duced in the world each year were dumped in the oceans and there was no breakdown, it would take over 9,000 years to reach 1 part per billion of DDT in the oceans.

Do not misunderstand me. The extinction of any of our species is to be avoided if at all possible. However, the gradual extinctions of a species will hardly cause a ripple in the living world, so rapidly is the function it served taken over by others. I value, just as much as anyone, the California Condor, the whooping crane, the osprey, the grizzly bear and other endangered species, for these are cherished by me as a biologist. But I also recognize that the passing of the relatively few individuals, which make up these populations and have been declining for years, will have no significant impact on the environment.

In summary, man must manipulate the environment to survive. His survival will carry with it the survival of most plant and animal species. In fact, by his interest in wildlife, he will undoubtedly prolong the existence of species that nature would otherwise have eliminated. He will significantly enhance the population of species that are of economic value to him.

On the other hand, man must deliberately attempt to minimize the competition from pests that endanger his food supply or health.

The changes he institutes to survive will inadvertently affect some species. In this regard, man is no harsher an administrator of the environment than "nature", which is totally indifferent to the immediate present, or the welfare of any particular species. What is farming, but an attempt to shift nature in a direction that will help feed and clothe man. I cannot help but feel that there are more efficient ways of producing protein than buffalo grazing on prairie grass and carbohydrates from grains and berries growing wild.

Let me close by reading a short essay written by Dr. John Carew:

In Balance With Nature by Dr. John Carew **

In the beginning there was earth; beautiful and wild; and then man came to dwell.

At first, he lived like other animals feeding himself on creatures and plants around him. And this was called in balance with nature.

Soon man multiplied. He grew tired of ceaseless hunting for food; he built homes and villages. Wild plants and animals were domesticated.

Some men became farmers so that others might become industrialists, artists, or doctors. And this was called society.

Man and society progressed. With his God-given ingenuity, man learned to feed, clothe, protect, and transport himself more efficiently so he might enjoy life. He built cars, houses on top of each other, and nylon. And life was more enjoyable.

The men called farmers became efficient. A single farmer grew food for over 40 industrialists, artists, and doctors, and writers, engineers, and teachers as well.

To protect his crops and animals, the farmer used substances to repel or destroy insects, diseases, and weeds. These were called pesticides.

Similar substances were made by doctors to protect humans. These were called medicines.

The age of science had arrived and with it came better diet and longer, happier lives for more members of society. Soon it came to pass that certain well-fed members of society disapproved of the farmer using science.

They spoke harshly of his techniques for feeding, protecting, and preserving plants and animals. They deplored his upsetting the balance of nature; they longed for the good old days. And this had emotional appeal to the rest of society.

By this time farmers had become so efficient, society gave them a new title: unimportant minority.

Because society could not ever imagine a shortage of food, laws were passed abolishing pesticides, fertilizers, and food preservaties.

Insects, diseases, and weeds flourished. Crops and animals died. Food became scarce.

To survive, industrialists, artists and doctors were forced to grow their own food. They were not very efficient.

People and governments fought wars to gain more agricultural land. Millions of people were exterminated. The remaining few lived like animals, feeding themselves on creatures and plants around them, and this was called in balance with nature.

**In Balance With Nature is included as a part of this speech with permission from Dr. Carew. It first appeared in print in the American Vegetable Grower.

Population Supporting Potentials of Agricultural Systems

Gilbert Lindstrom
Instructor in Agriculture and Agri-Business, Northeastern Junior College

Ecology includes a study of the interaction of populations. Food is the primary basic need of a population for survival and development. The ultimate size of a population depends primarily on its food supply. Agriculture is the primary basic producer of food for the highest kind of population, man.

Our objectives in agriculture must focus on production of an adequate supply of food, both in terms of quantity or total calorie intake and in quality which includes such factors as protein, vitamin and mineral contents of the food. The quantity of food per capita of population depends on the food producing area per capita and the yield of consumable calories per unit area. Of these the yield of calories per unit of land area is most important. To illustrate this, before 1700 the continental United States produced only enough consumable calories to supply an estimated one to two million Indians with levels of food which periodically left them in famine. Today this land produces enough food for 200 million people at a level never previously enjoyed by any people in addition to vast quantities for export and a surplus.

Total yield of calories per acre depends on two factors: (1) the yield of the crop per acre and (2) the inherent efficiency of the crop or crop-livestock system in converting energy to consumable calories. Many crops will convert sunlight, CO_2, H_2O, and minerals directly into products for human consumption. Examples of these include potatoes, rice, fruits, and vegetables. Other crop products can be used directly as food or converted to food products through animals such as cereal grains. A third group of plants, which must be processed into food by animals, include forage crops, and pasture. In general those crops which produce consumable food tend to yield more food calories per acre than those which must be converted to food by livestock. However, livestock provides the only means whereby we can obtain food from much of our land area which is best adapted to pasture or forage crops.

The consumable calorie production per acre varies among crops. An estimate of this for various crop and livestock systems is shown by the calculations in Table 1. These estimates are based on good production levels on highly productive land and livestock systems that are well managed. Maximum production levels however are well above these levels but average production levels are well below these levels. Of the systems shown, the calorie production per acre varies from 400,000 to 12 million calories per acre, a 30 fold difference.

