



A Monthly e Magazine
ISSN:2583-2212
Oct, 2023; 3(10), 2735-2748

Status Paper

Potato in Maharashtra

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AICRP- Potato, ZARS, Ganeshkhind Pune
<https://doi.org/10.5281/zenodo.10076203>

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the four major food crops of the world, next to other crops i.e. rice, wheat and maize. It is an important crop and it can supplement the food needs of the country in a substantial way as it produces more dry-matter food, has well balanced protein and produces more calories from unit area of land and time than other major food crops. The problem of malnutrition and under nutrition can be largely solved if potato is accepted as a major food and not merely as a vegetable in our country. It is a nutritious food containing practically all the essential dietary constituents. Like cereals, carbohydrates are the major constituents of potato. Besides, it contains essential nutrients such as proteins and minerals like calcium, phosphorus and iron, and vitamins (B1, B2, B6 and C). Ability of potato to produce highest nutrition and dry matter on per unit area and time basis, among major food crops made FAO to declare it the crop to address future global food security and poverty alleviation during 2008.

Potato is grown almost in all states of India. However, the major potato rowing states are Himachal Pradesh, Punjab, Uttar Pradesh, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, West Bengal, Bihar and Assam. In Maharashtra, this crop is mainly grown in Pune, Satara, Ahmednagar, Aurangabad and Nashik districts. In some areas of Satara (koregaon and Khatav tahsil), Pune (Khed and Ambegaon tahsil) and Ahmednagar (Parner tahsil), potato is grown in *kharif* season; however, it is grown in all the districts only as *rabi* crop.

It is a much-branched bushy herb, usually 0.5 to 1m in height possessing underground stems bearing the edible tubers. The leaves are odd pinnate with a large terminal leaflet. It flowers in cymose panicles.



1.1 Nutritional Levels:

Sr.No.	Particulars	Quantity	Sr.No.	Particulars	Quantity
1)	Protein(%)	1.6	15)	Moisture (%)	47.2
2)	Fat(%)	0.1	MINERALS (mg/100g)		
3)	Mineral matter(%)	0.6	16)	Phosphorus	40
4)	Fibre(%)	0.4	17)	Potassium	247
5)	Carbohydrate(%)	22.6	18)	Calcium	10
6)	Calories(Kcal)	97	19)	Magnesium	30
VITAMINS (mg/100g)			20)	Iron	0.48
7)	Carotene	24	21)	Sodium	11
8)	Thiamine	0.1	22)	Copper	0.16
9)	Riboflavin	0.01	23)	Manganese	0.13
10)	Niacin	1.2	24)	Zinc	0.53
11)	Vitamin C	1	25)	Sulphur	37
12)	Choline	100	26)	Chlorine	16
13)	Folic acid-Free	3	27)	Molybdenum	0.07
14)	Folic acid- Total	7	28)	Chromium	0.007

2. POTATO PRODUCTION SCENARIO

Potato is widely grown as vegetable crop in the state. In Maharashtra it is grown on an area of 22.03 thousand ha producing about 491.94 thousand tonnes with an average productivity of 223.30 qtls/ha in 2020-21. (<https://agricoop.nic.in/en/StatHortEst#gsc.tab=0> (Table 1).

Table 1: Potato area, production and productivity of Maharashtra from 2014-15 to 2020-21

Sr. No.	Year	Area (‘000 ha)	Production. (‘000 t)	Productivity (qtls/ha)
1	2014-15	11.07	200.72	181.3
2	2015-16	12.50	251.46	201.2
3	2016-17	20.80	536.62	258.0
4	2017-18	11.09	259.22	233.7
5	2018-19	19.00	492.00	258.9
6	2019-20	23.00	455.00	197.8
7	2020-21	22.03	491.94	223.3



3. POTATO PRODUCTION TECHNOLOGIES

3.1. Soil and climatic conditions

The potato can be grown almost on any type of soil except saline and alkaline soils. Soils, which are naturally loose, offer least resistance to the enlargement of the tubers is preferred. Loamy and sandy loam soils, rich in organic matter with good drainage and aeration are most suitable for cultivation of potato crop. The soil with pH range of 5.2-6.4 is considered to be ideal. Potato is a temperate climate crop; however, it grows under a diverse range of climatic conditions. It is grown only under such conditions where the temperature during the growing seasons is moderately cool. The vegetative growth of the plant is best at a temperature of 24°C while tuber development is favoured at 20°C. The minimum temperatures (13-16°C) during rabi season favours the low accumulation of reducing sugars and high dry matter in tubers as compared to Kharif crop.

