Ethiopian ATI
Agricultural Transformation Institute
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ONION SEED PRODUCTION BUSINESS

TRAINING COURSE FOR YOUTH AGRI-ENTREPRENEURS

Ethiopian Agricultural Transformation Institute

ADDIS ABABA, ETHIOPIA
2025

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OVERVIEW OF THE MODULE

This training module is designed to equip youth and women groups, farmers and any groups interested to acquire knowledge and skill on onion seed production. This skill and knowledge enable the youth groups, farmers and others involved in onion seed production to apply the technologies so as to increase the production of onion seed thereby improve their income. The module consists of ten sections: ecological requirements for onion seed production, onion variety selection, nursery management, mother bulb production, seed production and management, harvesting and postharvest handling, quality assurance, marketing and distribution, and financial feasibility, risk management of onion seed production as a business. The module also contains pre and post assessment questions at the end of each section to enable the trainee to evaluate their understanding about each topic.

The Agriculture-focused Dignified Employment for Youth (ADEY) program is implemented by the Ethiopian Agricultural Transformation Institute in partnership with the Mastercard Foundation to enable 611,343 inclusive and dignified work opportunities for young women and men and support youth entrepreneurship, employability, and sustainable livelihoods in the agribusiness sector.

INTRODUCTION

Onion is one of the most important vegetable crops produced on large scale in Ethiopia. The crop is produced both under rain fed in the meher season and under irrigation in the off season. This crop plays an important role in creating jobs and source of income for small-scale farmers and youth groups across the value chain. In Ethiopia, one of the problems of onion production is shortage of improved seed, which is true-to-type and has high germination capacity. There is high demand for improved onion seed in the country as the supply is very limited. Due to the limited local availability of high-quality seeds, farmers mostly rely on expensively imported onion seeds. Hence, onion seed production is one of the business areas among the onion value chain where youth groups can be organized and produce improved seeds to fill the gaps. Therefore, the objective of this manual is to serve as a reference material for onion seed producers to ensure quality onion seed production.

Target groups: Target group of this module is youth and women groups, farmers and other groups who have an interest in onion seed production.

Training methods: Group discussion, brainstorming, lectures, presentation, assignment, visit

Training materials: Flip chart, LCD, markers, white board

Training duration: 24 hours

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SECTION 1: ECOLOGICAL REQUIREMENTS OF ONION SEED PRODUCTION

Overview of the section

The quality and productivity of onion seed production depends on the ecological suitability of the production areas. Onion seed production is influenced not only by genetic factors but also ecological factors such as altitude, temperature, rainfall, soil condition and the presence of beneficial insects. Therefore, this section of the module describes the ecological requirement of onion seed production to maximize the productivity and quality of the produce. It also includes the requirement and importance of crop rotation and onion crop calendar in onion seed production.

Learning Outcomes

At the end of this training section the trainee will be able to:

- Understand ecological requirement for onion seed production
- Understand edaphic requirement for onion bulb production
- Understand the importance of crop rotation in onion seed production
- Identify the cropping calendar of onion seed production

Duration: 3hrs

Learning question

- Which ecological requirement is very determinant for onion seed production in Ethiopia?
- Is crop rotation common in onion seed production areas in your region?

1.1 CLIMATE AND EDAPHIC REQUIREMENT

- Onion seed production is influenced by environmental factors such as altitude, temperature, rainfall, and soil conditions and others.

Altitude

- Most of the onion varieties are adapted to low and mid altitude areas (700-1800 m.a.s.l), even though onion can grow up to 2000 m.a.s.l.

Temperature

- Temperature greatly influences the flowering activity of the crop.
- Cool conditions with an adequate moisture supply are most suitable for early growth of onion, followed by warm, drier conditions for seed maturation.
- Low temperature (9 to 17 oC) is required for flower stalk development.
- Higher temperature can prevent flowering
- Around the upper Awash, from September to February with temperatures of 26-28 oC during the day and 10-18 oC during the night are more favourable conditions for flower stalk emergency and satisfactory seed set for easy bolting varieties.
- When started from bulbs, cool weather with ample moisture supply is required for flower stalk initiation.
- Drier and low humid, ample sunshine and absence of strong wind are required for flowering, pollination, seed set, seed maturity, ripening, harvesting, and processing.
- Onion seed production in the country is best if mother bulbs are planted in September and October for flowering to take place in the months of January and February- cooler and drier months
- It is also important to know specific requirement of the crop varieties.
- For instance, Bombay and Adama red can flower and produce higher seed yield under relatively lower chilling temperature while Red Creole needs very low temperature and cannot produce sufficient seeds in the Central Rift Valley and similar areas.
- High temperature during flowering also results in flower abortions and hence lower seed yield.

Rainfall

- Onions require well-distributed rainfall between 350 and 650 mm during the growing period.
- Sown onion seed must not dry out and the soil surface must not be allowed to crust during the post-planting, pre-emergence periods which can last 10 to 20 days after the initial irrigation.
- Onions require frequent irrigation or rainfall throughout the season because onion have a shallow root system.
- During flowering, seed development and maturity, however excessive rainfall and very cool condition is undesirable as they lead to disease development and poor seed setting and ripening
- Good sunshine at the time of full blooming stage will facilitate the activity of beneficial insects for higher rate of cross pollination and seed set.
- The relative humidity should be lower at the time of seed development.

Soils

- Onions grow in a wide range of soil types
- Excessively dense clay soils interfere with root growth, while sandy soils require very frequent irrigation.
- Onions are shallow-rooted and grow best on friable soil with good moisture retention.
- Loam soil with fertile and drainage and pH of 6.0-7.0 is preferred for onion seed production.
- Loam silt soils are best suited for seed production.

1.2 POLLINATING AGENTS

- Onion is a cross-pollinated crop and efficient pollination depends largely on presence of insects in the area and their activity at flowering time.
- It is essential to ensure that there is sufficient population of pollinating insects including honeybees to achieve the full potential of onion seed and consequent higher seed yield.
- Promoting honey production around the production site can increasing the pollination efficiency.

Figure 1. Honey production around onion seed production area

1.3 CROP ROTATION

- Repeated planting of the same crop accentuates most of the afflictions of that crop because pests could persist and increase.
- Rotating crops is done by planting one crop in a field for a season, and then planting a different crop in that same field the next season.
- Crop rotation helps to control insects, disease, and weed infestations by limiting crops' existence to one season in a designated field every few years.
- The minimum number of seasons required for rotating onion seed production shall be three years for breeder, pre basic, basic, and certified seeds (C1) (Figure 2).
- Crop rotation shall be based on non-alternate host crop.

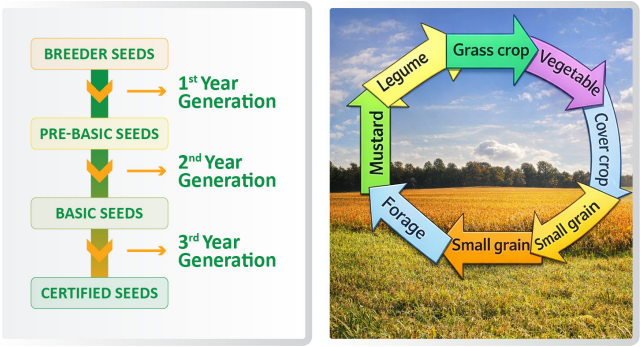


Figure 2. Classes of early generation seed and crop rotations.

1.4 CROP CALENDAR

- Selection of appropriate months in each locality is crucial in onion seed production venture.
- For onion seed production, seeds are planted from late July to August for the seed-to-seed system in the country.

- Seeds should be sowed on beds from early March to late March for bulb to seed system
- In bulb to seed production method bulbs are planted in September to October for flowering to occur in December and January in cooler and drier months.
- The crop calendar may vary from area to area and from season to season and depending on the existing/prevailing temperatures. This is particularly true in the Central Rift Valley areas where this experience was developed.

Seed sowing on the beds	Seedlings transplanting	Bulbs harvesting	Re-planting bulbs	Seed harvesting
First week of March	Last week of April	Mid to last week of Aug.	Mid Sept. to first week of Oct.	Early Feb. to late-Feb.

Table 1. Onion seed production schedule for bulb to seed system

Post assessment questions

1. What are the best sites for onion seed production?
2. Describe nutrient requirement for onion seed production
3. Describe water requirement for onion seed production?

