From: Bill Rooney
To: "Nilesh Dighe"
Subject: give my exam
Date: Sunday, October 18, 2009 5:23:48 PM
Attachments: Exam I - Fall 2009.doc

Nilesh:

Please print the following exam and give it to my Agro 642 class on Thursday, Oct 22. You will need 12 copies (should be 11 students). If they need a little extra time, that is fine, it shouldn't take too much extra time.

If you have questions you can e-mail them to me. I should be able to check e-mail again early Tuesday morning (Texas time).

Regards,

Bill

Name:_____

AGRO 642 – Fall 2009
Exam I – 10/22/09

1. Briefly define the following terms and explain their importance in terms of plant breeding. (10 pts)

   a. Coefficient of Inbreeding –

   b. Mass Selection –

   c. Overdominance -

   d. Breeding Value -

   e. Mating Design -

2. True or False. If the statement is false please correct it or explain why it is wrong. (10 pts).

   a. _____ All epistatic variance is heritable and can be selected.

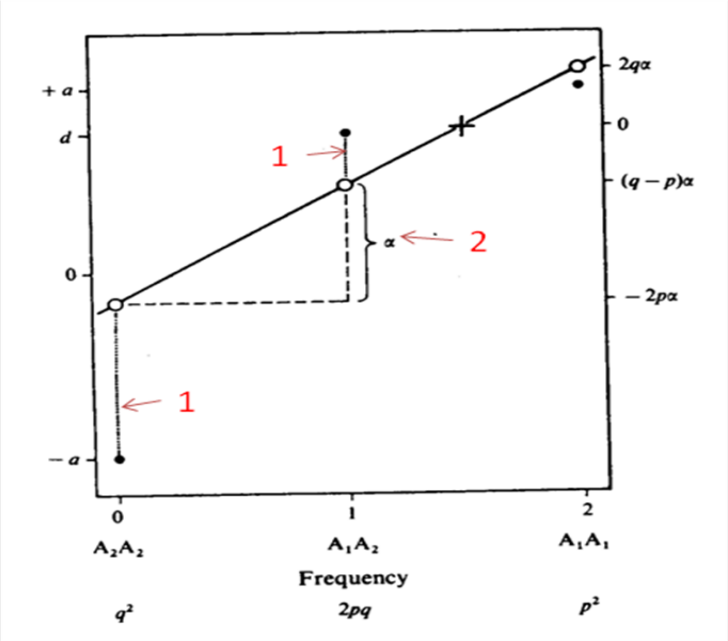
   b. _____ Theoretically, effective selection over generations will eventually reduce genetic variation and heritability.

   c. _____ Broad-sense Heritability estimates should always be equal to or higher than narrow sense heritability estimates.

   d. _____ Dominance effects are not heritable; however they are extremely important in hybrid crop and their effects can be captured in the production of hybrids.

   e. _____ Generation means analysis is used primarily to estimate genetic effects. It is most useful when all favorable alleles are derived from one parent in the cross.

3. Below is a figure of the effect of performance of a single locus A, (two alleles) has on performance in a population (8).



a. The lines identified by "1" are referring to what concept?
   i. Average Effect
   ii. Dominance Deviation
   iii. Epistatic Interaction

b. α (identified by "2") refers to what concept?
   i. Average Effect
   ii. Dominance Deviation
   iii. Epistatic Interaction

c. The variation associated with lines identified by "1" is
   i. Total Genetic Variation
   ii. Additive Genetic Variation
   iii. Dominance Genetic Variation
   iv. All Epistatic Variation
   v. Error Variation

d. The variation associated with α (identified by "2") is
   i. Total Genetic Variation
   ii. Additive Genetic Variation
   iii. Dominance Genetic Variation
   iv. All Epistatic Variation
   v. Error Variation

4. Assume that the following loci control grain yield in wheat (a self-pollinated crop) and that we know the relative contributions from each loci (see below). Also, for this problem assume that there is no epistasis. (12)

Locus	a	d
1	4	4
2	3	3
3	5	5
4	1	1
5	8	0
6	8	0
7	4	2
8	3	3
9	6	8

a. What type of dominance is expressed at locus 1? (circle one)
   i. None
   ii. Partial dominance
   iii. Complete dominance
   iv. Overdominance

b. If you randomly advanced 200 F_2 plants from this population via single seed descent (without selection) to the F_8 generation and then estimated genetic variances in both the F_2 and the F_8 what would you expect to change in those estimates of variance? (explain if needed).
   i. From the F_2 to the F_8, I expect that V_a will (circle one)
      1. drop
      2. remain the same
      3. increase

   ii. From the F_2 to the F_8 I expect that V_d will (circle one)
      1. drop
      2. remain the same
      3. increase

c. If you started selection in this population,

   i. Which locus (or loci) would you likely fix for the favorable alleles fastest? Please explain your choice.

   ii. Which locus (or loci) would be the most difficult to select (ie, fix in a favorable genotype) ? Please explain your choice (if necessary).

