RESEARCH STRATEGY FOR ONION PRODUCTION

K.A. Mettananda and V. Arulnandhy
Research Officer and Coordinator (Condiments)
Regional Agricultural Research Station
Maha Illuppallama

ABSTRACT

Onion (Allium cepa L.), consumed as a vegetable in western countries, is used as a spice in many countries of Asia, including Sri Lanka. Several constraints prevent farmers in Sri Lanka from obtaining high onion yields. This paper focuses on production constraints and research priorities, while providing research results which could lead to the formulation of strategies to expand onion production and extend its availability throughout the year.

INTRODUCTION

Onion (Allium cepa L.) is consumed as a vegetable in western countries and as a spice in many countries of Asia. In Sri Lanka, it is an important spice in the daily diet. Since its nutritional value is low (Table 1), its main appeal is in its flavor and pungency. Its pungency is due to a volatile oil known as allyl-propyl-disulphide.

Red (small) onions and big onions are the most important types grown in Sri Lanka. Both types are highly profitable cash crops in the Dry Zone (Table 2).

The local production of red and big onion combined is sufficient for the country's needs, although off-season shortages occur. Such shortages are due mainly to poor storage and inadequate post-harvest technology. Onions are imported to make up the shortfall, using a substantial amount of foreign exchange (Table 3).

The extent of big onion production has increased since 1980 but the average yield has remained static at about 10 mt/ha since 1983 (Table 4). The world average is 14 mt/ha (FAO, 1984). Sri Lanka's Dry Zone has the potential for yields as high as 40 mt/ha (1989 Annual Research Report, Agricultural Research Station, Maha Illuppallama).

Table 1. Average nutritive value of vegetables (per 100 g of edible portion).

Vegetable	Moisture (%)	Vit. A (mg)	Vit. C (mg)	Protein (g)	Iron (mg)	Calcium (mg)
Carrot	89.5	1627.0	10.3	1.0	2.1	36.0
Eggplant	92.0	83.0	11.8	1.4	0.7	6.6
Okra	88.1	11.7	7.9	1.5	2.1	107.6
Soybean	10.2	6.0	0.0	35.1	8.5	226.6
Tomato	94.1	111.0	23.4	0.9	0.5	17.0
Onion	88.6	0.1	9.0	1.6	1.0	30.0

Source: AVRDC, 1987

Table 2. Profit from production of big onions and other cash crops.

Crop	Profit (Rs/ha)
Big onion	134,750
Potato	117,600
Chilli	34,300
Small onion	36,750

Source: DOA, 1989

Table 3. Quantity (mt) and cost (Rs '000,000) of big onion imports.

Year	Quantity	Cost
1982	7390	44.0
1983	8180	56.4
1984	23780	155.2
1985	26698	198.3
1986	51254	439.0
1987	33927	379.4
1988	34604	350.0

Source: Customs report, 1989

Table 4. Extent, production and yield of big onion in Sri Lanka, 1980-1989.

Year	Extent (ha)	Production (mt)	Yield (mt/ha)
1980	27	230	8.52
1981	87	822	9.45
1982	156	1129	7.24
1983	217	2173	10.01
1984	279	2890	10.34
1985	172	2063	11.99
1986	504	5555	11.02
1987	421	4037	9.59
1988	607	6661	10.97
1989	900	9000	10.00

Source: DOA, 1989

Several factors are responsible for low onion yields. A research program on onion production is urgently needed in order to increase yields, particularly of big onion. Simple, appropriate technology packages acceptable to farmers should be developed. This paper identifies production constraints and research priorities, and provides research results on which strategies can be based to expand onion production and make it available throughout the year.

CROPPING PATTERN

Onions fit a wide range of climatic situations. However, the low country Dry Zone provides almost all of the crop's climatic needs. Well drained loamy soils are ideal, although any well drained soil is suitable if organic manure has been incorporated. The prime time for onion cultivation in the Dry Zone Lowland (DL_1) region is a 4-month period from late April to the end of August. They can also be grown in January with intensive spraying to control fungal diseases such as downy mildew and purple blotch. Small onions (red onions) are better suited to January planting than big onions. Major cropping patterns in the onion growing areas of Sri Lanka are rice - onion, other vegetables - onion, fallow - onion. In some regions an onion - onion pattern is followed mainly for small onions.