Key message

Ecological suitability is one of the determining factors for onion seed production

SECTION 2: ONION VARIETY SELECTION

Overview of the section

One of the factors that determine onion seed production is the potential and type of the onion variety used for seed production. In Ethiopia, both open pollinated and hybrid varieties are commonly used for onion seed production. Hence, this section addresses the description, ecological requirement and yielding ability of open pollinated and hybrid varieties that are commonly used for onion seed production in Ethiopia.

Learning Outcomes

At the end of this training section the trainee will be able to:

- Understand about onion variety selection for onion seed production.
- Identify the difference between hybrid and open pollinated onion varieties.

Duration: 2hrs

Learning question

- Which types of onion varieties (open pollinated, hybrid) are commonly used for seed production in your areas?
- Do you think onion seed production is profitable as business for youth groups

Onion variety selection

- Based on production mechanisms onion varieties are grouped into hybrids and open pollinated varieties.
- In Ethiopia the use of both hybrid and open pollinated onion varieties are very common for onion seed production.

- Onion variety used to produce good quality seed is dependent on seed yield, good quality and marketability.
- While selecting onion varieties for seed production, emphasis should be given to the most popular varieties under production.
- When selecting a variety for its seed production the yield and seed quality as well as marketability and area coverage of that variety should also be considered.

Open pollinated varieties

- In Ethiopia, there are a lot of open pollinated onion varieties that has been used for onion seed production.
- The description of the three commonly known onion varieties (Nafis, Adama Red and Bombay Red) are listed below

NAFIS	ADAMA RED	BOMBAY RED
• Most widely grown onion variety under irrigation in the country • Produce higher yield (bulb and seed) • Yields up to 400 qt /ha under farmer's fields in central rift valley • Resistant to disease and insect pests • Suitable for production under even rain fed as it is not easily rots in the field if rain fall is encountered during maturity stage.	• Produced under rain fed conditions as it tolerates rotting due to rain effects during maturity stage. • Produce good size bulbs only at plant spacing greater than 6cm	• Yields up to 350 qt /ha was observed on farmer's fields in central rift valley • Tolerance to higher plant population • Not suitable for production under rain fed as it is easily rots in the field if rain fall is encountered during maturity stage.

VARIETIES	YEAR OF RELEASE	BULB YIELD ON RESEARCH PLOTS (T/HA)	AREA OF ADAPTATION	IMPORTANT FEATURES
Adama red	1980	35.00	**Altitude:** 700-2000 m.a.s.l. **Temp:** 18-240 C at day & 10-120 C (night) for bulb production	High seed set, Dark red and pungent bulbs, relatively long shelf life
Bombey red		30.00	**Altitude:** 1100-1800 m.a.s.l. **Temp:** 18-240 C at day & 10-120 C (night) for bulb production	Light red, medium size, easily bolting
Melkam	1998	40.00	**Altitude:** 700-1800 m.a.s.l. **Temp:** 18-240 C at day & 10-120 C (night) for bulb production	High seed set and bulb yield, Light red bulb color, large bulbs size averagely 70-90g
Nasik red	2004	38.00	**Altitude:** 500-1900 m.a.s.l. **Temp:** 18-240 C at day & 10-120 C (night) for bulb production	High seed set, medium maturity date, medium red of bulb color
Nafis	2010	40.00	**Altitude:** 500-2200 m.a.s.l. **Temp:** 16-240 C at day & 16-280 C (night) for bulb production	High seed set, early maturing, deep red color of bulb, very firm
Robaf	2018	32.00	700-2000 m.a.s.l.	Released for rain fed areas

Table 2. Name of varieties, maturity date, bulb and seed yield obtained per ha and important features of open pollinated onion varieties.

Figure 3. Open pollinated onion variety (Naffis) seed multiplication field

Hybrid varieties

- A large number of competing onion hybrid varieties are available for onion bulb production in the country.
- Most commercial fresh market bulb onions are now hybrids, though open-pollinated varieties are still used for dehydrator bulb onion production. However, seeds of these varieties are mostly imported and difficult to produce locally.

VARIETY	IMPORTER/ SOURCES	PRODUCTIVITY (T/HA)	MATURITY DAYS	UNIQUE CHARACTERISTICS OF THE VARIETY	YEAR OF REGISTRATION
Neptune	Green line trading	62.00	-	Red bulb	2009
Sivan	Green line trading	63.60	90-105	Long shelf life, light red bulb, can be produced for export market	2011
Jember	Mekobu	75.00	90	Uniform bulbs, bright red bulb color	2011
Red King	Marcos	58.20	90-100	Bright red bulb color, early maturing	2011
Russet	Green line trading	65.50	80	Extra early maturing with good shelf life	2013
Ada	Green line trading	69.70	70	Extra early maturing suitable for salads with golden bulb color	2013
Sweet Carolin	Impact Mondial	25.01	105	Not easily flowering	2012
Carmel	Impact Mondial	23.50	105	Not easily flowering, light yellow bulb color	2012
Sirius	Gawt	58.10	103	Bulb not easily peel off	2007
Rigent	Gawt	58.80	101	Early maturing with yellow bulb	2007
Red Coach	Gawt	50.40	107	Not easily flowering used for savoring foods and processing with bright red bulb color	2007
Melbek	Gawt	56.10	105	Bright red bulb with tightly closing the tip	2007

Table 3: Description of hybrid onion varieties registered for bulbs production in Ethiopia.

Post assessment questions

1. What is the difference between open pollinated and hybrid onion varieties for onion seed production?
2. Which variety of onion do you prefer for seed production? Why?

Key message

Seed yield of onion varies depending on the type of varieties used in production

SECTION 3: NURSERY MANAGEMENT

Overview of the section

In onion production nursery selection and management is the most important practice to produce healthy seedlings suitable for transplanting. Therefore, this section of the module describes the detailed activities required for nursery selection and management to produce healthy seedling for onion seed production. The section addresses about site selection, nursery bed preparation, seed rate, seeds and sowing, water management, mulching, rouging, weed management, nutrient management, use of shade and plant protection measures. It also includes the farm tools and equipment required during nursery operations.

Learning Outcomes

At the end of this training section the trainee will be able to:

- Identify the farm tools and equipment required for onion seed production
- Understand about nursery site selection and its management
- Understand about the seedling management at nursery site

Duration: 3hrs

Learning question

- Why is nursery selection and management required for onion seed production?
- List the farm tools and equipment required for onion seed production
- Mention the type of seed bed preferred at lowland area

3.1 TOOLS AND EQUIPMENT

- Farm tools and equipment are some of the things that make farming possible.
- There are numerous implements that are used for various purposes at different stages of onion seed production, from soil preparation to planting and harvesting.

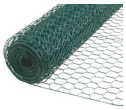
Hoe		Rope	
Water can		Peg	
Spade		Wheel-barrow	
Rake		Trowel	
Sprayer		Fork	
Grass straw for mulching		Water pump	
Hose		Crate	
Bucket		Jug	
Wire mesh		Sieve	

Table 4. Tools and equipment supporting onion seed production

3.2 NURSERY SITE SELECTION

Sunlight exposure

- Choose a site that receives ample sunlight.
- Ensure that the nursery site is not shaded by tall structures or trees.

Soil quality

- Use a well-draining soil mix for the nursery.
- Onions prefer loose, friable soil.
- Avoid heavy clay soils that can become compacted and hinder seedling growth.
- Onions thrive in slightly acidic to neutral soil with a pH between 6.0 and 7.5.

- **Location:** Accessibility to public transports, accesses to weather roads and convenient for evening events.
- **Wind protection:** Consider natural windbreaks or install temporary barriers to protect the seedlings from strong winds.
- **Quality water:** Ensure nursery site access easily to a quality water source for irrigation.
- **Temperature:** Choose a site with a moderate and consistent temperature. Onions prefer temperatures between 15-24°C.
- **Prevailing pest and disease conditions:** Select site that is free from disease and insect pests.
- **Land gradient (steepness of the land):** the recommended land gradient for onion nursery is 3 to 5% slope.

3.3 SEED BED PREPARATION

Nursery site clearing and cultivation of the soil.

- Trees, shrubs, and weeds draw water and minerals from the soil that is needed for onion.
- Shade caused by their leaves hinders crop development and shelters insects.
- Hence, shrubs and trees must be completely removed, and land must be cleared.

Bed preparation.

