CHAPTER 8

PROCEDURE FOR QUALITY CONTROL OF ONION SEED AND BULB PRODUCTION IN SRI LANKA

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Abstract

Local production of onion (*Allium cepa* L.) is insufficient to achieve self-sufficiency. Unavailability of good quality seeds of recommended big onion varieties is a major constraint for increasing the productivity. The requirement of quality true seed of big onion and sets of red onion were 27,450 kg and 6,908 mt, respectively in 2013. In 2014, Government has spent about Rs. 103 million to import 20,597 kg onion seeds. Due to the demand for onion seeds and export restrictions in India, the quality of imported big onion true seeds is not up to the standard. Therefore, seed quality control through seed certification has become a prime requirement in the country. Seed certification on onion has been implemented after the release of red onion variety Thirunelvely Red and big onion varieties Dambulla Selection and MIBO 1 by Department of Agriculture. Registering under seed certification service and obtaining its service throughout the production period and use of farmer's own quality assurance system after registering under Seed Act by establishing the seed crop using basic seeds are two methods that can be adopted by farmers for the quality assurance of onion seeds.

Introduction

Red onion and big onion are the most important bulbous crops grown in Sri Lanka and essential food item consumed mainly as spice due to their flavour and pungency. The annual requirement of big onion in Sri Lanka is around 309,000 mt assuming annual per capita consumption of about 10 kg whereas annual requirement of red onion is around 70,000 mt. However, local production is insufficient to achieve the self-sufficiency of big onion (SEPC, 2013). The average

big onion extent, production and seed requirement during 2000 to 2013 have been recorded as 4,460 ha, 67,004 mt, 28,990 kg, respectively and the production accounts for 31% of the national requirement. The highest extent of 6,988 ha and production of 92,167 mt has been recorded in 2007. Similarly, the average red onion extent, production and seed requirement during the same period have been reported as 4,680 ha, 52,715 mt and 7,019 mt, respectively where the highest extent of 6,228 ha and production of 72,339 mt have been recorded in 2006 and 2010, respectively.

The use of quality seed helps in achieving higher productivity and also plays a primary role to derive the full potential of all inputs such as fertilizer, agro-chemicals and irrigation water. In general, it is estimated that the direct contribution of quality seed alone to the total production is about 15-20% and it can be further raised up to 45% with efficient management of other inputs (Poonia, 2013).

Unavailability of good quality seeds of recommended big onion varieties is a major constraint for increasing its productivity (Mettananda, 2006; Hewavitharane *et al.*, 2010). Seed material (seed sets or true seeds) must be available during the cropping period and they should be of high vigour and free from seed borne diseases (Sumanarathne *et al.*, 2002). During 2013, based on seed rate of 6.5 kg/ha of true big onion seeds and sets at 1.5 mt/ha of red onion, the requirement of quality true seed and sets were 27,450 kg and 6,908 mt, respectively. Red onion seed (sets) requirement has been met mainly from local production and big onion seed requirement by farmers own seed or imported seeds (Table 1). However, the quality of the imported big onion true seeds is not up to the standard as they reach the country through illegal routes due to export restrictions in India (Edirimanna, 2003). Thus, setting of quality control system for onion seeds and bulbs is a prime requirement for achieving self-sufficiency.

Onion Seed Production and Importation

Local big onion seed production began in early 1980's by few farmers in Matale district in the Central province. Later, during both *maha* and *yala* seasons, the cultivation expanded as it became a very profitable business as seeds fetch

around Rs. 12,000-15,000/kg. Matale district is the major big onion seed producer in the country (Tables 2 and 3).

Table 1: Big onion and red onion true seed imports - 2007 to 2014.

