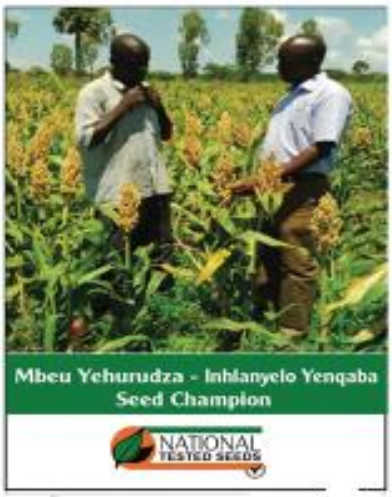
PRODUCTION CERIALS



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Introduction

National Tested Seeds produces quality seeds to farmers. The company is committed to enhance productivity of farmers. This is achieved through the provision of quality seed well suited to different agro-ecological environment of Zimbabwe. This can be achieved through use of the right crop variety and certified seed. This document provides some basic information that will help farmers produce good quality seed of maize, sorghum, pearl millet and wheat. NTS contract farmer to produce crops for export market and local market.

Seed is a basic agricultural input and it is an embryo, embedded in the food storage tissue (endosperm). Seed is also defined as a matured ovule which consists of an embryonic plant with storage of food and surrounded by a protective seed coat. Every farmer should be able to access healthy seeds which are genetically pure, with high seed vigour and good germination percentage. It is necessary to maintain the varietal purity of seed and control the seed borne disease to produce high-quality seed.

Therefore, this document will provide basics that NTS farmers do to produce quality maize, sorghum, cowpea and wheat.

Planning and Planting Phase	Vegetative Growth	Post-Harvest Stage
1. Crop Planning. Contracting /Inputs sourcing	4. Plant Population verification	10. Harvest and storage
2. Land Preparation	5. Post Emergence Disease and Weed control 1st stage	11. Shelling and Packaging
3. Planting and Basal Fertilizer Application	6. Top Dressing 1st Stage	12. Farm Financial Analysis
	7. Top Dressing 2nd Stage	13. Record Keeping
	8. Disease and weed control 2nd stage	
	9. Yield estimate	

Factors to consider on land selection

History of the field- It is very essential to know the history of the field before approving it for seed production. A field that was previously under maize cultivation cannot be put under seed maize production because of volunteer plants that may contaminate the seed crop. This the rule for other crops. There is also carryover of pests and disease from the previous crop due to a continuation of existence of host plant in concurrent seasons. Continuous use of the same type of chemicals due to mono-cropping will also lead to build up of resistance and at the same time it is not environmentally sustainable. The company will check the history of the farm/ field and make sure there is sound rotation for seed production.

Size of field- The company looks at equipment and labour on the farm**.** For instance, due to the time pressure for detasselling in hybrid seed fields, a maximum field size of 50 hectares should be planted in blocks depending on labour availability and irrigation capacity.

Field map- This is helpful to establish the size of the field, isolation distances and for future records. The farm map is also required which shows an accurate representation of the seed maize fields and other cropping enterprise. NTS will assist the growers to do field maps.

Step by Step Seed Production

Inputs

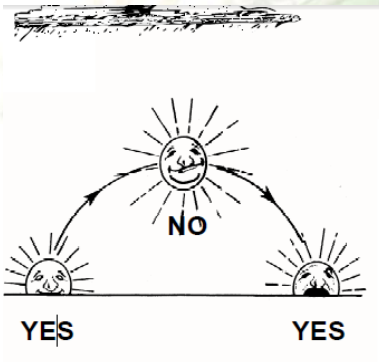
Farmers need to have the correct quantities of inputs before planting. The company will issue out inputs that include foundation seed, fertilizers, herbicides and pesticides on the selected growers.

Planting

The planting operation is one of the most important in crop farming because it is the time when the seed or seedlings are placed in the ground to establish the crop. If there is poor establishment, yield potential is immediately limited. Factors to consider are the time of planting, the plant spacing, the depth of seeding and placement of the seeds relative to fertilizer. The planting operation starts with land preparation. Land is prepared so that the crop is planted in the field. The objective is to create a seedbed with a fine tilth to enable crop establishment. The land will be prepared using tractor drawn implements such as ploughs, disc and reapers. Some farmers mainly smallholder farmer use ox drawn ploughs to do land preparation.

