

# POTATO

**IN HOMESTEAD PLOTS**

# GROWING

RECOMMENDATIONS FOR PRIVATE HOUSEHOLDS



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The recommendations were developed by the Institute of Agricultural Microbiology and Agro-Industrial Production of the National Academy of Agrarian Sciences of Ukraine on the request of the International Humanitarian Organization ZOA in cooperation with the Food Security and Livelihoods Cluster (FSLC). The printed materials are free of charge and are distributed among vulnerable households that grow potatoes in their private plots.

Chernihiv, 2024

## POTATO PLANTING AREA, THE CONCEPT OF MONOCULTURE AND CROP ROTATION

Potatoes grow best in open, sunny, and well-ventilated areas. The main mistake of the beginners is planting potatoes under fruit trees. Potatoes can grow under apple trees, but they will not yield a good or even average harvest. In the shade, the tops stretch out, the potato bush might get sick, and small tubers are formed in the bush.

The best soils for growing potatoes are light ones – sandy, sandy loam, and loamy soils – as the underground part of the bush also breathes. The potato plant needs oxygen in the soil during the germination of the mother tuber, the growth of the root system, the stolon formation and, especially, tubers formation. Potatoes will also grow on heavy clay soils, but, in addition to general soil improvement measures (sanding, adding sawdust, straw, peat), they will require additional care, including additional loosening, water drainage in wet weather, etc. On heavy loams, potatoes germinate on average 5-6 days later than on light soils, and on floating clay soils, some of the planting tubers do not germinate at all (they rot due to suffocation).

### **NOTE: SOIL TYPES BY MECHANICAL COMPOSITION**

(ratio of sand to clay):

**SANDY SOIL.** Lightweight, quickly permeable to water and it dries quickly. It is not fertile and requires all kinds of fertilisers, especially organic ones. Also, due to the climate change, it now requires irrigation or watering. The water-holding capacity of light soils can be increased by systematic application of organic fertilisers.

**SANDY LOAM SOIL.** Lightweight, highly permeable to air and moisture. Unlike sandy soil, it contains clay particles, which means it a little absorbs and retains moisture, and has a higher content of nutrient minerals and humus. However, it requires fertilisation for good yields.

**LOAMY SOIL.** In general, it has an optimal ratio of sand and clay. These soils have a granular structure, they warm up well, absorb and retain moisture and heat. Typically, loams contain a lot of nutrients and trace elements, have an optimal level of acidity, and a fairly high humus content.

**CLAY SOIL.** Very dense and viscous. Air is poorly permeable. It absorbs water well, in large quantities, but it does not penetrate to a considerable depth. With insufficient rainfall, the clay can crack, and with excessive rainfall, it can float. However, the properties of clay soil allow it to retain nutrients for plants.

**NO CROP ROTATION, OR MONOCULTURE,** where potatoes are grown in the same place every year, provided that intercrops are used, is acceptable. Intercropping green manure with green manure crops plays a key role in maintaining soil health and

fertility, as well as the productivity of the main crop (potatoes).

Intercrops or harvest crops are sown in late summer or early autumn after the tuber harvest. The soil is already loose, so it is levelled with harrows or rakes. And seeds of cruciferous plants (oil radish, mustard, rapeseed) or winter rye are sown. Then the green mass is ploughed in autumn (spring crops such as oil radish or white mustard form a good mass and can even bloom) or, if it is rapeseed or rye, in spring. Each grower chooses their own option; each of them has its advantages and disadvantages. The advantage of autumn ploughing, for example, is that you can still add any organic fertilisers to the field, the green mass of green manure will contribute to their better mineralisation, and the owner will have a ready-made plot in spring, all that remains is to loosen it up and plant the crops.

**NEIGHBOURS IN THE KITCHEN-GARDEN.** Since ancient times, potatoes have been compacted with beans, sown in the last row along the border or perimeter of the plot. In addition to beans, corn and pumpkins feel good with potatoes. It is advisable to alternate early potatoes with red or fodder beets: a row of potatoes – 2 rows of beets. While the beets are small, the potatoes grow freely, are well lit and ventilated. After the potatoes are harvested, space is freed up for the beets to grow freely.

**BY THE WAY, IT IS NOT RECOMMENDED TO PLANT SUNFLOWER NEXT TO POTATOES.**

## APPLYING FERTILISERS

To form 1 centner of tubers, potatoes take about 0.5 kg of nitrogen, 0.2 kg of phosphorus, 0.9 kg of potassium, and 0.4 kg of calcium out of the soil. You can (and should) replenish the supply of plant nutrients in the soil with fertilisers. Fertilisers are divided into organic and mineral ones.

**MINERAL FERTILISERS** are produced by industry and can be purchased in stores, where the packaging will indicate the name of the fertiliser and the content of the main nutrients (active ingredient): nitrogen (N), phosphorus (P, or  $P_2O_5$ ), potassium (K, or  $K_2O$ ), as well as calcium (Ca), magnesium (Mg), and trace elements. Mineral fertilisers can be simple (ammonium nitrate, superphosphate) or complex, containing several components (for example, Nitroammophosphate (*the Nitroammophoska*) N16:P16:K16). Mineral fertilisers also include ash (grass, wood, peat) and chalk.

Fertilisers that contain a significant portion of organic matter are called **organic** ones. Manure, slurry, humus, peat, all types of compost, wet or granular chicken manure, and feces are **all organic fertilisers**.

Cattle and pig manure is applied to the soil at the rate of 5-6 kg/m<sup>2</sup>, horse and sheep manure – 4-5 kg/m<sup>2</sup>. On light soils, the dose can be increased to 8-9 kg/m<sup>2</sup>. Pure lowland peat (up to 7-8 kg/m<sup>2</sup>) is a very good tool for improving the structure and moisture-holding capacity of light sandy and sandy loam soils, as well as loosening

heavy loams. However, pure peat does not provide enough nutrients and is better used as a composting base and applied with composts.

Organic fertilisers release nutrients in the year of application and the following year, so it is recommended to apply them at least once every two to three years. Annual application of organic fertilisers will also not be superfluous, as it will improve the soil structure and increase its fertility.

On loamy soils, organic fertiliser is applied and ploughed or buried into the soil in autumn, and on sands – in spring.

