

## The History of Potato (*Solanum tuberosum* L.) Research in Spain

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**Abstract** Principal activities of the NEIKER-Basque Institute of Agricultural Research contributing to potato research in Spain are described from its origin in 1933 to 2004. In the first period, the genetic crosses begun and the first Spanish variety called “Eminencia” was obtained. From the 1950s (second period) the Station was divided into four sections: virology, ecology, pre-basic potato production and genetics. In 1979 (third period) a new generation of scientists was brought in to reinvigorate activities like genetic breeding and to start new ones, such as tissue culture, nematology, pathology and serology. Since the 1980s, a total of 23 varieties have been registered, which have good industrial attributes or fresh consumption characteristics.

**Keywords** breeding · clonal selection · genetics · ecology · virology

### Introduction

Potato was introduced into Spain at the beginning of the 16th century. The first written mention in South America dates from 1536, by Juan de Castellanos, in his work “History of the New Kingdom of Granada.” In the same year, purchases of potato appeared in the account books of the Blood Hospital of Seville, with the intention of feeding hospital patients. In about 1776, the potato was introduced into Alava by the “Royal Basque Society of Country Friends.” This society had previously introduced the potato into Biscay and Gipuzkoa in 1772 with specific cultivation instructions (Sánchez-Monge, 1988).

The breeding of new potato varieties started in Spain at the beginning of the 1940s at the “Estación de Mejora de la Patata” (EMP, Potato Breeding Station). This Station was founded by José-María Díaz de Mendivil under an order from the Ministry of Agriculture, dated March 16th 1933, to try to alleviate the appalling

situation the crop was in at that time, with low-yielding, degenerate varieties, chronically infected by viruses. The Station was a part of the “Instituto Nacional de Investigaciones Agronómicas” (INIA, National Institute of Agronomic Research). During the early years, the work was mainly done at the Iturrieta farm, situated in the mountains, at an altitude of 990 m. It was here where the regeneration and multiplication of Spanish varieties, the organisation of seed potato production and the importation of varieties from different European countries and studies on their adaptation started. During the next two decades, the first research on genetic breeding was carried out and focused on four main selection criteria: yield, drought resistance, early maturity and frost resistance.

### **First Period (1933–1950)**

In 1933, the regeneration and multiplication of Spanish varieties cultivated at that time started using apparently healthy material, with the objectives: high yield, drought resistance, early maturity and frost resistance. However, little success was achieved and the work was abandoned after only a few years, as the desired characteristics could not be identified among local varieties.

At the same time, a seed potato production system was organised using clonal selection. The EMP produced certificated potato seed until 1941 when the “National Seed Potato Service” was segregated from it. The clonal selection continued at EMP in order to obtain prebasic and basic material.

During this time about 40 cultivars from The Netherlands, Germany, United Kingdom and USA were imported, and adaptation studies were carried out (Zubeldia and López-Campos, 1954; Ubillos, 1960). From The Netherlands the varieties Saskia and Robijn (Basabe) were studied. From Germany the cultivars, Allerfrüheste Gelbe (Palogán), Erntedank, Oberarnbacher Frühe (Santa Lucia), Ackersegen (Sergen) and Merkur (Alava) were imported and adapted and the variety Katahdin from the USA.

Subsequently, and because of the Spanish civil war (1936–1939), the contribution of new national and foreign varieties stopped, until 1941 when new cultivars were imported from Germany. In this first period, genetic crossing began and the first Spanish variety called “Eminencia” was obtained, a high yielding, early maturing cultivar, which is now lost.

### **Second Period (1950–1979)**

In the 1950s, the EMP continued working at the Iturrieta farm to produce prebasic potato, while the rest of the activities were moved to the “Granja Modelo” (Model Farm) situated in Arkaute, near Vitoria-Gasteiz (Alava), on a high plain (the Llanada Alavesa) at 600 m altitude. In this second period, under the directorship of Miguel Odriozola, the work was diversified and specialised, and the Station was divided into four sections (Sánchez-Monge, 1988):

- Virology, where the susceptibility of the varieties was studied, as well as symptomatology, transmission of the main viruses and detection techniques such as the callose test to detect the Potato leaf roll virus (PLRV) in the tuber.

This work was presented at the Third Conference on Potato Virus Diseases in Lisse-Wageningen (Rodríguez-Sardiña et al., 1957), a precursor of the EAPR Virology Section.

