In the cultivation of starch potatoes, the most important factor is the yield of starch

(Tuber yield x % starch content)

High starch yields can only be achieved through careful tillage and planting in conjunction with harmonious fertilization and properly selected crop protection. For this, healthy and yield-forming seed potatoes of varieties suited to the farming conditions and the site in question should be included, which is the main condition for obtaining high yields.

Potato, by virtue of its origin, is a temperate climate plant that prefers lighter soils. Starch potatoes do not generally have different site requirements compared to other potatoes, although climate, weather patterns, and soil have different effects on yield, starch content and starch quality. With varying weather conditions, there can be fluctuations of about 2% in starch content. Also, varying soils can cause fluctuations of 2%. In general, a guarantee of high starch yield is a long growing season with constant access to nutrients and water, with sufficient sunlight for the plants.

Shifting

When including starch potatoes in the rotation, it is necessary to remember to maintain the general and applicable natural and phytosanitary principles, as well as to ensure a sufficiently long growing season. This is needed for good processing of pre-crop residues, especially fine shredding of straw and even spreading on the field. On light sites, it is good to compensate with nitrogen fertilization to accelerate straw decomposition. The following crops are recommended as intercrops: oilseed radish, legumes, lupine. When doing so, be sure to thoroughly process the mass. With a large amount of organic matter, there is a risk of rhizoctoniosis, which can result in a lower yield of tubers and starch, as well as the possibility of high contamination of tubers at harvest.

Due to the low potential for nematode control, potato acreage should not exceed 25% in the rotation. Knowledge of nematodes on the farm (1-2 samples per hectare) is needed in case of their occurrence, so that resistant varieties can be selected in advance.

Corn residues cause more problems with rhizoctoniosis.

Evenly spreading the straw on the surface is very important.

Soil preparation

When preparing the soil for starch potatoes, consider as few passes as possible to be able to plant seed potatoes early into loosened, well-tilled and properly warmed soil, not too wet soil. Avoid compacting the soil to avoid soil contamination during harvesting.

Potatoes root to a depth of 1m. The root system, as the fundamental organ that supplies the plant, is very sensitive to hardened areas that inhibit its development, and therefore impede water supply and can cause premature aging of the plant. For this reason, it is absolutely necessary to avoid compacting the soil, possibly loosening it. Testing the soil in a planned potato plantation with a soil probe is a simple and cost-free control procedure.

On compact and medium sites, fall plowing is preferred. The lighter the soil, the earlier spring plowing can be done. The important assumptions here are that the soil should dry to the right depth in the spring, not cause excessive moisture loss and not delay the planting date of potatoes. When spring plowing, it is recommended to use a medium-heavy roller to lightly compact the soil, ensuring proper planting.

On heavy soils, or when using a 6-row planting system, it may be advisable to form the rows earlier by avoiding passage paths, compacting the soil and limiting root growth, the formation of clods, and earlier drying of ridges. With the 6-row technique, it is easier to achieve more accurate planter guidance.

Also, when pre-forming, be sure to avoid soil compaction, that is, use large and narrow wheels on the tractor on soils with adequate moisture.

SEEDLING QUALITY AND PREPARATION

In the cultivation of starch potatoes, the priority is early tuber establishment and maximum starch formation in the tuber. For this, it is necessary to use healthy, physiologically efficient seedling material. Such material should be free of viruses, since tubers from plants with symptoms of viral diseases have lower yield potential and contain up to 2% less starch than those from healthy plants. High infestation with rhizoctonia or blackleg causes an even greater reduction in starch yield. Many years of official research continue to confirm that the use of certified seed potatoes increases yield by more than 25% on average per year.

To realize the full potential of potato yields, tubers must be:

, "Stimulated and warm" - sautéed

Possible germinating, or stimulation of seed potatoes makes it possible to extend the growing season by about 2 weeks, which is better utilized in the spring moisture in the development of the vegetative part, as well as in the beginning of starch setting in the tubers, on the other hand, the time of starch setting will be completely exhausted.

Also, for high starch yields during earlier delivery dates, stimulation is an essential condition.

The planting date depends on soil conditions (temperature and moisture). The better the tubers are stimulated, the more concessions to soil temperature.

