of grasses (*Poaceae*). Maize is grown globally and one of the most important cereal crop in the world. In many countries, corn is the main agricultural crop, and are used as food, feed and industrial raw materials. Together with rice and wheat, corn included in the cereals that provide about 65% carbohydrates and 50% protein that humans need. For this purpose, many developing countries, especially in Asia and Africa are in a strong effort to increase their corn yields through the use of better seeds. Although in Indonesia, corn is the second important food crop after rice, however, with the rapid growth of the livestock industry, corn is a major component (60%) in feed ingredient. It is estimated that more than 55% of the corn used for feed in Indonesia. Java Downy Mildew (*Peronosclerospora maydis*) is the main disease that is concerned by maize corn growers. This disease often resulting in substantial losses for farmers, even reach 100% in susceptible genotypes. Therefore screening trial on 11 new prospective hybrids was conducted with the expectation that these new cultivars can be classified in the criteria "less resistant or higher" according to the criteria of modified Reid. Of the 11 new hybrid cultivars, 3 new hybrids (27.3%) classified in the criteria "very resistant", 4 new hybrids (36.4%) classified in the criteria "resistant", 2 new hybrid (18.2%) classified in the criteria "less resistant", and 2 other new hybrids (18.2%) classified in the criteria "less susceptible".**

Keywords*— Maize; corn; genotype; java downy mildew; *Peronosclerospora maydis

I. INTRODUCTION

Maize (*Zea mays* L.) belongs to the family of grasses (*Poaceae*). Corn grown globally and is one of the most important cereal crop in the world. Corn is not only an essential nutrient for humans, but also the basic elements of animal feed and raw materials for the manufacture of many industrial products. These products include corn starch, maltodextrin, corn oil, corn syrup, as well as products of fermentation and distillation industry. At present time the corn is also used as biofuels [1]-[4]. In many countries, corn is the main agricultural crop, and are used as food, feed and industrial raw materials. Together with rice and wheat, corn classified in the cereals that provide about 65 % carbohydrates and 50 % protein that needed by humans. For this purpose, many developing countries, especially in Asia and Africa are in a strong effort to increase their corn yields through utilization of better seeds [5]-[8].

In economic classification of Indonesian food crops, corn is placed in the second important food commodity after rice. However, with the rapid growth of the livestock industries, especialy poultry and aquaculture where corn is a major component (about 60 %) in feed ingredients. It is estimated that more than 55% of the domestic corn used for feed, while for food consumption is only about 30%, and the rest for other industrial purposes and seed. Thus, the role of corn actually has changed from mainly as food to raw material of industrial products [9]-[13].

Java downy mildew *Peronosclerospora maydis* is the main disease that is most concern of corn growers. This disease which at the first time found in the Island of Java but now spread to all over Indonesia, often resulting in substantial losses for farmers even cause "zero yield" on susceptible varieties. Corn yield loss due to diseases reported to be vary. In case of java downy mildew *Peronosclerospora maydis*, yield losses can often reach 100% in susceptible varieties [14]-[16].

Infection of this disease leads to a decreasing yield and occurs from year to year. The disease also causes decreasing in grain quality for food, feed as well as for seed. Disease infection varies from time to time depending on weather conditions. This trial (screening) against java downy mildew *Peronosclerospora maydis* is conducted because in contrast to other major diseases of maize, java downy mildew *Peronosclerospora maydis* can result in severe damage to total loss if infects susceptible genotypes, while metalaxyl is no longer effetive to control this diseases [17] although several foliar disease can be managed by plant population dynamics [18] and the fungicide treated biomass still can be used as fodder [19]. This phenomenon resulting the

mandatory for farmers to grow resistant cultivars only, especialy in area where java downy mildew *Peronosclerospora maydis* considered to be endemic. Therefore, to comply with the above considerations, as an initial screening, 11 new genotipes are tested in the resistance trial to java downy mildew *Peronosclerospora maydis*.

