Grain Sorghum Bulletin

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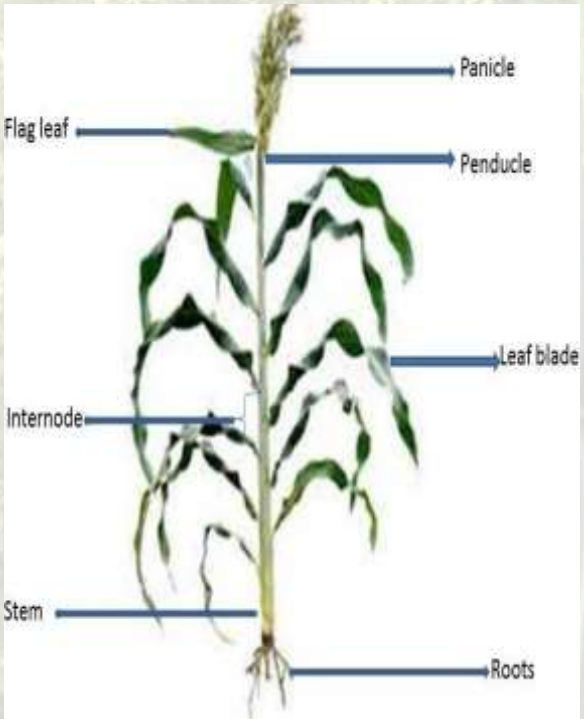
Description of Grain sorghum

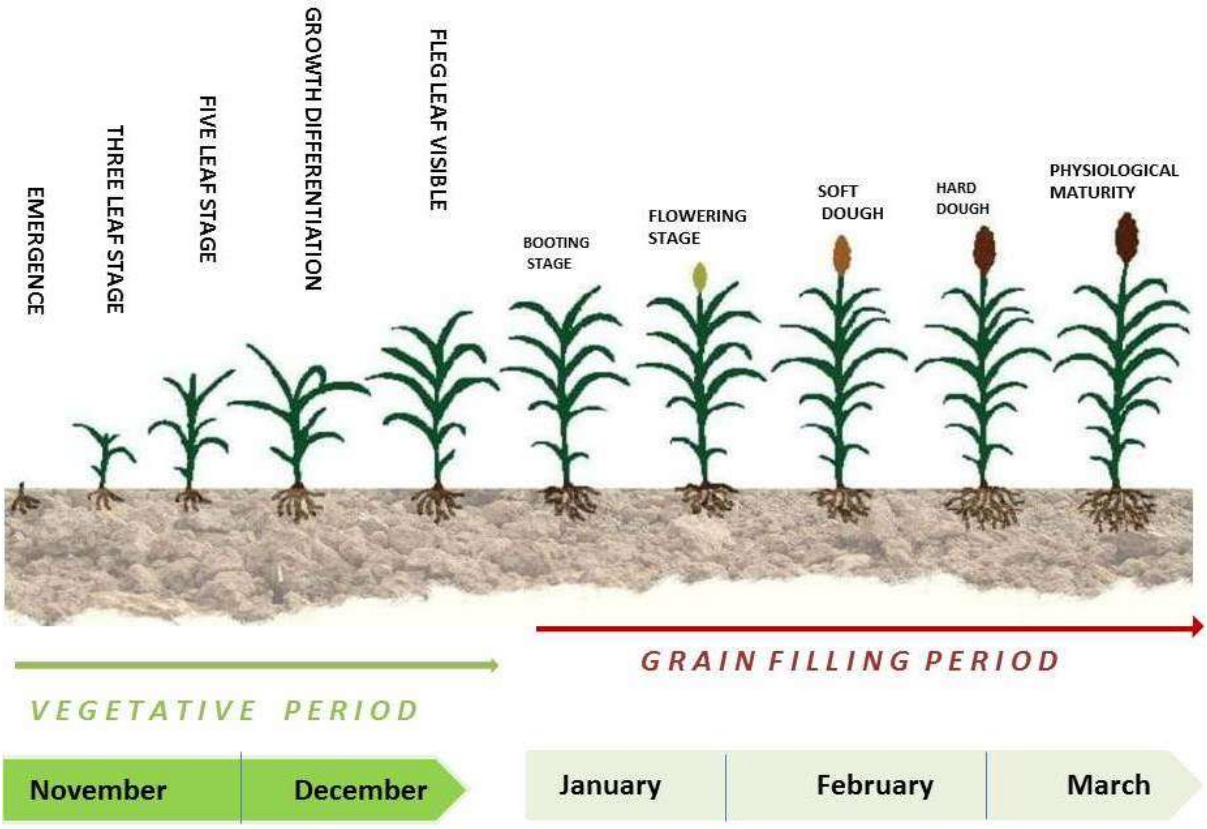
Sorghum is a genus of plants from the grass family (Poaceae). It is considered an ancient grain. Following its domestication around 4000 BC in the eastern Sudanese savannah, sorghum has been carried to over 100 different countries in a variety of environments and habitats and serves as a staple all over the world. Today, sorghum is one of the top five cereal crops in the world. Sorghum [*Sorghum bicolor* (L.) Moench] is the world's fifth most important cereal after maize, rice, wheat, and barley. Sorghum bicolor, is an important crop grown in Lesotho as well.