Trowels the size of a pinhead in the mesh of the

Kwalifikowany materiał sadzeniakowy

Tubers	Start of planting Soil temperature
Cold and unwakeable	> 8°C
Warm and stimulated	> 6°C

SEEDING

In preparing the field before planting, it is important to make as few work passes as possible, as each additional spring pass dries the soil and reduces the water holding capacity of the site. Also, additional travel paths should be avoided.

Before planting, check the planter regarding planting efficiency, as by double planting or inaccurate planting, the cost of seedlings can increase significantly. Also pay attention to gentle slopes and properly made rows. Plant early enough into drained and heated soil. Planting at the optimum time, without delay, is a gift for increasing yields.

Planting density per row depends on many factors: soil type, water relations, harvest date, seedling size, variety. These factors have a leading role in determining planting density per hectare. While the above factors can be evaluated objectively, factors such as germination strength and germination capacity are often classified subjectively. Here, too, the conditions of seedling production and storage can be taken into account, possibly the origin and supplier of the seedling material. Poor estimation of the above factors carries the risk of high yields and becomes apparent in the final result of management.

Taking into account the cost of seedlings, the following guidelines should be taken into account when calculating the planting density (with a row spacing of 75 cm)

Check the accuracy of the planting randomly at a length of 3 m.

VARIETY - optimal planting density (75 cm - rows)		
28 - 30 cm	30 - 32 cm	32 - 34 cm
Roberta, Tomba, Tomensa, Eurostarch, Kuras	Amado, Toccata, Eurobravo, Euro- flora, Susanna, Euroresa, Danuta, Eurotango, Euroluna	Eurobona, Eurogrande

factor	Correction of planting density
Light soils (< 30 BP)	+ 2 cm
Soils with uneven water supply	+ 2 cm
Early planting date (< early April)	- 2 cm
Later planting date (> mid-April)	+ 2 cm
Thick caliber (35/55 mm)	+ 2 cm
Fine caliber (35/55 mm)	- 2 cm
Overcalibration (> 55 mm)	+ 4 cm
Drying (< 35 mm)	- 4 cm
Optimal germination power	+ 2 cm
Physiologically obsolete seed potatoes	- 2 cm

At longer distances, special attention should be paid to the accuracy of planting. Also, when choosing the depth of planting, pay attention to the flatness of the tubers to ensure reliable and rapid plant growth.

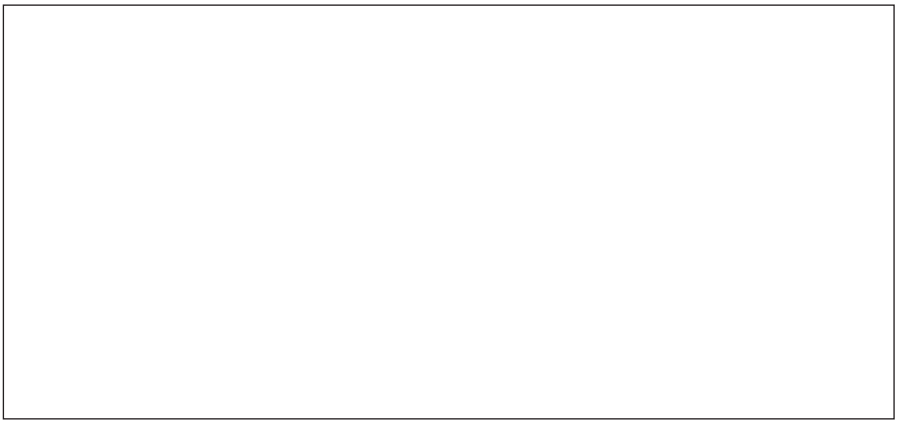

Diagram: Optimal tuber placement and row formation. Primary field area, seedling, harvesting depth.

The top edge of the tubers should be at the height of the original plane of the cultivated field (see diagram). Exceptions are varieties, e.g. TOMENSA, ROBERTA and EUROFLORA, which bind the tubers deeper and should be planted 1 -2 cm shallower.

Treating tubers against rhizoctoniasis is ordered especially when disease pressure is high (high humus content, straw, weeds, early planting date, susceptibility

varietal). The optimal dressing treatment is the liquid form at the time of planting potatoes

Fertilizati on

Fertilization and the action of nutrients significantly affect not only the yield, but also its quality. Therefore, all nutrients must be supplied according to a balanced fertilization plan, that is, specific doses of mineral and organic fertilizers.

