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Basic Components of Integrated Crop Management

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SUMMARY

Integrated crop management (ICM) is a system of crop production which conserves and enhances natural resources while producing food on an economically viable and sustainable base. It is based on a good understanding of the interactions between biology, environment and land management systems. Integrated pest management (IPM), integrated disease management (IDM), integrated weed management (IWM), integrated nutrient management (INM) and integrated water management (IWM) are the major components of ICM which focus more specifically on pests, diseases, weeds, nutrient and water management aspects of crop production, respectively. ICM is an agricultural system that allows farming to be practiced in a way that safeguards the environment. At the same time, it recognises that the quantity, quality and price of produce are all essential if the overall economic viability is to be preserved.

INTRODUCTION

Integrated crop management (ICM) is a significant holistic approach and ancient procedure to farming practices that combines the best of the conventional or traditional methodologies with proper new and modern techniques, balancing the economic crop production with positive environmental management depending upon the understanding of the complicated balance between environment and agricultural sector (Rohullah, 2016). ICM is particularly appropriate for small farmers because it aims to minimize dependency on purchased inputs and make the fullest possible use of indigenous technical knowledge and land use practices. Agricultural development has contributed significantly to improved rural livelihoods; however, high input, intensive farming systems are still having a negative effect on natural resources and ecosystems, and are one of the drivers of climate change. These issues are addressed with an approach designed to make agriculture more sustainable and resilient which is known as integrated crop management.

Important Components of Integrated Crop Management

ICM is initially conceived as an alternative system to be operated instead of conventional farming and has evolved to address perceived problems associated with traditional agriculture by extending and building on the concept of Good Agricultural Practices (GAPs).

Seedling Establishment

- Maintenance of optimum plant population
- The manipulation of row spacing dimensions
- Manipulation of overall spatial arrangement of crop plants in a field
- All these activities help to get higher yield and quality of farm products and to improve yields, production efficiencies, and profits.
- Plant breeders have altered plant architecture which may improve light interception by crop plants.
- Maintenance of seed quality considering variety and seed lot, seed germination, vigour, seed size, green seed, etc. affects germination and crop establishment
- Proper sowing methods including depth of sowing, right time of sowing, spacing, seed rate, seed treatment, fertilizer placement, surface residues, equipment settings, etc. help to achieve optimum plant population under field conditions

Integrated Disease Management (IDM)

- Selection and application of harmonious range of disease control strategies
- Sowing of seeds of disease resistant crop varieties and employment of sound agronomic practices
- Conduct disease survey in each season
- Practice farm hygiene principles

- Provide a balanced crop nutrition
- Manage crop residues to minimize carryover of pathogens into subsequent crops
- Develop a sound crop rotation strategy
- Use chemical and biological means to control diseases, if required
- Achieves a level of disease control that is acceptable in economic terms to farmers
- Causes minimal disturbance to the environments of non target individuals
- An integrated control program may be aimed at all of the diseases that affect a particular crop or developed for a specific disease that affects a crop
- Prevention of introduction of a disease that is not already present in the area
- Reduction in the rate of build up of a disease that has been introduced to the new area
- Elimination of a disease that may affect profitability or minimization of the impacts of a disease on crop growth and/or productivity

Integrated Pest Management (IPM)

- It is a crop protection philosophy effectively combining and using short and long term production tactics to optimize net profits while minimizing the risk of undesirable environmental and health effects.
- Identify the problems correctly
- Determine the extent of the problem by sampling
- Critically assess the importance of the problem
- Evaluate and select appropriate management alternatives
- Implement selected management actions in a timely manner
- Evaluate the effectiveness of control actions
- Development of IPM is a response to the failure of many chemical pesticides to provide long term solutions to pest menace.
- Certain pesticides may possess massive impacts at the time of application but on the other hand, many pests may develop resistance power to that chemical in the long run.
- IPM is a holistic concept of pest management strategy emphasizing the amalgamation or integration of pest suppression methodologies including biological, physical, chemical, legal and cultural methods and a systematic or sustainable approach to crop protection that utilizes enhanced information and improved decision making paradigms with the aim to decrease purchased inputs, concentrate on long term prevention or suppression of pest hazards and improve economic, social, health and environmental conditions on the farm and in society.
- Encouragement of using naturally occurring biological control, alternate plant species or varieties that resist pests, pesticides with lower toxicity to humans or non-target organisms
- Adoption of pruning, fertilizing, or irrigation practices that reduce pest problems
- Changing the habitat to make it incompatible with pest development
- Broad spectrum pesticides are considered as a final resort when cautious inspection suggests that chemical pesticides are required according to pre-established guidelines
- Crops may be bred to make them tolerant to pest and disease infection
- Selection of seeds least affected by pests should be done by the cultivators for sowing in the next year and this type of preferential selection is a form of genetic modification.
- Genetic alteration of a pest through an engineered disadvantageous character and release of modified individuals into the outside world.

Integrated Weed Management (IWM)

- A farming system combining a diversified array of interdependent physical or mechanical, cultural, biological and chemical weed control methods is termed as integrated weed management with the principal objective to

decrease the selection for tolerance to any single control agent and delay or hinder the development of herbicide resistant weeds.
- IWM involves an array of tools including rotation of available herbicide groups, ensuring that weeds are exposed to a diverse range of control mechanisms.

