Agriculture-9

(For Ninth Class)

Punjab School Education Board

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FOREWORD

Punjab School Education Board since its inception has constantly been putting its efforts for re-designing lessons and preparing books according to the needs of national educational view point and occupational requirements of the state.

The present textbook has been prepared in the light of National Curriculum Framework 2005 and Punjab Curriculum Framework 2013. Accordingly, it has been felt that more emphasis should be laid on vocational courses. India is mainly an agrarian economy and Punjab is considered as Food Bowl of the country. This book contains information about agricultural economic development of the country, some common tips about agriculture and information about agriculture based supplementary enterprises and industrial occupations so that students can be made aware to adopt it.

This book prepared by experts of Punjab Agricultural University, Ludhiana will prove helpful for students and teachers.

Suggestions from field are welcome for making the book better.

Chairperson

Punjab School Education Board

CONTENTS

Chapter -1

KHARIF CROPS

Kharif crops are sown in June-July or on the onset of monsoon and are harvested in October - November e.g. rice, basmati rice, maize, moong, mash, groundnut, cotton, sugarcane, sorghum and bajra etc. These crops have been classified into three categories in this chapter.

1. CEREALS
2. PULSES AND OILSEEDS
3. COTTON, SUGARCANE AND *KHARIF* FODDERS

1. CEREALS

Rice, basmati rice, maize, sorghum and bajra are the major *kharif* cereals. These crops, being an integral part of human diet, are major determinants of country's food security. In this chapter only major *kharif* crops of Punjab are discussed.

1.1 RICE (PADDY)

China occupies 1st position in world in its production and West Bengal is the largest producer of rice in India. It is also known as *Jhona*, *Dhaan* and *Jeeri*. In Punjab, it is grown on about 28 lakh hectares and gives an average yield of about 60 quintals paddy per hectare.

Climate and soil: Rice requires high temperature, high humidity, prolonged sunshine and assured water supply. It can grow well on a wide range of soils with low permeability but loamy soils are the best. It can also be grown on acidic and alkaline soils.

Crop rotations: Crop rotation is the sequence of crops grown on a field in a year. Rice-wheat/berseem, Rice-wheat-sathi moong/sathi maize/green manure, Rice-potato-sathi moong/sathi maize/sunflower

Improved varieties: PR 124, PR 123, PR 122, PR 121, PR 118, PR 116

Field preparation: The field should be laser levelled and puddled well to have efficient use of irrigation water and better control of weeds.

Nursery sowing: 15-30 May is the optimum time of nursery sowing. Eight kg good quality seed sown on an area of about 6.5 *marlas* is sufficient for transplanting one acre. Mix 12-15 tonnes of well-rotten farmyard manure or compost per acre in the soil. Apply 12 kg nitrogen, 10 kg phosphorus and 13 kg zinc per acre. Pre-germinate the wet and treated seeds by spreading them uniformly in 7-8 cm thick layer on wet gunny bags and cover them with wet gunny bags. Keep the layer of seeds moist by sprinkling water on it periodically. The seeds sprout in about 24-36 hours. Sow the pre-germinated seeds by broadcasting and keep the soil moist by irrigating the field frequently. For control of weeds, use Butachlor or Sofit herbicides. Apply 12 kg nitrogen per acre about a fortnight after sowing. The seedlings are ready when they are 20-25 cm tall or have 6-7 leaves.

For transplanting rice with paddy transplanter, nursery is grown on polythene sheet in the form of mats of the size required for transplanter. A perforated polythene sheet is spread on soil and iron frames of required size are placed over it. Soil is filled in the frames upto the top surface. Pre-germinated seeds are spread on the frames. Cover the seeds by a thin layer of soil and sprinkle water by hand sprayer for proper setting of the soil. Lift frames and repeat the above procedure for sowing the required number of mats. The mats are kept wet by giving daily irrigation. About 10-12 kg seed is sufficient to sow about 200 mats required for transplanting one acre.

Transplanting: Second fortnight of June is the optimum time of its transplanting. Transplant 33 seedlings per m^2 in a puddled field.

Fertilizers: Apply 50 kg nitrogen, 12 kg phosphorus and 12 kg potassium per acre. Use potassium on soil test basis. Apply 1/3 nitrogen and whole phosphorus and potassium before the last puddling. Broadcast the remaining nitrogen in two equal splits at three and six weeks after transplanting. Do not apply phosphorus if preceding wheat crop was supplied with recommended phosphorus as due to high temperature and high moisture conditions the phosphorus already present in soil becomes available to the crop.

Zinc deficiency: With zinc deficiency the lower leaves become rusty brown near the base and ultimately dry up. The seedlings remain stunted and tillerless. Zinc sulphate as soil application is used to control its deficiency.

Iron deficiency: Iron deficiency appears when there is scarcity of water in the field. Chlorosis occurs in the youngest leaf about three weeks after transplanting and the crop may fail completely. On appearance of symptoms, give heavy and frequent irrigations to the crop. One percent Ferrous sulphate solution (1 kg Ferrous sulphate in 100 litre water) should be sprayed on crop for 2-3 times at weekly interval.

Weed control: *Swank* and *mothas* are its major grass weeds. Inter-culture the crop with a paddy weeder or do hand weedings at 15 and 30 days after transplanting. If herbicide is to be used for the control of weeds then use either Machete, Arozin, Rifit, Sathi or Topstar. Use these herbicides by mixing with sand in 4-5 cm ponded water within 2-3 days of transplanting. If herbicide is to be used at a later stage then use Nominee Gold at 20-25 days after transplanting. Same group of herbicide should not be used every year as it leads to appearance of herbicide resistant and new type of weeds. For broadleaf weeds like *ghrilla*, *sanni* etc use Algrip or Segment herbicide at 15-20 days after transplanting.

Irrigation: Keep the water ponded in the crop continuously for two weeks after transplanting so that the seedlings get properly established and weed emergence is also less. Afterwards, apply irrigation two days after the ponded water has infiltrated into the soil but care should be taken that soil does not develop cracks. To save irrigation water, install tensiometer in the rice field and irrigate only when water enters the yellow strip of tensiometer. Stop irrigation at 15 days before harvesting the crop so that crop is harvested easily and timely sowing of wheat is possible.

Direct seeded rice (DSR): Direct seeding of rice is recommended only in medium to heavy textured soils. Its cultivation in light textured soils is not successful due to severe iron deficiency in these soils which lowers the crop yield. Optimum time of its sowing is 1-15 June. Sowing should be done with rice seed drill using 8-10 kg seed per acre in 20 cm spaced rows at 2-3 cm depth. Short duration

varieties are more suitable for direct sowing. Weeds should be managed by using Stomp herbicide within two days of sowing and Nominee Gold at 30 days after sowing if *swank* and *mothas* are present and Segment herbicide if broadleaf weeds are present. Apply 60 kg nitrogen per acre in three equal splits at 2, 5 and 9 weeks after sowing. It does not require ponding of water and should be irrigated at 5-10 days interval.

Harvesting and threshing: Harvest the crop when ears are nearly ripe and the straw has turned yellow. The grains should be stored at 12% moisture.

Insect-pests and diseases: The major insects-pests are stem borer, leaf folder, plant hoppers and hispa. The major diseases are bacterial leaf blight, blast, sheath blight and false smut.

1.2 BASMATI RICE

Basmati occupies a special status in rice cultivation due to its excellent cooking and eating qualities. To have its superior cooking and eating characteristics the crop should mature in relatively cooler temperature. The high temperature during grain filling period lowers these quality characteristics and elongation of grains on cooking is less and grains become sticky.

Crop rotations: Basmati rice-wheat/sunflower, Basmati rice-wheat-sathi maize/ sathi moong

Improved varieties: Punjab Basmati 3, Pusa Punjab Basmati 1509, Pusa Basmati 1121

Sowing: Cultural practices like field preparation, seed rate, seed treatment, raising of nursery, weed control, irrigation etc are same as that of rice. The other cultural practices are as under:

Nursery sowing: Optimum time for nursery sowing of Pusa Punjab Basmati 1509 is 2nd fortnight of June and for others it is 1st fortnight of June.

Transplanting: Optimum time for transplanting Pusa Punjab Basmati 1509 is 2nd fortnight of July and for others it is 1st fortnight of July.

Fertilizers: Application of higher dose of nitrogen to basmati causes its excessive vegetative growth and plant height. This makes the crop prone to lodging thus

resulting in its lower yield. Apply 12 kg phosphorus per acre at the time of last puddling. Apply 16 kg nitrogen per acre to Punjab Basmati 3 and Pusa Basmati 1121 and 24 kg nitrogen per acre to Pusa Punjab Basmati 1509. Apply nitrogen in two equal splits at 3 and 6 weeks after transplanting.

Direct seeded basmati rice: Most of the agronomic practices for its direct seeding are similar to that of direct seeded rice except that its optimum sowing time is 2nd fortnight June and should be supplied 24 kg nitrogen per acre in three equal splits at 3, 6 and 9 weeks after sowing.

Insect-pests and diseases: The major insects-pests are stem-borer, rice hispa and leaf folder. The major diseases are blast and foot-root.

1.3 MAIZE

USA occupies 1st position in world in its production and Andhra Pradesh is its largest producer in India. Maize occupies about 1 lakh 25 thousand hectares in Punjab with an average yield of 15 quintal per acre.

Climate and soil: Maize requires considerable moisture and warmth from germination to flowering. Extremely high temperature and low humidity during flowering may damage the foliage, desiccate the pollens and interfere with proper pollination resulting in poor grain setting. A well-distributed rainfall of 50-75 cm is conducive to its proper growth. It thrives well on well drained sandy-loam to silty-loam soils.

Crop rotations: Maize-wheat/barley/potato/berseem, Maize-wheat-sathi maize/ sathi moong/ green manure, Maize-potato-wheat/sunflower

Improved varieties: PMH 1 and PMH 2 are normal varieties whereas Punjab sweet corn 1 and Pearl Popcorn are special purpose varieties.

Sowing: Use 7 kg seed per acre for Pearl Popcorn and 8 kg for other varieties. Treat the seed with recommended fungicides. Optimum time of its sowing is last week of May - end of June but can also be sown in 2nd fortnight of August. Sowing should be done at a row to row spacing of 60 cm and plant to plant spacing of 20 cm.

Fertilizers: Apply 50 kg nitrogen, 24 kg phosphorus and 12 kg potassium per acre. Use potassium on soil test basis. Drill one-third of nitrogen and the entire quantity of phosphorus and potassium at the time of sowing. Top dress one-third of nitrogen at the knee-high stage and the remaining one-third at the pre-tasseling stage. If maize follows wheat, which had received the recommended quantity of phosphorus, omit its application to maize.

Weed control: Give two hoeings at 15 and 30 days after sowing or herbicide Atratаf can be used within 10 days of sowing to control weeds. This herbicide controls annual grasses and broadleaf weeds but is more effective against *itsit*. Lasso can also be used within 2 days of sowing if *itsit* is not a problem weed. Use 2, 4-D for control of *dila*/*motha* at 20-25 days after sowing. For cultural control of weeds, grow one or two rows of cowpea in between maize rows and harvest it for fodder at 35-45 days after sowing before it starts twining the maize plants and thereafter no weed control operation is required.

Irrigation: Generally, 4-6 irrigations are required depending on the rainfall. Adequate water-supply is essential particularly during the pre-tasselling and silking stages.

Harvesting and threshing: The crop is ready for harvesting even when the stalks and leaves are somewhat green but the husk cover has dried and turned brown. Maize dehusker cum thresher is also available for shelling of un-husked maize. Grains should not have more than 15% moisture.

Insect-pests and diseases: The major insect-pest is maize borer and major diseases are seed rot, seedling blight and stalk rot.

2. PULSES AND OILSEEDS

Kharif pulses include moong, mash and arhar and *kharif* oilseeds include groundnut and sesame. Soybean is both a pulse and an oilseed crop.

2.1 PULSES

India ranks 1st in production of pulses but it also leads in its consumption and that is why we need to import pulses every year. Rajasthan leads in production of pulses in India. The area under pulses in Punjab decreased drastically with

success of rice-wheat system in post-green revolution era. Moong, mash, arhar and soybean are grown on small acreage during the *kharif* in Punjab.

2.1.1 MOONG

Moong occupies about 5.0 thousand hectares in Punjab and its average yield is about 350 kg per acre.

Climate and soil: Moong requires a hot climate and can tolerate drought also. It is also suitable as a summer crop. A well drained loamy to sandy loam soil is more suitable and saline-alkaline or waterlogged soils are not suitable.

Crop rotations: Moong-raya/wheat

Improved varieties: PAU 911, ML 818

Field preparation: Give two or three ploughings followed each by planking.

Sowing: Eight kg per acre seed is required. Inoculate the seed with recommended microbial culture and then treat it with recommended fungicides. Sowing should be done in 2nd fortnight of July at a row spacing of 30 cm and plant to plant spacing of 10 cm.

Fertilizers: Drill 5 kg nitrogen and 16 kg phosphorus per acre at sowing.

Weed control: One or two hoeings are required to control the weeds. Weeds can also be controlled by using herbicide Basalin or Treflan before sowing or Stomp within 2 days of sowing.

Irrigation: Irrigation is required only if there are no rains.

Harvesting and threshing: The crop should be harvested with sickle when 80% of the pods are mature. Thresher can be used for threshing. If crop is to be harvested with combine harvester, then for drying of crop foliage spray Gramoxone (paraquat) when about 80% of the pods are mature.

Insect-pests and diseases: The major insects-pests are jassid, aphid, whitefly, hairy caterpillar, pod borer and mite. The major diseases are yellow mosaic virus, Cercospora leaf spot and root rot.

2.1.2 MASH

Mash is grown on an area of about 2.0 thousand hectares in Punjab and its average grain yield is about 180 kg per acre.

Climate and soil: It requires hot and humid climate. It can do well on all type of soils ranging from sandy loam to heavy clay except the saline-alkaline or water logged soils.

Crop rotation: Mash-wheat

Improved varieties: Mash 114, Mash 338

Field preparation: One or two ploughings followed each by planking.

