UNIT 5 CULTURAL PRACTICES IN CROP PRODUCTION

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1.0 INTRODUCTION

Crop production is a complex process involving series of sequential and non-sequential operations leading to the harvest of mature consumable produce. These operations are practices and techniques carried out during the crop production process which are directly aimed at creating a favourable environment for crop growth and development, and the realization of crop's potential yield and produce quality. Specifically, the "cultural" practices are beneficial to optimum crop yield and quality through improved competitiveness with weeds, control of weeds, other crop pests and pathogens and modify the soil environment (such as physical conditions, water status, fertility level, biochemical activity).

Breeding of improved crop varieties (especially genetic engineering) is a modern cultural operation which has contributed significantly to considerable increases in crop yields and produce quality through pathogen and pest resistance, adaptation to adverse environments, and even pesticide-resistant crop varieties. In some cropping situations, cultural practices serve as alternative to herbicides when none is available or when the grower decides against herbicide use.

2.0 OBJECTIVES

By the end of this unit, you should be able to:

- learn about the overall aim of carrying out cultural operations in crop farms
- become familiar with the sequence of operations used in producing crops generally, and specific crops in particular
- understand the specific benefits of certain operations in crop production
- understand the practical application of the various operations for profitable and environment-friendly crop production.

3.0 MAIN CONTENT

3.1 Pre-Planting Practices

3.1.1 Seed Pre-Treatment

Dormant seeds are often difficult to germinate because they have hard seed-coats or other seed coverings. These dormancy problems are removed physically by scarification (especially using sand-paper), shelling or cracking and soaking in water overnight. Seeds of some crops require hot water treatment or scarification with concentrated sulphuric acid to break their dormancy. Cold temperatures (stratification/vernalisation) and use of chemicals such as gibberellic acid (plant growth hormone) and potassium nitrate also helps to break seed dormancy of some seeds types.

3.1.2 Seed Protection Treatments

Seed health and protection are the first steps in the reliable production of economically-viable crops. Seed treatment, whether by chemical, physical or biological means, is a vital input in today’s agricultural and horticultural production systems. Seed treatment fungicides are useful tools to manage seed- and soil- borne pathogens. Lower-quality seeds or poor seed viability results in poor crop establishment and associated higher weed pressure and reduced final yield and farm income. Seed-borne diseases are controlled using disinfectants and systemic fungicide treatments. Disinfectants are applied to seed surface to control pathogens. Often, organo-mercury chemicals are effective. Fungicide treatments help to control pathogens within the seed structure. The applied chemical is absorbed by the developing seedling where they inhibit internal fungal development e.g. Carboxin. The use of soil sterilants for controlling soil-borne diseases is restricted largely to control environment soils because they are generally non-selective. Soil protectant fungicides are more useful, and can be applied at sowing time to protect emerging seedlings from attack by soil pathogens such as damping-off e.g. thiram, captan. However, there is a need to identify the pathogens on the specific field in order to choose the best fungicide or combination of fungicides. Also, choosing the correct fungicide is critical to limit the losses due to seed-borne pathogens. Other seed treatments for the control of seed- or soil-borne disease in grain cereal and legume crops are Apron plus, Apron XL (mefenoxam), Maxim (fludioxonil), Allegiance (metalaxyl), Agrosol FL (captan, TBZ), Agrosol T (thiram TBZ), Raxil-Thiram (tebuconazole, thiram), Vitavax-200 (carboxin, thiram). For vegetatively-propagated crops (e.g. cassava, yams), stem cuttings, meristem cuttings, yam setts or seed yams should be obtained from healthy mature plants. Fungicide powders, e.g. Benlate and wood ash, are very effective for dusting setts and seed yams while fungicide dips are used for treating cuttings.

3.1.3 Land Preparation

3.1.3.1 Land Clearing

Soil preparation for sowing involves land clearing and tillage. Wet soil may need to be drained while dry soil may require irrigation. Land clearing may be done manually (using machete, hoe), mechanically (using bulldozers!, stumper) or chemically (using non-selective herbicides in zero or no-tillage system). Bush burning (uncontrolled, controlled) helps to get rid of fallow or excess debris. Except in mechanical land clearing, farmers retain the heavier, bigger and more economically-useful trees such as palms, fruits, exportable timber, nitrogen-fixing trees, NFTs, some of which also help to preserve the soil environment.