Mineral fertilisers for potatoes are applied in spring. For most soils in Ukraine's Polissia region, it is recommended to apply nitrogen and phosphorus in the range of 45-60 and potassium 60-75 kg of active ingredient per hectare. The active ingredient is converted to the physical weight of the fertiliser based on the content of the active ingredient in a particular type of fertiliser or the average amounts presented in Table 1.

### 1. APPLICATION RATES OF DIFFERENT TYPES OF MINERAL FERTILISERS ON FERTILE AND POOR SOILS

Types of fertilisers	Application rate per 100 square metres, kg of physical weight	
	On fertile soils or with organic fertilisers	On poor soils or with insufficient organic fertilisers
Ammonium nitrate	2,5-3,4	3,4-4,3
Urea	1,9-2,6	2,6-3,3
Superphosphate	4,5-6,0	4,5-6,0
Potassium chloride (in autumn) *	2,4-2,7	3,1-4,0
Kalimag	5,6-6,4	7,2-8,8
Nitroammophosphate (10:10:10)	9,0-12,0	12,0-15,0
Nitroammophosphate (16:16:16)	5,6-7,5	7,5-9,3
Ammophos 12:50	7,5-10,0	10,0-12,5
Azophos 22:22	4,1-5,4	5,4-6,2

**NOTE:** \* Potassium chloride is applied in the areas for potatoes planting only in autumn, so that during winter the chlorine, which is detrimental to potatoes, is washed out.

The simplest option for households in the absence of soil analysis, intensive cultivation technology and the desire to calculate fertiliser types is the following one: for a yield of about 20-25 t/ha, 7.5 kg of Nitroammophosphate (the Nitroammophoska) 16:16:16 and 1 kg of potassium magnesium (40:3) should be applied per 100 m<sup>2</sup>.

The fertiliser can be spread over the surface of the plot immediately before spring ploughing or loosening before planting, either all at once or divided so that 2/3 or 1/2 is used first and the rest is applied later, as a top-dressing during wrapping. It is very good to apply the fertiliser in the furrow between the tubers or in the holes during planting with a shovel. However, to prevent burns to the tubers, fertiliser is thrown into the hole first, followed by a layer of soil, and then the tuber.

When planting potatoes, it is common among growers to add humus (200-300 g) or compost (400-500 g) or an organic-mineral mixture to the hole.

Here is a **common recipe of an organic-mineral mixture** for 35-40 bushes. The mixture is prepared of 4 main components: humus – 1 bucket, superphosphate – 1 half-litre jar, dry bird droppings – 4-5 half-litre jars, wood ash – 2-3 half-litre jars. All components are thoroughly mixed and applied 250-300 g, or an incomplete half-litre jar, under each future bush, and also overlaid with soil to preserve the tuber.

Fertilisation of potatoes with mineral fertilisers is carried out on light soils at the stage of full germination before wrapping by spreading them in the row spacing. The amount of mineral fertiliser depends on how much of the calculated amount was applied during planting (2/3 or 1/2). At the same time, it will not be superfluous to fertilise with an ash solution (1 glass per bucket of water) to spill the rows before or after rain or watering. This method significantly improves the taste of tubers.

Fertilising with organic fertilisers (their aqueous solutions) is advisable only if insufficient fertiliser was applied before planting and is carried out immediately after a good rain or watering, when the soil is wet to a depth of 20-25 cm. Manure, urine or mullein is diluted 5-10 times and the solution is spilled into the aisles at the rate of 120-150 litres per 1 square metre (10 litres per 3-5 linear metres).

## SOIL PREPARATION

As mentioned above, potatoes need loose, weed-free soil to provide the plants with sufficient light, ventilation, and oxygen for the underground part of the bushes. Therefore, the task of a potato grower is to provide these conditions.

On heavy soils, it is mandatory to slash them or plough / dig them up, regardless whether intermediate green fertilisers (green manure) or organic fertilisers were applied to the area or not. It is worth noting, that a large amount of cut straw (after wheat, for example) on all soil types should be treated with a destructive agent or 10-15 kg/ha of nitrogen active ingredient should be applied to the field for its rapid decomposition and discing. It is better to direct the mineralisation of straw in a way controlled by an agronomist to prevent the further development of Fusarium on the next crop – potatoes. In autumn, no cultivation or harrowing is done after ploughing to promote better freezing and greater moisture accumulation. Freezing of the soil in winter ensures its disinfection and restoration of structure.

**NOTE: Destructive agents** are biological products based on microscopic fungi or bacteria that accelerate the decomposition of stubble, straw, cobs, and other crop residues in the field. The most common destructors are products based on Trichoderma fungal spores and Bacillus bacteria. The products help to replenish soil by suppressing pathogenic microflora, as well as restoring the natural structure and fertility of the soil by accelerating the mineralisation of plant residues.



In spring, it is important to preserve winter moisture, so at the earliest opportunity, the plot is harrowed to a depth of 4-5 cm or loosened with a rake. Before planting potatoes, fertilisers are applied, and the soil is loosened in various ways – cultivating, milling, and ploughing. The choice of how to loosen the soil depends on a number of factors, including the availability of appropriate equipment, soil type, whether or not to apply fertiliser, how to apply organic fertiliser, weather conditions, the chosen method of planting potatoes, etc. The decision is up to a grower.

In addition, there are also areas where excessive moisture needs to be dealt with in spring, and in this case, to ensure faster drying and warming of the area for potatoes, ridges are formed with a width of 2-4 rows of potatoes, separated by deep furrows.

## POTATO VARIETIES

All potato varieties authorised to be used in Ukraine are included in the State Register of Plant Varieties. You can buy a high-quality seed material of your favourite variety from the originators establishments – scientific-research institutions engaged in the selection (creation) of potato varieties (Institute of Potato Growing of the National Academy of Sciences of Ukraine, PJSC Research and Production Association Chernihivelitkartoplia), seed farms united in the Association of Potato Seed Producers, and stores for gardeners: Zelenyi Svit (means, Green World), Svit Roslyn (The World of Plants), Ogorodnyk (Gardener).

