Evaluation of Resistance of Super and Ultra Early Maturity Maize to Downy Mildew (*Peronosclerospora spp)*

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ABSTRACT. Downy mildew (*Peronosclerospora spp)* is one of the major diseases in maize production. The objective of this study was to evaluate the resistance of super and ultra early maturity maize against downy mildew. The experiment was conducted from May to July 2012 at the experimental field of Indonesian Cereal Research Institute in Maros, South Sulawesi Indonesia. There were 50 varieties and lines evaluated, which consisted of 25 BGJH varieties and lines and 25 BDLM varieties and lines. There were two check varieties used, namely Anoman–1 as susceptible check and Bima 10 as resistance check. The experiment was arranged in a randomized block design with three replications. The result showed that from BGJH varieties/lines there were three varieties considered to be resistant to downy mildew disease, namely: BGJH 011, BGJH 017 and BGJH 020. 16 varieties and lines were categorized as moderately resistant and one variety, BGJH 013, was susceptible. There were five highly susceptible varieties namely BGJH0 12, BGJH 014, BGJH 023, BGJH 024, BGJH 025. Meanwhile, in the BDLM varieties/lines there were four varieties considered to be resistant, namely BDLM 005, BDLM 011, BDLM 012 and BDLM 018. Sixteen varieties/lines showed moderately resistance reaction, namely BDLM 001, 002, 003, 004, 006, 007, 008, 009, 013, 014, 015, 016, 017, 019, 020, 021 and 025. The highly susceptible varieties were BDLM 010, BDLM 022, BDLM 023, BDLM 024. The resistant genotypes will be used for varietal improvement in maize breeding programs.

Key word: downy mildew, *Peronosclerospora spp,* early maturity

Introduction

Downy mildew (*Peronosclerospora spp.)* is a major disease in maize production in Indonesia. It causes yield damage and lost from 70 up to 100% (Semangun 1993) and varies from time to time and from one city to another. Yield loss due to downy mildew has been associated with the intensity of infection. Infection at early developmental stage resulted in higher yield loss to a failed harvest. In Indonesia, the disease is widespread in almost all provinces (Anonymous 1994). In recent years, downy mildew outbreak was reported in several places in Indonesia such as in West Kalimantan (Wakman *et al.* 2008), East Java Kediri (Soenartiningsih 2010).

Symptoms of downy mildew on maize chlorotic is characterized by the presence in some or all infected plant leaf blade, the bottom leaves look a white powder, which is conidiophores and clearly visible on the lower surface of infected leaves downy mildew. Downy mildew is caused by the fungus *Peronosclerospora* spp. and there are 10 species that infected maize cultivation spread throughout the world (Smith *et al.* 1999). While in Indonesia there are three species, namely *Peronosclerospora maydis*, *Peronosclerospora philippinensis* and *Peronosclerospora sorghi.* The symptoms of these three species are almost the same, only different in conidia shape. The conidia of *P.maydis* forms spherical spreading and was detected in Bogor, Yogyakarta, Pemalang and Pekalongan. The conidia of *P. philippinensis* spreading oval shape and was found in South Sulawesi, North Sulawesi and Gorontalo. While *P. sorghi* forms ovoid shape conidia and distributed in karo (Barastagi) northern Sumatra and Malang (Batu).

Controling the desease using downy mildew resistant varieties is necessary since the use of resistant varieties has been declared as a good way to control. It is cheap, environmentally friendly, easy to do, and can be combined with other control components (Saleh 1993). Genetic diversity is critical formation of varieties resistant to downy mildew, it reduces the level of attacks and yield loss at lower levels (George *et al.* 2004). Therefore, the Indonesian government has obliged every new released maize variety to be equiped with resistance to downy mildew as an absolute requirement.

Given the rank of varieties resistance to downy mildew, maize varieties have been circulating in the community both in hybrid and composite types. Therefore, it is necessary to evaluate the level of its resistance. In addition, the level of resistance in a variety will be reduced from time to time and at one place to another.