3.1.3.2 Tillage

This involves the turning of the topsoil either manually (traditionally, minimum tillage) mechanically (conventional tillage), essentially targeted at creating a favourable environment for crop establishment. Primary tillage loosens the soil and mixes in fertilizer and/or plant material, resulting in soil with a rough texture. Secondary tillage produces finer soil and sometimes shapes the rows. It is done by using various combinations of equipment such as mouldboard plough, disc plough, harrow, dibble, hoe, shovel, rotary tillers, subsoiler, ridge- or bed –forming tillers, and rollers. No-till farming involves the growing of crops without tillage through the use of herbicides, genetically-modified (GMO) crops that tolerate packed soil and equipment that can plant seeds or fumigate the soil without really digging it up. Tillage uses hoofed animals, animal–drawn wooden plough, steel plough and tractorised ploughing.

3.1.4 Planting/Transplanting

Seeds of many crops can be planted by direct sowing in well-prepared field plots. Direct seed-sowing is achieved by broadcasting (especially for small seeds), drilling and planting in holes. In manual planting, seeds are sown using planting stick or cutlass. Mechanical planters are available and some of them perform combined operations such as seed sowing, fertilizer and pesticide application simultaneously. Vegetative propagules are usually manually planted in holes dug in soil with a cutlass and at reasonable depth, or mechanically. For some crops, seeds require pre-nursery (e.g. oil palm) or nursery (e.g. tomato) where seeds and seedlings are hardened for subsequent field establishment. Growth chambers, nursery bags and seedbeds are also required for germinating some crops. Transplanting involves carefully moving seedlings (potted, unpotted ‘nursery transplants’) at appropriate times from the nursery to the field, during the rainy season or under copious irrigation. Field planting of crop propagules requires adequate spacing to obtain optimum yields.

3.2 Post-Planting Practices

3.2.1 Thinning

This is the removal of excess seedling stands from a hill or row of crop. Thinning helps to reduce interplant competition thereby creating adequate growth environment for optimum productivity.

3.2.2 Supplying

This involves the filling of empty stands of crop arising from sowing, germination or emergence failure, or localized herbivory in a field. In some crops, viable seedlings removed during thinning may be used for supplying missing stands.

3.2.3 Watering

In transplanted crops, copious watering is required immediately after transplanting for initial seedling establishment on the field. Irrigation, through controlled application of water over a crop field, is required for dry planting and production of crops. Proper irrigation leads to increased yields from more plants, and higher yields from healthier plants. Over-irrigation is damaging, because poor drainage causes waterlogging which results in poor crop establishment, growth and salting of farmlands. The type of irrigation to be adopted depends on water sources, methods of water removal and transportation of water. Techniques include manual system using buckets (bucket irrigation), sub-irrigation (seepage irrigation), lateral move (side roll, wheel line) irrigation, centre-point irrigation, sprinkler (overhead) irrigation, drip/trickle irrigation, localized irrigation, surface irrigation and in-ground irrigation.

3.2.4 Weed Management

This encompasses all aspects of weed control, including prevention of spread and land use practices and modification in the crop's habitat that interfere with the ability of the weeds to adapt to the crop's environment. The three methods of weed management are:

i. Preventive Approach- This involves forestalling the incidence of weed infestation through plant quarantine, animal quarantine, fallow management, farm sanitation, rogging isolated stands, preventing weed seeding, re-seeding and propagule regrowth and weed contamination of crop propagules. Other measures are choice of variety and field, planting rather than sowing, crop sequence, accurate sowing and planting, using certified weed-free plants, seeds, growth media and soil amendments.

ii. Eradication Approach- This involves the complete removal of a weed species from infested land. It is achievable in non-agronomic situation but undesirable in agro-ecosystems. The reasons for this are that it is too costly, it disturbs natural ecosystem functioning and the activity of bioagents may lead to crop failure.

