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Onion Seed Production Techniques

A manual for extension agents and seed producers

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Asella, Ethiopia

ONION SEED PRODUCTION TECHNIQUES

A Manual for Extension Agents and Seed Producers

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FOREWORD

Onion ((*Allium cepa*) is a recently introduced crop to Ethiopia. The release of a variety from introduced materials (from Sudan) has marked the beginning of extensive production of onion in the country. Ever since the crop is distributed to different parts of the country and is now become an important vegetable crop for markets and in daily life of people in the Oromia region as well as the country as a whole. Increasing onion production contributes to commercialization of the rural economy and creates many off-farm jobs.

FAO has been involved in the promotion of high value horticultural crops production, and onion seed production is part of the intervention underway in Arsi zone of Oromia region since 2007. This simplified manual is developed based on the last four years practical experiences with the FAO-Crop Diversification and Marketing Development Project (CDMDP) in Arsi zone, published works and the trainings materials provided to experts, development agents and farmers in collaboration with different stakeholders (especially Melkassa Agricultural Research Center) during the project implementation period. It aims to provide information on onion seed production practices and attendant crop management practices. To make the guide very user friendly, detail descriptions for each step were provided in simple English with supporting Figures. The manual targets development agents and onion seed producers (including farmers) to ensure quality onion seed production be it for sale or own consumption. It also meant to serve as a guide and reference material for agricultural professionals and any actors engaged in agricultural development.

Finally, we hope that the manual will play an important role in upgrading technical knowledge and skills of development agents and farmers in Oromia Region and the country as a whole in quality onion seeds production in particular and onion bulb production in general.

Olani Nikus and **Fikre Mulugeta**

1. INTRODUCTION

Onion is considered as one of the most important vegetable crops produced on large scale in Ethiopia. It also occupies an economically important place among vegetables in the country. The area under onion is increasing from time to time mainly due to its high profitability per unit area and ease of production, and the increases in small scale irrigation areas. The crop is produced both under rainfed in the *meher* season and under irrigation in the off season. In many areas of the country, the off season crop (under irrigation) constitutes much of the area under onion production. Despite areas increase, the productivity of onion is much lower than other African countries. The low productivity could be attributed to the limited availability of quality seeds and associated production technologies used, among the others.

For the supply of such seeds, the informal sector is playing significant role in out reaching large number of farmers. Most of the demand for onion seed is either meets by private sectors or unorganized program and imported seeds. The formal sector, Ethiopian Seed Enterprise (ESE) is not generally supplying onion seed. Limited amount is catered by public sector organizations like Ethiopian Institute of Agricultural Research (EIAR) as popularization activities.

The quality of seed supplied by the informal sector in most cases is not good enough. Most of the times there have been problems related to germination capacity of the seeds and true to type ness. The problem is further exacerbated by the short shelf life of onion seed (one year under favorable condition). Owing to these, producers are using 6- 8 kg of seeds per hectare as opposed to the recommended rates of 3.5-4 kg/ha in order to guarantee good seedling emergence. This incurs more cost to farmers besides the ever increasing price of onion seed on the local markets. All these are hampering the advancement of onion production. Therefore, it becomes necessary to increase the supply of quality seed through participation of private sectors and farmers in onion seed production.

In this regard, it is paramount important that the government extension agents and producers knowledge and skill be improved in the areas of seed production technology. True to type bulb selection, seed production practices, harvesting, seed processing and storage are the underlying principles in the production and supply of quality onion seed.

Thus, this simplified manual that encompasses the main processes in onion seed production technology is prepared in order that higher and quality seed yields are produced and supplied to users. It also plays significant role in the maximization of profits from the intervention in seed production.

2. ENVIRONMENTAL REQUIREMENTS FOR ONION SEED PRODUCTION

Onion seed production is influenced not only by genetic factor but also environmental factors such as temperature, rainfall, soil conditions and presence of beneficial insects.

