

CSS/Hort 430 Exam 1 2009

1. A general definition of plants is they are eukaryotic, multi-cellular organisms and are usually photosynthetic. In this definition, “eukaryotic” means that plants
  - a. have membrane-bound nuclei
  - b. lack the power of locomotion
  - c. contain chlorophyll
  - d. have three distinct genomes
  
2. A plant gene could be located in the nucleus, mitochondrion, or chloroplast
  - a. T
  - b. F
  
3. You observe a qualitative frequency distribution for disease resistance (50 resistant: 50 susceptible) in 100 doubled haploid progeny. This result suggests that
  - a. There is excellent fit to a monohybrid F2 ratio
  - b. Disease resistance is controlled by many genes
  - c. Disease resistance is controlled by one gene
  - d. Disease resistance and susceptibility are pleiotropic effects of the same gene
  
4. You observe that in a very large ( $n = 1000$ ) F2 population derived from the cross of two completely homozygous parents, two specific combinations of traits are always inherited together: all blue-flowered progeny are susceptible to a viral disease and all white-flowered progeny are resistant to the viral disease. This is most likely a case of
  - a. Linkage (with 15% recombination between genes)
  - b. Incomplete penetrance
  - c. Epigenetics
  - d. Pleiotropy

*You would like to determine if your neighbor's Roundup Ready™ crop has pollinated your certified organic crop (which is susceptible to Roundup). F1 plants grown from seed harvested from the organically-grown plants are all resistant to the herbicide. You allowed the Roundup resistant F1 plants to self-pollinate. You plant the selfed seed harvested from F1 plants to produce a population of 100 F2 plants. In the F2, 75 plants are resistant to Roundup and 25 are susceptible. Based on this information, answer questions 5 and 6.*

5. Roundup resistance shows what kind of inheritance?
  - a. Quantitative
  - b. Qualitative
  
6. If you produced doubled haploids from the Roundup resistant F1 plants, what ratio of Roundup resistant to Roundup susceptible plants would you expect?
  - a. 1:1
  - b. 3:1
  - c. 2:1
  - d. all resistant

7. Cytoplasm inheritance refers to the inheritance of traits controlled by genes in chloroplasts and mitochondria. Since these organelles are always maternally inherited in angiosperms and gymnosperms, genetic engineering of organelles will be a better way to prevent unwanted flow of transgenes than placement of transgenes in nuclear chromosomes.
- T
  - F
8. A trait determined by a gene in the mitochondrion of maize (which has maternal inheritance of organelles) is expected to show a 3:1 phenotypic ratio in the F2 progeny of two parents differing for the trait.
- T
  - F
9. Autosomal inheritance refers to traits encoded by genes that are
- in sex chromosomes
  - in nuclear chromosomes, except for sex chromosomes
  - in chloroplast genomes
  - in mitochondrial genomes
10. The ADH-1 gene in maize is over 1000 nucleotides long. Therefore, many alleles are possible at this locus but any single (diploid) maize plant can have a maximum of two of these alleles.
- T
  - F
11. An allele can be best described as
- the part of a gene where transcription is initiated
  - a homozygous genotype
  - a heterozygous genotype
  - one of several possible forms of a gene
12. According to Komatsuda et al., the dominant allele at the Vrs1 locus encodes a transcription factor. This means that
- The dominant Vrs1 allele is not transcribed
  - The dominant Vrs1 allele does not code for a protein
  - The dominant Vrs1 allele encodes a protein that binds to another gene (or genes) and regulates the expression of these other genes
  - The dominant Vrs1 allele does not have a promoter

Assume there are 30,000 genes in the tomato genome. You create an F1 hybrid by crossing two completely inbred parents that have contrasting alleles at 10,000 of the 30,000 loci. Answer questions 13 and 14 based on this information.

13. The F1 is expected to be heterozygous at 10,000 loci and homozygous at 20,000 loci
- a. T
  - b. F
14. You save seed harvested from the F1 plants and you plant it the next year. You expect that:
- a. The F2 plants will all look the same
  - b. The F2 plants will all look different

For the question 15-17, assume that the progeny were derived from crosses between completely inbred diploid parents with contrasting alleles at the number of loci specified. Assume that if there are two loci, the loci are on non-homologous chromosomes.

