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Breeding of The Soybean Varieties, Aged Maturity and Resistant To Rust Disease

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Abstract

Rust disease, caused by *Phakopsora pachyrhizi*, Syd. is one of the many diseases that cause losses and important disease of soybean in soybean producing countries in Asia, Australia, USA and Indonesia. The disease has resulted also it is very significant in economic losses in Taiwan, Thailand, Indonesia, Philippines, Vietnam, and in some parts of China, Japan, Australia, Korea, and India. Experiments Carried out in the field with a randomized block design (RAK) was repeated three times using four genotypes namely POLIJE-2 and POLIJE- 3 for the parent of a high production and a short maturity and varieties Rajabasa and Ring-1 and for the donor parent who have the advantage of rust disease resistance. Crosses performed to Obtain 16 cross offspring consisting of 12 hybrids and 4 parent-shelving results conducted on the experimental pots. Furthermore, 16 genotypes of F1 seeds were planted in the field using a randomized block design (RAK). In the F1 plants with the plant resistance test performed IWGSR method, age maturity pod (R7), the production of seeds per plant, days to flowering (R1) and the number of pods per plant, where the parameter is used as the basis of Unmatched genotypes from crosses. The results of four studies selected Among the Plant selection results in as many as 71 lines, with criteria grain yield per plant ranges between 17-32 grams, peas ripe maturity of 70-76 days after planting and leaf rust resistant disease caused by the fungus *P. pachyrhizi*, number of pods ranging from 53-160 and weight of 100 seeds ranges from 11-17 g.

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Keywords: Soybean, Resistency, Rust Disease, IWGSR

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1. Introduction

The main objective of soybean breeding program is to obtain varieties are high yielding. According to Sumarno and Fehr (1982), the factors that cause low seed yield of soybean per hectare which may be approached in terms of breeding, as (a) the potential results, (b) the age of the plant, (c) resistance to important diseases such as leaf rust, viruses, and nematodes, (d) mportant pest resistance, seed flies (*Ophyomyia phaseoli*), worms, leaf (*Prodenia litura*), caterpillars inch (*Plusia chalcites*), leafhoppers soybean (*Phaedonia inclusa*), pods destructive pests, especially caterpillars grain borer (*Etiella zinckenella*), (e) tolerance to low pH, (f) tolerance to shade, and the quality of the seeds in the seed storability.

Combining all the good qualities into a single high-yielding varieties is very difficult; yet regionally issues faced not related to any of these factors, so the varieties to be obtained may constitute the combined one to three factors alone. Rust diseases caused by *P. pachyrhizi*, is one of many diseases that cause damage and disease are important soybean in soybean-producing countries in Asia, Australia, USA and Indonesia (Sudjono, 1979). The disease has also been constitute significant economic losses in Taiwan, Thailand, Indonesia, the Philippines, Vietnam, and in some parts of China, Japan, Australia, Korea, and India (Tszchanz and Shanmugasundaram, 1985).

Infectious diseases rust on soybean plants before the formation of pods, will greatly affect the formation of pods, pod filling, and reducing the number of seeds are formed, so that the production decline. Conversely, when the attack occurred after the formation and pod filling, the effect on soybean production is relatively small (Mardinus, 1986).

An effort to overcome losses from leaf rust disease that has been done is through crop rotation, the use of pesticides, and planting resistant varieties. Suprapto (1992) suggested that the use of resistant varieties can reduce yield losses due to soybean rust pathogen attack. The use of resistant varieties is a best method, because it is more economical and not the Result environmental pollution. Soybean is an important crop because of its role as a source of vegetable protein and can be used as industrial raw materials. In Indonesia the result is still low so every year need to import large enough to meet national demand (Karamoy, 2009). The low productivity of soybean and high production costs caused soybean production in the country is still very difficult to keep pace with the increasing demands, but by looking at the potential production is still possible to be improved. Leaf rust disease caused by *P. pachyrhizi* often affects soybean plants is one of the causes of low production.

