

## **VI. POTATO (SOLANUM TUBEROSUM)**

### **General Situation**

The potato, alongside rice, wheat, maize and highland barley, is one of the major crops in the Himalayas and in the Hengduan Mountain Region.

Originally from the South American Andes, between 10°N and 20°S at altitudes above 300m asl, potatoes are mainly cultivated in temperate zones. Potato contains high value protein, various vitamins, especially vitamins B and C, carbohydrates, enzymes and other substances necessary for human nutrition.

Before the 1950s the potato was mainly cultivated in Yadong, Nyalam and Gyirong on the southern flanks of the Himalayas, Nyingchi, Bomi, in the forest area on the northern side of the eastern Himalayas, as well as at Aba, Garze, Lijiang and Xichang Prefectures in the Hengduan Mountain Region, mostly at altitudes of 2000-3000m asl., while in the middle reaches of the Yarlung Zangbo River, the potato was fragmentarily cultivated on the manor.

The area under potato cultivation has been expanded to the middle reaches of the Yarlung Zangbo River and the broad valleys and basins on the northern flanks of the Himalayas. Various units and institutions of local government and the barracks of the PLA grow potato to resolve the shortage of vegetables in the High mountainous regions.

The upper limit for potato cultivation is at Saga with an elevation of 4650m asl in the upper reaches of the Yarlung Zangbo River with semi arid climate; at 4300m asl in the south eastern part of areas

with sub-humid climate, and it reaches 4300m asl at Gar in the Ngari Region with an arid climate.

### **Ecological Characteristics**

Despite its wide distribution, the potato is a typical plant of a temperate climate, characterized by a short growing season and high, stable yield.

Potato tubers begin germinating at 3-5°C, 5°C daily mean temperature is considered the lowest possible for plant growing at the seedling stage, and 10°C daily mean temperature is the lowest limit for blossom and tuberization. A soil temperature of 16-18°C is regarded as the most favourable for tuberization, which approximately corresponds to an air temperature of 10-14°C at night and 20° at daytime. Cool nights (10-14°) are essential for the best yields. Potato tubers are retarded in growth if the optimal temperature is either lowered or raised. The potato will not tolerate frost, it is subject to freeze injury at a temperature of -2 to -3°C, and dies at a temperature of below -4°C.

In the middle reaches of the Yarlung Zangbo River, the temperature regimes in July and August, with a mean temperature of 15-20°C in the daytime, 8-10°C at night and a ground temperature of 18-20° at 10cm below the surface are favourable for high yield of potato tubers. The middle and late maturing varieties with a growing season of 150-180 days, can be widely used in this area.

On the northern flanks of the Himalayas with an elevation of above 4000m asl, the mean temperature of 10-15°C at daytime, 4-8°C at night and a ground temperature of 14-18°C at 10cm below the surface in the warm season, the early maturing variety with a growing season of 100-120 days is suitable.

At the initial stages the potato does not require much moisture. Its requirements for moisture reach a maximum during the period of flowering and the plant develops well only if the soil moisture reaches 60-80 per cent of the field water capacity.

The potato, being a light-preferring plant, it forms its flowers and tubers at any light-day length, but with shorter days the development is considerably increased. Long warm days with moderate sunshine prove to be favourable for haulm growing, while short days are necessary for the growth of tubers.

Deep, well-drained, aerated light-textured fertile loam is preferred for potato cultivation, the PH may range from 4.8 to 7.8. Because the tuberization zone is mainly located 10-15cm underneath, porous soils well aerated are favourable for root development and tuber growth.

Sandy soil is suitable for sprouting tubers with a good quality and high yield, as well as resistance to disease; while clay soil, located at wet lowlands is unfavourable to tuberization of the potato because of drainage difficulty. Most of the soils in the study area are suitable for potato cultivation.

The potato must be, primarily, resistant to disease degeneration and drought. Early ripening varieties of potato, because they produce tubers in short growing periods (usually three months, maximum four), have been frequently used in the Himalayan and the Hengduan Mountain Regions.