Organic fertilization

The importance of organic fertilization lies primarily in improving soil fertility and productivity. It maintains the humus level in the soil, promotes the development of soil microorganisms by which it activates metabolism. Also, the chemical and physiological properties of the soil (water abundance, nutrient abundance, soil structure,) are improved.

To avoid losses in yield and quality, nutrients from organic fertilizers must be carefully balanced. Indicative average nutrient contents are included in Tab 1. In-house testing of nutrient contents gives a more accurate result.

Table 1: Average nutrient content of organic fertilizers.

	Content in kg per t or. kg per m^3					
kind of	s. m. %	general N	NH4-N	P_2O_5	K2O	MgO
Cattle manure	23	5,0	(1,5)*	3,0	6,5	1,8
Manure from pigs	23	7,0	(2,5)*	7,0	6,0	1,4
Bird droppings	60	28,0	(8,0)*	26,0	18,0	6,0
Bovine slurry	8	4,0	2,0	2,0	5,8	0,9
Manure from pigs	6	5,1	3,6	3,3	3,8	1,0
Poultry manure	14	8,7	5,3	7,3	5,1	1,7

* N-activity with late autumn-early spring application in 1.year. Analytical values are actually lower.

Manure fertilization is recommended at the time of spreading AND fertilizing with straw, possibly with intercropping. When fertilizing in the spring, be sure not to

exceed the dose of 40-50 kg NH_4-N. Carry out fertilization with manure along with soil mixing no later than 5-6 weeks before planting.

Ammonium nitrogen (NH_4-N) in slurry applied in the spring should be treated as a dose of mineral fertilizer. This is difficult to accept in autumn fertilization, since it is difficult to determine the loss of components (nitrogen and potassium) during the winter. (Especially on light soils)

• **Example 1: (<40 BP).**	15 m^3 slurry from pigs in the fall to under oilseed radish. The crop froze over the winter, Reworking the mass with a thicker in late February, planting in late April.	30 - 40 kg N i 30 - 40 kg of K2O has been released
• **Example 2: (<40 BP).**	20 m^3 cattle manure under oil radish, thorough processing in late October, wet winter, planting in late April	10-(20) kg N i <10 kg K_2O has been released

The non-ammonium form of nitrogen in organic fertilizers is relatively tightly bound and is only released in subsequent years (about 2-5% per year). As a result of many years of manure application, the amounts applied should be added up in the rotation (Adjustment Factor, see N-fertilization).

The advantages of using manure refer to its good ability to metabolize organic matter and balanced nutrient content. Due to the difficulty of calculating the amount of nitrogen supplied, doses of more than 25 tons of manure should not be used in potato cultivation. ***If we already apply manure, it should be for the pre-crop of potatoes, the year before.***

Problems with low starch content and delayed ripening are particularly evident **on cattle farms.** The reason for this mostly lies in the underestimation of the N rate in the organic matter supplied. Uwa l l i n g a z o t u a t i o n a r e g u l a t e d i n the early part of the year (especially June/July).
Also, **post-harvest rests** (primarily well-processed sugar beet leaves, with an average value of 40-50 kg N/ha) must be included in the overall fertilizer balance.
The importance of **green manures refers to the** improvement of air and water conditions, protection against erosion and reduced leaching of nutrients. Legumes have an advantage in this regard, as they fix free nitrogen from the air through papillary bacteria and **put up *to 100 kg N/ha at the* disposal of potatoes**.

On lighter soils (< 40 BP), the timing of green manure treatment is of great importance. The date of treatment (the beginning of processing) for hardly decomposable organic matter (field grasses, etc.) is recommended to be done in late autumn, for easily decomposable green manure (oilseed radish, phacelia) at the latest.
6 t y worthy pr ed pl anowed s adz en.

Potassium deficiency of varying severity.

In addition to lowering the overall nitrogen rate, the nitrogen rate can also be waived by splitting the nitrogen rate (2. Dose before row shortening). Since potatoes at the stage of shortening of rows/beginning of flowering take up the largest part of nitrogen, they react to excessive nitrogen fertilization with excessive vegetative development (shoots in the tubers). At the same time, the deposition of reserve substances and plant maturation are delayed in the tubers. The consequence is a significantly lower starch yield, poor skin maturity, high susceptibility to bruising as well as low suitability for storage.