3.2. Varieties

Kharif potatoes are mainly grown in Pune and Satara districts. The farmers procure potato seed from the traders who bring the seed potatoes from Punjab, Madhya Pradesh and West Bengal. Varieties suitable for this zone should be early bulking with tuberization ability under high temperatures and resistant to bacterial wilt, late blight, viruses, mites and potato tuber moth. The varieties like *Kufri Jyoti*, *Kufri Pukhraj*, *Jyoti Super*, *Kufri Lauvkar* and *Kufri Chandramukhi* are mainly grown in *kharif* season. During *rabi* season the farmers mainly grow *Kufri Chipsona-1*, *Kufri Jyoti*, *Kufri Chandramukhi*, and *Jyoti Super*. The new varieties of potato provided by private companies for contract farming during *rabi* season are Atlantic, FL-1533, *Kufri Chipsona-3* and *Kufri Chipsona-1*. Some other varieties suitable for cultivation in the state are *Kufri Khyati*, *Kufri Surya*, *Kufri Badshah*, *Kufri Garima* and *Kufri Kiran*. Details of popular varieties are given below.

Early duration varieties

***Kufri Lauvkar*:** It is an early maturing variety (75-80 days) and can be grown both in *Kharif* and *Rabi* seasons. It can build up yields rapidly under warmer climate. The variety is susceptible to major diseases. The yield potential is 30 t/ ha. The tubers of the variety are large, round, white, fleet eyes with prominent eyes brows, flesh white and can be used for chip making.

***Kufri Chandramukhi*:** It is an early maturing variety (80-90 days). The variety is susceptible to major diseases. The yield potential is 25 ton / ha. The tubers of the variety are large, oval, slightly flattened, white, fleet eyes, flesh dull white, and largely for table purpose as having very good taste.

***Kufri Surya*:** It is an early maturing (75-90 days) heat tolerant variety and can be grown in warmer areas. The variety is resistant to hopper burn and immune to wart, mild resistant to late blight,



moderate resistance to mite damage. The yield potential is 35 ton/ ha. This variety yields excellent defect free tubers with high proportion of large (>85mm) tubers.

Kufri Pukhraj: It is an early maturing variety (75-90 days). The variety is resistant to early blight and moderately resistant to late blight, Immune to wart. The yield potential is 40 ton / ha. Tubers are white, large, and oval and are suitable for table purpose.

Kufri Khyati: Early maturing variety (70-80 days) with moderate resistance to late blight. The variety yields higher than existing early cultivars both at 60 and 75 days after planting. It possesses good keeping quality and moderate tuber dry matter (15%). Tubers are medium- large, round-oval with cream flesh and are suitable for table purpose.

Medium duration varieties

Kufri Jyoti: It is a medium maturing variety (90-100 days). The variety is moderately resistant to late & early blight. Resistant to wart. The yield potential in plains is 30 t/ha. Tubers are large, oval having tendency to crack and suitable table and also for instant flakes and chips.

Kufri Chipsona-1: It is a medium maturing variety (90-100 days). The variety is resistant to late blight. The yield potential in is 35 t/ha. Tubers are white, medium to large, oval. It has high dry matter, low reducing sugars and low phenols which make the variety suitable for chips, French fries and owing to its excellent taste it is also becoming popular as table purpose variety.

Kufri Chipsona-3: It is a medium maturing variety (90-110 days). The variety is resistant to late blight. The yield potential in is 35-40 ton / ha. Tubers are round to oval. It has high dry matter, low reducing sugars and low phenols which make the variety suitable for chips and flakes.

Kufri Badshah: It is a medium-late maturing variety (100-110 days). The variety is moderately resistant to early and late blight. Resistant to Potato Virus X. The yield potential in is 50 ton / ha. Tubers are large, oval and smooth skinned. Used for table purpose and not suitable for processing.

Kufri Jawahar: It is a medium maturing variety (80-90 days). The variety is moderately resistant to late blight and immune to wart. The yield potential in is 35-40 ton / ha. Tubers are Creamy white with pale yellow flesh. Used for table purpose.

Kufri Garima: A medium maturing variety (90-100 days).The variety possesses field resistance to late blight. Its tubers are light yellow, ovoid with shallow eyes and light yellow flesh colour. It is capable of yielding 30–35 t/ha under optimum agronomical practices. Suitable for table use.