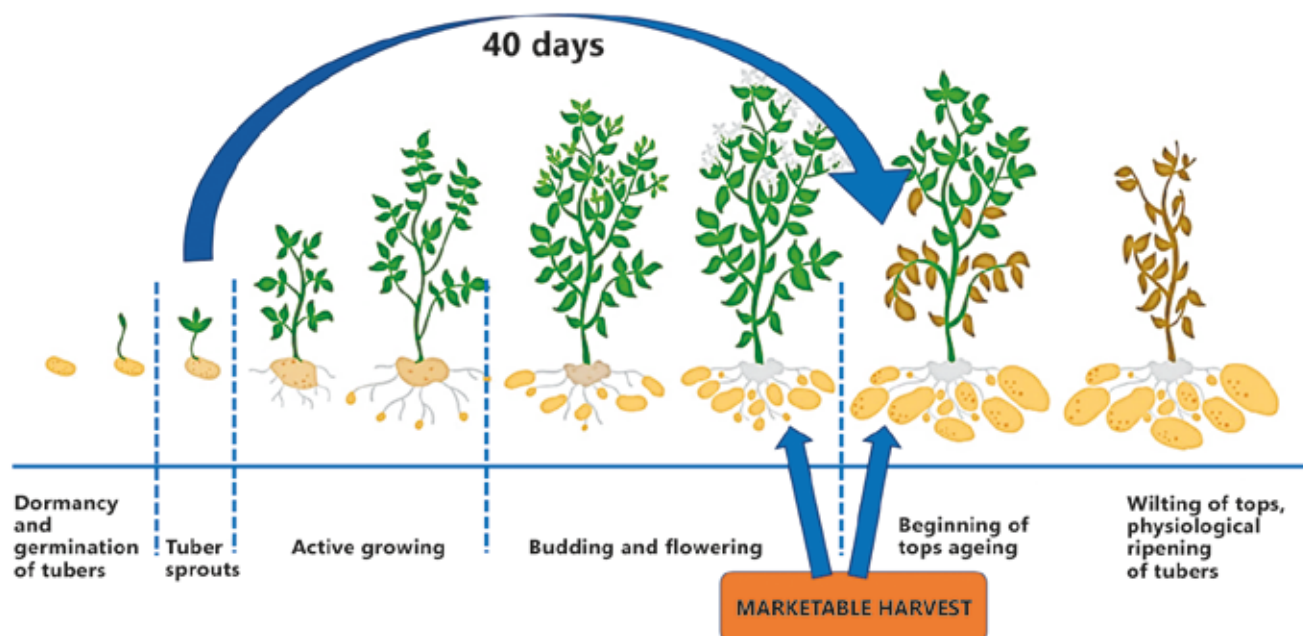
Potato varieties are divided into the following range, according to their early maturity, or the length of the growing season – the period from planting to tuber formation and tops dying off:

<b>80-90</b> days from planting	<b>100-115</b> days from planting	<b>115-125</b> days from planting	<b>125-140</b> days from planting	<b>&gt; 140</b> days from planting
EARLY	MEDIUM EARLY	MID-SEASON	MEDIUM LATE	LATE

The length of the growing season can be reduced by preparing planting material, planting dates, and the quality of plant care. Sometimes in the professional literature or on the Internet, varieties are classified by maturity, although the countdown of days is not from planting, but from the emergence of seedlings. According to this classification, early varieties will have 60 days of ripening, medium-early varieties – 90 days, and so on.

### NOTE: THE FORTY-DAY POTATOES

Ultra-early varieties, or **'forty-day' varieties**, are early varieties with intensive crop formation rates, when a marketable tuber crop can be dug up as early as 40 days after germination (Fig. 1). However, it should be understood that the vegetation period of this variety does not end when it is able to form a mass of marketable crops, but continues for several more weeks until the tops die off and the tubers physiologically ripen. By the way, tubers of any variety, including early and ultra-early varieties, must be physiologically ripe for seed purposes.



**FIGURE 1. POTATO GROWING SEASON AND GROWTH STAGES WITHIN THE GROWING SEASON**

Potato varieties are divided into table (for consumption) and technical (for the processing industry). The classification of potatoes by culinary properties types (European assessment) is shown in Table 2.

**2. EUROPEAN CLASSIFICATION OF POTATOES BY CULINARY PROPERTIES TYPES (TUBERS AFTER COOKING)**

The Quality Indicators of Tubers	The Culinary Properties Type			
	A	B	C	D
Ability to boil	Hard-boiled	Low-boiled	High-boiled	Crumbly
Consistency	Solid	Moderately solid	Sufficiently mild	Mild or hard-grained
Starch Content (flouriness)	Non-starchy (Non-floury)	Low starchy (Low floury)	Starchy (Floury)	Extra starchy (Extra floury)
Moisture	Moist	Low moist	Sufficiently dry	Dry
Flesh structure	Small-size	Sufficiently small-size	Sufficiently	Крупна
Flavour	Imperceptible	Slightly perceptible	Perceptible	Significantly perceptible
Darkening of the Flesh	No	Low	Medium	High

Potato varieties also differ in taste, flesh texture (coarse, tender, watery) and ability to boil. According to the colour of the flesh, tubers can be white, yellow of various shades, pink, red and purple.



Yellow potatoes contain more carotene than white potatoes. The coloured varieties that have recently become popular also contain other compounds (anthocyanins, antioxidants) that give them dietary and medicinal properties. For example, 'Solokha' variety developed by the Potato Institute has a blue-purple flesh colour, while 'Khortytsia' has a red flesh colour. 'Chorny Lybid' variety, developed by Chernihivelitkartoplia, has a deep dark purple flesh.

The interest of people in coloured potato varieties is not accidental, as eating them helps to improve health and prevent illnesses, such as cancer and cardiovascular diseases. These potato varieties are a source of vitamin C, folic acid, minerals, potassium, iron, zinc and phenolic compounds. Coloured potatoes are an excellent prevention of many diseases, their main secret is the low starch content and the increased content of antioxidants – anthocyanins and carotenoids – compared to ordinary potato varieties. By the way, the more intense the colour of the tubers, the higher their antioxidant content, almost as much as in blueberries and pomegranates. Antioxidants 'help' protect proteins and DNA from the harmful effects of free radicals. Coloured potatoes are ideal for boiling and steaming, frying and baking, as they have low levels of acrylamide, which is produced when potatoes are fried or baked. However, when growing, coloured potato is more demanding on soil fertility and air content.

