Fusarium vs. Soybean

Gensata, a company which produces soybean seed for commercial sale in Nebraska, is responding to the migration of Sudden Death Syndrome (SDS) into Nebraska soybean fields. An infestation of SDS is feared – which could prove disastrous for the crop industry. While yield losses vary throughout a field, it is not uncommon to see 20 to 60% yield loss in a field; loss of up to 100% has been seen in isolated areas. The company is responding to customers concerns by increasing the research and development budget to produce a variety that is resistant to SDS.

SDS is caused by a soil borne fungi – Fusarium virguliforme. SDS was first discovered in Arkansas in 1971 and has slowly been expanding its reach. Farmers generally don't notice symptoms until after the beginning of flowering. They also notice more loss in areas where the soil is wet.

- **Economic impact**
  - Average soybeans yield in NE in 2011: *41.8 bushels/acre*
  - Average yield loss due to SDS: *40%*
  - Average acres soybeans planted in NE, 2012: *5.05 million acres*
  - Estimated number of fields effected in IA, 2011: *50%*
  - Price per bushel of soybeans, 2012: *$12.60*
- **Biological cause**
  - SDS is caused by the soilborne fungus *Fusarium solani* f. sp. *glycines*, synonym: *Fusarium virguliforme*.
- **Environmental factors**
  - SDS is most severe when soybean is planted early into cool, wet soils and when heavy midsummer rains saturate the soil.
- **Symptoms**

  Early symptoms: diffuse chlorotic mottling, crinkling of the leaves (Figure 1).

  Later symptoms: leaf tissue between the major veins turns yellow, then dies and turns brown, leaflets die and shrivel.
- **Diagnosis**
  - Roots will gave a blue coloration on the roots. When split, the lower stem and taproot of a plant infected with SDS will exhibit a slightly tan to light brown discoloration compared to a healthy plant. The pith will remain white or slightly cream-colored (Figure 2).

Figure 1

Figure 2

Biotechnology Team Activity Chapter Name _____

Team Members _____

Your team is a group of plant breeders trying to make advancements in a soybean variety resistant to Sudden Death Syndrome (SDS). Use the information provided, and your knowledge of plant breeding, to explain your plan for breeding a variety of soybeans with resistance to SDS.

1. Goal

The migration of SDS into states surrounding Nebraska has created a market for a SDS resistant variety of soybeans. Your team will create a plan for creating a soybean parent line that is resistant to SDS and is an improvement of Gensata 315. In addition to SDS resistance, it is also important that the variety have a light seed coat.

2. Starting Point

The breeder has three varieties of soybeans as shown below. Gensata 315 is the best-selling variety in Nebraska – best-selling because it has proven to yield well in Nebraska fields. AR11 SDS/SCN and AR10SDS are germplasm lines (varieties that farmers do not grow but have important genes which the breeders wish to utilize). Remember the F1 seed is planted and it self-pollinates; the F2 seed is planted and it self-pollinates, etc. Short plants would be preferred, as it eliminates the need for progeny testing.

Soybean Germplasm Sources Table:

LINE		Seed Coat EE and Ee dark ee light	Growth Habit DD and Dd tall dd short	SDS Resistance RR and Rr partial resistance rr susceptible
AR11SDS/SCN	(EEddRR)	EE	dd	RR
AR10SDS	(eeDDRR)	ee	DD	RR
Gensata 315	(eeddrr)	ee	dd	rr

Your team will decide which of these lines you will use to start your breeding plan.

Contest requirements:

3. Multi- Generation Breeding Plan

Outline on the sheet the first three generations of your breeding plan. Start with the two parents you selected, based on your goal, and use the diagrams to predict how the parent genes will be passed on to their offspring in each generation. Indicate the final genotype you want to select. Identify the two routes for determining whether we have true breeding homozygotes – selecting plants that have the final select homozygotes genotype you are looking for?