The average consumption of calories per person in two areas of the world is shown in Table 2. As indicated the total calories consumed per person per day by the North Americans is about 50% greater than that consumed by the average Oriental. The quality of the diet differs even more as indicated by an eight-fold greater consumption of animal protein by the North American than by the Oriental.

Table 3 relates the calorie and diet quality difference between the Oriental and North American to the amount of land required to produce a yearly supply of calories per person. To simplify calculations the diet composition is only an estimate. Using these values, the basic production of 1.23 acres of highly productive land would provide the calories for consumption of one North American whereas the same production potential would provide the diet for nearly nine Orientals.

These calculations indicate the following conclusions:

1. The basic agricultural production of a country in terms of calories per person determines the caloric intake per capita in addition to the quantity and type of animal products that will be available per capita.
2. Gross inequalities exist in the basic productivity per capita in different areas of the world. The basic production has more influence on the

quality of the diet than it does on total calorie intake.

3. Adequate calorie production per person can be maintained on much less productive area than is done at present in certain world areas. Thus, the population can increase from a food supply standpoint but this will necessitate a shift in the diet. Table 3 indicates that a shift in the basic diet of the average North American from what we now enjoy to that of the average Oriental would allow roughly nine times our present population in the United States or about 1.8 billion people providing this population increase did not decrease our basic producing land area or, in other words, the United States could feed one-half the present world population a subsistence diet with present production. An adequate diet quality can be maintained if items of high production efficiency such as milk or soybeans are used as a primary protein supply.

4. Luxury foods are produced to utilize excess caloric production in calorie rich areas of the world such as the United States. The United States is the only country in the history of the world that has had enough basic productivity to divert major amounts of cereal grains to fatten livestock in sufficient quantity to provide substantial levels for consumption by the common working class of people.

5. Developing areas of the world need to place emphasis on the production of efficient converters of sunlight to calories that are consumable by man.

References

1. Nutritive Value of Foods. USDA Home & Garden Bulletin No. 72, U.S. Government Printing Office, Washington, D.C. 1964
2. McVickar, M. H., Fertilizer Technology and Usage, Page 2. Soil Science, Soc. Am., Madison 11, Wisconsin 1963

Table 1. Comparative Productive Capability of Agricultural Crops [1]

POTATOES

$$\frac{\text{Cal.}}{\text{A}} = 450\ \text{bags/A} \times 100\ \text{lb/bag} \times 3\ \text{potatoes/lb} \times 90\ \text{cal/potato} = 1.2 \times 10^7\ \text{cal/A}$$

RICE

$$\frac{\text{Cal.}}{\text{A}} = \frac{185\ \text{cal.}}{168\ \text{gm cooked}} \times \frac{3\ \text{gm cooked}}{1\ \text{gm dry}} \times \frac{454\ \text{gm}}{\text{lb}} \times \frac{3500\ \text{lb}}{\text{A}} = 5.25 \times 10^6\ \text{cal/A}$$

SWEET CORN

$$\frac{\text{Cal.}}{\text{A}} = \frac{70\ \text{cal.}}{\text{ear}} \times \frac{1.5\ \text{ear}}{\text{stalk}} \times \frac{25{,}000\ \text{stalks}}{\text{A}} = 2.63 \times 10^6\ \text{cal/A}$$

CABBAGE

$$\frac{\text{Cal.}}{\text{A}} = \frac{35\ \text{cal.}}{100\ \text{gm raw}} \times \frac{454\ \text{gm}}{\text{lb}} \times \frac{40{,}000\ \text{lb}}{\text{A}} = 6.4 \times 10^6\ \text{cal/A}$$

SUGAR BEETS

$$\frac{\text{Cal.}}{\text{A}} = \frac{770\ \text{cal.}}{200\ \text{gm sugar}} \times \frac{0.14\ \text{gm sugar}}{1\ \text{gm beets}} \times \frac{454\ \text{gm beets}}{\text{lb}} \times \frac{2000\ \text{lb}}{\text{T}} \times \frac{17\text{T}}{\text{A}} = 8.4 \times 10^6$$

MILK PRODUCED FROM CORN SILAGE

$$\frac{\text{Cal.}}{\text{A}} = \frac{160\ \text{cal. 3.5\% milk}}{\text{cup}} \times \frac{16\ \text{cup}}{\text{gal.}} \times \frac{6\ \text{gal.}}{\text{cow} \times \text{day}} \times \frac{\text{cow} \times \text{day}}{25\ \text{lb TDN}} \times \frac{.21\ \text{lb. TDN}}{\text{lb. corn silage}} \times \frac{2000\ \text{lb corn silage}}{\text{T}} \times \frac{20\text{T}}{\text{A}} = 5.17 \times 10^6$$