The resistance of varieties is one important component of disease control and very beneficial in crop protection. The resistance of varieties is the nature of a population of plants that allow the population to withstand the attack of a kind that cause disease so that damage is not meant for production decline (Sudjono, 1979). Soybean varieties have different resistance. The resilience of one variety of soybean rust pathogen can vary depending on the location of the testing and the age of the plant (Semangun, 1990). Suyamto et al. (1990) reported that the resistant soybean varieties are generally dark green leafy, a bit old, and live longer than those susceptible. Known, each plant has a mechanical and chemical barrier different. According to Hartana (1986) mechanical barriers may be morphological factors that exist in every plant, could form the content of wax, cuticle thickness, leaf epidermis and stomata. Bonde et al. (1976); McLean (1979) and Sudjono et al. (1975) reported that the pathogen infection leaf rust on soybean plants not through stomata, or rarely directly to the stomata, but the infection sprouts uredospore directly penetrate the epidermal tissue, so that the wax layer and the epidermal tissue is thick will hinder or prevent the entry of fungi into plant tissue.

Soybeans are known to produce a phytoalexin, which can also determine plant resistance to pathogen infection. Day (1974) states that phytoalexin produced in response to invading pathogens host plant. Keen (1981) reported that a compound phytoalexin gleceolin on cotyledons. Ingham et al. (1980 In Keen, 1981) reported gleceolin isomer III on soybean leaves. Moreover, Keen (1981) reported that the cause gleceolin accumulated in the plant tissue are biotic factors, and directly or indirectly in the biosynthesis induced by certain enzymes.

Plants that are resistant or susceptible actually equally produce phytoalexin, but the resistant plant phytoalexin formed more quickly with quantity more (Brown, 1980). Keen (1981) reported that the resistant plant phytoalexin able to inhibit or halt the growth of pathogens. According to Sudhanta and Prayitno (1987) the older the soy it contains prohibitin and phytoalexin used to inhibit the development of rust fungi growing decline. Keen (1981) reported that the type of resistance which appears as a result of activity of phytoalexin synonymous with vertical resistance.

Getting efforts Varieties Resistant Search varieties resistant soybean rust disease not obtain satisfactory results, thus yielding varieties that have been released turns out most susceptible to rust disease (Hardaningsih, 1997). In the search of superior soybean varieties generally based only on field resistance properties that are easily broken (Hardaningsih, 1997). Procurement of soybean varieties resistant or tolerant rust diseases by identifying the properties of stainless indispensable because varieties of soybean that has been released has been no really are resistant or have only tolerant nature if the properties of resistant rust is also unknown (Hardaningsih, 1994).

Steadiness reaction soybean varieties for rust fungi must be maintained in a variety of growing conditions and various levels of attack. Genetic stability of this reaction must be stable and if the rust fungi have several races, then the soybean varieties must have resistance to races which may attack (Murdan, 1986). Sudjono (1979) conducted a study using gamma rays from Co-60 to induce the nature resistant to rust fungi on a variety Orba and Shakti has shown positive results in the generation of the M5 and M6. The positive influence of gamma rays to the strains M5 and M6 from Orba varieties was greater than Shakti varieties. Sudjono and Sudjadi (1977) state that between longevity with resistance, and between short lifespan (early maturing) there is a positive correlation with vulnerability.

2. Materials And Methods

Field experiments were implemented with a Randomized Block Design (RBD) that using five genotypes were repeated three times. Size of experimental plot was 2.8 m x 4.5 m (12.6 m2, according to the technical guidelines of the national soybean consortium) with a spacing within rows was 40 cm and 15 cm in the rows. Every hole was filled two seeds.

Crosses made to acquire 16 cross offspring that consisting of 12 hybrids and four parent from shelving results conducted on experimental pots. Every genotype as planted in 20 pots. Experiments in pots was implemented by using a Randomized Complete Design (RCD) using five genotypes.

3. Results and Discussion

Observations using the system IWGSR leaf rust (International Working Group Soybean Rust) on 5 October 2013 (50 days after planting) was as shown as Table 1. Based on a 4×4 di-allele crosses, obtained 12 in the cross (hybrid) and four elders shelving result, it acquired the 12 results of cross-bred plants reaction Uncategorized resistant (R = Resistant). One parent, which was apparently based on the results F-Test for Ring Uncategorized as moderately resistant (MR=Moderately Resistance). The results of field testing in Jember, was not in accordance with the variety description issued by Balitkabi-Malang, where Dering be described as a rust-resistant varieties that were not somewhat resistant to corrosion.