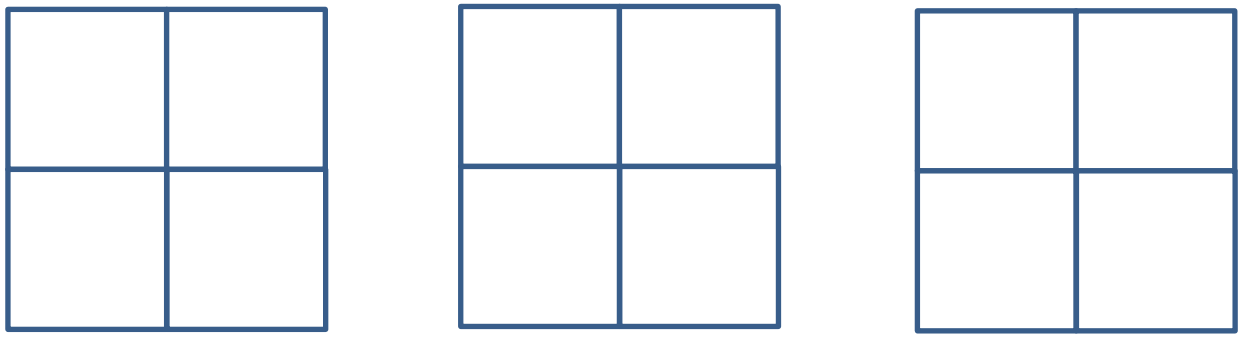
4. Genetic Engineering Plan

Traditional plant breeding is not working – but a resistance to the fungus which causes SDS has been found in another organism. List the steps to create a genetically engineered plant.

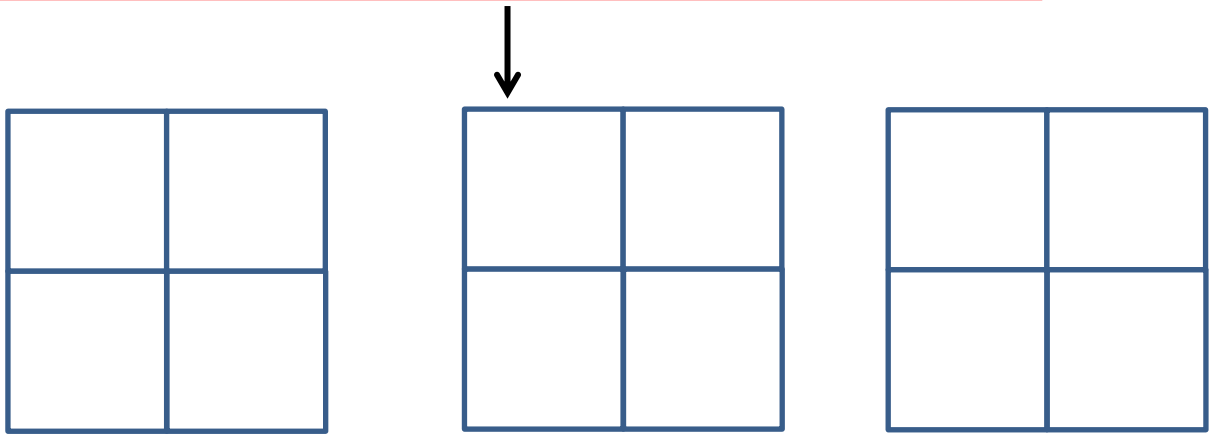
3. Breeding Plan (parent to F2 or F3 generation)