Atlantic: Atlantic is a medium late maturing variety have tolerance to scab and *Verticillium* wilt; high yields of attractive tubers; high solids content; excellent chip and French fry quality and acceptable fresh market quality. It is low in total glycoalkaloids.



*Kufri Lauvkar**K Chandramukhi**Kufri Surya**Kufri Pukhraj**Kufri Khyati**Kufri Jyoti**K Chipsona- 1**K Chipsona- 3**Kufri Badshah**Kufri Jawahar**Kufri Garima**Atlantic*

3.3. Seed production scenario and seed sources

Potato is a vegetatively propagated crop; hence, the disease-causing pathogens are carried through mother tubers. Therefore, seed potatoes should be pure, healthy and of uniform in size for getting higher yields.

In Maharashtra, seed tubers for planting are purchased from Punjab, Haryana and Madhya Pradesh. The traders procure potato seed from Punjab, Madhya Pradesh and West Bengal, and in general such potato seed is uncertified. This is the main reason for lower yields in Maharashtra.

3.4. Land preparation and method of planting

The potatoes are planted in June in *Kharif*, while October/November in *rabi* season. Potato being a tuber crop requires soft, friable and deep soil for the development of uniform and large size tubers. The well drained, medium black or alluvial soils are mostly preferred for potato planting. Soil pH must be around 5.5-7.5. The heavy, *chopan*, water logged and salty soils are not suitable for potato planting. The land is ploughed with mould-board plough to a depth of 20-25 cm and exposed to sunlight for about a month. After ploughing, land is harrowed 2-3 times and FYM or compost is applied before the last harrowing. All the stubbles and non decomposed organic matter are removed. Usually, half dose of N and full dose of P and K fertilizers are broadcasted at the time of planting and mixed thoroughly in soil. This is followed by planting



operation where in potato tubers are manually placed in the rows at a distance of 20 cm, with a row to row spacing of 60 cm. The light irrigation is given immediately after planting.

3.5. Manures and fertilizers

Nutrient requirement of potato crop is quit high and the application of fertilizers and organic manures is considered essential to obtain economic and high yields. Potato responds well to manures and fertilizers. The optimum dose of fertilizer application varies greatly depending upon the soil type, soil fertility, climate, crop rotation, variety, length of growing season, and moisture. FYM is found to be useful for getting good growth and production. It is applied @ 20-25 tones/ha at the time of field preparation. The doses of chemical fertilizers are 150, 60 and 120 kg/ha N, P₂O₅ and K₂O. The full P and K are applied at the time of planting. While N is applied to the crop in split doses, half at the time of planting and remaining half after one month at the time of earthing-up. Phosphorus increases tuber yield by increasing the number of medium size tubers, whereas, potassium increases the number of large size tubers. Urea is a cheaper source of nitrogen, however, calcium ammonium nitrate and ammonium sulphate are good sources of nitrogen for potato crop. Single super phosphate, di-ammonium phosphate, 10: 26: 26 grade fertilizers, muriate of potash *etc* are various sources used for potato cultivation in Maharashtra state.

3.6. Weed Control

The potato crop develops canopy in about 4 weeks after planting and weeds must be controlled by this time to gain competitive advantage for the crop. If the weeds are large, they should be removed before the ridging operations begin. After earthing up the weeds between the growing plants and at the top of the ridge should be removed by mechanical or herbicide application. Alternatively pre-emergence spraying of weedicides such as Fluchloralin (0.70-1.0 kg a.i./ha) or Pendamithilin (0.50 kg/ha) is recommended for controlling annual grass weeds and broad leaf weeds.

3.7. Earthing-up

This operation is attended with the help of wooden plough at 25-30 days after planting. The main object of earthing up is to keep the soil loose and destroy weeds. It helps to loosen the soil and increases aeration for tuber development. It also covers nodes which later on grow into stolons and tubers. Earthing-up protects potato tubers from exposing to the sunlight and avoids greening and heat injury. Two or three earthing up should be done at an interval of 15-20 days. The first earthing-up should be done when the plants are about 15-25 cm high. The second earthing up is often done to cover up the tubers properly. Timely earthing-up helps in reducing the infestation of potato tuber moth in field conditions.



