Agrico PSA Potato growing guide for farmers in Kenya

Potato farming can be a great venture if done well. Sadly, many farmers do not have the right information on how to manage their potato farm and get maximum yields. The purpose of this Potato Growing Guide is to share our experience growing potatoes in Kenya successfully, and help farmers understand the basic needs and inputs for good potato farming so that potato farming becomes enjoyable and profitable.

SEEDS:

When you use good and certified healthy seeds your crop will perform better and you should expect higher yields than from uncertified or recycled seed.
Please note, some people will speak of 'clean seed'; it is never clean and disease-free until lab analysis by KEPHIS confirms so. Therefore, we always recommend, to buy certified seed.

When collecting the seeds from the seed merchant Agrico PSA, the farmer is advised not to store the seed for more than 5 days.
Potatoes should not be stored in a space where other potatoes are kept, where other foodstocks, chemicals or fertilizers are kept. The storage space needs to be disinfected prior to use.
If potatoes are stored temporarily, it should be in a dry, dark, very well-ventilated place where temperatures don't go below 10 degrees or above 20 degrees, and the potatoes can not be affected by rodents or insects, or other elements of nature.

Be careful when transporting your seeds. Do not transport potato seeds in an open truck. If it rains and the potatoes get wet, they can start rotting within 24 hours.
Potatoes should not be transported in a truck together with any other products, especially with ripening fruits. Fruits emit high levels of ethylene, which can damage the sprouts and stop the potatoes from germinating. Potatoes should not be transported in a truck that carries or has carried fruits a day before.
If that is the case, make sure the truck is cleaned and keep the doors open for a long time to reduce the level of ethylene prior to loading.

Just plant one variety in the field or, in case of more varieties, have them properly separated for easy management. Different varieties may mature at different times, or may need different agronomical management. Note that there is no risk of cross pollination in potatoes.

The temperature of the seeds shouldn't be too low. If too low the seeds will take a longer time before germinating. Agrico PSA supplies the seed at the right temperature, and farmers can store it above 12 degrees Celsius for maximum 5 days.

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We advise the farmer not to de-sprout the seeds if the sprouts are more than 1cms. This is to prevent uneven growth and yield reduction. We also discourage splitting of seed in two or four, a practice sometimes done by farmers. This practice can cause a lot of viral and other disease transmission.

GOOD SEEDS ARE EXPENSIVE TO BUY, BUT WILL ASSURE YOU OF A GOOD CROP!

All farmers are advised to buy seeds from a certified seed multiplier. Agrico PSA's varieties are restricted by plant breeders' rights from re-multiplying for seed use by unauthorized parties. Those who buy Agrico PSA varieties and re-multiply them to sell to farmers as seed stand to be reported to KEPHIS and shall face the law.

FIELD:

Have a good crop-rotation, just once in four years potatoes on the same field, otherwise the number of nematodes will increase. Fields for ware production should be free from nematodes! If no other alternatives, use a nematicide (nematode killing or disabling chemical) before or simultaneously at planting. Chemicals can be Velum prime (Bayer).
The same principle of crop rotation applies to the risk of bacterial wilt, which is becoming a big challenge in many parts of the country. Once you have bacterial wilt in your farm, you will hardly get rid of it and experience significant decrease in yields plus a hardly sellable end product.

The fields from which you will harvest your potatoes, can be planted with other crops that are not botanically related to potatoes. Potatoes are in the Solanacea family, other crops in this family are e.g. tomatoes, capsicums, nightshade (managu), tobacco, eggplant, but also weeds like sodom apple. Cereals and legumes are the best to rotate with potatoes for better pest/disease cycle disruption.

Besides nematodes and bacterial wilt, it is useful to check the pH level of the field. The pH plays a significant role in the availability of microelements.

SOIL TESTING & FERTILIZER:

Find out about the nutrients in the soil by doing soil sampling, and check for the following nutrients:

Nitrogen: Nitrogen is important in fueling growth and providing high yields. It ensures optimal photosynthate production in leaves. Nitrogen is important in fuelling growth

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and providing high yields. It is largely needed during leaf formation and then for tuber growth and yield, when it ensures optimal photosynthate production in the leaves.[1]

Phosphorus: Phosphorus is important for early root and shoot development, providing energy for plant processes such as ion uptake and transport. At tuber initiation, an adequate supply of phosphorus ensures supplies of optimum numbers of tubers are formed. While potatoes are very responsive to fresh soil phosphate, the economic optimum rate is often very difficult to define. Rates will depend on soil type and soil test results.[2]

Potassium: Potassium plays a key role in water relations and good overall plant health. Potato plants absorb large quantities of potassium throughout the growing season. Potassium has an important role in the control of the plant water status and ionic concentrations inside plant tissues, including stomata. As a result of the improved cell strength that potassium provides in potatoes, stress such as frost can be better tolerated.[3]