Potassium (K) is always present in organic matter in a water-soluble form by which it is entirely available to growing plants. **Magnesium (Mg)** is also easily soluble and permanently available to potatoes. On light soils when fertilizing with K and Mg, losses must be expected due to leaching during the winter.
Phosphorus (P) can be included in the rotation up to 100% because it does not leach from the soil.

Mineral fertilization

Adequate potassium fertilization of plants strengthens the use of water and other nutrients, and thus drought resistance and yield formation. Therefore, adequate potassium fertilization is the basis for high potato yields. Exceeding potassium doses can result in a decrease in starch content, with this dependence strongly dependent on site and weather conditions.
An indicative potassium application rate, with average soil abundance in starch potato production, is 150 to 200 kg/ha K_2O (see Table 2). When applying organic fertilizers in the rotation, these amounts should be taken into account in the development of the dose (see organic fertilization). With little or insufficient potassium fertilization, there is an increased risk of deficiency of potassium supply to plants with corresponding negative effects on tuber yield AND drought resistance.
Additional fertilization is recommended in case of poor supply (primarily light soils), (see Tab.2).

Table 2: Fertilizer recommendations for potassium (K) in starch potatoes

Class of abundance	A	B	C	D	E	
	low		**average**	high		Allowance for higher yield kg/100 dt
Potassium-needs (K_2O kg / ha)	200	250	**150**	50	0	6 0

When the chloride form of potassium is used, there is a likelihood of lowering the starch content. Chlorine hinders the transport of water and other nutrients in the plant and, by delaying the development of the vegetative part, lowers the starch content. This form of potassium can be applied after the pre-crop or for intercropping, by mid-February at the latest. At doses below 80 kg K_2O/ha chloride form

Potassium should not be any problem. When fertilizing before planting, it is recommended to use the sulfate form of potassium (Patentkali or Potassium Sulfate 50).

Also when using farm fertilizers, it is important to remember that potassium is present in them in the chloride form (manure AND slurry), so it is not recommended to apply them before planting. **The amounts of potassium supplied in farm fertilizers must necessarily be taken into account in the balance.** .

Phosphorus influences the amount and speed of tuber setting in potatoes, and thus has a positive effect on tuber yield AND starch content. Phosphorus should be applied in sufficient quantities before planting potatoes to eliminate the risk of losses in the leaching process. Unabsorbed excess phosphorus can be used by the next crop in the rotation.

Table 3: Fertilizer recommendations for phosphorus (P) in starch potatoes.

Class of abundance	A	B	C	D	E	
	low		**average**	high		Allowance for higher yield kg/100 dt
Phosphorus - needs ($_{P2O5}$ kg / ha)	200	150	**100**	70	50	20

At medium soil richness (C) in starch potato cultivation, the dose of 100 kg/ha of P_2O_5 should be sufficient (see Tab.3). In doing so, we must keep in mind assimilability and availability of phosphorus at the right time of the plant's greatest need. If most of the phosphorus dose will be delivered in the form of organic fertilizers, a starting dose of phosphorus in an easily assimilable form (Superphosphate, DAP) should be applied.

In the production of starch potatoes, it is also important to properly and sufficiently fertilize with magnesium, since **magnesium** is an essential component of chlorophyll and seriously affects the production of starch and its storage in the tuber. Unfortunately, lighter soils are often deficient in magnesium, so when choosing fertilizers (lime, potassium) it is imperative that we remember a sufficient dose of this component. Potatoes take up only about 50-60% of their Mg-need until flowering, so it is important to remember that at the time of flowering the plants have access to magnesium in the later stages of vegetation. A base dose of 60 kg/ha of magnesium is recommended at medium abundance grades (possibly splitting the dose; 2nd dose of Kizerite 25% MgO). At high abundances, half of this dose can be applied, at low abundances it should even be doubled.

Table 4: Fertilizer recommendations for magnesium (Mg) for starch potatoes.

Class of abundance	A	B	C	D	E	
	low		**average**	high		Allowance for higher yield kg/100 dt
Magnesium-needs MgO (kg / ha)	160	160	**80**	40	0	20

On very weak sites, additional fertilization with magnesium in the form of magnesium sulfate at a dose of about 10 (-20) kg added to the first 2-3 treatments against potato blight is recommended. (Follow the application directions!).