### **Present Extent of Cultivation**

In the Hengduan Mountain Region, the area under potato cultivation made up 1/10th of the total cultivated area of cereal crops in the 1960s. Of which, Liangshan and Xichang account respectively for 27.1 per cent and 24.6 per cent, Li-jiang 20.3 per cent, Aba 14 per cent, Garze; Diqing and Nujiang together account for the remaining 14 per cent.

According to a study made on the altitudinal variation of farming types in Central Yunling, located in the middle section of the Hengduan Mountains, the area under potato cultivation accounted for the following shares in total cultivated areas (including buckwheat and oats) of the different farming

types:

- crop farming dominated in broad valley basins: 14 per cent
- forestry and agriculture combinations on slopes and piedmont of hills and mountains: 41 per cent
- forestry, agriculture and animal husbandry combinations on mountain slopes and intermontane basins: 58 per cent

It can be seen that the proportion of area under potato cultivation dominates the higher elevations. This is because the geo-ecological conditions do not suit the major cereal crops.

In Lhasa Prefecture a moderate estimate puts the total area under cultivation of potato at 1120 ha. in 1985, when it made up 2.96 per cent of the total area under cultivation.

It can be seen that the area under potato cultivation made up a much higher proportion of the total cultivated area in Lhasa city and the adjacent counties (Table 13).

**Table 13: The Area Under Potato Cultivation in Proportion to the Cultivated Area of Cereals, Lhasa Prefecture, 1985**

County	A the total cultivated area ha	B area of cereal crops ha	C area under potatoes ha	D proportion of C/B percent	E total production of potato tons
Nyingchi	2600	2160	7	0.31	150
Gongbogyanda	3400	2647	47	1.76	156
Maizhokunggar	5733	4607	113	2.46	304
Dagze	4533	4320	193	4.48	373
Lhasa	2400	2280	120	5.26	286
Doilungdeqen	6400	6100	273	4.48	517
Quxu	4267	3967	133	3.36	250
Nyemo	2933	2747	60	2.18	96
DamXung	/	/	/	/	/
Lhunzhub	6467	5580	147	2.63	171
Medog	1133	940	/	/	/
Mainling	2933	2433	27	1.10	53
Total	42799	37781	1120	2.96	2356

Based on incomplete statistics in 1981, the total area under potato cultivation in Lhasa and Xigaze

accounted for 120 ha, the tuber production amounting to 215 tons; of which about 72 per cent of the total area (under potato cultivation), and 73 per cent of the total potato production are respectively planted and produced by farmers, both cooperatives and individuals.

**Table 14: Cultivated Area and Production of Potato in Lhasa and Xigze (1981)**

Responsibility System	Total	State Farming	Collective enterprise	Institutions and individual barracks, and others	Co-operatives and individual farmers
Area (ha)	120	7	7	20	87
Yield (ton)	215	7	13	38	157

On the basis of experiments in Lhasa, the yield of potato tubers could reach 23-38 ton/ha. The statistics show that yields (Table 13) are much lower than the potential productivity, resulting possibly from the normal mixed cultivation of potato and rape in the region.

## Cultivation Techniques

### *Planting*

The successful cultivation of potatoes in the study area depends primarily on the proper timing of cultivation activities.

In the Hengdun Mountain Region two planting times have been accepted, early spring and summer, depending chiefly on geo-ecological conditions and cultivation habits. Early spring potatoes depend on the temperature regimes of the initial growth period and the early spring potatoes are mainly planted in the plateau and upper mountain areas. Planting takes place from the middle of February to middle April, and harvesting from the end of June to the end of September. The summer potatoes are planted after the harvesting of early maize and wheat, from the end of June to the middle of July, and are harvested in October. The early maturing varieties should be selected for their short growing season. Winter potatoes, planted mainly in the river valley at low altitude on the southern section, are planted from the end of October to the middle of November, and harvested in May in the following year.

The middle and late maturing varieties of potatoes are widely planted in the middle reaches of Yarlung Zangbo; planting starts when the soil is warmed up to 6-7°C at 10cm below ground in March and April, e.g. at the end of March to beginning of April in Lhasa district (3600-3700), and the beginning and middle of April in Xigaze district (3800-3900m). Harvesting takes place in August and September with a growing season of 150-180 days. On the north side of the Himalayas, the potatoes are chiefly early maturing varieties; the planting begins at the beginning and middle of May and harvesting from the end of August to the middle of September, with a growing season of 100-120 days.