Time of Planting

Cereals crops like maize, sorghum, pearl millet and popcorn are planted from October to December depending on the time of crop maturity. The optimum time for planting winter wheat is between mid-April and the last week of May and even earlier in the Lowvelds. The time of planting has a major effect on the yield of a crop. For most crops there is an optimum time of planting, which depends on the climatic conditions and the time taken to reach maturity. For summer crops, such as maize, cotton and groundnuts, early planting at the beginning of the rainy season is desirable, as yields decrease with late planting. iii. Do not sow seeds during the hot time of day. It is better to plant seeds during the morning or late afternoon. This will keep moisture in the soil.



Plant Spacing

The plant spacing refers to the distance between rows and between plants in the row. The closer the spacing, the greater the number of plants per hectare. The ideal plant spacing depends on the type of crop, variety and the climatic conditions such as rainfall/water availability.

Sowing rates.

- Sorghum: Seed rate of 8-10 kg /ha is recommended to achieve a plant population of 130000-150000 plants/ha.
- Pearl Millet: Seed rate of 6– 10kg /ha is recommended the crop will be thinned to 50 - 75cm inter-row and 20– 30cm in-row to give a population of 53 333 to 100 000 plants per hectare.
- Wheat: Seed Rates broadcasting – 120 -130 kg/ha, Drilling- 100 to 120 kg/ha and row spacing is 15-25 cm. The optimum plant population for wheat is 220-250 plants per m2.
- Maize: Seed rate of 25 kg /ha is recommended to achieve a plant population of 50000-65000 plants/ha.

Crop	Seed Rate (Kg/Ha)	Planting time	Spacing (cm)		Days to maturity	Plant population	Yield (Tons/Ha)
			In-row	Between rows		(Plants/Ha)	
Maize	25	Mid Oct - End Dec	20 - 25	90	120 - 160	45 000 - 60 000	3 - 10
Sorghum	5 - 15	Late Nov - Late Dec	5 - 15	50 - 100	110 - 130	150 00 - 250 000	2 - 6
Wheat	100	Mid May - Mid June	Broadcast	Broadcast	110 - 150	2 000 000	3.5 - 10
Pearl Millet	5 - 15	Late Nov - Late Dec	5 - 15	50 - 100	110 - 130	150 00 - 250 000	2 - 6

Sowing Depth

The sowing depth of a crop depends on the size of the seed, the type of soil and the weather. Generally, smaller seeds are sown at a shallower depth than larger seed, while the deeper the seed is planted, the longer will the seedling take to emerge and the weaker will the plant be at emergence, which may reduce plant vigour and yield.

Field isolation practices for cereals

- By space. Maintain a distance as given in the Seed Act between the seed crop and any similar crop.
- By time. Sow your seed crop earlier or according to Time Isolation as given by the Seed Act from the neighbouring fields with same crop.

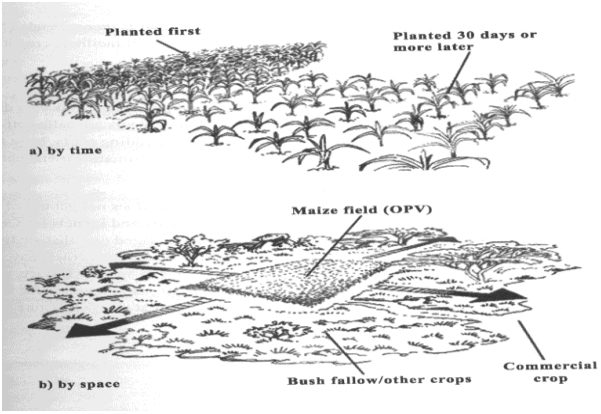


Figure 1: Field isolation practices for maize

Crop Inspection

NTS do the following Seed inspections

No	INSPECTION STAGE	ZSTA
1	Land verification	√
2	Foundation seed verification at farm	√
3	Planting	√
4	Emergence	√
5	Vegetative	√
6	Pre-flowering	√
7	Flowering	√ X 6
8	Grain-filling	√
9	Maturity	√
11	Pre-harvest	√
12	Purity Tests	√
13	Harvesting	√
16	Pre-Delivery Farm tests and sampling	√
Total		21