Of all the nutrients, **nitrogen** has the greatest impact on starch yield, in addition to potassium. Its deficiency leads to premature aging of the plant, and thus to low starch yields. Too much nitrogen leads to too strong development of the vegetative part, with reduced starch production (see organic fertilization).

Therefore, it is important to determine and take into account the abundance of nitrogen in the soil, especially with organic fertilization. Varieties show different degrees of nitrogen uptake as well as the ability to use it, so nitrogen fertilization should also be targeted to the needs of individual varieties (varietal nitrogen fertilization recommendations). Early starchy varieties need higher doses of nitrogen, as the main uptake takes place during worse conditions (low soil temperature, shorter day). Late varieties, by having a longer vegetation period, are better able to utilize later nitrogen mineralization. These varieties quickly utilize nitrogen limits AND achieve the highest yields.

To ensure the best use, mineral nitrogen fertilization should take place immediately before or after planting. For doses above
100 kg/ha it is advisable to divide the dose, especially on light soils where there is a high risk of leaching of the component. The second dose of nitrogen should be applied by the beginning of flowering at the latest, because by this time the plants cover 90% of their nitrogen needs. Late doses of nitrogen or foliar feeding hinder the formation of starch ("shoot in the bald").

Table 5: Fertilizer recommendations for nitrogen (N) for starch potatoes

General-N-dose =		160	160
N-content in the soil		-Nmin	
Yield level	200-300	-20	
	300-450	0	
	> 450	+20	
Forecrop	legumes, rapeseed	-20	
	sugar beets	-30	
Intercrop	harvested legumes	-20	
	redesigned	-40	
	not legumes harvested	-10	
	redesigned	-20	
Sorte	Kuras, Tomba	-30	
	Tomensa, Susanna, Euroresa, Eurotango, Amado	-20	
	Roberta, Eurobona	+20	
	Standardsorten wie Danuta, Eurobravo, Euroflora, Eurostarch, Eurotango	+/- 0	
Organic fertilizers. and livestock farming		N+K	

Foliar fertilization

Many experiments with foliar fertilization produce results described as , "shot in the vacuum". But in experiments optimal conditions are usually created, experimental plots do not suffer from "headaches" and do not need any
, "aspirin". Therefore, our recommendation to use foliar fertilizers - only in certain situations.

stress, , , potatoes have a headache".
Herbicide damage, moisture, hail, Ph-problems, rhizoctoniosis infestation

At an interval of 5 - 7 days, apply an easily absorbed foliar fertilizer (not AHL, not urea) with a significant proportion of nitrogen. Especially with multi-component fertilizers, pay attention to sensitivity and growth stage.

When the plantation is in decline, it is advisable to use premium mixtures, for example, AHL + magnesium sulfate.
Calcium does not have a significant and direct effect in potato cultivation, rather it is a soil fertilizer. But since it affects many soil processes through the pH value, especially the availability of nutrients to plants, a tailored lime fertilization should be sought. On light soils, it should be noted that at a pH value of 5.7 a deficiency of Manganese can become apparent. Therefore, the advisable value is about pH-5.5, while on better soils a higher pH value-about 6-is advisable.

Nurse
acja

By timely ordering of certified seed potatoes and planting them, we must strive to keep the canopy compact in June, so that there will be effective starch accumulation for 90 days. Early utilization of sunlight is the greatest reserve for yield formation in starch potato production, as daily yield increases can reach up to 1.5 t/ha during the main period. The tuber growth time not used in June, July and August cannot be recovered in September and October, as there is a lack of intense sunlight and the plants are no longer as productive. For this reason, a starch potato plantation, according to the length of vegetation of a given variety, must be kept as long as possible at full production capacity without weeds that hinder plant growth and harvesting.

When planning mechanical weed control, it is particularly important to remember to plant potatoes at an even depth and width between rows, and to carefully AND early form ridges, possibly with the help of a forming sheet. The later you carry out the treatment, the sooner the plants can be damaged on the stolons, stems or roots. This damage is an open door for bacterial AND fungal infections, which also reduce yield and quality.


Late dicing leads to damage to lateral roots and causes moisture to escape

For these reasons, as well as from an economic point of view, the focus in recent years has been more AND more on chemical weed control.