II. Materials and Methods

This trial uses 24 (twenty four) cultivars/genotypes hybrid corn as material. The trial consists of 11 (eleven) prospective genotypes which is being tested with 13 genotypes of hybrid maize varieties which already exist in the seed market of Indonesia. The control cutivars consist of hybrids with susceptibility "very resistant" to "very susceptible.

The 11 prospectives genotypes which being tested are the result of the author breeding program which began in 1997. This trial using a randomized block design with three replications where each plot was planted with 200 plants [20]. Detailed data regarding the 11 new genotypes and 13 control varieties are presented in Table I.

Trial implementation procedures are as follows:

A. Preparation of Inoculation Material

Inoculation material (inoculum) obtained from farmers corn fields which is being infected by java downy mildew *Peronosclerospora maydis* around the trial site. Prior to trial, farmers land that is being infected by java downy mildew *Peronosclerospora maydis* which will be used as a source of inoculum has been identified.

B. Planting of Spreader Rows

Two weeks before planting genotypes/tested materials, maize varieties which susceptible to java downy mildew *Peronosclerospora maydis* had to be planted. These varieties, Pulut Harapan and sweet corn were planted around the area which would be planted with tested materials. Inoculum sourcer is planted with the direction of the rows perpendicular to the direction of the rows of tested materials. Seven days after planting, urea fertilizationis applied with a dose of 300 kg/ha.

C. Planting of Tested Genotypes

Two weeks after planting spreader rows, at which time the spreader plant has been infected by java downy mildew *Peronosclerospora maydis* of more than 75%, the trial materials are grown. Along with this planting, fertilization of urea with doses as at the time of planting spreader rows, which is 300 kg/ha is also applied.

D. Inoculum Spreading to The Trial Material

In addition to naturally transmission, the transmission of inoculum of java downy mildew *Peronosclerospora maydis* from spreader rows to trial materials is also done by spraying the inoculum which is mixed with water to the trial materials. Spraying is done every day when the age of trial materials between 10-21 days after planting (DAP), and carried out at 4 o'clock to 6 o'clock early in the morning.

E. Observations onthe Degree of Infection

Observation of the intensity of java downy mildew *Peronosclerospora maydis* infection is done at age 21 DAP (days after planting), 28 DAP, 35 DAP and 42 DAP. The percentage of downy mildew infection was calculated based on the formula below and the results are classified by the criteria of modified Reid [21], as presented in Table II.

$$DoI = \frac{\sum DMI}{\sum PPP} \times 100\%$$

Where, DoI : Degree of Infection
$\sum$ DMI : Cummulative infected plants
$\sum$ PPP : Plants per plot

TABLE I
Trial Materials

No	Hybrid Code	Cross	Remark
1	SSU3X17782	Threeway cross	Tested genotype
2	SSU3X28871	Threeway cross	Tested genotype
3	SSU3X29131	Threeway cross	Tested genotype
4	SSU3X30735	Threeway cross	Tested genotype
5	SSU3X45172	Threeway cross	Tested genotype
6	SSU3X68276	Threeway cross	Tested genotype
7	SSUSX02971	Single cross	Tested genotype
8	SSUSX06145	Single cross	Tested genotype
9	SSUSX48274	Single cross	Tested genotype
10	SSUSX68849	Single cross	Tested genotype
11	SSUSX76844	Single cross	Tested genotype
12	Pioneer P12	Single cross	Control "very resistant"
13	Pioneer P31	Single cross	Control "very resistant"
14	CNMS NT10	Single cross	Control "resistant"
15	Sukmaraga	OPV	Control "resistant"
16	Pioneer P21	Single cross	Control "less resistant"
17	Pioneer P23	Single cross	Control "less resistant"
18	BISI 18	Single cross	Control "less susceptible"
19	Monsanto DK3	Modified single cross	Control "less susceptible"
20	BISI 2	Single cross	Control "susceptible"
21	Pacific PAC759	Single cross	Control "susceptible"
22	Syngenta NK22	Single cross	Control "susceptible"
23	Pulut Harapan	OPV	Control "very susceptible"
24	Sweet Corn	OPV	Control "very susceptible"

