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A SMALL, EFFECTIVE SEED MULTIPLICATION  
PROGRAM: TUNISIA

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Abstract

Tunisia provides the case of a small, highly productive seed potato multiplication program which was established with partial external funding and technological assistance, but is now fully institutionalized in the country's research-extension system and financed entirely with local funds. The seed program's impact on potato production and its economic benefits are great. As of 1983 the program's net internal rate of return is estimated to be at least 40%; it is projected to be at least 50% by the end of the decade. These returns are higher than those offered by most other Tunisian development projects. There are three keys to the success of the Tunisian program. First, while CIDA (Canada) provided funds and the International Potato Center (CIP) provided technical assistance, the program was established within the framework of existing national institutions and was perceived from the outset as a Tunisian program. Second, the program focused on solving an apparently simple, but critically important problem: seed in poor physiological condition at planting time. Third, as the seed program expanded, high quality standards were maintained. Through its seed multiplication program, extension, and training, the Tunisian Potato Program contributes to expansion of the potato crop, yield increases, cost reduction, and reduced dependence on foreign seed sources. Through CIP's regional programs, other countries are learning from the experience of the Tunisian program.

Resumen

Túnez ofrece el caso de un programa de multiplicación de semilla de papa pequeño y altamente productivo que se estableció con financiamiento y asistencia técnica externa parcial y que, en la actualidad, está financiado enteramente con fondos nacionales e integrado al sistema de investigación y extensión del país. El impacto del programa de semilla sobre la producción de papa y sus beneficios económicos han sido considerables. La tasa interna de retornos del programa se

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estimó en 40% para 1984 y su proyección para fines de la década sobrepasará el 50%. Estos beneficios son mayores que los generados por la mayoría de los proyectos tunecinos de desarrollo. Hay tres factores claves en el éxito de este programa. Primero, aun cuando CIDA (Canadá) proporcionó financiamiento y el Centro Internacional de la Papa (CIP) ofreció asistencia técnica, el programa se estableció dentro del marco institucional existente y fue percibido desde sus inicios como un programa tunecino. Segundo, se centró en resolver un problema aparentemente simple pero importante para el país: la deficiente condición fisiológica de la semilla de la papa en la época de siembra. Tercero, a medida que el programa crecía, se mantuvo la calidad de la semilla. El programa de papa de Túnez, a través de la multiplicación de semilla, la extensión y el adiestramiento ha contribuido a la expansión del cultivo de la papa, los incrementos de rendimientos, la reducción de costos y la disminución de la dependencia de fuentes de semilla extranjeras. A través de los programas regionales del CIP, otros países están aprendiendo de las experiencias del programa de semilla tunecino.

### Résumé

La Tunisie représente le cas d'un programme petit mais hautement productif de multiplication rapide de semence, établi avec des fonds et de la technologie en partie externes, mais actuellement complètement intégré dans le système national de recherche-vulgarisation et financé entièrement sur fonds locaux. L'impact du programme de semence sur la production de pomme de terre et ses bénéfices économiques sont élevés. Pour 1983 l'estimation du taux de rendement interne net du programme est d'au moins 40%; sa projection pour la fin de la décennie est d'au moins 50%. Ces rendements sont plus élevés que ceux de la plupart des projets tunisiens de développement. Trois éléments-clés expliquent le succès du programme tunisien. Premièrement, alors même que ACIDI (Canada) procuraient les fonds et le Centre International de la Pomme de Terre (CIP) l'assistance technique, le programme était établi à l'intérieur du cadre des institutions nationales existantes et était perçu dès le départ comme un programme tunisien. Deuxièmement, le programme s'attachait à résoudre en priorité un problème apparemment simple, mais vital: la mauvaise condition physiologique de la semence à la plantation. Troisièmement: avec l'extension du programme de semence des critères élevés de qualité furent néanmoins maintenus. A travers son programme de multiplication de semence, la vulgarisation et la formation, le Programme de Pomme de Terre de la Tunisie contribue à l'extension de la culture de la pomme de terre, l'augmentation des rendements, à une réduction des coûts et de la dépendance par rapport à des sources externes de semence. Grâce aux programmes régionaux du CIP d'autres pays tirent des enseignements du programme tunisien.