Year	Red onion			Big onion		
	Companies (Number)	Varieties (number)	Quantity (kg)	Companies (number)	Varieties (Number)	Quantity (kg)
2007	-	-	-	6	8	41,494
2008	-	-	-	9	8	32,097
2009	-	-	-	7	6	21,639
2010	-	-	-	7	5	38,210
2011	-	-	-	3	2	8,968
2012	-	-	-	6	4	23,113
2013	1	1	600	2	5	7,500
2014	2	1	1,200	6	3	20,597

Source: SEPC, 2013

Other districts such as Anuradhapura, Polonnaruwa, Kurunegala, Kandy, Mahawali areas, a few private sector organizations, government seed farms under Seed and Planting Materials Development Centre (SPMDC), Agrarian Service Department are also involved in producing substantial amount of big onion seeds. The rest of the big onion seed requirement is met by importing seeds from India. A decreasing trend of importation of big onion seed was observed during 2007 to 2014 (Table 1). The red onion true seed importation started by importing 600 kg from India in 2013 which doubled in 2014. The balance planting material requirement of red onion was met from local bulb (setts) production and small amount of true seed produced locally. Big onion seed crops established by SPMDC were certified by Seed Certification Service (SCS; SEPC, 2013) and while own certification was done for seed crops managed by private sector. The other seed producers can be categorized as informal or own seed producers without registering under the Seed Act of Sri Lanka.

Table 2: Big onion seed production in *maha* season in Matale district.

Season	No. of farmers	Amount of mother bulbs planted (kg)	Seed yield (kg)	Selling price (Rs.)	Value (Rs. million)
1984/85	4	60	3		
1992/93	45	1,800	105		
1995/96	118	3,636	202		
2000/01	152	8,000	345		
2001/02	257	9,301	370		
2002/03	247	10,478	430		
2003/04	207	10,000	553		
2004/05	205	12,378	857		
2005/06	379	25,480	1,300	5,000	6.5
2006/07	500	30,000	1,725	7,500	13
2007/08	671	48,468	1,132	7,500	8.5
2008/09	750	55,000	4,183	9,000	38
2009/10	1,000	61,000	4,500	9,500	43
2010/11	1,200	93,850	3,500	12,000	42
2011/12	1,500	120,000	11,600	12,000	139.2
2012/13	1,500	125,000	9,000	12,000	108
2013/14	1,700	117,910*	11,822	15,000	177.3

*Amount of vernalized (108,530 kg) and non vernalized mother bulbs in 2013/14 *maha*

Seed Quality Control

The farmers must be provided with an assurance on good quality seed and planting material to obtain a high yield. Considering the quality, the most important parameters are genetic, physical, physiological and seed health attributes, which ultimately determine the value of seeds and planting materials. Seed certification is a legally sanctioned system for quality control of seed and planting materials production and distribution (SCS, 1985).

Table 3: Big onion seed production in *yala* season in Matale district.

Season	Farmers (number)	Amount of mother bulbs planted (kg)	Seed yield (kg)	Seed selling price (Rs.)	Value (Rs. million)
2001	7	113	4.7		-
2002	11	1,805	71.5		-
2003	15	1,955	66		-
2004	30	2,000	65		-
2005	34	2,900	163	5,000	0.8
2006	51	5,000	522	7,500	4.0
2007	60	9,043	925	7,500	7.0
2008	113	8,036	1,083	9,000	8.2
2009	170	21,940	2,225	9,000	20.1
2010	250	29,000	3,000	9,500	28.5
2011	300	22,000	2,600	12,000	31.2
2012	350	60,000	6,043	12,000	72.5
2013	350	55,000	4,185	15,000	62.8
2014	355	56,000			

History of Seed Testing in Sri Lanka

In 1956, seed paddy was tested for varietal purity and germination. In 1958, generation system of seed multiplication began after the release of rice variety H_4. This led to the launching of systematically designed seed paddy program with the help of government seed farms and private seed growers. As a result, in 1958, the government improved its seed testing facilities with the assistance from the international co-operative administration of USA by establishing a seed testing laboratory at the Royal Botanical Gardens, Peradeniya. In 1968, seed testing was expanded to include vegetables and other field crops (OFC) seeds. In 1970, a new seed laboratory was established with modern facilities at Gannoruwa with the help of Australian Methodist Church. This process led to gain membership of International Seed Testing Association (ISTA) in 1974.