The planting pattern depends chiefly on the soil and climate conditions. Ridge planting is preferable, particularly under irrigation, because the ridge raises the temperature of the soil, improves aeration for tuberization, and favours irrigation and drainage.

Level planting of potato is more feasible in semiarid regions with insufficient moisture; the

embedding depth depends on soil and climatic conditions. The plants are usually covered with 7-8cm thick soil, earthed up after they grow to a height of 20-30cm. The optimum density of potato plants is usually 75-90 thousand per hectare.

### *Management*

Soil and plant management includes tillage of row spaces before rows contact, regular weeding, irrigation, fertilization and the application of herbicides. Owing to the long period before shoots emerge and the impermeable soil, the soil should be harrowed lightly before the plants sprout.

After sprouting, the row spaces are usually tilled. The first loosening with slight hilling to a depth of 8-10 cm is made when the plants reach 6-8cm in height, then in 10-15 days the second tilling and hilling follows. The row space may be slightly hilled to facilitate tuber development.

### *Irrigation*

In the early stages of growth, the water consumption is less owing to the small leaf surface; at the later stages, when the tuber is expanding it needs aerated soil and the leaves are gradually turning yellow, and the transpiration is also smaller. But at the budding stages, the water requirement reaches its maximum for the formation and development of tubers.

According to the experience in Namling county, the first irrigation with sufficient water supply starts one month after sprouting, the second begins when tubers are in formation. The timing of irrigation and its volume depends on the moisture regimes and plant growing status.

### *Fertilizers*

Potatoes demand soil fertility and respond well to mineral and organic fertilizers. Mineral fertilization of potatoes on all kinds of soil facilitates high yields.

Various fertilizing systems are applied to potato cultivation. The basic application of organic and mineral fertilization during ploughing is necessary for potato growth and tuberization. Top dressing with quick-action fertilizer is usually accompanied by irrigation and hilling, especially during tuberization. Potassium and phosphorus fertilizers are suggested, such as potassium sulphate, plant ashes which contain 13.8 per cent of potassium oxide, and are quick-acting, and calcium superphosphate.

Potatoes can be sensitive to the type of fertilizers applied, e.g., if mineral fertilizers with chloride components are applied, it decreases the tuber starch content and its quality. Therefore, ammonium and potassium chloride should be avoided as potato fertilizers.

### *Diseases and pests*

Two kinds of potato diseases are reported, which are late blight (*Phytophthora infestans*) and early blight (*Alternaria solani*), occurring especially in the southeastern part of Tibet and the mid southern section of the Hengduan Mountains under humid and subhumid conditions. On the northern flanks of the Himalayas and Yarlung Zangbo River, the blight is characterized by diseases of the kind due to low temperature and humidity in a temperate semiarid climate.

The main pests of potatoes include *Polyphylla sikkimensis*, *Anomala* sp., *Amethes Cnigrum*, *Euxoa segetum* and *Cicadulla viridis*, which occur in eastern Tibet, the Hengduan Mountains as well as in Lhasa district.

Insect control in Tibet is mainly dependent on insecticides and artificial control. Dipterex is one of the important insecticides applied to control pests there. The measures to control grubs of *Polyphylla sikkimensis* include agricultural control measures such as autumn ploughing, artificial catching, and

insecticide control methods such as earth mixing, sprays and irrigation. An integrated method of control is expected to come into use in future.

To establish and improve quarantine measures is very important to control damage by other pests that occur in adjacent areas.

#### *Significance of rational rotation*

Continuous cultivation of potatoes can give rise to severe damage by disease and degeneration. Potatoes cannot be alternated with other crops of the Solanaceae Family, such as tomatoes, because of their poor resistance to the diseases of the Solanaceae crops. The best way is to let the land be fallow before commencing potato planting and to follow it with legumes and cereals. To efficiently control damages by disease, potatoes should be rotated for at least three years.