- Three types of bed (raised, flat and sunken) can be used in onion seedling production depending on soil type and moisture condition of an area.
- Raised bed is the most used method in central rift valley areas as it avoids risks of bed over moistening during irrigation.
- Soil should be well prepared and seed beds be leveled.
- The size of the bed will be 1mx5m or 1mx10m, 60 cm path, and 30-40 cm foot paths.
- This makes nursery management practices (watering, weeding, cultivating and pesticide spraying) easy.
- Arrange the seed beds longer dimensions to the direction from an east to west. This will give the seedlings a more even distribution of sunlight.

Raised Beds

Flat Beds

Sunken Bed

Figure 4. Three types of seed beds used for onion seed production.

3.4 SEED SOWING

Seed rate

- The seed rate for onions can vary based on factors such as:
  - The onion variety
  - The cultivation method (direct seeding or transplanting)
  - The desired final spacing.

- Based on germination percentage, botanical seed rate could be
    - 80-100gm for 1mx5m bed (for seeds >90% germination).
    - 3-4 kg/ha for hybrid varieties (with seeds > 85% germination)
    - 6.5-7.5 kg/ha for open pollinated varieties (OPVs) (with seed > 85% germination)
    - 12kg/ha is required for direct sowing in the field, three times more than using transplants
- Always follow the recommendations provided by the seed supplier, as they often consider the specific characteristics of the onion variety.
- Additionally, consider local climate conditions, soil types, and other environmental factors when determining the ideal seed rate for your onion crop.

Sowing the seed

- Sowing seeds on the beds can be done manually by drilling seeds into the ridges of seedbed within
    - Rows opened at 10 cm space
    - At shallow depth of 0.5-1cm against bed length
    - Then covered slightly with soil
- Thin the seedlings later to achieve the desired final strength.

Figure 5. Drilling onion seeds into the ridges of seedbed

3.5 FERTILIZATION

- Fertilizing onions in the nursery stage is crucial for promoting healthy growth and development.
- Apply a balanced fertilizer at the time of planting or sowing.
- NPS and Urea at the rate of 200 g and 100 g, respectively can be applied for 10 m2 seedbed.
- NPS fertilizer should be applied during seedbed preparation while urea will be applied 15 days after sowing.
- Urea fertilizer application is dependent on the growth performance of the seedlings on the seedbed.

Figure 6. Fertilizer application during sowing of onion seed

3.6 MULCHING

- After seed sowing, mulching of the seedbed is necessary to
    - Promote optimal growth,
    - Conserve moisture,
    - Control weeds
    - Prevent certain diseases.
    - It also protects the seeds from being washed away during watering.
- Grass mulch or locally available materials of 2 to 5 thickness shall be used as a blanket for the germinating of seeds.
- Remove the mulch when the seeds germinate- before the seedlings grow over the mulch.

Figure 7. Mulching of the seed bed after sowing

3.7 IRRIGATION/WATERING

- Water the seedbed using a water-can or a hose pipe fitted with a fine rose to avoid seed splashing.
- The bed should be irrigated in the morning or afternoon from sowing day until two weeks after seedling emergence.
- If possible better to continue the same watering time till transplanting or use furrow irrigation with care.
- Ensure good aeration and avoid waterlogging, as onions do not thrive in waterlogged conditions.

Figure 8. Watering the seedling at nursery

3.8 HARDENING OFF SEEDLINGS

- Hardening and transplanting are crucial steps in the onion seedlings transplanting from nursery to the outdoor environment.
- Seedlings should be hardened before being lifted from the beds to reduce losses.
- Start the hardening off process about 1-2 weeks before transplanting date, typically when seedlings are 6-8 weeks old.
- Gradual exposure of the nursery seedling to harsh environmental conditions is very important to increase establishment rate during transplanting.
- Hardening off ensures successful transition of onion seedlings from the nursery to the garden or field.
- Hardening off helps to acclimatize the plants to the outdoor conditions and promotes healthy growth in their new environment.

3.9 SEEDLING TRANSPLANTING

- The seedlings should be watered thoroughly a day before transplanting.
- The usual time of seedlings ready for transplanting ranges from 45-60 days after seed sowing or when 3-4 true leaves emerge; this is just before bulb formation starts.
- If seedlings overstay on beds for more than 60 days after sowing, bulb formation starts and potential for bulb size development reduced with consequent significant yield reduction.
- Seedling should be free from any disease
- Quality seedlings should be healthy and vigor, have large root systems and small medium stems i.e. a balance between roots mass and shoot must be achieved.
- Select and reject very weak, thin, and unhealthy seedlings
- Always better to plant good seedlings in smaller area than poor seedlings in a wide area.
- Generally, seedlings that do have shoot to root ratio not more than 2:1, strong shoot, healthy and no deformation should be selected and planted.

Figure 9. Seedling uprooting and transplanting

Post assessment questions

- Seed rate used for open pollinated and hybrid varieties are the same in onion seedling production (True/False)
- List the three types of seed beds used in onion seedling production in Ethiopia
- Why hardening off onion seedling is a very critical operation in seedling management at nursery?
- F Why Transplanting of seedling is more recommended that direct sowing the seed in the field in onion production?

Key messasge

- Seed rate for onion seedling production largely depends on the type of planting system (transplanting Vs direct sowing) employed and variety (OPV Vs hybrid) selected for production

SECTION 4: ONION SEED PRODUCTION METHODS AND FIELD MANAGEMENT

Overview of the section

The production method and subsequent management is one of factors that should be considered critically in onion seed production. Seed should be multiplied in the most favorable climatic conditions in a region to exploit the potential of specific cultivar(s). There are two major methods of onion seed production system in Ethiopia: Seed to seed and bulb to seed production methods. Both can be used in the seed production systems depending on conditions, but the most used method is bulb to seed method. This section of the module therefore addresses the detailed description of the two main onion seed production methods and the subsequent management (planting, fertilization, rouging, weeding, disease and insect pest management etc) in the country.

Learning Outcomes

At the end of this training section the trainee will be able to:

- Understand methods of onion seed production
- Select suitable site for onion seed production.
- Apply optimum agronomic practices (fertilizer rate, plant population, irrigation frequency and rate for onion seed production.
- Identify and manage important insect pest and disease of onion crop

Duration: 4hrs

Learning question

- Which method of onion seed production very common in your region/areas
- List the advantage and disadvantage of using seed to seed and bulb to seed onion production method
- List major disease and insect pest of onion in your regions
- When is the right time of seed sowing for onion bulb production in June?

4.1 SEED PRODUCTION METHODS

4.1.1 SEED TO SEED METHOD

- In seed-to-seed production method the first season bulb crop is left in the field to produce seed in the following season.
- The bulbs produced during June-September months are used for onion seed production.
- Plants raised for seeds are allowed to produce flower stalks and seeds in the same season
- It takes 7-8 months to produce seed (requires short period to produce the seed compared to bulb to seed production system)
- However, this method lacks the option for selecting bulbs of good size, uniform, typical colour, and free from diseases and physical damages. Moreover, it produces less flower stalk per bulb compared to bulb to seed method, and hence produce lower seed yield

4.1.2 BULB TO SEED METHOD.

- In the case of bulb to seed method the bulbs produced in the previous season are lifted, selected, stored, and replanted to produce the second year.
- The seeds are sown in December to January for harvesting of bulbs in May to June
- The typical mother bulbs are selected and stored for one to two months until ready for planting in the cooler seasons (early September to October).
- Selected bulbs are planted in September to October to produce seed in December to January for use in the next season.

- Bulb to seed method takes 10-11 1/2months to produce seed (4- 4 1/2 months for bulb production and 6-7 months for seed set and maturity)
- The bulb to seed is the commonly used method of onion seed production in Ethiopia because of the following advantages over the seed-to-seed method.
    - It permits selection of bulbs of good size, uniform, typical color, and free from diseases and physical damage.
    - It produces several stalks per bulb, hence gives higher seed yield. Seed yields up to 20 qt/ha can be obtained on farmer's field for the variety Bombay red.
    - The method is also good to maintain the variety identity (true to type).


