PARTIAL RESISTANCE TO RICE BLAST DISEASE IN SOME COMMERCIAL RICE CULTIVARS UNDER EGYPTIAN CONDITIONS
Sehly, M. R.; S. M. El - Wahsh; Z. H. Osman; E. A. S. Badr; E. A. Salem and Nagwa M. A. Mahmoud

ABSTRACT

Ten commercial rice cultivars were evaluated to partial resistance for blast disease under greenhouse conditions at Rice Research and Training Center, Sakha, in 2000 season. Ten isolates of *Pyriclularia grisea* collected from different locations were tested and identified on the international differential rice varieties (IDV) and commercial rice cultivars. Five from the new cultivars i.e Giza 177, Giza 178, Sakha 101, Sakha 102, and Sakha 104 showed susceptible reactions to one or two of the tested isolates. Giza 159 and Giza 171 were susceptible to all tested isolates. The isolates placed in seven race-groups i.e. two isolates for each of group IA, IC and ID, whereas, one isolate conformed each of IB, IG, IH and II races. Two races IA-69 (Isolate No.5) as highly virulent and IG-1 (isolate No.52) as a less virulent on the IDV were selected to study partial resistance parameters. Total number of lesions / leaf or plants, sporulation density and lesions type that developed differed greatly among cultivars. The number of lesions decreased by increasing leaf age. High numbers of necrotic spots (type 1-2) on new rice cultivars than on old cultivars could be attributed to hypersensitivity phenomenon. The new rice cultivars had lower number of type 4 lesions and less number of spores / lesion (sporulation capacity) than the old cultivars. This is may reflect a level of partial resistance in addition to major gene effects on the new cultivars than the old ones.

INTRODUCTION

Rice blast disease caused by *pyricularia grisea* (Cooke) Saco. is a major disease of rice, Jeanguyot (1983). Up to the present, most breeders concentrate on the development of the highly resistant cultivars. A low infection type usually characterizes this resistance as an interaction between the pathogen race- specificity, and a simple inheritance. Unfortunately, in the most cases this type of resistance is broken soon after release of the cultivars (Ezuka, 1972; Jeanguyot, 1983, Ou, 1985 and Roumen, 1992). Resistance to infection of rice leaves by *P. grisea* was strongly depende on age and stage of leaf expansion. Resistance rapidly increased in more expanded (older) leaves, resulting in a reduced number of sporulating lesions per leaf area (Roumen et al., 1992). Kamel et al. (1987) reported that number of lesions per leaf differed between the different cultivars and increased as leaf age decreased. In addition, sporulation capacity differed for the entries. Partial resistance has been defined as a reduced epidemic build-up in the field despite a susceptible infection type (Parlevliet and Van Ommeren, 1975). Partial resistance to rice blast appears to be predominantly race non- specific and in some cultivars, partial resistance has been shown to be durable (Ezuka, 1972 and Yeh and Bonman, 1986), thus breeding for higher levels of
partial resistance may be the better alternative for developing blast resistant rice cultivars. It may be more efficient to evaluate components of partial resistance and select for one or more of the components. Among the components associated with higher levels of partial resistance a reduced infection frequency, a longer latent period, and a reduced sporulation capacity (Parlevliet, 1979). Yunoki et al. (1970) and Ezuka (1972) screened for the partial resistance in the greenhouse by single isolates with many virulence factors, since partial resistance in the temperate Japonica cultivars appeared to be largely race-non-specific. Also they reported that, the number of sporulating lesions which developed after inoculation was found to be important parameter. The high correlation between the number of sporulating lesions and number of leaves on the main culms developing such lesions regardless of isolate and despite large differences in a aggressiveness between the isolates, strongly supports earlier findings that a relatively high partial resistance in genotype is closely associated to a rapid increase of resistance with aging of the newly emerging leaves to high resistance leaves (Roumen, 1992 and Roumen et al., 1992). Among 108 trials conducted in the International Rice Blast Nursery, Moroberekan showed qualitative resistance (0-3 scores) in 69% of the trails. It further showed the highest level of partial resistance among the six durable resistant cultivars tested (Ahn 1994). He objective of this study is to evaluate the level of partial resistance to blast disease in some new rice cultivars compared with the old susceptible cultivars.