As an example, here are descriptions of several varieties recommended for cultivation in Chernihiv region.



#### **POTATO VARIETY «SUVENIR CHERNIHIVSKYI»**

was developed by Chernihivelitkartoplia and has been included in the Register of Plant Varieties of Ukraine since 2009.

- Medium-early variety for table use
- Culinary properties type: CD
- Vegetation period: 96-107 days
- Large tuberous, with excellent taste and high yield.
- Marketability is 95-97%.

The plant is quite tall, bright green in colour, medium-sized leaves, white flowers. The tubers are round-oval, large, the skin is light yellow, covered with a fine mesh, and have a very attractive appearance. There are 8-10 tubers in one bush, the size of individual tubers is about 300 g. The flesh is creamy, crumbly in texture. Tubers of this variety are ideal for baking.

The starch content is medium – 15%, the taste is excellent. It is resistant to potato cancer. Due to the mesh skin, tubers are resistant to common and silver scab. Vegetative mass has high field resistance to late blight. Potential yield: 40-45 t/ha. The variety responds to watering very well.



### **POTATO VARIETY**

#### **«CHERNYI LYBID»**

was created by PJSC RPA Chernihivelitkartoplia and is included in the Register of Plant Varieties of Ukraine.

- Medium-ripening variety of potatoes for table use.
- It has an exotic appearance. It is valued for its extremely high antioxidant content and is used as a dietary product and for decorating gourmet dishes.
- The tubers are round-oval.

The skin is dark purple, the flesh is dark purple.

The eyes are distinguished.

The taste is excellent.

The starch content is 18%.

Potatoes are suitable for use as a natural food colouring.

The variety is resistant to the common potato cancer pathotype, relatively resistant to late blight and viral diseases.

The potential yield is 40 t/ha at the end of the growing season. The variety is recommended for cultivation in Polissia, Forest-Steppe, and Steppe regions.

In addition to the varieties of domestic selection and breeding, it is worth noting the foreign varieties that have been adapted to the conditions of Chernihiv region and are popular with the people.

The German variety Bellarosa has also taken root in Chernihiv region.



### **POTATO VARIETY**

#### **«BELLAROSA»**

- This is an early variety for table use.
- The weight of marketable tubers reaches 120-200 g, and one bush can produce up to 8-9 potatoes. They have a pink skin and milky yellow flesh; it is crumbly and has a great taste

As well as the Dutch-bred 'Picasso' variety, which is so popular with local potato growers that it has received additional names: 'Ivan and Marya', 'Little Red Riding Hood' and 'Drunkard'.



### **POTATO VARIETY**

#### **«PICASSO»**

The tubers are large, even, weighing 100-120 g, oval in shape, the skin is pale yellow with shallow bright red eyes.

The starch content is low – up to 12%. The potatoes are low-boiled, have a pleasant taste and aroma, and are suitable for cooking various types of dishes. It is stored until late spring without sprouting or withering.

Importantly, the variety can withstand heat and temporary drought.



**FIGURE 2. A POTATO BUSH OF 'SLOVIANKA' VARIETY IN THE GARDEN**

'Slovianka' variety, developed by the Institute of Potato Growing, never fails to deliver its owner in the kitchen garden. Large tubers of good shape, always a stable harvest. Potatoes of this variety are easy to care for and resistant to viral diseases.

## **SEEDING MATERIAL AND ITS PREPARATION**

Quality seeding material is one of the most important factors affecting harvests. Growing potatoes at the household level, it is optimal to use seed material of the 1st or 2nd reproduction for changing or growing new varieties. Such potatoes will be valuable for planting more than one year. However, households usually use lower quality planting material that is more affordable. So, what is the best way to prepare potato seeding material for planting?

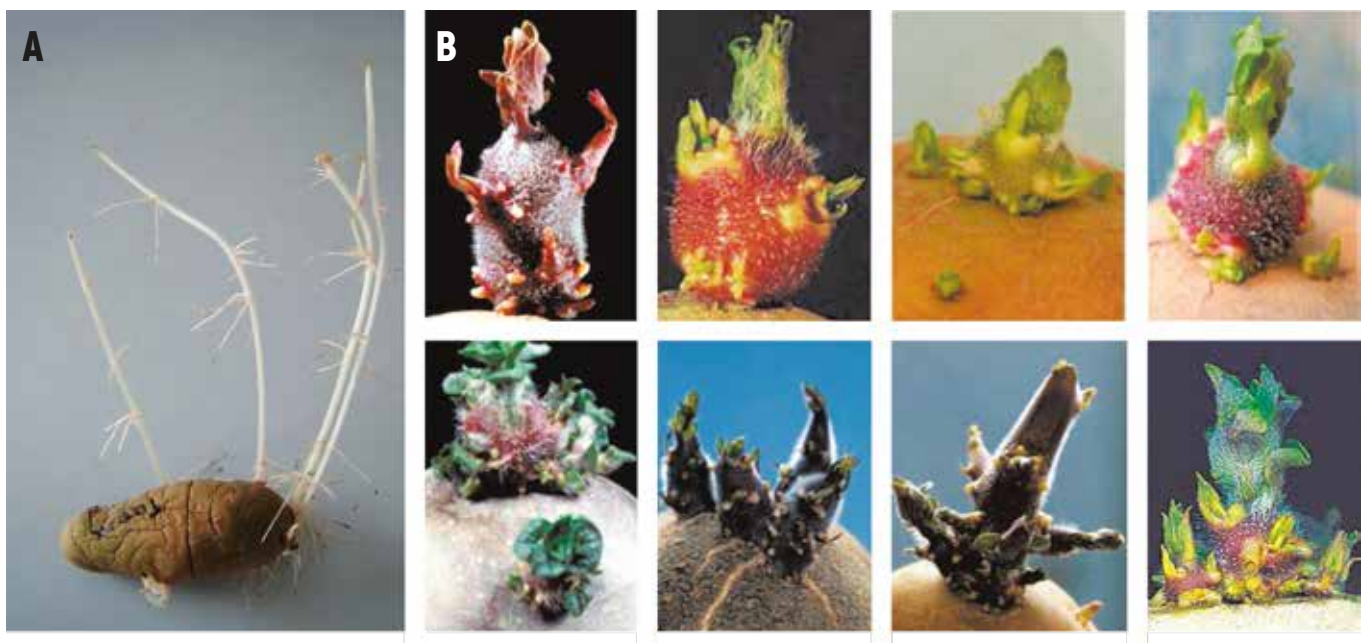
Of course, potato bushes will grow from any tubers, but in order to get seedlings of the same development and subsequently healthy, strong bushes, you need to take care of preparing the tubers for planting.