Seed to seed method


bulb to seeds

Figure 10. Onion Seed production methods

4.2 FIELD MANAGEMENT

4.2.1 LAND PREPARATION

- Appropriate site onion seed production should be selected based on the ecological requirement of the variety
- The land should be ploughed at least three times and prepared well
- Farm fields levelling, ridging, and cutting by blocks for planting and watering
- The road width between blocks should be 1 m and furrow width need to be 50cm

Figure 11. Field preparation for onion seed production

4.2.2 MOTHER BULB PLANTING

- The size of the mother bulb greatly influences the quality and quantity of seed yield.
- Use bulb size of 65 to 80 mm to produce maximum yield
- For true seed production bulb planting should be done from September to October for flowering to take place between the end of December to early February
- Bulb planting can be done in November and December, but seed yield is reduced dramatically.
- Hence, duration between September and February with temperature of 26 to 28oC during the day and 11-18 oC nights with low humidity were found to be suitable for flower stalk emergence and satisfactory seed set for easy bolting varieties like Adama Red.
- Bulb planting can be done either single row planting or double row planting
    - In single row planting spacing of 50 cm between rows and 20 cm between plants is recommended for ease of weeding, irrigating and pesticides applications, but there is yield reduction.
    - In double row planting spacing of 50 cm between ridges, 30 cm between two double row and 20 cm between plants is recommended
- Bulbs are planted in the soil with 2 to 3 cm depth.
- In double row planting system, 80 to 90 quintals per hectare of mother onion bulbs are required
- The bulb rate for single row planting system could be reduced by half from double row planting, but there is yield reduction
- Moreover, because of the pressure of disease development single row planting system is recommended for mother onion bulb production for onion seed production although there is onion bulb yield reduction

4.2.3 ISOLATION REQUIREMENTS

- Onion is highly cross-pollinated crop.
- Isolation of the seed fields by distances or times from all possible source of contamination (genetic, physical, or pathogenic contamination etc) is very important to keep true to type seeds.

- For seed production seed field should be isolated from other flowering type of onions by 500-1000 meters based on the seed classes to avoid cross pollination.
- For bulb production 5-10 meters isolation is required.
- Time isolation can also be used whenever possible.

4.2.4 FERTILIZER APPLICATION AND RATE

- Fertilizer application can vary from location to location. Attention must be taken when deciding the rate of fertilizer application.
- If the soil of an area is poor in fertility, generally a total of 200-250 kg NPS is applied at planting and 100-150 kg Urea in split: half at planting and the other half a month after emergence.
- The rate can be used for bulb production depending on soil fertility of the areas.

4.2.5 IRRIGATION

- The field should be irrigated three days after planting to facilitate for easy germination of bulbs.
- The crop field should be irrigated every seven days until full flowering and then at every 10 days interval followed by 10-15 days interval near maturity depending on soil types.
- Drip irrigation is recommended for onion seeds production to save water, reduce salinity and minimize disease spread.
- The flowering period is very sensitive to water deficiency. Water stress from the start of bulb sprouting to the beginning of anthesis reduced the numbers of umbels and flowers per plant.

Seed maturity takes longer to ripen if unnecessary irrigation is applied towards the end of the season

4.2.6 POLLINATION

- Onions are highly cross pollinated (up to 90%); the male flower weathers before the female matures.
- Bees and flies pollinate onions. Hence, placing beehives near the farm is advisable
- Insecticides should not be applied during the noon time when the beneficial insect activity is high
- So, insecticides should be applied during the time when there are no movements of insects.

4.2.7 ROGUING

- Diseased and off-type plants should be rogued out before flowering for quality seed production.
- In seed-to-seed system
  - **During the first season:** remove plants with off-type foliage, off-type bulb or stem color and any plants bolting in their first year.
  - **At the start of anthesis, in the second season:** remove plants with off-type foliage, off-type bulb or stem color and check inflorescence characters where appropriate.
- In bulb to seed system
  - **Before bulb maturity:** remove plants with off-type foliage, off-type bulb or stem color and any plants which are either late maturing or showing premature bolting.
  - **When sorting lifted bulbs:** check that morphology, color and relative size of bulbs to be retained for seed production (mother bulbs). Discard any bolting, bull-necked, bottle-shaped, split, doubles, damaged or diseased bulbs.
  - **At replanting** (i.e. if the mother bulbs are not immediately replanted after previous roguing), check characters as described above when sorting, also discard bulbs which are sprouting early.
  - **At the start of flowering:** when appropriate, check inflorescence and flower characters. Flowering heads of plants infected with Ditylenchus dipsaci (‘bloat’ or eelworm) tend to bend over; infected plants should be removed from the seed production site and burnt.

4.2.8 FIELD INSPECTION

- During farm fields inspection, inspectors should approve fields for seed multiplication.
- Inspectors should inspect nursery sites and farm fields selection, ridge & seed beds preparations, seed sowing on beds to harvest seeds/ seedlings.
- Inspectors from internal & external bodies should inspect fields based on the national field standards at list three times before bulb harvesting.
- Selections of farm fields and nursery sites are decided through internal inspection before external inspectors evaluated the fields & sites.
- During seedling growing in nursery, inspectors should approve seedlings rising on nursery site for seed and or bulb production.

- The external inspectors are inspecting the nursery site after it established & ready for seed planting on the beds.
- Generally, inspectors should inspect onion fields 6 to 7 times from nursery site establishment & fields' selection, for bulb to seed production.

CHARACTERISTICS	PRE BASIC SEED -A	PRE BASIC SEED -B	PRE BASIC SEED -C1	PRE BASIC SEED -C2	PRE BASIC SEED -C3	PRE BASIC SEED -C4
FIELD STANDARD						
Rotation (min, year) Isolation (min, meters) Off types & other cultivar (max %)	3 1000 N.S	3 700 0.01	3 500 0.02	2 500 0.03	2 500 0.03	2 500 0.05

Table 5. Minimum and maximum open pollinated onion seed field Standards

Figure 12. Inspectors' evaluation of onion fieldStandards

Post assessment questions

- What is the importance of roguing off types in onion seed production?
- List the two most used onion seed production method in Ethiopia
- Why isolation of the seed fields by distances or times from all possible source of contamination is important

Key message

Bulb to seed method is the most used method in onion seed production

SECTION 5: CROP PROTECTION

Overview of the section

Insect pests and diseases are major constraints of onion seed production. Any part of the onion may be affected by insect pests and diseases, but it is important to assess whether the damage has crossed the economic threshold or reached the economic threshold to apply control measures. Hence, this section addresses the major insect pests and diseases of onion and their management methods.

Learning outcome

At the end of this section the learner able to:

- Identify economically important onion disease and insect pests
- Identify major damage symptoms of major onion disease and insect pests
- Understand different methods used for management of major onion disease and arthropod pests
- Identify major onion weeds and their management

Duration: 4hrs

Learning question

- What are the major diseases that affect onion seed production in your region/areas
- What are the major insect pests that affect onion seed production in your region/areas
- What are the major weeds that affect onion seed production in your region/areas

5.1 ONION DISEASES AND THEIR MANAGEMENT

- Onions are prone to several different diseases, especially in wet growing seasons. These often get started on their leaves, and if severe, can reduce bulb growth and yield.
- Purple blotch (Alternaria porri), downy mildew (Peronospora distructer), stemphylium leaf blight (Stemphilum vesicarium) and bulb rot (Sclerotium cepivorum) are the most important disease of onion in Ethiopia.
- The followings are an overview of major onion diseases and their management.

Recognize the negative impacts of disease on onion production

Identify disease and their damage symptoms

Report their findings to management or advisors.

Understanding of sustainable disease management practices and application

Undertake and plan farming practices with knowledge of their environment

5.1.1 PURPLE BLOTCH

- Purple blotch (Alternaria porri) is the major production constraint of onion wherever the crop is grown.
- The disease is favored by frequent rainfall and high humidity during the active growth stages of the crop.
- Yield losses caused by purple blotch can reach 30-40% of bulb production around the central rift valley area.

Symptoms

- Initial symptom of purple blotch is white spots on the leaves. During favourable weather conditions these spots enlarged and become purplish or brown in color.
- At the latter stage of crop infection, all leaves may dry and collapse. Severe infection causes smaller bulb size and not fit to the market.
- Warm (18-30 °C) wet periods favour the development of the disease.
- Small brown spots with purplish centers are characteristic of this disease.


