Fusing the cells of two plant species

It would be nice if botanists could grow a plant that has the hardiness of crabgrass, needs no more water than a cactus, produces fruit with the texture of an apple and the flavor of an orange and has edible roots. But in practice it hasn't been possible. Most attempts to cross different species of plants or animals yield sterile offspring, if any. Thus a horse and an ass can be crossed to produce a mule, but the mule cannot reproduce.

Now researchers at Brookhaven National Laboratory have developed a new method of producing hybrids that bypasses the normal barriers to reproduction between different species. Peter S. Carlson, Harold H. Smith and Rosemarie D. Dearing have grown a mature hybrid plant from fused genetic cells of two species of tobacco. The method thus bypasses sexual reproduction, and its restrictions, altogether.

The biologists isolated cells from leaves of the two species and removed the cellulose walls surrounding the cells by exposing them to enzymes capable of digesting cellulose. Some of the wall-less cells (protoplasts) were then fused by simple chemical manipulations to form new self-reproducing cells that contained an entirely new set of genetic characteristics. Protoplasts had been previously fused by researchers in England, but they remained as cells.

The Brookhaven biologists then placed the fused cells in a regenerative culture medium that would support the growth of only those fused cells containing the genetic information for the desired hybrid. When the fused cells grew into colonies they were removed from the regenerative medium and placed in another medium where the hybrid developed rudimentary shoots and leaves. The final step was to graft these shoots onto freshly cut stems of one of the parent plants where they grew into fertile, mature plants. The hybrid produced by this method, called parasexual hybridization, was identical to a hybrid produced by conventional methods from the same two species, except that the new hybrid is fertile and can reproduce to begin a whole new species of tobacco.

The researchers point out that parasexual hybridization could have an enormous effect on agriculture because it would permit crossbreeding between widely divergent plant species to produce entirely new crops. Existing species could also be modified by this method to give them higher yield or resistance to disease.

It will be a while before parasexual hybridization can actually be practiced, as the method requires more development. But "the remaining problems are technical rather than theoretical," says Carlson. "We know what can be done using a model system. Now the crucial task is to characterize the special requirements of the individual species and hybrid desired from parasexual reproduction." The method may eventually be applied to mammals, but that, notes Carlson, would be much more complicated and lies far in the future. □

Brookhaven National Laboratory

Carlson, Dearing, Smith: Parasexual hybridization with two tobacco species.

Particulate emissions: Many unsolved problems

State, Federal and local pollution-abatement officials—as well as industry—have tended to see the problem of particulate air pollution in an oversimplified way. If a utility removes 90 percent of the particles from the gas coming from its stacks, it views its accomplishment as a solid 90 percent gain in particulate abatement. A new National Academy of Engineering report points out that particulate pollution is far too complicated to allow such gross measurements to be meaningful all by themselves.

For instance, the report, issued late last week, says: " . . . Collection efficiencies [of abatement devices] for the finest particles, which play a key role in air-pollution effects, are significantly less than for larger particles." With certain fibrous filters used as industrial particle collectors, the lowest collection efficiency occurs when particles are 0.1 to 1.0 micron in size, a range "which is particularly important . . . with respect to visibility, health effects and weather modification."

Although the report calls the inability of many industrial particle-collection systems to capture these smaller particles the single most serious problem, it mentions a number of other difficulties and complexities. One obvious one is the chemical and physical makeup of particles released into the air. Some particles are far more harmful than others. "There is a pressing need for detailed physical and chemical information on the nature of particulate emissions from various sources." Of special importance are hazardous trace metals and organic compounds, says the report.

Another problem is the difference between the claimed efficiency of collection devices and their real efficiency. Electrostatic precipitators give an electric charge to particles, then collect them by attracting them to an electrode with an opposite charge. They are generally regarded as the most efficient collection devices. But the precipitators are subject to many difficulties. For instance, low-sulfur coal, desirable for abatement of sulfur oxides, decreases their efficiency. And the charging wires in the precipitators tend to break because of vibration. Says the report with regard to these problems: ". . . Reported emissions may understate the true average because they are often measured only on the best of newest units operating under optimum conditions."

A final problem is the one of "secondary particulates" formed from gases after the gases have entered the air. In some cities, such as Los Angeles, secondary particles make up the largest percentage of all particulates, and scientists are learning more about their formation. For instance, photochemical smog reacts with sulfur dioxide to form sulfuric acid, which in turn reacts with ammonia to form ammonium