Fertilization

Soil fertility is the ability of the soil to supply plant nutrients. A fertile soil produces good crops and high yields. In Zimbabwe, the sandy soils are generally poorer soils than the clay soils. Despite which soil type you have, if you grow crops, those crops will take nutrients from the soil to produce stover and grain. The higher your yields, the more nutrients are extracted by the plants. This empties the soils store quickly and must be replaced. Hence addition of the fertilisers to maize crop is very important for good seed quantity and quality. Developing appropriate recommendations that match crop nutrients requirements (fertiliser additions) and minimise nutrient losses in the fields is critical. This leads to the 4R Nutrient Stewardship concept, applying the Right source of nutrients, at the Right rate, at the Right time and in the Right place. Right source means matching the fertiliser applied to soil properties. Right rate implies matching the fertiliser applied to the crop needs. Right time means making fertiliser

nutrients available to the crop when they are needed relative to crop growth stages. Nutrient use efficiency can be increased significantly when nutrient availability is synchronised with crop demand. Split application is an example of how fertilisers can be better timed for efficient crop uptake. Right time means making every effort to place and keep nutrients where crops can use them. Fertiliser and manure must be applied taking into consideration the soil's ability to supply nutrients, the requirements of the intended crop (i.e., the yield targets) and the economics of fertiliser application.

Soil sampling and soil testing

NTS Seed growers do soil testing. It is a requirement in seed production as we select fields to be used so that soils with low soil pH can be adjusted and soil pans/soil compaction can be destroyed. In case that the soils have low pH lime will be added. NTS base fertiliser recommendations on soil analysis and field specific.

Basal fertilizer application

The fertiliser regime management in cereal crops must be tailored to the soil fertility status, the yield potential and the grain quality requirements. As a general guide, cereals a basal application of 300 to 500 kg/ha of a compound fertiliser (7%N: 14% P_2O_5: 7% K_2O). The rates are informed by soil tests and may differ from soil type. Farmers got Compound D from NTS.

Top dressing fertilizer application

NTS growers use Ammonium nitrate (34.5 %N) as top dressing. For maize, sorghum, pearl millet, the top-dressing fertilizer is split-applied at 3, 6 and 9 weeks after emergence in the ratios of 30%, 40% and 30%, respectively. The general recommendation is 400 – 500 kgs /ha

Weeding

Weeds compete for nutrients, sunlight, space and water with seed crops. Besides, they also harbor pests and diseases that can subsequently reduce the quality of the seed. Besides, the weed seed can be harvested with the crop and can contaminate the seed after harvesting. Some other weeds for example Upright star bur (Acanthospermum spp.) are noxious and only one seed of this weed type result in the whole seed lot condemned. A maize crop should be maintained weed-free for at least 2 to 6 weeks after establishment. NTS growers use three types of weed control. (1) Hand weeding, using a hoe. Farmers weed 2-3 times using hand hoes to keep fields weed-free at all times. (2) Mechanical using ploughs and cultivators. (3) Chemical control through use of herbicides for weeds management. The table below shows some of the chemicals used.

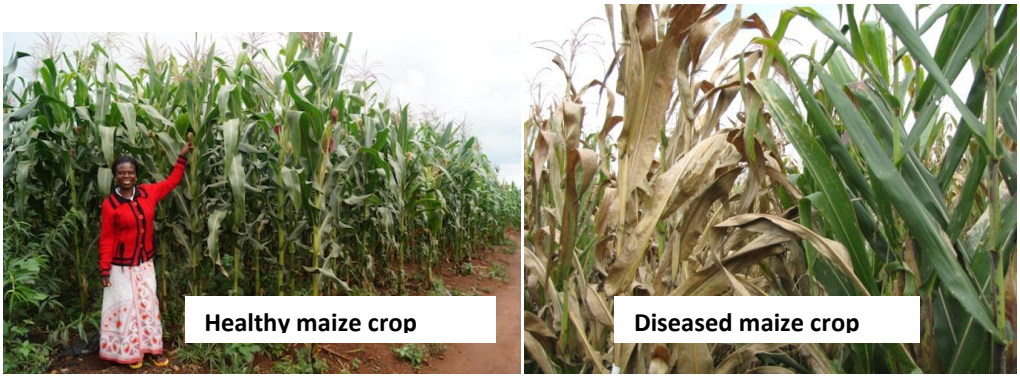
Maize	Pre-emergence	Post-emergence
	Atrazine 50 fw	Basagran 48 EC
	Harness 900 EC	Stellar Star
		Glyphosate
		Metolachlor
		Agil
		Fusion
Sorghum / Millet		Atrazine 500 FW
		Basagran 480 EC
		Buctril DS
		MCPA
Wheat		Banvel 48 SL
		Dicamba 48 SL
		MCPA
		Ally 20 DF
		Metsulfuron-methyl 60 WDG