iii. Control Approach- This involves the suppression of weed populations to a tolerable level that renders the cropping situation economically safe for agricultural production. It is the most important and environment-friendly approach to weed management in agro-ecosystems. The different methods are cultural, mechanical, chemical and biological control. Cultural weed control involves any practice adopted by the farmer in his crop production effort not directly aimed at weed control. The practices help to minimize the number of weeds in the crop, suppress competition by surviving weeds and reduce weed seed production, thereby making the crop more competitive with weeds e.g. shifting cultivation, land preparation (stale seedbed), clean crop propagules, crop rotation, mixed cropping and mulching or soil cover with plant residues or plastic mulch. It is very efficient in controlling weeds in subsistence (peasant) agriculture. Mechanical weed control involves any procedure governing direct physical removal or suppression of weeds on agricultural lands. These include hand weeding, hand hoeing, slashing, mowing, cultivation/tillage, flooding, burning (flaming) and smothering with non-living (*in situ*) mulch. Chemical weed control involves the use of chemicals (herbicides) at toxic concentrations to kill or suppression (interrupt normal growth and development) of weed growth. Herbicides may be inorganic (early types) or organic (most herbicides) compounds, which may be primarily selective (benzoic acids, carbamates) or non-selective (bipyridylium salts, glyphosate). They can also be applied pre-plant, pre-emergence, post-emergence or post-maturity to the crop. Herbicides are of diverse formulations, including solutions, emulsifiable concentrates, wettable powders, flowables, granules, liquids, pellets suspensions, dust, paste, micro-encapsulation and micro-granules. A major limitation of chemical weed control is the insufficient specificity of chemicals under the mixed farming systems of the humid tropics. The National Advisory on Weed Control (NACWC) has published "Weed Control Recommendations for Nigeria", Series 3, under the sponsorship of the Department of Agriculture, Federal Ministry of Agriculture, Nigeria. Biological weed control is the use of natural enemies (bioagents) of weeds in weed control. The organisms may be predators (fish, insects, snails), parasites (nematodes, plants) and pathogens (fungi, bacteria, viruses). Other methods are live mulching, preferential grazing, cover cropping of food and non-food species, allelopathy, crop manipulation and myco-herbicides (plant pathogens). However, biocontrol enhances shifts in weed species composition and possible allelopathic interaction.

iv. Integrated Weed Management- This is a weed management method that economically combines two or more weed management systems at low inputs to obtain a level of weed suppression superior to that ordinarily achieved with one weed management system. It ensures that weed interference is kept below threshold economic levels, thus preventing economic loss to the farmer. It is aimed at efficient and economic use of resources with minimum hazard to the environment and ultimately, sustained crop production.

3.2.5 Fertiliser Application

Fertilisers are chemical (inorganic) or organic materials containing plant nutrients, which are added to the soil to supplement its natural fertility or replenish lost fertility. There are many types of fertilizers, namely nitrogen fertilizers (primarily supply nitrogen; ammonium sulphate (AMS), calcium ammonium nitrate (CAN), urea), phosphorus fertilizers (primarily supply phosphorus; single superphosphate (SSP), triple superphosphate (TSP), basic slag, natural rock phosphate), potassium fertilizers (primarily supply potassium, potassium chloride (KCl), potassium sulphate, K_2SO_4, potassium-magnesium phosphate, K_2SO_4-$MgSO_4$), and mixed fertilizers (e.g. NPK 15-15-15, NPK 20-10-10, NPK 23-13-13, mono-ammonium phosphate (MAP), di-ammonium phosphate (DAP), potassium nitrate (KNO_3). Fertilisers may be applied by broadcasting, row placement by banding and ringing, or topdressing by either method. Micronutrients are also applied as foliar sprays to target crops. Organic fertilization involves manuring (especially the ageing form) and composting (use of compost consisting of crop residues, straw, manure, kitchen wastes, etc.). Also, liming involves the use of lime, steel slag or other materials to the soil to increase its pH level and subsequently, improve conditions for the growth of both crops and micro-organisms. Natural sources of lime are coral, marl, wood ash and steel slag. Artificial sources are lime, CaCO3 and CaO (unslaked lime). In a closed irrigation system, artificial fertilizers and pesticides are applied through "fertigation".

3.2.6 Green Manuring

This consists of ploughing in green (non-woody) species or parts of living mulch, cover species of second crop (grown after the main crop), fallow weed vegetation, or leaf-litter or prunings of shade or hedgerow plants. A major objective of this practice is making nutrient available to the main crop. Green manure crops include Crotalaria spp., cowpea, Mucuna utilis and Leucaena leucocephala. The blue-green algae (used as biofertilser in India) and green alga (Azolla Africana for rice in China and Vietnam) are potential green manure sources.

3.2.7 Mulching

This involves the covering of the ground in a crop field with organic (dead, living) or inorganic materials, especially to protect the soil from degradation and ensure sustainable agriculture. Organic mulch materials include crop residues, straw, leaf-litter, prunings, weedfree compost and black soil. Inorganic mulch materials such as paper, biodegradable and plastic films are particularly desirable for physical weed control in high-premium vegetables and greenhouse crops.

3.2.8 Cover Cropping

This is the practice of planting food and non-food crops which are capable of spreading growth on the soil surface and "smothering" weed growth. Food cover species include sweet potato, pumpkin, melon, pulse crops, rye, oats, and sorghum-sudan grass. Non-food cover species are mostly herbaceous weed legumes and fodder grasses.