- Ecology, to study the adaptation of the varieties to local conditions, and agronomic studies. (Odriozola, 1954; Escribano, 1955, 1958, 1960).
- Prebasic and basic potato production.
- Genetics, including the cytogenetic study of different species within the genus *Solanum* (Sañudo, 1960, 1963), and the characterisation of old cultivated varieties with a view to their possible use in genetic breeding. The germplasm conservation and its study and selection were carried out by D. José Buesa, especially over the period 1949–1954 (Buesa, 1963).

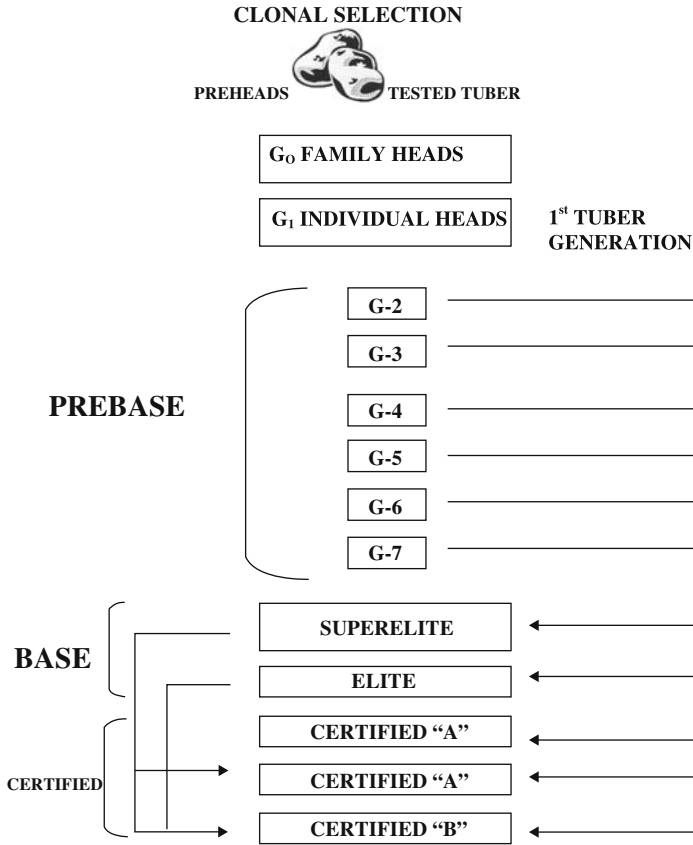
The evaluation of newly introduced foreign varieties continued, which demonstrated that many of them were satisfactory with regard to yield and health status. However, most fared poorly in two important traits: cooking quality and adaptation. These qualities were present in old varieties, introduced much earlier and practically nationalised, which could be utilised as parents (López-Campos and Zubeldia, 1958). All this had led Díaz de Mendivil to consider new varieties trying to combine the advantages of the old ones with those of the recently introduced. By 1943, Ubillos had started a large crossing programme selecting five varieties, which were submitted to the National Registry of Commercial Varieties in 1957, with the names Victor, Goya, Olalla, Turia and Duquesa (Table 1).

The objectives of the Genetic Breeding Programme were reassessed around this time (Odriozola, 1955), looking for early maturity (Zubeldia, 1955), drought tolerance and frost tolerance. In the latter case, wild species like *S. acaule*, *S. demissum*, *S. toralapanum*, *S. simplicifolium* and *S. andigena* were used as parents in the crossing programme (Blanco and Ubeda, 1966). For drought tolerance Lopez-Campos (1955, 1956) utilised other wild species, like *S. stenotomum*. As a result of this research that began in 1957 in cooperation with the “Valencia Horticulture Station” in order to obtain two harvests in a year (Lopez-Campos, 1959) and following the new objectives, three new varieties were submitted to the Registry (Zubeldia, 1967). Two of the new varieties, Lora (Saskia × Kathadin) and Aurea (later Gauna; Erntedank × Kathadin), belonged to the early maturity selection programme, while India (Sergen × Kathadin) came from the drought tolerance programme. These new varieties were added to the seed potato certification scheme in 1966 (Fig. 1).

In the following years the varieties shown in Table 2, developed from these programmes, were selected and registered.

**Table 1** Varieties registered in Spain in 1957.

Variety	Cross
Duquesa	Blanca Temprana × Katahdin (Erdgold)
Goya	Blanca de Cernégula × Flava
Olalla	Merkur × Pedro Muñoz
Turia	Blanca de Cernégula × Dolkowski's Regina
Victor	Robijn × Industrie



**Figure 1** The first seed potato certification scheme in 1966.

During this period, a selection method for earliness in seedlings was developed (Zubeldia, 1963). This allowed a first selection to eliminate the late clones at the seedbed stage. This researcher (Zubeldia) attended the 1st EAPR Conference in Braunschweig-Völkenrode.