Some other weeds for example Upright star bur (Acanthospermum spp.) are noxious and only one seed of this weed type result in the whole seed lot condemned

Pests and Diseases

Pest and diseases need to be controlled for quality seed crop production. Chemical, cultural and biological methods are all needed for effective control of pest and diseases. Crop rotations where a crop is followed by another crop from a different family helps reduce disease and pest incidences and eliminating hosts. In maize, rotations with legumes do not only help break disease, pest and vector cycles, but also add N to the soil thereby increasing yields. Timely planting, as a pest and diseases control practice, ensures efficient use of water, nutrients, and helps contribute to increased crop vigour and therefore ability of crops to withstand pest attack. Effective weed control results in good establishment, thereby improving crop vigour and ability to survive pest and disease attack. This also reduces the chances of pests surviving on wild relatives, and/or on alternative hosts (overwintering sites). Low levels of pests and diseases may be of little concern, but when they increase above certain limits (called Economic Threshold Levels-ETLs), then they must be controlled otherwise yield reduction and economic losses may occur. In many cases, especially with diseases, the pre-disposing factors of the

problem must also be determined and dealt with if the problem is to be overcome sustainably. When chemical sprays are used, safety precautions and correct application techniques must be followed.



Scouting for Pest and disease management

- Scout and identify pest and disease before action
- Ensure proper and safe use of chemicals
- Rogue and burn diseased plants
- Remove alternative pest and disease host plants on and off season
- Keep the field weed free
- Use disease and pest free equipment (e.g. witch weed seed)
- Avoid unnecessary movement of people across the field
- Practice crop rotation

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Aphids	Demeton-S-Metyhyl
	Dimethoate
	Thiometon
Armyworm	Carbaryl
	Malathion
Leaf hopper	Benfuracarb
	Carbofuran
	Imidacloprid
	Dimethoate
Stalk-borer	Carbaryl
	Trichlofin
	Endosulfan
Termites	Fipronil
	Imidacloprid
Weevils	Pirimiphos methyl + Permethrin
	Malathion
	Pirimiphos methyl

Harvesting and Storage

The field must be finally inspected for any deviating seed heads or diseased plants before harvesting. Seed harvesting should commence when the crop is at moisture content below 20%. This is so that the seed is manageable in storage and handling. The seed should be grouped according to clear differences in terms of diseased cobs or pods so that grading is reduced at shelling. When the cobs are cleaned of diseased seed, they can then be moved to the clean seed group**.** Place the harvested on a clean and dry surface. Maize seed stores best at less than 12.5% moisture content. Mechanical mixtures should be avoided when harvesting.

After shelling, clean the seed by removing dirty and other inert matter. Remove seeds that are small, look diseased, have started to germinate, or are damaged by insects. Various standard tests including moisture content, germination and physical purity are conducted to evaluate the quality of the seed before certification.

Physical purity analysis

The seed analyst separates the delivered seed into pure seed, inert matter, weeds, stalk, stone, sand. All the different components are then weighed separately and thereafter, the percentages are calculated. The minimum purity requirements for maize, sorghum, pearl millet should be above 98%.

Germination tests

This is conducted after purity analysis. Different suitable media and substrate for planting are used. These include open wooden boxes filled with loose soil, and paper towels or newspapers. Normally, 200 or 400 seeds are planted for issuance of local certificate (for local market). An evaluation of germinated seedlings is conducted when all the essential structures have developed. The seedlings are categorized according to the degree of deformity. Thereafter, percentages are calculated, and results are presented on the certificate. For maize, the minimum germination percentage for certification is 90%.

Threshing/Shelling

It is the separation of the kernels from the cob/pods/stalk. This is difficult at high moisture content levels hence for efficient operations moisture content should be as low as possible (<14 for maize). For maintenance of high seed quality, hand shelling of seed crops is ideal, but not always economically feasible. The use of mechanical shellers when available for shelling crop seeds is feasible but requires skill and knowledge of the equipment so that seed is not damaged. Abrasion damage mainly affects the seed coat and results from seed rubbing against rough surfaces.