Cultivars: Seed production potential also depends on cultivars. Some onion types produce few flower stalks in the country due to their higher chilling requirement. So, producers should exercise seed production on adapted onion varieties like Bombay red, Adama red, etc.

Likewise in selecting onion varieties for seed production, emphasis should be given to the most popular varieties under production. Currently, Bombay red is the most widely grown onion variety under irrigation in the country due to its higher bulb yield and earliness. This variety is not suitable for production under rain fed as it easily rots in the field if encounters rain during maturity stage. Yields up to 400 qt for Bombay red were observed on farmer's fields in CRV areas, which is mainly due to its tolerance to higher plant population (can successfully produce good size bulbs at spacing as low as 4cm between plants). On the other hand, Adama red can produce good size bulbs only at plant spacing greater than 6cm. Unlike the former, Adama red can be produced under rain fed conditions as it tolerates rotting due to rain effects during maturity stage. Thus, when selecting a variety for its seed

production the yield and area coverage of that variety should also be taken in to account.

Temperature: 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. The ideal temperature for mother bulb production is 18^0c-24^0c day and 10-12^0c night temperature. For bulb production it can go higher beyond these ranges.

However, it is major factor for flower stalk development and seed set. Higher temperature can prevent flowering. After bulb develops, cool weather with ample moisture supply is required for flower stalk initiation. Then, drier conditions with good sunshine are required for seed maturity, harvesting and processing. 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 variety like Red Creole needs very low temperature and can not produce sufficient seeds like the other varieties in the CRV and similar areas.

High temperature during flowering also results in flower abortions and hence lower seed yield. So, selection of appropriate months in a given locality is crucial in onion seed production venture. Studies and experiences show that 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- in cooler and drier months. This is the best period for getting higher and quality seed yields. This is particularly true in the Central Rift Valley (CRV) areas where this experience was developed.

Rainfall: During flowering, seed development and maturity excessive rainfall and very cool condition is undesirable as they lead to disease development and poor seed setting. Good sun shine 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: light soil with good fertility and drainage and pH of 6.0-8.0 is preferred for onion production. Loam or clay loam soils are best suited for seed production.

Pollination: Onion is 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.

3. METHODS OF ONION SEED PRODUCTION

There are two methods of onion seed production. Seed to seed and bulb to seed method; both can be used in seed production. But the bulb to seed is the most commonly used method in Ethiopia. This method has a number of merits; options of selection of bulbs of good size, uniform, typical color, free from diseases and physical damages. It produces several stalks per bulbs hence gives higher seed yield. This is in conformity with CDMDP experiences where seed yields up to 20 qt/ha was obtained on farmer's field for the variety Bombay red. The method is also good to maintain the variety identity. However, in this method it 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 seed to seed method lacks the above mentioned merits. It also produces less flower stalk per bulb. But it takes 7-8 months to produce seed.

This manual describes in detail onion seed production using the bulb to seed method.

4. BULB TO SEED METHOD OF ONION SEED PRODUCTION

4.1 MOTHER BULB PRODUCTION

4.1.1 NURSERY MANAGEMENT

The following recommended practices should be followed in preparing beds and raising good quality seedlings.

Nursery site: site should be near water and with good soil condition, not planted with crops like onion, garlic, tomato etc in the previous two seasons.

Seed bed: soil should be well prepared and seed bed be leveled; bed size to be of 1m width x5m length (most commonly used bed size). Bed size can also be of 1mx10m. Types of bed can be raised, flat or sunken bed depending on soil type and moisture condition of an area. Raised bed is the most commonly used in CRV areas as it avoids risks of bed over moistening.

Seed treatment: treating onion seed with fungicide like Apron Star is recommended particularly in CRV areas to avoid fungal diseases like damping off.

Seed rate: 80-100gm/1mx5m bed (for seeds >90% germination), 3.5-4 kg/ha.