In 1977, a seed laboratory at MahaIlluppallama was established and independent Seed Certification Service (SCS) was commenced in 1978 under assistance from the Government of the Netherlands. Subsequently, two more seed laboratories were established at Alutharama and Bataatha in 2000 to fulfil growing demand for seed testing services both from the government and the private sector. All seed laboratories in Sri Lanka follow the rules of the ISTA. In 1985, the Peradeniya seed laboratory became an ISTA accredited laboratory with the right to issue international orange certificates after achieving the international recognition of seed testing activities (DOA, 2013b). This facility is not available at present.

SCS was organized into six major sub sections covering, field inspectorate (seed grower registration, seed crop inspections and seed farmer training, post-harvest supervision, sampling of seed for lab testing and post control testing, labelling and sealing of seed lots, inspection and sampling of imported seeds, implementation of Seed Act activities, follow up on complains regarding seeds and planting materials etc.), seed testing (varietal purity, physical purity, moisture content, germination, seed health testing etc.), variety and post control (characterization of DOA varieties, testing of promising varieties for Distinctness, Uniformity and Stability [DUS test] prior to release, post control testing [grow out], and trueness to label testing), fruit plant registration, seed research (established in 2012 to test seed samples for the presence of seed borne pathogens and find-out solutions for seed and planting material related problems) and Seed Act (established in 2008 to implement Seed Act No. 22 of 2003 which stipulated that seed should confirm to a minimum level of genetic and physical purity and compulsory labelling with required information) to carry out its duties more efficiently and effectively.

Formal seed certification for seed paddy was begun in 1980. Later, these services were expanded to OFC in 1983, vegetable in 1984, seed potato in 1987 and other planting materials in 1990. The legal status of the SCS is covered under Seed Act No. 22 of 2003. Altogether, 32 units (24 SCS regional units, four seed testing laboratories and four post control units) are operated under SCS and scattered throughout the country and is under the Seed Certification and Plant Protection Centre, Department of Agriculture. Initiation of a regional office at Mulathivu, seed testing

laboratory at Paranthan and two post control fields at Bataata and Karadiyanaru are planned (DOA, 2013a).

Onion Varieties

Until release of Thirunelvely Red in 2009 for the Northern region of the island by the Department of Agriculture, there were no locally released varieties of red onion (DOA, 2009a). However, there are several popular cultivars such as Vethalan, Jaffna Local, Thellula Selection used in Sri Lanka (DOA, 2013b). Vethalan and Jaffna Local varieties are widely grown an additional advantage of Vethalan is that it produces flowers and sets seeds after vernalization under local conditions, thus true seed production of red onion is feasible in Sri Lanka (DOA, 2014).

There are several introductions (eg. Pusa Red, Rampur, Bomby Red, Agrifound Light Red, Nasik Red) and cultivars selected from introductions by big onion farmers eg. Dambulla Red and Galewela Light Red from Pusa Red and Agrifound Light Red which are popular among farmers. Locally developed big onion varieties, Kalpitiya Selection, Dambulla Selection (DOA, 2009a) and MIBO 1 (DOA, 2014) were released in 1992, 2009 and 2014, respectively. Even before the releases of varieties, some farmers have been producing true seeds using introduced cultivars in Dambulla area (MASL, 2009). Later, the onion true seed production became popular and private sector companies and producers entered into this profitable business.

Certification of Onion Seed

In 2009, seed certification procedure for onion was developed and implemented for DOA recommended varieties, mainly in the Government seed farms. For certification procedure, one of the two methods can be adopted. The first method is registering under SCS and obtaining SCS service throughout the production process. The second method is using own quality assurance system after registering under Seed Act by establishing the seed crop using basic seeds.

Farmer demand for locally produced true seeds of onion is very high and the demand is expected to grow rapidly. However, farmers are following their own seed certification procedure with a help from extension staff of DOA to produce their own

seeds. Onion is a biannual, predominantly cross-fertilizing, in which a strong inbreeding depression is present (Masayoshi and Chris, 2002). Therefore, a practical and appropriate quality control system is a necessity.

Certification Methodology for Onion

The main objective of the seed certification of onion is to ensure the acceptable standards of genetic, physical, physiological attributes and seed health.

Eligibility Requirement for Onion Seed Certification

General requirement of the variety

Full certification can be done only for the varieties released by the DOA. Presently, one variety of red onion (Thirunelvely Red) and two varieties of big onion (MI BO 01 and Dambulla Selection) are eligible for full certification. However, some exemptions are given for farmer varieties for testing seed in seed laboratories of DOA as listed below.