Table 1. Yield from Year 3, F4 Plant

Genotype	Ful maturity, R7	100	100 Seed Weight	Seed Yield Per Plant	IWGSR notation	Criteria Security (IWGSR)
Rajabasa	78	82.0	16.30	21.72	222	T
Dering	76	79.0	11.20	20.78	223	T
Polije 2	70	78.0	16.10	23.01	322	AT
Polije 3	71	73.0	16.70	24.07	232	AT
RD 4.2	74	86.5	11.20	20.93	223	T
RD 4.7	71	94.0	11.08	22.98	222	T
RD 4.10	74	81.0	13.33	20.84	223	T
RD 5.4	74	85.5	12.05	20.34	323	AT
RD.1.1	72	82.0	11.00	17.07	0	-
RD.1.3	70	80.0	13.86	15.48	233	T
P2R.1.6	73	79.0	12.60	20.38	323	AT
P2R.2.2	74	73.5	12.60	22.34	323	AT
P2R.3.5	74	104.0	14.89	25.79	323	AT
P2R.4.1	74	81.5	13.35	16.55	323	AT

Genotype	Ful maturity, R7	100	100 Seed Weight	Seed Yield Per Plant	IWGSR notation	Criteria Security (IWGSR)
P2R.4.4	74	94.0	11.22	20.72	323	AT
P2R.5.5	76	109.0	17.00	31.80	323	AT
P2R.5.7	76	82.0	15.45	21.25	323	AT
P2R5.8	76	160.0	16.02	21.25	323	AT
P2D.1.2	74	70.5	13.20	21.35	323	AT
P2D.1.6	74	79.0	14.9	20.38	323	AT
P2D.3.6	72	82.0	16.00	25.28	222	T
P2D.2.9	71	57.0	15.98	19.58	222	T
P2P3.1.1	72	66.0	15.80	20.66	223	T
P2P3.1.5	75	66.5	15.50	24.01	223	T
P2P3.1.6	74	60.5	15.70	23.71	223	T
P2P3.2.6	75	71.0	16.68	26.50	222	T
P2P3.3.2	72	53.0	16.41	22.09	222	T
P2P3.3.7	73	95.5	15.55	30.17	222	T
P2P3.3.9	72	103.0	15.60	32.54	223	T
P2P3.4.9	72	55.5	16.23	23.06	223	T
P2P3.5.1	73	50.0	14.42	23.14	223	T
P2P3.5.2	73	43.0	14.70	22.23	222	T
P2P3.5.7	75	77.5	16.34	28.76	0	-
P3R.1.1	71	54.5	13.91	23.88	233	AT
P3R.1.3	73	55.5	17.13	21.36	233	AT
P3R.2.9	71	57.0	14.89	20.82	233	AT
P3R.3.1	71	46.0	16.22	23.43	233	AT
P3R.3.2	70	50.5	14.65	20.26	233	T
P3R3.10	73	77.0	15.33	27.21	123	T
P3R.4.1	71	62.5	15.20	22.93	233	T
P3R.4.2	74	54.0	14.33	20.33	233	T
P3R4.3	72	54.0	14.58	20.86	323	AT
P3R4.4	72	66.0	15.35	24.90	323	AT
P3R5.3	74	56.5	14.25	20.17	323	AT
P3R.5.4	74	78.5	14.99	27.44	223	T
P3R.5.5	73	78.0	15.18	27.93	223	T
P3R.5.7	75	69.0	15.47	27.51	223	T
P3D.1.1	75	66.5	15.56	24.94	0	--
P3D.1.3	75	58.3	16.17	20.98	0	-
P3D.1.6	76	69.0	14.67	21.61	0	-
P3D.2.1	75	58.0	14.76	21.03	0	-
P3D.2.3	75	64.0	15.45	22.14	0	-
P3D.2.5	76	100.5	15.31	34.76	0	-
P3D.2.7	75	88.0	14.12	27.84	0	-
P3D.4.1	75	89.5	16.76	26.33	0	-
P3D.4.2	76	69.0	13.54	20.78	223	T
P3D.5.3	76	75.5	14.75	23.22	223	T
P3D.5.4	74	54.5	14.00	20.57	223	T
P3D.5.5	75	82.0	15.90	29.62	323	T
P3D.5.6	74	94.0	16.17	28.05	223	T
P3D.5.7	75	63.0	17.08	21.97	223	T
P3P2.1.1	74	59.5	16.27	22.19	223	T
P3P2.2.6	74	75.5	15.90	30.61	223	T
P3P2.2.7	74	52.0	16.90	21.02	223	T
P3P2.2.10	71	52.5	15.90	21.68	223	T
P3P2.3.1	74	54.0	15.56	20.47	323	AT
P3P2.3.6	76	72.5	17.73	30.41	323	AT
P3P2.3.8	75	86.0	14.67	30.14	323	AT

