TECHNOLOGIES FOR DEVELOPMENT

UNDERSTANDING MULTIPLE CROPPING

by
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UNDERSTANDING MULTIPLE CROPPING

By VITA Volunteer Dr. Glen M. Wood

I. INTRODUCTION

Multiple cropping, simply defined, is the growing of two or more crops on the same field during the same year. When the crops are grown one after another the term "sequential cropping" is applied. If the second or later crops are the result of regrowth of the first crop, then the term "ratoon cropping" is used. Sugar cane (*Saccharum* spp.), sorghum (*Sorghum* spp.), and even rice (*Oryza sativa* L.) can be ratoon cropped. Crops that produce no regrowth, as in the case of most annuals, cannot be ratoon cropped.

When two or more crops are grown simultaneously on the same plot of land the term "intercropping" is appropriate. Such crops may be mixed planted, that is, the plants of different crops are intermingled; or they may be sole (pure stand) planted in alternating rows, that is, the plants of each crop are grown in separate rows or strips (wide rows). When one crop is interplanted with a second crop as the first crop approaches maturity, the practice is termed "relay cropping." All of these cropping practices come under the general heading of multiple cropping.

All forms of multiple cropping have the potential to utilize the soil more efficiently, resulting in greater production from a given unit of land. This is especially true in tropical or subtropical areas of the world with wet and dry seasons. Where water for irrigation is available, exploitation of the abundant solar energy in the dry season is possible. Double, triple, and even quadruple cropping has dramatically increased food production in some countries—making them exporters instead of importers of food crops. Less dramatic increases can also result from other forms of multicropping. Beans (*Phaseolus vulgaris* L.), for example, can complete their life cycle in dry periods, if fertilized and relay planted in corn or maize (*Zea mays* L.) toward the end of the wet season.

The exploding world population continues to place a severe strain on existing land resources and their ability to provide enough food. Any technology that can result in increased food production from present land holdings has great potential for easing hunger.
around the world. Some researchers consider multiple cropping the most important of today's agricultural practices. Both high and low technology societies can profit from greater use of multiple cropping.

Multicropping is not a new agricultural technique. Evidence of the practice has been found in Egypt dating back to 300 B.C. The Maya Indians in Central America and the Incas in South America practiced both sequential and intercropping.

II. SYSTEMS OF MULTIPLE CROPPING

SEQUENTIAL CROPPING

Sequential cropping, to be used most effectively, requires the use of fertilizers, high yielding plant varieties, pest control, high planting rates, mechanization, and, where appropriate, irrigation. Sequential cropping of plants with relatively short growing seasons offers better total annual use of land than does a single crop system. It is particularly important to use the improved, early maturing, high yielding varieties. Unlike traditional varieties, these improved types do not lodge, or fall over to the ground, when heavily fertilized and also produce more grain per unit of fertilizer applied. Pest control, as well as irrigation and fertilizers, allows them to yield more nearly at their full potential.

Mechanization, or the use of appropriate mechanical equipment, allows the farmer to perform promptly all the operations of soil preparation—planting, pest control, and harvesting—so that the next crop in sequence is not delayed and a portion of the growing season wasted. In the United States and other more temperate regions of the world where growing seasons are shorter, no-tillage planting is widely used. With the use of specially designed equipment and early maturing varieties, crops can be planted in the stubble of a previous crop without any further soil preparation. This ensures a minimum of delay and full use of the available growing season. Leaving the stubble in place also minimizes water and wind erosion and affords protection for the newly emerging seedlings.

The use of day-neutral varieties—those not requiring a specific day length to flower and set seed—allows the farmer to grow them at any time of the year, regardless of latitude, if growing conditions are favorable. The availability of water for irrigation permits full use of the dry season.

Early maturing varieties may also suffer less damage from pests. As a general rule, the most serious crop loss due to weeds occurs
during the first third of the life cycle. An exception occurs where late maturing varieties compete better with barnyard grass (*Echinochloa crusgalli* L. Beauv.). Although crop rotation with different crops will generally result in better pest control, it may be feasible to rotate different varieties of the same crop having different disease and insect resistance and better ability to compete with weeds. Sometimes natural predators of pests (biological control) build up to more effective levels when same crop follows same crop. The buildup of the pests with continuous cropping is perhaps more likely to happen, however, and thus rotation with different crops is preferred.

**RATOOON CROPPING**

The principles involved in ratoon cropping, a form of sequential cropping, are different from other types of multiple cropping because of such factors as the presence of a well developed root system, earlier maturity, and the perennial nature of the plant. Although the term may be applied to perennial pasture plants, it is considered more appropriately used with respect to field crops such as sugar cane, sorghum, banana (*Musa sapientum*, *M. caven­dishii*), cotton, kodra millet (*Paspalum scrobiculatum*), pineapple (*Ananas comosa*), and rice.

The advantages of ratoon cropping include the following:

1. reduced cost of production through savings in land preparation and care for the plant;
2. reduced crop cycle: crop planted less often, so replanting cycle is longer;
3. better use of growing season;
4. higher yield per unit area in a given period of time;
5. less use of irrigation water and fertilizer than main (original) crop because of a shorter growing period; and
6. simple and effective way to provide windbreaks for vegetable production.

On the other hand, ratoon cropping has a number of drawbacks. These include:

1. later crops have lower yields than the first crop;
2. buildup of insect pests;
3. buildup of harmful weeds;
4. increased disease problems;
5. greater cost per unit produced;
6. where heavy equipment is used, the soil may become hard,
   causing poor drainage and lack of oxygen for roots;
7. loss of crop density (number of plants per unit of land);
   and
8. growth of volunteer seedlings inferior to sown variety.