Sowing: 6-8 kg bold seed per acre is required. Sow the irrigated crop from last week of June to the first week of July. The rainfed crop may be sown with the onset of the monsoon. It should be sown in rows at 30 cm apart.

Fertilizers: Drill 5 kg nitrogen and 10 kg phosphorus per acre at sowing.

Weed control: One hoeing is needed at one month after its sowing. Weeds can also be controlled by using herbicide Stomp within 2 days of sowing.

Irrigation: The crop normally needs no irrigation but if the rains fail for a long period, then apply one irrigation.

Harvesting: Harvest the crop when the leaves are shed and most of the pods turn greyish black.

Insect-pests and diseases: The major insects-pests are jassid, aphid, whitefly, hairy caterpillar, pod borer and mite. The major diseases are yellow mosaic virus, Cercospora leaf spot and root rot.

2.1.3 SOYBEAN

USA leads the world in soybean production. In India, Madhya Pradesh is its largest producer. Soybean is a high value crop with multiple food, feed and industrial uses. Edible oil, soymilk and its products, bakery products, antibiotics and fresh green beans are some of its major uses.

Climate and soil: It requires a warm climate. It can be grown on a wide range of soils but thrives well on fertile, non-saline/alkaline and well drained loamy soils.

Crop rotations: Soybean-wheat /barley

Improved varieties: SL 958, SL 744

Field preparation: Give two ploughings followed each by planking.

Sowing: 25-30 kg seed per acre is required. Inoculate the seed with microbial culture and then treat it with recommended fungicides. Sow the crop in the 1st fortnight of June in rows 45 cm apart.

Fertilizers: Apply 4 tonnes of farmyard manure per acre at the time of field preparation. Apply 13 kg nitrogen and 32 kg phosphorus per acre at the time of sowing.

Weed control: Weeds can be controlled by giving two hoeings at 20 and 40 days after sowing. Alternatively, use herbicide Stomp within 2 days of sowing or Parimaze at 15-20 days after sowing.

Irrigation: If the rains are good and well distributed, there may be no need of irrigation. Otherwise, crop requires 3-4 irrigations. Irrigation at the time of pod-filling is essential.

Harvesting: Harvest the crop when most of the leaves fall off and the pods change their colour. The moisture content of grains should not exceed 7% at the time of storage.

Insect-pests and diseases: The major insects-pests are hairy caterpillar and whitefly. The major disease is yellow mosaic virus

2.2 OILSEEDS

These are the crops from the seeds of which oil is extracted. USA is the top oilseed producing country in the world and Rajasthan leads in its production in India. In Punjab, groundnut and sesame are sown as *rabi* oilseeds.

2.2.1 GROUNDNUT

China leads the world and Gujarat leads India in its production. It is grown on an area of about 1500 hectares in Punjab and its average yield is about 7.0 quintals per acre.

Climate and soil: A well distributed rainfall of at least 50 cm during July, August and September is essential for the rainfed crop. A well-drained sandy soil overlaying a loamy sub-soil is considered ideal for the rainfed crop.

Crop rotation: Groundnut - *rabi* crops

Improved varieties: SG 99, SG 84

Field preparation: Give two ploughings followed by planking.

Sowing: Use 38-40 kg seed (kernels) per acre and it should be treated with recommended fungicides. Sow the rainfed crop with the onset of monsoon. Where irrigation facilities are available, sow the crop from end April to end May. The crop should be sown at a row to row spacing of 30 cm and plant to plant spacing of 15 cm.

Fertilizers: Apply 6 kg nitrogen, 8 kg phosphorus and 10 kg potassium per acre. Use potassium on soil test basis. Drill all fertilizers at sowing. Prefer Single Super Phosphate as a source of phosphorus as it contains sulphur which is essential for oilseed crops. If phosphorus is not to be applied to field then apply 50 kg Gypsum per acre as a source of sulphur.

Weed control: Give two hoeings at three and six weeks after sowing. Weeds can also be controlled by using Treflan before sowing the crop or Stomp within 2 days of sowing.

Irrigation: Two or three irrigations may be necessary depending upon the seasonal rainfall. Give first irrigation at flowering and one or two at pod formation depending on the rainfall.

Harvesting and threshing: Crop should be harvested at uniform yellowing of leaves as well as the shedding of older leaves.

Insect-pests and diseases: The major insects-pests are aphid, white-grub and hairy caterpillar. The major diseases are collar-rot, seed-rot and tikka or Cercospora Leaf-spot.

3. COTTON, SUGARCANE AND *KHARIF* FODDERS

Cotton for textile and sugarcane for sugar are two important *kharif* crops of Punjab. Maize, sorghum and bajra are important *kharif* fodder crops.

3.1 COTTON

China leads the world and Gujarat leads India in its production. lt is grown on about 5 lakh hectares in Punjab and its average lint yield is about 230 kg per acre.

Climate and soil: It requires hot and dry climate and can successfully be grown on all type of soils except sandy, saline or waterlogged soils.

Crop rotations: Cotton-wheat/barley, Cotton-sunflower, Cotton-senji/berseem/oats, Cotton-raya

Improved varieties of American cotton: Bt hybrids- RCH 650, NCS 855, Ankur 3028, MRC 7017; **Non-Bt hybrids-** LHH 144; **Varieties**- LH 2108

Improved varieties of *desi* cotton: Hybrid- PAU 626H; **Varieties**- FDK 124, LD 694

Sowing: Seed requirement for sowing one acre is 750 g for Bt hybrids, 1.5 kg for non-Bt hybrids, 3.5 kg for varieties, 1.25 kg for desi cotton hybrids and 3 kg for desi cotton varieties. Treat the seed with recommended fungicides. To protect the crop from jassid treat the seed with Gaucho or Cruiser. Optimum time of its sowing is 1st April - 15th May. Sowing should be done in rows at 67.5 cm apart. The plant to plant distance in rows should be 60 cm in case of American cotton (*narma*) and 45 cm in *desi* cotton. For Bt and non-Bt hybrids of American cotton the plant to plant distance should be 75 cm and for desi cotton hybrids it should be 60 cm.

Fertilizers: Apply 30 kg nitrogen and 12 kg phosphorus per acre to varieties and 60 kg nitrogen and 12 kg phosphorus per acre to Bt and Non-Bt hybrids. Use potassium on soil test basis. Drill all phosphorus at sowing. Apply half nitrogen at thinning and the remaining half at the appearance of the first flower.

Weed control: Two or three hoeings are required and the first hoeing should be done before first irrigation. For hoeing, hand wheel hoe or tractor drawn cultivator or bullock driven *Triphali* can be used. Chemical weed control can be done with herbicides. To control itsit/chupati and madhana/makra use Treflan before sowing the crop or use Stomp within 24 hours of sowing. After 45 days, give one hand

weeding or use Gramoxone or Roundup as directed spray on weeds in-between the crop rows by using a protective hood.

Irrigation and drainage: It requires 4-6 irrigations depending upon the seasonal rainfall. The first irrigation should be given 4-6 weeks after sowing and thereafter at 2-3 weeks interval.

Picking: To fetch good price in market, clean and dry cotton should be picked at 15-20 days interval.

Insect-pests and diseases: The major sucking insects-pests are jassid, aphid, whitefly and mealy bug. The other insect-pests are tobacco caterpillar, pink bollworm, spotted bollworm and American bollworm. Bt cotton is resistant to American bollworm as it contains a gene from a bacteria named Bacillus which produces a special protein that is toxic to these bollworms. But Bt cotton is prone to attack of sucking insect-pests and tobacco caterpillar. The major diseases are leaf curl, bacterial blight, wilt, tirak and parawilt.

3.2 SUGARCANE

Brazil leads the world and Uttar Pradesh leads India in its production. lt is grown on about 80 thousand hectares in Punjab and its average cane yield is about 280 quintal per acre. The average sugar recovery is about 9.4%.

Climate and soil: Sugarcane is best suited to tropical climate and can successfully be grown on all types of soils ranging from sandy loam to clay loam but well-drained loamy soils are the best. It is semi-tolerant to sodicity and/or salinity.

3.2.1 SPRING CANE

Crop rotations: Rice/maize/cotton-raya-sugarcane- ratoon I-ratoon II-wheat

Improved varieties: CoJ 85 and CoJ 83 are early; CoPb 91 and CoJ 88 are medium and CoJ 89 is late maturing variety.

Field preparation: Give 4-6 ploughings followed each by planking. Deep ploughing upto 45-50 cm called sub-soiling increases yield as it helps in breaking the hard pan, increases water infiltration rate and results in better penetration of sugarcane roots.

Sowing: Only top two-third portion of the canes should be used as seed. Use 20,000 three-budded sets or 15,000 four-budded sets or 12,000 five-budded sets per acre. On weight basis, use 30-35 quintals of seed for one acre. Treat the seed with recommended microbial culture, fungicides and insecticides. Mid-February to the end of March is the optimum time for its planting. Planting should be done by placing sugarcane sets in furrows spaced at 75 cm apart followed by planking and irrigation. Give one more irrigation at 4-5 days after planting.

Intercropping: One row of summer moong or summer mash can be intercropped in between two rows of sugarcane to get 1-2 quintals per acre grain yield of these crops. These crops have no effect on cane yield of sugarcane and are beneficial to soil health.

Fertilizers: Apply 8 tonne farmyard manure per acre at 15 days before planting the crop. Apply 60 kg nitrogen per acre to planted crop and 90 kg nitrogen per acre to ratoon crop. To planted crop apply half nitrogen with first irrigation after germination and remaining half in May or June. Apply full dose of phosphorus, based on soil test, at the time of planting. In ratoon crop, top-dress one third nitrogen in February, one-third in April and the remaining one-third in May. Phosphorus on the soil-test basis should be drilled along the cane rows at the time of first cultivation in February.

Weed control: Two or three hoeings are required. The spreading of trash between the cane rows helps to suppress weeds and conserve soil moisture. Weeds can also be controlled with application of Atratаf or Sencor within 2-3 days of planting. Use 2,4-D for control of climbing *vel* and other broadleaf weeds. If summer moong or summer mash is sown in sugarcane then instead of these herbicides use Stomp within two days of sowing the crop.

Irrigation: Irrigate the crop at 7-12 days interval during April to June due to hot and dry climate. During winter, irrigate the crop at monthly intervals.

Prevention from lodging and frost: To prevent the crop from lodging earth up the crop in end June and prop the crop in end August or early September. To save the crop from frost, prevent lodging of crop as it becomes more prone to frost damage. Give frequent and light irrigations during winter as irrigation raises the

soil temperature. In ratoon crop, irrigate the field and plough the field in between the crop rows.

3.2.2 AUTUMN CANE

Improved varieties: CoJ 85, CoJ 83

Sowing: Optimum time of planting is 20 September – 20 October. Seed rate is same as that for spring cane. Planting should be done in rows 90 cm apart.

Fertilizers: Apply 90 kg nitrogen per acre - 1/3 at planting, 1/3 in end March and the remaining 1/3 in end April. Phosphorus and potassium should be applied on soil test basis at the time of planting. Apply fertilizers to inter crops as per the recommendations.

Intercropping: Potato, wheat, raya, gobhi sarson, toria, winter maize, cabbage, radish, pea, gram and garlic can be intercropped in sugarcane rows.

Weed control: If wheat or raya is intercropped then use lsoproturon and if garlic is intercropped then use Stomp.

Irrigation: Give first irrigation at one month after planting followed by three irrigations upto February and subsequent irrigations as per the recommendations for the spring crop. Rest of the recommendations are also same as that for the spring crop.

Insect-pests and diseases: The major insects-pests are pyrilla, whitefly, termite and different types of borers. The major diseases are red rot, wilt, smut, red stripe, top rot and stinking rot.

3.3 FODDERS

Green fodder is a major component of animal diet. An adult animal requires about 40 kg green fodder per day and its availability is far less than this. *Kharif* fodders include maize, sorghum, bajra, napier bajra, ginny grass, guara and cowpea.

3.3.1 MAIZE

Maize is major fodder crop in *kharif* season and it takes about 50-60 days to supply good quality fodder for milch animals.

Crop rotations: Maize-berseem-bajra/maize+cowpea

Improved varieties: J 1006

Sowing: Use 30 kg seed per acre. It can be sown from the first week of March onwards till the middle of September. Sow the crop at a row to row distance of 30 cm.

Fertilizers: Apply 10 tonnes farmyard manure per acre at the time of field preparation. Apply 23 kg nitrogen and 12 kg phosphorus per acre. Drill half nitrogen and whole phosphorus at sowing. Apply the remaining nitrogen after 3-4 weeks.

Weed control: Use Atratаf within 2 days of sowing the crop but it can also be used at 2-3 leaf stage of the crop. If mixture of maize and cowpea is sown then use Stomp within 2 days of sowing.

Harvesting: Harvest the crop when the plants are between the milk ripe stage and the dough stage of grain development (50-60 days after sowing).

Insect-pests: The major insect-pest is maize borer.

3.3.2 SORGHUM

Sorghum, also called *jowar* and *chari*, remains green and palatable over a longer period than maize and bajra fodders.

Climate and soil: Sorghum grows well in hot and dry climate. Increased humidity enhances the incidence of red leaf spot disease. It grows on all types of soils, but heavy soils are more suitable.

Improved varieties: SL 44

Field preparation: One ploughing with harrow and two ploughings with a cultivator should be followed by planking.

Sowing: Sow 20-25 kg seed per acre in rows 22 cm apart. The seed should be treated with recommended fungicides. The optimum sowing time is mid-June to mid-July.

Fertilizers: Apply 20 kg nitrogen and 8 kg phosphorus per acre at the time of sowing and another 20 kg nitrogen per acre about one month later.

Weed control: Use Atratаf within 2 days of sowing. It controls seasonal weeds particularly *itsit*/*chupati*. If mixture of sorghum and guara is sown then use Stomp within 2 days of sowing.

Irrigation: About five irrigations should be given to the March-June sown crop and one or two irrigations to the monsoon crop, depending upon the rains.

Harvesting: Harvest the crop from boot to milk stage (65-80 days after sowing).