Calcium: Calcium is a key component of cell walls, helping to build a strong structure and ensuring cell stability. Internal disorders such as IRS (internal rust spot or internal brown spot - IBS) can be reduced by a good calcium supply, in the form of calcium nitrate, at ridging or during tuber initiation. Experience shows that ensuring there is a minimum of 0.15% calcium in the peel, improves potato skin finish, boosts disease tolerance and minimizes IRS.[4]

The required amount of nutrients and fertilisers differs per potato variety, but also available potash in the soil, expected crop, and weather conditions. All nutrients, especially the major ones being N, P, and K, should be added in good balance as per your soil analysis, to avoid irregular feeding. Irregular feeding can lead to tuber cracks and hollow hearts, just like may happen if moisture is irregular during THE growing season. Calcium, Magnesium, Sulphur, and Borium are considered as part of the most secondary essential nutrients, just like NPK.

A potato crop needs to be given nutrition ideally three times during the crop cycle. About 60% of the nutrition demand lies at planting and should be given to the plant with a base fertilizer at planting, 20% to come during top dressing at **5 weeks** after germination during **tuberisation**, and another 20% of nutrition needs to be given through top dress or foliar feed at **8-9 weeks**.
The recommended pH level for potatoes is 6.2. However, from a soil with pH of 5.0 you can still grow potatoes, but then add lime to the soils.

[1] https://www.yara.us/crop-nutrition/potato/role-of-nitrogen/
[2] https://www.yara.us/crop-nutrition/potato/role-of-phosphorus/
[3] https://www.yara.us/crop-nutrition/potato/role-of-potassium/
[4] https://www.yara.us/crop-nutrition/potato/role-of-calcium/

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As said before, only once in four years potatoes in a field must be the rule. This also means that volunteer potatoes in other crops during rotation should be taken out in the three years without potatoes. If you don't take out volunteer plants, bacteria and nematodes can stay alive. The volunteer plants can also become a source of diseases, such as blight or insects.
Also, the weeds that host bacterial wilt must be destroyed in those three years. This is the only way to get rid of this disease, together with the use of clean seeds of course.

Be aware also of infections from other fields (clean your boots, jembe, machines, tractor / car wheels). Farmers can use Kerrol or comparable products to disinfect.

LAND PREPARATION BEFORE PLANTING:

The field should be leveled, otherwise in the deeper parts water logging can occur which will affect your plants and reduce yields.
Prepare the soil before planting in a way that will give you about 28-30 cm of loose soil in the depth.

When you want to have a nice and equal field with plants it is good to grade the seeds into several sizes. In Kenya we have 2 seed sizes; Size 1 is 28-45mm (egg size) and Size 2 is 45-60mm (fist size).

Try to work properly with the row-distances of 75cms; it makes the ridging much easier. Place the seed just under the ground and make a little ridge above it, so that the seeds are just below the surface. It is important all seeds are planted at same depth to ensure even germination and ease of harvesting.

When you want to do your land preparations mechanically, we suggest you use a horizontal working rotovator to ensure you get enough loose soil for the 30cms depth. In case you have been working your land with a disc plough for many seasons, you may have a hard pan right under the top soil. You will need to break this hard pan using either a ripper or a chisel plough. This will allow for better root penetration for your potato, but also other crops resulting in a stronger, healthier crop and eventually higher yields and higher quality tubers. This should translate into more profit for the farmer. At the same having good loose soil also means better aerated soil and better drainage of water.

If you are using a tractor for planting, use narrow wheels to avoid destroying your ridges, or having a lot of space between the ridges. You can use a bed-former or moulding board or ridger first, and then plant your seeds in the ridges, not in the furrows.
Avoid working with machinery on wet soils, lest you create a hard pan.

The best planting method for can be demonstrated to you by one of our technical staff on the date of seed collection, if given advance notice.

In order to control erosion and damage from heavy rains, it is advisable for the farmer to dig small water holes in between the ridges. These holes will hold water and soil in case of very heavy rains. You can dig about 2-3 holes per meter, about 10cms or 6 inches deep, in between your ridges. This will also help with water retention in case of drought.

PLANTING DISTANCES:

The distance of the plants in the row depends on the size of the seeds and also on the variety. Good grading and even separation of tubers at planting will optimize the crop and result in better yields for the farmer, therefore more profitable potato farming.

For ware potato growing, an average of 18 stems per square meter are required (3 – 5 stems per meter in the row) at a row width of 75cm.