d. Assume that loci 8 and 9 are tightly linked in coupling phase in the group of 200 unselected RILs. Because of this linkage, we expect the V_a will be _____. (circle one)
      1. underestimated
      2. overestimated
      3. accurately estimated

5. The following crossing schemes were used to estimate genetic variation in the same plant populations. (6)

XING 1

Parents (females)	Parents (males) 1	2	3	4
1	---	X_{12}	X_{13}	X_{14}
2	X_{21}	---	X_{23}	X_{24}
3	X_{31}	X_{32}	---	X_{34}
4	X_{41}	X_{42}	X_{43}	---

XING 2

Parents (females)	Parents (males) 1	2	3	4
5	X_{15}	X_{25}	X_{35}	X_{45}
6	X_{16}	X_{26}	X_{36}	X_{46}
7	X_{17}	X_{27}	X_{37}	X_{47}
8	X_{18}	X_{28}	X_{38}	X_{48}

a. Xing 2 is typical of what type of Mating Design?

b. Xing 1 is best described as a
   i. Two factor mating design
   ii. One factor mating design
   iii. Three factor mating design

c. Which of these designs is most appropriate if estimating genetic variances (Vg, Vd and Va) is your ONLY objective? Please explain the logic of your choice.

6. The selection environment is critical because if affects the performance of the individual and consequently what is advanced to the next generation. Given this fact is it critical to know what happens to genetic variance and heritability estimates in different environment. Based on experimental data in the literature, answer the following questions (6)

a. Genetic variation is typically _____ in stress environments than that observed in the same population in non-stress environments (circle one)
   i. reduced
   ii. increased
   iii. unchanged
   iv. dependent on other factors

b. Error variation is typically _____ in stress environments than that observed in the same population in non-stress environments (circle one)
   i. reduced
   ii. increased
   iii. unchanged
   iv. dependent on other factors

c. Heritability estimates for yield are usually highest in what type of environment?
   i. Stress
   ii. Non-stress
   iii. Generalizations cannot be made.

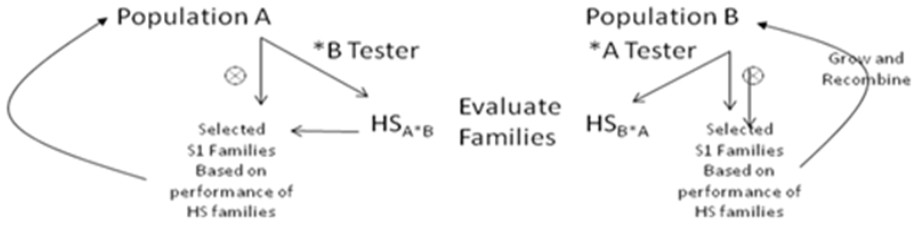
7. The schematics describe three different population improvement schemes. Answer the questions below regarding these population improvement approaches (8).
    a. Schematic A is an example of what type of recurrent selection program?
        i. Half Sib Interpopulation Improvement
        ii. Full Sib Interpopulation Improvement
        iii. Mass Selection
        iv. Half Sib Intrapopulation Improvement
        v. Full Sib Intrapopulation Improvement
        vi. S1 Intrapopulation Improvement

    b. Schematic B is an example of what type of recurrent selection program?
        i. Half Sib Interpopulation Improvement
        ii. Full Sib Interpopulation Improvement
        iii. Mass Selection
        iv. Half Sib Intrapopulation Improvement
        v. Full Sib Intrapopulation Improvement
        vi. S1 Intrapopulation Improvement

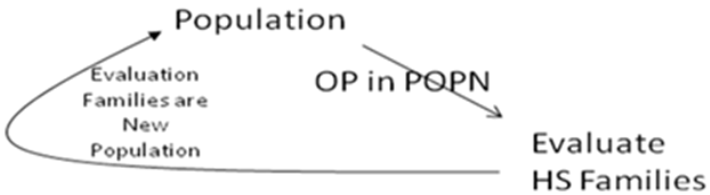
    c. Schematic C is an example of what type of recurrent selection program?
        i. Half Sib Interpopulation Improvement
        ii. Full Sib Interpopulation Improvement
        iii. S2 Intrapopulation Improvement
        iv. Half Sib Intrapopulation Improvement
        v. Full Sib Intrapopulation Improvement
        vi. S1 Intrapopulation Improvement

    d. When comparing Schematic B and C, which has the greater parent control (c-value)?

A.



B.



C.

