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Evaluation of Native Soybean Collection for Resistance to Purple Blotch

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蒐集在來種大豆의 자주빛무늬病(*Cercospora kikuchii*)에 對한 抵抗性檢定

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Abstract

Native soybean collections were evaluated to search a resistant gene source to purple blotch caused by *Cercospora kikuchii*.

Among 467 native lines, about 28.9% of the lines was less than 0.1% and 13.4% was over 2% in natural infection of purple blotch. Natural infection seemed to be significantly associated with weather conditions at the early podding stage.

A significant correlation between natural infection and purple discoloration by seed inoculation was observed and this method seemed to be effective as a preliminary screening technique for resistance to purple blotch. Most of the late maturing native soybeans showed susceptible reaction by the seed inoculation contrary to low infection under natural conditions, indicating that the low natural infection might be due to disease escaping by the late maturing instead of their genetic resistance.

Introduction

Purple blotch, which is caused by *Cercospora kikuchii* (Mats. & Tomoy.) Gardner was first reported by Nakata and Takimoto in 1934[7]. It occurs in all areas of the country where the soybean is grown and reduces the seed quality by purple discoloration. Significance of this disease also deals with its effects on seedling emergence and growth[5,6,9,10,].

Naural infection of the disease is so variable that highly susceptible variety may have as much as 50% purple stained seed in certain year, whereas in other years only trace amounts occur[8]. This seasonal fluctuation of incidence might be due to difference in environmental condition during the period of infection. Soybean varieties differ in the expression of purple blotch, but data are lacking on resistance of soybean genotypes to the disease. Therefore, this study was conducted to determine effects of environmental conditions to incidence of purple blotch and to search sources of resistance from soybean germ plasm collection.

Materials and Methods

Four hundred and sixtyseven soybean lines which

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is a portion of the soybean germ plasm maintained in Radiation Agriculture Division, Korea Advanced Energy Research Institute were evaluated for *C. Kikuchii* by natural infection. Thirty seeds of each entries were planted with spacing 3m long x 70cm between rows on 20 May 1980 with check varieties, Bong-Eui, Chungbuk-Baek and KEX-2, at intervals of 40 rows. After harvest, percent severity of the disease was determined by the number of purple stained seed to total seeds of the entry.

For seed inoculation test, some seeds sterilized in 0.1% mercuric chloride for one minute and then, rinsed with sterile water were embedded on 2% water agar plates containing 50 ppm sodium salt of 2,4-D (2,4-Dichlorophenoxy acetic acid). Inoculation was made by placing a $2mm^2$ mycelial mat of the fungus, which was grown on Potato dextrose agar, on the seed coat. The petridishes containing inoculated seeds were kept at 23~25°C during the period of test. Observation was made 3~4 days after inoculation. Disease severity was arbitrarily classified into 1~5 degaree depending upon the purple stained area on the inoculation site.

Results and Discussion

A total of 467 native lines which was yellow seed coat were evaluated for purple blotch. Out of the entries, about 28.9% of the lines was less than 0.1% and 13.4% was over 2% in natural infection of purple blotch. Among them, 27 lines were over 3% in natural infection and the highest war KAS 633-3 with 12.7% infection (Fig. 1).

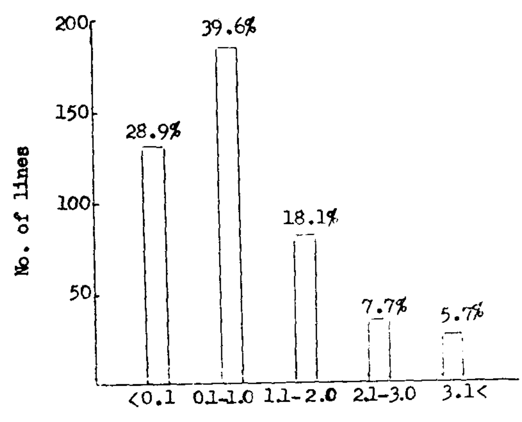

Fig. 1. Varietal frequency for purple seed stain in native soybean collections.

Percent severity of purple blotch seemed to be related with the maturity of the entries(Table 1). When the entries were classified into six groups at intervals of five days from 120 days to 142 days in maturity, larger part of the entries showing high incidence of purple stained seed belonged to early maturing groups.

Table 1. Varietal frequency of for percent of purple seed stain in different maturity on native soybean collections.

Maturity (day)	Percent degree of purple stain				
	below 0.1	0.1~ 1.0	1.1~ 2.0	2.1~ 3.0	above 3.1
below 120	8.7	40.1	30.5	15.7	9.5
121~125	12.2	38.3	28.4	15.9	8.2
126~130	15.1	41.1	25.2	11.2	8.3
131~135	38.4	41.5	12.3	7.3	7.4
136~140	51.6	40.2	5.6	5.6	2.1
above 141	68.2	1.7	1.2	0.9	0.7

Since the maturity of the entries influenced total seed infection, general weather condition of the Kumkok Experiment Farm during these growing season were reviewed (Fig. 2). Minimum temperature of the day decreased below than 20°C from August 5 which corresponded to flowering stage

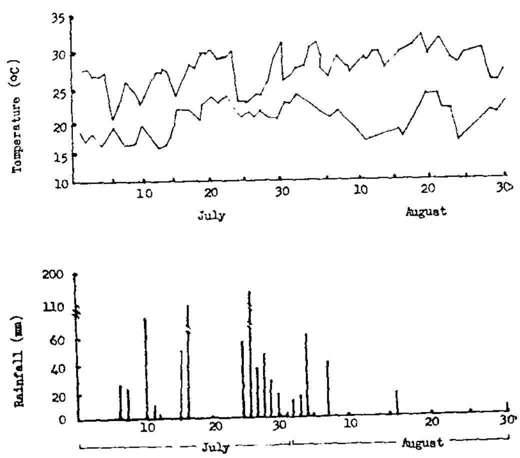

Fig. 2. General weather condition from July 1 to August 31, during 1978~1980 at Kumkok experimental farm, KAERI.