PRODUCTION CONSTRAINTS

Big onion, a new crop in Sri Lanka, has several production constraints; small onion has few constraints.

Big Onion

1. A lack of quality seed of high yielding varieties

   Success of big onion cultivation depends primarily on the availability of good quality seed. Several factors contribute to seed quality, the primary ones being varietal purity, viability and vigor, and absence of seed-borne diseases. An irregular supply of quality seed has also been a major constraint in big onion production.

2. Inadequate technical information available to growers

   The profit potential in big onion production encourages farmers to cultivate it. However, successful cultivation of this crop, which requires intensive care to produce high yields, depends entirely upon the use of appropriate technology. Most farmers get low yields because they are not familiar with this technology.

3. Seasonality

   Big onion can be grown successfully during the Yala season in the DL$_1$ region. Off-season cultivation usually results in low yields. Therefore, a year round supply is not possible unless proper storage facilities are available.

4. Nursery problems

   A major constraint which discourages many farmers from growing big onion is the intensive nursery management required.

5. Crop management

   Proper use of chemical fertilizers, pesticides and irrigation water are management problems to be considered in improving big onion yield.

6. Harvesting and storage

   Improper harvesting techniques reduce the keeping quality. Insufficient technical information on big onion storage is a constraint that should be overcome before expanding the extent under cultivation.

Small Onion

1. High cost of planting material

Seed bulbs are usually used to establish small onion. The planting rate is 1200-1700 kg/ha, depending on the variety. In 1989, the cost of planting material was about Rs 30,000/ha.

RESEARCH OBJECTIVES

Identification of Suitable Varieties

Since a major constraint to onion production is a lack of suitable varieties, the DOA's Research Division is continuing its effort to identify varieties which:

a) are well adapted to local conditions
b) produce good quality bulbs with high pungency and pink or red skin color
c) have good storability
d) are tolerant to pests and diseases.
e) can flower and set seed under local conditions

Development of Appropriate Management Technologies

The following major technologies need to be developed:

a) low cost nursery management
b) appropriate time of planting
c) correct plant spacings for different conditions
d) suitable fertilizer levels
e) pest and disease control measures
f) quantity and frequency of irrigation
g) the feasibility of intercropping to increase productivity

Harvesting

As quality, marketability and storability of big onion are largely determined by the stage and method of harvesting, one of our research objectives is to develop a package of practices for proper harvesting.

Storage

As onion production increases, long-term storage will be necessary to ensure a stable market and a year round supply. Therefore, our research program includes studies of methods for long-term storage with minimum losses.

Seed Production

To reduce dependency on foreign sources for seed, a program was started to identify varieties with high yield, high pungency, and good skin color. In addition, varieties will be selected for ability to flower and set seed under local conditions. Research on the production of good quality seed is also included in the program.

Seed Storage

Since there is rapid loss of seed viability under ambient conditions, studies are focusing on seed storage.

Small Onion

The high cost of establishing small onions by means of bulbs has prompted a program to promote the use of true seed. Therefore, one of the research objectives is to develop technology to improve true seed production of the variety Vethalan.

Identification of ways to reduce the planting rate of seed bulbs is another research objective for small onion.

RESEARCH HIGHLIGHTS

Big Onion

1. Identification of suitable varieties

   Varietal evaluation studies conducted at the Maha Illuppallama Regional Agricultural Research Station (RARC) and on farmers' fields have shown that Poona Red, Bombay Red, N-53 and Rampur are promising under local conditions. Kalpitiya 1, a local selection that ranked next to the above varieties has the important advantage setting seed under local conditions. After further selection for required characters, it is hoped that it will be released to farmers in the near future.

2. Nursery management technologies

   A complete low cost technology package has been developed for big onion nursery management. A study at the Maha Illuppallama RARC in Yala 1989 indicated that 0.5-1.5 cm is the optimum depth of sowing in the nursery in order to obtain the highest number of healthy seedlings (Table 5).