**1** Firstly, the tubers to be planted should be of medium size (like a chicken egg), without external and internal defects. It is a bad practice to plant with small tubers. Another folk wisdom should be remembered – you reap what you sow.

**2** Secondly, if the tubers were stored in a cold basement, they should be warmed up for 2-3 weeks at a temperature of 10 to 16-18°C, preferably in the light, to wake them up and give them a boost. In the light, the sprouts will be small and strong; in the dark, they will stretch out and break off during further work. Tubers can be germinated on shelves, in a thin layer in boxes, or simply on the floor.

Some potato growers germinate especially valuable material in 3-litre jars on window sills or in small plastic sleeve-bags 25-30 cm wide and 120-140 cm long, turning them evenly throughout the entire period. Jars are not closed; holes are made in the sleeve bags for breathing. The bags are hung or placed on the floor. After germination, before planting, it is obligatory to remove tubers with thin thread-like sprouts (Fig. 3) – these are signs of viral, mycoplasma or viroid disease.



**FIGURE 3. A – FILAMENTOUS SPROUTS OF A DISEASED TUBER;  
B – LIGHT SPROUTS OF HEALTHY TUBERS OF DIFFERENT VARIETIES**

**3** Thirdly, before planting in the ground, tubers should be treated (sprayed) with a solution of microelements, for which liquid concentrated humate-based fertilisers or others diluted with water according to the manufacturer's guidelines are well suited.

You can sprinkle the tubers with ash at the rate of 0,5 kg per 100 kg of tubers. You can also, if desired, use commercially available disinfectants (also according to the manufacturer's guidelines). It is also suggested that for primary protection against the Colorado potato beetle, the insecticide Aktara should be used to treat seed tubers at the rate of 5.0 g per 35 kg of tubers (140 g/t of tubers). 5 g of Aktara is diluted in 150-200 ml of water and this solution is used to spray tubers laid out in a single layer on a film (sheeting). After spraying, the tubers should be covered with the film and kept for half an hour for complete absorption of the preparation by the skin of the tubers.

## DATES AND METHODS OF POTATO PLANTING

Potatoes are usually planted when the soil warms up to 8-10°C. In Polissia region, this is the last decade of April – early May. A very good folk omen is when the leaves on the birch trees open up to the size of a modern 5-hryvnia coin. The depth of planting tubers depends on the mechanical composition of the soil – on light sandy soil, tubers are planted deeper than on heavy loam. Under any circumstances, the soil layer above the tuber should not be less than 8-10 cm. Tubers planted shallowly take a long time to germinate, sometimes until autumn, because they cannot form a sufficient mass of roots. A mistake some potato growers make is to plant tubers vertically, with the tops up or down. The tuber should lie horizontally in the furrow, this is its natural condition.

Tubers are planted mechanically or manually. Small-scale mechanisation tools are now available, such as tractors and walk-behind tractors with a set of tillage tools and potato planters. In this case, the potatoes are planted to a certain depth, sprout in straight rows with defined row spacing (usually 70-75 cm), and are already in ridges suitable for further mechanised cultivation.

In the absence of a planter, the 'plough' method is also used, when one pass of a tractor with a double-hulled plough (or two passes of a horse with a single-hulled plough) opens a furrow where people spread the planting tubers with tape at a depth of 8-10 cm from the surface of the ridge so that the next pass of the plough covers them with soil. This creates a smooth planting without distinguished ridges and allows the soil to be harrowed before the potatoes germinate to kill weeds. However, the potato rows will not always be even, especially in the case of horse planting, the row spacing will be between 50 and 70 cm, and it is not always possible to ensure that the tubers are planted evenly deep. It depends on the effort whether the tuber falls to the bottom of the furrow or whether the tuber strip is evenly covered with soil in the next pass. All subsequent cultivations will either be done using horse-drawn traction with a hiller (cultivator) or manually.

There is another good way to plant potatoes – in the furrows opened by the hiller (Fig. 4). To do this, the area for the potatoes is harrowed and future rows are marked with a marker. Then a furrow (row) is opened through the row with a horse hiller or a hand hiller, or a hoe to a depth of 8-10 cm and tubers are manually laid out every 25-28 cm (shoe length). Between the tubers, you can spread heaps of mineral fertiliser (1 tablespoon of complex fertiliser), or composts, or organic-mineral mixtures, as described above. You can close the rows with your feet or with subsequent passes of the horse-drawn harrow. This method ensures even rows with the specified row spacing, uniform tuber depth, uniform fertiliser application without contact with the tubers, and a light cloddy ridge over the tuber row and trampled row spacing. Weeds germinate quickly in the row spacing, which can be easily destroyed by pre-germination layering of the row spacing. The rows create very favourable conditions for planting tubers: close contact with the bottom of the furrow, into which the roots grow, and a light, dry top layer with sufficient oxygen, through which potato shoots quickly sprout and weed seeds do not germinate because it is dry for





**FIGURE 4. PLANTING POTATOES IN FURROWS**

The most unproductive but widespread method of planting potatoes is with a shovel. Rows are marked (or not) on the plot and tubers are planted by digging holes along the row. Fertiliser is thrown in, followed by a layer of soil, then a tuber, then cover with soil from the next hole. This method of planting is called smooth planting, meaning that they plant, trample on it, and some people also rake it in – and that is all; the rows will only be visible when the potatoes sprout. And this takes at least 10 days, or even up to three weeks, depending on the weather and the way the tubers are prepared. During this time, weeds sprout densely, but it is undesirable to weed them blindly, risking breaking potato sprouts. In addition, if the soil becomes waterlogged from rain and a crust forms, the emerging sprouts will lack oxygen – the seedlings will be unequal and sparse. When potato seedlings finally appear with this method of planting, the field looks like a solid green mass, and it is very difficult, time-consuming and unpleasant to weed. The potatoes can get caught in the weeds and need to be hilled quickly.