**MATERIALS AND METHODS**

The tested commercial rice cultivars were seeded in plastic trays (30 x 20-x 15 cm), each tray comprised 18 rows representing: 10 rice cultivars and eight international differential varieties. The trays were kept in the greenhouse at 25-30º C, and fertilized with Urea 46.5% (5 g/tray).

Ten *Pyricularia grisea* isolates were used for inoculating the entries in the trays. Isolates were collected from rice plants grown in the previous season. The isolates were grown and multiplied on banana medium (200g. Banana, 10g. Dextrose and 20g. Agar) under florescent light for 10 days at 28º C for spore production. The spores were harvested at a density of at least 25 spores / microscopic field, examined by 10 x objective. Rice seedlings of 20-day old, in the trays, were inoculated by spraying the water suspension of isolates. A spore suspension (100 ml.) of *P. grisea* was sprayed per 3 trays (representing one replication). The spray (5 x 10⁴ spores / ml) was practiced in the evening to avoid the retarding effect of light on both spore germination and germtube growth. The reaction of tested entries to blast infection was estimated according to IRRI scale (1996) seven- days after inoculation.

Two of the tested isolates were used as indicators for the partial resistance study. The first was isolate No. 5 (Race IA-69) as high virulent isolate as mentioned before. While, the second was isolate No. 52 (Race IG-1) as less virulent, using the same previous methods.
Measurement of partial resistance parameters:

A- Developmental type lesions:
   Different type of lesions, resistant type lesions (1-2), moderately resistant type (3) and susceptible type lesion (4), were estimated started from 3, 5, and 7-days after inoculation.

B- Number of lesions /leaf and plant:
   Ten seedlings from each entry and replication were examined for different type of lesion on different leaves of the plant i.e. second, third, and fourth leaf from the top. The mean number of each type lesion was calculated for each entry.

C- Sporulation capacity:
   Number of spores for each entry was measured by cutting single leaves with type 4 lesion and incubated in test tube 9cm with 1-ml distilled sterilized water for 24 hrs. The lesions were chalked very well to harvest the spores in the lesions. Number of spores per lesion was calculated by examining 5 microscopic fields (10 x) and the corresponding number by hymocytometer.

RESULTS AND DISCUSSION

Ten commercial rice cultivars were evaluated against 10 purified isolates of Pyricularia grisea under greenhouse conditions, data in Table (1) indicated that, 5 from the new cultivars i.e. Giza 177, Giza 178, Sakha 101, Sakha 102 and Sakha 104 showed susceptible reactions to one or two of the tested isolates. Giza 159 and Giza 171 were susceptible to all tested isolates. Giza 176 was susceptible to five isolates and moderately resistant to 2 isolates, however the old rice cultivars Reiho was susceptible to 3 isolates out of 6 isolates tested.