Spacing: seeds are drilled on the rows opened at 10cm space and 0.5-1cm depth against the bed length and slightly covered with soil.

Fertilizer: 100 gm Urea per bed (1mx5m) or manure should be applied during sowing.

Bed covering/Mulching: bed should be covered with grass (dry) at 3-5cm thickness; green or non dried grass and broad leaved materials should never be used to cover the beds.

Grass cover removal: the grass cover is removed when seedlings emerge; best time is in the morning or late afternoon.

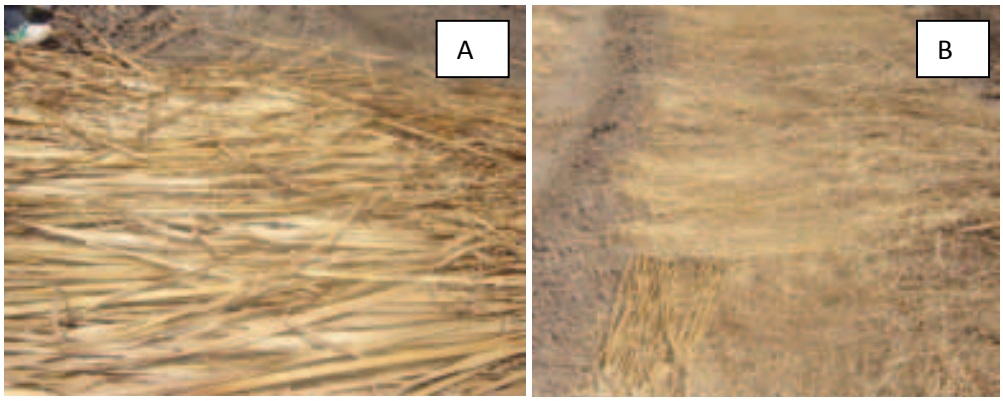

Figure 1. Inappropriate-broad leaved (A) and appropriate-dry grass (B) for covering seed beds

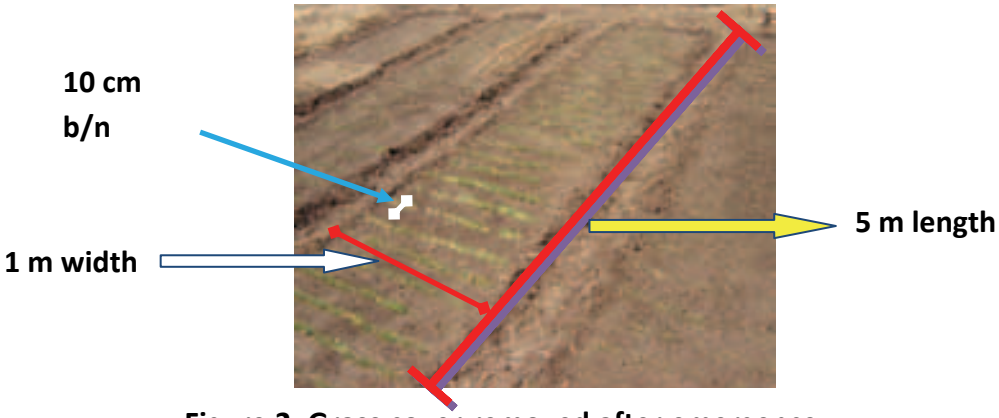

Figure 2. Grass cover removed after emergence on raised beds, 1mx5m

Bed Irrigation: the bed should be irrigated with watering-can in the morning or afternoon from sowing until two weeks after seedling emergence, then if possible better to continue same till transplanting or use furrow irrigation with care.

Pest control: better to apply registered fungicides like Ridomil Gold within 3-4 days after grass cover removal, then after fungicides/insecticides application depends on disease or insect appearance.

4.1.2 PRECONDITIONS AND TRANSPLANTING OF SEEDLINGS

The following preparations and practices should be followed for transplanting seedlings from seed bed to fields.