## Introduction

Since independence in 1956 the Tunisian government has promoted cultivation of potatoes and other high-value vegetable crops in newly irrigated areas, known as "irrigated perimeters." As a consequence, potato production has tripled since the early 1960's and now totals 140,000 tons produced on 12,000 hectares (Table 1). The Tunisian diet remains heavily dependent upon cereal grains but annual potato consumption has risen to an average of about 20 kilograms per capita. Potato production is expanding much faster than total food production in Tunisia (Figure 1).

Potatoes are grown in Tunisia in three distinct seasons (Table 2, Figure 2): early (primeur), main (saison), and late (arrière saison). The early crop is restricted to the frost-free northern coastal regions of Cap Bon, Bizerte, and Sahel. The main and late crops are grown both in the coastal regions and in irrigated areas throughout the country. Yields tend to be higher in coastal regions than in newer irrigated perimeters, and they are higher in the main season than in early and late seasons. But potato acreage and production are expanding most rapidly in the irrigated perimeters.

Tunisian farmers depend upon imported European seed for planting the early and main crops; the late crop is planted with tubers harvested in the preceding early season.

Scarcity of healthy seed tubers in good physiological condition often delays planting, reduces yields, and raises production costs per unit of output.

## The Program

The Tunisian National Potato Program was established in 1976 through an agreement between the Government of Tunisia and CIP. In that year a 5 year cooperative program, titled, "Promotion of Potato Cultivation in Tunisia's Irrigated Perimeters," was initiated. Funding was provided by the Canadian International Development Agency (CIDA) and the Tunisian government. CIP provided a full-time potato specialist as well as technical and administrative backstopping. The program's 2 objectives were: (1) production of high quality seed, and (2) expansion of potato production in Tunisia.

Under the terms of the agreement a "Technical Committee" was created within the Ministry of Agriculture to coordinate implementation of national policy regarding the potato crop. This approach differed from that of many other development projects operating in Tunisia, which have chosen to set up their own administrative structures and operate outside the established official institutional framework. Planners and executors of the Potato Program made a

conscious effort to work with and strengthen existing institutions and facilitate coordination of their actions through the Technical Committee. Five Tunisian institutions were most directly involved in the program:

1. GIL: Groupement Interprofessionnel des Légumes, responsible for seed multiplication.
2. CPRA de Saida: Centre de Perfectionnement et Recyclage Agricole, responsible for training.
3. INRAT: Institut Nationale de Recherche Agronomique de Tunisie, responsible for research.
4. INAT: Institut Nationale Agronomique de Tunis.
5. DPV: Direction de la Production Végétale, responsible for extension.

In 1976 the new Tunisian program team and consultants from CIP concluded that seed multiplication for the late season should have top priority for potato research, extension and training. The Tunisian-CIP team observed that potato fields in both early and late seasons had many single-stemmed plants, an indication that seed tubers were physiologically young at planting time. Because potato crop yields are highly correlated with number of mainstems/plant, the team hypothesized that yields could be increased by seed management practices, such as desprouting and better storage, which increased the number of vigorous sprouts and stems produced by each seed piece. Seed specialists from GIL began testing this hypothesis in on-farm trials and exploiting the research results in the seed multiplication system. Soon, CPRA and INAT began incorporating the findings into extension and training messages for farmers.

On-farm trials (Table 3) showed that yields in the late crop could be increased by more than 50% through relatively simple improvements in seed production techniques such as:

- Desprouting imported seed and planting as early as possible in the early season,
- Early harvesting of the seed crop and eliminating unhealthy tubers before storage,
- Desprouting before planting in the late season.

### Program Costs and Benefits

Few seed potato programs established in developing countries with foreign technical assistance succeeded in producing a significant proportion of the seed tubers required by farmers. Most programs remain insignificantly small or collapse after a few years. The Tunisian program is an exception to this general rule.

Beginning with 64 tons in 1977, production of improved seed for the late season rose to about 900 tons per year in 1981-83. This is approximately 20% of the late season's total seed requirements.

Prior to 1976, Tunisia imported certified class A seed from Europe for the early and main seasons. In 1977 GIL began importing small amounts of "élite" class E seed for its multiplication program. Class A seed continued to be imported and distributed to farmers for production of consumer potatoes and common seed for the late crop. The price of class E seed generally exceeds that of class A seed by about US\$30 per ton.

On the basis of field trials, which showed yields of late season crops grown from "élite" class E and class A seed were roughly the same, in 1983 GIL began importing the cheaper class A seed to multiply for the late season.