8. List four assumptions that are made when utilizing the principles of Hardy-Weinberg Equilibrium (4)

9. Germplasm from two soybean breeding programs were characterized for yield, agronomic, and quality traits and the following data were generated. (6)

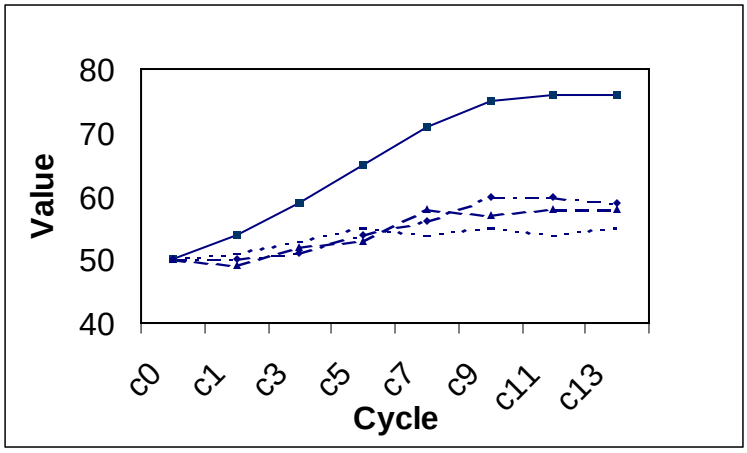
Trait	Set 1	Set 2
Mean Yield	35 bu/acre	65 bu/acre
Genetic Variation (yield)	40	10
Notes	Wide variation from elite exotic material	Highly elite material with little exotic germplasm

   a. Assume that you are working for a private company whose goal is to sell soybean cultivars. Which of these germplasm sets would you prefer to use as your base population? Justify your decision.

   b. Assume that you are working for the USDA-ARS as a soybean geneticist. In this situation, would you choose either of these germplasm sets or would you prefer to find other sources of germplasm?

   c. Is there any other information that would be useful to have prior to making this decision?

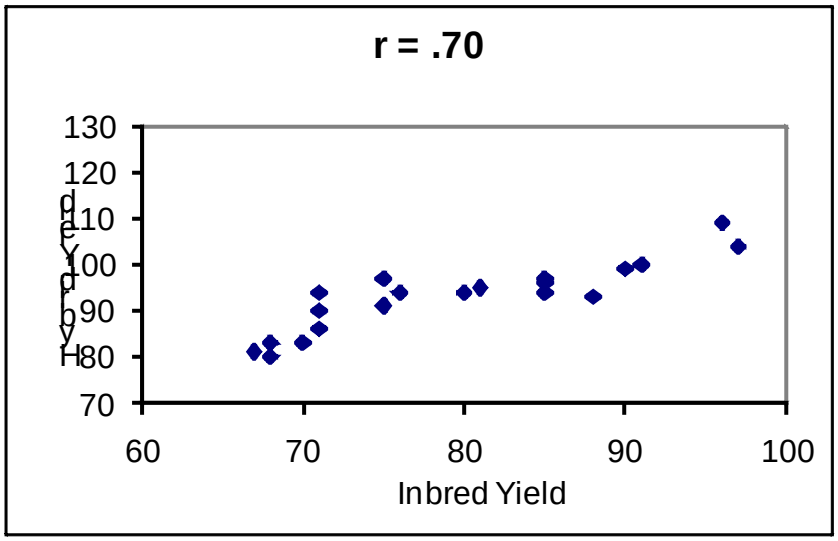
10. A single population was randomly divided into four smaller populations (designated A,B,C,D), and these populations were subjected to improvement over a twenty year period. At the end of the twenty years, individual cycles of the each method were evaluated to compare gain per year for each population. The graph below depicts the gain over years for the smaller populations. Answer the questions listed below the graph. Remember to think in terms of the gain from selection formula. (12)



a. List <u>three</u> factors that could account for the differences in response seen between the four "sub"-populations?

b. What could cause the lack of response that was seen in groups B, C, D? (List <u>three</u> factors.)

11. A large multinational crop improvement company that has plant improvement programs for many different crop species has hired you. The company has developed technology making it possible to economically produce hybrids in wheat. They have hired you to start and develop the hybrid testing program. The first question that you must address is how many of the developed lines must be evaluated in testcross combinations. If possible, they would like to eliminate as many poor lines prior to testcrossing to reduce the number of testcross hybrids. As an experienced plant breeder, you wonder if this is a wise choice, so you conduct an experiment to determine the relationship between inbred yield and hybrid yield. You obtain the following data. (8):



a. Based on the data, would you recommend selecting inbreds for hybrid testing based on inbred line yield? Justify your decision.

b. Based on the data, can you make any inferences regarding the value of heterosis, and the relative importance of additive and dominant gene action in this population? If so, what are they? If not, why not?

12. Answer the following questions pertaining to genetic variation and crop improvement. (12)

    a. Plant breeders know that variation is crucial to future improvement. In theory effective selection will reduce genetic variation in a breeding population. However, long-term selection experiments indicate that genetic variation is not diminished to the level expected in theoretical models. What are <u>three</u> possible explanations for the continued presence of genetic variation?

    b. While genetic variation has certainly not been exhausted, the rate of genetic improvement in the yield of our major crops has been reduced. What are <u>three</u> possible explanations for this trend?