of the late maturing soybean. While conidia production of *Cercospora kikuchii* is limited at temperature 18~21°C[9]. Accordingly, the decrease in temperature seemed to result in reduction of inoculum potential at early podding stage which is critical period of fungal penetration for producing purple stained seed at harvest[1]. Rainfall was also remarkably decreased at podding stage of the late maturing soybean. In view of the fact that temperature and relative humidity at the time of penetration and several days afterward was considered most important[4,8], weather coniditons during early podding stage seemed to affect incidence of purple stained seed.

Establishment of an effective screening method is a key to success in crop breeding. Since purple blotch cause a purple discoloration on the seed coat, seed inoculation was used for differenciating resistance to the disease. Significant correlation ($r = 0.721$) between incidence of purple stained seed by natural infection and the infection by artificial seed inoculation was observed in early maturing soybean (Fig. 3). Based on this result, a total of

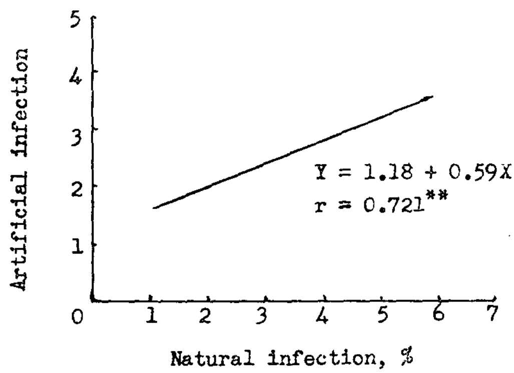

Fig. 3. Relation between natural infecion and pigmentation by artificial inoculation with purple seed stain.

211 entries originated from different countries were tested for resistance by the seed inoculation method (Table 2). Most of the late maturing 85 entries with more than 132 days maturity showed susceptible reaction by seed inoculation contrary to that was classified as resistant lines at the base of purple stained seed. In this point of view, selection for resistance based on incidence of purple

Table 2. Frequency distribution of pigmented lines /varieties due to artificial inoculation on seed with purple seed stain.

Variety	Degree of pigmentation					Total No. of var.
	I	II	III	IV	V	
Germ plasm (Late maturing group)	0	0	12	38	35	85
Korea	0	0	0	14	22	36
U.S.A.	1	2	6	14	16	39
Japan	0	0	1	5	10	16
Taiwan	0	0	0	7	9	16
Vietnam	0	0	0	4	7	11
Philippines	0	0	0	2	6	8
Total	1	2	19	84	105	211

stained seed seemed not to be reasonable in late maturing soybean group, because the incidence was largely affected by the soybean maturity. Most of the entries tested showed susceptible reaction, but three entries from the United States, varieties Hill, Sac and Harosoy were comparatively resistant.

With 244 isolates of *C. Kikuchii* isolated from different locations and soybean varieties, ability of

Table 3. Pigmentation of resistant soybean lines by artificial inoculation with two different strains of purple seed stain.

Line	Natural infection (%)	Artificial infection*	
		B-strain	P-strain
KAS 238-2	3.1	1	4
KAS 681-27	1.0	3	4
KAS 544-11	1.0	3	4
KAS 540-16	1.0	3	4
KAS 230-7	0.8	3	4
KAS 150-19-2	0.8	2	4
KAS 551-5	0.8	2	4
KAS 351-1	0.5	2	3
KAS 233-1	0.5	2	4
KAS 330-4	0.5	2	4
Harosoy	—	2	4
Hill	—	2	4
Sac	—	1	3

* Degree of pigmentation (1~5) was measured in 3 days after inoculation.

purple pigmentation were tested on Potato dextrose agar and soybean seed coat. No difference in ability of pigmentation was found among the isolates, except for an isolate which produced less pigmentation on the potato dextrose agar as compared to other isolates. This isolate was designated temporarily to B-strain in contrast to profusely pigmented P-strain of *C. kikuchii*. Purple discoloration of soybean seed by B-strain was less than that by P-strain(Table 3). This result agreed with reports[2,3] that a fair correlation existed between the ability of an isolate to cause discoloration in potato dextrose agar and its ability to discolor soybean seeds. If the pathogenicity of *C. kikuchii* is associated with the ability of purple discoloration, this isolate seemed tobe a strain with a different pathogenicity. Meantime, the seed inoculation technique seemed to be effectively used for preliminary screening resistance to purple blotch.

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摘　要

대두 자주빛무늬병에 對한 抵抗性因子源 選拔을 위하여 韓國에너지研究所, 放射線農學研究室에서 保存하고 있는 蒐集在來種을 自然感染率과 人工接種法에 依한 抵抗性檢定을 實施하였다. 供試한 蒐集在來種 467系統中 28.9%는 0.1%以下의 감염율을, 약 13.4%는 2% 以上의 감염율을 보였으며 이 自然感染率은 結莢初期의 氣象條件과 밀접한 相關을 보였다. 種子接種에 依한 紫斑의 形成은 자연감염율과 正의 相關을 보여 一次的인 抵抗性 檢定方法으로서 効果的이었으며 晩熟大豆系統은 病害逃避에 依한 抵抗性을 보였다. 그리고 갈색무늬병균의 病原性과 關係되는 種子의 紫斑程度는 培養基의 着色程度와 높은 相關을 보였다.