Seedling stage: Age of the seedlings is important for establishment and higher final bulb yield. Seedlings are ready for transplanting at 45-55 days after sowing or when 3-4 true leaves emerge; this is just before bulb formation starts (Figure 3). 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.

Figure 3. Good qualities, disease free seedlings on raised beds and ready for transplant

Bed irrigation: irrigate slightly seedling bed before uprooting for transplanting to avoid damage to seedlings.

Trimming: root or shoot trimming is not recommended when seedling is transplanted at the appropriate stage. The practice reduces the final bulb yield. Producers usually trim shoots when it gets older and taller, and also lightly trim roots to facilitate planting operation (Figure 4). If practiced better to trim shoots part only or root parts very lightly; not good to trim both at one time as it reduces yield significantly.

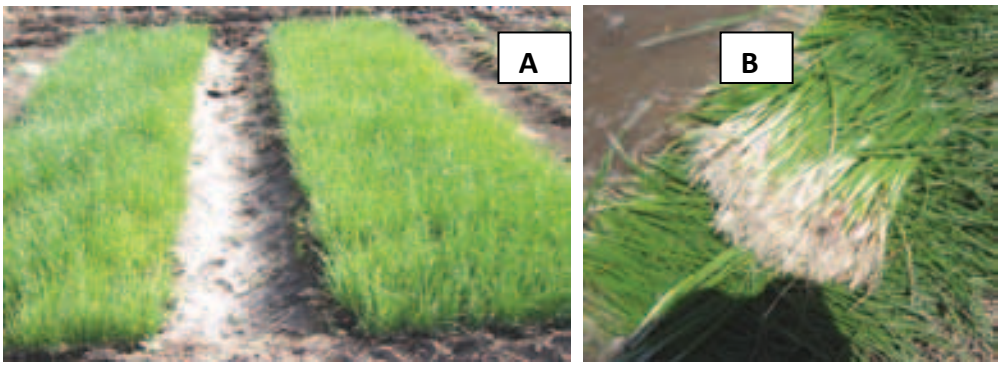

Figure 4. Lightly irrigated beds before uprooting (A) and lightly trimmed seedlings (B)

Furrow/ridge preparation: the field should be prepared well and furrows opened at 40 cm distance including ridge (Figure 5).

Field pre-irrigation: better to irrigate the ridges/field just immediately before transplanting to facilitate planting operation and reduce seedling damage.

Transplanting/spacing: This depends up on the variety. For the variety **Bombay red**, strong and healthy seedlings selected is planted at 5 cm space between plants on the rows and 20 cm space between the two rows on a ridge while for variety **Adama red** the spacing between plants should be 6-8cm. It is better to transplant in the morning or in the afternoon for better establishment.

Fertilization: The rate depends on the soil fertility of an area. 200 kg DAP all at transplanting and 100 kg Urea in split, half at transplanting and the other half at 30-45 days after transplanting is recommended for CRV areas on sandy loam soil.

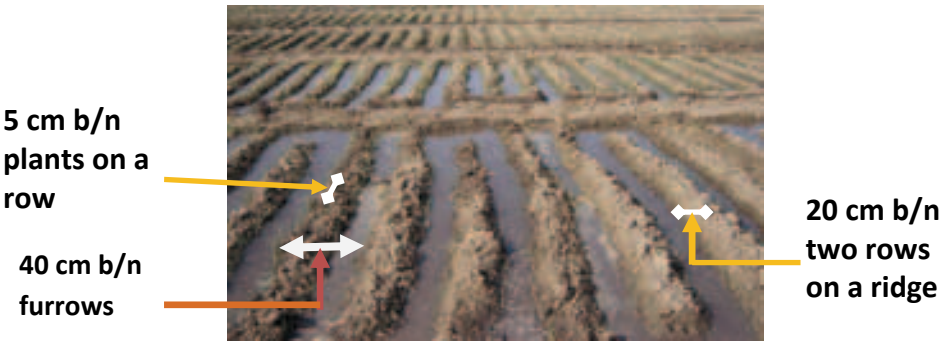

Figure 5. Ridges preparation and field pre-irrigation before transplanting

4.1.3 CROP MANAGEMENT AFTER TRANSPLANTING

Different management practices are followed in the field for the production of quality and higher bulb yield.