Insect-pests and diseases: The major insects-pests are shoot fly, pyrilla and mite. The major diseases are seed rot and seedling mortality.

3.3.3 BAJRA

Bajra (Pearlmillet) being a hardy fodder crop can withstand adverse agroclimatic conditions. It can grow in light soils with low moisture. It can tolerate hot and dry weather.

Crop rotations: Bajra-maize-berseem

Improved varieties: PHBF 1, FBC 16

Field preparation: Give 2 or 3 ploughings.

Sowing: Sow the crop by broadcasting 6-8 kg seed per acre. The seed should be treated with recommended fungicides. Optimum sowing time is March - August.

Fertilizers: Apply 10 tonne farmyard manure per acre at the time of field preparation. Apply 10 kg nitrogen per acre at sowing and another 10 kg at 3 weeks after sowing.

Weed control: Use Atratаf to control weeds within 2 days of sowing.

Irrigation: Two or three irrigations are required.

Harvesting: The crop should be harvested at ear-initiation or soon after the flag- leaf emergence (45-55 days after sowing).

Insect-pests and diseases: The major insects-pests are root bug and grasshopper. The major diseases are green ear or downy mildew and ergot.

Note: For the control of insect-pests, diseases and weeds, use pesticides (insecticides, fungicides and herbicides) recommended by the Punjab Agricultural University, Ludhiana. Use these pesticides at recommended doses and at recommended times as their over-use is harmful to human health, animal health and environment.

Exercise

A) Answer in 1 - 2 words:

1. Name two *kharif* cereals.
2. Name two important varieties of rice.
3. Give seed requirement of *desi* cotton hybrid for one acre.
4. Name one major insect-pest of maize.
5. Name two diseases of sugarcane.
6. Name two pulse crops.
7. Give seed rate of maize for one acre.
8. Give sowing time of cotton.
9. Name one inter crop in sugarcane.
10. Name two fodder crops.

B) Answer in 1 - 2 sentences:

1. What is crop rotation?
2. Name two rice based crop rotations.
3. What are deficiency symptoms of zinc in rice?
4. Write the sowing methods of maize.
5. Give control of *Itsit* in maize.

6. Why puddling is done in rice?
7. Give seed requirement of sugarcane.
8. Write time and method of sowing for autumn sugarcane.
9. Give method of defoliation in moong for combine harvesting.
10. Write method of weed control in rice.

C) Answer in 5 - 6 sentences:

1. Discuss use of fertilizers in rice.
2. Explain direct seeding of rice.
3. Give details of seed treatment in cotton.
4. Discuss preventive measures for lodging in sugarcane.
5. For which crops and why sulphur is essential?

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Chapter -2

SUMMER VEGETABLES

Vegetable: -

Any succulent part of a plant i.e. leaf, fruit, root, stem, flower etc. which is eaten fresh as salad or after cooking is called vegetable.

Importance of vegetables: -

Vegetables have a great importance in human diet as they contain sufficient amount of carbohydrates, protein, minerals and vitamins which are essential for maintenance of good health. The importance of vegetables is relatively more in India as its large population is vegetarian.

Consumption of 284 gm vegetables per person per day is essential for maintenance of good health. They should include leafy vegetables (spinach, methi, lettuce and saag), flower buds (cauliflower), fruit (tomato, brinjal), root crops (carrot, radish, turnip and potato). The two main reasons of per capita low consumption of vegetables in India are population explosion and post harvest losses of vegetables.

Major vegetables:-

Chilli, tomato, brinjal, okra, bottle gourd, sponge gourd, bitter gourd, squash melon, long melon (tar) etc. are some important summer season vegetables.

The basic information regarding these is given below:-

1. **Chilli:-** Punjab Surkh, Punjab Guchhedar and CH-1 are its important varieties/hybrids. The seed rate is 200 g per acre for nursery sowing. Sow nursery in one marla (25 m^2) area to transplant one acre. The seed is sown in nursery during end October to mid-November and transplanting is generally done in February-March. Seedlings should be planted on ridges at 75 cm apart with a plant to plant spacing of 45 cm. Apply 10-15 tonnes well rotten farmyard manure, 25 kg N, 12 kg phosphorus and 20 kg potash per acre. First irrigation should be given immediately after the transplanting. Subsequent irrigations should be given at 7-10 days intervals. Harvest red or green chillies according to the demand of market.

2. **Tomato**:- Punjab Varkha Bahar-1 and Punjab Varkha Bahar -2 are two main varieties of tomato in Punjab. Seed rate is 100 g/acre for nursery sowing. Sow nursery in two marla (50 m^2) area to transplant one acre. Sow the nursery in 2nd fortnight of July and transplant the seedlings in the 2nd fortnight of August. Keep 120-150 cm distance between rows and 30 cm between the plants. To control weeds, apply Stomp or Sencor. First irrigation should be given immediately after transplanting and subsequent irrigations should be given at 6-7 days interval.
3. **Brinjal:-** Punjab Neelam (round fruited), BH-2 (oblong fruited) and PBH-3 (small fruited) are its important varieties. To plant one acre 300-400 g of seed is sufficient. Sow nursery in one marla (25 m^2) on 10-15 raised beds. Four successive crops of brinjal can be taken in one year i.e. by sowing nursery in October, November, Feb-March and July. Keep 60 cm spacing between rows and 30-45 cm between plants. First irrigation should be given immediately after transplanting and subsequent irrigations should be given at 6-7 days interval.
4. **Okra:-** Punjab-7, Punjab-8 and Punjab Padmini are its improved varieties. The spring crop is sown in February – March whereas the rainy season crop is sown in the June - July. 15 kg seed is required for sowing upto 15th February, 8-10 kg for March sowing and 5-6 kg for June-July sowing. Soak the seed in water for 24 hours before sowing. Sowing should be done on ridges in February-March and on flat surface in June – July. The row to row spacing should be 45 cm and plant to plant 15 cm. To control weeds, give 3-4 hoeings or use Stomp herbicide. The crop is ready for harvest in about 45-50 days depending upon the season and the variety.
5. **Cucurbitaceous vegetables:**
   - **(i)** **Summer squash**: Punjab Chappan Kadoo-1 is its improved variety. The crop can be grown two times in a year i.e. January - March and October – November. Prepare 125 cm wide beds and sow two seeds/ hill at a distance of 45 cm on both sides of bed. 2 kg seed is sufficient for sowing one acre. The crop is ready for harvest at 60 days after sowing.

(ii) Bottle gourd:- Punjab Barket and Punjab Komal are its improved varieties. The crop can be grown in Feb-March, June-July and November –December. The crop is ready for harvest at 60-70 days after sowing.

(iii) Bitter gourd:- Punjab-14 and Punjab Kareli-1 are improved varieties of Bitter gourd. Its sowing time is mid-February - March and June - July. 2 kg seed is sufficient for sowing one acre. Sowing should be done on both sides of 1.5 m wide beds, keeping plant to plant distance of 45 cm. The crop is ready for harvest at 55-60 days after sowing depending upon season and variety.

(iv) Sponge gourd:- Pusa Chikni and Punjab Sponge gourd-9 are its improved varieties. The sowing time is mid Feb-March. The crop can also be sown in mid-May to July. Sow atleast two seeds per hill on one side of 3 metre wide beds at a spacing of 75-90 cm. Use 2 kg seed/ acre. The crop is ready for harvest in about 70-80 days after sowing.

(v) Ash gourd:- PAG-3 is its improved variety. The sowing time is Feb–March and June-July. Use 2 kg seed/acre. Sow atleast two seeds per hill on one side of 3 m wide beds at a spacing of 75-90 cm.

(vi) Cucumber:- Punjab Naveen is its improved variety. The sowing time is February-March. Use 1 kg seed/acre. The seeds are sown on both sides of 2.5 metre wide beds at a distance of 60 cm. For early crop and higher income, the cucumber can be grown under low tunnel polythene sheets.

(vii) Long melon: - Punjab Long Melon-1 is its improved variety. Sow crop in February-March and use 1 kg seed per acre. Seeds are sown on both sides of 2.5 metre wide beds at a distance of 60 cm. Its fruits are ready for picking in about 60-70 days after sowing.

(viii) Squash melon:- Tinda-48 is its improved variety. Sow the crop in February - March and June - July and use 1.5 kg seed/acre. The seeds are sown on both sides of 1.5 metre wide beds at a spacing of 45 cm. Fruits are ready for first picking after 60 days of sowing.

(ix) Muskmelon:- Though muskmelon is used as a fruit but scientifically it is considered as a vegetable. Punjab hybrid, Hara madhu and Punjab sunehri are its improved varieties. Sow the crop in February-March. For sowing one acre, 400 g seed is sufficient. The seeds are sown on 3-4 metre wide beds at a distance of 60 cm. Irrigate the crop every week during summer. At the time of fruit maturity, water should be given when it is absolutely necessary. The over flooding of the field should be avoided.

Exercise

A) Answer in 1 - 2 words:

1. Write name of two varieties of chilli.
2. How much is requirement of vegetables per person per day for maintenance of good health?
3. Write name of two improved varieties of tomato.
4. How much seed per acre of okra is required for sowing in February?
5. How much spacing is required between rows in brinjal crop?
6. Write name of two varieties of bitter gourd.
7. When sowing of bottle gourd should be done?
8. How much seed of cucumber is required per acre?
9. How much seed of muskmelon is required per acre?
10. What is sowing time of sponge gourd?

B) Answer in 1 - 2 sentences:

1. What do you mean by vegetable?
2. How much seed and area is required for raising nursery for transplanting one acre tomato?
3. How much fertilizers are used per acre for chilli crop?

4. How four crops of brinjal are raised in a year?
5. What is sowing time and seed rate of okra?
6. Give the reasons for low availability of per capita per day vegetables in our country.
7. What is the ideal time for sowing and transplanting of nursery of tomato?
8. How many days are required from sowing to harvesting in bittergourd?
9. Write two improved varieties and sowing time of muskmelon.
10. How can we get early and higher yield in cucumber?

C) Answer in 5 - 6 sentences:

1. Write name of summer vegetables and describe any one of them?
2. Write short note on improved varieties, sowing time, seed rate and control of weeds in okra.
3. What is importance of vegetables in human diet?
4. Describe cultivation of bottlegourd.
5. How to raise successful crop of ashgourd?

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Chapter -3

FLOWER CULTIVATION

Flowers are associated with human life since time immemorial. They are used for worshipping, marriages and other social functions in India. Indian women use flowers to adorn their hair. Now-a-days, flowers are used for gift purposes and also for making flower arrangements. During ancient times, these requirements were met from home grown flowers but these days the cultivation of flowers has assumed a remunerative agricultural activity. As the living standard of the people has improved over the years, the demand for flowers has also increased substantially. Area under flower cultivation in Punjab is around 2160 hectares out of which 1300 hectares are under fresh flowers and remaining under production of seeds of flowering annuals. Demand of flowers for various social occasions is being met from the flowers grown in our state as well as by importing substantial quantities from other states. Flower crops can be divided into following two categories:

a) Loose flowers:

These flowers are harvested from the base of flowers without their stems/ branches, e.g. marigold, annual chrysanthemum, rose, motia (Jasmine) etc. These flowers are mostly used for making garlands, worshipping and also for other decoration purposes.

b) Cut flowers:

These flowers are harvested and marketed along with their long stems/ branches. These type of flowers are generally used for making flower arrangements and also for gift purposes. The demand for these flowers has also increased during the past few years. Major cut flower crops are gladiolus, chrysanthemum, gerbera, rose and lilium.

Gladiolus

Cultivation of major flower crops:

Gladiolus

It is a major cut flower crop of our state and is cultivated from the corms. The corms are planted in the field from September to mid November at a

spacing of 20×30 cm. The staggered planting at 15 days interval is usually practiced to have regular supply of flowers.

Flower spikes are harvested and marketed when basal floret is half or fully open. These cut spikes can also be stored by keeping in water for nine days in cold store. Six to eight weeks after harvesting the flower spikes, the corms are dug out from the soil. These corms are cleaned and dried under shade and are stored in the cold store for planting in the next season.

Marigold

Marigold

It is a major loose flower crop of our state and is cultivated throughout the year. The soils of Punjab are highly suitable for its cultivation. It is of two types- African marigold and French marigold. It is cultivated from seed by raising its nursery on raised beds. Six hundred gram seed is required for raising seedlings for one acre. Marigold is cultivated during rainy, winter and summer season. For rainy season crop, sowing is done during last week of June or first week of July, while for winter season, sowing is done during the mid September. For summer season, sowing is done during first week of January. Seedlings are ready for transplanting about one month after sowing. African type marigold is transplanted at 40 × 30 cm while French marigold is transplanted at 60 × 60 cm spacing. The crop starts flowering 50-60 days after transplanting. Fully opened flowers are harvested for marketing. Yield of loose flowers of rainy season crop is around 200-250 quintal per hectare while it is around 150-170 quintal per hectare for winter season crop.

Chrysanthemum

Chrysanthemum:

Chrysanthemum is cultivated for cut flowers, loose flowers and as pot plants. The terminal stem cuttings of plants are cut from old plants (known as mother stock) from end June to mid July. These

cuttings are planted in the soil under semi shade conditions. The rooted cuttings are transplanted in the field during mid July to mid August at a spacing of 30 × 30 cm. Flowering occurs during November-December. For cut flower purpose, the cut stems are harvested 5 cm above ground while for loose flowers fully opened flowers are harvested. After harvesting the flowers, the plants are kept as mother stock for obtaining cuttings during next season.

Rose: Rose is cultivated for cut and loose flowers. For loose flower production generally red rose is cultivated. Rose plants are pruned annually during the second week of October. For marketing as loose flowers, fully opened flowers are harvested but for cut flower production, they are harvested along with long stems at tight (closed) bud stage. Cut flower varieties are propagated through T-budding whereas the plants for loose flower production are propagated from stem cuttings in November-December.

Rose

Gerbera: Gerbera is cultivated under protected conditions in Punjab. It is grown as a cut flower crop. The flowers of gerbera with red, orange, white, pink and yellow colour are in more demand. Gerbera plants are propagated through tissue culture and its planting time is September - October. A crop once planted would produce flowers for three years. Fully opened flowers are harvested for marketing.