3.8. Irrigation

Irrigation has a special significance in the potato production as the plant has shallow and sparse root system. In Maharashtra pre-planting irrigation is given by the farmers for uniform emergence. In *kharif* season, the crop is irrigated when there is a long dry spell or as per the need of the crop. During *rabi* season after pre-planting irrigation, second irrigation is given after about a week and subsequent irrigations at intervals of 8-10 days. Light and frequent irrigations are better than heavy and less frequent irrigations. In brief, water is applied efficiently and economically at critical stages of crop development *i.e.* at stolon formation, tuber initiation and tuber development. Irrigation is discontinued about 10-15 days before harvesting of crop to allow firming of peel of tubers.

The crop is irrigated through furrows, whereas the micro-irrigation systems like sprinklers and drip are becoming slowly popular for potato production in the state. The drip system of irrigation is most economical giving highest productivity and saving almost 50% water. It also enables application of fertilizers through irrigation water. The sprinkler system gives uniform distribution of water and reduces water losses by percolation and run off. Sprinkler irrigation is beneficial on frosty nights as it reduces frost damage in potatoes.

3.9. Haulm cutting and method of harvesting

The time of haulm cutting and harvest is very important in potato. The development of tuber continues till vines die. The main crop is ready for harvest within 75-120 days of planting depending upon the area, soil type and variety sown. The crop should be normally harvested when the soil is not very wet. Tubers lifted during the monsoon have a poor keeping quality and also develop various types of rots. The main crop is ready for harvest when majority of the leaves turn yellow-brown. At this stage, the tops are cut near the ground level. Haulm cutting is done 10-15 days before harvesting of crop. In some areas to avoid labour cost of haulm cutting sheep / goats are allowed to feed on the haulms but this is not desirable as it harms tuber qualities. The time of harvesting of early crop is determined largely by market demand. However, it is highly desirable to harvest the crop at proper maturity. A more matured potato is usually of higher specific gravity and can be harvested with less bruising injuries. The crop is harvested 10-15 days after last irrigation. This allows tuber peel to become firm and tubers do not bruise during harvesting. Harvesting is done with the help of bullock drawn single row plough or wooden plough and collected manually. In Maharashtra, no mechanical harvester is used for harvesting. Grading of tubers is done after harvesting. Before grading all the cut, damaged and rotten tubers are removed. Tubers are graded and packed in gunny bags according to sizes. Preferably the tubers are graded in four sizes *i.e.* small (below 25 g), medium (25-50 g), large (50-75 g) and extra large



(above 75 g). Large and extra large tubers are sent to distant markets while small and medium size potatoes are sold in the local market.

3.10. Yield

The yield varies from variety to variety. However, the average yield of the early-maturing varieties is about 20 t/ha and that of the late varieties about 30 t/ha.

3.11. Potato based cropping systems

Potato being a short duration and fast-growing crop can be harvested at any time after 60-70 days of planting till 100-110 days. It is an ideal crop for intercropping with other crops. Potato fits well with several other crops in different inter-cropping and crop sequences. It can be successfully intercropped with preseasonal sugarcane, as the cultural operations and resources used in both the crops are mutually complimentary. In Maharashtra, usually, farmers grow potato as intercrop in sugarcane and maize. It is also successfully grown in crop sequences such as paddy-potato, maize-potato, green manuring-potato, potato-wheat, potato-pea, potato-groundnut etc.

3.12. Organic farming

In Maharashtra, the trend of organic farming is increasing in other vegetable crops, however, in potato the efforts were started by ITC Ltd., Ranjangaon in a limited area. The organic product 'Wellgrow soil' which is made up from neem cake and karanj cake is marketed by ITC Ltd., for higher production of potato tubers but results regarding its success are awaited.

3.13. Contract farming

Contract farming in potato has been initiated by various private companies in Maharashtra. The ITC Ltd., Ranjangaon is growing this crop on 600 ha area and it had capacity of 80 metric tonnes per day for processing. The Pepsico India Holdings Pvt. Ltd., Ranjangaon is growing potato crop on 1600 ha area and has a capacity of 240 metric tonnes per day for processing. Another private company the Parle Biscuits Pvt. Ltd., Nasik is growing potato contractually for its factory having capacity of 40 metric tonnes per day for processing.

The private companies are growing potato varieties Atlantic, Cycloon, FL-1533, Kufri Chipsona-3, Kufri Chipsona-2, Kufri Chipsona-1, Kufri jyoti, Kufri Chandramukhi, L. Bianca, L. Chrysti, L. Claire, L. Joe, L. Olympia, L. Rosetta, L. Valora, Melody, Saprano, Innovator, Kennabec, etc. The private companies use these varieties for preparation of chips, French fries and fried chivda, etc. They procure potato produce from the farmers @ Rs.6/kg by providing the necessary inputs to the growers.