Grain Sorghum is relatively hardy crop. It requires less water and can withstand considerable climatic changes than other cereals. In the face of global warming giving rise to climate change, sorghum could be a way to cultivate crop. However, sorghum is not immune to abiotic and biotic stresses but has potential to yield under unexpected weather conditions.

Sorghum Plant Structure



Grain Sorghum growth stages



Growth Stages •

Grain sorghum has three distinct stages of development after emergence – seedling development, panicle initiation and reproduction. The time required for the plant to go through each stage is dependent upon the genotype (variety) maturity days and available heat units during the vegetative growth as well as fruiting stages. The grain sorghum crop recommended for Lesotho will spend between 45 days to 55 days during vegetative stage prior to flowing. The recommended number of days for grain sorghum maturity days in Lesotho should not exceed 120 days. Grain sorghum planted early in the season when temperatures are still cool will progress through the stages more slowly than grain sorghum planted later in the season when temperatures are warmer.

Crop Development Growth stage I- Seedling Development •

The seedling development stage is characterized by vegetative growth. There is rapid growth of vegetative matter including leaves to provide a bigger surface area for carbohydrate production during photosynthesis. It s at this stage when varieties produce leaves and tillers, some varieties recommended in Lesotho do produce branches at the axillary buds at this stage. The high the number of leaves tillers ad branches the more biomass produced and more carbon capture and snlight for photosynthesis.

The rate and mangitude of growth in stage I is largely dependent on air temperature and the variety maturity. The more leaves formed by the plant, the longer maturity. Early maturity varieties typically produce 15 leaves per plant, while medium and late maturity hybrids produce 17 and 19 leaves each. At this stage it is easy for a crop to recover from natural disaster/stress such as drought/dehydration, hail and freezing temperatures in Growth Stage I with little negative effect on grain yields. Beyond this stage such disasters such as drought may have detrimental effects on yield.

Tillering and hence branching are promoted by lowering of atmospheric temperatures during sunny summer days to bellow 18°C promote tillering when the plants are in the 4- to 6-leaf stage. Moreover tillering is also experienced under low plant densities. Some genotypes produce panicles that develop into mature heads with some do not depending on when panicles from the tillers and thus branches developed. Those that develop late in the season ultimately fail to produce mature grain sorghum heads. Panicles of tillers are often smaller and flower later than those of the main stem. Tillers formed can compensate somewhat for low plant populations.

Crop Development Growth Stage II –

Panicle Initiation

This is the stage that represents the start of reproductive stage in sorghum. It is when the apanicle (terminal epical bud of orghum) differentiate into a flower. This flower of sorghum has both male and female flower parts. The panicle begins to form from the base of the stem. This stage marks the end of vegetative stage and beginning of head formation and seed set.

This stage is very critical for seed development and grain yield. The plants nutrient and water uptake increase at this stage due to increased demands, thus during this period, plants are especially sensitive to any type of stress such as temperature extremes, nutrient deficiencies or water deficits or excess, any of which may reduce the potential seed numbers. It is the stage that determined the number of seed produced per head. This attribute number of seeds per panicle accounts for 70 % of the grain yield. Thus drought or any kind of interfering stress during this period shall significantly reduce the grain yield. It is thus important to synchronize this growth stage agronomicaly with the rainy period of summer cropping and or supplement irrigation during such periods.