Gerbera

Tuberose: Tuberose flowers are used as cut flowers, loose flowers and also for oil extraction. Tuberose is of two types i.e. single and double. Single types are more fragrant and are used for oil extraction. Tuberose is propagated from underground bulbs. Bulbs

Tuberose

are planted during February - March and flowering occurs during July - August. From one acre around 80,000 cut flowers or 2.0-2.5 tonnes of loose flowers can be harvested.

Motia (Jasmine): Motia has an important place among the fragrant flowers. Flowers of motia are of white colour, which are used for making garlands for worshipping and also for oil extraction. Summer season and dry weather are suitable for its growth and flowering. Light to heavy soils with good drainage are suitable for its cultivation. After flowering the plants are cut back upto 45-60 cm above ground level from second year onwards. Flowers appear from April-August-September. Unopened flower buds are harvested for marketing.

Motia (Jasmine)

Exercise

A) Answer in 1 - 2 two words:

1. Which is the major cut flower crop?
2. Which is the major loose flower crop?
3. How much area is under flower crops in Punjab?
4. What are different types of flowering crops being cultivated in Punjab?
5. When gladiolus corms are planted in the field?
6. Which month is suitable for making chrysanthemum cuttings?
7. How gerbera is propagated?
8. Which colour of the rose is widely grown for loose flower production?
9. Which flowers are used for extraction of oil?
10. Which flower is generally grown in protected conditions?

B) Answer in 1 - 2 sentences:

1. Define cut flowers and name the major cut flower crops under cultivation.
2. How gladiolus spikes are harvested and stored?
3. How the roses are propagated?
4. Which months are suitable for raising nursery of marigold crop?
5. What is the planting time for winter season marigold?
6. Write the harvesting stages of following flowers

   a) Gladiolus b) Rose as cut flower

   b) Motia
7. What is plant spacing in African and French marigold?
8. What is planting time of gerbera? For how many years gerbera crop gives flowers?
9. Write names of loose flowers and write their uses.
10. Which is the appropriate soil for Jasmine production?

C) Answer in 5 - 6 sentences:

1. What is the importance of flowers in human life?
2. What is the difference between cut flowers and loose flowers? Give examples.
3. Write a brief note on importance and cultivation of motia?
4. Write a short note on transplanting, harvesting and yield of marigold?
5. How the following flowers are propagated

   a) Gladiolus b) Tuberose

   c) Chrysanthemum d) Gerbera

Chapter -4

Marketing of Farm Produce

Marketing of farm produce means an efficient sale of crop produce in the market. The majority of the farmers think that marketing begins after harvesting of the crop but such thinking is totally incorrect as agriculture and marketing now is not just an ancestral occupation but it has taken the shape of a commercial venture. Therefore, farmers should take marketing of farm produce in consideration even before sowing or in the beginning of sowing of crops. To get good quality produce the farmers need improved-certified seeds and require good farm planning such as which crop is to be sown on how much area and what resources are needed to cultivate the crops. The sowing, hoeing, irrigation, use of weedicides and insecticides, right combination of chemical fertilizers, harvesting and threshing of crops should be carried out with the guidance of the farm experts. Among the crops, wheat and paddy, being the most important from food security point of view, are covered under minimum support price (MSP) programme and public sector agencies intervene in their marketing.

At the time of marketing of crops the produce should be clean, free from dust and dirt, admixture of other crops, and damaged grains. Before taking produce to the market the farmers should take approximate weight of the produce because sometimes weigh men overweigh it. Before disposal of the produce the farmers should have complete market information such as quantum of market arrival, prevailing prices and entry of government procurement agencies. It would be better if the farmers dispose of their produce after grading. The graded produce fetches higher price by 10 to 20 percent. The grading of produce should be done according the norms set by the government or procurement agencies. The moisture content in the produce should be as per permissible norms. There should be minimum losses during transportation of the produce to the market. The produce should be brought in the morning in the market so that farmers can return to their homes after disposal of the produce by the evening. It has commonly been observed that farmers bring the produce to market immediately after threshing of crops which causes glut in the market and farmers receive lower prices for their produce. Therefore, the farmers should store some of their produce in stores/

godowns and sell later on when prices increase. The following points should be taken into consideration for proper marketing of crops to earn reasonable profits:

1. **Harvesting and threshing of crops**: Time of harvesting is as important as the timely sowing of crops and the use of recommended dosages of fertilizers and irrigation. Harvesting of crop before proper ripening leads to shrinkage of grains resulting in deterioration of quality of the produce thereby, reduction in its sale value. On the other hand if the harvesting is delayed, there may be grain loss leading to less yield, and the farmers will not even recover the expenses incurred on raising the crops. The harvesting and threshing of crops at proper time ensures timely sowing of the next crop.
2. **Preparation of farm produce for market**: Before bringing the produce to the market two things may be taken care of such as cleaning of produce and its moisture content. Mostly the crops are thrashed on *katcha* floor, as a result grains get mixed with dirt and dust. So, before taking produce to the market it is important to clean the produce at farm itself in order to avoid wastage of time in the market. All the government procurement agencies offer prices of the produce on the basis of moisture content. If the moisture content is higher than the prescribed limits then the farmers face difficulties in the disposal of the produce.
3. **Grading of the produce:** The grading means categorization of produce in different groups. Producers can realize the higher profits from their produce simply by selling the graded produce. The grading becomes more important, when some part of crop is damaged due to lodging or some disease. The help of the grading assistant posted in the market should be taken in this regard. As far as possible different varieties should be marketed separately. By doing so the right price of the produce can be realized.
4. **Supervision of produce in the market**: The supervision of produce in the markets is as important as at the time of harvesting and threshing of crops. The presence of the producer/seller is important from unloading till weighment of the produce. It has commonly been observed that the *palledars* (market labour) sometimes mix produce of two farmers or the produce with waste material leading to loss to the farmers. In order to avoid such losses the farmers should take care of his produce till weighment.

5. **Supervision at the time of auction:** The farmers should remain present at the time of auction of their produce so that farmer can know about the price at which his produce is sold. If the farmer finds the offered price to be lower than his expectation he can simply refuse to sell his produce. Otherwise it will not be possible for him to do so if he is not physically present at the time of auction. Sometimes, the farmers leave their produce at the goodwill of the commission agents who may tell less price even though the produce was sold at higher price. It is pertinent to mention here that at time of marketing of produce some educated family member should be present in the market.
6. **Right to test weighment**: Under Markets Act 1961, every farmer has the right to test weighment. If the farmer has doubt that the weighment of the produce is not done properly, then according to this Act, the producer/ seller has the right to go for test weighment of the produce up to 10 percent of the produce free of cost. The test weighment can be done in the presence of the officials of the concerned market committee. If there is over weighment of the produce, the matter should be brought in the notice of higher officials of the market committee. In this way farmers can prevent over weighment of their produce.
7. **Procurement of J Form:** After the sale of the produce, the farmers should not forget to get **Form-J** wherein all the details about the name of the produce, name of purchaser, weight of the produce, price and total charges are mentioned. With this form, farmers can avail the opportunity of getting bonus declared by the government from time to time and fudging of the market fees by the commission agents can also be saved.
8. **Cooperative marketing:** As far as possible the farmers should market their produce through cooperative societies. These societies mostly work as commission agencies. These societies are of the farmers and help to ensure that the farmers get better prices for their produce and payments are made earlier than the commission agents. In addition to this, these societies provide other facilities to the farmers like crop loan, fertilizers, insecticides, etc. at the reasonable rates.
9. **Use of mechanical handing units:** The Punjab Mandi Board has set up some mechanical handling units in Punjab by which cleaning of produce,

bag filling, and weighment are done mechanically. These units help in saving time to perform these operations. It is worth mentioning here that farmers are to pay less for these operations and moreover, the produce is sold at higher price. The on the spot payment is done in cash. Therefore, the farmers should avail this facility so that they can dispose of their produce in less time and realize higher price. The Food Corporation of India (FCI) has established bulk handling units at Mandi Gobindgarh, Moga and Jagraon for storage and handling of wheat on large scale. The farmers can sell their produce directly through these units. This has many benefits like payment on the same day, no market charges to be made and produce is saved from natural calamities such as rain, storms, etc.

10. **Market information:** Due to increase or decrease in the volume of market arrivals the prices keep fluctuating. Farmers should collect information regularly on prices from the nearby markets. The farmers should examine the prices of nearby markets before taking the produce to the market in order to get good price for their crop. The information of prices can be obtained from radio, TV, newspapers, internet, etc.
11. **Market committee and farmers:** The market committee is an institution of the farmers whose main job is to protect the interests of the farmers in the market. Market committee coordinates the auction of the produce and ensures that the produce is auctioned at the right time. In addition to this the market committees ensure right weighment of the produce. If the farmer faces some problem in disposal of his produce then the higher officials of the market committee can be contacted.

Exercise

A) Answer in 1 - 2 words:

1. Is the efficient marketing of produce start before or after harvesting of crop?
2. What is the major job of the market committee for the farmers?
3. If there is faulty weighment of produce to whom the farmers should complain.

4. Before the farmers bring their produce in the market what are the two major issues to be taken care of?
5. Name the agency which has established bulk handling units at Mandi Gobindgarh, Moga, and Jagraon.
6. Which form is to be procured by the farmers from the commission agents after the weighment of produce?
7. What are different sources of market information about the prices of different kind of farm produce?
8. What is basis on which the government procurement agencies quote the prices of agricultural produce in regulated market?
9. In the case of doubtful weighment of the produce what percent of produce is rechecked for test weighment free of cost?
10. Which Act, gives right to the farmers for test weighment of the produce?

B) Answer in 1-2 sentences:

1. What are different issues relating to the farming on which the expert needs to be consulted?
2. What points are to be taken care of in choosing the crops for cultivation?
3. Before bringing produce to the market what major factors are to be examined?
4. What factors should be taken care of while disposal of farm produce in the market?
5. What are advantages of disposing of the produce at the bulk handling units/silos?
6. Why the supervision of the produce is important in the market?
7. What are advantages of the knowledge of prices of produce in different markets?
8. What are two major functions of the market committee?
9. What is meant by grading?
10. What are the advantages of taking J-Farm?

C) Answer in 5-6 sentences:

1. Write short note on public intervention in marketing.
2. Give a brief account of cooperative marketing.
3. What are advantages of grading of the produce?
4. Write a brief note on mechanical handling units.
5. What are advantages of efficient marketing of farm product?

Chapter - 5

QUALITY CONTROL OF SEEDS, FERTILIZERS AND INSECTICIDES

Seeds, fertilizers and insecticides are three main commodities required for profitable farming. Therefore, quality of these must be assured. If seeds are not of good quality, then all the hard work of doing other operations goes in vain. Likewise, if fertilizers are also not of good quality, then farmers cannot obtain potential yield from the crops. In order to prevent weeds, insect-pests and diseases of crops usage of good quality agrochemicals is of paramount importance.

Therefore, the Govt. of India under the essential commodities act has made certain laws to ensure quality of seeds, fertilizers and insecticides, which are given below:-

i. Seed control order

ii. Fertilizer control order

iii. Insecticide Act

In Punjab, all these three laws are implemented by Department of Agriculture, Punjab. If anyone finds these inputs of poor quality or adulteration in these agri-inputs, then complaint can be filed/made to the Chief Agriculture Officer of the respective district or to any other officer appointed by the Government. These officers check these agri-inputs at their own level and also take samples of these items in a routine manner. In case any evidence of poor quality is found in these commodities, then legal action is taken against culprits and their license of sale can also be cancelled.

1. Seed control order :

Main provisions of Seed Act are:

(a) Right to give license: According to this order, the state Government can appoint any officer as license officer and also decides his jurisdiction area. In Punjab state, this right is with the Department of Agriculture.

(b) Seed inspector: Under this Act, Government appoints the Agriculture Development Officer as seed inspector and also notifies his jurisdiction

and powers. Seed inspector can acquire/get any information regarding stock of seeds, purchase of seeds, sale of seeds, etc. Seed inspector can check the seed shops and can also take samples of seed. He can get these samples tested from a seed testing laboratory, can restrict the sale of seeds and can also take documents related with seeds into his possession. Apart from that, he can also write to the officer concerned to cancel the license of violator of the act.

(c) Rights of farmers: Under this Act, rights of the farmers are secured who purchase the seeds, so that in case of any problem, farmers can get the compensation for their expenditure on seeds. If the buyer of seeds feels that low quality of seeds, provided to him by the seed dealer, was the main reason for the failure of his crop, then he can also file written complaint against the dealer to seed inspector. In order to file a complaint against the seed dealer, he should attach below given documents with his complaint as evidence:

- Receipt/bill provided by the dealer
- Label tagged on the seed bag
- Empty seed packet/bag/container
- Sample which was taken from purchased seed

On receiving the complaint, seed inspector investigates the matter and if he finds that failure of crop was mainly due to poor quality of seeds, then he takes legal action against the seed dealer.

(d) Law regarding sale of seeds: Under article 7 of the seed act, sale of only notified seeds is allowed. These seeds should be in sealed packets, containers or bags and should have a quality label of certified seeds or truthfully labeled (TL) seeds.

(e) Certification/Attestation of Seeds: Producers of seeds have full freedom for certification of seeds. It is their choice whether they want to get certification for the seeds produced by them or not.

2. Fertilizer Control Order:

Fertilizer Control Order-1985 was made to ensure quality and correct weight of fertilizers and also to prevent sale of adulterated, low quality and non

certified fertilizers. The implementation of this Order is entrusted to Agriculture Officer and Agriculture Development Officer (ADO) under the supervision of Director, Department of Agriculture. In order to sell fertilizer at any place, a dealer is required to get license from Chief Agriculture Officer of the district.

In order to check the quality of fertilizers, monitoring is done at various levels according to the rules of fertilizer control act. No dealer is permitted to sell the fertilizer, which is below specified standards. The competent authority which does inspection of fertilizer factories has also been given the right to check the quality of fertilizers which are supplied to farmers by dealers or shopkeepers.

