Chapter 8

Challenges in improving agricultural products

From the chapter 'Our food' in Class 6 you came to know that we require different kinds of foods. They include various kinds of seeds like wheat, rice, dal, different types of leaves like spinach, menthi and many other things. In addition, non-vegetarians eat meat, fish, eggs etc. While discussing food chains in the chapter 'Ecosystem' we also learned that our diet as well as that of several of our domestic animals is eventually linked to plants.

- Try to estimate how much grain your family consumes in a month.
- Also, try to guess how much land is required to grow this amount of grain?

A family consisting of four members requires 50kgs of grains per month or 600kg per year. The area of land required for the same is around 1.4 square kilometers .Can you estimate how much area of land would be required to grow the quantity of grain needed for your family in a year? You know if the members of a family increase, food requirement also increases accordingly. If the requirement cannot be met it leads to food crisis. We know that population of our country increases every year. Is the food production able to meet the need of increasing population? Does the rate of food production increase proportionately to population growth? We shall try to find out the answers to some of such questions by doing the following exercise.

Given below is the tabulated data of population growth and production of food grain of the concerned decade. Read the table carefully and find out answers for the given questions.

Table:1 Rate of growth of population and food grain production

Decade	Population Growth(PG)	Food grain production(FP)	Ratio FP/PG
1961-1971	2.4	2.83	1.18
1971-1981	2.23	1.8	0.80
1981-1991	2.16	3.13	1.45
1991-2001	1.95	1.1	0.56
2001-2011	1.65	1.03	0.62

- In which decade population growth is higher?
- In which decade food grain production is higher?
- What major differences did you find in the table?
- Is food grain production increasing according to population growth?
- In which decades production of food grains not satisfied the needs of population? What will happen if the production is not sufficient?
- The decade 1991-2001 shows that rate of food production was nearly half as compared to population. What can you infer from the decade when population growth was highest?

Increasing food production in proportion to compensate the needs of increasing population is a big challenge for our country. Our farmers are constantly trying to meet the challenge against all odds.

Write your suggestions to improve food production.

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- Share your ideas with classmates. What are the common suggestions in your list?

Apart from human beings, other living creatures also need food to survive. Many of these animals have been domesticated and live with us. So we need to provide them fodder, grain etc.

In this chapter, we shall discuss what methods are used to increase the production of the crops we grow for food. There is one thing that needs to be stressed when we talk about increasing production. It can be explained more easily through an example. Suppose we plant a crop of wheat. Suppose the plants grow nice and healthy but they do not produce any grain. Would you call this a good wheat crop? So when we talk about increasing production, what we mean is increasing that part of the crop that is useful for us.

Let us now begin our discussion on increasing production.

The production of a crop does not increase because of any one factor alone. Only when there is a proper combination of several factors, the production can increase. Some of these factors include the kind of seeds planted, the properties of the soil, the availability and proper application of irrigation and fertilizers, the weather, controlling insect attacks, the growth of weeds and so on.

Fig-1 Paddy

Experiments done with corn have shown the impact of some of these factors on crop production. Some results of these experiments are given in Table 1.

Table-2

Method	Production (kg/he)	Gain (kg/he)
Time of planting		
A month after the onset of rains	3,400	
Immediately after the onset of rains	5,830	2,430
Density of planting		
plants per hectare 39,600	4,100	
plants per hectare 19,800	5,130	……..
Weeding		
Once	4,040	
Twice	5,200	……..
Nutrient application		
Without phosphorus	4,570	
56 kg of phosphorus	4,660	……..
Without nitrogen	4,320	
78 kg of nitrogen	4,900	……..

The table shows us the gains achieved in production by using different methods. For example, planting the seed at the correct time resulted in a production gain of 5,830 - 3,400 = 2,430 kg per hectare.

Calculate the exact gain from each method mentioned in the table and note the results in the table.

You now have some idea about some of the factors that affect the production of various crops.

Let us now discuss the various factors that affect the production of crops in more detail.

How to increase the food production?

We know that the cultivated land is very limited. If we make use of plenty of land for cultivation some forests may be destroyed. So we need to think of another solution. Observe the following solutions.

1. Increasing the area of cultivated land.
2. Increasing production in the existing land.
3. Developing high yielding varieties.
4. Alternating crops.
5. Mixed crops.
6. Cultivating short term crops like Rabi.

- Which of the above option do you think is more meaningful?

You have already learnt about long term and short term crops or Kharif and Rabi crops. Short term varieties produce grains more than long term varieties.

Alternating of crops preserve the soil fertility. Mixed crops system helps the farmers to produce variety of crops as well as increase production.

To get high yield 3 types of methods are being used.

1. Improving high yielding varieties.
2. Using high yield management methods. (Crop production management)
3. Crop protection management.

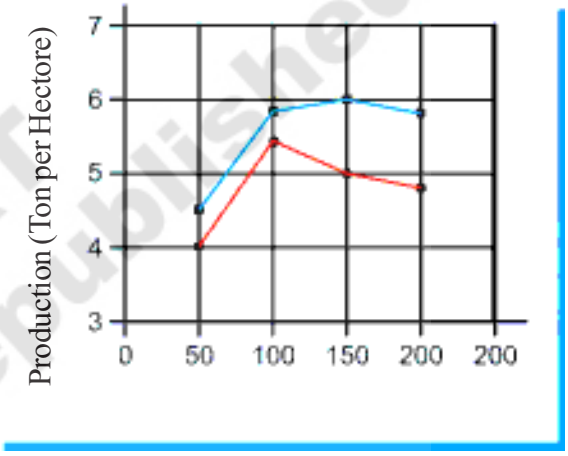
Improving high yielding varieties

Observe the size and colour of maize in your kitchen. (if not, ask your mother why she doesnot purchase maize as a food material) Some seeds are small with yellow colour and some are large with white colour. The white coloured large ones are hybrid variety. They give high yielding.