## **CROP CARE**

**PROTECTION AGAINST FROST.** If you planted potatoes early, or if the spring is cold and prolonged, you may need to protect the area or part of it from frost. The best way to do this is with agrofibre, which is spread over the required area. If the seedlings are just emerging and the frost may linger, the potatoes are spudded, and after the threat passes, the heavily spudded rows are opened. Short-term frosts are neutralised by smoke.

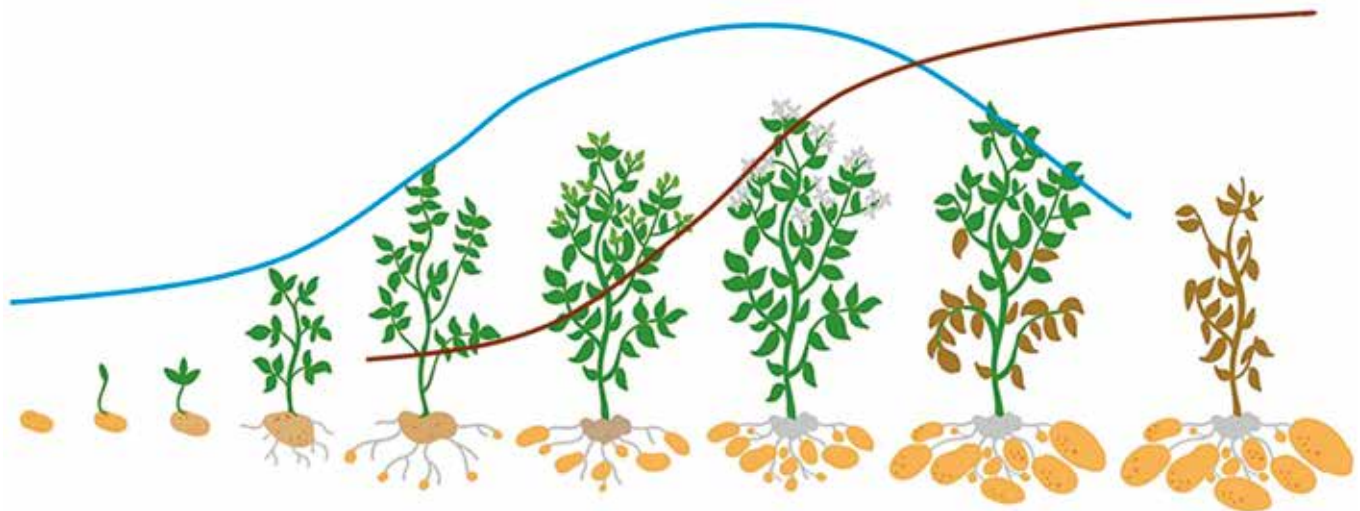
**INTER-ROW CULTIVATION** begins 6-8 days after planting, when the bulk of the emerging weeds are in the filamentous or cotyledonous leaf stage.

If there was a smooth planting, it is advisable to harrow across the rows or



diagonally. If the planting was such that there are tubercles or ridges in the place of future rows, layer the row spacing manually with various devices or mechanically. Such layering (loosening) is carried out as needed, and when the height of the potato seedlings is 10-15 cm, they begin to huddle them, while destroying weeds. The last hilling is carried out before closing the rows. If it is carried out manually, the soil should be taken from the bottom of the furrow so as not to cut the stolons, and raked as close to the stems as possible.

**FERTILISATION**, as described above, should be carried out in the rain or after rain before hilling. There is also foliar fertilisation (spraying the leaves), and both are appropriate for potatoes. The first is aimed at enhancing plant health, so it is carried out during the phase of active growth, before flowering, and any liquid fertiliser with trace elements in chelated form or humate solutions are used, as described in the instructions for the product. The second foliar feeding is aimed at accelerating the ripening of tubers and increasing their nutrient content. Use a solution of phosphate fertiliser so that 2 g of the active ingredient ( $P_2O_5$ ) is applied per  $1\text{ m}^2$ . In particular, a 10-litre sprayer is poured over 2 hectares, and 400 g of  $P_2O_5$  should be delivered with the solution, i.e., for the working solution, for example, 1 kg of superphosphate or another amount of another phosphate fertiliser (e.g., water-soluble potassium monophosphate) should be dissolved. In the case of superphosphate, the solution must be filtered and topped up with up to 10 litres of water before pouring into the sprayer.



**FIGURE 5. THE GRAPH OF TOPS GROWTH, WHICH ALSO CORRESPONDS TO THE WATER REQUIREMENT OF POTATOES, IS IN BLUE AND THE GRAPH OF TUBER WEIGHT GROWTH IS IN BROWN.**

**WATERING.** Potatoes are very sensitive to both a lack of water (they will quickly end the growing season) and an excess of water (rotting of the bushes, suffocation and subsequent rotting of tubers). The critical period for the availability of water is the period of active growth of the aboveground mass, which occurs during the budding – flowering phase, so if the drought lasts more than a week and you can organise watering, do it. Good, strong tops already have the potential for water and sugars to be poured into tubers, and after flowering, the potato's water requirement is significantly reduced. In Figure 5, the blue graph shows the growth of tops, which correlates with water demand, and the brown graph shows the formation of tuber mass during the growing season.

**PROTECTION AGAINST DISEASES AND PESTS.** It is advisable to keep the use of chemical plant protection products to a minimum in private plots and vegetable gardens.

In the areas of early potatoes intended for consumption, it is advisable to collect beetles and larvae by hand, and in the main field, use industrial pesticides (insecticides) according to the guidelines. New pesticides appear every year; this is the general name for all plant protection products – PPPs. Within this large group, there are specialised groups of products aimed at the harmful object: herbicides for weed control, insecticides for pest control, fungicides for fungal plant diseases, and others.