**Table 2** Varieties registered in Spain between 1958 and 1979.

Variety	Cross
Lora	Saskia × Kathadin
Aurea (Gauna)	Erntedank × Kathadin
India	Sergen × Kathadin
Alda	Erntedank × Kathadin
Belda	Palogán (Allerfrüheste Gelbe) × Kathadin
Buesa	Palogán (Allerfrüheste Gelbe) × Kathadin
Iturrieta	Palogán (Allerfrüheste Gelbe) × Kathadin
Zubeldia	Erntedank × Kathadin
Diba	Palogán (Allerfrüheste Gelbe) × Kathadin
Fenix	Palogán (Allerfrüheste Gelbe) × Kathadin
Onda	Palogán (Allerfrüheste Gelbe) × Kathadin

**Table 3** Varieties registered in Spain between 1979 and 2003.

Variety	Cross
Arene	Desirée × Baraka
Asun	Kennebec × Palogán (Allerfrüheste Gelbe)
Ayala	Alda × Zubeldia
Edurne	LT-1 × Buesa
Gorbea	V2 × Asun
Idoia	Serrana × Gloria
Iker	Alda × Blanka
Inca	Spunta × Aracy
Isla	Spunta × Aracy
Mayka	Avenir × AN66-42
Mikel	Palogán (Allerfrüheste Gelbe) × Kathadin
Montico	Alda × Rosalie
Nagore	Desirée × Baraka
Nerea	Kennebec × Baraka
Zadorra	Onda × 81035/02
Zarina	CIP 324/04 × Cascade
Zela	Fanal × HT-2
Zepa	CIP 324/04 × Cascade
Zorba	CIP 312/35 × Carola
Zunta	Palogán (Allerfrüheste Gelbe) × Erdgold

In the 1960s epidemiological work was carried out on PLRV transmission (Pérez de San Román, 1963) and some North American varieties were freed from PVX and PVS by combining thermotherapy and meristem culture (García-Orad and Pérez de San Román, 1971), under a collaborative agreement with the USDA. For several reasons, work related to genetics and ecology was gradually abandoned at the EMP, and in the 1970s only the virology and basic seed sections remained.

### Third Period (1979–2004)

In 1979, Spanish agricultural research was regionalised and the Basque Government took over the Station. A new generation of scientists was brought in to reinvigorate some activities, such as genetic breeding, and to start new ones, such as tissue culture, nematology, pathology and serology. The breeding objectives set were early maturity, yield and resistance to the main diseases, including late blight (*Phytophthora infestans*), leafroll (PLRV) and virus Y (PVY).

A germplasm bank, containing both commercial varieties and advanced clones, was created in order to provide enough genetic variability for the crosses in the breeding programme. Sheep and forestry breeding was introduced at the Station, which changed its name to CIMA (Centro de Investigación y Mejora Agraria, Agricultural Research and Improvement Centre). Collaboration with CIP was established at this time and CIMA researchers attended the 9th Triennial EAPR Conference in Interlaken, in 1984. CIMA itself organised an EAPR Agronomy Section Meeting in 1989.

In this third period, the ELISA technique was adopted very early for virus detection, in collaboration with Mariano Cambra from IVIA (Valencian Institute

for Agricultural Research; Cambra et al., 1979; Pérez de San Román et al., 1983; Ruiz de Galarreta et al., 1987). Other techniques adopted were related to bacterial diagnosis (Francés and Marquínez, 1987), virus elimination using meristem culture, and rapid in vitro propagation (Ceballos et al., 1987).

As a result of regionalisation, the neighbouring Government of Castilla-León set up a second rapid multiplication facility in Burgos in the 1980s, called APPACALE. In 1993 they started a breeding programme that has already submitted two clones to the National Registry.

The 1990s were the time for biotechnology. While APPACALE applied genetic markers for selecting new varieties, CIMA was a partner in several EU projects on the potato genetic map. Enrique Ritter organised the 8th Virology Section Meeting in 1992, became the Section Chairman and, later, EAPR President. Since 1998 the Institute has been run as a Basque Government Agency, having adopted the name NEIKER.

Since the 1980s, a total of 23 varieties have been registered, as shown in Table 3. Presently, Zorba and Nagore, which have good industrial attributes, are grown in Germany. Gorbea, registered in 2001, is grown in Spain for fresh consumption with good prospects for the future. In 2004 the varieties Jana and Irati were submitted to the National Registry, where they are at the Provisional Inscription stage.

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