- Producer should purchase certified basic mother bulbs or true seeds from authorized sources (from SPMDC in the DOA).
- Producer shall make a request within 2 weeks of planting for registration. Origin of the material used for planting shall be confirmed by providing seed labels.

Methods of seed production and seed classes

Onion is biennial crop and takes two full seasons for producing seeds. Bulbs are formed during first year and flower and fruiting take place in the second year. There are two methods of true seed production: (i) seed to seed and (ii) bulb to seed methods. However, in Sri Lanka, only bulb to seed method is used for seed production. Production cycle and seed classes of onion are given blow.

- Mother bulbs are obtained from planting of true seeds and the next generation true seeds are obtained from the planting of these mother bulbs or *vice versa*.
- There are five seed classes (Nucleus, Breeder or Pre basic, Basic, Standard and Commercial) of setts or true seed for red onion planting materials in the seed multiplication process.

1. Nucleus seed is produced by the breeder and it is genetically pure seed.
2. Breeder seed (pre-basic seed) is produced by the breeder from breeder bulbs produced from Nucleus seeds and certified by the SCS. Tag with pink colour design in white background is affixed by the SCS.
3. Basic seed is produced at the government seed farms of the SPMDC by using basic bulbs produced from breeder seeds under the supervision of SCS. Tag with brown colour design in white background is affixed by the SCS.
4. Standard seed is produced at the government seed farms or by contract growers of the SPMDC or private sector by using standard bulbs produced from basic seeds under the supervision of SCS. Tag with yellow colour design in white background is affixed by the SCS or label approved under Seed Act by the private producers.
5. Commercial seed is produced mainly with contract growers of the SPMDC or private sector by using certified bulbs produced from standard seeds under the supervision of SCS or producers own certification. Tag with light green colour design in white back ground is affixed by the SCS while label approved under Seed Act is affixed by the private producers.

Land requirement and isolation

Land to be used for onion seed or bulb production should free from volunteer plants. There should be a minimum extent of 100 m^2 while maintaining required isolation distance as specified in Table 4.

Table 4: Minimum isolation distance (m) required for onion seed production

Mother bulb production stage - bulb crop (m)				True seed production stage - seed crop (m)			
Breeder	**Basic**	**Standard**	**Commercial**	**Breeder**	**Basic**	**Standard**	**Commercial**
5	5	5	5	1,000	1,000	500	500

Field Inspections

Usually seed quality inspections are done in several stages as indicated below.

a) Seeding to mother bulb production

- First inspection at seedling stage
- Second inspection at bulb initiation
- Third inspection at bulb maturity

Minimum of two inspections shall be done and rouging of off-types *viz.* those having different shapes, colours, maturity durations of plants, leaves and bulbs.

b) Final inspection at harvesting stage

Minimum of two inspections shall be done with rouging of off-types. Leaves and bulbs of those having different shapes, colours, maturity durations should be removed. Rough estimate of bulb yield should be mentioned in the final report.
Awareness should be given to the producers on post-harvest activities on mother bulb harvesting and storage such as stopping irrigation two weeks before harvesting and harvesting should be done at proper stage.

After harvesting and selecting mother bulbs according to the criteria given in Table 5, SCS officer shall complete a lot inspection report (including the weight of the bulbs) before sending bulbs for vernalization.

Table 5: Standards for mother bulbs.

Bulb part	Character	
	Character for big onion	**Character for red onion**
Neck	Slender and sealed	Slender and sealed
Diameter of the widest part of the bulb (cm)	4.0 to 5.0	Medium and large size bulbs
Weight (g)	60 to 80	
Maturity	Well matured, single centre	Well matured

Bulb to Seed (Production of True Seeds from Mother Bulbs)

Producer shall make a request for registration within 2 weeks of planting.