4. POTATO PROTECTION MEASURES

4.1. Diseases

The crop grown in *khariif* as well as *rabi* season from Pune area is badly hit by two major



fungal diseases viz., early blight caused by *Alternaria solani* and late blight caused by *Phytophthora infestans*. Cooler nights and drizzling rains are most favourable for increasing severity of late blight disease.

4.1.1. Late Blight (*Phytophthora infestans*):

The disease affects all plant parts, viz., leaves, stems and tubers. It appears on leaves as small pale green spots, which enlarge into large water-soaked lesions. A white mildew (cottony growth) ring forms around the dead areas on the lower side of leaves. In dry weather, water-soaked areas turn necrotic brown. On stems, light brown elongated lesions are formed which may encircle the stem. Tubers develop reddish brown, shallow to deep, dry rot lesions. The affected tuber flesh becomes 'caramalised' with a sugary texture. Frequently metallic tinge develops on the margins of the affected tissue. Tubers carrying the pathogen are the real carriers and serve as the source of the disease in the subsequent season. Infected seed tubers grow into healthy plants but under favourable conditions for the disease (10-12°C and RH > 80%) development, the disease infects the stem and lower leaves.

Control:

Seed potatoes should be checked thoroughly before storage. All blighted tubers must be removed and buried deep in the soil. Ridges should be made high enough to cover all daughter tubers and reduce chance of their infection upon exposure. If the weather conditions (temperature 10-20°C, RH > 80%) are favourable for the disease development irrigation should be stopped immediately. If essential only light irrigation is given. When the disease affects 75% crop foliage, the haulms should be cut, removed from the field, and buried deep. Protective sprays with a contact fungicide, viz., Mancozeb (0.2%) before appearance of the disease is effective. Subsequent sprays if necessary should be repeated at 8 to 10 days interval. In case of severe blight attack, one or two sprays of Metalaxyl (0.25 %) are given to check the further spread of the disease. Mancozeb is applied at an interval of 15 days after the Metalaxyl application. Spray of copper oxychloride @ 30 g or metalaxyl MZ-72 @ 20 g per 10 liter water is also suggested. Sprays are repeated at an interval of 10 days depending upon disease progression. Application of fungicides should be started at very initial stage of the out break of the disease and this decides the success of control of the diseases.

4.1.2. Early blight (*Alternaria solani*):

The disease mainly infects leaves and tubers. Initially the symptoms occur on the lower and older leaves in the form of small (1-2 mm) circular to oval brown spots. These lesions have the tendency to become large and angular at later stage. Mature lesions on foliage look dry and papery, and often have the concentric rings, looking like bulls eye. The symptoms on the tuber comprise of



brown, circular to irregular and depressed lesions with underneath flesh turning dry, brown and corky. Lesions tend to enlarge during storage and affected tubers later become shriveled.

Control:

Use of disease-free seed tubers for raising the crop. The crop must be given balanced doses of fertilizers, especially nitrogen. Spraying the crop with urea (1.0%) at 45 days after sowing and giving subsequent sprays 8-10 days after the first spray helps the crop to easily escape the severe onslaught of early blight disease. In the hilly regions, spraying of mancozeb @ 30 g or Chlorothalonil @ 25 g or Copper Oxychloride @ 30 g per 10 liter water and Bordeaux mixture (1.0%), is recommended at an interval of 12-15 days for control of early blight disease. Solanaceous crops, which act as the collateral hosts for the disease organism, hence their cultivation nearby potato fields, must be avoided.

4.1.3. Common Scab (*Streptomyces spp.*):

The disease does not cause yield losses but disfigures the tubers, thereby reducing the market value and increasing peeling losses. The disease mainly affects potato tubers causing any of the following symptoms viz., mere abrasion of skin (russetting); corky lesions around lenticels which may be star shaped or irregularly circular; irregular concentric corky rings around lenticels; raised rough corky pustules and 3-4 mm deep pits surrounded by hard corky tissues. In case of severe attack, dark brown lesions may develop on roots and stolons.