Table 5. Number of healthy seedlings obtained at various depths of seeding.

Depth of seeding (cm)	Average no. of healthy seedlings/0.5 m^2
0.0	416
0.5	1035
1.0	872
1.5	818
2.0	579

Source: K.A. Mettananda, 1989

Earlier research showed that seedling mortality due to fungal diseases caused mainly by Fusarium, Pythium and Sclerotium can be easily controlled by:

- Selecting a well drained open area for nursery establishment
- Disinfecting nursery soil by burning, solarization or chemical means
- Treating seed with a suitable fungicide before sowing
- Using a nursery cover during the first 2 weeks after seedling emergence to protect seedlings from the impact of heavy rains
- Applying suitable fungicides every 2 weeks as a precautionary measure

3. Dry set technology

Technology for production of dry sets from true seed has been developed. Dry sets can be used as planting material for a period of 5-6 months after they are harvested. Research carried out for several seasons showed that dry sets 1-2 cm in diameter are ideal for planting in order to obtain high yields (Table 6).

4. Seedling stage for transplanting

Research conducted at the Maha Illuppallama RARC during 1989 Yala indicated that yield is improved if healthy seedlings are transplanted at the 3-leaf stage, i.e. about 4 weeks after emergence (Table 7).

Research has also shown that there is a very high correlation (r=0.95) between initial plant height and final bulb yield.

Table 6. Bulb yield of big onions as affected by the size of dry sets.

Diameter of dry set (cm)	Average bulb yield (kg/ha)
Less than 0.5	12416
0.5 - 1.0	13047
1.0 - 1.5	17842
1.5 - 2.0	19041

Source: K.A. Mettananda, 1989

Table 7. Yield of big onions when established by seedlings at various stages of seedling development.

Seedling stage (no. of leaves)	Average yield (kg/ha)
Less than three	24362
Three	33589
More than three	27478

Source: K.A. Mettananda, 1989

5. Time of planting

Research has shown that the best time for planting big onion in the DL_1 region is from the first week of May to the first week of June (Table 8). Later plantings resulted in drastic yield declines. Because yield declines were due to a reduction in bulb size it is advisable to use closer plant spacings when late planting is unavoidable.

6. Plant spacing

Studies have shown that a 8 cm x 8 cm spacing is superior to 10 cm x 10 cm and 10 cm x 15 cm spacings (Table 9).

Table 8. Yield response of big onions to different planting dates.

Date of planting	Average bulb yield (kg/m^2)
June 6, 1989	8.0
June 15, 1989	5.0
July 1, 1989	3.0

Source: K.A. Mettananda, 1989

Table 9. Yield response of big onions to different plant spacings.

Plant spacing (cm)	Plant population/ha	Average bulb yield (kg/ha)
10 x 15	400,000	18347
10 x 10	600,000	21038
8 x 8	900,000	27739

Source: R.M. Ranaweera Banda, 1986

7. Fertilizer management

Response to N, P, and K fertilizers is highly variable with location. There was no response to P and K when big onions were grown in paddy fields where P and K persisted from the previous paddy crop. On average, response to P and K did not exceed 50 kg/ha. Response to N varied from 50 to 150 kg N/ha, depending on the season and the inherent fertility (mainly organic matter content) of the soil (Mettananda, 1987-1989).

8 Pest and disease control

Several pre-emergence herbicides are effective in controlling weeds in big onions.

Recommendations are available for control of major pathological problems such as bulb rot and purple blotch.

The major insects, thrips and leaf eating caterpillars, can be easily controlled with insecticides.

9. Irrigation

Recommendations have been developed on the quantity and frequency of irrigation for big onions. Future research will be aimed at modifying the present recommendations.

Harvesting

Research has established that irrigation should be stopped 2 weeks prior to harvest and that top leaves should be dry.

Storage

Research studies conducted at the Maha Illuppallama RARC have shown that onions harvested after drying in the field store longer than those harvested prematurely (Table 10).

Studies have also shown that bulb size has no bearing on storage losses (Table 11).