Typical purple blotch symptoms

Management of Purple blotch disease

- Practice crop rotation system
- Use of disease-free seeds and bulbs: Use certified planting material (healthy seed or bulb)
- Use improved varieties that are high yielder and resistant to the disease
- Deep burring of debris through deep ploughing as sanitary precautions
- Use well drain fields to prevent further spread of the disease.
- Treatments of seed and bulb with fungicides like Thiram 80% WP, Proseed plus 63 WS (Carboxin + Thiram + Imidaclopride), Imdalm T 450 WS (Imidaclopride + Thiram) and Carbendazim prior to sowing.
- Thiram or Captan or Mancozeb at 3 g/kg seed
- Cover the seed crop with white polythene at night during rainy periods to minimize crop damage.
- Spraying of fungicides such as chlorothalonil, tebuconazole, mancozeb, Nativo 300 SC (trifloxystrobin + tebuconazole), Ford 325 Sc (Azoxystrobin + Difenoconazole), Doctor 400SC (Difenoconazole + pyraclostrobin), Ridomil MZ63.5® (a.i. Metalaxyl + Mancozeb): 3.5 kg/ha, Mancozeb (3.0kg/ha) or Captafol 80% WP, 0.3% at about 500-700 litres of water/ha at 7 days interval for 5-7 times

5.1.2 DOWNY MILDEW

- It is is common in areas with high rainfall and high humidity causing up to 75 % yield loss.
- It very prevalent during the cold dry season (October to Februally) in Ethiopia.
- And hence concides with onion seed production calander that makes it very important disease in onion seed sector.

Symptoms

- At the beginning of infection, symptoms appear as gray masses of fungal growth. When the disease progresses, infected parts turn to brown to purplish color.
- During severe infection, leaves get dry and bulb size reduced.
- The disease often starts in patches and is favored by cool, (less than 22°C) humid weather.
- Diseased leaves quickly turn pale green, then yellow, and collapse and die.
- Girdled in the region where mildew develops and the seed stalk collapse.

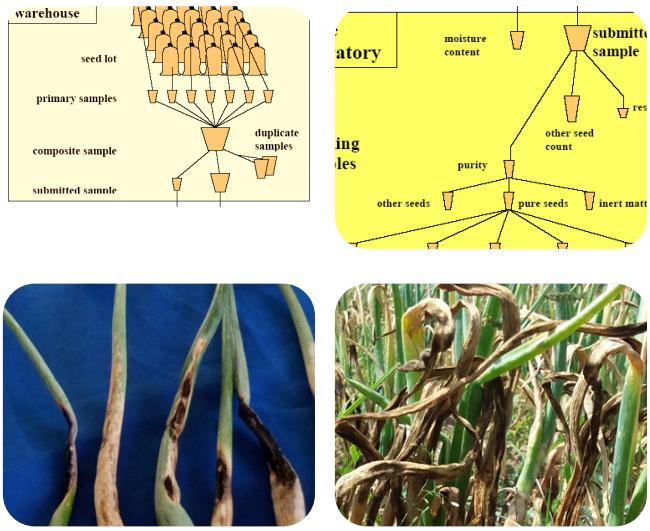


Figure 13. Downy mildew of onion symptoms.

Management of downy mildew

- Seed treatment
- Field sanitation: Removal of debris and cull piles.
- Avoid planting onion sets that are contaminated with the fungus.
- Plant rows in the direction of the prevailing winds and use drip irrigation, if possible, or furrow irrigation rather than sprinkler irrigation.
- Crop rotation- 2-3 years rotation out of onions in areas where the disease is present.
- Regular fungicide spray program based on climatic conditions: Sinoko 77% WP, Ridomil Gold MZ 68 WG, Mancozeb, Metalaxyl 8% WP + Mancozeb 64 WP.

5.1.3 STEMPHYLIUM LEAF BLIGHT (STEMPHYLIUM VESICARIUM)

- Stemphylium leaf blight caused by the fungus, Stemphylium vesicarium and is a newly recurring disease that caused significant onion bulb yield losses (15 to 27 %)

Symptoms of Stemphylium leaf blight

- Symptoms begin in small, random foci usually initiated away from field edges, when bulbs are approximately 2.5 cm in diameter.
- Lesions are initially small, tan to brown, and may be water-soaked, becoming spindle shaped to ovate-elongate or diffusate spots.
- As the disease spreads, the lesions rapidly progress along the leaf initially in an asymmetric pattern causing longer lesions down on one side of the leaves but eventually resulting in complete defoliation.

Figure 14. Onion leaf damage due to Stemphyllium leaf blight.

Management of stemphylium leaf blight

- Residue management is an important means to promote degradation and overwintering of inoculum between seasons.
- Enhancing residue breakdown and burial of onion leaf residue after harvest has been recorded for significant delays in Stemphylium blight epidemic initiation and progress.

- Crop rotation to a non-host for at least one year may significantly reduce inoculum densities to reduce SLB epidemics in the subsequent onion crop.
- Resistance/ tolerance variety: In Ethiopia acceptable levels of tolerance or resistance to Stemphylium blight within commercial onion varieties has not been observed. However, some varieties could have difference in their reaction to the disease.
- Good field drainage
- Reduce the plant density by optimum spacing (15 cm x 10cm)
- Avoid excess nitrogenous fertilizer applications
- Seed treatment with Thiram or Captan or Mancozeb at 3 g/kg seed
- Spray fungicides, Mancozeb @ 0.25% at 10-15 days interval from 30 days after transplanting or as soon as disease appears. Other fungicides can be used to manage or reduce epidemic of stem blight phylium. These are Essence 38 WG (Boscallid + Pyraclostrobin), Rova 75 WP (chlorothalonil) and Yewag (Dimethomorph + Cymoxanil)

5.1.4 WHITE ROT (SCLEROTIUM CEPIVORUM)

- The pathogen propagates only by the production of circular sclerotia, produced on decayed roots and bulbs.
- It is a very serious problem because it may spread fast by irrigation water, farm equipments like tractor, exchange of planting materials (bulbs and seedlings)
- Once it is introduced in a field, it can persist for many years (>20 years) and slowly the production of onion in the entire field is threatened.
- It usually affects during bulb formation and onwards since then.
- The disease is most severe in areas with high rainfall and high humidity causing up to 75 % yield loss.
- The pathogen survives on volunteers, bulbs, seed, soil, infested crop residues.

Signs and symptoms of white rot disease

- Above ground, the first symptom is yellowing and wilting of the foliage, especially in dry weather
- Under wetter conditions the plants may not wilt, but will become loose in the soil
- Below ground, the pathogen rots the roots and then invades the bulb
- White, fluffy fungal growth appears on the base of the bulb, and later this growth becomes covered in small, round, black, seed-like structures
- Collapse of the affected leaves, usually of older leaves and death of the entire plant

Figure 15. Symptoms of white rot disease on leaves and bulbs

Management of white rot

- Use clean planting materials (certified seed, seedlings and bulbs)
- Sanitation
- It is extremely important to avoid moving infected material into disease-free areas.
- Do not let irrigation water run from an infected field to a clean field.
- Follow a long-term rotation with any other crops except allium crops.
- After harvest do not compost infected bulbs- dispose of them by burning or burying
- Fungicides: Apron star, Folicur (Tebuconazole 250 EC (25.9% w/w) and Maxium

5.2 MAJOR ARTHROPOD PESTS OF ONION AND MANAGEMENT

- In Ethiopia, the production and productivity of onion is constrained by insect pests.
- The major insect pest of onion in Ethiopia is the onion thrips (Thrips tabaci).

- Monitoring, correct identification and the use of appropriate management options are important.
- It is a major insect pest of onion in Ethiopia.
- It is a highly polyphagous and economically harmful pest of cultivated plants, particularly a pest of onion, leek and cabbage, and important as a tospovirus vector.
- It is the most common during dry months.
- Adults: Adults are pale yellow to light brown and have a pair of wings fringed with long hairs

Damage symptoms: Both adults and nymphs feed by piercing and rasping the leaf surface and drinking the liquid, causing the surrounding tissue to die.

- Feeding by thrips results in silver-grey patches on leaves.
- The vigor of the plant is reduced by loss of chlorophyll.
- During sever infestation the leaves themselves can shrivel.

Management Cultural control

- Field sanitation – remove weeds and alternate hosts
- Crop rotation
- Plow fields after harvest and remove crop residue to eliminate resting and/ or overwintering sites for the pest

5.3 MAJOR WEED FLORA OF ONION AND ITS MANAGEMENT

- Weed species composition varies across different agro- ecologies and soil type.
- Onion germinates and grows relatively slow and hence weed competition is more critical both at the nursery and up to 40 days after transplanting.
- Hence, any weed species that prevail in onion field should be controlled through affordable weed management practices.
- This can be done through use of appropriate weeding tools, such as jembe, “Finger Hoe”, “Split Hoe” and “Flat Hoe”.