Yearly project costs and benefits up to 1983 are summarized in Tables 4 and 5. The assumptions underlying the figures presented are extremely conservative in two respects. First, all program costs financed by CIDA are included. Actually a substantial portion of these costs were for activities such as training, which generated benefits outside the seed program (and, in part, outside Tunisia). Second, only benefits from farmer use of improved seed distributed by GIL are included. In reality, the "spinoff" benefits of the seed program, which reached farmers via extension and training, may exceed the direct benefits from use of program seed. For these reasons, the rate of return presented in the following paragraphs should be considered as minima.

After an initial brief period, the program's annual benefits have exceeded costs. For the period 1976-83 the discounted value of benefits exceeds costs by a wide margin, and the project's internal rate of return was in the neighborhood of 40%, higher than the returns of most other development projects implemented in Tunisia in the same period.

Tunisia's seed potato program is well established, and since 1982 all its operational costs have been locally funded. Plans are to continue the seed multiplication for the last season at about the present volume, and to hold future program costs at present levels. As a result, the anticipated internal rate of return for the seed program over the entire period 1976-1990 is a minimum of 50%.

In 1983 GIL began multiplying local seed for the early season, to substitute for imported seed, which generally reaches Tunisia so soon after its harvest in Europe that it is still dormant and low yielding. On-farm trials indicate that seed which is cold-stored from one year's early season harvest (April-May) until planting time the next early season (November-December) outyields imported seed despite its higher levels of virus infection.

Funds provided by a new CIDA project were used to construct a cold store for the seed program, and in 1984 seed is being cold stored for the first time for large-scale planting in the early season.

### "Spillover" Effects

The economic rates of return presented above are extremely conservative, since they assume that all program costs were for seed production and that benefits resulted only from yield increases on farmers' fields planted with improved seed from GIL. In fact, the seed program has had many "spillover effects." Many Tunisian farmers have learned -- from training courses, field days and observing their neighbors' fields -- how to improve their own seed stocks. Hence, the total benefits generated by the Tunisian Potato Program far exceed the value of the additional production resulting from use of improved seed from GIL.

As farmers improve their own seed, the future demand for seed distributed by GIL in the late season may decline, and the seed program may contract in size. This should not be interpreted as a sign of the program's failure, but of its success in completing its technology transfer mission.

The spillover effects of the Tunisian Potato Program have not been limited to the country itself. Tunisia's Potato Program has benefitted the programs of other French speaking countries, mainly as a result of training. More than 100 scientists and extension agents have been trained in international francophone production courses and in specialized courses held in Tunisia (Table 6). The beneficial horizontal transfer of technology between countries was formalized in 1982 when CIP established a regional program for North and West Africa, based in Tunisia.

**Table 1.** Potato production and foreign trade in Tunisia  
1961/65 (average) and 1966-82

	Area (000 ha)	Production (000 t)	Yield (t/ha)	Imports (000 t)	Exports (000 t)
1961/65	n.a.	48.8	n.a.	10.8	2.0
1966	8.0	68.0	8.5	9.0	5.3
1967	8.5	78.9	9.3	4.6	9.2
1968	8.5	60.0	7.1	6.1	.8
1969	8.7	61.0	7.0	9.3	1.1
1970	9.0	67.0	7.4	7.0	4.7
1971	9.5	80.2	8.4	6.7	4.8
1972	9.5	100.0	10.5	9.2	4.2
1973	9.5	71.0	7.5	14.4	2.7
1974	10.0	80.0	8.0	17.0	2.8
1975	10.0	100.0	10.0	11.9	4.5
1976	10.0	105.0	10.5	7.2	1.4
1977	11.4	85.0	7.5	26.3	2.0
1978	9.7	105.0	10.8	28.6	.5
1979	10.0	125.0	12.5	17.8	6.5
1980	10.7	120.0	11.2	12.6	4.3
1981	12.2	140.0	11.5	24.4	.2
1982	12.0	140.0	11.7	10.8	3.5

Source : FAO Production Yearbooks.

n.a. = not available.

Table 2. Characteristics of the three potato seasons in Tunisia

Season	Main seed source	Area (000 ha)	Yield (t/ha)	Production (000 t)	Use of output
Early	Imported	2	12	24	Local market and export
Main	Imported	7	14	98	Local market
Late	Local	3	10	30	Local market and export

Table 3. Results of on-farm trials with improved seed multiplied by GIL, common farmer seed, and imported seed

	No. of experiments	Yield (t/ha)			
		Improved seed	Farmer seed	Imported seed	
<u>Late Season</u>					
1978	4	24.6	13.6	--	
1979	8	20.6	11.6	--	
<u>Early Season</u>					
1979	7	18.1	--	10.9	
1980	8	26.3	--	23.3	

Source: Tunisian Potato Program Annual Reports.