Fig-2(a) HybridVariety

Fig-2(b) Local Variety

An experiment was conducted to find out how irrigation affected the production of a crop. In the experiment, crops were grown in two fields. One field was irrigated while the other wasn't. The same amount of nutrients, like nitrogen, was applied to both the fields. However, the amount of nitrogen was increased by the same quantity for successive crops in both the irrigated and unirrigated fields. The results of the experiment are illustrated in Graph-1.



Supply of Nitrogen (Kg. Per Hectore)

Sufficient supply of water

Less supply of water

Graph-1

On the basis of Graph 1, explain the importance of irrigation in increasing crop production.

What difference is there in crop production when the same quantity of nitrogen is applied to both the irrigated and unirrigated field?

What does a plant do with water?

We learned in the chapter 'Nutrition in plants' in Class 7 that a plant absorbs water

from the soil. What does it do with this water? We saw that the plant combines water and carbon dioxide with the help of sunlight to produce carbohydrates. Starch is one such carbohydrate. Different types of sugar and cellulose are also carbohydrates. A chemical analysis will show that 100 grams of water react with 260 grams of carbon dioxide to form 180 grams of carbohydrate.

But the plant does not use all the water it absorbs through its roots to produce carbohydrates. Actually, most of this water evaporates into the air.

Activity-1

Take a polythene bag. Cover the bag on leaves and tie it. Keep it 4-5 hours. You observe it. What did you find in the polythene bag? Where did they come from? Do this experiment during day time and night time separately. Note the differences in your note book.

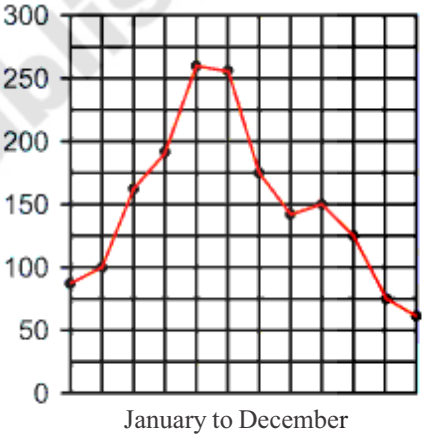
Fig-3 Transpiration

If you tie a plastic bag over a leaf, you will be able to see how much water a plant releases in the air. It is estimated that a plant uses only 0.1 percent of the water it absorbs to form carbohydrate.

That means, if a plant absorbs one litre of water, only one millilitre will be used to produce carbohydrate. The remaining 999 millilitres evaporate from the leaf.

The relationship between water and crop yields

You may have wondered what difference it would make if water is scarce when only 0.1 percent is used to produce carbohydrate. Let's investigate the matter a little more in depth. Graph 2 below tells us how much water evaporates from plants in different seasons.



Water evaporates from plants(in m.m)

Graph-2

- Find out from the graph the months in which the most water evaporates from plants.
- Are these the same months in monsoon season when the rainfall is heavy?
- So how does the availability of more water effect the plant?

Let us now look at an interesting fact. Most of the water released by plants evaporate from the leaves. The leaves have tiny, microscopic holes called stomata.

Water evaporates through these stomata. We know that more water evaporates when the weather is hot. In such a situation, the stomata begin to close. This lessens the amount of water that evaporates from the leaves.

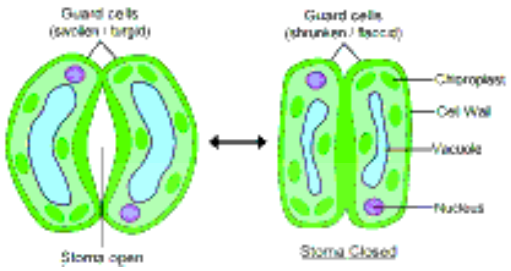


Fig-4 Stomata in the leaf

We learned in the chapter 'Nutrition in plants' that plants absorb carbon dioxide. The carbon dioxide also enters the leaves through the stomata.

- When the weather is hot and the stomata close, what effect would this have on the absorption of carbon dioxide by the plant?
- What effect would a change in the amount of carbon dioxide absorbed have on the growth of the plant?
- If the plant does not get water at this time, what effect would this have on its growth? Discuss in your class and findout reasons.

Plants cannot absorb nutrients directly from soil. Only the nutrient that dissolves in water is absorbed by the roots of the plant. We discussed about transportation of substance in the chapter "Transportation of substances through plasma membrane" and in the chapter "Plant Cell". Try to think of how xylem and phloem are useful in transportation.

- What are the main water sources in your village for agriculture? How farmers utilize them?

Paddy require more quantity of water.

Can you give such examples? Cultivation of paddy, wheat and sugar cane are suitable where places have rich water resources. If we cultivate such crops under wells and bore wells what will happen?

Most of the farmers of our state cultivate crops like paddy, sugar cane irrespective of proper availability of water, only because of supporting price and marketing facility. So farmers invest more on irrigation of water, electricity bills, pesticides and fertilizers. Agriculture Officers advise to cultivate dry land crops (Aruthadi Pantalu) in less water areas. And also to practice different water management practices.

- Make a list of crops which require less amount of water.

Drip irrigation is a good practice in agriculture to prevent water wastage. In drip irrigation, water is supplied through small pipes. These pipes have small holes through which water passes drop by drop.

Think and discuss

- In what way this kind of water supply is useful to the crop as well as the farmer?
- Water Shed is a process to improve ground water level. In what way it is related to irrigation? Support with your answer.

Activity-2

- Make a block diagram of irrigation of water from major water resources in your village?
- Draw the route map of Jawahar and Lal Bahadoor Canals of Nagarjuna Sagar in Andhra Pradesh map.