Eight international differential varieties were used to identify those isolates to races. Data in Table (2) showed that the isolates placed in seven race-groups i.e. two isolates for each of group IA, IC and ID, whereas, one isolate conformed each of IB, IG, IH and II races. Bidaux (1976) and Notteghem (1981) observed that virulent strains existed for all the identified genes of vertical resistance and most of the strains possessed virulent genes, which were not necessary for their survival. Sehly et al. (1990) evaluated twenty seven rice entries under both field and greenhouse conditions, some entries showed complete resistance under both tests, other were resistant in one test but susceptible in the other. While Giza 171, Giza 172 and Giza 159 showed completely susceptible in greenhouse and field conditions. Races IC 31, I D 3, I D 15, I G1, I H, and II were identified in the obtained isolates. Sehly et al. (2000) inoculated forty-five isolates of P. grisea inoculated on eight international differential varieties. The most common races were IH-1 (36.6%), I D-race group (17.8%), I A (13.3%), I G-1 (13.3%) and a virulent race group II (9.0%).
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Two races I A-69 (Isolate No.5) as highly virulent race and I G-1 (isolate No.52) as a less virulent one were selected to study partial resistant parameters. Data presented in Table (3) for race IA-69 indicated that, the number of sporulating lesions (type 4) / plant ranged from 0.03 to 6.9 lesions/plant. The greatest number of lesions was shown on Giza 171 (6.9) followed by Giza 176 and Giza 159, which had 3.5 and 3.2 lesions, respectively. Whereas, the lowest number of lesions was obtained from Sakha 101 cultivar as 0.03. The rest cultivars showed intermediate number of lesions ranged from 0.07 to 1.3 lesions / plant. On the other hand race I G-1 gave 5.2 lesions on Giza 171 rice cultivar followed by Giza 159 with 2.7, while the other eight cultivars ranged from 0 for Giza 178 and Sakha 103 to 0.51 lesions / plants for Giza 177. This agree with Roumen et al. (1992) who reported that, total number of sporulating lesions that developed differed greatly among cultivars. The number of sporulating lesions on C039 was about eight-fold than that in IR 36 which had partial resistance. Roumen (1992) found that, large differences between genotypes were found for the number of sporulating lesions that developed, and this factor was closely related to the period that leaves remained susceptible after appearance. Sporulation capacity per lesions (number of spores) differed greatly for all cultivars in both of the two races as shown in Table (3) the greatest number of spores were obtained per lesion from Giza 176 followed by Giza 159, Giza 171 and Reiho with 52.5, 25, 20 and 18.75 thousand spores / lesion, respectively. While Sakha 101, Sakha 102 and Sakha 103 rice cultivars gave the less and same number of spores with 1.25 thousand spores / lesion under the high virulent race (IA-69) whereas race IG-1 on Giza 171 gave the highest number of spores / lesion followed by Giza 159, Reiho and Giza 176, while Giza 178, and Sakha 101 where completely resistant (zero spores).

Table (3): Number of lesions per plant and sporulation capacity on ten rice cultivars inoculated with two races of *Pyricularia grisea*

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Race IA-69</th>
<th></th>
<th>Race IG-1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of lesions / plant</td>
<td>No. of spores / lesions(1000)</td>
<td>No. of lesions / plant</td>
<td>No. of spores / lesions(1000)</td>
</tr>
<tr>
<td>Giza 159</td>
<td>3.20</td>
<td>25.00</td>
<td>2.70</td>
<td>27.50</td>
</tr>
<tr>
<td>Giza 171</td>
<td>6.90</td>
<td>20.00</td>
<td>5.20</td>
<td>50.00</td>
</tr>
<tr>
<td>Reiho</td>
<td>0.80</td>
<td>18.75</td>
<td>0.13</td>
<td>16.25</td>
</tr>
<tr>
<td>Giza 176</td>
<td>3.50</td>
<td>52.50</td>
<td>0.20</td>
<td>13.75</td>
</tr>
<tr>
<td>Giza 177</td>
<td>1.30</td>
<td>13.75</td>
<td>0.51</td>
<td>1.25</td>
</tr>
<tr>
<td>Giza 178</td>
<td>0.14</td>
<td>2.50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sakha 101</td>
<td>0.03</td>
<td>1.25</td>
<td>0.07</td>
<td>1.25</td>
</tr>
<tr>
<td>Sakha 102</td>
<td>0.13</td>
<td>1.25</td>
<td>0.34</td>
<td>1.25</td>
</tr>
<tr>
<td>Sakha 103</td>
<td>0.07</td>
<td>1.25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sakha 104</td>
<td>0.20</td>
<td>2.50</td>
<td>0.06</td>
<td>1.25</td>
</tr>
</tbody>
</table>