15. The expected genotypic ratio for the F2 - one locus
- a. 1:1
  - b. 1:2:1
  - c. 3:1
  - d. 9:3:3:1
  - e. 1:1:1:1

16. The expected phenotypic ratio for the F2 – two loci: note – the wrong answer was specified as correct on the on the Scantron (c).

- Therefore – if you chose “c” your score remains the same.
- If you chose a or b, you got 2 points added.
- If you chose “d” you got 4 points added.

- a. 1:1
- b. 1:2:1
- c. 3:1
- d. 9:3:3:1
- e. 1:1:1:1

17. The expected genotypic ratio for doubled haploids – two loci

- a. 1:1
- b. 1:2:1
- c. 3:1
- d. 9:3:3:1
- e. 1:1:1:1

18. Segregation can be observed in both monohybrid and dihybrid crosses but independent assortment can only be observed in dihybrid crosses.

- a. T
- b. F

Consider the following data from Oregon Wolfe Barley doubled haploid population and use it to answer questions 19-23.

- The doubled haploids were derived from the F1 of the cross between the two completely inbred parents.
- The Dominant parent has a 2-row inflorescence.
- The Recessive parent has a 6-row inflorescence.
- The F1 has a 2-row inflorescence.

<i>Inflorescence type</i>	<i>Number of doubled haploid plants</i>
2-row	40
6-row	54

19. Head type shows complete dominance.

- a. **T**
- b. F

20. How many loci do you hypothesize determine this trait?

- a. **1**
- b. 2
- c. 3
- d. 4

21. The general formula for the chi square is  $(O-E)^2/E + \dots (O-E)^2/E$ . Your calculated Chi-square is closest to which of the following values?

- a. 1
- b. **2**
- c. 3
- d. 4

22. How many degrees of freedom do you use for the Chi square test?

- a. **1**
- b. 2
- c. 3
- d. 4

23. You will reject the hypothesis that the data fit the expectation for segregation of alleles at a locus.

- a. T
- b. **F**

24. In the angiosperms, there are many more species with dioecious flowers than with hermaphroditic flowers.

- a. T
- b. **F**

25. All dioecious species are gymnosperms
- T
  - F
26. Which of the following best describes a perfect flower?
- Has petals and sepals
  - Functional male and female organs in the same flower
  - Present in all monoecious species
  - A structural mechanism to ensure 100% self-pollination
27. Many plants with perfect flowers do not self-pollinate, or self-pollination is relatively infrequent compared to cross-pollination. This is because
- Perfect flowers do not have male organs
  - Recombination between X and Y chromosomes prevents self pollination
  - There are often advantages to heterozygosity, including avoidance of inbreeding depression
  - The flowers are self-compatible
28. Self-incompatibility, as in *Corylus* spp. is best defined as
- Pollen failure due to a mutant gene in the cytoplasm
  - Failure to set seed when self-pollinated with viable pollen
  - Male sterility due to non-functional pollen
  - Female sterility due to a lack of stigmas
29. “T cytoplasm” corn plants with a mutant *T-urf13* allele in the mitochondrial genome are male sterile and susceptible to southern corn leaf blight. Billion dollar losses due to southern corn leaf blight were caused by the fact that so many corn hybrids were produced using the “T” cytoplasm. This case study shows that:
- Genes showing cytoplasmic inheritance can show pleiotropy.
  - Male sterility is always encoded by nuclear genes
  - Genetic uniformity is an excellent strategy for controlling plant diseases
  - Another pleiotropic effect of the *T-urf13* allele is to allow pistillate flowers to develop on the tassel
30. Which of the following mechanisms will encourage cross pollination in hermaphroditic and/ or monoecious plants?
- Separate male and female plants
  - Differential maturation rates of pollen and stigma
  - Neither a nor b
31. The basis of sex determination in plants is
- Determined during the S phase of meiosis
  - Determined prior to meristem differentiation
  - Due to the selective abortion of flower organs
  - Never due to an XY chromosome system, as seen in mammals

