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COST OF SEEDLING TUBERS PRODUCED FROM TRUE POTATO SEED: AN ESTIMATE BASED ON EXPERIMENTAL PRODUCTION IN EGYPT

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ABSTRACT

Estimates of costs of producing seedling tubers - small tubers produced from densely plants TPS - under experimental conditions in plastic tunnel-protected nursery beds in the CIP Kafr El Zayat station in Egypt during several seasons are documented. Average yields of 6 kg/m2 were recorded. Variable costs account for 63% of total costs with plastic and imported peat moss as the largest single cost items. The cost of TPS was not an important factor. A ton of seedling tubers cost $ 645, only 53% of the cost of locally produced seed tubers planting material.

I. INTRODUCTION

In Egypt the potato is an important vegetable crop with increasing trends in production and consumption. In 1987 potatoes were planted on 79,800 hectares producing 1.8 million tons (Ministry of Agriculture, 1988). Accounting for exports, wastage and seed (Horton, 1988), per capita consumption is estimated to be 25 kg annually. The seed system is dependent on imports of seed tubers from Europe for planting in the Spring season (January to May). Seed tubers are saved from this crop, stored during the summer and planted in the Autumn and Winter seasons starting with initial plantings in August and final harvests in January (Sharara, 1987). The costs of seed are over 50% of total production costs and the quality of the traditional farmer seed is low (El Bedewy et al, 1987). There is inadequate refrigerated storage and many farmers must rely on traditional on-farm ambient temperature stores (nawalla) where storage losses result from high summer temperatures, rats and potato tuber moth (Phthorimaea operculella). Commonly practiced seeding rates for tuber seed are 2 t/ha for imported cut seed during the Spring season and 4-5 t/ha for locally produced whole seed during the Autumn and Winter seasons. This high Autumn and Winter seeding rate results from farmers using whole ungraded tubers weighing as much as 80-100g each as seed, and a planting density that may reach 50,000 plants/ha.

The Ministry of Agriculture has assigned high priority to developing alternative low-cost seed systems. To address this issue, in cooperation with the Ministry of Agriculture, CIP has conducted research on true potato seed-based seed production for North Africa since 1983. True potato seed (TPS) can be employed in several forms in seed systems, including the production of virus-free mother plants, production of seedlings to be transplanted or the production of seedling tubers -- the small tubers produced from densely planted TPS (Malagamba & Monares, 1988). A practical system for Egypt is to produce seedling tubers in nursery beds during the Spring season for use as high quality seed in the Autumn season (El Bedewy et al., 1987). This strategy offers several advantages over the current system; there is less virus infection of the seedling tubers and because the seedling tubers are small, a greater percentage of seed requirements can be kept in refrigerated stores. Seedling tubers have been produced at an experimental level for seven seasons in Egypt. The Pioneer Overseas Corporation has recently initiated a program to commercially produce seedling tubers in Egypt for sale to Egyptian farmers (Al Ahram, June 1988).

As seedling tubers are being proposed as a low-cost alternative to seed tubers, it is important to know the cost of producing seedling tubers. An estimate of costs of producing seedling tubers in Egyptian conditions is presented in this report. The data are based on costs incurred for seedling tuber production under experimental conditions in several seasons during 1986 and 1987 at the Kafr El Zayat-CIP station (30o 40'N, 30o 50'E). The station is located in the main potato producing zone in the center of the Nile delta (8m above sea level).

Seedling Tuber Production

Under Egyptian conditions, research has shown it is optimal to sow TPS in nursery beds in semi-controlled conditions (Engels and Schwenkel, 1986). The bed consists of a sand and peat moss mixed with the soil in the top 3-4 cm. The seedlings are thinned to a density of approximately 100/m2 from an original sowing of 200-400 seeds/m2. Fertilization rates are devised to maximize seedling tuber production. Insecticide use is to guard mainly against potato tuber moth and aphids. Fungicides are used against late and early blight (Phytophtora infestans and Alternaria solani). Irrigation is done from sprinkling cans as required by the weather. From mid-January to mid-March, the seedlings are protected against low night temperatures by plastic covers. See El Bedewy et al. (1987) for a more complete description of the agronomic practices.

The TPS is planted in mid-January and harvested after 100-120 days depending on progeny and weather. The seedling tubers must be stored through the summer season for use in the autumn or winter. There are two options for the storage of seedling tubers, refrigerated stores or in improved 2 nawalla. The seedling tubers must be pre-sprouted before planting. This is accomplished by placing the seedling tubers in shallow chitting trays where they are exposed to indirect light for three weeks period planting. Assuming spring production of seedling tubers for autumn or winter planting and accounting for pre-planting treatment, the average storage time is 3 to 4 months.