3.2.9 Pest and Disease Control

Pests and pathogens are among the most serious factors limiting economically-efficient crop production and utilization of natural resources in both tropical and temperate agriculture. Pests, which cause damage to crops, consist of both arthropods (winged and wingless insects, mites, millipedes) and non-arthropods (slugs, snails, nematodes/ eelworms, birds, mammals). Micro-organisms such as viruses, bacteria, fungi and mycoplasma cause crop diseases, such as anthracnose, leaf spots, mosaic virus disease, bacteria wilt, blast and stem and root rot. Approaches to pest and disease control are many and varied, but they are broadly based on the principles of prevention, control/curative and eradication in special situations. The methods include physical, cultural, biological, chemical and legislative measures. These include the use of resistant crop varieties (less effective than in disease control), cultural methods (crop rotation, burning, soil cultivations, soil drainage, crop sowing time, removal of alternative weed hosts and crop residues, plant quarantine), chemical methods (pesticides) and prophylactic measures for pest control. In disease control, resistant cultivars of crops have been successfully bred for multiple resistances to diseases, crop rotation (most common), weed control, soil drainage, type of soil cultivation, low nitrogen fertilization, choice of sowing date and destruction of inoculum sources. Legislative measures include seed certification schemes and preventing the movement of diseased plants within a country. As in pest control, a large number of pesticides is available for the control of soil-borne diseases (sterilants, protectant fungicides, systemic fungicides) and air-borne diseases (foliar protectant fungicides e.g. maneb; foliar eradicants; foliar systemic fungicides, benomyl). Generally, insecticides and fungicides are most commonly applied to crops during the post-planting period.

3.2.10 Staking

This is the process of providing support for plant stems or vines. It is commonly practised in tomato and yam production. In yam, staking enhances crop leaf exposure to full sunlight for optimum growth and yield. In tomato, staking prevents lodging and fruit rot by infection by soil pathogens.

3.2.11 Harvesting

For different crops, there is need for one complete harvest or several pickings e.g. cowpea. Timely harvesting is necessary to prevent infestation by pests and infection by pathogens. Traditionally, most crops are harvested manually by hand or aided by the use of simple implements such as the sickle, hoe and cutlass. Mechanical harvesting in some crops (especially cereals), is facilitated by using combined harvester.

3.2.12 Storage

Harvested (usually surplus) crop produce is stored in good condition until needed. A good storage should be effective against rain, excessive direct heat, theft, insects (especially weevils) and other pests (rodents, birds), and pathogens (moulds). Crop products can be stored in many different kinds of storage containers, varying from earthen gourds, baskets, cribs to big metal and cement silos. The method of storage is determined by the financial status, available materials and external (climatic) conditions. Storage methods can also be separated into airtight and non-airtight storage. Airtight storage can be achieved using pots and gourds that are vanished or treated with linseed oil, pitch, bitumen or any thick, sticky substance. Other airtight methods include plastic bags, the Pusa bin, oil drums, metal silos, underground pits and brick or concrete silos, which are specially treated with waterproof mortar or waterproof paints. Airtight storage has the advantages of cheap insect eradication and prevention of the entry of moist outside air. The disadvantages include the need for complete air drying before storage, impossibility of complete airtight storage, inability to use part of the stored material during storage, and difficulty of regular check of the product.

3.2.13 Farm Mechanization

This involves two types of implements, namely farm tools and farm implements. Farm tools are mostly simple hand tools and used for manual work, e.g. cutlass (machete), hoes, mattock, pick-axe (digger), axe, rake, spade, shovel, digging fork, hand fork, trowel, garden shears, secateurs, watering can, wheelbarrow, go-to-hell, scraper, budding knife and sickle. Farm implements are heavy, usually animal- or tractor-drawn and used for difficult farm work. They include ploughs, harrows, ridgers, cultivators, planters and combine harvesters. Both farm tools and implements are maintained by washing and drying immediately after use, greasing of dried parts with engine oil or palm oil, lubricating with oil and grease, and storing in cool, dry place, preferably a shed or store. In addition, farm machines such as tractor are maintained daily by checking the level of engine oil and water, to prevent damage to the engine through friction.

4.0 CONCLUSION

By the end of this unit, you should be able to understand that:

i. crop production involves a series of cultural operations to ensure sustainable and optimum food quantity and quality,
ii. specific crops require specific cultural operations for optimum production, and
iii. cultural operations need to be judiciously carried out as recommended to achieve the desired objective in the crop production process.

5.0 SUMMARY

Crop production is a complex process which requires the implementation of certain cultural operations for optimum and good-quality produce.

6.0 TUTOR-MARKED ASSIGNMENT

1. Make a distinct classification of the cultural practices used by farmers in producing their crops.
2. Briefly explain four benefits of "cultural" practices to optimum crop yields and produce quality.
3. Differentiate manual and mechanical land clearing.

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