Control

The pathogen is difficult to control because of long survival both on seed tubers and in soils. However, using disease free seed tubers could minimize the disease incidence. Before planting the seed, tubers are treated with organomercurial compounds (0.015% for 20 minutes) or Boric Acid (3% for 30 minutes) and dries in shade. The same treatment is repeated before the storage of the tubers. Maintaining high moisture in ridge at least for a few weeks during the initial tuber formation phase creates adverse conditions for the development of the disease. Following crop rotations with wheat, pea, oats, barley, lupin, soybean, sorghum and bajra checks the disease development.

4.1.4. Potato Leaf Roll Virus (PLRV):

The PLRV invokes primary or secondary types of symptoms in plants depending upon the age of infection. The primary symptoms develop during the crop growth. These symptoms are confined to top young leaves, which usually stand upright, roll and turn slightly pale. The secondary symptoms of PLRV develop when plants are grown from infected seed tubers. Such symptoms are rather prominent in older leaves. Infected plants have characteristic pale, stunted and upright appearance with rolling of lower leaves that turn yellow, brittle and are leathery in



texture.

Control

The disease is managed by using virus-free seed potatoes. Multiplying virus-free seed in aphid free areas. Population of aphid vectors is controlled by application of suitable contact/systemic insecticides.



Early Blight



Late Blight



Common scab



Potato Leaf Roll Virus

4.2. Insect pests

The potato crop in Maharashtra is damaged by several insect pests in the field and in storage. Some of the major pests attacking potato are potato tuber moth, cut worms, aphids, jassids, mites and tobacco leaf eating caterpillars. Potato tuber moth (*Phtharimaea apercullala*), this pest is serious under both in field as well as in country stores but it causes more damage in country stores. In the plains, it is active throughout the year and passes its life cycle on potato plants in the field from November to March and on tubers in the stores from April to November.

4.2.1. Cutworm (*Agrotis ipsilon* Rott.)

This is serious pest of potato at seedling stage. It is serious in low lying areas which remain waterlogged for considerable time during the year. The caterpillars cause crop damage. They feed at night on young shoots or underground tubers. In the early stages of crop, the caterpillars cut the stem of the young plants near the ground and feed on the shoots and leaves. After tuber formation, they bore and nibble into the tubers affecting both tuber yield and market value. The destruction by the pest is much more than actual feeding.

Management:

Heaps of green grasses be kept at suitable intervals in infested field during evening and collected next day early in the morning along with caterpillars and destroyed. Apply 10% carbaryl dust on the soil. In case of severe infestation, apply 5 % poison bait of carbaryl 50 WP in the field. Hot weather ploughing in plains reduces the population of immature stages. A number of birds, feed on insects that get exposed upon ploughing. Spraying insecticides like Chlorpyrifos 20EC (2.5 litres/ha) and drenching the ridges on noticing the cutworms controls the pest.

4.2.2. Aphids (*Myzus persicae* Sulz. And *Aphis gossypii*) and jassids (*Amrasca biguttula* I)

There are several kinds of aphids that feed on potato plants. Aphids transmit a virus disease and



cause severe damage to the plant by sucking the juice from leaves and young stems. Nymphs and adults of aphids suck cell sap from leaves and shoots as a result, the affected leaves turn yellow, get wrinkled. The aphids exude honeydews on which sooty mould develops and this affect the photosynthetic activity of the plant. The plants may be stunted, with the leaves tightly curled and rolled when the attack is severe. Besides, they transmit viral diseases of potato.

Jassids are sucking pests and their nymphs and adults suck cell sap from lower surface of leaves. The damaged leaves curl upward along the margin, turn yellow, then brown and show burnt patches which adversely affect the growth and yield of the crop.

Management:

When the incidence of aphids is two aphids/leaf and that of jassid is one nymph/leaf, spray the crop with 5 % neem seed kernel extract. Give second spray when ETL level of the pests given above is reached with imidacloprid @ 4 ml/IO litre water or *Verticillium lecani* @ 2.4 g/litre.

4.2.3. Mites

This is minor pest of the crop occasionally appear in severe form. Both adults and nymphs damage the crop by foliage feeding. They suck the cell sap from leaves. Mite attack starts from the top potato leaves showing downward curling. In the early stages of infestation, the lower side of leaves appears 'oily'. Gradually these symptoms can be seen on the entire plant. The infested leaves become short and leathery in appearance with characteristic copper colour, peculiar bronzy deposits on lower side. Under severe mite attack, the infested leaves dry up and wither away resulting into death of the plant.