The TPS progenies used in this study were Serrana x DTO-28, Serrana x DTO-33, Atzimba x DTO-28, Atzimba x DTO-33 and CFK-69.1 x DTO-33. All the progeny were produced in Chile and are well adapted to Egyptian conditions. Yields have been averaging 6kg/m2 in production in Kafr El Zayat, other governmental, and Potato Growers Cooperative stations. This figure is a significant improvement over yields previously reported for Egypt and those reached elsewhere. In Egypt and Peru the average yield of seedling tubers has been 4kg/m2 (Engels and Schwenkel, 1986, Monares, 1984). Seedling tubers are small; 80% are less than 20 grams. After rejecting the very small and damaged seedling tubers, the production of usable planting material in Egypt in recent seasons has averaged 4-5 kg/m2 depending on the progeny.

Seedling Tuber Production Costs

The costs3 detailed in the table illustrate several interesting points -- the high share of variable costs and the relative unimportance of TPS costs. Unless otherwise noted, costs are based on prices prevailing in local markets.

Materials costs account for over half the variable costs. Peat moss, an imported commodity in Egypt, makes up over 75% of materials costs. Peat moss has been shown to be unsuitable for repeated use and thus should be replaced for each planting. A locally-produced alternative may be animal manure. Two to four cubic meters of manure could replace the peat moss requirements. Available at $2/m3, this would be a significant cost reduction. Chemical inputs such as fertilizers, insecticides and fungicides are used in such small quantities that they account for only about 3% of total costs.

As presented, the cost of the TPS is relatively insignificant. The TPS costs are based on estimates of Monares and Achata (1988) who found TPS production costs in Chile to be approximately $336/kg. It should be noted that this estimate does not assume a return to investment. As comparison, however, a kilogram of hybrid tomato seed currently costs $1,200 in Egypt, thus even if the TPS costs were quadrupled to that level, the TPS share of total costs would increase from 4% to only 13%.

Labor costs account for 15% of total costs. The hours of labor are estimates based on work needed for experimental beds, and costs do not include management. For larger scale commercial production at least one manager is needed for a 1000 m2 nursery. In Egypt, casual agricultural labors often include small boys for jobs of the nature as noted in the table. Labor does not have to be specially trained as the activities are similar to seedling management in other vegetable crops grown in Egypt.

The structures to protect the TPS seedlings are welded steel cages covered with plastic. With a share of 23%, these structures represent a fairly significant portion of total costs. Refrigerated storage is charged at $37/ton and it is assumed that all seed is placed in this type of storage. An alternative, however, is to use the nawalla which could be charged at a much lower rate.

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2 Traditional nawalla are unpainted, unscreened, mudbrick buildings. Improved nawalla are painted white, screened to protect against potato tuber moth and rats and have redesigned windows to promote ventilation. Storage losses can be 80% in unimproved nawalla.

3 All costs are given in US dollars. An appendix table gives the costs in Egyptian pounds. L.E.2.32 = $1.

II. DISCUSSION

This report is based on the scenario of spring production of seedling tubers for autumn planting. It should stressed that the data presented here are preliminary and based on experimental production practices. It can be expected that these costs may change significantly in commercial production, for example the plastic and imported peat moss may increase in price while improvements in labor efficiency may decrease labor costs.

Total production costs in 100 m2 of nursery beds under experimental conditions were found to be $290. Research has shown that approximately 450 kg of marketable seedling tubers can be produced from such a nursery. A marketable seedling tuber is one that weighs over 5g and is suitable for sale. Tubers smaller than this are not a loss but can be planted in nursery beds to produce a second generation of seedling tubers (see Crissman et al, 1990). The value of these tubers is not considered here. Thus the unit cost of seedling tubers with interest charges on the money investment but without other producer profit margins or marketing costs is nearly $0.64/kg. Preliminary studies indicate that the seeding rate for seedling tubers should be 600 to 700 kg/ha. This gives a total seed cost per hectare ranging from $384 to $448. This should be compared to costs for Autumn or Winter season plantings. In September, 1987 local seed of the most popular variety cost $172/t and if planted according to local practice of 4-5 t/ha would give a seed cost of $688-860/ha.

III. SUMMARY

Costs of seedling tuber production under experimental conditions in Egypt were estimated. Based on average 1986/87 yields, production costs for sufficient seedling tubers to plant a hectare were about 53% of the cost to plant one hectare with locally-produced seed tubers. Variable costs were almost 64% of total costs. Plastic and imported peat moss contribute the largest single cost shares. TPS accounted for only an estimated 4% of total costs.

TPS is not the only solution to replace a good seed program. At best in Egypt, TPS provides an alternative to some problems and should be part of a comprehensive seed scheme which includes imported and improved locally-produced seed.