Therefore, when choosing a chemical product for use on a personal plot, one should clearly understand **what to use it against, when and in what concentrations.**



**FIGURE 6. CONSEQUENCES OF IMPROPER USE OF PLANT PROTECTION PRODUCTS ON POTATO PLANTS AND TUBERS**

The main threats you should protect your potato plantations from are the Colorado potato beetle, which can destroy your plot in a matter of days, the bacterial disease blackleg, and viral diseases.

**COLORADO POTATO BEETLE.** It hibernates deep in soil, so it does not freeze. In spring, the adult beetle crawls out, feeds very actively on potato seedlings, mates and lays eggs, from which voracious larvae quickly emerge. In warm summer weather, there can be three cycles: beetle – larva – beetle. Today, there are many products that destroy adults (adult beetles), eggs and larvae. The most vulnerable are the first instar larvae – small, dark, and just emerged from eggs. It is then that chemical treatment should be carried out. Chemicals should be purchased only in specialised stores to reduce the risk of buying a fake, expired or unsuitable product. Use strictly according to the instructions!



**BLACKLEG AND SOFT ROT OF POTATOES** is a bacterial disease. In the field, one or more stems in the bush (or the entire bush) wither, and the affected stem rots black from below, hence the name 'the black leg'. And on tubers, during and after harvesting, this disease manifests itself as soft rot, when the middle of the tuber or part of the tuber rots (Fig. 7).



**FIGURE 7. POTATO STEM WITH SIGNS OF BLACKLEG AND TUBER WITH SIGNS OF SOFT ROT**

It can get into your plot or garden only with poor quality seeds. In a few seasons, all potatoes will be affected, and in rainy summers, it can leave the owners without a harvest: everything will rot, some in the field, and the rest during storage. Then the soil will have to be disinfected with biological products and all seed potatoes will have to be completely replaced. There are no chemicals to combat this disease; tuber disinfectants do not work on these bacteria. The only thing that can be done on the garden plot is to periodically and carefully inspect the potato rows and remove the affected bushes at the first sign of blackleg (Fig. 8). The bushes should be removed from the garden completely, with tubers that have or have not formed, and the removed diseased plants should be buried in a hole, layered with lime.



**FIGURE 8. POTATO BUSHES IN A FIELD AFFECTED BY BLACKLEG**

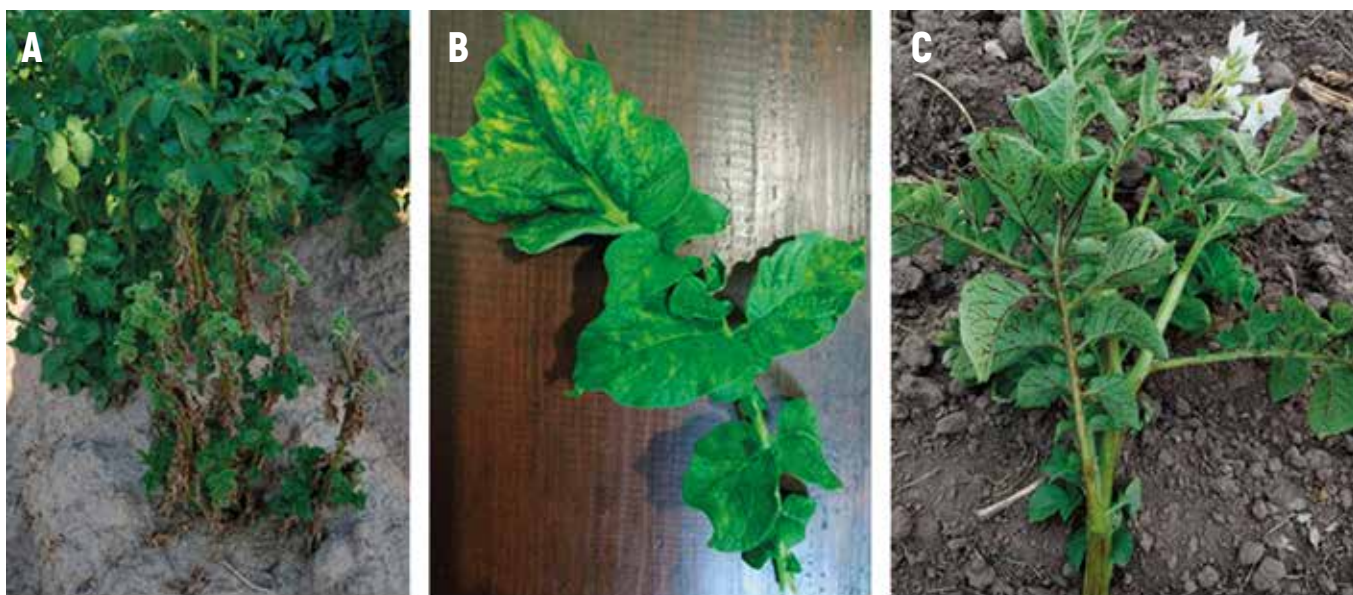


Viral diseases are another problem with potatoes in private plots. There are many of them, but one thing to remember is that it is better to remove diseased bushes from the garden immediately (Figures 9-10) than to replace all planting material later. This method is effective not only in home gardens, but is also used in specialised seed farms when growing basic material. It is called **phytosanitary cleansing**. There are three types of such cleansing, which help to identify and destroy diseased plants – sources of infection – and maintain seed plantations within the standards for the relevant categories of seeds.

Signs of viral diseases can be seen not only on the tops, but also on tubers from diseased bushes (Fig. 11).



**FIGURE 9. SIGNS OF VIRAL DISEASES ON POTATO PLANTS (CURLING AND WAVING)**



**A - NECROTISATION (DEATH OF VEINS); B - ORDINARY MOSAIC; C - WRINKLED MOSAIC**

**FIGURE 10. SIGNS OF VIRAL DISEASES ON POTATO PLANTS**



**FIGURE 11. SIGNS OF VIRAL DISEASES ON POTATO TUBERS**

## **HARVESTING AND SORTING FOR SEED PURPOSES**

Potatoes should be harvested as early as possible in the garden. It is worth remembering that if you plant early varieties, their physiological ripening period is in early or mid-August. The longer the potato tubers lie in the soil, the bigger number of temperatures they accumulate, which means they will be poorly stored, come out of dormancy early and start germinating in January or February. In addition, the longer the tubers remain in the soil, the greater the risk of their damage by soil pests (wireworms, May beetles) and mice. A variety of fungi and bacteria begin to develop on tubers that have been in the soil for a long time. Therefore, in the second half of summer, you should carefully observe the potato field and catch the moment when the tops begin to change from a rich dark green colour to a light green. This is the beginning of the phase of tops dying off.