Irrigation: Amount and frequency of irrigation varies with soil type, climatic condition and stage of the crop. Some light irrigation is necessary

on same day immediately after field transplanting. Then field should be irrigated every 4-5 days for the first one month on light soils for good establishment, and then after can be irrigated every 5-7 days until maturity. It should not be over irrigated and as well stressed; both could dramatically reduce bulb yield.

Weeding/Cultivation: onion is susceptible to weeds and should be free from weeds during the first 60 days (especially between 21-60 days) after transplanting. Hence, 2-3 cultivation is needed; the first is 21-30 days after transplanting, second 45-55 days and the third weeding as necessary.

Protection: It is critical for production of disease free, quality and higher bulb yields (Figure 6). The most common disease of onion is purple blotch and downy mildew, which are mainly severe during rainy season and under moist conditions. The first measure is to follow appropriate cultural practices including production during meher season and crop rotation with non related crops to reduce pest buildup. The other is use of chemical control measures. Commonly used fungicides like Ridomil gold, Agrolaxyl or mancozeb can be used against these diseases. The main insect pest attacking onion is onion thrips. When the insect appears it is better to insecticides like selecron which is the most common and effective chemical at the moment. Pesticides should be used at appropriate rate for effective control of pest in target and also to reduce likely development of resistance pests (See table in appendices for the rates).

Figure 6. Disease free and quality onion bulb productions

4.1.4 MOTHER BULB HARVESTING, SELECTION AND STORAGE

There are preconditions and practices to be followed during onion bulb harvesting to storage.

Maturity: bulbs are ready for harvest when greater than 75 % of necks falls/bends down.

Bulb harvesting and curing: irrigating the fields should be stopped 2 weeks before bulb harvest. The matured bulbs are harvested with its necks attached and put under shade for about three - four days to dry/cure and then necks are cut at 2cm height from the bulb (Figure 7, 8).

Figure 7. Cutting necks from bulb after curing

Figure 8. Appropriate cutting height of neck from bulb

Bulb selection: 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. Bulbs which are white, damaged, twins/ split and very large are discarded (Figure 9, 10).

Bulb storage: Store the selected bulb for at least 15 – 30 days in aerated or ventilated storage for good germination (Figure 11).

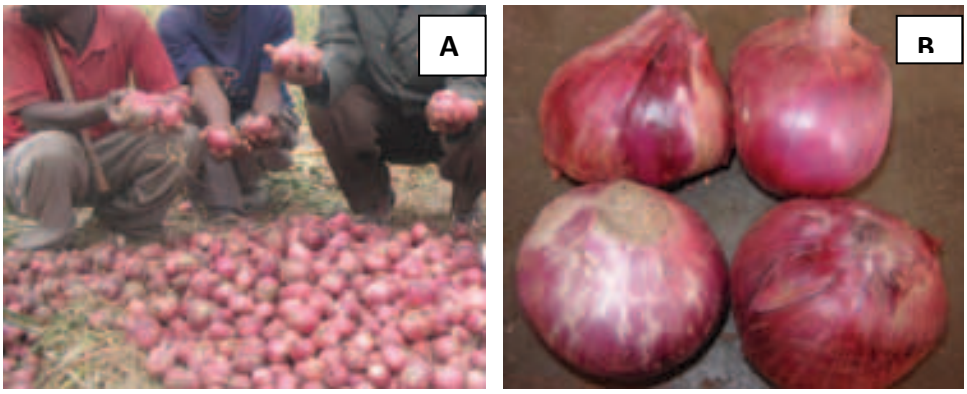

Figure 9. Bulb selection (A) and large bulb rejected (B)