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Table. Estimates of seedling tubers production costs for a 100 square meter nursery, Kafr El Zayat, Egypt.

	Quantity	Cost $	Percent share
Variable Costs			
Labor (hours)			
Soil Preparation	22	6.88	2.4
Sowing	4 boy days[1]	4.30	1.5
Irrigation, Fertilization	30	9.46	3.2
Hilling, Weed control	6 boy days	6.45	2.2
Harvesting	14 hrs + 4 boy days	8.60	3.0
Post-harvest labor	14 hrs + 2 boys	6.45	2.2
Total		42.14	14.5
Materials			
TPS (g)	28	12.00	4.1
Peat Moss (kg)	200	86.00	30.0
Sand (m3)	4	8.60	3.0
Fertilizer (kg)			
P2O5 (15.5% a.i.)[2]	40	1.38	-
Nitrogen (20.5% a.i.)	7.2	.56	-
KO2 (48% a.i.)	3.0	.22	-
Fungicide			
Ridomil (g) (3x20g)	120	1.55	-
Insecticide			
Silicron (cm3)(3x20cm)	120	1.55	-
Zinc Phosphate (g)	500	1.29	-
Maize grain spreader (kg)	4	.43	
Total		113.58	39.1
Rent for nursery bed (5 mo)		4.30	1.5
Post-harvest			
Storage ($37/t for 3 mo)[3]		22.20	7.6
Pre-planting		4.30	1.5
Total		26.50	9.1
Total Variable Costs		186.52	64.2

Table continued

Fixed Costs			
Plastic tunnels (cost per year)			
Steel rods (5 year life)		28.81	9.9
Plastic (3 year life)		32.75	11.3
Rope (1 year life)		4.30	1.5
Total		65.86	22.7
Sprinkler can (5 year life)		1.72	-
Chitting trays (6 year life)	20 trays	8.60	3.0
Total Fixed Costs		76.18	26.2
Interest cost (14% annual for 9 mo.)		27.58	9.5
Total Costs		290.28	100.0
Yield (kg/m2)		6	
Total Production (kg)		600	
Marketable Seed (kg)		450	
Cost/ton of seed ($)		645	

Notes:

[1] Children are frequently employed for selected agricultural activities and are paid different wages than adult workers.

[2] Active ingredient

[3] Includes jute bags, sorting & transport costs.

Appendix Table. Estimates of seedling tubers production costs in Egyptian Pounds for a 100 square meter nursery, Kafr El Zayat, Egypt

	Quantity	Cost L.E.	Percent Share
Variable Costs			
Labor (hours)			
Land Preparation	22	16.00	2.4
Sowing	4 boy days[1]	10.00	1.5
Irrigation, Fertilization	30	22.00	3.2
Hilling, Weed control	6 boy days	15.00	2.2
Harvesting	14 hrs + 4 boy days	20.00	3.0
Post-harvest	14 hrs + 2 boys	15.0	2.2
Total		98.00	14.5
Materials			
TPS (g)	28	22.00	4.1
Peat Moss (kg)	200	202.00	30.0
Sand (m3)	4	20.00	3.0
Fertilizer (kg)			
P2O5 (15.5% a.i)[2]	40	3.20	-
Nitrogen (20.5% a.i.)	7.2	1.30	-
KO2 (48% a.i.)	3.0	0.50	-
Fungicide			
Ridomil (g) (3x20g)	120	3.60	-
Insecticide			
Silicron (cm3)(3x20cm)	120	3.60	-
Zinc Phosphate (g)	500	3.00	-
Maize grain spreader (kg)	4	1.0	
Total		260.20	39.1
Rent for nursery bed (5 mo)		10.00	1.5
Post-harvest			
Cold store (L.E.86/mo for 1 mo)[3]		51.50	7.6
Pre-planting		10.0	1.5
Total		61.48	9.1
Total Variable Costs		432.73	64.2

Appendix Table continued

Fixed Costs			
Plastic tunnels (per year)			
Steel rods (5 year life)		67.00	9.9
Plastic (3 year life)		[illegible]	11.3
Rope (1 year life)		10.00	1.5
Total		152.00	22.7
Sprinkler can (5 year life)		4.00	-
Chitting trays (6 year life)	20 trays	20.00	3.0
Total Fixed Costs		176.00	26.2
Interest cost (14% annual for 9 mo.)		63.98	9.5
Total Costs		673.45	100.0
Yield (kg/m2)		6	
Total Production (kg)		600	
Marketable Seed (kg)		450	
Cost/ton of seed (L.E.)		1496	

Notes:

1 Children are frequently employed for selected agricultural activities and are paid different wages than adult workers.

2 Active ingredient

3 Includes jute bags, sorting and transport costs.