INTERCROPPING

Intercropping requires only 60-80 percent of the land to equal
the production of monocropping systems. Traditional farmers in
many parts of the world have practiced intercropping in various
forms for many centuries. This form of multiple cropping, which
generally involves the growing of rain-fed crops in mixtures,
uses available resources and permits farmers to maintain low but
often adequate and relatively steady production.

Intercropping can take any of three forms—strip planting, row
planting, or mixed planting. The form chosen should be based on
crops grown and such factors as ease of planting, weeding, and
harvesting. Yields may also be affected. Intercropping is particu-
larly suited to those situations where labor is abundant and land
is not. If it is to be successful economically, the sum of the
competition of the interplanted species should be less than when
the species are grown alone. Crops of different maturities have
varying peak requirements for water, fertilizer, light, and
space. Thus, there may be less competition between different
crops than there is in a sole planting of identical plants.
Moreover, disease and insect infestation of intercropped plants
tends to be less. For example, virus diseases may spread more
easily through adjacent plants than to those separated by unlike,
and frequently non-susceptible, neighboring plants. Insects that
spread disease are also thwarted or at least slowed. Insects
tend to be less attracted to plants that are intermingled with
other species than to those in solid stands of the same species.

Interplanting of some crop species, however, may be harmful
because of allelopathic effects. Allelopathy is defined as "any
direct or indirect harmful effect that one plant has on another
through the production of chemical compounds that escape into the
environment."* The harmful compound may take varied forms such as volatile chemicals produced by roots, or leached from leaves. Dead or decaying plant tissues may also be a source of allelopathic substances. Note that the nitrogen released from legumes is not considered a form of allelopathy.

Some common combinations are maize-bean, maize-soybean (*Glycine max* L. Merr.), maize-rice, maize-sorghum, sorghum-millet, sweet potato (*Ipomoea batatas* Lam.) in sugar cane (*Saccharum officinarum* L.), and cotton (*Gossypium* sp.) with peanuts (*Arachis hypogaea* L.). The net result of such combinations can vary widely from productive to unproductive compared to sole planting of the same crops. Factors such as fertilization schedule, seeding rate and spacing, selection of variety and type of plant, e.g., dwarf versus normal (maize), bush versus pole (bean), as well as many other cultural factors can markedly influence results.

The overall advantages of intercropping include the following:

1. provides increased protection against erosion;

2. insures against crop failure;

3. spreads labor and harvesting more evenly during the growing season and helps minimize storage problems;

4. helps allocate space for crops required in small quantities, and facilitates production of many commodities in a limited area;

5. results in efficient use of resources by plants of different heights, rooting systems, and nutrient requirements;

6. where legumes are grown with grasses (or other non-legumes), grasses may benefit from the nitrogen fixed by the legume companion crop; and

7. inhibits the spread of diseases and pests since not all crops involved are susceptible to the same extent to the same problems.

Disadvantages, on the other hand, are:

1. mechanized planting and harvesting are difficult;

2. it is more difficult to apply needed fertilizers and other chemicals as in sole cropping; and

3. experimentation with intercropping is more complex and difficult to manage than with sole cropping.

RELAY CROPPING

Relay intercropping is a common practice in wet-dry climates where the wet season is not sufficiently long for two full season crops. Generally corn is the wet season crop, with beans interplanted as the corn approaches maturity. With relay planting, greater crop density and protection against wind and water erosion are achieved. Since the first crop has reached maturity, its
demands on soil moisture and fertility are minimal as natural aging and deterioration of leaves occur. The relay interplanted seedling crop likewise places small but increasing demands on the soil. As the first crop gradually fades out of the picture and is finally removed entirely through harvest, the sequential crop continues to advance and the transition is completed.

III. SUMMARY

Multiple cropping in some form can help get the maximum crop production from fixed land holdings, particularly in subtropical and tropical areas of the world. Both low and high technology societies can profit by adopting one or more of the various multicropping techniques. Even small farmers who lack the capital to purchase inputs (e.g., equipment, fertilizers, herbicides) but generally have abundant hand labor, can find the practice of some form of multicropping to be to their benefit.

Multiple cropping places heavy demands on the soil and cannot be successful unless the crop is supplied with adequate fertilizer. Where the extra fertilizer is not available, a few crops with low fertilizer needs may be planted (such as cassava (Manihot sp.) and plantain (Plantago sp.)). Many marginal farmers find the purchase of inorganic fertilizers beyond their means, even if obtainable, and should not consider intensive multicropping systems. More limited multicropping can be practiced where substantial amounts of animal manure and/or composted plant materials are available. Minerals provided by burning cleared land have only temporary value. On the other hand, many systems of multicropping originated under subsistence farming and can be made to work using available sources of fertilizer. Placing fertilizer in bands between plants or directly in the planting hole are two ways of making more efficient use of fertilizer at hand. Where possible, legumes should be planted for their ability to obtain nitrogen from the air and convert it into forms available to plant roots.

The advantages of multicropping include greater use of available solar energy in the dry season, improved pest control, greater insurance against crop failure, better nutritional balance for families because a wider variety of foods is produced, and a more stable farm income.

As in any departure from traditional methods, some cautions and hazards may be encountered in switching from mono- to multicropping. Farmers should consider their options carefully and seek help if necessary from local extension agencies or from technical assistance services such as VITA.