Weed Management

- Weeds can also be removed by hand pulling to avoid damaging the roots.
- Since weeding is labour intensive and hence costly, some farmers prefer using selective herbicides to control weeds such as: Galigan EC® & Oxygold EC® (a.i. Oxyfluorfen), Stomp EC® (a.i. Pendimethalin).
- Application Pendimethalin @1.37 kg/ha and S-metolachlor @1.44 kg/ha before emergence is effective for the control of annual broad leaf and grass weeds on onion.
- Moreover, Clethodim, Oxyfluorfen, and Clodinafop-Propargyl are recently registered herbicides to be used whenever the need comes.

Post assessment questions

- Diseases are more economically important than insect pests on onion seed production in Ethiopia (True/False)
- Use of health soil, health seed, good agronomic practices and supplementary fungicide is an example of integrated disease management (True/False)
- Rainy seasons favor major onion diseases development (True/False)

Key message

Onions are prone to different diseases, especially in wet growing seasons. Thrips are the only major insect of onion in Ethiopia

SECTION 6: HARVESTING AND POSTHARVEST HANDLING

Overview of the section

Improper harvesting and post-harvest handling of onion contributed to post harvest losses. In Ethiopia, about 30 % of the onion is estimated to be lost during different postharvest handling and storage. The purpose of this section is to train youth and small business groups on proper harvesting and post-harvest handling practices of onion. Hence, this section addresses harvesting, postharvest handling, storage, processing and value addition of onion.

Learning outcomes

At the end of this section the trainees equip on:

- Understand onion harvesting indices.
- Understand postharvest handling of onion bulb for seed production.

Duration: 2hrs

Learning question

- What is the level of post-harvest loss of onion from your experiences and its main causes
- How onion seed producers in your region reduce onion post-harvest loss?

6.1 HARVESTING

- Onion bulb should be harvested at the right stage.
- Physiological maturity and healthy dried leaf are an indicator for harvesting time.
- In general, time of harvesting can be determined based on the following criteria.
  - Counting the number days from transplanting to bulb maturity
  - Percentage of necks bent over
  - Nature of leaf tops discoloration and bending
  - Reduced thickness of sheath leaves surrounding the bulbs
- Depending on variety and season of the year, onions are ready for harvesting after 110-130 days after transplanting
  - Onion takes 55-65 days to develop visible bulbing from the time of transplanting
  - Onion takes 60-70 days from bulbing to maturity.
- Bulb onions are ready for harvesting when 75% of the plants have their necks bent over and tops dried.
- Harvesting of onion bulb can be done either manually or mechanically
  - Manual harvesting is the most common practice in most developing countries. It is carried out by levering the bulbs with a fork to loosen them and pulling the tops by hand.
  - Harvesting of the bulbs are done by hand when the onion bulbs are formed on the soil surface, while fork is used for harvesting when the bulbs are developed below the ground
  - Mechanical harvesting is commonly used in large scale farms, particularly in developed countries.

6.2 SELECTION/ GRADING OF ONION BULBS

- Bulbs with typical colour and shape of the variety in question are selected.
- Medium size bulbs (4-5cm) are then selected and stored until planting (20-30 days).
- In the 1st selection bulbs which are white, damaged, twins/ split and very large are discarded.
- In the 2nd selection sprouted, deteriorated, escaped small and large sized bulbs are discarded.

Figure 16. Onion bulb grading

6.3 BULB STORAGE

- Store the selected bulb for at least 20-30 days in aerated or ventilated storage for break dormancy and good sprouting.

Figure 17. Storage of onion bulb before planting

6.4 BULB PLANTING FOR ONION SEED PRODUCTION

- After one month storage the bulbs should be further reselected one day before planting.
- Damaged, discolored, sprouted, and rotted onion bulbs should be discarded.
- Plant the healthy selected bulbs in the selected & prepared fields for onion seed production.

Figure 18. Planting of onion bulbs under the field

6.5 BOTANICAL SEED HARVESTING

- All umbels per plant do not mature at one time due to difference in the stalks to flowering; hence harvesting may take 3-4 times.
- Also, one could start harvesting when greater than 10 % of black seeds are exposed on an umbel.
- However, it is better to harvest mature umbels when about 50% black seed is exposed on an umbel; if overstayed the seed heads shatters the seeds readily in the field.
- Harvesting is done by hands. When heads are cut, it should be supported in the palm of hand and held between the fingers to avoid seed shattering.

Figure 19. Harvesting of onion seeds from the field

6.6 THRESHING AND CLEANING

- The seeds must be properly separated from the umbels.
- While seed extraction carry out there should not be any damage to the seed.
- Dried umbels of onion can be threshed by adding it to the mortar and rubbing with pestle and then cleaning the seeds by winnowing and sorting manually.

6.7 DRYING UMBELS

- The harvested umbels should be dried by spreading the umbels on canvas and putting under shade or in the morning or late afternoon sun for few days.
- 1st dry the umbels by spreading on the mats for three days and after that select well dried umbels to rub the umbels.
- 2nd dry spread the umbels on the mats not well dried for two days and then rub the umbels before threshing in the mortar with pestle.


Figure 20. Drying of onion umbels

6.8 SEED CLEANING AND GRADING

Seed grading: cleaning seeds manually by winnowing, blowing and sorting out impurities from the seeds.


Figure 21. Winnowing seeds manually (left) and separating pure seeds from light/floater seed and chaffs(right).

Onion seed soaking: Seed soaking into the water to identify floater and some chaffs.


Figure 22. Onion seed soaking

6.9 SEED DRYING

- The pure seed settled in a container should be taken immediately to the prepared places and spreading on the canvas and dried under the morning and late afternoon sun or under shade for 3-4 days.

Figure 23. Drying of onion seeds on the ground

6.10 LABELLING, TAGGING AND SEALING

Labelling

Each container of onion seeds shall be always labeled with: Name and address of the producers, name of the crop, name of variety, competence assurance certificate number, seed class, net weight/ No in SI unit, year of production, date of packaging, date of approval, expiry date, lot reference number, treated/ untreated (warning text if treated), logo and address of certifying body.

SEED CLASSES	LABEL COLOUR
Breeder/Pre-basic Seed	Violet band on white
Basic seed	White
Certified Seed (1st Generation)	Blue
Certified Seed (2nd – 4tht Generation)	Red
QDS	Grean

Table 6. Seed classes

Seed Tagging

Seed Sealing

- Finally, after all processes finished seeds should be sealed either manually or by machine and then sample taken by external regulatory bodies for seed quality approval and certification.

6.11 BOTANICAL SEED STORAGE

- Dried and cleaned seed should be stored in recommended materials.
- Seed storage should be in dry and aerated conditions.
- Moisture content of seeds need to be 9%.
- Store seeds in optimum storage structures and longevity.
- If seed moisture content is high, normally it loses its viability at faster rate.
- Store seeds in areas having low temperature and low RH.
- Store seeds in cold storage on constructed pelleted to reduce moisture absorption.

Post assessment questions

- In the post harvesting seed processing, why seed soaking and the difference between soaked and un-soaked seeds?
- What is the importance of seed tagging, labelling and sealing?
- What are the types of seeds store and storage structures, how can we store, for how long can we store one onion botanical seed?

Key Message

Cleaning, drying and labeling is very critical for the quality of onion seed

SESSION 7: QUALITY CONTROL AND ASSURANCE

Overview of the section

Seed quality control and assurance is the combined efforts and activities undertaken to ensure that the seeds that are being produced for the end users (farmers) conform to mini- mum quality standards. This training section involves seed quality control, seed quality assurance, quality declared seed, and seed certification procedures for production, processing and marketing quality seed.

Learning outcome

To equip trainees on:

- Seed quality control and assurance mechanisms.
- Enabling trainee to know about seed quality control processes.
- Enabling trainee to easily identify and carry out internal seed quality assurance mechanisms.

Duration: 1hr

Learning question

- Do you know the seed quality control procedure and standards to assure seed quality?