Plant nutrients

Just as we need different kinds of nutritious food, plants also require different kinds of nutrients. You know that a plant absorbs carbon dioxide from the air and water from the soil and produces carbohydrates with the help of sunlight.

Plants also absorb different kinds of mineral salts from the soil, in addition to water. Among these are the salts that plants require in larger quantities. For example, plants need nitrogen, phosphorus and potassium salts in larger quantities. These are called Macro Nutrients. Some nutrients are necessary for plants in small quantities. These are called Micro Nutrients. Ex: Iron, Manganese, Boron, Zink, Copper, Molybdenum, Chlorine etc.

These salts are obtained from the soil. When we grow a crop, the plants absorb some salts from the soil. Table-3 shows the amounts of nitrogen, phosphorus and potassium salts absorbed from the soil by different crops.

Table-3: Absorption of salts by different crops

Crop	Yield per hectare	Nitrogen	Phosphorus	Potassium
Rice	2,240	34	22	67
Wheat	1,568	56	22	67
Millet	1,792	56	15	146
Corn	2,016	36	20	39
Sugarcane	67,200	90	17	202
Groundnut	1,904	78	22	45

Every time, any of these crops sown in a field, absorb these amounts of nutrients.

Soil Nutrients

- If a field is cultivated for many years, what would happen to the nutrient content of the soil?
- How does the soil get back or replenish these nutrients?

Let us examine this question in more detail.

Nutrients present in the soil are consumed by plants and are replenished or returned to the soil in many different ways. In nature the continuous process of death and decay add nutrients to the soil and the process is too slow to be commercially useful. Rotating crops, adding organic

manure or chemical fertilizers etc. are man made processes.

Crop rotation

Usually, farmers do not grow only one crop in a field. Different crops are grown in different seasons. It has been seen that cereal crops take lot of nutrients from the soil. Legumes are different. While they do take nutrients from the soil, they also provide some nutrients to it. Growing leguminous crops result in an increase in the quantity of nitrogenous salts in the soil. Thus to grow a leguminous crop between cereal crops is beneficial either by alternating cropping system or by mixed cropping.

Nitrogen, Phosphorus and Potassium are the important nutrients.

Let us observe the following table.

Table-4:

Nutrient	Uses
Nitrogen	New leaves, flowers arise fast.
Phosphorus	Penetrates roots deep in to the soil to absorb nutrients quickly
Potassium	Resistance towards pests, increases the quality of smell, colour, and taste of fruits.

To avoid nutrient deficiency in the soil, farmers cultivate alternate crops.

- A farmer cultivated sugar cane in his land for the last five years. Another farmer cultivated sugarcane in the first year and soya bean in the second year and sugarcane in third year.
- In which case do you think has the land lost most of its nutrients?

Crop rotation is the process in which one crop is followed by another crop on an agricultural field. Some best combinations for crop rotation are given below.

- After cultivation of paddy, blackgram/ groundnut has to be grown, followed by paddy again for cycle to continue.
- After cultivation of tobacco, mirchi has to be grown for the cycle to go on.
- After cultivation of redgram, maize/ paddy has to be grown for the cycle to go on.

What is the benefit of crop rotation?

When cereals are cultivated more nutrients are utilized. If legumes are grown in the soil, less nutrients are utilized. Not only this, they synthesise some nutrients into the soil. Do you find any crop rotation methods in your village? What are they? Ask your village elders and collect the information about it.

Cultivating mixed crops

- Have you ever seen two types of crops in the same field?
- Which crops are grown in this way?
- What are the uses of cultivating mixed crops?

Discuss in groups and display your writings in your classroom.

If more than one crop is cultivated in the same field then it called mixed crop. Because of mixed crop cultivation the soil becomes fertile. The nutrients which are

used by one crop will be regained by cultivating another crop.

Which crops can be cultivated as mixed crops? Observe the following...

Soya grown along with Pea

Pea grown along with Green gram

Corn grown along with Black gram

Groundnut grown along withsunflower

Maize grown along with Red gram

Sorghum grown along withPea

Cotton grown along with Groundnut

Fig-5 Red gram in Haldhi

Fig-6 Cabbage in ground nut

Generally pulses and cereals are grown as mixed crops. Short term crops are grown in Long term crop fields. In the fruit growing fields like Lemon, Pomegranate, Papaya, etc., pulses like Red gram, Black gram, Green gram, etc., are cultivated as mixed crops.

Fig-7 Betel Leaf

- Is betel (Tamalapaku) a mixed crop? How can you justify your answer?

Can you name some leguminous crops? Leguminous crops usually have many small nodules on their roots. Several different kinds of bacteria live in these nodules. These bacteria absorb nitrogen from the air and convert it into a form that can be used by the plant.

- Ask your teacher about names of the nitrogen fixing bacteria.

You could uproot a soya bean plant or a Bengal gram plant to see the nodules on their roots.

Root nodules in legume plants

The microorganisms in the nodules use some of the nitrogen for their own purpose. Some nitrogen is used by the leguminous plant itself. But after the crop is harvested, the roots remain in the soil. So the soil gets some nitrogen in this way.

Experiments have shown that a leguminous crop gives about 50 kg to 150 kg of nitrogen per hectare. The crop grown after the leguminous crop can take advantage of the availability of more nitrogen in the soil.

Fig-8 Rood Nodules

Nowadays a bacterial culture is also available. This is mixed with the seeds. When the seeds are sown, the plants are able to produce more nodules on their roots.

Apart from this, there are various kinds of blue-green algae that add nitrogen to the soil. Blue-green algae culture is also available. It is applied in rice fields.

So if a leguminous crop is rotated with a cereal crop, the leguminous crop replenishes, to some extent, the nitrogen taken from the soil by the cereal crop. But potassium, phosphorus and other nutrient elements cannot be replenished in this way.