Figure 10. Bulbs rejected- split (A), and whitish (B) bulbs

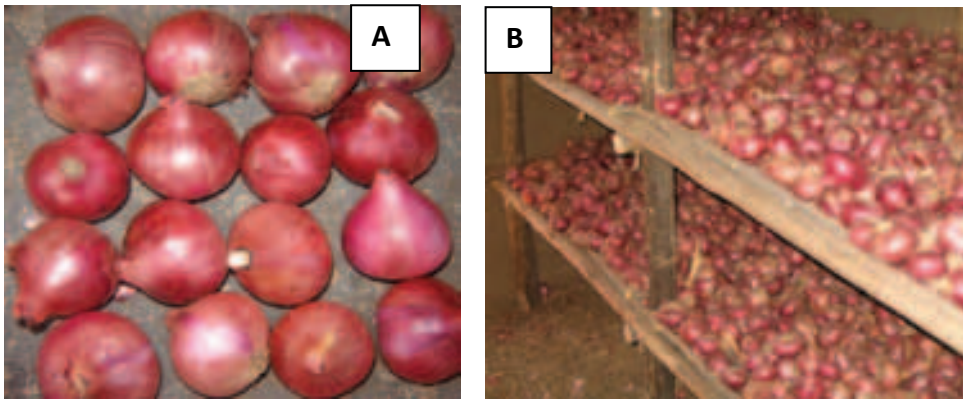

Figure 11. Quality and true to type bulbs selected (A) and stored under good storage condition (B)

4.2 TRUE SEED PRODUCTION

The bulbs produced during June-September months are used for onion seed production. The seed yield and quality depend on the technologies followed during the true seed production.

Bulb planting time: for true seed production bulb planting should be done during September to October months for flowering to take place between ends of December to early February. All the environmental factors required for seed production will be there for bulbs planted during September to October months. Can also be planted in November and December months but seed yield is reduced dramatically.

Isolation: Onion is cross pollinated crop; seed field be isolated from other flowering type of onions by 500 – 1000 meters to avoid cross pollination by insects. Time isolation can also be used whenever possible. For bulb production 5-10 meters is required.

Land preparation: the land be ploughed at least three times, the field be prepared well and ridges be made at 50 cm furrow distance including ridge.

Planting/spacing: can be planted in double row or single row per ridge. In double row, mother bulbs are planted at 30 cm space between rows on a ridge and 20cm between plants on a row; this gives higher yield. Producers mostly use single row per ridge with a similar spacing (i.e. 50cm between rows and 20cm between plants) for ease of weeding and pesticides applications. However, when single row per ridge with similar spacing is used there is yield reduction that producers incur.

Fertilizer: Cautions must be taken when deciding the rate of fertilizer application. If the soil of an area is poor in fertility, generally 200-250 kg DAP all applied at planting and 100-150 kg Urea in split; half at planting and the other half a month after emergence. Also, the rate for bulb production can be used depending on soil fertility of an area.

Irrigation: the field should be irrigated three days after planting to facilitate for easy germination of bulbs. Then 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.

Weeding: weeding frequency for seed production is similar to practice for bulb production. However, care should be taken during flowering as weeding at this stage damages flower stalk. Hence filed should be free from weeds just before flowering.

Pest control in onion: pest control is very critical in seed production unlike bulb production. Once a flower stalk is attacked no revival is expected, hence complete loss of the stalk. Prevention is more important than application after pest attack. Careful monitoring of fields and early detection and control of pests is crucial for healthy flower production and higher seed yield (Figure 16).