These data are coincide with the findings of Kamel et al. (1987) who mentioned that, sporulation capacity per lesion differed greatly for all cultivars, Reiho and Giza 159 showed the highest sporulation capacity, while the line GZ-1394-10-1-1 showed the less, GZ – 2175-5-6 and GZ -2175-5-4 also exhibited low sporulation capacity.
The youngest leaf (1st leaf) which emergence after inoculation was discarded. The obtained data were shown in Table (4). The number of lesions on the 2nd leaf was much more than that on the 3rd and 4th leaf. This may be due to the increase of resistance by age. This agree with Roumen et al. (1992) who reported that the importance of leaf age as the best parameter to evaluate partial resistant and mentioned that, most lesions were found on the youngest leaf closet to the top, in all cultivars. At the same time, the proportional distribution of the lesions over the leaves varied between genotypes, nearly all lesions were located in the top leaf (ranged from 93-98%). The third leaf from the top was also completely resistant in IR50, but in this cultivars relatively more lesions developed in the second youngest leaf (mean of 12%). Roumen (1992) mentioned that, the number of sporulating lesions per cm² leaf area was highest in very young leaves and declined with increasing leaf age.

Table (4): Number of type 4 lesions per leaf on ten rice cultivars inoculated with two races of Pyricularia grisea

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Race IA-69</th>
<th>Race IG-1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of lesions / leaf</td>
<td>No. of lesions / leaf</td>
</tr>
<tr>
<td></td>
<td>2nd leaf</td>
<td>3rd leaf</td>
</tr>
<tr>
<td>Giza 159</td>
<td>1.93</td>
<td>1.20</td>
</tr>
<tr>
<td>Giza 171</td>
<td>4.03</td>
<td>2.50</td>
</tr>
<tr>
<td>Riho</td>
<td>0.20</td>
<td>0.40</td>
</tr>
<tr>
<td>Giza 176</td>
<td>3.03</td>
<td>0.47</td>
</tr>
<tr>
<td>Giza 177</td>
<td>1.33</td>
<td>0.0</td>
</tr>
<tr>
<td>Giza 178</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Sakha 101</td>
<td>0.03</td>
<td>0.0</td>
</tr>
<tr>
<td>Sakha 102</td>
<td>0.10</td>
<td>0.03</td>
</tr>
<tr>
<td>Sakha 103</td>
<td>0.07</td>
<td>0.0</td>
</tr>
<tr>
<td>Sakha 104</td>
<td>0.17</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Few lesions were found on the 4th leaf on the old commercial cultivars Giza 159, Giza 171 and Reiho with 0.07, 0.40 and 0.20 lesions under IA-69 race. The fourth leaf on the rest of the tested cultivars exhibited completely resistance. The same trend was obtained on the cultivars, which inoculated, by IG-1 race except on fourth leaf of Giza 171, Giza 177 and Sakha 104 which exhibited a few lesions. The old commercial cultivars gave the greatest number of lesions compared with the others new ones. Roumen (1992) found the large differences between genotypes were due to the number of sporulating lesions that developed, and this factor was closely related to the period that leaves remained susceptible after appearance. Differences between genotypes were also found in lesion size, and lesion density.