Seed size	Tuber diameter	Avg # of stems	Planting distance within the row (seed to seed)
Size 1	28-45mm	3-4	25 - 30 cms
Size 2	45-60mm	4-6	30 – 35 cms

NB: May vary depending on variety&field conditions, ask the AgricoPSA agronomist for advise

If you follow the recommended spacing as above ranging from 25 - 35cms between the tubers, and 75cms between the rows, you will need about 800 – 1,000kgs (16-20 bags) of seed size 1 and 1,000 – 1,500 (20-30 bags) of seed size 2 to cover 1 acre. The targeted plant population per acre is about 18,000 plants.

RIDGING:

Ridging or hilling up the soil around the potato plant, helps the farmer in many ways. One is controlling weeds. The best moment to re-ridge is when the new plant is just emerging, at the 4-8 leave stage. If there are weeds at this stage, you can cover them together with the potato plant, and they will not be strong enough to re-emerge, contrary to your potato plant.
A second reason for re-ridging is to give the new tubers more space to grow.
A big ridge also protects your tubers from growing out of the ridge onto the surface area, and as a result becoming green because of exposure to sunlight. Green tubers are not suitable for consumption, they are poisonous!

Manual (re)ridging can be done with a jembe or hoe, where you dig some loose soil from the furrow and put it on top of the ridge. The soil you heap to form a ridge also plays an important role to protect the young roots and stolons from the scorching sun when there are no rains. The trenches between ridges helps in harvesting the water

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during the rains, thus keeping your soil most until another rainfall. Always be careful not to cut the stolons and roots when digging up the soil for ridging; they grow very close to the surface and if you damage them a lower yield will be the result.

Ridging / hilling up is making a nice wide and high ridge. If the planting has been done properly just 2cms of soil will be added on top of the original ridge. Never bury new plants deeper than 4cms, as this may stress or suffocate the plant and will bring an enormous decrease in yield. Do not ridge on very wet, or very dry, soils. Moderate soil moisture is necessary for good firm ridges.

When using a tractor, you need narrow wheels to ensure you do not break or destroy the ridges with the tyres.

IRRIGATION:

For a good and regular growth, the potato plant requires a sufficient water supply, especially when the stolons (off shoots of the main roots where the potatoes are attached) are developing and the number of tubers is established. When the soil is dry during this period fewer tubers will be created. The ultimate way is the use of drip-irrigation, this way the plant has sufficient water all the time, no water is spoiled by evaporation and the soil condition stays good. In some soils the use of sprinkler irrigation will compact the soil so oxygen becomes a problem and the potatoes grow slowly and harvesting becomes difficult.
If you are able to manage your time well and it is practical, we recommend irrigation to be done late afternoon to avoid a lot of evaporation.

WEED CONTROL:

Weed control can be done by hand, just be careful about the potato roots.

For chemical control, there are several methods and products that can be used. Chemical use to control weeds should be subject to which weeds the farmer experiences in his field. Farmers can call the representatives of agro-chemical companies, or the Agrico agronomist for a referral, to get advise on the chemicals that can control weeds on the different Agrico seed varieties.

Always read the label of any chemical you intend to use, and seek expert advise whenever possible.
Also remember to wear the appropriate Personal Protective Equipment (PPE) when using chemicals. A proper PPE should consist of boots, spray suit, gloves, glasses / goggles, mask.
Ensure you also safely dispose of the empty chemical containers after use; best is to ask the chemical company representative to come and collect, or return empty bottles to your agrovet.

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WARNING: between spraying of different kinds of chemicals, always have at least 4 days interval between the sprays, especially when mineral oil is used! Manual weeding is recommended.

DISEASE PREVENTION:

Prevention & Treatment of Late Blight[5]:

When you are using certified seed from Agrico PSA the prevention of fungi is important especially Late Blight is commonly observed. Late blight is caused by the fungus-like oomycete pathogen Phytophthora infestans. This potentially devastating disease can infect potato foliage and tubers at any stage of crop development and can have a devasting impact on yield and tuber quality. Late blight mostly occurs during cool and wet weather. Symptoms are lesions on the leaves, that are initially dark green or black and at a later stage turn brown and surrounded by a lighter halo. During active growth, especially in cool, wet weather, a white mildew-appearing area is visible at the edge of the lesions. The white mildew is the actively growing part of the late blight. Late blight infected tubers will show depressed dark rotten spots on the surface of the skin which will grow deeper in the tuber itself (varying from brown to purplish).[6] Blight infested tubers can keep spreading the disease.
We recommend farmers do preventive sprays against blight every week, from when the first plants emerge. When the first late blight infections will appear, the fungi can destroy your crop in less than a week.
We recommend a mix of chemicals to be used, in order to avoid resistance of the potatoes or the fields to one specific chemical.