BEEF PRODUCED FROM CORN SILAGE

$$\frac{\text{Cal.}}{\text{A}} = \frac{250\ \text{cal.}}{85\ \text{gm}} \times \frac{454\ \text{gm}}{\text{lb}} \times \frac{0.5\ \text{lb meat}}{\text{lb carcass}} \times \frac{620\ \text{lb carcass}}{1000\ \text{lb steer}} \times \frac{\text{lb steer}}{8.3\ \text{lb TDN}} \times \frac{0.21\ \text{lb TDN}}{\text{lb corn silage}} \times \frac{2000\ \text{lb corn silage}}{\text{T}} \times \frac{20\ \text{T}}{\text{A}} = 4.16 \times 10^5\ \text{cal/A}$$

Table 2. Calorie intake by peoples of Far East and North America

	Calories/ Capita/ Day	Calories/ Capita/ Year	Total protein g/capita/day	Animal protein g/capita/day
Far East	2070	7.62×10^5	56	8
North America	3120	1.14×10^6	93	66

Table 3. Productive Area Requirement Per Person

Diet Component	% Composition	Yearly Consumption/person	Calorie production/A	Acres required per person
Oriental 7.6×10^5 calories/year				
Rice	50	3.8×10^5 cal.	5.2×10^6	.073
Cabbage	30	2.3×10^5 cal.	6.4×10^6	.036
Milk	20	1.5×10^5 cal.	5.2×10^6	.029
				.138A
North American 1.14×10^6 calories/year				
Beef	40	4.5×10^5 cal.	4.2×10^5	1.07
Potatoes	30	3.4×10^5 cal.	1.2×10^7	.03
Sweet Corn	30	3.4×10^5 cal.	2.6×10^6	.13
				1.23A

MUTANTS OF MAIZE TEACHING EXAMPLES[1]

V. E. Youngman, D. E. Green, and L. H. Smith [2]

The maize plant (Zea mays L.) is of American origin and an important food, feed, and industrial crop. Many fundamental principles of genetics have been established or substantiated with maize. While some of these characters are useful only as genetic markers, other mutants form the basis for improvement of the crop. Examples of useful mutants include the endosperm mutant for high lysine content, the cytoplasmic male-sterility and restorer system for hybrid seed production, and the high amylose and waxy mutants forming the basis of new industrial products from maize starch.

Neuffer, Jones, and Zuber (1968) authored the book Mutants of Maize,[3] in which pictures of the mutants were shown in color for various seed and plant characters. The purpose of this paper is to point out the possible use of selected mutants as well as the book in the classroom and/or laboratory of courses in the biological sciences.

The following mutants are suggested to demonstrate selected genetic principles.[4] Each character is listed with descriptive name, gene symbol, numerical order of gene position on the linkage map beginning with the end of the short arm of each chromosome, and chromosome location. For example, the glossy gene is located 36 units from the end of the short arm on Chromosome 7.

1. 3:1 ratio
   A. GLOSSY - gl_1 - 36 - Chromosome 7.
   B. VESTIGIAL GLUMES - Vg - 85 - Chromosome 1.
   C. SUGARY ENDOSPERM - su_1 - 71 - Chrosome 4.
2. 9:3:3:1 ratio
   ANTHOCYANINLESS - a_1 - 111 - Chromosome 3, and
   , SHRUNKEN ENDOSPERM - sh_1 - 29 - Chromosome 9.
3. 9:7 ratio
   ANTHOCYANINLESS - a_1 - 111 - Chromosome 3,
   ALEURONE COLOR - C - 26 - Chromosome 9, and
   ALEURONE AND PLANT COLOR - R^r - 57 - Chromosome 10.
4. Linkage
   SHRUNKEN - sh_2 - 111.2 - Chromosome 3, and
   AUTHOCYANINLESS - a_1 - 111 - Chromosome 3.
5. Xenia
   YELLOW ENDOSPERM - Y_1 - 17 - Chromosome 6.
6. Dosage effect
   A. COLORED ALEURONE - R_2 - 49 - Chromosome 2.
   B. COLORLESS ALEURONE - c_2 - 123 - Chromosome 4.
7. Pericarp effect
   PERICARP AND COB COLOR - P - 26 - Chromosome 1.

Summary

Maize mutants which may be useful in demonstrating certain genetic principles are suggested.

Literature Cited

Neuffer, M. G., Loring Jones, and Marcus S. Zuber. 1968. Mutants of Maize. Crop Science Society of America, Madison, Wisconsin. 74 pp.

1 Published with the approval of the Director of the Colorado State University Experiment Station as Scientific Series Paper No. 1659.

2 Associate Professor, Department of Agronomy, Colorado State University; Professor, Department of Agronomy, Iowa State University; and Professor, Department of Agronomy and Plant Genetics, University of Minnesota, respectively.

3 The book, Mutants of Maize, is available from the Crop Science Society of America, 677 S. Segoe Road, Madison, Wisconsin, 53711.

4 Germ plasm quantities of seed of these mutants are available from Dr. R. J. Lambert, Department of Agronomy, University of Illinois, Urbana, Illinois, 61803. The necessary stocks to maintain the mutant will also be provided. If one does not wish to grow his own plant materials, ears may be purchased from any of several leading biological supply houses.