Genotype	Ful maturity, R7	100	100 Seed Weight	Seed Yield Per Plant	IWGSR notation	Criteria Security (IWGSR)
P3P2.4.1	74	73.0	16.00	28.3	222	T
P3P2.4.9	74	59.0	16.89	22.45	222	T
P3P2.5.7	74	50.0	16.23	21.29	222	T
Ringgit	79	89.0	08.00	16.98	332/332	AR
Malabar	74	66.0	12.00	18.83	0	-

T= Resistant AT=moderately Resistant REs AR= Moderately Susceptible

1. Rajabasa, Dering was the parent from rust-resistant disease
2. Polie-2 and Polije-3 were high production elders
3. The Ringgit was leaf rust susceptible varieties
4. Malabar was early maturity varieties

4. Conclusion

Plant selection results in as many as 71 lines, with criteria grain yield per plant ranges between 17-32 grams, peas ripe maturity of 70-76 days after planting and leaf rust resistant disease caused by the fungus *P. pachyrhizi*, number of pods ranging from 53-160 and weight of 100 seeds ranges from 11-17 g.

References

Bonde M.R., Melching, J.S., Bromfield, K.R., 1976 Histology of the Suscept Pathogen Relationship between *Glycine max* and *Phakopsora pachyrhizi* the Cause of Soybean Rust. Phytopathology 66, 1290-1294.

Brown, J.F., 1980. Mechanisms of Resistance in Plant to Infection by pathogens. In Brown J.F., F.A. Kerr, F.D. Morgan and I.H. Parbery (eds). A Course in Plant Protection Manual. Australian Vice-Chancellors Committee. Australia.

Day, P.R., 1974. Genetics of Host-Parasite Interaction. W.H. Freeman and Company.

Hardaningsih, S., 1994. Evaluation of Resistance Against Soybean Rust Disease Leaf. Results Nuts Budget Budget 1993/1994. Balittan Malang.

Hardaningsih, S., 1997. Reactions Some Soybean Genotypes Against Fungi Rust (*Phakopsora pachyrhizi*). Prosid. PFI XIV and the National Seminar. Palembang.

Hartana. 1986. Pemulian Plant Disease Resistance. Plantation Research Institute Jember. Jember.

Karamoy, L., 2009. Hubungan iklim dengan pertumbuhan kedelai (*Glycine max* L. Merrill). Soil Environment 7(1), 65-68.

Keen, N.T., 1981. Evaluation of the Role of Phytoalxins in Staples RC, GH Toenniessen (eds). Plant Disease Control. John Wiley and Sons. New York. Chichester. Brisbane. Toronto.

Mardinus., 1986. Effect of Time Attack Causes Fungus Rust (Phakopsora pachyrhizi) The development and Soybean Production. Penel report. Andalas University, Center Penel. Padang.

McLean R.J., 1979. Histological Studies of Resistance Soybean Rust *Phakopsora pachyrhizi* Syd. Aust. J. Agric. Res. 30, 951-956.

Murdan., 1986. Studi Eksposi Masal Kematangan Reaksi Varietas Kedelai Terhadap Jamur Karat *Phakopsora pachyrhizi* Syd. Fakultas Pertanian Universitas Mataram. Mataram.

Sudhanta, I.M., Prayitno, H., 1987. Reaksi Varietas dan Umur Kedelai Terhadap Penyakit Karat. Prosid. Kongres PFI X. pp.421-426.

Sudjono, M.S., 1979. Ekobiologi Cendawan Karat Kedelai (*P. pachyrhizi*) dan Resistensi Varietas Kedelai (*Glycine max*).Tesis MS. Instute Pertanian Bogor. Bogor.

Sudjono, M.S., Sudjadi., 1977. Kedelai. Badan Penelitian dan Pengembangan Pertanian. Pusat Penelitian dan Pengembangan Tanaman Pangan. Bogor.

Sumarno, Fehr, W.R., 1982. Response to Recurrent Selection for Yield in Soybeans. Crop Science 22, 295-299.

Suprapto. 1992. Bertanam Kedelai. Penebar Swadaya. Jakarta.

Suyamto, M., Anwari, Marwoto, Sunardi, Winarto, A., 1990. Hasil Penel. Balittan Malang Tahun 1988/1989. Balittan. Malang.

Tszchanz, A.T., Shanmugasundaram, S., 1985. Soybean Rust. Proc. World Soybean Research Conference III. Westview Press. London.