The samples of fertilizers are taken and sent to the fertilizer testing laboratories at Ludhiana and Faridkot. Legal action is taken against the companies whose samples are found to be of poor quality or below specified standards and their licenses can also be cancelled.

3. Insecticide Act:

This Act was made in 1968 and the main objectives of this Act are to control and monitoring of import, production, transportation and proper use of insecticides in order to prevent human beings and animals from their harmful effects. Under this Act, Government of India has constituted Central Insecticide Board (CIB), which gives advice or suggestions to Government for the implementation of this Act. Central Registration Committee made under this Act, provides registration for the manufacturing of agro-chemicals or insecticides and also gives permission for their import and export. This Act has been implemented to check adulteration and discrepancies in the insecticides. According to this Act, sale of insecticides having their expired date of use and which are below specified standards is illegal. Punjab Government has given the authority to Chief Agriculture Officer of respective districts to provide license to the dealer in order to sell insecticide. Under the Insecticide Act, ADO has been declared as insecticide inspector. These inspectors do inspection of insecticide shops, godowns and sale centers, which fall under their jurisdiction. They take samples of insecticides and send them to laboratories at Ludhiana, Amritsar and Bathinda for further investigation. The licenses of those who defy/flout the Act are cancelled and legal action is also taken against them.

Exercise

A) Answer in 1 - 2 words:

1. Name the Act to control the quality of seeds?
2. Name the Act to control the quality of fertilizers?
3. Name the places where laboratories for checking the quality of fertilizers are located.
4. Name the Act to control the quality of insecticides?
5. Who gives advice to Government of India regarding implementation of insecticide act?
6. Name the places where laboratories to check quality of insecticides are located?
7. Who gives permission to import pesticides from foreign countries?
8. Under insecticide act who is declared as insecticide inspector?
9. To whom shall you file a complaint against a dealer who sells low quality fertilizer?
10. Name the item for which TL label is used?

B) Answer in 1-2 sentences:

1. Why the quality control of fertilizers is important?
2. Why the quality control of seeds is important?
3. Name the commodities related to agriculture which are included under Essential Commodities Act?
4. Name the laws which are implemented to control the quality of seeds, fertilizers and insecticides?
5. What are the rights of seed inspector for controlling the quality of seeds?
6. What are the rights of a farmer under seed control order?
7. What evidence is required to file a complaint against dealer who sold low quality seeds?

8. Name the law for assurance of quality of fertilizers? Name the officer of agriculture department deputed for the proper implementation of this act?
9. To check the quality of insecticides, what are the important actions taken by an insecticide inspector?
10. Write about article-7 of seed act?

C) Answer in 5-6 sentences

1. Why is it important to control the quality of seeds, fertilizers and insecticides?
2. How the quality of insecticides is controlled with the help of insecticide act?
3. Describe the five main articles of seed control order?
4. What are the rights that are enjoyed by the farmers under seed control order?
5. Name three products required for the development of agriculture and also give a brief description about their quality control?

Chapter -6

DAIRY FARMING

With the implementation of World Trade Organization (WTO), it is necessary to produce good quality milk economically so that demand for quality products is more and earning is also higher. In Punjab, two-third population is living in rural areas and its major occupation is agriculture. Agriculture fails to provide the year-round employment. Moreover, land holding is decreasing day by day. Thus, agriculture is becoming uneconomical. Hence, diversification of agriculture, along with establishment of agro-industrial units in rural areas, is the need of the hour. Animal husbandry, especially, dairy farming can play an important role in diversification of agriculture. It increases family income and yield of agricultural crops, improves soil fertility and provides pollution free energy as gobar gas. It also solves the problem of unemployment and provides employment to every member of family as per one's strength and choice. Involvement of family labour helps in increasing the family income. It improves social status of family and provides regular income throughout the year.

1. Milk Production in Punjab

There are about 17 lakh cows and 50 lakh buffaloes in Punjab which produce approximately 94 lakh tonnes of milk annually. Punjab is one of the leading milk producing states in the country with 937 g per day per capita availability of milk while at country level, it is 291 gram. Daily milk requirement for a healthy person is 250 gram.

India ranks 1st among the milk producing countries in the world. In order to compete in the world market, we have to make efforts to reduce per unit cost of milk production and improve quality of milk. Milk production can be increased either by increasing number of animals which are already in excess in India or by improving the potential of existing dairy animals or importing exotic cows. But the exotic animals face problems of adaptation to local environment and have more health problems. Hence, improvement of genetic potential of existing animals is the best option. To achieve this objective, rearing of the improved breeds of animals and adoption of optimum management practices are the solutions.

2. Breed Improvement of Buffaloes and Cows

In order to increase milk production; animals must be of good breed which is a basic necessity. For economical dairy farming, animals must have the following qualities:

Quality parameter	Buffalo	Cow
305 days lactation milk yield (kg)	2500	4000
Peak yield (kg)	12-13	19-20
Age at first calving (months)	36	30
Service period (months)	2-4	2-4
Dry off period before calving (months)	2	2

For breed improvement of animals with above qualities, the selection of breeding bull is very important. For selection of good quality bulls, we have to test them on the basis of the performance of their progeny at large scale. In plain areas of Punjab, for breed improvement of cows, crossbreeding with Holsteinv-Friesian is advocated. In sub-mountain areas, Jersey breed is used for this purpose because there is shortage of fodder in that area and Jersey is a short statured breed. Holstein-Friesian gives the highest milk while Jersey has more fat percentage in milk. Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana provides semen of improved and progeny tested bulls for this purpose. Punjab government has also chalked out a mass programme to provide semen doses of Holstein Friesian and Jersey breed for crossbreeding of cows which will lead to white revolution. Result of breed improvement is visible after 5-7 years when next generation starts giving milk after calving. In order to avoid inbreeding, keep the record of name or number of bulls and genetic potential of bulls.

Selection of Dairy Animals

In Punjab, cows and buffaloes are the major dairy animals. Always purchase a dairy animal after 3 times regular milking. Animal must have thin skin, wedge (triangular) shaped body while seeing from top, front and hind side. Udder should not have any hard lump and it must shrink after milking. Purchase animal in

second or third lactation and is better if animal is having a female calf.

3. Cow rearing

In India, indigenous breeds of cows are reared for milk production but these breeds give less milk. Now, government has started cross breeding programme for improving milk yield of cows.

3.1 Indigenous breeds of cows

(A) Hariana: This breed has its origin in Rohtak, Hisar, Karnal and Gurgaon districts of Haryana. Its animals have white to light grey colour, medium size, long length and long legs. It is the best dual purpose breed because cows give more milk and males are good and strong bullocks. Body is compact with tight skin. Average lactation milk yield is 1000 kilogram with about 4% fat.

(B) Sahiwal: It is the best Indian milch breed. This breed is native of Montgomery (Pakistan). However, animals are also found in Ferozepur, Fazilka, Amritsar and Tarntaran districts of Punjab. Body size is medium to large; light red to red colour, loose skin, voluminous dewlap and short legs. It has short horns and large udder. Bullocks are lethargic and slow for work. Average lactation milk yield is 1800 kilogram with 5% fat.

(C) Red Sindhi: This breed belongs to Sindh (Pakistan). Animals are of medium size, docile and have good milk yield. Its colour is dark red, compact body, loose skin and short legs. It gives an average milk yield of 1800 kilogram per lactation. Its milk has 5% fat.

(D) Tharparkar: This breed has its origin in Sindh (Pakistan), Kutch (Gujrat), Jodhpur and Jaisalmer districts of Rajasthan. Animals have medium size, compact body, white or greyish colour, broad forehead, short legs and large udder. Its average lactation milk yield is 1400 kilogram. It is a dual purpose breed.

3.2 Exotic breeds of cows

(A) Holstein-Friesian: This breed is a native of Holland but now, it is dominating in almost all the countries of world. Animals of this breed are the heaviest and give the highest milk yield. Cows have long body and large udder. It has dark and white colour but animals with red and white colours are also available. Average lactation milk yield is 5500-6500 kilogram with 3.5- 4% fat.

(B) Jersey: This breed belongs to Jersey Island of England. Animals are short statured. Animals have brown to brownish red colour (fawn colour). Average milk yield is 3000-5000 kilogram with 5% fat.

Feeding of cows

Feed nutrients for animals can be classified into 4 parts i.e. energy, protein, minerals and vitamins. Good quality feed is the basic requirement of animal for body functions and milk production. All animals meet their energy requirement from carbohydrates, proteins and fat. In dairy animals, 80% energy requirement is met from carbohydrates. Plant cellulose and starch are the major sources of carbohydrates and are supplied through fodders and concentrated feed. An average cow or buffalo with 400 kg body weight requires about 35 kg green fodder (Berseem, lucerne, maize, sorghum and bajra) for daily body maintenance. Mix 2-3 kg of wheat *bhusa* in lush green berseem or lucerne as they contain higher amount of moisture and protein and less amount of dry matter. Milk production and growth requirement is met through good quality green fodder and balanced ration.

Concentrate (Feed)

Concentrate is prepared by mixing cereals (grains), oilseed cakes and bi-product of cereals to meet their daily feed requirement. While feeding leguminous fodder, i.e. berseem, lucerne, cowpeas, concentrate with less protein (13-15%) is fed while feeding non-legume fodder, protein is increased (16-18%) in concentrate as given in the Table 1:

Table 1. Composition of one quintal of concentrate mixture

Feed ingredients (kg)	Protein	
	13-15 %	16-18%
Cereals (wheat/maize/oats/bajra etc.)	45	37
Oilseed cake	22	30
Rice bran/wheat bran	30	30
Mineral mixture	2	2
Common salt	1	1

3.4 Management of cows

i. **Dry and pregnant cow:** Dry off the pregnant cow 60 days before the expected date of calving. Stop feeding concentrate feed for 5-7 days and reduce green fodder quantity. Infuse intra mammary antibiotic tubes in teats to prevent mastitis after last milking. Isolate the pregnant animal from rest of herd in a clean and disinfected room. Put bedding in the room. Don't transport the pregnant animal and avoid slipping of animals. Keep the animal under close observation to prevent any problem and injury.

ii. **Management at calving**: If there is delay in calving or any other problem, then contact the Veterinary Doctor. Offer one bucket of warm water with 50 gm of common salt after calving. Give 1 kg cooked ground wheat dalia in ½ kg jaggery (gur) twice a day for 4 days. Milk the animal within 2 hours of calving. Avoid complete milking of high yielder for 2-3 days after calving.

iii. **Management of newly born calf:** Clean the calf with clean and dry cloth. Cut the naval cord after keeping 4 inches with a sterilized scissor. Dress the naval cord 2-3 times daily with tincture of iodine or Dettol till it sheds off. It is very necessary to feed colostrum within 2 hours of birth. In case of death of mother, feed warm mixture of one litre cow milk, 5 ml castor oil, 5 ml cod liver oil and one egg. Feeding of calf starter should be started at the age of 15 days and thereafter feed succulent green fodder daily.

iv. **Weaning:** Always feed milk to calf and avoid sucking. Wean off the calf immediately after birth from mother so that it can be easy to estimate the exact milk production of the cow and the calf can be fed clean milk as per the requirement. Weaning will also help in avoiding injury to teats and transmission of infectious diseases. Animals give milk easily even in case of calf mortality.

v. **Disbudding**: Disbudding should be done at the age of 7-10 days in case of buffalo calves and 15-20 days in case of cow calves. It is done with red hot iron method. After disbudding, apply antiseptic cream on the wound till complete healing. Disbudded animals look beautiful, avoid fighting, require less space and can be kept in loose housing system.

vi. **Identification of calves and management:** In large herds, tattooing in ears or number can be put in neck with rope or chain for identification of calves. In heifers and adult animals, ear tags or branding with hot iron can be done for this purpose. Prevent the attack of ticks and lice by keeping them clean with brush or currycomb (*kharkhra*) and in case of their infection, use recommended insecticide regularly. Get the calves vaccinated for prevention of foot and mouth disease, hemorrhagic septicemia, etc.

vii. **Heifer management**: Feed them well for proper body weight gain. Heifers should have 300 kg weight at the age of 18 months. Watch the heifer for heat system at the age of one year.

3.5 Clean milk production

Milking should be done quietly and cleanly in clean utensils. If possible, milking should be done in a separate room. Animals should be washed and well fed before milking in a regular manner. Clean the udder with a cloth soaked in a disinfectant or Dettol or potassium permagnate. Complete the milking within 6-8 minutes with full hand method. Avoid use of thumb for milking. Milking utensils should be clean. If milking machine is used, use all precautions. Follow teat dipping in 50% betadine and 50% glycerin solution. Store the milk below 5^{o}C temperature till its disposal.

3.6 Cow shed

Keeping in view the prevalent climatic conditions in Punjab, animals sheds should be such that animals can be tied during feeding and milking and kept loose for rest of the time. Keep the length of shed in East-West direction and if possible, make the manger in the North.

Space requirement: Every adult animal requires 120-140 square feet of space out of which 42 square feet should be covered and 85 square feet should be open area.

Floor: One animal needs 5-7 square feet long and 4 feet wide space for standing. For efficient drainage of water, keep slope from manger towards gutter. Floor should be made of *pucca* bricks and cement. It should be non-slippery. Make corrugations in floor. Open space should be brick laden. Erect a boundary wall of 5-6 feet height around the shed.

Roof: Roof of bricks and wooden battons is economical and comfortable. Height of roof should be 10 feet. Put plastic sheet on the roof to prevent leakage during rains. Treat the wooden material with insecticide to prevent termite attack.

Water manger: Height of the water manger should be 2 feet for adult animals and 1 feet for young calves.

Silo pit: Silo pit for silage making should be made near chaff cutter at higher elevation than ground so that rain water does not enter in the pit. Size of 20 x 12 x 5 feet is sufficient to store 150 quintals of green fodder in a silo pit.

Management of cow dung: Remove the cow dung everyday and put it in a pit which should be away from shed. Start filling the pit from one side and go on covering the filled pit with soil to avoid wastage of nutrients. Use well prepared farm yard manure for fields. Try to use farm yard manure in *Rabi* season because temperature is less during this season and nutrient loss is less. If animal shed is in the agriculture field, then mix urine with irrigation water.