7.1 ONION SEED QUALITY CONTROL OPERATIONS

- Is a systematic approach towards achieving and maintaining minimum seed quality standards.
- Quality Control Operations includes

7.1.1 INSPECTING SEED PRODUCTION FIELDS

CHARACTERISTICS	PRE-BASIC SEED -A	BASIC SEED- B	CERTIFIED SEED-C1	CERTIFIED SEED-C2	CERTIFIED SEED-C3	CERTIFIED SEED-C4	COMMERCIAL/ EMERGENCY CLASS-E
FIELD STANDARD							
Rotation (min year)	2	2	2	2	2	2	1
Isolation (min meters)	100	100	50	50	50	50	50
Off types & others cultivar (max%)	0.1	0.1	0.2	0.3	0.3	0.4	

Table 7. Maximum and minimum seed field standard for onion seed certification
Source: ESA, 2017

7.1.2 SAMPLING SEED LOTS

- Sampling is fundamental importance at all stages of seed quality evaluation
- A seed that passed the field inspection shall be subjected to laboratory test
- The sample should drown by authorized professionals

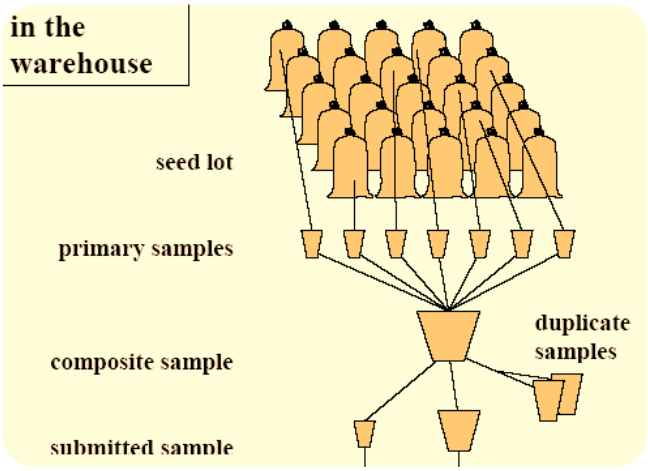


Figure 24. Seed sampling flow chart in the store

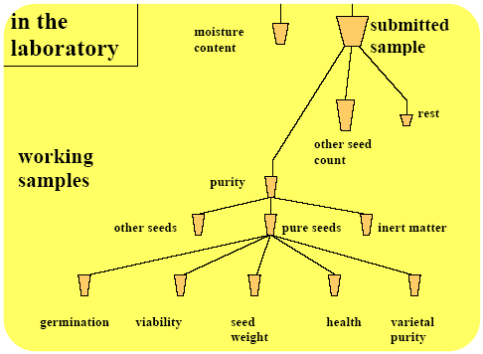


Figure 25. Seed sampling flow chart in the laboratory

7.1.3 LABORATORY TESTS

- Important components of seed quality testing parameters includes:

Purity analysis

- Composition of seed lot (pure seed, other seed, inert matter)
- Nature of contaminants in a lot
- Determination is based on weight

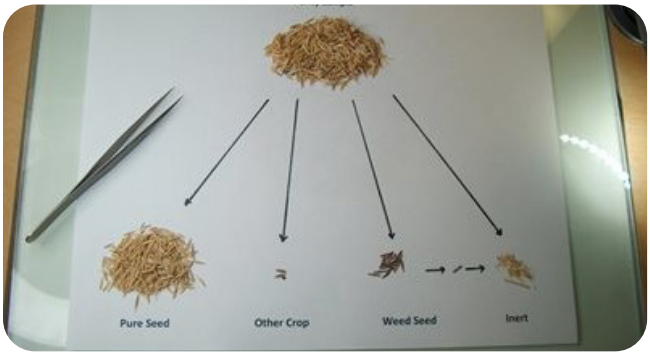


Figure 26. Seed purity analysis

Germination tests;

- Hundred seeds of 4 replicates tested under favorable conditions and classified into:
  - Normal seedlings
  - Abnormal seedlings
  - Fresh un-germinated /hard seeds
  - Dead seeds


Figure 27. Onion seed germination test in laboratory

Seed health test

- Seed serves as a vehicle for dissemination of diseases and pests.
- Infected seeds may fail to germinate, reduced emergence or reduce productivity.

Seed treatment and enhancement

- Seed treatments and enhancements can improve stand establishment, survival, and quality and appearance of onions.
- Seed enhancements include seed priming and seed coating procedures that is intended to improve the handling and planting of seed, reduce the time to germination, or increase the uniformity of seedling emergence.
- Seed treatment the application of insecticides and/or fungicides to the seed to help protect the seeds and young seedlings from insect pests and fungal pathogens

7.1.4 TAGGING, LABELLING AND SEALING SEED BAGS

CHARACTERISTICS	PRE-BASIC SEED -A	BASIC SEED- B	CERTIFIED SEED-C1	CERTIFIED SEED-C2	CERTIFIED SEED-C3	CERTIFIED SEED-C4	COMMERCIAL/ EMERGENCY CLASS-E
LABRATORY STANDARD							
Pure seed (min %)	98	98	97	97	97	97	97
Other crop seed (max %)	N.S	0.05	0.1	0.2	0.2	0.2	0.3
Weed seed (max %)	N.S	0.05	0.1	0.2	0.2	0.5	0.5
Infected/ Infested/ seeds (max %)	N.S	0.1	0.5	0.5	0.5	0.5	0.6
Inert matter (max %)	N.S	N.S	2	2	2	2	2
Germination (min %)	85	85	75	75	75	70	70
Moisture content (max %)	10	10	10	10	10	10	10

Table 8. Maximum and minimum laboratory seed standard for onion seed certification
Source: ESA, 2017

7.2 SEED QUALITY ASSURANCE

- Is an important aspect of seed production and marketing.
- Seed producers or seed traders distinguish themselves from grain producers or grain sellers by offering quality seeds.
- Among quality assurance mechanisms Quality Declared Seed (QDS) and Certification are practicing in our country.
- Different quality assurance mechanisms were practicing in different countries which include, Self-control, truthfully labelled, Group control, Quality Declared Seed (QDS) and Certification. However, seed certification system is common quality assurance mechanism where QDS is rarely practicing in Ethiopia.

7.3 QUALITY DECLARED SEEDS (QDS)

- Form of quality assurance that was created to reduce the burden of rigorous conventional seed certification. Quality assurance is organized locally, through individual self-control or through group-based mechanisms.
- The national seed inspection services only routinely check a random sample of seed producers.
- QDS seed is marketed locally and is restricted to OPVs, to reduce the competition with fully certified seed.
- Seed producers must be registered to produce QDS seed.
- Cost of QDS-based quality assurance is lower than that of certified seed.

7.4 CERTIFICATION

- The general procedure for seed certification begins with;
    - Verification of the source of the basic seed to be used for production of certified seed,
    - Verification of germination rates, grading, and other functions to assure quality.
- Crops are produced in accordance with regulations and standards set by ESA.
- Seed crops varieties are inspected throughout the season by a third-part inspector, to assure that regulations are being met.
- A crop inspection report is forwarded to the Regional Seed Quality Control Agency office for appraisal.
- If the crop meets all certification requirements, the seed grower receives a crop certificate as proof of the variety of the seed crop and the field is harvested.
- After harvest, certified seed is cleaned by a registered seed establishment and tested for germination and purity in recognized lab to assure all seed quality requirements are met. This involved
    - Genetic purity,
    - Analytical purity,
    - Physiological quality and
    - Seed health.

Post assessment questions

- What is the importance of seed quality control?
- What is the importance of seed inspection?
- What is purity test?

Key takeaway

The seed quality control and assurance are critical procedures in production and marketing of legally acceptable quality seed.

SECTION 8: FINANCIAL FEASIBILITY

Overview of the section

Financial feasibility describes whether agri-business is financially viable. It involves determining initial investment (resource) requirement to start the business, estimating production cost, operation expenses, and sales revenue. These are used to determine the initial investment requirement, profitability of the business, break-even point (minimum level of production) to attain the profit zone, and pay-back period (number of years required to recover initial investment). These series procedures are used to make wise decisions to accept or reject the agribusiness investment alternative.

Learning Outcomes

To equip trainees on:

- How to determine initial investment requirement to start the business
- How to estimate periodical production costs, operating expenses, and sales revenue of the business
- How to determine profitability and cash flow of the business
- How to calculate break-even point (minimum level of production) to recover total cost and generate profit.
- To calculate payback period (time requirement to recover initial investment and
- How to make decision to accept or reject the investment alternative

Duration: 4 hours

Learning question

- Do you know how to determine financial feasibility of the given specific agri-business to make wise investment decision?