Checking for readiness to shell/thresh is done by either biting the kernel, ease of shelling (maize)/ separation from pods (pulses) or head (small grains) N.B: Shelling/threshing at high/ very low moisture content increases mechanical damage and leftover kernels

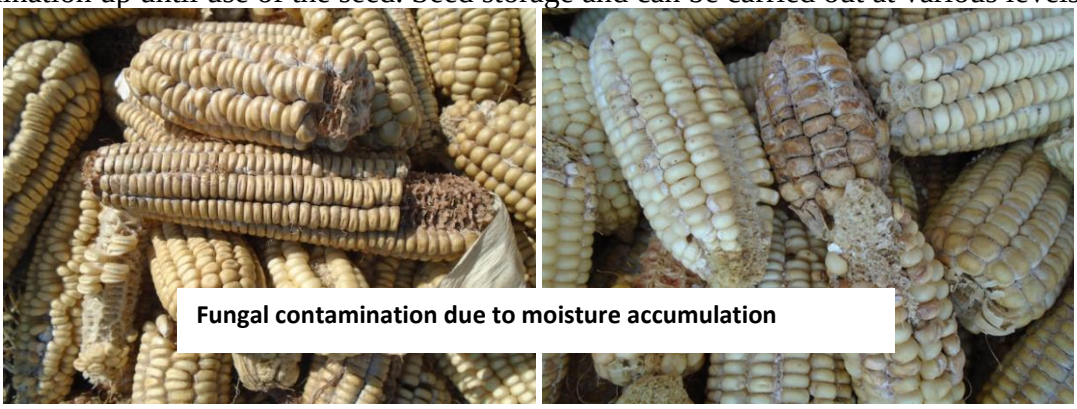
Grading

As you might expect, a good heavyweight will beat a good lightweight any day. So the aim of seed grading is to maintain this quality from one season to the next by removing all these destructive elements such as weed seeds, Straw, soil dust and other inert material, Immature, shrivelled, damaged, cracked, undersized or oversized seed. The cost of cultivating, fertilizing and controlling weeds are high and you cannot afford to permit faulty, foreign or diseased seed to occupy your carefully prepared land. When efficient grading methods are used, the small

grain which is unsuitable for seed is taken out and can be sold at market rates and remains with the high-quality seed.

Storage

Maize seed is dry enough for storage at <12.5% moisture content. The objective is to preserve germination up until use of the seed. Seed storage and can be carried out at various levels:



Fungal contamination due to moisture accumulation

- Homestead prior to delivering to seed house
- Processing plant prior to processing
- Processing after packaging (waiting distribution/ carry over seed)
- Foundation seed

Under normal circumstances all commercial seed should be immediately sold to minimise handling costs associated with storage (facilities, labour, and chemicals). However, there may be some lag periods, and farmers should be knowledgeable on how to store the seed. It is critical to understand the storage environment in relationship to conditions suitable for preserving germination.

Storage conditions that favour seed storage are

Pest free environment (insects, rodents, microflora).

- Low water activity environment- seed should be kept in a dry environment and stored at low moisture content levels. Damp conditions promote pest development and also affect germination.
- Low oxygen environment- seed respiration/oxidation leads to reduced germination potential. Oxygen availability creates conducive environment for pest multiplication (insects and fungi) and is a source of water for insects in the form of metabolic water.
- Cool environment- high temperatures promote pest multiplication and have a negative effect on germination

Bagging for Delivery to Seed house

The seed should be bagged in clean bags at the farm with no chemicals or extraneous material which will reduce the quality of seed. Each bag should have a label sowed in at the middle of the bag. The label should have half of it inside the bag and the other half outside. The labels should have enough information to identify the grower, year, crop variety, address of farmer and grower number. It should be such that the details inside the bag are the same with those on the outside. This will ensure identity of the seed is maintained.

Bagging for Delivery to Seed house

Upon certification by NTS the seed will be bagged in clean bags at the farm. Each bag will be labelled. The label will have the following information identify the grower, year, crop variety, and address of farmer. This will ensure identity of the seed is maintained.

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