TABLE II
Criteria of Resistance Level by modified Reid (2005)

No	Criteria	Degree of Infection (%)	Symbol
1	Very resistant	0 - 5	VR
2	Resistant	> 5 - 20	R
3	Less resistant	> 20 - 35	LR
4	Less susceptible	> 35 - 50	LS
5	Susceptible	> 50 - 65	S
6	Very susceptible	> 65	VS

F. Location and Time of Trial

This trial was conducted in the Village of Kepuh, District of Papar, Kediri Regency, East Java Province, Indonesia.

This trial was conducted in the rainy season 2014. This location was choosen because its endemic to *P. maydis* [22],[23].

III. Results and Discussion

Based on the data presented in Table III it can be ensured that the transmission of java downy mildew on this trial has been done well. This is shown from the infection level on the control genotypes which is inline in accordance with their level of resistance. So it can be ascertained that there is small possibility of the occurrence of the "stress escape" phenomenon on the trial materials.

TABLE III
DATA OF JAVA DOWNY MILDEW INFECTION

No	Hybrid Code	Viable Plants	Infected Plants	Degree of Infection (%)	Criteria
1	SSUSX02791	198,7	0,0	0,00	VR
2	Pioneer P31	189,3	0,0	0,00	VR
3	SSUSX48274	187,0	4,7	2,50	VR
4	SSU3X30735	184,3	5,7	3,07	VR
5	Pioneer P12	182,3	8,3	4,57	VR
6	SSU3X17782	178,7	9,7	5,41	R
7	CNMS NT10	191,3	12,3	6,45	R
8	SSU3X68276	193,0	14,7	7,60	R
9	SSU3X29131	194,7	16,3	8,39	R
10	SSUSX68849	195,0	23,3	11,97	R
11	SSUSX76844	172,7	46,7	27,03	LR
12	SSUSX06145	190,3	64,3	33,80	LR
13	SSU3X45172	193,7	75,3	38,90	LS
14	SSU3X28871	169,0	74,3	43,98	LS
15	Sukmaraga	174,7	80,3	45,99	LS
16	Pioneer P21	182,0	86,7	47,62	LS
17	Monsanto DK3	146,7	70,3	47,95	LS
18	Pioneer P23	183,7	91,3	49,73	LS
19	BISI 18	189,3	112,7	59,51	S
20	Pacific PAC759	180,7	108,7	60,15	S
21	BISI 2	178,0	107,3	60,30	S
22	Syngenta NK22	180,3	125,3	69,50	VS
23	Sweet corn	194,7	194,7	100,00	VS
24	Pulut Harapan	179,0	179,0	100,00	VS

Table III also shows that based on the criteria of resistance level modification Reid (2005), from 11 tested genotypes, three genotypes (27.3%) which are SSUSX02791, SSUSX48274 and SSU3X30735 can classified as very resistant genotypes (VR). While 4 teste genotypes (36.4%), which are SSU3X17782, SSU3X68276, SSU3X29131, and SSUSX68849 can be classified to the criteria of resistant genotypes (R).

Obtained two tested genotypes (18.2%), which are SSUSX76844 and SSUSX06145 can be classified in the criteria less resistant (LR). While two other tested genotypees (18.2 %), which are SSU3X45172 and SSU3X28871 must be classified in the criteria less sensitive (LS).

IV. Conclusions

It can be concluded that 7 tested genotypes or 63.6%, which are SSUSX02791, SSUSX48274, SSU3X30735, SU3X17782, SSU3X68276, SSU3X29131, and SSUSX68849 can be proceed to multilocation trials in order to release new varieties of hybrid maize in Indonesia.

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