Organic manure

Do you ever saw a herd of goats in a vacant field? Why shepherds make arrangements to stay their goats and sheeps in the fields?

The organic (natural) manure is produced by decaying the plant and animal wastes! The manure produced from decomposed plant and animal products has more organic material. This gives good nutrients to the soil. It makes the soil fertile. Because of humus, the natural manure, water holding capacity of soil is increased.

Natural organic manures are generally divided into two types. One is concentrated organic manures and the other is Macro organic manure.

Groundnut, Gingili, Castor, Coconut, Neem, Jetropa Seed powders are the examples of Concentrated organic manures. These are also used as fodder for cattle and poultry.

Animal excreta, compost, deep litter are the examples of Macro organic manure. Nutrients are rich in the concentrated organic manures than in macro organic manure.

By organic manure we normally mean the plant and animal residues in the field, such as stalks and roots, cow-dung, urine etc. The percentage of various nutrient elements in one tonne of organic manure is given in Table 5.

Table-5: Percentage of nutrient elements in organic manure (kg/tone)

Manure	Nitrogen	Phosphorus	Potassium
Goat manure	5-7	4-7	3-4
Dry compost	5-10	4-8	6-12
Dry organic manure	4-15	3-9	3-10
Neem powder	5-6	1-2	1-2
Vermi compost	1-3	1-2	1-2

(Dry organic manure is made by mixing cow-dung, hay, urine etc)

Suppose a paddy crop is grown in a field and five tonnes of rice are harvested.

Calculate from Table 3, how much nutrient elements this crop must have taken from the soil. To replenish this quantity of nutrient elements in the soil, how much of dry compost needs to be added?

Green Manure crops

Do you know that some crops are grown so that they can be ploughed back into the soil? Some examples are berseem, kulthi, sunhemp, lobia, green gram etc. Details of these crops and the nitrogen they provide per hectare are given in Table 6.

Fig-9 Green manure crops

Table-6: Percentage of nitrogen in different green manure crops

Name of crop	Nitrogen (kg /tonne)
Lobia, beans	7.1
Dhaincha	6.2
Kulthi	3.3
Green gram	7.2
Sanhemp	7.5
Horsegram	8.5

If the total weight of the green manure crop in a field is 8 to 25 tonnes per hectare, the amount of nitrogen it provides on being ploughed back into the soil is 70 kg to 90 kg per hectare.

Farmers, who have no sufficient time for making Green manure, are suggested to use green leaf manure. Any plant leaves are used as green leaf manure.

Find out whether all the green manure crops mentioned in Table 6 are leguminous crops.

On the basis of Table 6, explain the reason for growing green manure crops.

Soil testing

How do farmers know what type of crop needs to be cultivated? What types of crops are suitable for the soil in their fields? Farmers, who are experienced, are able to make out from the colour and texture of the soil.

- You had also studied about the same in your earlier class. Ask a farmer to find out about crops that can be grown in different types of soil.

Nowadays, Agricultural officer and the Soil Testing Technologist are available in every area. They observe the field and suggest what to do.

Have you ever heard about *'Bhusara Pariksha Kendra'* (Soil Testing Centre)? At these centers the soil technologist collects soil samples from fields and tests the fertility levels of soil. They give us knowledge about the soil. The testing centers are situated in division and district

levels. If you send the sample of soil from your field, they send you a report after testing it. By the report you will be able to know that which nutrient is lesser and which is more. This helps the farmer to select the type of crop, manure, fertilizer etc and its quantity. This prevents wastage and minimizes investment.

Vermi Compost

To replenish soil nutrients, adding of natural manure is a good practice. Vermi compost is one of the techniques in soil nutrient management. Let us read the following case study to know about vermi compost.

The farmers are Bomma Raju Cheruvu of Vinjamur Mandal faced many problems in using of chemical fertilizers. They searched for alternate practices. Farmers understand the importance of soil health. They formed a group to grow vermi compost with the help of Agriculture Field Officers of DOT centre.

They constructed 10x1x1/2 *meters vermi compost beds in sheds which protect these beds from direct sunlight and rain. They collected coconut, banana and sugarcane leaves, coconut coir and dry black gram plants. They made them into 3 to 4 inches layer. This inner layer was wet with water. They collected house hold waste of dry cattle dung from the village to fill the bed. They did not use, wet dung. They were careful to avoid glass, polythene, rubber and metal objects in the bed.*

After two weeks of making bed, they kept thousand earth worms per square meter and covered the bed with Gunny bags to maintain 30 to 40% of moisture. After 60 days they collected their first manure. Second time they, got the manure within 40 to 45 days. Every year they got the manure 6 times from these beds. They got one ton of compost from three tons of organic wastes. They said that after using this organic manure, investment on chemical fertilizers and other pesticides became reduced and the quality their agricultural products increased.

Fig-10 Vermi compost culturing

Fig-11 Vermi compost beds

Think and discuss

In what way vermy compost is better than chemical fertilizer.

Panchgavya

This is also a natural manure. The main ingredients of Panchgavya are milk, curd, ghee, dung and urine of cow. Mix cow dung and cow ghee. Settle it for four days. On the fifth day, add urine, milk and curd of cow. Also add kallu, coconut water and sugarcane juice to the mixture. And then add banana paste. Settle it for ten days. Stir the material morning and evening. Then you will get Panchagavya the only sprayer type of manure. 3% of Panchgavya is helpful to grow crop with higher yielding. It is also used as food for hens and fish in ponds.

Fig-12 Panchagavya

Organic farming

By using chemical fertilizers, we can get high yielding for only 20 to 30 years. After that soil becomes reluctant to plant growth. These chemicals damage soil fertility. If the soil health is proper, then only the soil responds to fertilizers. Otherwise, using of fertilizers become mere waste.