Parent Generation: Cross _____ X _____

F1 Generation



F1 to F2 Generation: Cross _____ X _____



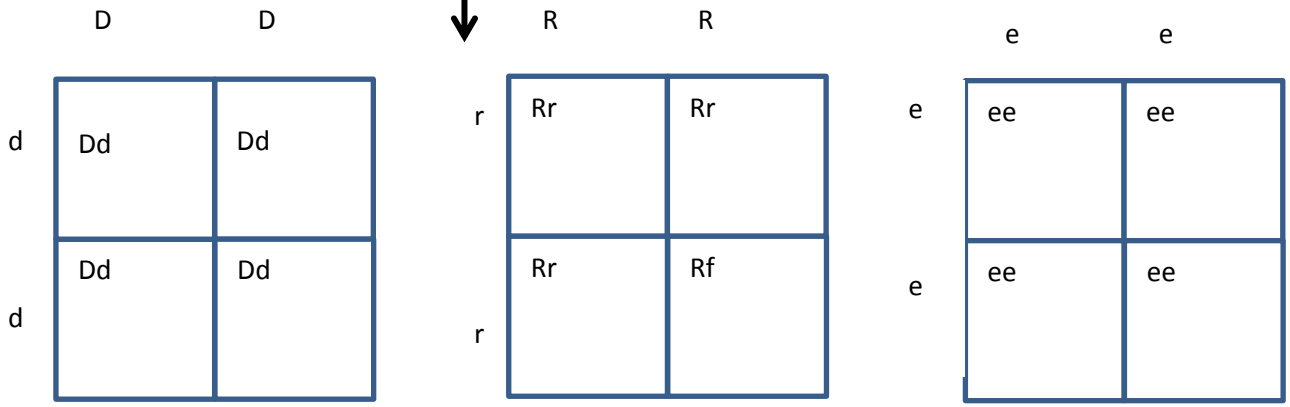
F2 to F3 Generation: Selected F2: _____

Identify 2 ways to identify true breeding homozygotes: _____

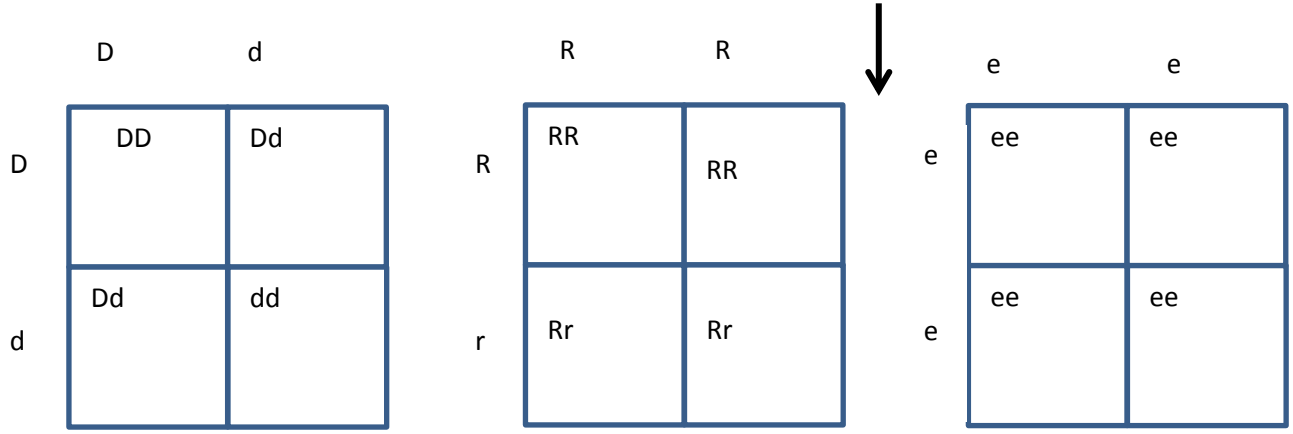
_____

Parent Generation: Cross __eeDDRR____ X _____eeddrr_____

F1 Generation