Purple blotch and downy mildew are the two most important disease of onion in CRV areas. Purple blotch is the major production constraint of onion wherever the crop is grown (Figure 12). It is number one problem of onion in central rift valley areas than the others. The disease is favored by frequent rainfall and high humidity during the active growth stages of the crop. While, downy mildew of onion is a major and widespread problem of onion in areas with high and frequent rainfall (Figure 13). There other important disease is bulb rot of onion (Figure 14) which is highly pronounced in areas with high rainfall, humidity and excessive soil moisture and not common under irrigation. The later two are less problematic in the CRV areas.

Control measures includes, use of disease free seeds/seedlings, crop rotation, seed treatment (Apron star), and application of registered fungicide (Ridomil Gold, Agrolaxyl, Mancozeb) (see Appendix B).

Thrips (*Thrips tabaci*) is the only economically important insect pest of onion (Figure 15). It is the most common during dry months. Insecticides are commonly used to control thrips. Currently, effective insecticide in Ethiopia includes selecron and karate, even if resistance is being developed to the later. Besides the use of chemicals, cultural practices like plowing and crop rotation are useful tools to combat thrips. Better to plough fields immediately after harvesting to eliminate resting sites for the pest. Also, rotating fields with unrelated crops reduces buildup of insects.

Figure 12. Symptom of Purple blotch (*Alternaria porri*) on onion

Figure 13. Early damage symptom of downy mildew (*Peronospors destructor*) on onion

Figure 14. Symptom of bulb rot (*Sclerotium cepivorum*) on onion

Figure 15. Onion thrips (*Thrips tabaci*) and its damage symptom on onion leaves

Figure 16. Quality onion seed production field, protected from diseases and insects, Sheled 2009

Pollination: onion is pollinated by insects like honeybees (Figure 17). Insecticides should not be applied during the noon time when the beneficial insect activity is high; so it should be applied during the time when there are no movements of insects.

Figure 17. Flowering onion pollinated by honey bees during the noon time, Sheled 2009

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 stat 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 should be supported in the palm of hand and held between the fingers to avoid seed shattering (Figure 18).

Figure 18. A mature umbel ready for harvest

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 (Figure 19).

Figure 19. Drying of the seed umbels under shade

Seed extraction: The seeds must be properly separated from the umbels. While seed extraction there should not be any damage to seed. Seeds can be threshed by mowing or rubbing of dried umbels and then cleaning the seeds by winnowing followed by pure seed separation by floatation.

- The dry umbels are gently mowed and winnowed to separate the seeds from chaffs (Figure 20).

Figure 20. Mowing and winnowing of umbels

- The winnowed and unclean seed be put in a bucket and soaked with clean water and left for 3-5 minutes in the water (Figure 21).

Figure 21. Soaking of seed with clean water

- Then pure seed be separated from light seeds and other trashes based on their weight after 3-5 minutes soaking; heavy seeds sinks and poor quality seeds and chaffs floats (Figure 22).

Figure 22. Separating clean seeds from light seeds and chaffs

Seed drying: the pure seed settled in a container should be taken immediately and dried under the morning and late afternoon sun or under shade for 3-4 days; should not be dried in the sun during noon the time.

Seed Storage: Dried seed should be stored in porous materials such as cloth or paper bags or similar materials in dry and aerated conditions at 7-9 % moisture. Do not store in plastic bags for long time. The seed moisture could significantly affect seed quality. If seed moisture content is high, normally it loses its viability at faster rate.