Disinfection of shed: Disinfection of shed kills germs which help in prevention of diseases. Disinfect shed with 4% phenyl solution. After 6 hours disinfection, wash the walls, floor and equipment with clean water. If the floor is *katcha* one, then remove one inch of top soil and replace it with new soil.

Summer management: Offer adequate amount of clean and freshwater for drinking in summer. Grow shady trees around sheds. Give bath for 3-4 times in a day. Install fans and coolers for hybrid and costly animals.

Winter management: Keep the animals under roof during rainy and winter seasons. Replace wet bedding daily especially in calves. Give more energetic ration during extreme winter. Put curtains or gunny bags on sides of sheds to prevent animals from ill effects of extreme cold weather.

4. Buffalo rearing

Indian breed of buffalo is the best in the world. Hence, crossbreeding is not possible for genetic improvement. There are 15 breeds of buffalo in India. Average lactation milk yield is 500 kilogram in India while in Punjab; it is 1500 kilogram per lactation.

4.1 Breeds of buffalo

In Punjab, there are only 2 popular breeds.

A. **Murrah:** It is a native of Rohtak (Haryana). Colour of this breed is jet black but switch of tail may be white. Horns are tightly curled, neck and

head are slim, large udder and long teats. Average lactation milk yield is 1700-1800 kilogram with 7% fat.

B. Nili-Ravi: Origin of this breed is Montgomery (Pakistan). Colour is black with white forehead, white legs below knees and white tail. It is also known as *Panj-Kaliani*. Horns are short, curled, blue eyes and medium stature. Average lactation milk yield is 1600-1800 kilogram.

4.2 Selection of buffaloes for breed improvement

Select the buffaloes on the basis of milk production in first lactation. In first lactation, it should produce at least 2000 kilogram while in succeeding lactations, milk production must be more than 2500 kilograms. Age at first calving should be 36-40 months and calving interval should be 15-16 months.

4.3 Feeding of buffaloes

Economical milk production can be achieved by feeding good quality green fodder. Quantity and quality of concentrate depend on quality of green fodder. Surplus legume green fodder can be conserved as hay while non-leguminous green fodder can be conserved as silage. During shortage of green fodder, wheat *bhusa* and other crop residues can be used as fodder.

Start feeding half kilogram of concentrate feed daily and increase the quantity gradually till it reaches the maximum limit to meet the milk production requirement. Nutrient requirement in the first half of lactation is more. Feed 0.5 to 1 kg extra concentrates to animals below 5 years of age as these animals gain body weight during this period.

Special management points for feeding

i. Always feed concentrate before milking or during milking in equal quantity.
ii. Avoid sudden change in concentrate.
iii. Always use ground coarse grains for feeding.
iv. Always chaff the fodder of Napier bajra, bajra, maize, etc. before feeding.
v. Mix small quantity of chopped wheat straw (*Turi)* or other dry fodder in lush green legume or green fodder to avoid bloat and indigestion.
vi. Feed silage after milking otherwise its unpalatable odour will appear in milk.

4.4 Management of calves

Proper management practices should be adopted before and after birth. Pay proper attention towards newly born calf. Keep the calves in small groups in separate rooms having comfortable bedding. Do regular deworming. Timely vaccination should be done to prevent them from infectious diseases.

5. Handling of milk

i. **Handling of fresh milk**: In order to keep the milking parlour clean, remove the animals immediately after milking. Strain the milk to remove unwanted inert material like straw or fodder particles, hairs, dust, insects, etc. Strain the milk with iron, plastic sieve or muslin cloth. After every straining, wash the sieve properly and disinfect it. This will decrease bacterial load in milk and shelf life of milk will increase.

ii. **Cold storage:** Milk clots if it is not properly stored. Always store the milk below 5°C to have minimum bacterial count. Milk should reach at milk collection center within 2-3 hours especially in summer season.

iii. **Utensils:** Milk utensils are made of many metals but avoid using iron or copper utensils because these metals dissolve in milk. This unwanted chemical reaction produces unpalatable taste and bad odour in milk. Always use tinned copper; galvanized iron and chrome or nickel plated milk utensils but these are costly. Utensils made of aluminum are better, cheaper and durable. These utensils do not affect the quality of milk. These can be cleaned and disinfected easily and help in maintaining good quality of milk.

After cleaning, disinfection of utensils destroys harmful pathogens. Utensils can be disinfected by keeping on steam for 2-3 minutes. Sodium and Calcium hypochloride can also be used for disinfection of utensils. Utensils should be washed thoroughly after chemical disinfection otherwise residue of these chemicals can cause harm to quality of milk and milk products.

6. CONSERVATION OF SURPLUS GREEN FODDER

Always feed good quality fodder for economical milk production. In July-September and March-April, there is surplus green fodder. Conserve this surplus green fodder as hay or silage.

i. **Hay:** Harvest the surplus green fodder and keep it in the field for 1-2 days in sun. Chaff it in 5-6 centimeter length and spread in 5-6 inch thick layer on a clean floor. Stir it well once or twice a day. After 4-5 days, store the dry legume fodder in heaps or room just like wheat *bhusa*.

ii. **Silage:** Non-legume green fodder can be conserved as silage as it contains more dry matter. Keep the harvested fodder in field for 1-2 days. Chaff the fodder in 5-8 centimetre length and store the chaffed fodder in a 10 x 30 x 1 metre silo pit by proper pressing. Fill the silo pit one metre above the ground level. Cover the filled silo pit with polythene sheet and cover the sheet with mud. Silage will be ready within 45 days. Feed 25-30 kg silage per animal daily.

TRAINING

Before establishing a dairy farm, get proper training of this occupation. Contact Deputy Director (Dairy Development) or Krishi Vigyan Kendra of concerned district or Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana for this purpose so that one can avail the benefit of loans, subsidy or other facilities.

Exercise

A) Answer in 1-2 words:

1. Give number of cows and buffaloes in Punjab.
2. Give the name of best cow breed.
3. How much milk is required for a healthy person daily?
4. How much milk is produced by Red Sindhi?
5. What is the optimum dry off period of pregnant cow?
6. Give daily green fodder requirement for 400 kg heavy cow or buffalo?
7. At what age body weight of heifer is 300 kg?
8. What is the average lactation milk yield of Murrah buffalo?

9. Where one should contact for dairy farming training?
10. Name the buffalo breeds in Punjab.

B) Answer in 1-2 sentences:

1. Give characteristics of Sahiwal breed.
2. What do you know about Holstein Frisian Breed?
3. How a best cow can be selected?
4. Give management aspect of cow after calving.
5. Give the characteristics of a good floor in animal shed.
6. What is a concentrate?
7. How cow dung should be managed?
8. How milk utensils can be cleaned?
9. Give detail of management of calves.
10. Give precautions during milking.

C) Answer in 5-6 sentences:

1. Write a note on management of dairy animals.
2. Give important tips for feeding of dairy animals.
3. Write a note on management of fresh milk.
4. Write a note on disbudding of calves.
5. Give details about purchase of a dairy animal.

Activity:

1. Visit a dairy farm and prepare a detailed report about various activities.

Chapter -7

MILK PRODUCTS AND THEIR MARKETING

Milk is an almost ideal and unique food for mankind. It has high nutritive value. It supplies body building proteins, bone-forming minerals and health-giving vitamins and provides energy giving lactose (milk sugar) and fat. All these nutrients are present in an easily digestible and assimilable form and thus make milk an important food for pregnant mothers, growing children, adolescents, adults and patients. Its importance in diet becomes even more significant amongst vegetarian population.

Marketing of milk

Milk production can be an ideal business if assured market and remunerative price are available to the producers. Producers of milk and milk products, however, get the maximum advantage when there is collective approach through Co-operative institutions. If individuals carry out their operations starting from production upto sales, then they are exploited by middlemen and the major share of profit goes to them. This is because the individual producer can neither process the milk into milk products nor he can take it to a distant market to get higher price.

To sell milk as fluid milk we have to maintain certain legal standards (PFA standards) for different milks e.g. cow milk should have 4% fat and 8.5% SNF (solids not fat) and buffalo milk 6% fat and 9% SNF . The legal standards for other fluid milk products are as under:

Milk type	Fat(%)	SNF(%)
Toned milk	3.0	8.5
Double toned milk	1.5	9.0
Standardized milk	4.5	8.5

Selling of milk products

It is absolutely necessary to convert the milk into different milk products because of the following reasons:

i) to increase shelf life as shelf life of raw milk is very less. It has to be processed and preserved by converting into different products to avoid any spoilage. Shelf life of milk products is more as compared to milk.

ii) to increase profit by converting milk into different milk products. The margin of profit increases as we go in for the product preparation. We can get more price for *khoa* as compared to milk and even more if we convert this *khoa* into different *khoa* based sweets.

iii) to reduce bulk of milk for easy handling and transportation.

iv) to reduce transportation cost.

v) to remove the middlemen (particularly in the sale of milk) to have more profit.

vi) to involve all the family members in preparation of products to create self employment.

Different milk products

For value addition and higher profitability farmers have started production of indigenous milk products. Traditional milk products have a significant role in the economic, social and religious functions of the Indian masses. About half of the India's total milk production is utilized in the preparation of different traditional milk products.

The products which could be prepared by the farmers at a small scale are as follows:

I. *Khoa*

Khoa is a partially dehydrated whole milk product prepared by continuous heating of milk in a *karahi* (Iron pan) and constantly stirring-cum-scrapping by using a *khunti* (Scrapper) till it reaches a semi-solid (doughy) stage. Thereafter, the pan contents are removed from the fire and worked up into a solid mass known as *khoa-pat*. Normally, the yield of *khoa* is 200 g from one kg cow milk and 250 g from one kg buffalo milk. The shelf life of *khoa* can be increased by

keeping at low temperature and by using polythene packaging materials upto 13 days at room temperature and upto 75 days in cold storage.

II. *Paneer/Chhana*(Cheese)

Paneer/Chhana is a product obtained by acid coagulation of boiled hot whole milk and subsequent drainage of whey. The commonly used acids are lactic or citric, in both their natural and chemical forms. Normally, the yield of *Chhana* is 180 g from one kg cow milk and 250 g from one kg buffalo milk.

III. *Ghee*

Ghee can be prepared either from butter/*makhan* or directly from cream. Since milk fat is susceptible to deterioration due to exposure to light, air and metals, *ghee* should be properly packaged immediately after its production so as to retain its natural flavour and nutritive value. *Ghee*, if stored under sealed conditions in lacquered tin containers at 21^{o}C, can be kept for 6-12 months. *Ghee* with high moisture tends to deteriorate faster than one with normal moisture.

IV. Fermented milk products

i) ***Dahi*** or curd is obtained from pasteurized or boiled milk (whole milk or skim milk) by lactic acid bacterial culture. It may be sweet or sour.

ii) ***Lassi/*butter milk** can be prepared from skim milk or whole milk *dahi*. It may be salted, spiced or sweet.

Both these products have to be kept at low temperature till they are consumed.

Besides above products, there are certain other milk products which can also be prepared by the farmers like *khoa* based sweets (burfi, peda, kalakand and gulabjamun), paneer/chhana based product (rasgulla, chhana murki), kheer, rabri and kulfi.

There are certain other milk products which are being prepared at commercial level e.g. standardized milk, toned milk, double toned milk, flavoured milk, yoghurt, cheese, condensed and evaporated milk, skim milk powder, whole milk powder, butter, infant foods and ice cream.

Marketing of milk products

There are certain key points which are to be kept in mind for successful marketing of the milk products to get higher profit:

i) Maintenance of legal standards of the milk products.

ii) Maintenance of hygienic conditions during product preparation.

iii) Attractive packaging

iv) Labeling

v) Advertisement of the product

vi) Maintenance of product quality.

Thus, the farmers can take up such traditional milk products which can be prepared easily, are popular in the region, have ready market and earn more profit. Dairy business becomes profitable only when high margin products are handled.

In order to provide maximum profit to producers, a collective form of business under the banner of co-operatives is being popularized. Collectively producers can utilize the services of trained professionals and all facilities can be created for converting milk into remunerative products and price can be obtained by collective bargain.

Besides following the traditional methods for product preparation, some innovative farmers can go in for the preparation of milk products by adopting latest technology on commercial scale. The information regarding preparation of these products can be obtained from Punjab Agricultural University, Ludhiana, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana and National Dairy Research Institute, Karnal (Haryana).

Exercise

A) Answer in 1-2 words:

1. What is the yield of *khoa* from cow milk?
2. What is the yield of *khoa* from buffalo milk?
3. What is the yield of *paneer* from cow milk?
4. What is the yield of *paneer* from buffalo milk?
5. Write the names of fermented milk products.

6. What is the fat percentage in cow milk?
7. What is the solids-not-fat (SNF) percentage in cow milk?
8. What is the fat percentage in buffalo milk?
9. What is the solids-not-fat (SNF) percentage in buffalo milk?
10. What is the fat percentage in toned milk?

B) Answer in 1- 2 sentences:

1. What is the importance of milk in human diet?
2. Which are the nutrients present in milk?
3. Which milk products are being prepared on commercial scale?
4. What is the shelf-life of *khoa*?
5. How *ghee* can be preserved for a long time?
6. What is the shelf-life of *paneer*?
7. From where the training for preparation of milk products can be obtained?
8. Give the legal standards of double toned milk and standardized milk.
9. How *khoa* can be preserved?
10. Which are the sweets prepared from *khoa*?

C) Answer in 5-6 sentences:

1. What are the advantages of selling milk products?
2. What is method of *paneer* preparation?
3. Write the method of *khoa* preparation?
4. What are the legal standards for different milks?
5. Which are the points to be kept in mind for successful marketing of milk products?

Activity

Prepare *khoa* and *paneer* from one kg of milk each and note down the weight of the product.

Chapter -8

Poultry Farming

Poultry includes all type of birds which are reared to fulfill the economical needs of human-beings. It includes chicken, turkey, ducks, geese, Japanese quails, emu, etc. In Punjab, mostly hens are reared for commercial purpose.