Long term high yielding capacity of soil (soil productivity) depends on both availability of nutrients in the soil (soil fertility) and suitable physical, chemical and biological characters of soil (soil health).

To maintain soil productivity organic farming comes into existence. In this type of farming, farmers use natural manures and natural pest controlling methods and they also practice crop rotation and mixed crop systems.

In organic farming farmers use bio fertilizers, instead of using chemical fertilizers and synthetic pyrithroids, to get higher yielding.

Some micro-organisms which are useful to synthesise nutrients from the environment or from soil to plants. These are called microbial cultures or bio-fertilizers.

Bio fertilizers

Bacteria		Algae	Fungi	
Nitrogen Fixers: Ex: Rhyzobium Azotobacter Azospyrillum	Phosphorus Solubulisers: Ex:Bacillus Pseudomonas	Nitrogen fixer: Ex: Bluegreen algae	Phosphorus moralizers: Ex:Micoryza	phosphorus solubuliser: Ex: Pencillium

Generally bio fertilizers are two types. One is nitrogen fixers and the other is Phosphorus moralizers, solublelisers. Observe the flow chart of different bio-fertilizers.

- What do you find from the flow chart
- What are the major nutrients synthesized by this.

Bio fertilizers are useful to maintain soil health and productivity. These do not have nutrients in them like organic manures. They synthesize nutrients from environment and soil. These are also called farmer (eco) friendly fertilizers.

Fig-13 Bio fertilizers

Chemical Fertilizers

You may have heard names like urea, NPK and superphosphate. These are chemical nutrients. These are partially or completely synthetic in origin.

We have already seen that plants get many of their nutrients from the soil. The quantity of nutrients in the soil decreases if plants continue to absorb them. We have also seen some ways in which soils replenish their nutrient content. There is one other way in which soils can receive nutrients by adding chemical fertilizers.

The percentage of nutrients differs in various chemical fertilizers. So a farmer, who uses a chemical fertilizer, first checks how much of which nutrient he gets from that fertilizer before applying it in his fields.

Table 5: Percentage of nutrients in different chemical fertilizers

Name of fertilizer	N (%)	P (%)	K %)
Urea	46	0	0
Superphosphate	0	8-9	0
Ammonium sulphate	21	0	0
Potassium nitrate	13	0	44

If we use 50 kg of urea, then according to Table 5, 23 kg of nitrogen (46 percent) will be added to the soil.

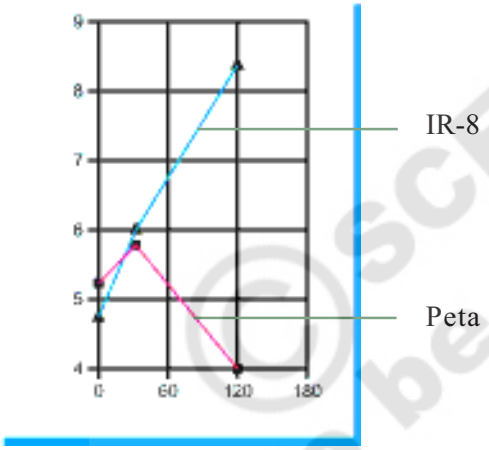
- To get the same quantity of nitrogen, how much ammonium sulphate should we add?
- If 50 kg of superphosphate is added to the soil, how much phosphorus would the soil get?

But whether we use organic manure or compost or chemical fertilizers, it is not enough to know the percentage of nutrient elements they contain. It is important to know how much of this nutrient is finally available to the plant. It is also necessary to know which is the best time to provide the nutrients so that the plant can make the fullest use of them. We must also examine which is the best way to add the nutrients to the soil. For example, would it be better

to sprinkle them in the field or to dissolve them in the irrigation water or to place them under the soil.

The Method Determines The Effect

It is not necessary that the production of all crops increases equally if an equal amount of nutrients is applied. The type of crop determines the effect of the nutrients. For example,the effect of applying nitrogen fertilizers on an indigenous rice variety (Peta) and a hybrid rice variety (IR-8) is shown in Graph-3.



Graph-3

- What is the difference in effect of nitrogen fertilizer on Peta and IR-8?

Normally, a farmer uses chemical fertilizer to increase the crop production from his fields. The question is, how much fertilizer should he add?

Graph 3 shows the resultant increase in crop production for different quantities of chemical fertilizers.

- Look at the graph and say whether crop production will continue to increase as we add more and more quantities of nitrogenous fertilizers?

Suppose 120 kg of nitrogen per hectare are added to a crop of Sonora-64 wheat. A total of 5.3 tons of wheat will be produced.

On the basis of Table 2, calculate how much of phosphorus and potassium will be absorbed from the field by this wheat crop. Is it advisable to add only nitrogenous fertilizer to increase production? What effect will this have on other nutrients in the soil? Explain with reasons. Now let us consider the last factor relating to crop production.

Crop protection

Suppose we take best variety of seeds, sow them at the correct time, apply fertilizers properly at proper intervals and irrigate a crop well. Will there be any obstacle in getting a good crop?

There are many other factors that affect a crop production. Let's look at some of them.

Weeds

Often, other plants grow in a field along with the crop. These plants are called weeds. Do you know any names of weeds in paddy field?

What effect do weeds have on a crop? Before trying to answer this question, discuss the following points in your class:

1. How would weeds affect the supply of nutrients to the crop?
2. How would they affect the sunshine available to the crop?
3. What effect will there be on the water available for the crop?

- Will these factors affect crop production? Look at the crop figures

relating to weeding in Table 1 and explain what effect there would be on crop production if a field is not weeded. What do you think should be done to rid a field of weeds?

Activity-3

Make a list of the major weeds in your area. Find out which weeds grow with which crops. If possible, collect these weeds and make display. Find out what farmers do to get rid of these weeds.