Table 4. Estimated benefits of the Tunisian seed program 1977-83 (US\$)

	A	B	C	D	E	
	Seed produced (t)	Area planted (A/1.5) (ha)	Yield increase (B x 4.6) (t)	Value of yield incr. (C x \$180) (000\$)	Incr.income of seed growers (A x \$15) (000\$)	Total benefits (D + E) (000 \$)
1977	64	43	196	35	1	36
1978	160	107	491	88	2	90
1979	320	213	981	177	5	182
1980	680	453	2,085	375	10	385
1981	960	640	2,944	530	14	544
1981	740	493	2,269	408	11	419
1983	886	591	2,717	489	13	502

Sources: Seed produced: GIL Annual Report. Area planted: seed produced (t) divided by estimated seed rate of 1.5 t/ha. Yield increase: area planted with improved seed (ha) multiplied by average yield increase of 4.6 t/ha estimated in on-farm trials. Value of yield increase: yield increase multiplied by GIL estimate of potato price (US \$180/t). Value of income increase of seed growers: improved seed production (t) multiplied by estimated average income increase of seed growers with respect to what they could have obtained as potato producers.

Note: Calculations were done with un-rounded figures.

Table 5. Estimated costs of the Tunisian seed program 1976-83 (000\$)

	Program budget		Increased cost of seed		Total costs
	CIDA +CIP	GIL	Class E imported	Improved seed from GIL	
1976	90	24	0	0	114
1977	90	24	2	5	121
1978	90	30	1	12	133
1979	90	30	2	24	146
1980	90	36	8	51	185
1981	35	42	13	72	162
1982	20	42	15	56	133
1983	0	54	*	66	120

Sources: IDA budget: project proposal. CIP budget: CIP accounting department. GIL budget: personal communications. Increased cost of imported class E seed: quantity of class E seed imported multiplied by average price difference between class E and A seed (\$50/t). Increased cost of improved seed from GIL: quantity of seed distributed by GIL multiplied by average price difference between improved and common seed (\$75/t).

\* In 1983 GIL imported 300 t class A seed to multiply for the 1984 late season and 300 t class E seed to multiply for the 1984 early season. The costs of this seed are not considered in the present cost-benefit analysis, for which the time horizon is only through 1983.