8.1 INITIAL INVESTMENT

- Initial investment is the minimum capital requirement to start the business.
- Example of initial investment requirement to start seed production business includes tools and equipment, seed storage, land, tractor, working capital, etc

DESCRIPTION	TOTAL COST	REMARK
Total		

Table 9: Template to estimate initial investment requirement for agri-business

8.1.1 LONG-TERM INVESTMENT

- Long-term investment in agri-business involves all asset requirement for the business which can serve for more than one year.
    - Example tools and equipment, tractor, storage, land, etc

TYPES OF INVESTMENT	UNIT OF MEASUREMENT	QUANTITY	UNIT COST	TOTAL COST

Table 10: Template to calculate total cost for acquisition of long-term investment

8.1.2 WORKING CAPITAL

- Working capital for the planned agri-business includes all payments requirement for day-to-day operating activities such as production costs and operating expenses.

Example

  - Production costs include cost of seed, fertilizer, chemical, labor cost etc
  - Operating expenses includes administrative salary, sales commission, promotion, etc

- Working capital excludes long term investments such as warehouse, tools and equipment, land, tractor, and etc

A. Production cost

- Production costs are a key component in agri-business.
- It includes all costs associated with production including value addition to make the product ready for sale.

TYPES OF INVESTMENT	UNIT OF MEASUREMENT	QUANTITY	UNIT COST	TOTAL COST

Table 11: Template for estimating production cost per hectare for onion seed production

B. Operating expenses

- Operating expenses are all costs not directly associated with production.
- They are common costs incurred for administrative and selling activities.
- Example administrative salary, promotion cost, sales commission, transport cost to sale,

TYPES OF COSTS	TOTAL COST

Table 12: Template to estimate operating expenses for agri-business

8.2 ESTIMATED PRODUCTION AND SALE REVENUE

- Production volume is the main source of revenue for the agri-business to generate profit.
- Producers should determine the estimated average production volume from the planned production season.

Formula -1
Tolal production volume = Average production per hectare X Land size (ha)

- After determining the estimated volume of production, it is possible to determine the expected sales revenue for the planned production.

Formula -2
Total sales revenue = Tolal production volume X unit selling price

A	B	C	D	E	F
TYPES OF CROPS	TYPE OF SEED	LAND SIZE (HA)	ESTIMATED PRODUCTION/ HA	TOTAL PRODUCTION	TOTAL SALES REVENUE (D X C)

Table 13: Template for estimating volume of production and sale revenue

8.3 PROFIT AND LOSS STATEMENT

- The primary objective of any business is to generate profit.
- Profit and loss statement is the main tool to calculate profitability of the business.
- It is used to accept or reject the investment based on estimated profit.

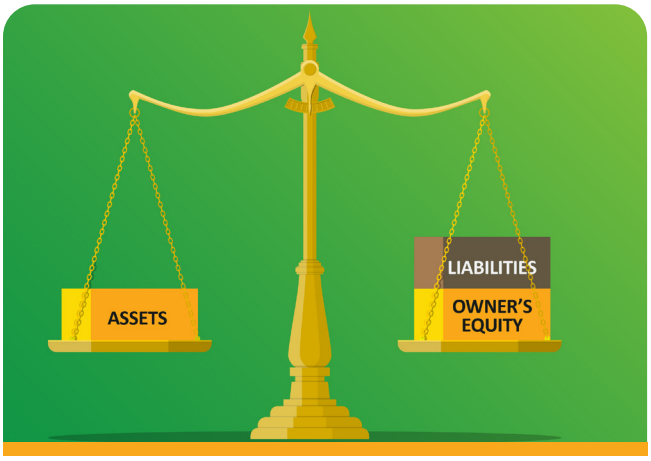
Formula -3

a. Gross profit = Total sales revenue – Cost of goods sold
b. Net profit = Gross profit – Total operating expenses

DESCRIPTION		
Sales Revenue		
Costs of production (-)		
Gross profit		
Operating Expenses (-)		
Net profit		

Table 14: Template for profit and loss statement preparation

8.4 BALANCE SHEET



Balance sheet used to know the total resource owned, amount of claim by creditors and amount of owners' equity

- Balance sheet used to know the total resource owned, amount of claim by creditors and amount of owners' equity
- Balance sheet contains asset, liability, and own capital
- Assets are all resources available for use or for sale
  - Example cash, inventory, warehouse, land, equipment etc
- Liabilities are all debts obtained from bank, microfinances, individuals or others
- Own equity/capital involves own/member contribution, grant/donation, etc

Formula -4

Total Asset = Total liability + Total own capital

DESCRIPTION		
Asset		
Current asset		
Cash		
Inventory		
Total current asset		
Fixed asset		
Tools and equipment		
Warehouse		
etc		
Total fixed asset		
Total asset		
Liability and Capital		
Liability		
Loan		
Debt from relative		
Total liability		
Owners capital		
Own capital contribution		
Grant/donation		
Total owners' capital		
Total liability and capital		

Table 15: Template for balance sheet preparation

8.5 CASH FLOW STATEMENT

Cash flow is all cash inflow and outflow for any purpose in the business operation

Example:

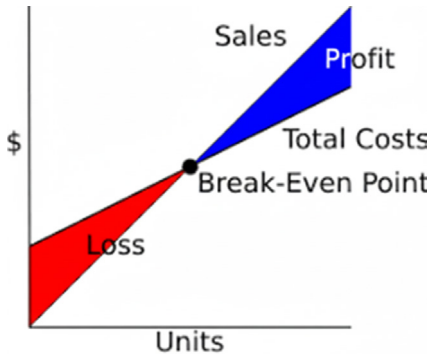
- Cash inflows include sale of seed/seedling, debt obtained from banks, members capital contribution, etc
- Cash out flow includes purchase of input, payment for construction, repayment of debt, payment for salary, etc

Formula -5
Beginning cash balance + total cash inflow = ending cash balance + total cash out flow

DESCRIPTION	AMOUNT OF OUTFLOW	AMOUNT OF INFLOW
Owners' investment		
Debt		
Grant		
Sale revenue		
Warehouse construction cost		
Purchase of equipment		
Purchase of input		
Land rent		
Irrigation cost		
Labor cost		
Cash Operating costs		
Ending cash balance		
Total		

Table 16: Template for cash flow statement preparation

8.6 BREAK EVEN ANALYSIS



- Break even analysis is used to determine the minimum level of production to cover total cost
- At break-even point no profit no loss
- To make profit, level of production and sale should exceed/greater than breakeven point.
- Fixed costs are fixed in total amount regardless of increase/decrease in volume of production.
  - Example depreciation, warehouse rent, administrative salary, promotion cost, etc
- Variable costs varied in total in response to increase/decrease in level of production
  - Example production costs, packaging cost, loading and unloading, etc

Formula -6
Beginning cash balance + total cash inflow = ending cash balance + total cash out flow

8.7 PAYBACK PERIOD

Payback period is used to determine number of years/periods it takes to recover initial investment.

Formula -7

a. When the annual profit of the business is uniform/equal
   Payback period = Initial investment/annual profit
b. When the annual profit fluctuate/vary from year to year
   Pay back period = # of year before coverage + uncovered amount/profit of the next year

Post assessment questions

1. Which of the following is part of working capital
   a. Purchase of fertilizers,
   b. Purchase of tractor,
   c. Transportation cost,
   d. Purchase of chemical
2. Which of the following should include in profit/loss statement
   a. Purchase of tools and equipment,
   b. Sales revenue,
   c. Debt,
   d. Owner investment
3. Which of the following is variable cost
   a. Purchase of seeds,
   b. Administrative salary,
   c. Depreciation,
   d. Rent of storage

Key message

Analyzing financial feasibility of agribusiness enables to pre-determine the applicability of the business in terms of initial investment requirement, profitability, and sustainability.

SECTION 9: POTENTIAL RISKS AND MITIGATION MEASURES

Potential Risks	Mitigation measures
Limited demand driven input/ early generation seed supply	Create strong, sustainable, and diversified linkage with suppliers through contractual based early generation seed production
Climate change	Use climate adoptive crop varieties, use irrigation scheme, use climate prediction information and tends of climate change, use diversification, understand effective crop Calander
Inflation/market fluctuation	Conduct effective demand assessment, understand competition in the business, apply cost-based pricing strategy, understand the market trend, use diversified market outlets
Limited access to finance	Create strong linkage with diversified source of finances such as banks, microfinance, use family/friends/ partner, develop saving,
Insects and disease	Use quality and certified seed, apply crop rotation, understand the type of the insects/disease and use chemicals/manual mitigation method
Security	

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