Insects and plant Diseases

Apart from weeds, plants are affected by insect attacks. Some insects eat the stems of plants, some nibble at the leaves, while others destroy the roots. But there are also insects that are useful for plants. For example, many insects help in the pollination of plants.

There are several microorganisms that destroy plants. We cannot see them, but we can see the destruction they cause in plants. These include shriveling and discolouration of leaves, rusting of the stem and leaves, fungal growths etc. There are, however, some useful microorganisms that make nitrogen available for plants.

The diseases caused by insects and microorganisms affect crop production. The question is, how should we deal with this problem? Nowadays, farmers use insecticides, fungicides and other chemicals. However, there are other ways to solve the problem. For example, weeding could rid a field of weeds. Or insects can be captured and removed from the fields.

Insecticides are actually chemicals. They are used to kill insects.

Ask your teacher about whether insects can develop immunity to the insecticides used to destroy them? Immunity means the insecticide no longer has any effect on the insect it targets.

There is another problem when we use insecticides to kill pests or weedicides/ herbicides to destroy weeds. A large percentage of these chemicals remain in the soil. From the soil, these chemicals find their way into water sources. Do you think that a chemical used to kill insects will have no effect on humans?

People who spray these chemicals in the fields are exposed to them and some of the chemicals enter their body. What effect do you think these chemicals will have on their health? discuss in yourclass.

Fig-14 Diseases in plants

Another problem is that these chemicals destroy all insects. We have seen earlier that some of these insects are useful and helpful to plants. In our state, Prakasham and Guntur districts are the places where pesticides and insecticides are used in large quantities.

Look at the pictures

- If insects that pollinate crops are killed, what effect will this have on crop production?
- In recent times, why farmers touch the flowers with handkerchiefs in sunflower fields?

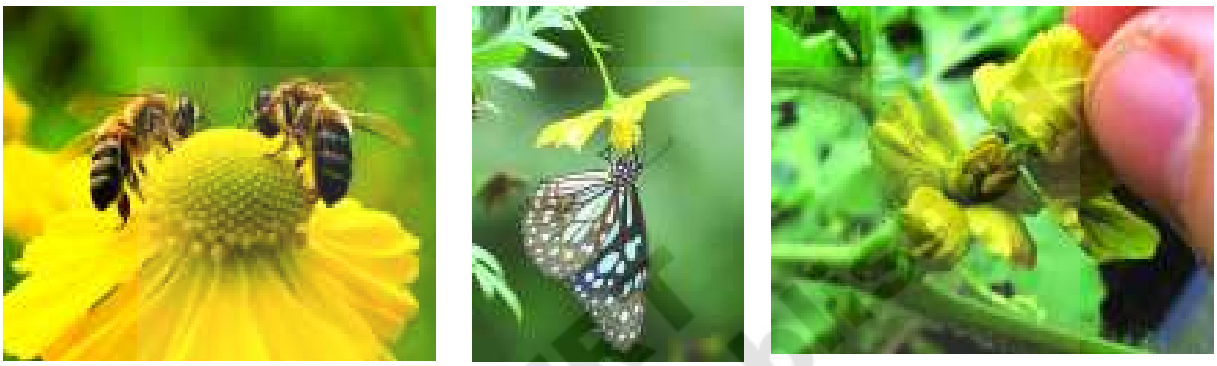


Fig-15 I nsects and birds helping in pollination Pollination with hands

- Some people ask this question: If we don't use these chemicals, how can we get a good crop? How can we increase production? Is there an answer to this question? What could it be?

Suppose we can use some other methods that do not give rise to these problems. For example, they say we can make use of the natural food chains to control pests. Remember, we had discussed food chains in the chapter 'Different Ecosystems'. There are many insects that eat other insects. They are called predatory insects. We can make use of these insects. There are also birds that eat insects. We can use these birds to get rid of insects.

Similarly, people say we can capture harmful insects and kill them. The problem is that this method is both slow and time consuming. However, supporters of this method say the process can be speeded up. For example, if a lighted bulb (Deepapu Teralu) is placed in a field, insects would cluster around it.

- Discuss with your friends and try to find out some other alternates for pesticides.

Natural pest controlling methods

Generally farmers use synthetic pyrithroids like pesticides, insecticides to control pests on crops. There are so many natural pest controlling techniques.

- Which are followed by our farmers?

Some insects control the harmful insects and they are called friendly insects. Spiders, dragon fly, Krisopa, mirids, lady bird beetle, etc., are the insects that eat worms like jasids, trips, and stem borers. Trycoderma bacterium lives in the eggs of

stem borer, tobacco cater pillar, gram cater pillar and destroy these pests at the egg stage. Some bacteria like Bacillus Turengenisis destroy some pests.

Fig-16 Biological control by natural enemies (Predatory Insects)

Some mixed crops also control some pests and diseases. After paddy, cultivating black gram, groundnut etc. prevents Tungro virus disease on paddy. After cotton, cultivating maize and gingili prevent gram cater pillar. After Red gram, cultivating maize and corn prevents spotted bole worm and dried disease. These are called Akarshaka Pantalu.

- Do you know why Jetropa in cotton fields, marigold in Mirchi fields cultivated?

Improvement in food production and sustaining soil health, environmental protection are the both sides of agriculture practices. Farmers should be aware of quality, innovative practices in agriculture.

Key words

Weeds, insecticides, fertilizers, fungicides, irrigated farming, unirrigated farming, predatory insects, bacteria, immunity, stomata, carbohydrate, bacterial culture, crop rotation, mixed crop, organic farming, vermi compost.

What we have learnt

- Food production is not increasing in accordance with increase in population.
- Factors for the increase of food production are quality and variety of seed planted, properties of the soil, availability and proper application of irrigation and fertilizers, weather, controlling insect attacks, controlling the weeds etc.
- Mixed crops system helps the farmers to produce varieties of crops as well as increasing production also.
- Alternative of crops preserve the soil fertility.