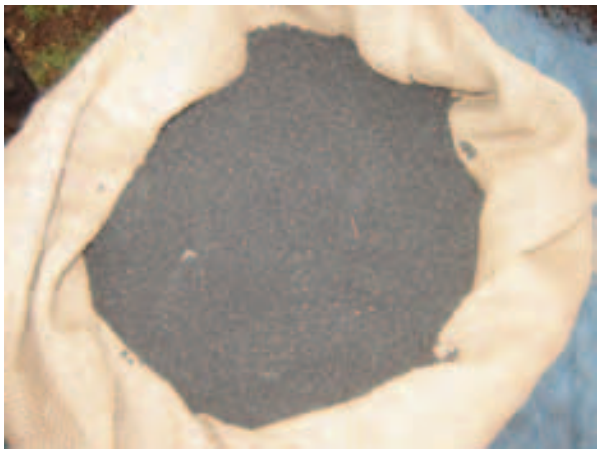

Figure 23. Seed stored in a sack

5. SEED QUALITY INSPECTION AND TIMINGS

Seed quality inspection is being done in many stages. It starts from verifying whether seeds were obtained from authenticated source, verification of isolation distance and inspection during planting, flowering, harvesting, processing and bagging. Only those seeds harvested from fields having prescribed field standards and possessing and met required seed standards (see Table 1) are certified by the Certification Agency. For individual onion seed growers, an application for field inspection should be sent to seed certification agency (like the Asella seed laboratory in Oromia) before the start of the season. The application should have details on the seed grower, field, variety of onion, seed/bulb origin (like MARC), class of seed (basic, C1, C2 and C3), amount of seed and area to be planted. Seeds thus certified based on these results are offered for sales. However, up to know there is no practice of vegetable seeds certification including onion as there are no formal seed supplying agent. The CDMDP has linked the seed producing farmers to the seed quality control laboratory in Asella, and supervision and quality control is being practiced on the seed producing farmers' fields.

Field inspection is done at mother bulb production and seed production stage.

(a) **Mother bulb production stage**: A minimum of one inspection shall be made; the inspection shall be made during the bulbs lifting to verify the true to type ness.

b) **True seed production stage;** A minimum of two inspections shall be made as follows; At planting for isolation, volunteer plants, off types including bolters; the second inspection is at flowering to check the off type

etc . Finally the seed samples will be taken to test physiological and analytical purity.

Table 1. Seed standard for onion seed production (FAO quality declared seed standards)

Factor	Standard
Pure seed (varietal purity)	98%
Analytical purity	97%
Other crop seed(maximum)	2%
Weed seed	Reasonably free from weeds
Germination (minimum)	60%
Moisture (maximum)	8%

Source: FAO, 2006

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APPENDICES

Appendix A Recommended/released onion varieties for production in Ethiopia

Onion Cultivar	Maturity days	Bulb color	Bulb shape	Bulb size (gm)	Bulb yield (qt/ha)*	Seed yield, qt/ha*
Adama Red	120-135	Dark red	Flat globe	65-80	350	10-13
Red Creole	130-140	Light red		60-70	300	2-6
Bombay Red	90-110	Light red	Flat globe	70-80	300-400	13-20
Melkam	130-142	Red	High globe	85-100	400	11-15
Dereselegne	100-115	Red	Globe	85-100	380	-

Source: Adapted from Lemma Desalegn and Shimelis Aklilu (2003), * Yield includes research station and farmers field report.

Appendix B Descriptions and dosage of commonly used chemicals against major disease and insect pests of onion in Ethiopia

Name of pesticides	Pests	Remarks
Fungicides	**Disease**	
Ridomil Gold 68WP	Purple blotch, (*Alternaria porri*) Downy mildew (*Perenosporus destractor*)	Spray Ridomil at 2.5 kg/ha= 10gm/15 lit water, 1 full match box = 10gm
Agrolaxyl (contains mancozeb and methlaxyl)	Purple blotch, (*Alternaria porri*) Downy mildew (*Perenosporus destractor*)	Spray Agrolaxyl at 3 kg/ha= 15 gm/15 lit water
Apron star	Damping- off	Seed treatment before planting, 250gm/100kg seeds
Insecticide	**Insects**	
Dimethiote	Thrips (*Thrips tabaci*)	Spray dimethiote at 20 ml/15 lit water
Selecron	Thrips (*Thrips tabaci*)	Spray Selecron at 15ml/15 lit water
Karate	Thrips	Spray 200-400ml/ha, but these days thrips is resisting this chemical

Flow Chart for onion seed production

Bulb to seed method