Boot stage

At the boot stage is the stage when the premodia is developed into being a panicle. It grows inside the leaf sheath, the plant becomes swollen with the developing panicle. The flowers of the panicles are still soft and tender not yet fertilized, the duality of flower parts and pollen quality are determined at this stage. All leaves of the plant are now fully expanded; the very good time to determine the maximum light interception and canopy cover of genotypes. As paert of the panicle growth, the penducle elongates and later resulting in exertion of the head from the flag leaf sheath. The potential head size and shape can now be determined.

Lack of water leading to dehydration at this stage may interfere with elongation of the peduncle and exertion of the panicle from the leaf flag. Such incidences are evidenced by heads engloved in flag sheath leaves with no seed set for some parts of the head. Irrigation is important at this stage, however there are varieties developed to quickly elongate peduncle and seed set faster thus avoiding this loss in harvest quality. Following the boot stage, the peduncle grows rapidly extending the head through the flag leaf sheath. Supplementing nitrogen is important for increased yields at this stage; Urea and LAN are the most common efficient means to supplement nitrogen for crowing crops.

Growth Stage III

Reproduction

The reproductive stage of a sorghum plant begins when the flower emrges and continues till full physiologival maturity. Flowering begins when yellow anthers emerge on the panicle and the plant is said to be half bloom when half of the panicle is coverd with yellow pollen.

Figure 1panicle at half bloom

This is the final stage of the Sorghum Plant life. The pollen appears 5 to seven days after excertion. Over the next four to nine days, anther development progresses down the head. Many grain sorghum varieties grown in Lesotho require approximately 60 days from emergence for the plant to reach half bloom. The most critical time for water begins about one week before head emergence or the boot stage and continues through two weeks past.

The grain continues to fill during the soft dough stage. Here the starch from the photosynthetic site is translocated to the sink organ (panicle), and rapidly accumulates filling the grain. The grain size is determined by the amount of photosythates that are translocate in to the ovaries, and the rapidity of it. The water availability is critical at this stage as it is a vehicle through which the sugars are

transported through the phloem tissue into the panicle forming starch in the grains. The moisture content here is about 68%. The older leaves begin to senesce especially under water deficit.

Figure 2 Sorghum at soft dough stage

Planting •

Producers have a broad selection of varieties. The early maturing varieties yield lower than the intermediate maturing varieties. The best planting dates are mid September to mid October in

different regions. Most sorghum varieites tiller and early planting allows enough time for physiological maturity of the suckers.

Grain sorghum variety selection is important. Its important to cultivate the variety that has been tested in the growing environment or similar over years. There should be available scientific data justifying the good performance of such a variety in the region. There are multi stress tolerant varieties and optimum environmental condition suitable varieties recommended within the country