- Seeds with the desired characters were developed by using the Hybridization methods and Genetic Engineering techniques.
- Plants utilize 0.1% of water which it absorbs to form carbohydrates during photosynthesis process.
- Absorption of CO_2 and evaporation of water occurs through Stomata.
- Dry land crops (Aruthadi pantalu) are suitable for less water available areas.
- Plants need Nitrogen, Phosphorous and Potassium salts in large quantities, these are called Macro nutrients.
- Plants need some nutrients like Boron, Iron, Copper etc., in small quantities. These are called Micro nutrients.
- Nutrients are replenished to the soil by rotating crops, adding organic manure or chemical fertilizers.
- Mixed crop cultivation makes soil fertile. The nutrients which are used by one crop will be regained cultivating another crop.
- Humus and water holing capacity are increased in the soil by applying the natural manure.
- Any plants leaves can be used as green manure.
- Vermi compost is far better than chemical fertilizers.
- Over usage of pesticides leads to Soil pollution, water pollution and hazard to Bio- diversity.

Improve your learning

1. Suggest some ways in which our country could increase the production of rice to meat atleast global limits. (AS1)
2. How are biofertilizers more beneficial as compared to chemical fertilizers? (AS1)
3. (a) Find out the adverse effects of chemical fertilizers needed for growing the high yielding varieties of crops? (AS1)

   (b) Can high yielding varieties be grown without them as well? How? (AS1)
4. What threats to nature do chemical fertilizers, pesticides, insecticides and herbicides pose? (AS 6)

5. What are the adverse effects of using high yielding varieties of seeds? (AS1)
6. What are the essential measures that a farmer needs to take before sowing the seeds of a crop? (AS1)
7. Suppose you had a farm in a drought striken area of your state what crops would you grow and how? (AS1)
8. What measures will you take to save your field from seasonal outburst of insects?
9. What basis would you adopt to explain to a farmer using chemical fertilizers switch over to organic fertilizers? (AS 4)
10. A farmer had been using a particular insecticide for a long time. What consequences will it have on- a) insect population b) soil ecosystem? (AS 2)
11. Venkatapuram village is in drought prone area. Somaiah wants to cultivate sugar cane in his fields. Is it beneficial or not? You want to convey him-which questions will you ask him? (AS 7)
12. Draw a block diagram of water resources in your village? (AS 5)
13. Ramaiah has soil testing done in his field. The percentages of nutrients are 34-20-45. Is it suitable for cultivating sugar cane crop? Which crops can be cultivate without using pesticides in Ramaiah's field? (AS 2)
14. Organic manure is helpful to Bio diversity. How do you support this statement? (AS6)
15. Make a list of the major weeds in your area (you have already conducted the project). Find out the weeds which are grown in different crops? (AS 4)

Name of the Crop	Weeds that grown on crop

16. Spraying high dose of pesticides is hazardous to bio diversity and crop yielding. How can you support this statement? (AS 6)
17. Natural pest controlling methods are useful to Bio diversity. Comment it? (AS 7)

ANEXURE

a) Hybridization

In recent times the biotechnologists have developed high yielding varieties of different crops particularly food grains and vegetables. By using hybridization methods and genetic engineering techniques the seeds with desired characters are developed. You will learn more about this in future courses.

Tomatoes are soft and fleshy but they are not suitable to preserve for more than week days. If the tomato is somewhat harder and fleshy it would be suitable to preserve. So biotechnologists select the desirable characters and develop hybrid varieties. Seedless fruits like grapes and papaya are hybrid ones.

Think, why we need hybrid variety of paddy, millets and cereals?

Lab Activity

Take one example from each of millets, cereals, vegetables and fruits. First you have to list out the known characters of the above and then list out the characters that you want to change or modify in them. But you need to give your own reasons- why do you want to make such changes in them?

Hybrid tomato

S. No.	Type	Example	Known characters	To be changed characters	Reasons
1	Fruits				
2	Vegetables				
3	Millets				
4	Cereals				
5					

b) Hybrid Varieties:

Biotechnologists develop hybrid varieties by crossing between two plants which have genetically different characters and thus developing new variety with useful characters.

Hybridization as a process to yield high yielding variety of rice in India for commercial production was started in 1911. It was started by Dr. G. P. Hector, the erstwhile Economic Botanist during 1911 in undivided Bengal with headquarters at Dacca (now in Bangladesh). Subsequently, in 1912, a crop specialist was appointed exclusively for rice in Madras Province. Prior to the establishment of the Indian Council of Agricultural Research (ICAR) in 1929, Bengal and Madras were the only provinces which had specialist exclusively for rice crop. Later several other research stations were opened which released 445 improved varieties of rice by 1950. These varieties were of various characters such as-giving produce early, deep water and flood resistant, drought resistant, disease resistant etc

Pomato

The hybrid varieties that are produced by hybridization techniques are high yielding, disease resistant, can thrive on less rainfall and will grow in acidic soils also.

You people also can develop your own hybrid varieties. It's very interesting to do.

Let us do the following Experiment and record your observations carefully.

Red and yellow equal to rellow

If you want to make your own hybrid flower you need to do the following. But it is time consuming process and patient job too. For this you need red and yellow colour Chandrakantha plants.

- Select 5 or 6 red flowers on a plant.
- Remove all the other flowers of that plant.
- Take each flower, remove stamens carefully.
- Take yellow flower and rub with that flower gently on the stigma of selected red flower for pollination (You need to do this process in evening only. Because these flowers bloom in the evenings and fall down in the next morning).
- Tie a tag with a thread loosely to the pollinated flowers to avoid confusion in identifying these flowers for seeds in the next few days.
- Within a week days you will get black seeds.
- Keep them another two weeks to dry and sow them in a pot.
- Take care to grow the plants until they flower.