Management

Spray the crop with 0.2 % sulphur or 0.03 % dicofol or dust with sulphur @ 20 - 25 kg/ha.

4.2.4. Tobacco leaf eating caterpillars (*Spodoptera litura*)

This is also very serious pest of potato which feed gregariously in the early stages and defoliates the plant in the month of August and September.

Management

1. Collect and destroy the egg masses and leaves with young larvae feeding gregariously.
2. Spray the crop with SINPV @ 500-750 LE/ha or *Bacillus thuringiensis* @ 500 g/ha.

4.3. Management in field:

1. Timely earthing-up to cover exposed tubers which help in reducing the intensity of infestation.
2. Spray the crop twice with quinalphos or 0.1 % carbaryl at an interval of 15 days starting from 60 days after planting.



3. Heaps of harvested tubers should not be kept exposed in the field but covered with straw and infested tubers should be rejected before storage.

4.4. Management in stores:

1. The potatoes should be stored in well-ventilated cool and dry places with temperatures not-exceeding 21°C.
2. Walls of the stores should be sprayed with 1.5 % carbaryl at an interval of three months.
3. Treatment of seed potato tubers with 5 % malathion dust @ 125 g/100 kg is reported to offer good protection against the pest.



Cut worm



Aphid



Jassids

1. POTATO STORAGE

Traditionally, after harvesting potatoes are kept in locally made storage structures called 'Aran' method of potato storage. For this purpose, the farmers usually use locally available material like *Shevari*, *Bamboo*, local *bhendi*, sugarcane trash, wheat straw, etc. By using this material, they are preparing storage structures under the big tree which gives shade during day time. In this method, potatoes are kept by preparing heap of about 1.0 m wide at base with convenient length (3-4 m). The heap is covered with dry grass and *neem* leaves. Polythene is used for covering during rainy days. The potatoes are kept for about 3-4 months period in this storage.

Storage of potato is intended to avoid losses in quantity and quality. Potatoes are subjected to storage losses due to respiration, transpiration, sprouting, rotting and damage from pests and diseases. Therefore, long term storage of seed potatoes is done in cold stores at low temperatures (2-3°C) and high relative humidity (85-90%).

6. POTATO PROCESSING

Potato processing is one of the alternatives to avoid gluts and improve marketing. Potato flour can be prepared and used in baking industry, in baby food and as a thickener and flavoring agent in soups and sauces. Potato is used for making chips, French fries, flakes, chakli, papad, chivda etc. by the private companies like ITe Ltd., Ranjangaon, Pepsico India Holdings Pvt. Ltd., Ranjangaon and the Parle Biscuits Pvt. Ltd., Nasik in Maharashtra.



At village level, the potatoes are processed in the form of flakes, chips, chakli and papad and are mainly used for domestic consumption. Dehydration of potato is advantageous because it is cheaper, can be done at the level of individual farming families and add value to the product. Moreover, solar energy is abundant, naturally available and can be used for dehydration. Dehydrated potato products are cheap and within the reach of common man. It will also check the problem of glut in the market.

7. MAJOR CONSTRAINS IN POTATO PRODUCTION

- Non-availability of certified quality seed potatoes.
- Non-availability of high yielding varieties.
- Fluctuations in rainfall, temperatures, light and humidity.
- Incidence of biotic stresses.
- Shortage of cold storage facilities.

8. FUTURE PROSPECTS OF POTATO IN MAHARASHTRA

In Maharashtra state potato is cultivated in *kharif* and *rabi* seasons, whereas, on sloppy lands rainfed crop is cultivated in *kharif* season only. At present farmers are growing unspecified varieties, however, there is scope to grow varieties suitable for table and processing purposes. The soil type of Maharashtra is suitable for development of tubers. Already potato is being grown in few pockets of Maharashtra in *kharif* season and most of the districts in *rabi* season. In Maharashtra state, the potato crop reaches physiological maturity earlier and the produce is highly suitable for processing due to high dry matter content.

There is huge demand for table potatoes and value-added products from bigger cities in the state. The state is well connected by road and rail to transport the bulk of potato from its area of production to the consumers.

The farmers from Maharashtra state are innovative and increasing little awareness among them regarding potentialities of this crop will certainly help in achieving record yield of this crop. The mechanization of farm operations is taking place in the state, which will reduce cost of inputs and thereby increasing profitability.

With good chain of vegetable growers, cooperative associations and private companies in the state, the grass root level growers will also get good returns.