Preventive Measures
- Prevention is the most important but often least used control strategy.
- Weed dispersal occurs through the major agents like wind, water, wild animals, livestock and human beings.
- Sowing of certified crop seeds
- Clean machineries and vehicles
- Cut weed infested crops prior to weed seed production
- Clean hair and feet of animals prior to moving
- Control weeds in feed and bedding grounds
- Many weed seeds pass through the animal's digestive tract intact and viable
- Use only well rotted manure and the storage should be for four to five months

Physical Strategies
- For annual weeds, tillage prevents seed production and depletes current seed reserves in soil accomplished by encouraging weed seeds to germinate and subsequently killing them.
- Destruction of underground parts, prevention of seed production and reduction of seed reserves should be done in case of perennial weeds.
- Tillage kills weeds by
  - ✓ Burial of the entire plant in seedling stage
  - ✓ Depletion of food reserves by repeatedly removing top growth whenever it reaches sufficient size
  - ✓ Exposure of underground parts to frost or freezing temperature to kill the roots on or near the soil surface
  - ✓ Exposure of root systems to drying
  - ✓ Encourage rotting of underground parts
  - ✓ Physical injury to underground parts due to tillage enables the entry of decay causing bacteria
- Hand weeding of annual and biennial weeds and non-creeping perennials is done by simply pulling out.
- Hand weeding is best done when the soil is moist and before seed is produced and it is only economical for small patches or individual plant.
- Mowing should be done as close to the ground as possible before production of weed seeds mainly when weeds are too numerous in number to remove by hand pulling, too large to efficiently eradicate by cultivation practices, or in a region where cultivation is impractical.
- Repeated removal of top growth of weeds through grazing by different animals such as horse, sheep, goat and cattle can hamper seed formation and weaken underground parts like rhizomes, bulbs, tubers etc.
- When seed production has already occurred, majority of the seeds may be destroyed by burning.
- The principle of mulching with the use of clean straw, hay or manure, tar paper, sawdust and black plastic is to exclude light from the top of the weeds until the reserved food supply in roots is depleted and the weeds starve.

Cultural strategies
- Cultural control uses plant competition or cropping practices for suppression of weed species through the use of smother/competitive crops as well as crop rotation.
- Competition among plants is a cheapest and useful weed control practice for all the farmers.
- Optimum plant population should be adjusted.
- It is beneficial to establish a vigorous dense crop.
- Preparation of good seedbed is mandatory.
- Stale seedbed is another vital technique to control the first flushes of weeds.

- Heavier seeding rates varying from 25 to 100 percent more seeds can be used to reduce weed competition in areas where sufficient moisture is available.
- Selection of an appropriate crop variety well adapted to local conditions of soil, water, climate and disease pattern
- Fertilizer placement in crop rows has benefits over broadcasting method as most of the fertilizer is directly available to crops in the former approach.
- A smother crop is defined as a thick stand of rapidly growing crop competing with weed species to such an extent that their top growth is drastically suppressed and their roots are severely weakened so that the weeds are readily killed by the following cultivation practices; besides, the extensive root system of smother crops helps them to compete with weeds for water and their dense top growth can smother new weed growth with efficacy.
- Use of amendments to correct soil reactions is advisable where indicator weed species are prevailing.

Biological Strategies

- Biological management or bio-control is a self-regulating weed control method using natural agents like insects, nematodes, fungi, viruses, fishes etc. with the aim to reduce weed density to non-economic levels but the objective is never eradication.
- Grazing animals can harvest the noxious weeds.
- Bio-control is designed for non-cultivated lands where biennial or perennial weeds are troublesome.
- Cultivated lands are not generally feasible as the food sources of weeds for the biotic agent are removed periodically.

Chemical Strategies

- Man began to experiment with chemicals to control weeds in the 19th Century but it was the phenomenal success of 2, 4-D, introduced commercially in 1940s, that launched the present era of herbicides.
- Use herbicides only when weeds are in susceptible stage
- Use herbicides only when weather and soil conditions are appropriate for effective control
- Use wipe-on technology for weeds growing above the crop
- Band placement over the row and between rows
- Maintain application equipments and accurately calibrate
- Read the herbicide label before use

Integrated nutrient management (INM)

- Integrated nutrient management is a holistic approach to soil fertility management that combines organic and inorganic/mineral methods of soil fertilization with physical and biological measures for soil and water conservation.
- It is based on three fundamental principles:
  1.Maximize the use of organic material
  2.Ensure access to inorganic fertilizer and improve fertilizer use efficiency
  3.Minimize losses of plant nutrients
- Balanced application of appropriate fertilizers including secondary nutrients and micronutrients is a major component of integrated nutrient management.
- Nutrient conservation in soil is a crucial component.
- Soil conservation technologies classified into three general categories can prevent the physical losses of soil and nutrients through leaching and erosion.
- Terracing, alley cropping, and no till farming can alter the local physical environment of the field thereby preventing soil and nutrients from being carried away.
- Mulching, cover crops, intercropping and biological nitrogen fixation act as physical barriers to wind and water erosion and help to improve soil characteristics and structure.

- Organic manures like animal and green manures help in soil conservation through improved soil aggregation or structure and replenishment of secondary nutrients as well as several micronutrients.

CONCLUSION

As ICM involves the whole farm and is site specific, there are no hard and fast rules about how to achieve this but there are some general guidelines that can help all of the farmers to take practical steps in order to improve the management practices. ICM is a method of farming that balances the requirements of running a profitable business with responsibility and sensitivity to the environment including the practices to avoid wastes, enhance energy efficiency and minimise pollution. However, for the producer it must ensure a continuing living, and for the consumer a constant supply of affordable and quality produce. To improve the present situation, agricultural development strategies should be based on an integration of factors such as biophysical environment, land reclamation level and external input use determining the agricultural production potential of a particular zone. Integrated crop management can help to put these factors in the best perspective, and to set the priorities for agricultural research and development accordingly.

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