The development of different types of lesions during (latent period), for P. grisea races is shown in Table (5). Three days after inoculation (DAI), necrotic spots differed within genotypes. Giza 171, Giza 178 and Sakha 104 were free from infection, while Reiho, Sakha 101 and Sakha 103 had one necrotic spot each. Giza 159 and Giza 176 had 3 necrotics each, but Giza...
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177 and Sakha 102 exhibited the highest sensitivity (6 spots / 10 plants). The number of spots on the old commercial cultivars (Giza 159, Giza 171, Reiho and Giza 176) progressively increased from type (1-2) to types 3 & 4. Number of lesions on Giza 171 developed from 0 to 77 and 68 at 3, 5 and 7 days, respectively. The same trend was obtained with Giza 159 and Giza 176, whereas the number of necrotic spots decreased from 6 to 4 and 2 (type 3 and 4 lesions) on Giza 177 and from 6 to 5 and 1 on Sakha 102. Giza 178, Sakha 101 and Sakha 104 had more lesions of type 3 than lesions of type 4. The same trend was obtained by IG-1 race, but the number of type 4 lesion on the old cultivars was less compared with IA-69 race. However, on Reiho number of lesions developed from 2 (3-DAI) to 3 (5-DAI) and 11 type 4 (7-DAI). Sakha 103 proved to be completely resistant to both blast races. This is may indicate that, the lower numbers of susceptible type (4) lesions on new rice cultivars than that on the old cultivars could be attributed to some degree partial resistance. Rodriguez and Galvez (1975) reported that latent period ranged from 5 to 9 days depending on the cultivar. However, examination of their results revealed that the isolates used by these authors appeared to be avirulent to most of the tested cultivars. The latent period increased when cultivars developed a more resistant infection type, but cultivar differences were not very clear when the isolate was virulent. Brodni et al. (1988) found five-day differences for latent period among seven rice cultivars, but no information on the infection type was supplied.

Table (5): Developmental and number of different types of lesions, 3, 5 and 7-days after inoculation on 10 rice cultivars with two races of Pyricularia grisea

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Race IA-69</th>
<th>Race IG-1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of lesions / 10 plants</td>
<td>No. of lesion / 10 plants</td>
</tr>
<tr>
<td></td>
<td>3 days (1-2)</td>
<td>5 days (3)</td>
</tr>
<tr>
<td>Giza 159</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>Giza 171</td>
<td>0</td>
<td>77</td>
</tr>
<tr>
<td>Reiho</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Giza 176</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Giza 177</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Giza 178</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Sakha 101</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Sakha 102</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Sakha 103</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sakha 104</td>
<td>0</td>
<td>5</td>
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</table>
REFERENCES


المقاومة الجزئية لممرض اللفحة في الأرز لبعض الأصناف التجارية تحت الظروف المصرية

محمد رشدي سحلى وصلاح محمود الوحش وظريف حافظ عثمان وسهيل علاء سعد وعيسى أحمد سالم ونجوى محمد أحمد
قسم أمراض الأرز - مركز بحوث أمراض النبات - مركز البحوث الزراعية

تم تقييم المقاومة الجزئية لممرض اللفحة على عشرة أصناف أرز تجارية تحت الظروف المصرية بمركز البحوث والتدريب في الأرز بسخا موسم 2000. استخدم في الاختبار عشرة عزلات مختلفة للفطر P. grisea تم تجميعها من مواقع مختلفة خلال موسم زراعة الأرز حيث تم تعريض السلالات الفسيولوجية لهذه العزلات على مجموعة أصناف الأرز العالمية واختبارها على الأصناف التجارية (International differential varieties)

وكشف النتائج أن: مسمى من الأصناف التجارية الحديثة وهي جيزة 177، جيزة 178، سخا 101 وسحا 13 1 وسحا 129 أصيبت واحدة أو أكثر من العزلات بينما الصفح جيزة 159 وجيزة 177 أصيبا بكل العزلات التي تم اختبارها. استخدم في الاختبار عشرة عزلات مختلفة من السلالات الفسيولوجية II, IH, ID, IG, IA & عزلة واحدة فقط لكل من مجموعة للعزلتين فهو عزلة رقم 5 (العزلة رقم 52) شديدة الفطر المرضية و1-IG-IB (عزلة رقم 69) تم اختيار السلالتين I-IA (العزلة رقم 69) و I-IG-IB (عزلة رقم 52) التي كانت المقاومة للمرضية الأقل على الأصناف المفرقة العالمية لدراسة المقاومة الجزئية

