Resistance breeding

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Gene for gene resistance

- Host resistance is conditioned by dominant allele, R
- In the pathogen, virulence is conditioned by recessive allele, a
- Resistance reaction occurs when complementary genes in both host and pathogen are dominant
- A host genotype that carries no dominant alleles at any locus is susceptible for all the races of pathogen (even if pathogen is avirulent)
- Avirulent (“A”) allele is dominant over virulent (“a”) allele and resistant allele “R” is dominant over susceptible allele “r”.
- Compatibility depends on the genotype of the host and the genotype of the pathogen (“-” indicates incompatible and “+” indicates compatible reaction types)

$Host\ genotype$	$Pathogen\ genotype$
	Aa
R	$-+$
r	$++$

Multigenic resistance

The host and pathogen genotypes are given below. Similarly, incompatible (-) and compatible reaction types are also given. With the help of this information, which host is the most resistant and which one is the least? Give your logical explanation.

	Pathogen genotype							
Host genotype	A1A2a3	a1A2a3	A1a2A3	a1a2A3	A1A2A3	a1A2A3	A1a2a3	a1a2a3
r1r2r3	+	+	+	+	+	+	+	+
r1r2R3	+	+	-	-	-	-	+	+
r1R2r3	-	-	+	+	-	-	+	+
r1R2R3	-	-	-	-	-	-	+	+
R1r2r3	-	+	-	+	-	+	-	+
R1r2R3	-	+	-	-	-	-	-	+
R1R2r3	-	-	-	+	-	-	-	+
R1R2R3	-	-	-	-	-	-	-	+

Notes

- In multigenic systems, presence of only single resistance gene is sufficient to confer incompatibility reaction (previously annotated as “-”), and hence the resistance. But the durability might be compromised due to monogenic resistance.

Terminologies

1. Resistance: Capacity of a plant to reduce the growth, development and reproduction of the natural enemy
2. Susceptibility: Incapacity of a plant to reduce the growth, development and reproduction of the natural enemy
3. Tolerance: It neither restricts parasitic contact nor the growth and development of the parasite after establishment. As a consequence, it does not affect the amount of damage/symptoms per unit quantity of parasite present.
4. Sensitivity: Character of the host plant to develop relatively severe symptoms or severe damage per unit quantity of the natural enemy.

$$Sensitivity = \frac{\frac{Yield\ without\ pathogen - Yield\ with\ pathogen}{Yield\ without\ pathogen}}{Concentration\ of\ the\ pathogen}$$

On the basis of following table, answer the following questions:

Cultivar	Virus concentration	Yellowing	Yield with virus	Yield without virus
A	100	8	80	90
B	60	0	97	100
C	50	0	90	70

a. Which cultivar is the most susceptible and why?
b. Which cultivar is the most resistant and why?
c. Which cultivar is the most tolerant and why?
d. Which cultivar is the most sensitive and why?

Answers

a. Cultivar C is most resistant because it has likely permitted least development of pathogen (as seen from the lowest concentration of virus).
b. Cultivar A is most susceptible as it has allowed maximum multiplication of pathogen. i.e with highest virus concentration.
c. Based on the relationship we have for sensitiviy index,

$$Sensitivity = \frac{\frac{Yield\ without\ pathogen - Yield\ with\ pathogen}{Yield\ without\ pathogen}}{Concentration\ of\ the\ pathogen}$$

$$Sensitivity(Cultivar\ A) = \frac{\frac{90-80}{90}}{100} = 0.0011$$

$$Sensitivity(Cultivar\ B) = \frac{\frac{100-97}{100}}{60} = 0.000$$

$$Sensitivity(Cultivar\ C) = \frac{\frac{70-90}{70}}{50} = -0.006$$

Cultivar B has the least sensitivity index (or highest tolerance). Despite a significant load of pathogen concentration, it shows relatively feeble reduction in yield.

d. Based on the index calculated above, Cultivar A is the most sensitive. Despite a lesser concentration of virus, it shows greater reduction in yield.

Note that cultivar C has negative sensitivity value. This is probably because other factors other than the recorded data have affected the yield performance.