Today's wide selection of herbicides gives good results and effective action. With troublesome weeds like perz, burdock, etc. It is necessary to reach for special measures. It should also be borne in mind that with high humus content in the soil and severe drying, the action of the herbicide may not be effective, so it may be necessary to make a second post-emergence treatment. With low weed pressure, one treatment made after plant emergence may be sufficient.

Through intensive protection against potato blight, an average 1% higher starch content can be achieved, as well as a significantly higher starch yield. Intensive protection against blight especially concerns farms that use irrigation. Alternariosis is also in the spotlight. It is
, a "stress" fungal disease by which, especially in late varieties, can cause large yield losses. The first symptoms occur early, often in early June, on plants infected with rhizoctoniosis or viruses.

Degrees of alternariosis infestation

Therefore, in the production of starch potatoes, especially in the group of medium-early to late varieties, planned protection against alternariosis is recommended. This often refers to the elimination of stress factors, such as aphids, nutrient and water deficiencies, etc. Some fungicides also act additionally against alternariosis. Such action is demonstrated, among others, by fungicides containing mancozeb. The dose of applied mancozeb must be a minimum of 1200 g/ha every 10 days. Also in many other fungicides mancozeb is an additional active substance. Also with a large presi, the use of other agents, , "specialists" in the control of alternariosis should be considered.

More and more farms are using **irrigation,** which, applied at the right times, especially during periods of moisture deficit, ensures and stabilizes starch production, especially in early and medium-early varieties. Water doses of more than 25-30 mm at a time are not recommended. Varieties with longer vegetation have a better opportunity to take advantage of late-summer rainfall. If we do not have

irrigation, especially on sites where periodic phases of drought are common, it is imperative that we be careful AND use measures to reduce soil drying.

Roughing up the stolons - ensure moisture!

On such sites, it is also necessary to select varieties that have a fairly good tolerance to periodic moisture deficiency. These include: AMADO, EUROFLORA, EUROBRAVO, EUROTANGO, ZUZANNA or EUROGRANDE.

In commodity starch potato cultivation, destroying the cuttings is not always used, as some varieties mature naturally. Sometimes mechanical destruction of the swales is sufficient to ensure a trouble-free potato harvest. Chemical desiccation of the swales is recommended at the time of prolonged maturation of the plants to ensure timely harvesting and stable starch content. It is essential to avoid re-"bouncing" the shoots, as then the starch content of the tubers seriously decreases.

In recent years, the disease caused by the Sclerotinia fungus has become increasingly common in potatoes. To prevent it, it is recommended in the chemical protection program to apply Altima 2-4 times, especially on sites that favor the pathogen (rapeseed, oil radish, mustard, intercrop).

Collection

Harvesting is carried out according to the delivery date of the potatoes. Also, when harvesting earlier at the beginning of the campaign, 50% of the leaves should be mature, otherwise there may be significant yield losses. With significant cultivation, it is advisable to select varieties with different vegetation lengths to match the delivery dates and, above all, to avoid yield losses.

Starch potatoes should be harvested in such a way as to cause as little damage to the tubers as possible, so that there is not too much contamination, and so that there is high machine productivity. Especially in the case of temporary storage (often makeshift short-term storage), harvesting should be carried out under dry AND warm conditions (min. 10º C). Only under such conditions will there be rapid drying of tubers and healing of wounds and injuries on tubers. High share of damaged or rotten tubers, if the tubers are not dried immediately after harvesting, can lead to total yield losses.

Careful digging guarantees a harvest without loss

With the effective use of outside air to dry the tubers, dissipate heat from the respiring tubers, as well as the free CO generated I and also to reduce the temperature of stored potatoes, it is possible to reduce overall losses from a value of about 10% - 15% to 5-6%. However, the storage temperature should not be lowered below 5ºC, as this leads to starch transformation in the tubers

in sugar, and consequently to a reduction in starch yield.

These cultivation recommendations are addressed especially to producers who are engaged in the cultivation of starch potatoes, possibly growing our varieties. It is in the production of starch potato that special attention should be paid from the very beginning to eliminate any production and technical errors in order to enjoy a sufficiently high income.
The use of certified seed potatoes, as well as the consideration of the above recommendations, is the best guarantee for achieving adequate profitability of this crop.

We wish all producers much success in growing potatoes, and we are at your disposal for any further questions.

Loading of certified seedling material.