Materials and Methods

Collection of inoculum *Peronosclerospora spp* in the greenhouse

Propagation of inoculum was carried out in the greenhouse because of the disease is an obligate. The multiplication of inoculum was carried out by spraying inoculated conidia on the plant source (spreader rows) in the field. The conidia used as in this research was from *Peronosclerospora philippinensis*.

Evaluation of resistance to downy mildew

The experiment was conducted in the experimental field of Indonesian Cereal Research Institute, Maros, South Sulawesi Indonesia, from May to July 2012. The aim of the study was to select resistant super and ultra early maturing maize varieties/lines to downy mildew. The spreader row, sensitive variety to downy mildew as source of inculum, was planted two rows around the experimantal plots with distance between plants of 75 cm x 20 cm. The evaluated varieties and lines were planted one month afterward. The infection was carried out 7 days after planting by spraying conidial suspension of *Peronosclerospora* in the morning before sunrise or around 4:00 to 5:00 a.m.

There were 50 varieties and lines evaluated, which consisted of 25 BGJH varieties and lines and 25 BDLM varieties and lines. There were two check varieties used, namely Anoman–1 as susceptible check and Bima 10 as resistance check. The experiment was arranged in a randomized block design with three replications. Fertilization was carried out at 10 and 30 days after planting, with the dosage of 400 kg Phonska and 200 kg Urea/ha. Furadan was applied during maintenance with the dosage of 3 g dose of 10 kg/ha.

The percentage of downy mildew severity was calculated by the following formula:

$$I = \frac{a}{b} \times 100\%$$

Description:
I = intensity of severity
a = number of plants infected by downy mildew
b = Population plant

Results and Discussion

The evaluation showed there was variation of desease severity intensity among fifty maize varieties. Three varietites of BGJH, namely BGJH 011, BGJH 017, BGJH 020

Table 1. Scoring of downy mildew disease and resistance category.

No	Percentage of severity	Reaction
1	0-10	Highly resistance (HS)
2	>10-20	Resistance (R)
3	> 20-40	Moderately resistance (MR)
4	> 40-60	Susceptible (S)
5	> 60-100	Highly susceptible (HS)

Figure 1. Conidia of *P philippinensis* (a) and Symptom of *P philippinensis* (b).

Table 2. Intensity severity of downy mildew infection on fifty varieties/lines. The observation was carried out at 2, 3, 4 and 5 weeks after planting (wap).

Variety/ lines	Intensity severity (%)				Reaction
	2 wap	3 wap	4 wap	5 wap	
BGJH 001	0	7,82	15,65	28,91	MR
BGJH 002	0	9,29	18,67	33,92	MR
BGJH 003	0	7,74	20,45	27,33	MR
BGJH 004	0	10,7	19	28,46	MR
BGJH 005	0	12,15	20,34	27,73	MR
BGJH 006	0	11,95	26,19	39,28	MR
BGJH 007	0	7,91	17,28	25,53	MR
BGJH 008	0	9,16	20,47	37,74	MR
BGJH 009	0	9,8	16,98	31,84	MR
BGJH 010	0	7,22	14,64	27,88	MR
BGJH 011	0	7,76	13,27	18,62	R
BGJH 012	0,92	31,48	49,59	75,29	HS
BGJH 013	0	8,81	20,1	45,26	S
BGJH 014	0,92	33,93	52,83	78,32	HS
BGJH 015	0	9,09	19,71	33,31	MR
BGJH 016	0	6,85	16,15	26,34	MR
BGJH 017	0	5,85	9,91	17,98	R
BGJH 018	0	11,33	12,77	23,3	MR
BGJH 019	0	6,16	13,63	22,96	MR
BGJH 020	0	3,18	11,62	18,92	R
BGJH 021	0	10,8	19,09	39,59	MR
BGJH 022	0	15,63	22,78	34,7	MR
BGJH 023	0	35,63	43,38	71,56	HS
BGJH 024	2,28	49,85	59,04	71,47	HS
BGJH 025	0	34,2	49,94	68,46	HS
BDLM 001	0	6,93	15,18	20,57	MR
BDLM 002	0	10,29	20,5	31,09	MR
BDLM 003	0	14,01	28,98	38,7	MR
BDLM 004	0	15,9	26,89	36,46	MR
BDLM 005	0	6,98	12,95	19,84	R
BDLM 006	0	7,28	13,8	20,4	MR
BDLM 007	0	6,1	16,63	28,33	MR
BDLM 008	0	6,04	12,72	21,1	MR
BDLM 009	0	16,06	25,63	36,4	MR
BDLM 010	0	31,65	43,57	68,13	HS
BDLM 011	0	5,17	10,52	18,84	R
BDLM 012	0	3,93	8,45	13,15	R
BDLM 013	0	10,26	19,28	26,54	MR
BDLM 014	0	10,73	22,84	30,42	MR
BDLM 015	0	31,88	48,55	47,11	MR
BDLM 016	0	14,89	25,16	35,49	MR
BDLM 017	0	16,47	29,51	39,3	MR
BDLM 018	0	4,96	9,33	14,29	R
BDLM 019	0	15,7	25,54	33,71	MR
BDLM 020	0	9,17	15,48	24,92	MR
BDLM 021	0	6,29	14,81	29,12	MR
BDLM 022	2,58	54,82	68,43	75,43	HS
BDLM 023	1,04	48,64	70,53	79,53	HS
BDLM 024	2,09	43,39	58,02	70,97	HS
BDLM 025	0	7,24	15,66	24,2	MR
Anoman (Cek Susceptible)	3,25	57,22	67,74	82,83	HS
Bima 10 (Cek Resistance)	0	4,24	7,54	9,89	HR