An investigation of storability showed that some varieties store better than others (Table 12).

Table 10. Effect of harvesting methods on loss of big onion during 3 months of storage.

Stage of harvesting	% weight loss due to		Total
	Drying	Rotting	
Dry (matured)	22	12	34
Premature	25	25	50

Source: K.A. Mettananda, 1989

Table 11. Effect of bulb size on storage losses.

Bulb size	Storage weight loss (%)
Large (90 - 100 g)	29
Medium (50 - 60 g)	32
Small (20 - 30 g)	28

Source: K.A. Mettananda, 1989

Table 12. Storage losses for various varieties.

Variety	% weight loss after 2 months of storage
K-1	35
N-53	15
Rampur	25
Poona red	20
Early red (hybrid)	66
Hasira 704	45

Source: K.A.Mettananda, 1989

Seed Production

Research on seed production is being conducted at the Kalpitiya RARC and by Japanese scientists at Toda Farm, Girandurukotte. The Japanese scientists have proved that most exotic varieties of big onion will flower after vernalization of dry sets or mother bulbs before planting. A local selection, Kalpitiya 1, is able to flower and set seed under normal conditions. Research on this selection is continuing with the aim of producing sufficient seed to meet requirements.

Seed Storage

Cold storage facilities are not available in most locations where onions are grown. Therefore, identification of alternate methods of storage is necessary. Research has shown that the viability of big onion seed is not seriously affected by 2 months of storage in sealed polyethylene under ambient conditions (Table 13). Cold storage is necessary if seed is stored for a longer period. It is important to note that seed moisture must be kept between 6-8 percent.

Small Onion

1. Planting materials

An experiment conducted during Yala 1988 and 1989 to determine the effect of seed bulb size on final bulb yield found yields are increased if large seed bulbs are planted (Table 14). However, small bulblets are more economical because there are more bulbs per unit weight.

Table 13. Percent loss in seed viability under various storage conditions.

Storage method	Percent germination		
	Initial	Months in storage	
		2	3
Sealed polyethylene at room temperature	80	78	50
Open pan at room temperature	80	48	38
Sealed polyethylene in a refrigerator	80	80	76

Source: K.A. Mettananda, 1987

Table 14. Effect of bulb size on the yield of small onions.

Size of seed bulb	Average bulb yield (kg/ha)	
	1988 Yala	1989 Yala
Small (7g/10 bulblets)	15225	14406
Medium (15g/10 bulblets)	16869	16573
Large (25g/10 bulblets)	18647	17471

Source: K.A. Mettananda, 1988, 1989

2. Intercropping

An experiment conducted at the Maha Illuppallama RARC showed that land productivity can be increased by intercropping small onions with chillies. Onion yield was not decreased by intercropping with chilli (Table 15).

Table 15. Yield (kg/ha) of small onion and dry chillies under various cropping systems.

Cropping system	Small onion		Dry chilli	
	1988	1989	1988	1989
Onion monocrop	21842	15467	-	-
Chilli-onion intercrop	21225	18067	1308	524
Chilli monocrop	-	-	2863	1689

Source: S.N. Jayawardena, 1988, 1989

FUTURE RESEARCH PRIORITIES

Storage Studies

Expansion of onion extent has made storage an important area of study. Several studies are planned, including:

a) varietal screening for storability

b) the effect of various agronomic practices on storability, e.g. N fertilizer level, spacing, irrigation, time of planting, method of harvesting

c) testing of different storage structures

d) testing of storage conditions, e.g. location, conditioned storage

Extending the Cropping Season

Studies will be carried out to explore the possibility of off-season cultivation of both big and small onions. This will include varietal selection for characteristics suited for off-season cultivation.

Seed Production Technology

Efforts are continuing to produce quality seeds locally in order to save foreign exchange.

Biological Disease Control

Investigations will be continued to develop methods of biological control (such as soil amendments and antagonistic microorganisms) for fungal diseases, mainly bulb rot caused by Fusarium, Pythium, and Sclerotium, in both small and big onions. This will help to reduce environmental pollution and save foreign exchange on costly fungicides (de Zoysa, 1989).

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