Table 6. Participants in international training courses held in Tunisia 1977-83

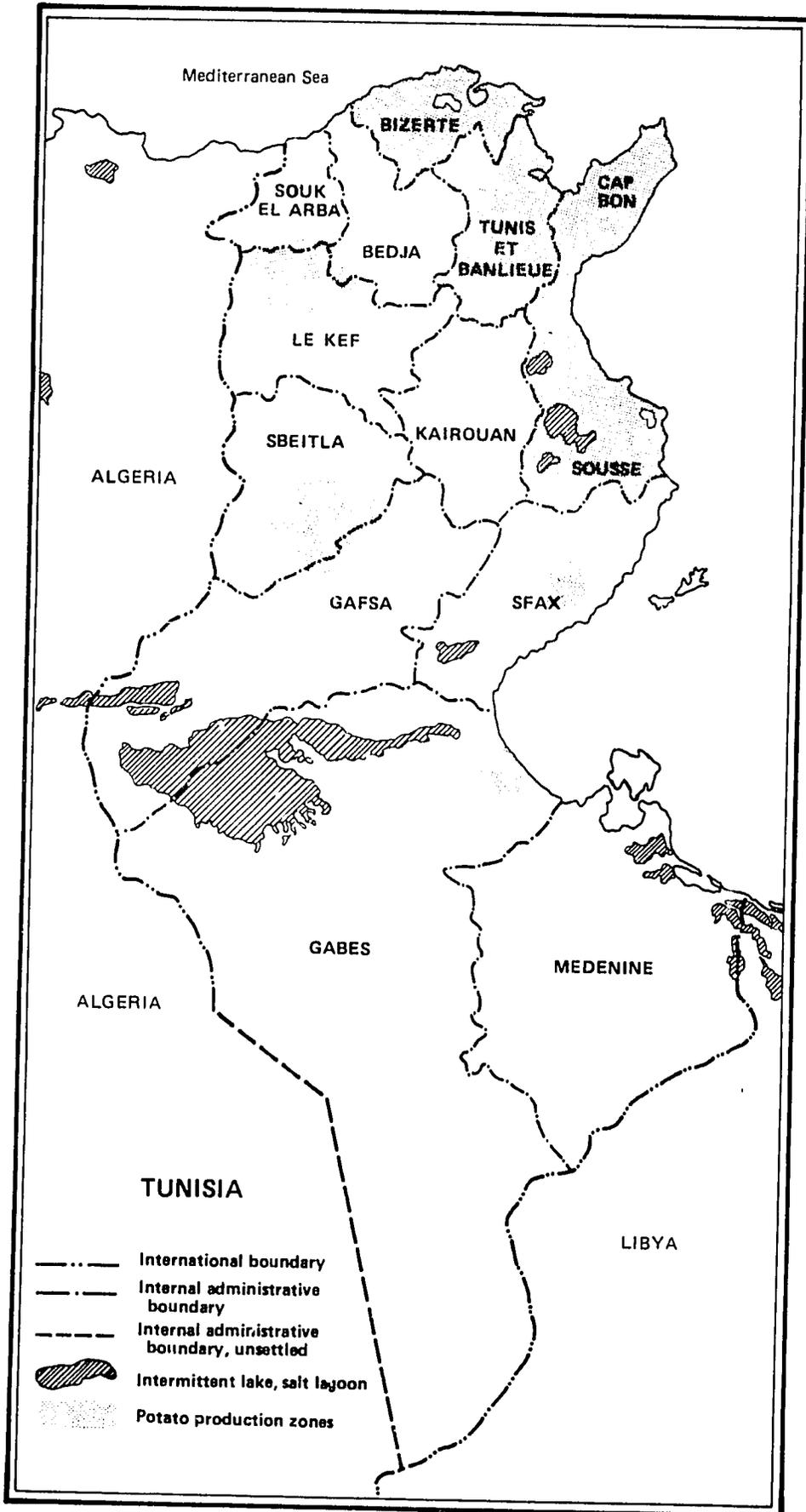
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<u>North Africa</u>		<u>Central Africa</u>	
Algeria	15	Burundi	9
Morocco	12	Rwanda	8
Tunisia	32	Zaire	1
<u>West Africa</u>		<u>Other Countries</u>	
Guinea	1	Cyprus	2
Ivory Coast	1	Jordan	1
Mauritius	1	Madagascar	8
Senegal	3	Syria	2
Togo	3	Turkey	9
Upper Volta	1		
Total		109	

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Source: Course records of CPRA de Saida.

Map 1. Tunisia: Potato Production Zones.



Source: U.S. Department of Agriculture.

Figure 1. Tunisia: Three Moving Averages of Index (1961/65 = 100) of Potato Production and Total Food Production (TFP) 1966-83.

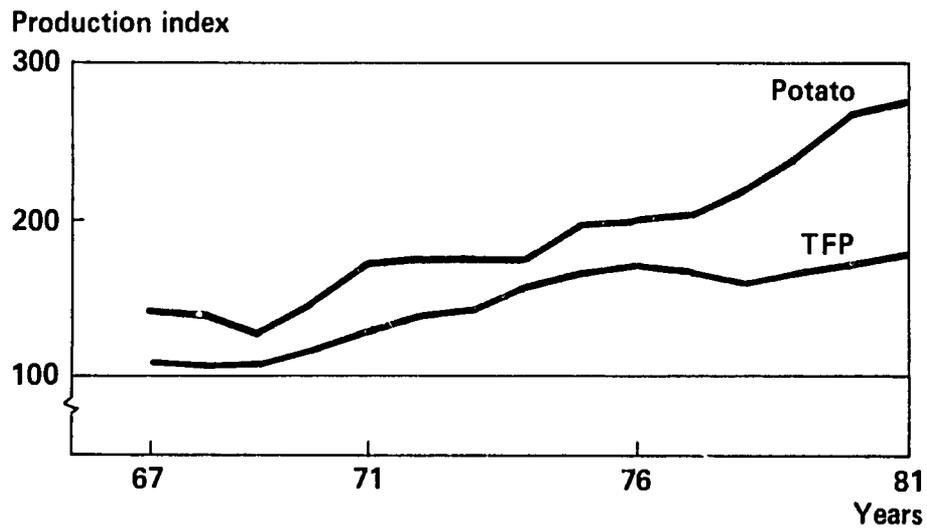


Figure 2. Tunisia: Potato Cropping Seasons.