Guidelines for seeding rate

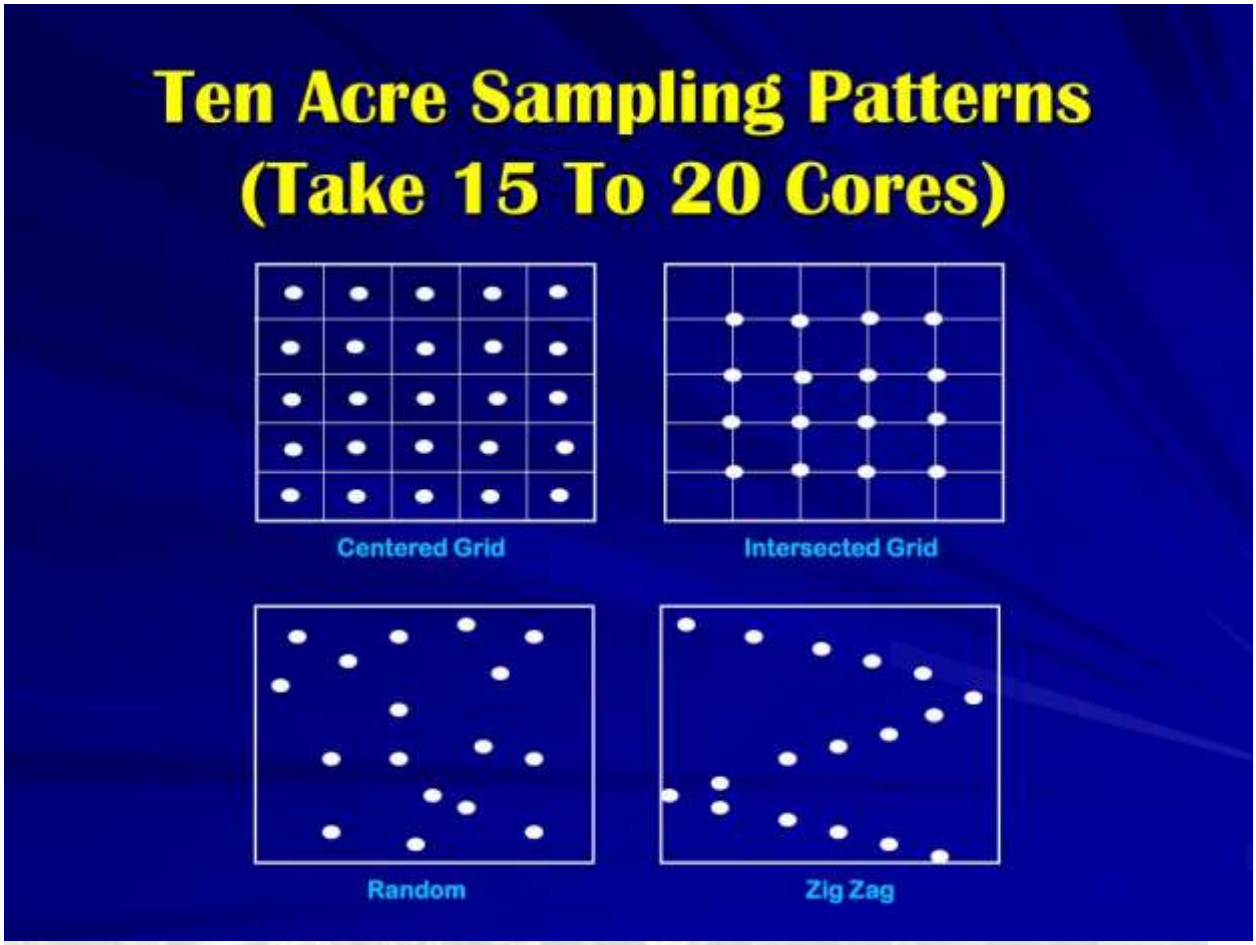
Moist conditions	intermediate maturing variety	30 seeds per square meter
Dry conditions	intermediate maturing variety	15 seeds per square meter
Moist conditions	early maturing varieties	40 seeds per square meter
Dry conditions	early maturing varieties	25 seeds per square meter

Cultivating Grain Sorghum

Soil Sampling and nutrient analysis

Soil sampling and testing can be highly informative. Information from a well-conducted soil-sampling event can be useful in monitoring changes in soil fertility, developing fertilizer recommendations, and improving on-farm nutrient efficiency. Regardless of the particular soil-sampling program a farmer can employ, soil sampling using a consistent, well-conducted, and organized approach will lead to the most usable and informative soil test results.

The goal of soil sampling for whole-field management is to get a sample representative of the typical soil in the field. To do this, subsamples are distributed across large areas to ensure the entire field is represented. To achieve this, samples are collected in a zig-zag pattern or random pattern. Each composite sample should consist of 10 to 20 subsamples spread evenly across a field. At least one composite per 20 acres should be collected. The picture below indicates methods of taking soil samples.



Upon completion of soil sample collection, a farmer will then take samples to the laboratory for analysis. Samples should be as many as possible depending on number of terraces and slope of the field. Soil analysis will be made by scientists as per recommended crop, location as well as agro-ecological zone. Moreover, soil sample should be collected after harvesting in order to get the exact amount of nutrients available on the soil. It is recommended that soil sampling be quided by the trained technician and extension agent.