Breeds of hen

i. **Sutlej Layer:** Punjab Layer-1 and Punjab Layer 2 are two types of this breed. Sutlej Layer gives about 255-265 eggs annually. Average egg weight is 55 gm. Hen starts laying eggs at the age of 160 days. It is the number one breed in egg laying.

ii. **IBL-80 Broiler:** This breed is reared for meat purpose. It attains a body weight of 1350-1450 gm at the age of 6 weeks.

iii. **White Leghorn:** It is an exotic breed of layer. Its colour is white and gives white eggs. It gives 220-250 eggs annually. Due to small size, its feed consumption is also less.

iv. **Rhode Island Red:** It is also an exotic breed of layer. Its colour is red. It gives about 180 eggs annually. Egg colour is brown. It consumes more feed than White Leghorn as it is heavier in weight. It is dual purpose breed and can be used for meat purpose also.

v. **White Plymouth Rock:** It is an exotic breed used for meat purpose. Its colour is white. It consumes more feed and gives about 140 eggs annually. Its chicks attain a body weight of 1 kg at the age of two months.

Management of chicks

Always purchase chicks from an approved and trusted hatchery. Keep the young chicks under brooder. Brooder is a device which keeps the chicks warm. Provide light for 24 hours for 6-8 weeks of age and give them good quality well balanced feed.

Feeding of adult birds (Hens)

In poultry 60-70 per cent expenditure is made on feeding of birds. Hence, profitable poultry farming depends on quality and cost of feed. So, give proper care towards feeding of birds.

For optimum growth and egg production, birds require about 40 feed nutrients. These nutrients must be available in required amount in feed. Deficiency of any nutrient may lead to health and production related problems. These feed nutrients can be divided into 6 classes i.e. carbohydrates, proteins, fat, minerals, vitamins and water. Poultry feed is generally prepared by mixing wheat, maize, broken rice, rice-polish, groundnut cake, soybean cake, fish meal, limestone and common salt, etc. Small quantity of antibiotics is also added in poultry feed.

Management of Poultry

It should be as under:

1. Shed:

Shed must be made at higher elevation. It should be well connected with road so that transport of feed, eggs and poultry litter is easy. Rain or flood water should not accumulate around the shed. Every bird requires 2 square feet of floor space. Width of shed should not be more than 30 feet and height of roof should be 10 feet. Direction of shed should be East-West. If poultry birds are kept in cages, then cages should be three tiers. Put 3-4 birds in each cage. Make provision of water and feed channel in front of cage. Eggs come rolling in front automatically due to slope. Poultry droppings fall on the floor. Two birds can be kept in 15 inch long and 12 inch wide cage.

2. Management of birds:

As birds do not have sweat glands and have enough feathers, they can bear winter but face difficulty in summer. Plant grass and shady trees like mulberry around sheds to reduce summer stress. Use sprinklers on the roof as they help to reduce shed temperature by 5-6 ^{o}C in hot and dry summer season. Side walls should not be more than 1-1.5 feet high. Put wire mesh net in rest of the wall. Put a thick layer of straw on the shed. In extreme hot water, sprinkle water on the birds also with spray pump. Double the number of waterers in the shed and change the water more frequently. Increase quantity of protein, minerals and vitamins in feed by 20-30%.

In winter, sometimes temperature goes down to sub zero which is problematic for birds. If proper temperature is not maintained in the shed, then one bird can eat 3-5 kg more feed. Put curtains on side windows. Stir the litter twice a week.

3. Management of poultry litter:

Always keep the litter dry. Wet litter may lead to many diseases and health problem in poultry. Wet litter leads to ammonia production in the shed which is problematic both for birds as well as for labourers.

Training:

Get training of poultry farming before starting a poultry farm. For this purpose, contact Deputy Director (Animal Husbandry), Krishi Vigyan Kendra of concerned district or Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana so that one can avail the benefit of available loans, subsidy and other facilities.

Exercise

A) Answer in 1-2 words:

1. At what age hen starts laying eggs?
2. Name two breeds of meat type poultry.
3. What is the average egg weight?
4. Which hen gives white eggs?
5. How many eggs are produced by Rhode Island Red annually?
6. Which gas is produced in poultry litter?
7. Which device is used to give heat to chicks?
8. What is the height of poultry shed?
9. What is the size of cage for two birds?
10. Whether feed consumption increases or decreases in winter season?

B) Answer in 1-2 sentences:

1. What is meant by poultry?
2. Give details of local *de*si breeds of layers.
3. Compare White Leghorn and Rhode Island Red hens.

4. Which nutrients are required for growth of birds?
5. Explain poultry shed.
6. Explain poultry management in summer.
7. What is the importance of poultry litter management?
8. Name the breeds reared for meat purpose.
9. Give details of IBL-80 breed.
10. How poultry feed is prepared?

C) Answer in 5-6 sentences:

1. Give details of exotic poultry breeds.
2. Explain feed nutrients of poultry.
3. What is the difference in summer and winter management of poultry?
4. From where poultry training can be attained?
5. Write a note on management of chicks.

Activities:

1. Visit and get knowledge about working of a poultry farm.
2. Visit a feed factory and get knowledge about working of the feed unit.

Chapter - 9

PIG, SHEEP, GOAT AND RABBIT REARING

People, engaged in agriculture, have some spare time which can be utilized successfully in pig, sheep, goat and rabbit rearing to augment their farm income.

1. Piggery

Pigs reproduce at a very rapid pace and their marketing is relatively easy. Pig produces more meat by eating less and cheap feed. Hence, piggery can be adopted with small investment to earn more profit.

Breeds of pig

Local indigenous breeds have poor growth rate and produce less number of piglets while exotic breeds grow at much faster rate and produce more number of piglets. There are mainly two exotic breeds.

i. **White Yorkshire:** Main characters of this breed are medium in size, white colour, long body and erected ears. Animals of this breed can easily be reared in Punjab. This breed is very popular in North India.

ii. **Landrace**: Animals are of white colour and have long body and drooping ears. It is native of Denmark. Its meat has less fat and is known as lean meat.

Tips for profitable piggery

Profitable piggery depends on selection of breed, selection of healthy male and female animals, optimum management, and efficient health management for prevention and treatment of diseases and economical balanced feed.

Female animal (sow) should be healthy with soft, pliable and tight skin, soft hair coat, bright eyes, strong legs and must have at least 12 teats. Healthy female comes in heat for the first time at the age of 5-6 months but mating should be done at the age of 8-9 months or when it attains the body weight of 90 kg. One female produces 10-12 piglets per farrowing and gives birth twicely in a year. In order to get more meat (pork) of good quality from piglets, castrate them at the age of 3-4 weeks.

Feeding of pigs

Feed of piglets should have 20-22% protein but fibre should be less than 5%. Growing pigs should be fed on feed with 16-18% protein. Adult animal can be given 2-3 kg green fodder also. In order to rear pigs economically, use leftover vegetables in the market, hotel, restaurant, hostel and canteen waste, sugarcane press mud and butter milk (*Lassi)*. Feed of pigs is prepared by mixing cereals/ grains, wheat bran, rice polish, molasses, oilseed cakes, fish meal, mineral mixture, antibiotics and vitamins.

Shed

Young growing pigs need 8 square feet space. In a shed of 160 square feet, 20 young animals can be reared. Dry female (sow) requires 10-12 square feet space. Ten sows can be put in one room.

Shed should be comfortable, economical and at higher elevation than surrounding. Put guard railing in the room of sow with newly born piglets so that piglets are not crushed under their mother. This railing should be 10-12 inches high and 10-12 inches away from wall.

2. Sheep/Goat rearing

When man started rearing animals for milk and meat for his requirement, then these included sheep and goat also. These animals can meet their nutritional requirement from green fodder and thus require less concentrate feed. Concentrate feed is required only in case of shortage of fodder. Every family member can play an important role for successful sheep and goat rearing. Goat is known as poor man's cow. Goat milk is very valuable for patients and old persons.

Breeds of goat

A. Indigenous breeds:

i. **Beetal:** Animals of this breed are found in Gurdaspur, Amritsar, Tarntaran and Ferozepur districts of Punjab. Its colour is black-brownish with white spots. It has convex forehead and long, drooping and twisted ears. Its udder is large. Its first kidding occurs at the age of 1 ½ years.

ii. **Jamnapari**: Animals of this breed of goat are very beautiful and are found in Western Uttar Pradesh. Its colour is white and light brown. It has light brown spots on face and head, has long, flat and drooping ears and convex nose. It has long body and long legs.

B. Exotic breeds

Saanen, Alpine and Boer are the exotic breeds of goat which produce more milk than local breeds.

Breeds of sheep

Merino and Corridale are the exotic breeds of sheep. These breeds produce more quantity of good quality wool than local breeds. Exotic breeds are used for improvement of local breeds.

Selection and management

Selection of a good goat is done on the basis of 120 days lactation milk production. Goat must produce first kidding up to the age of 2 years. Animal must has high milk production and good body length, be good in eating and has soft shinny hair coat. Udder size should be large and teat should be medium in length and pointed forward. Gestation period of sheep and goat is 145-157 days. Avoid inbreeding for breed improvement. Change the ram (male sheep) and buck goat (male) regularly.

Animals are kept loose in open airy sheds with damp-proof flooring. Keep the direction of shed in East-West direction. Every sheep and goat requires about 10 square feet space while young lamb or kid requires 4 square feet of space. Construct 5-6 feet high boundary wall of bricks or barbed wire around the shed so that stray animals like dogs may not enter their shed. Plant the deciduous shady trees like mulberry, popular or dharek, etc. around the shed. Use same concentrated feed as is used in cows or buffaloes as per the requirement. Manage the animals in such a way that they should give three kiddings in two years. Castrate the male at the age of 2 months for mutton purpose.

3. Rabbit rearing

Rabbits are reared for wool and meat production. These animals require less space for rearing. They use feed very efficiently. Female can become pregnant at the age of 5-9 months for the first time. Rabbit can produce kitten for 6-7 times in a year and every time, produces 5-7 youngones (kids). Average age of rabbit is 5 years. Rabbit farming can be started with few animals and expanded.

Breeds of rabbit

A. Wool type: Russian Angora, British Angora, German Angora.

B. Meat type: Soviet Chinchilla, Grey Giant, Newzealand White, White Giant.

All these breeds are exotic. In order to increase the wool and meat production, selection and breeding of animals is important. Annual wool yield of Russian, British and German Angora is 215, 230 and 530 gm, respectively. Sell the meat type animals up to the age of 3 months for getting maximum profit. At 3 months of age, body weight of rabbit is 1-1.5 kg. Its meat is a lean meat having less fat.

Feed

Rabbit is a single stomach animal and can be reared by feeding cereals, pulses, legumes, green and dry fodder, carrots, cabbage and kitchen waste. Feed should be given in pellet form to reduce respiratory problems and wastage of feed. Dry female should be fed with feed containing 12-15% protein and feed of milking female should contain 16-20% protein.

Rabbit relish eating berseem, cowpeas, guinea grass, napier bajra, spinach, green leaves, and leaves of vegetables. There should be adequate arrangement of clean and fresh water at the farm because rabbit consumes 10% water of its body weight. Concentrate feed for rabbit can be prepared by mixing wheat, maize, bajra, rice polish, ground nut cake, meat meal, mineral mixture and common salt. An animal of 6 weeks age can consume 100 gm of green fodder along with 50 gm of concentrate feed.

Cages

Rabbit can be kept in cages, rooms, nests or boxes. Wooden boxes are made of various sizes but keep in mind that there should be adequate arrangement of light and drainage of urine. Weaned kitten are kept in cages. About 20 young animals can be kept in one cage. Keep males and females separately. An adult animal can be kept in a cage of 2 x 2 x 1 feet size.

Shearing of wool

Wool is ready for first cutting at the age of 4 months. Wool length at the time of shearing should be at least 2 inches. Maximum wool yield is obtained at one year of age. One animal can produce 500-700 gm wool annually.

Training

For training on pig, sheep, goat or rabbit rearing and to avail other benefits like loan and subsidy, contact the concerned Deputy Director (Animal Husbandry), Krishi Vigyan Kendra or Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana.

Exercise

A) Answer in 1-2 words:

1. Name two breeds of pig.
2. How many piglets can be produced by a female pig in a year?
3. How many times a female pig produce piglets?
4. How much protein should be in the feed of dry female rabbit?
5. What is the weight of rabbit at age of 12 weeks?
6. Name the breeds of goat.
7. Name the breeds of sheep.
8. Name the native place of Beetal goat.
9. Name the native place of Jamnapari breed.
10. Name the age of castration of male pigglets.

B) Answer in 1-2 sentences:

1. Explain the difference between indigenous and exotic breeds of pig.
2. Explain about economical feeding of pigs.
3. What is the composition of feed of pigs?
4. Write the qualities of a good goat.
5. Name the wool and meat type breeds of rabbit.
6. Which type of feed is liked by rabbit?
7. Give description of nest or box used for rabbit.
8. How many times rabbit produces kitten annually and what is the total number of kitten produced?
9. What is the wool yield of various breeds of rabbit?
10. What is the protein content in rabbit feed?

C) Answer in 5-6 sentences:

1. What are the basic points for profitable piggery?
2. Give details of shed for pigs.
3. Write a note on sheep and goat shed.
4. Give composition of rabbit feed.
5. Give details of cages used for rabbits.

Chapter -10

FISHERY

Fishery is an important agriculture related subsidiary occupation and is more profitable than agriculture. Fish can be reared in low lying and water logged areas by using crop residues and waste of farm animals, pigs and poultry. The following points should be kept in mind for profitable fish farming.

1. Selection of fish:

Rear 6 breeds of fish i.e. three Indian major carps (Katla, Rohu and Mrigal) and three exotic carps (Common carp, Silver carp and Grass carp).

2. Selection of site for pond:

Select clayey land for making fish pond as it results in less seepage of pond water. In case of light soils, puddling may be done. Pond should be near to the water source so that water can easily be filled in the pond as and when required. If canal water is to be used, then wire mesh should be put at the mouth of inlet to prevent entry of carnivorous fish (which eat fish) in the fish pond.