كما وجد أن هناك انخفاض في عدد البقع الفموية (طراز 4) على الأوراق المسنة عن الأوراق الأصلية (طراز 3) على الأوراق المسنة. كما أن هناك انخفاض كبير جدًا في عدد هذه البقع على الأصناف الجديدة والمقاومة إلى الأصناف القديمة وذلك نتيجة لهذه البقع على إنتاج الجراثيم كانت عالية جدا على الأصناف القديمة مقاومة بعد العزلات على البقع المتكونة على الأصناف الحديثة وهذا يوضح أن الأصناف الجديدة لها القدرة على المقاومة الجزئية وكذلك المقاومة المتخصصة عن الأصناف القديمة.
Table (1): Reaction of ten-rice isolates on some Egyptian commercial rice cultivars under greenhouse conditions.

<table>
<thead>
<tr>
<th>Locations</th>
<th>Disouk</th>
<th>Sakha</th>
<th>Sakha</th>
<th>Gemiza</th>
<th>Gimiza</th>
<th>Itai El-baroud</th>
<th>Kafr Sakr</th>
<th>Kafr Sakr</th>
<th>Mansoua</th>
<th>El-simbla-wain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
<td>G. 171</td>
<td>G. 159</td>
<td>IR 10011 (AC)</td>
<td>Aschi Asahi</td>
<td>Reiho</td>
<td>G. 171</td>
<td>G. 171</td>
<td>S. 101</td>
<td>Reiho</td>
<td>G.171</td>
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<tr>
<td>Isolates Cultivars</td>
<td>275</td>
<td>5</td>
<td>344</td>
<td>383</td>
<td>387</td>
<td>363</td>
<td>52</td>
<td>316</td>
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<td>339</td>
</tr>
<tr>
<td>Giza 159</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>4</td>
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<td>Giza 176</td>
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<td>3</td>
<td>0</td>
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<td>(4)</td>
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<td>Reiho</td>
<td>5</td>
<td>7</td>
<td>-</td>
<td>-</td>
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<td>0</td>
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<td>Giza 177</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>0</td>
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<tr>
<td>Giza 178</td>
<td>0</td>
<td>4</td>
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<td>0</td>
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<td>0</td>
<td>(4)</td>
<td>0</td>
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<td>Sakha 101</td>
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<td>(4)</td>
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<td>0</td>
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<td>3</td>
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<td>Sakha 102</td>
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<td>0</td>
<td>(4)</td>
<td>0</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Sakha 104</td>
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<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>(4)</td>
<td>0</td>
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</tr>
</tbody>
</table>

(4): One lesion type 4.
* : Zero reaction.
**: Not tested.

Table (2): Reaction of ten-rice blast isolates on International Differential Varieties (IDV) under greenhouse conditions.

<table>
<thead>
<tr>
<th>Locations</th>
<th>Disouk</th>
<th>Sakha</th>
<th>Sakha</th>
<th>Gemiza</th>
<th>Gimiza</th>
<th>Itai El-baroud</th>
<th>Kafr Sakr</th>
<th>Kafr Sakr</th>
<th>Mansoua</th>
<th>El-simbla-wain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
<td>G. 171</td>
<td>G. 159</td>
<td>IR 10011 (AC)</td>
<td>Aschi Asahi</td>
<td>Reiho</td>
<td>G. 171</td>
<td>G. 171</td>
<td>S. 101</td>
<td>Reiho</td>
<td>G.171</td>
</tr>
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<td>Isolates Cultivars</td>
<td>275</td>
<td>5</td>
<td>344</td>
<td>383</td>
<td>387</td>
<td>363</td>
<td>52</td>
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<tr>
<td>Race</td>
<td>IH-1</td>
<td>IA-69</td>
<td>IA-45</td>
<td>IC-13</td>
<td>IB-47</td>
<td>IC-13</td>
<td>IG-1</td>
<td>ID-15</td>
<td>II</td>
<td>ID-15</td>
</tr>
</tbody>
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