1 Registration – Following requirements shall be fulfilled for registration and a fee of Rs. 400/= shall be paid.

a. Requirements for registration

i. Origin of the material used for planting shall be confirmed by providing lot inspection report.
ii. Minimum extent should be 100 m^2
iii. Bulb requirement
    (i) Big onion 80.0 kg/100 m^2
    (ii) Red onion 17.5 kg/100 m^2

b. Isolation distance should be maintained as indicated in Table 4
c. Should have a good plant population
d. Free from pests and diseases

2 Field inspection

At least three field inspections should be made and off types present in the crop is removed to maintain the approved standard (Table 6)

a. 1st inspection should be done at seedling stage (vegetative stage)
b. 2nd inspection should be done at flowering stage
c. Final inspection should be done at maturity stage. At this stage, suitable inflorescences shall be selected for seed collection.

Table 6: Allowable off type for onion seed production.

Factor	Maximum permitted in each seed type (%)			
	Breeder	Basic	Standard	Commercial
Bulb not confirming to varietal characters	0.10 (by number)	0.20 (by number)	0.20 (by number)	0.30 (by number)
Off-types	0.10	0.20	0.20	0.20

3 Harvesting shall be done when 10-15% of the capsules on individual heads expose the black seed.

4 Post harvesting activities

a. Until seed separation, inflorescences shall be kept horizontally as a bunch
b. Inflorescences shall be dried in sunlight for few days
c. Seeds shall be separated manually or by machines.
d. Inert matter shall be separated using a slow speed fan
e. Seed shall be packed and stored in a refrigerator or cool and dry place

5 Sampling

a. Processed seed lot shall be inspected for its suitability for sampling.

b. Labelling and sealing the lot shall be done before sampling.
c. Representative seed sample from the sealed seed lot shall be taken.
d. The sample taken shall be submitted to the seed laboratory for testing. Seed testing standards are given in Table 7.

Table 7: Seed standards for onion seed.

Factor		Breeder	Basic	Standard	Commercial
Pure seed (minimum) (physical) (%)		98	98	98	97
Genetic purity (minimum) (%)		98	98	98	97
Inert matter (maximum) (%)		2	2	2	3
Germination	B. onion (%)	80	80	70	70
	R. onion (%)	80	80	70	70
Weed seed (maximum/kg)		5	5	5	5
Noxious weed seeds (number/kg)		0	0	0	0
Moisture (maximum) non moisture proof containers	B. onion (%)	9	9	9	9
	R. onion (%)	8	8	8	8
Moisture proof containers (%)		6	6	6	6

Self Quality Assurance System after Registering Under the Seed Act.

Under this procedure, producer shall register under the Seed Act with the DOA. The producer shall follow standards and procedures stipulated by the DOA for onion seed production and certification. The producer shall take responsibility for the quality parameters shown in the seed packet. Presently, only a small extent of onion has been certified by the seed certification service (Table 8). Hence, it is necessary to increase the certified extent to produce quality seeds to achieve higher productivity and increase the basic seed production. In red onion, about 2.53 ha of commercial seed class requested for seed certification in 2013.

Conclusions

Unavailability of good quality true seeds or setts of recommended varieties in adequate quantities is considered as the main constraint for increasing production

Table 8: Extent of certified big onion seed production - 2012 to 2014.

Year	Class	Registered extent (ha)	Inspected extent (ha)	Actual extent (ha)	Yield (kg)
2012	Commercial	0.6073	0.6073	0.6073	400
	Basic	0.4251	0.4251	0.4251	-
2013	Commercial	0.6478	0.6478	0.6478	44
	Basic (bulb)	0.4049	0.4049	0.4049	2,250
2014	Commercial	0.6073	0.6073	0.6073	450
	Basic	0.3036	0.3036	0.3036	105
	Breeder (bulb)	0.4049	0.4049	0.4049	4,600

of big onion and red onion in Sri Lanka. Presently, few varieties have been released by the DOA for general cultivation. Certified quality seed or planting materials of such varieties with high physical purity assures farmers against the introduction of seed borne diseases, weeds or other crop seeds which could reduce productivity and lower seed quality. In order to achieve this objective, the onion seed producers should maintain the quality standard either by obtaining service from SCS or their own certification system. This will lead to achieve continuous supply of quality seed or propagating materials of recommended onion varieties for farmers. It also helps to avoid unnecessary losses in yields from planting seed or planting materials of unknown origin or contaminated varieties.

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