3. Design and digging of pond:

For commercial fishery, pond size can vary from 1 to 5 acres. However, if land holding is less, small fish pond can also be made. Depth of pond should be 6-7 feet. Base of pond should be plain and sides should be sloppy. Put valve on the inlet or outlet pipes for controlling the water inflow or outflow. Make pond preferably in the month of February so that fish seed can be put in March-April. Make one kanal nursery pond along with one acre fish pond so that seed fish can be put in to it.

4. Removal of weeds from old ponds:

To check weed growth in old ponds, keep the water level in pond at 5-6 feet. For control of weeds, adopt following approaches:

i. **Physical approach:** Remove the water from the pond and remove the weeds with a barbed wire/chain.

ii. **Biological approach**: Grass carp and Silver carp fish help in controlling many type of weeds.

5. Control of enemies of fish:

Carnivorous fish (Malhi, Singhara), weed fish (Shisha, Puthi Kanghi), frogs and snakes can be removed from old ponds with the help of net.

6. Depth of water:

Keep water level at 5-6 feet in all type of new and old ponds throughout the year.

7. Water quality:

Water dissolved oxygen and pH levels affect the survival and growth rate of fish. If water pH is below 7, then fine ground calcium carbonate (80-100 kg/acre), dissolved in water should put in pond.

8. Use of manures and fertilizers:

For regular supply of plankton (natural food) in newly constructed ponds, use farmyard manure, poultry manure, biogas slurry, urea and single super phosphate. In old ponds, quantity of fertilizers and manures depend on the quantity of plankton in the pond. Always put fertilizer in the pond 15 days before putting fingerlings (seed fish).

9. Release of fingerlings (seed fish):

Put seed fish of 1-2 inches size @ 4000 fingerlings per acre. Put the seed fish in the ratio as given below:

(A) Katla 20%, Rohu 30%, Mrigal 10%, Common carp 20%, Grass carp 10% and Silver carp 10% OR

(B) Katla 25%, Rohu 35%, Mrigal 20% and Common carp 20%.

Seed fish can be obtained from College of Fishery, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana or Government hatcheries.

10. Feed:

Fish feed should contain 25% protein. Soak the fine ground feed for 3-4 hours. Then make bolls and put these in trays, baskets or plastic bags having holes and should be kept 2-3 feet below the water level.

11. Catching fish and putting fish seed:

When the fish size is of marketable level (more than 500 g), then sell the stock. Replace this fish with the same number and same breed of fingerlings from the nursery.

12. Health management:

Dip the fingerlings in solution of Potassium permagnate (100 g per litre water) to prevent diseases. Monitor the fish stock for health problems at fortnight interval.

Training

Get training for fish farming before starting fishery. Contact the concerned District Fishery Officer; Deputy Director, Krishi Vigyan Kendra or Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana for training, availing benefit of loan, subsidy or other available facilities.

Exercise

A) Answer in 1-2 words:

1. Name two exotic breeds of fish.
2. What should be the depth of pond?
3. What should be the pH of water for fish rearing?
4. Which fertilizer can be used in new fish pond?
5. How many fingerlings can be put in one acre?
6. What is the source of fish seed?
7. Name two Indian breeds of fish.
8. What type of soil is required for fish pond?
9. What should be the size of commercial fish pond?
10. Name one carnivorous fish.

B) Answer in 1-2 sentences:

1. Name Indian and Exotic breeds of fish.
2. What do you know about design of fish pond?
3. Explain about the quality of water used for fishery.
4. What should be the ratio of different fish breeds in a pond?

5. How weeds can be removed from fish pond?
6. Write precautions for using canal water in pond.
7. Write about enemies of fish in pond.
8. How feeding is done in pond?
9. Write about health management of fish.
10. From where fishery training can be obtained?

C) Answer in 5-6 sentences:

1. Write a note on selection of site, design and digging of fish pond.
2. How old ponds can be used for fish rearing?
3. How weeds can be removed from old ponds?
4. What type of manures and fertilizers are used in fish ponds?
5. What is the role of Government Department of Fishery and Veterinary University in fishery development?

Activities:

1. Visit and study the working of nearest fish farm.
2. Visit the office of Fishery Department of your district and get technical and commercial knowledge regarding fish farming.

Chapter - 11

IMPORTANT CURRENT ISSUES IN AGRICULTURE

Man has been practicing farming for food and livelihood since time immemorial. However, demand for food, shelter and clothing continued to increase over time and posed challenges to human population during the entire course of civilization. In order to counter these challenges, remarkable innovations were made by man from time to time which revolutionized farming and enabled it to fulfill basic needs of ever increasing human population. Some of the recent advances and hotly debated issues such as genetically modified crops, protection of Plant Varieties and Farmers' Rights Act, Precision farming and impact of climate change on farming are discussed as under:-

1. Genetically Modified (GM) crops:

A crop which has been genetically improved by transfer of a novel gene from an unrelated plant or organism through the use of specialized genetic engineering technologies is known as a genetically modified crop. An important example of such crops is Bt cotton. The abbreviation 'Bt' is derived from the name of a soil bacterium *'Bacillus thuriengiensis'*. The DNA molecule i.e. hereditary material of this bacterium contains a specific gene (Bt gene) which produces a crystalline protein, endotoxin, which is highly toxic to the bollworms; insect pests of cotton. Bt cotton has been developed as a result of transfer of Bt gene from this bacterium to a normal cotton plant. When a bollworm feeds on flower bud or flower or boll of a Bt cotton plant, this toxic protein damages the digestive system of the insect and kills it. In this manner, cotton crop gets saved from these harmful insects without the use of any insecticidal spray. Bt cotton was first introduced in Punjab in 2006. At present, about 99% of the area under cotton is covered under Bt cotton hybrids. Initially Bollguard-I hybrids had only one Bt gene. Now a days Bollguard-II hybrids such as RCH 650 BG II and NCS 855 BG II possess two Bt genes which protect the crop from all four types of bollworms namely: American bollworm, pink bollworm, spotted bollworm and tobacco caterpillar. Prior to introduction of Bt cotton, cotton crop was being

severally damaged every year, resulting in a very poor yield of 2 to 3 quintals of lint per acre. After introduction of Bt cotton in Punjab in 2006, the yield of lint has significantly improved to about 5 quintals per acre and use of insecticides has also declined. Besides Bt cotton, several other GM crops like brinjal, soybean, maize and rice have been developed.

Possible risks of GM crops:

Ever since introduction of GM crops several environment protection organizations, social activists, human welfare groups and even some scientists have been raising their voice against GM crops. According to them, adoption of such crops will have adverse effect on human health, environment, biodiversity of plants and species of cultivated plants. Though, no substantial evidence could be produced in the favour of such arguments yet several countries have not allowed cultivation of GM crops.

2. Protection of Plant Varieties and Farmers' Rights Act-2001:

India is a signatory to World Trade Organization (WTO) conventions. In order to fulfill its international obligations and commitments, Government of India enacted 'Protection of Plant Varieties and Farmers' Rights Act (PPV&FR Act) 2001 with the aim of encouraging innovation in agriculture sector. For the effective implementation of this act, Government of India established the "Protection of Plant Varieties and Farmers' Rights Authority" on 11th November 2005.

The main objectives of this was to recognize and protect the farmers' rights in respect of their contributions made at anytime for the development of new plant varieties and to protect the rights of plant breeders to encourage development of new plant varieties.

Rights protected under this act: Farmers' rights, Breeders' rights and researchers' rights are protected under this act.

Farmers' rights

- A variety which is being traditionally cultivated and evolved by the farmers on their fields or a landrace of a variety about which farmers possess common knowledge can be registered as a Farmers' variety.

- Farmers are entitled to save, use, sow, re-sow, exchange, share or sell their farm produce including seed of protected varieties but without putting the brand name.

Varieties which cannot be registered:

A variety which contains any technology that is harmful to human beings or animals or plants including terminator technology cannot be registered under this act.

Duration of registration:

Initially this act provides protection for six years to general crops and nine years to trees and vines. However protection period may be renewed and extended up to 15 years for crop varieties and 18 years for trees and vines.

Penalties for infringement:

If a person gives different denomination to a registered variety, changes its name and address of its breeder and country and sells it in the market, such an infringement of this law is punishable with an imprisonment or fine or both. More information about this act can be obtained from website www.plantauthority.gov.in

3. Precision Farming:

Precision farming is a new concept of farming. This concept is based on the judicious use of various inputs as decided and calibrated by various scientific technologies so as to save the natural resources and enhance the productivity of a crop. For instance, fertility status of soil in different parts of a field is never same. If a farmer applies fertilizer uniformly in whole of the field, he may be wasting resources because in parts where soil was rich, lesser amounts of fertilizer was required whereas in other parts of the field where soil fertility level was poor, higher amounts of fertilizer was needed. Similarly, applying other inputs such as insecticides, weedicides and micronutrients uniformly throughout the field without ascertaining their need in different parts of a field, may also lead to wastage of natural resources and result in comparatively low yields. In developed countries, nitrogen sensors, a special kind of device is used to find out requirement of nitrogenous fertilizer in different sections of a field. Punjab Agricultural University (PAU) has recommended use of leaf colour chart (LCC) for need

based use of nitrogen fertilizer in wheat, rice and maize. Precision farming can also play an important role in providing need based irrigation to a crop and thus saving precious water. PAU has developed a special instrument (Tensiometer) for this purpose. Tensiometer is used to decide when and how much irrigation should be given to rice crop. Giving need based irrigation to a crop not only enhances the crop productivity but also helps to save precious diesel and electricity which is consumed in running tubewells. Introduction of laser land leveler is another example which helps in saving precious water resources especially in case of rice crop. In developed countries, several other precision farming technologies such as drip irrigation, sprinkler irrigation for irrigating big farms, various types of sensors, pneumatic planters for precise planting and global positioning system (GPS) for accurate measurement of the fields, Information and Communication Technology, Satellite Technology, Auto steering for plant spacing are deployed to maximize crop productivity with minimum use of natural resources. In Precision farming, every single agricultural input is applied at right time, in right manner, at right place and in right quantity.

4. Climate change and its Impact on Agriculture:

Climate change due to global warming has become a serious issue and a hotly debated subject these days. According to various scientific reports, the earth has warmed about 0.5^{o}C over the past 100 years and it is estimated that by the end of 21st century, temperature will further increase by about 1.8 to 4.0^{o}C. As a result, the atmosphere and ocean have warmed, the amounts of polar snow and ice have reduced, sea level has risen and concentration of Greenhouse gases has increased. As a consequence, warm days have become warmer and cold days colder, rains have become erratic and seasons have started overlapping. The seasonal variations have been converted into daily variations.

Factors responsible for climate change:

Following factors are responsible for global warming and climate change:

- Increased concentration of greenhouse gases
- Burning of fossil fuels
- Large scale deforestation

- Industrialization and urbanization
- Ever increasing human population
- Unabated use of refrigerators, air conditioners and foam industry which emit chloroflouro carbon gases
- Excessive use of agro-chemicals

Green House Effect:

Some gases such as carbon dioxide (CO_2), nitrogen oxide (NO_2) chloro-flouro carbon (CFC) and methane (CH_4) are the major factors responsible for pollution, global warming and climate change. These gases are known as Greenhouse gases. This name is derived from Green House which is made from a polythene sheet or glass. This polythene sheet allows sun rays to enter the green house but it does not allow infra red rays to go out after striking earth surface as reflection. As a result, temperature inside green house increases. These gases form a blanket type thick layer around the earth and trap the sun rays inside thus leading to increase in the temperature on the earth. Excessive use of nitrogenous fertilizers in crops leads to production of nitrogen oxide (NO_2) gas. Rice cultivation which involves cultivation of crop in continuous ponded water also results in production of methane (CH_4). The Green House effect can result in a rise of temperature to the tune of 3.2^{o}C by 2050 in India.

Impact of climate change on agriculture

- Climate change will affect different parts of the earth differently. In some countries, it may adversely affect agricultural production and thus food security but in other countries, climate change may have positive effect on crop productivity.
- Duration of crops, sequence of crop rotations and cultural practices of raising crops may change due to global warming
- As a consequence of rise in temperature and moisture, new diseases and insect pests may emerge in areas where these were not present previously and may seriously affect production of crops.
- Climate change may lead to unpredictable changes in the monsoon rainy season in India.

- Rising night temperature may adversely affect crop productivity.
- Any increase in day temperature during February and March will have adverse effect on wheat production in Punjab.

In order to mitigate climate change effects, use of solar energy, hydro-electricity generation and bio-energy should be encouraged and sole dependence on fossil fuel should be reduced by minimizing vehicular and industrial emissions of carbon dioxide and other gases.

Exercise

A) Answer in 1-2 words:

1. Write full form of GM.
2. Write full form of Bt.
3. Name the poisonous substance produced in Bt plant.
4. Write full form of PPV and FR.
5. When PPV & FR Act was passed.
6. Which instrument or implement is used for leveling of fields.
7. Write the name of instrument which is used for judicious use of water in paddy crop.
8. How much increase in earth's surface temperature has been recorded during the past century?
9. Name any two prominent green house gases.
10. Write full name of CFC.

B) Answer in 1-2 sentences:

1. Define GM crops?
2. Differentiate BG-I from BG-II ?
3. Why Bt cottons remain safe from any damage by the bollworms?
4. What is precision farming? List its benefits?
5. Discuss methods which need to be adopted for judicious use and saving of water.

6. What may be the impact of climate change on wheat crop?
7. Why temperature increases inside a greenhouse ?
8. List names of different Green House Gases.
9. What was the impact of Bt cotton varieties on cotton production in Punjab.
10. List names of important techniques used in Precision Farming.

C) Answer in 5-6 sentences:

1. Which GM crop is being cultivated in Punjab? Explain its benefits?
2. What are the dangers and risks associated with GM crops?
3. List objectives of PPV & FR Act. When was this act introduced?
4. How green house gases affect the climate?
5. Discuss impact of climate change on agriculture?