Farmers can be referred by the Agrico agronomist to the chemical companies who can develop a customized spray regime to follow. Farmers can also ask the chemical companies for their specific spray programs, or have a look at the website of the relevant chemical companies such as Bayer[7] or Syngenta.

On a general note: Always start with a preventive chemical, one to three times during the crop cycle, then apply preventive and curative. Rule of thumb is to spray at an interval of once a week, but may be altered based on weather conditions (i.e. if the weather or the season is very wet, the farmer may have to spray more often, like after 4-5 days).

[5] https://www.potatopro.com/news/2015/idaho-late-blight-outbreak-worst-1998 24/07/2018
[6] https://www.ag.ndsu.edu/publications/crops/late-blight-in-potato, 30/07/2020
[7] https://www.cropscience.bayer.africa/ke/en-ke/products.html, 13/09/2021

After flowering, when the plant starts tuber bulking, use a chemical that gives tubers protection. Your chemical spraying regime should be depending on climate circumstances.
No chemical is too strong to work alone without alternates, and no weather is too good to do away with the spraying.

Prevention & Treatment of Early Blight:

Early blight is a fungal disease somewhat similar to late blight. Early blight also gives stains on the leaves and slowly deteriorates the plant till it dies. The main difference with early blight is that the stains on the leaves are small spots and not larger blotches as with late blight. Early blight is also seen later on in the season and comes in once the plant starts showing signs of yellowing. This is why this disease is also called 'the ageing disease'. Early blight will accelerate the ageing process and have a big impact on your total yield at harvest, since potato tubers will add most weight towards the end of the growing cycle. Control of early blight can be done through anti-fungal sprays and can also be combined with your normal late blight control. There are several products available. We suggest you contact the leading agro-dealer in your area for advice on products, or the regional representatives for Bayer, Syngenta or similar companies for the correct products to use.[8]

Bacterial Wilt is common in Kenya.
Controlling this can be done by using certified seeds, clean fields and by avoiding the use of contaminated irrigation water. If you need to irrigate then test the water first.
Watch out for spreading of the bacteria by tractor and/or machinery or even by human beings. Disinfection of farm workers & tools is important.

CONTROLLING PESTS & INSECTS:

Insects needs to be controlled as well as they can be major transporters of diseases and viruses. Also, insects can damage the crop leaves and tubers, resulting in lower yields or lower quality tubers, affecting farmers profits.
There is a wide range of insects that can affect potatoes, and different insects at different stages of the crop may require different intervention from the farmer. Some common insects affecting potato farmers are cutworms, millipedes, aphids, thrips,

[8] https://www.agric.wa.gov.au/sitesgateway/files/alternaria%20%2824, 24/07/2018

leaf minors, snails, bugs, spider-mites, whiteflies, potato tuber moth, wire worm, and stemborer.

HARVESTING:

Your plants are ready for harvesting when the foliage has completely dried up, i.e. leaves have wilted and turned yellow or brown and dry, and also the stems feeding the tubers need to have dried off.
Harvesting should be done under good weather conditions, not too warm and not too wet. Prevent bruising the tubers by waiting until the skin of tubers is hardened off enough. You can do the 'finger test', with rubbing your thumb over a harvested tuber. If the skin of the tuber comes off, or peels, that is an indicator the tubers are not yet ready for harvesting.
Treat potatoes like eggs, they are very sensitive and fragile. Damaged and bruised potatoes are more susceptible for diseases and are likely to lose more weight during storage.

STORAGE:

Often the prices of potatoes are not so good during the harvesting period since most farmers will plant and also harvest all at the same time. In such case you can decide to store your potatoes and wait for better prices.
When storing potatoes, it is very important to do it correct. The potatoes must be ventilated mechanically or by natural ventilation in order to dry the tubers. You need to be careful to keep the potatoes dry but not to dry them out and cause weight loss.
If you are storing the potatoes in a place that has held potatoes before, you need to disinfect the store from last years' crop before putting in your fresh, clean potatoes. Otherwise, potatoes can still pick up diseases from the storage facility.
Depending on desired storage time one has to look at different storage options.
It is important for processing varieties (chips, crisps) that the tuber temperature does not drop below 7 degrees Celsius, otherwise sugar-content may increase above the required levels. This will not be acceptable to the processors as it will give them brown chips or crisps.
The cleaner (without dirt and rot and cuts) the crop is brought into the store, the better it will stay during storage.

Disclaimer:

Please note that this document is a general guide to potato farming in East Africa, but not an absolute instruction. Changes can be done depending on many factors, e.g. type of soil, climate, weather, market, etc.
Agrico PSA does not take any responsibility or liability in case of misinterpretation and loss of yields or crop as a result. When in doubt, always consult the Agrico agronomist, or other agronomists or technically skilled people.

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