LAND PREPARATION

When a farmer knows the level of nutrients in his field, the next step is to prepare the land in such a way that soil tilth is ideal for sorghum seed germination. For instance, land should be ploughed at least 30cm deep since sorghum have deep root system with the help of mould board plough. Secondly, land should be disced to break the clods and slice weeds. Lastly, the land should be harrowed using harrowing equipment to enhance the soil tilth and promote uniformity of sorghum stand.

Furthermore, Sorghum seed is relatively small and as such should be sown on well prepared fields. Land preparation should begin soon after the previous crop is harvested to allow enough time for weed control, decay of crop residue, storage of soil moisture and soil firming. Farmers can prepare land using either conventional tillage or conservation tillage. However, it is advisable to use Conservation or minimum tillage practices as they reduce soil erosion and preserve moisture.

Tillage Primary and secondary

Grain sorghum needs a warm, moist soil well supplied with air and fine enough to provide good seed-soil contact for rapid germination. A number of different tillage and planting systems can be used to get these conditions. These systems may involve primary or secondary tillage or no tillage operations prior to planting. An ideal seedbed should accomplish these goals: -

- Control weeds
- Conserve moisture
- Preserve or improve tilth
- Control wind and water erosion
- Be suitable for planting and cultivating with available equipment.

A good seed bed is important, because plant roots require water and oxygen from the soil roots pore space for sprouting. The right soil-air-water balance helps in limiting plant stress during drought periods and enables the plant to fully explore the soil profile for nutrients. Plants with a good soil-

air-water balance are able to use water efficiently reducing watering needs and grow strong roots for good anchorage.

Sorghum is a good alternative to Maize in areas where rainfall is reduced during the spring and summer. Although sorghum requires almost the same amounts of water and nutrients as maize the plants can better endure periods of stress also in the flowering phases. Particular physiologic and morphologic proprieties allow for plants to interrupt their growth during drought periods, and re-start quickly when water is available again. We can not manage nor water neither texture of soil. But we can manage tillage.

Ponding misconception:

ponding is a result of too much rainfall Not necessarily. Usually ponding is a result of poorly managed soil. When soil is compacted, it cannot absorb water. Compacted soil is like a sponge that is squeezed tight: there is no space for air and water. To make matters worse, compacted soil forms an impenetrable layer that prevents excess water from draining through. The result is ponding.

PLANT NUTRITION

Generally little fertilizer is required or applied to small grain crops like sorghum. Sorghum responds well to a low application of basal fertilizer (100 to 300 kg/ha) depending on rainfall availability followed with a top dressing of 100 to 200 kg/ha of 28 - 34% nitrogen fertilizer applied 4 to 6 weeks after crop emergence. Basal fertilizer should always be applied before or at planting, under the seed, making sure that it does not get into direct contact with the seed. This is achieved by covering the fertilizer with a thin layer of soil before sowing. Basal fertilizer is broadcast and incorporated by disking before planting is done. Top dressing fertilizer should be placed at least 5cm away from the plant to avoid fertilizer burn. Top dressing must be done when the soil is moist, preferably soon after a rain shower to avoid volatilization. In sandy soils, split application is recommended at 4 weeks and second application at 6 weeks after emergence. If plants are lacking nutrients for optimum growth and development, they will exhibit deficiency symptoms. These

symptoms can help indicate what corrective actions the farmers need to take to counteract nutrient deficiency. Deficiency symptoms of the three major nutrients, nitrogen, phosphorus and potassium (N, P, K) can be observed from the plants as follows:

Nitrogen (N) deficiency – nitrogen deficiency results in poor plant growth and yellowing of leaves. Young plants are light green or yellow-green, at a more advanced stage, older leaves start yellowing first with a characteristic inverted V shape.

Nitrogen deficiency

SEED SELECTION

When it comes to seed selection, a farmer should be meticulous since it's the critical step. There are two types of seeds known as hybrids and open pollinated varieties. In a nutshell, hybrids are improved seeds whereas open pollinated varieties are not improved. On the basis of sorghum production, farmers are recommended for hybrids seeds since they can grow high quality sorghum with massive yield. Apart from that, hybrid seeds such as PAN 8816 is known for excellent yield potential and stability. Very uniform growth habit and good standability. Again, it's attractive plant type and has a large-seeded grain, high bushel weight and good threshability. Good malt quality. Good general leaf disease tolerance as well as good Head Smut tolerance.