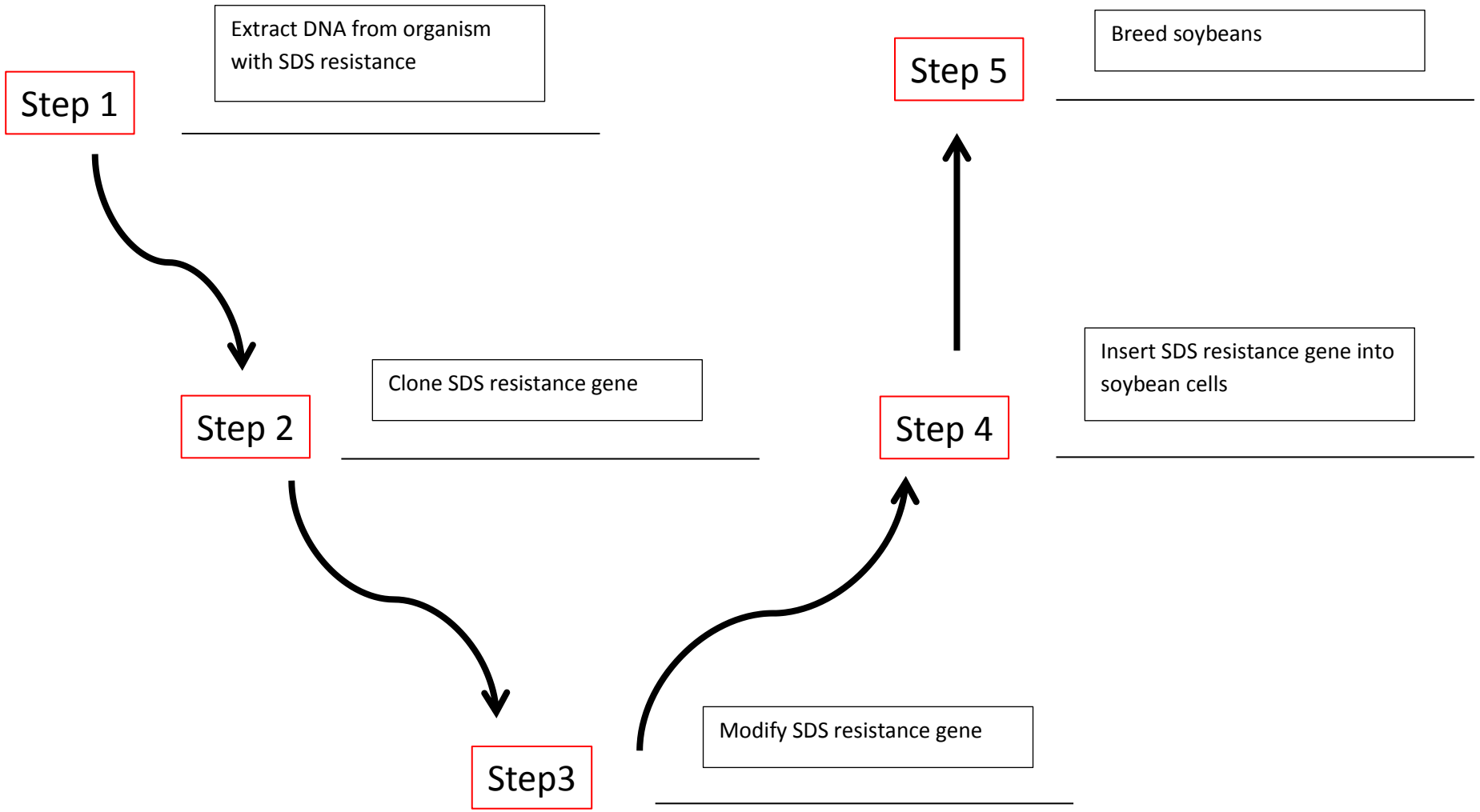
F1 to F2 Generation: Cross __eeDdRr____ X ___eeDdRr_____



F2 to F3 Generation: Selected F2: __eeddRR____

Identify 2 ways to identify true breeding homozygotes: _____1. Self pollinate F3s to select homozygous rows 2. DNEA test for DD and RR_____

4. Future Genetic Engineering Plan - **KEY**



4. Future Genetic Engineering Plan