color to the images. The color could be manipulated in green, yellow, blue, and red for line color. The background color could be changed into a wide range of hues which also altered the color of the image into subtle variations.

Applications of this program in computer-aided education include the use of programs such as **PC Crayon** as a tool which enables students to perceive and create graphic images with ease and clarity. The user can make a mistake and correct it without the time-consuming efforts of the traditional method of graphic illustration. Therefore, the student can be bold and run through a range of learning experiences without tightening up with fear of making a time-consuming mistake. This program might also help the student to produce better graphics at the drawing board. The perception of space, line, color, form, and texture can be improved through observation and mental manipulation of the electronic keyboard.

MicroCad was utilized for 3-D graphic design. This program allows images to be created in three dimensions and it can create them in different scales, perspective views, and rotation. Unfortunately, the lab is not yet equipped with a digitizer and plotter which would make the instruction of this important aspect of graphic design much more interesting and accessible to students.

Conclusion

Micro-computer Education in Landscape Architecture Design/Build Practice was well-received by the students. They showed more enthusiasm in learning this subject matter in a technological format than they might otherwise. One word of caution for the future management of a lab of this nature is that the size of the lab should be kept small with no more than ten students to one instructor. Since there are always students who learn more quickly than others, some students inevitably fall behind. A small class gives each student an equitable amount of the instructor's time.

Computer-aided education is quickly becoming a reality. Educators must join together to make the transition into the computer age a smooth one. Incoming students will be much more adept at computer application as the years advance. Therefore, it is equally important that we as educators keep abreast of advancements in computer technology. Landscape architecture curricula will eventually adapt micro-computer technology to their teaching programs. Teaching methodologies which not only expose students to current technologies but also develop necessary project and business management skills through efficient application of the microcomputer prepare students to meet the increasing demands of the workplace in the new electronic age.

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Overcoming Animal Breeding Teaching Problems

John P. Carlson

Animal breeding education has some unique problems in comparison to other areas of animal science, such as reproduction and nutrition. Probably the largest is the time factor involved. Genetic progress can be easily characterized as progress made in small amounts per time unit, yet having a large cumulative effect. While the addition of a feed antibiotic may show large, positive results within a few days, a 2-lb. per year increase in adjusted 205-day cattle weights is not as easily seen. A major difference, though, is that the fed antibiotic has done its good; a higher level will not likely improve results. Thus, progress will not continue upwards but can only stay the same or possibly go down if the antibiotic is withdrawn. Genetic progress, however, continues if proper selection procedures are followed. So genetic selection can easily be more economically beneficial. But a semester of class-room work is hardly sufficient time for a noticeable difference to occur, and charts with progress plotted by year or generation generally create little student enthusiasm.

Another problem arises in applying the classroom principles to real-life situations. A standard homework sheet with a listing of lamb tag numbers and the necessary information needed to calculate adjusted 90-day weights teaches the methodology. Lambs can be weighed in an on-farm laboratory setting, but by the time the calculations are completed, the lamb is out of view and little remains but a number. In both problems, the animal itself is removed from the mind. If the students are directed to select the ten top ewe lambs, simple mathematics places the winners. Little thought goes into herd continuity or complementation; the students are not forced to make real-life decisions. Unfortunately, most livestock evaluation courses, where the animals are more closely observed and scrutinized, use groups of four and contain no production data. No ancestors or progeny are viewed.

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Computer Simulation

To alleviate these problems to at least some extent, two techniques have been used successfully at Western Illinois University during the past three years with positive student course evaluations. One is the use in the animal breeding class of a swine herd simulated on a microcomputer, using a program written by the author. Each student is assigned an individual "herd" disk and can check out the program disk to produce a new generation of pigs.

Only one trait is used--days required to reach 230 pounds. As the purpose of the program is to show how much genetic progress can be made, introducing more traits would only reduce the amount of progress in any single trait and thus the main objective would be lost. Each student is initially assigned a herd of 30 gilts and 10 boars. The herd is unique to the student due to a random number generator. The days to 230 pounds response is randomly provided for each animal with a mean of 180 days. From the initial animals, the student must select 20 females to be bred to from one to five boars. From each mating zero to ten gilt offspring are produced per litter, with their days to 230 pounds listed. For matings in subsequent generations, a total of 20 females must again be chosen, but can be chosen from any of the sows used to produce the current generation or any gilts produced. Females not used are dropped from the herd disk and cannot be used later. On the male side, boars not used are dropped from the program. However, if n boars are used, then (10-n) new boars are created so that the selection of from one to five boars is again from a total of ten possibilities. Each new boar has a days to 230 pounds figure. While proven boars also retain this information, a progeny value is calculated which is the average deviation of the boar's progeny from their contemporaries. Accuracy of selection figures are provided on all boars.

After completing ten generations (corresponding to 15-20 years of selection in an actual herd), the students are required to plot the generation means and write a summary paper covering both what they feel they learned and an analysis of their progress. Through this teaching tool, the time gap involved in making selection progress is bridged.

Real-World Selection

Beyond the animal breeding class, students may elect to take the livestock evaluation class. While approximately half of the class sessions are allotted to judging classes of four with the intent of developing a judging team for various contests, the other half of the class sessions are designed to place the students in real-life selection situations. The same procedure is basically followed for cattle, sheep, and swine. Each student is first given a set of data from the university's cow or sow herd or sheep flock to process in the microcomputer. Adjusted 205-day and yearling weights are used for the cattle. Swine data includes the sow productivity index, days to 230 pounds and average backfat. For sheep, number of lambs per lambing and adjusted 90-day weights are provided. Thus, lifetime production figures are available on mature females and current available data is processed for potential female replacements. Both groups of animals for all three species are then visually appraised with the data in hand. From the combination of production data and visual observation, the students decide which mature females should be kept or culled, and which younger females should replace them.

Originally, the students were assigned a certain number of mature females to cull and an established number of replacement females to keep. However, it soon became apparent that the numbers set by the instructor were larger than some students desired, yet smaller than what others wished. Currently, students are allowed to cull as many mature females as they desire and to retain that same number of younger replacements, plus two to account for the usual lower conception rate of younger animals.

After making their decisions on the females, the beef, swine, and sheep evaluation stations at WIU are utilitzed for the selection of males. Central test performance records and visual appraisal are again combined. It is critical that the females first be appraised. Without knowing the strong and weak points of the females, selection of the males becomes less meaningful. Points can be made regarding the direction the herd or flock is heading. Overall weaknesses of that group can also be seen. Because producers normally select males based on what females they already possess, the order of male versus female selection is important.

Another variable for consideration is that the sheep flock is a purebred flock while the beef and swine herds are commercial herds. Thus, for sheep, the ancestry and progeny of each animal as well as lines within the herd become important.

After the students' decisions are made on a particular species, they individually confer with the instructor. Each animal and its role in the breeding program are discussed, with justification presented for each decision. Thus at the conclusion the student has been forced into a rather realistic situation combining decision-making, production records and visual appraisal.

Summary

Teaching the theory and practices involved in animal breeding and genetics often leaves behind the animals and the "real-world" decisions that must be made. Simulated breeding programs can help reduce this problem by providing the results of a lifetime in a few hours. And the future uses of such programs appear bright due to the increased interest in and ussage of microcomputers. Coupled with this, however, the student must be placed in as actual a situation as possible. Only then do uses of classroom instruction become distinctively clear.