HR = highly resistance, R = resistance , MR = moderately resistance
S = susceptible and HS = highly susceptible

were categorized as resistance to downy mildew with percentage of severity varies from 10–20%. Sixteen varieties/lines showed moderately resistance reaction, namely BGJH 001, 002, 003, 004, 005, 006, 007, 008, 009, 010, 015, 016, 018, 019, 021 dan 022. Meanwhile susceptible variety was BGJH 013 and highly susceptible varieties were BGJH0 12, BGJH 014, BGJH 023, BGJH 024, and BGJH 025 (Table 2).

Table 2. Intensity severity of downy mildew infection on fifty varieties/lines. The observation was carried out at 2, 3, 4 and 5 weeks after planting (wap).

Meanwhile, in the BDLM varieties/lines, four varieties, namely BDLM 005, BDLM 011, BDLM 012, BDLM 018, showed resistance to downy mildew with severity percentage varies from 10–20%. Seventeen varieties/ lines showed moderately resistance reaction, namely BDLM 001, 002, 003, 004, 006, 007, 008, 009, 013, 014, 015, 016, 017, 019, 020, 021 and 025. While variety BDLM 015 showed susceptible reaction to downy mildew. The highly susceptible varieties were BDLM 010, BDLM 022, BDLM 023, BDLM 024 (Table 2).

The result suggested that the infection on susceptible maize varieties was quicker and plant suffers more damage that it becomes stunted growth. Semangun (1993) suggested that downy mildew infection causes plant death, therefore it can be concluded that the yield loss due to downy mildew is closely related with the intensity of infection. According to Anonymus (2011), yield decrease due to downy mildew reaches 70-100% depending on the percentage of infection. Evaluation on 24 varieties/lines using molecular markers showed that each variety containted different resistance genes and four varieties were categorized as good resistant variety (Soenartiningsih 2008).

Conclusion

In the BGJH varieties/lines, there were three varieties, namely BGJH 011, BGJH 017 and 020 considered to be resistant to downy mildew; 16 variety/lines were moderately resistant; one varieties, BGJH 013, were susceptible and five varieties were highly susceptible (BGJH0 12, BGJH 014, BGJH 023, BGJH 024, BGJH 025). In the BDLM varieties/lines there were four varieties namely BDLM 005, BDLM 011, BDLM 012 and BDLM 018 categorized as resistant variety; sixteen varieties/lines showed moderately resistance reaction (BDLM 001, 002, 003, 004, 006, 007, 008, 009, 013, 014, 015, 016, 017, 019, 020, 021 and 025) and four varieties were highly susceptible (BDLM 010, BDLM 022, BDLM 023, BDLM 024).

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