- Observe the colour of the flowers. How are they?
- Record your findings at every step and discuss with your teacher.
- You know that it is a time consuming and patiently job. Think- how the scientists work for?

Do you know? You know Tomato and potato. Do you Know Pomato? Look at this photo.

Scientists developed pomato plant by the hybridization of Tomato and Potato plants. It produces tomatoes on the top and potatoes under the ground. How wonderful it is!

Is it beneficial or not?

c) Genetic engineering:

Another method of improving crop production is genetic engineering. The substances which carry desired characters are introduced into the plants and produced new varieties. These varieties are otherwise called as genetically modified seeds (GMS).

- Ask your teacher as to why some people fight against GMS.

The seeds thus produced are of good quality and grow in areas with different climatic conditions and different soils. This type of seeds is necessary for farmers. These are useful for them to improve crops in their areas.

Think- in what way less yielding time and cultivation of dwarf varieties are also good characters. Discuss in groups and write your findings in your notebooks.

Other side of the coin

Increase in production of crops is not at all a questionable task. To maintain balance between population growth and food requirement, there should be a need to implement more productive practices. Genetically modified seeds are solving the problem. But they the whole diversity of the food grains. Traditional and local varieties become extinct.Such mono-cultural practicesleadto increasing uncontrollable pests and diseases on plants. For this farmers use pesticides beyond limits. This causes undesirable damage to the eco system. For example cultivation of B.T. Cotton and Brinjal seed varieties resulted in committing suicides of farmers. Multinational companies impose the countries throughout globe to cultivate those seeds only. Think- how people like us raise our voice against this issue.

Comparison chart

	Chemical Fertilizer	Organic fertilizer (compost / biofertilizer)
Example:	Ammonium sulphate, ammonium phosphate, ammonium nitrate, urea, ammonium chloride etc.	Cottonseed meal, blood meal, fish emulsion, and manure and sewage sludge, etc.
Advantages:	Chemical fertilizers are rich equally in three essential nutrients i.e. Nitrogen, Phosphorus and Potassium that are needed for crops and always ready for immediate supply of nutrients to plants if situation demands.	Add natural nutrients to soil, increases soil organic matter, improves soil structure , improves water holding capacity, reduces soil crusting problems, reduces erosion from wind and water, Slow and consistent release of nutrients,
Disadvantages:	Several chemical fertilizers have high acid content. They have the ability to burn the skin. Changes soil fertility.	Have slow release capability; distribution of nutrients in organic fertilizers is not equal
Rate of production:	High, because of immediate supply of nutrients.	Moderate, because of slow release of nutrients.
Nature:	Chemical fertilizers are manufactured from synthetic material	Organic fertilizers are made from materials derived from living things.
Preparation:	Artificially prepared.	Prepared naturally. One can prepare organic fertilizers, themselves or can also buy.
Cost:	Costly	Cheap
NPK Ratio:	20 to 60%	About 14%
Nutrients:	Have equal distribution of three essential nutrients: phosphorous, nitrogen, potassium.	Have unequal distribution of essential nutrients.

A progressive farmer

Now a days, farmers - the back bone of our country- believe that agriculture is a non profitable occupation. In this scenario Gudivada Nagaratnam Naidu, a progressive farmer started revolution in agriculture and proved that it is one and only profitable occupation.

He got many National and International awards for his innovative practices in his fields. Scientists, intellectuals and presidents of different nations visited his field where glories of agriculture products practiced.

To overcome the challenges in the field of agriculture, farmers should attain knowledge of modern technologies in agriculture and marketing. It is direly essential for getting more profits. Let us look at his experience in his words.

"I am Gudivada Nagaratnam Naidu. I am a peasant; still I did not take any loan from any bank till today. Besides, I never lent any money from others. I feed my family with what I grow in my field. I grow oilseeds, uncontaminated fruits, flowers in my field for me and for others.

The root of my success lies in growing mixed crops. I started cultivation in one acre out of 17 acres of land which is situated in outskirts of Hyderabad of Hayathnagar mandal at Taramathi pet. But later i started cultivating the remaining 16 acares I used to grow food grains like paddy, groundnut, redgrams, and green grams, and black grams etc., vegetables like tomato, brinjals etc, flowers and also fruits. I never consulted any agriculturists for this purpose ever before. Having known my efforts, agriculturists are approaching me.

My efforts taught me that plants indeed get 95% of nutrients from nature and sunlight. Remaining 5% are supplemented by micro organisms present in the soil. So I realized that I have to take care of growing micro organisms in the soil. A healthy soil only nourishes the plants with the fertilizers we use.

A plant uses the nutrients that it requires and leaves the remaining for other plants. This is what I think as Biodiversity.

For example some plants maximum sunlight while others are exposed to limited sunlight. This is possible only because of

biodiversity. Drumstick plants are grown under coconut and Hellconia flowers can be grown under drum sticks. Aspergillus can be grown under coffee plants. This is the way of growing more plants with less investment in a limited area. This becomes success and beneficial when you implement the right pattern.

Usually it is difficult to yield 30 bags of paddy from an acre, but I yield 92 bags just by adapting some techniques. Most of the farmers are in wrong notion that SRI vari is a special type of seed. Actually, SRI vari is a system of cultivation in which we require less water and seeds. The real meaning of SRI is System of Rice Intensification. You can select any seed for this purpose. In this pattern of cultivation to get one kilo of paddy, we require only 2500 to 3000 litres of water. Where as in traditional system, for the production of same quantity of paddy, we require 5000 litres of water.

We should not prefer to cultivate a single crop, rather we should practice mixed crop for yielding. We should not blindly follow the ways and means what other farmers do."