To obtain a healthy tuber crop, it is advisable to mow and remove such tops from the field. Firstly, fungal spores will not fall off and infect tubers, as in the case of late blight, fusarium, anthracnose and other fungal diseases. Secondly, the larvae of the latest generation will not be able to feed and some of them will die during the winter. Thirdly, this method allows the tubers to ripen and form a skin.

If the owner's goal is to obtain their own high-quality seed material for the next season, it is advisable to immediately select the harvest of the most productive bushes in a separate bucket and put them in a separate pile when digging. If the crop is harvested mechanically or ploughed, then even, medium-sized tubers without any signs of damage are selected for seed from the total mound of tubers.

**DISEASES AND DAMAGE TO TUBERS.** HSeed tubers are best harvested in autumn, as even, intact tubers will store better and the absence of diseased tubers, which can be a source of infection even in storage, ensures that the material will be in healthy condition in spring.



Tubers that should not be selected for seed under any circumstances:

- with signs of viral diseases, as shown in the photo (Fig. 11);
- with signs of wet (Fig. 12) or dry rot (Fig. 13);
- with signs of black scab (rhizoctonia) on more than 1/10 of the tuber surface (Fig. 14);
- with signs of common scab (Fig. 15) on more than 1/3 of the tuber surface;
- tubers mechanically damaged or with growth cracks or irregular shape (Fig. 16).



**FIGURE 12. TUBERS WITH SIGNS OF WET BACTERIAL ROT**



**FIGURE 13. TUBERS WITH SIGNS OF DRY ROT**



**FIGURE 14. RHIZOCTONIA, OR BLACK SCAB OF POTATOES**

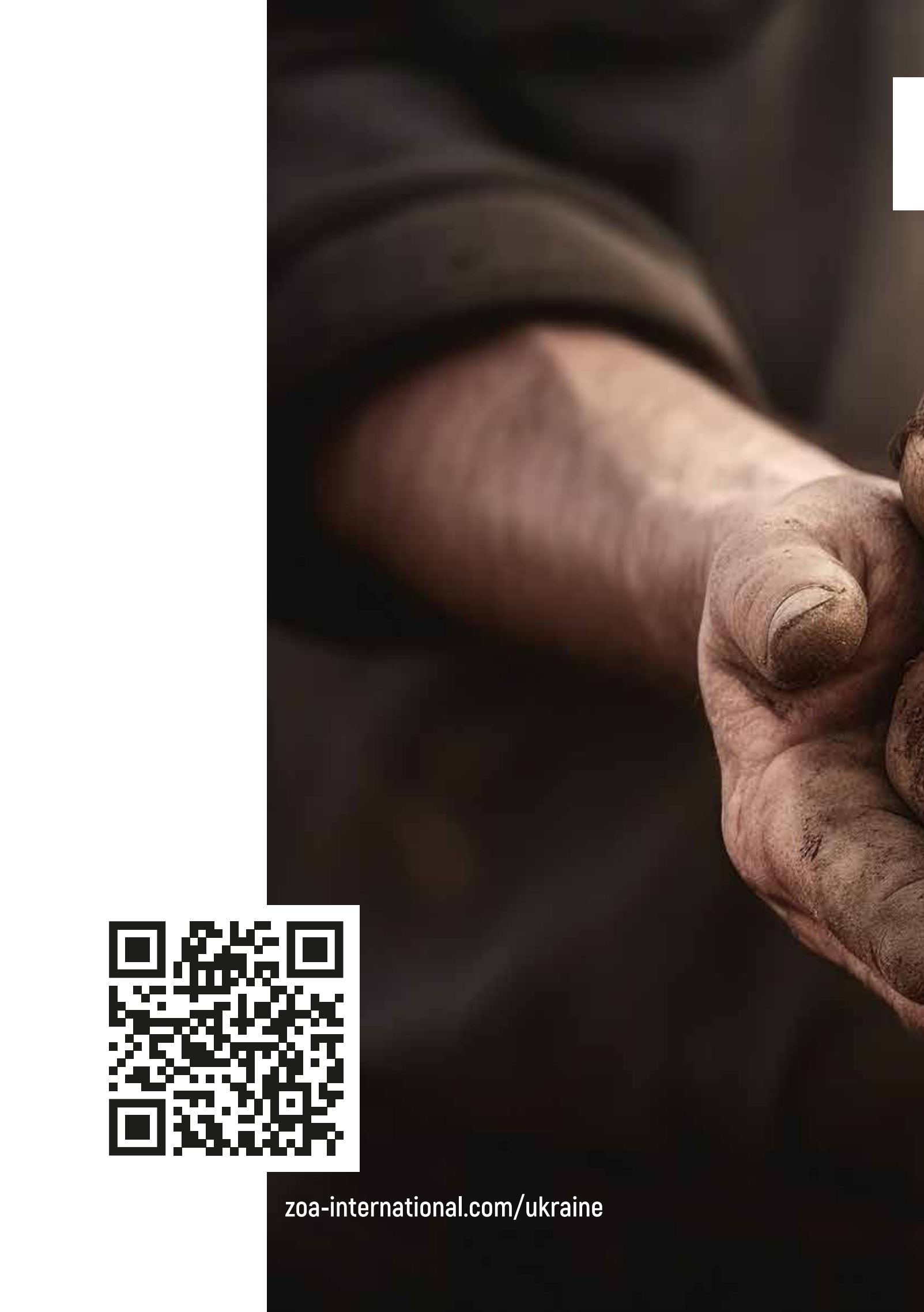




**FIGURE 15. COMMON SCAB ON POTATO TUBERS**



**FIGURE 16. TUBERS WITH SIGNS OF SECONDARY GROWTH AND GROWTH CRACKS**



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