32. It is possible that mutation in a single gene could give cause a hermaphroditic plant to become a monoecious plant.
- a. T
  - b. F
33. Two examples of dioecious plants with XY chromosome systems that were described in class are
- a. Barley and wheat
  - b. Cucumbers and garlic
  - c. Chickpeas and lentils
  - d. Hemp and asparagus
34. If doubled haploids are derived from XY (male) asparagus plants, the progeny will segregate
- a. 1XX:2XY:1YY
  - b. 1 YY: 1 XX
  - c. 1XY:1XX
  - d. 3YY:1XY
35. The papaya is a species that exemplifies the development of an incipient Y chromosome. In the paper by Liu et al. about a “primitive Y chromosome in papaya”, the term “Muller’s ratchet” was used to describe
- a. An increase in chromosome number each generation
  - b. The tool used to prune trees bearing pyriform fruits
  - c. Progressive shedding of deleterious mutations by chromosome elimination
  - d. Accumulation of deleterious mutations due to a lack of recombination
36. Each plant chromosome consists of two DNA molecules: one molecule is attached to each side of the centromere.
- a. T
  - b. F
37. Chromosome centromeres and telomeres are examples of euchromatin
- a. T
  - b. F
38. Facultative heterochromatin refers to a chromosome, or chromosome region which is not heterochromatic all the time.
- a. T
  - b. F

39. If a plant is  $2n = 42$ , at Anaphase of mitosis, how many chromatids will migrate to each pole?
- 7
  - 14
  - 21
  - 42
40. If a plant is  $2n = 10$ , how many pairs of homologous chromosomes would you expect to see at Zygonema?
- 5
  - 10
  - 20
  - 40
41. What key event in meiosis occurs that can lead two loci on the same chromosome to show independent assortment in a population of 100 individuals?
- crossover
  - mutation
  - tetrad formation
  - segregation
42. A chromosome can usually synapse with any other chromosome at Zygotene.
- T
  - F
43. Both meiosis and mitosis occur in all cells in all tissues and at all developmental stages during the plant life cycle.
- T
  - F
44. A haploid plant will have intact floral structures but it will be sterile. This is most likely due to which of the following:
- mitosis does not function properly in haploids.
  - haploid plants do not have an S phase.
  - spindle fibers do not work in haploids.
  - meiosis does not function properly because there is only one chromosome per homologous pair.
45. Recombination creates new alleles and new combinations of alleles at different loci.
- T
  - F

46. Genetic linkage refers to
- The association of two or more characters in inheritance because the genes controlling these characters show independent assortment
  - The association of two or more characters in inheritance because the genes controlling these characters are close together on the same chromosome
  - Segregation of alleles at a locus
  - The situation where one gene determines two or more phenotypes
47. A diploid organism with 14 chromosomes has a haploid genome with 7 chromosomes. How many linkage groups does this organism have?
- 28
  - 14
  - 7
  - 56
48. Single crossovers, 2-strand double crossovers, 3-strand double crossovers, and 4-strand double crossovers
- All give equal frequencies of parental and non-parental combinations of alleles
  - Give fewer non-parental than parental combinations of alleles
  - Have very different outcomes in terms of combinations of alleles at loci flanking the crossover event(s)
  - Are the principal source of new alleles

*A cross between a tall and ( **TTRR** ) and a short and yellow flowered plant ( **ttrr** ) gives F1 progeny ( **TtRr** ), which are tall and red flowered. 100 doubled haploids are derived from the F1 and the numbers in each of the four classes were:*

*46 TTRR (parental)*

*47 ttrr (parental)*

*4 TTrr (non-parental)*

*3 ttRR (non-parental)*

*Use this information to answer questions 49 and 50.*

49. The alleles at the T and R loci are in
- Coupling
  - Repulsion
  - Disgust
  - Conjugation
50. How would you best explain these results?
- There is independent assortment between the T and R loci
  - The percent recombination between the T and R loci would be calculated as 7/100
  - There is 100 % linkage between the T and R loci
  - There was some chromatin loss during crossover and that is why very few non-parental genotypes were recovered