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Short Communication

LETTUCE (*LACTUCA* SPP.) : AN UNDERUTILIZED CROP

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Lettuce (*Lactuca* spp.) is the world's most important and widely-consumed leafy salad vegetable. It represents a large genus of the Asteraceae (Compositae) family (x = 8,9,17) which includes approximately 100 species of annual and perennial plants and is allied with other genera, such as chicory (*Cichorium intybus*) and dandelions. They occur most abundantly in the temperate regions of the old world. The common cultivated salad lettuce, *Lactuca sativa*, is one of the four species with 9 pairs of chromosomes (i.e., $2n$=18), the other three being *Lactuca serriola, L. virosa,* and *L. saligna*. The latter three species have now become obsolete and are rarely cultivated. All four species are native to the Mediterranean basin and are interfertile with each other thus facilitating exchange of desirable genes among them for breeding purposes. Despite its cultivation under varied conditions it remains largely an underutilized crop.

Origin of salad lettuce

Three main theories have been advanced concerning the origin of cultivated lettuce (Damania, 1975). 1. It was domesticated from wild forms of *L. sativa*, 2. That it arose as a result of a natural cross between *L. sativa* and *L. serriola*, and 3 from hybridization among several species. The latter theory is based on cytological and genetical evidence put forward by Lindquist (1960). However, the most commonly accepted theory of domestication of *Lactuca sativa* is that it evolved as a natural selection from its closest wild progenitor, *L. serriola*, which is a prickly biennial of the temperate regions (Purseglove,

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1968). *Lactuca sativa* originated in the eastern Mediterranean about 7000 years ago, most likely in Egypt when the climate of that part of northeastern Africa was not as dry as it is today. Lettuce was a common oilseed crop in Upper Egypt as far back as 4500 B.C. as depicted by rosettes of a tall, large vegetable with subulate leaves painted on the walls of tombs at Thebes (2500 B.C.). The presence of latex in primitive lettuce also marked the plant as a fertility symbol (Damania, 1975). Unfortunately, the available illustrated record found in ancient monuments is not complemented by dry or carbonized remains of leaves or seed of this crop in Egypt. Keimer (1924) informs us that early agriculture in Upper Egypt included lettuce as a seed crop for its edible oil and was being used in that country as such as recently as 1964. Subsequently, other refined edible oils more economically extracted from ground nuts, sunflower, olive, and maize have taken over throughout the Mediterranean.

Early human selection for nonshattering seed heads, late flowering, non-prickly leaves, decrease in latex content, and hearting character (the tendency of leaves to congregate in layers in a heart shaped head) is said to have led to its domestication as a leafy salad vegetable (Ryder and Whitaker, 1976). Salad lettuce was brought to the New World following Columbus's voyage in 1492 and by 1565 it was being grown abundantly in Haiti and the Caribbean. A seedsman catalog published in 1806 lists 16 cvs. already being offered in America (Hedrick, 1919). Among the cultivated types there is extensive variation of forms but four main groups have been recognized, viz., asparagus, cabbage, cos, and curled lettuces (Purseglove, 1968). Around 6500 years ago lettuce was transported to Greece and subsequently spread throughout the Roman Empire and was known to Hippocrates, Aristotle, and Pliny. The Moors in Spain developed several varieties, especially in Andalucia, when that region was under Arab domination. In Syria and Palestine lettuce was widely grown and consumed in the river valleys during the Byzantine period. Lettuce reached China around the 7th century A.D. where a special cultivar (cv.) of the asparagus type (*L. serriola* f. *integrifolia*) was developed and reported by Fuchs in 1543 from Sinkiang. The local name of this cv. is 'usum' or 'on-sen'. According to Vavilov (1992) this form of lettuce is practically unknown in South West Asia. Domesticated *L. indica* is also grown in China and Japan and later introduced to Java and parts of Malaysia. Its leaves are usually boiled and eaten with chopsticks as a vegetable in chinese cooking. The cultivated vegetable lettuce exhibits a close relationship to a group of other *Lactuca* species. Its closest wild relative, *L. serriola* (prickly lettuce), which is found all over the Mediterranean region and the Near East, has colonized large areas as a weed much outside these territories. For instance, following the highly successful post Columbus colonization of the New World, *L. serriola* has become a proliferate weed in North America.

U.S. Plant explorer collects unique lettuce germplasm in Egypt

P.F. Knowles, a plant scientist working on oilseed crops in the Department of Agronomy at the University of California, Davis (UC Davis), USA, travelled to Upper Egypt in 1958 to collect safflower (*Carthamus tinctorius*) and other oilseed crop genetic resources for his research. He was made aware of the oilseed producing lettuces of Egypt when he happened to visit the Plant Breeding Station at Giza (near Cairo) and met Mustapha Serry who was in-charge of the Oil Crops Section at that time. During the discussions Serry mentioned that the Station had a sample of an obsolete form of *Lactuca sativa* which was being grown sporadically in Upper Egypt for its large seeds from which edible oil was extracted. Sensing an opportunity for collection of germplasm potentially useful for crop improvement in the U.S., Knowles requested and received a subsample (collector's No. K1020, PI 250020) of the seeds of these plants from the Station nursery. The seeds of this particular sample contained 30 per cent edible oil and the plants did not show any disease symptoms.

Samples of the obsolete lettuce form, which turned out to be *Lactuca serriola*, were cultivated exclusively for their relatively large seeds, and since the leaves are prickly and full of latex and bitter to taste this form is unpalatable as salad. Nevertheless, such germplasm had been known to possess resistance to several diseases (especially downy mildew and mosaic virus) which affect the normal salad lettuce crop in Europe, North America, and Australia. Due to its complete compatibility with cultivated lettuce, *L. serriola* accessions have been used to make crosses resulting in cvs. such as, "Calmar" and "Valverde". Prickly lettuce is reportedly also been utilized for improvement of iceberg type lettuce in California which produced 3 million tons of this crop valued at approximately a billion dollars in 1995.

The seeds of a prickly lettuce *L. serriola* (collector's No. K 1058), reportedly grown in Upper Egypt for its oil in the same manner as safflower, were obtained from the warehouse of El Haq Menoufi el Said at Kena. This lettuce sample together with samples of safflower and other crops collected in Egypt was brought to the U.S. on 13 August 1958 where it entered the New Crops Research Branch of the Crops Research Division of US Department of Agriculture (USDA) at Beltsville, Maryland.

The entire collection from Egypt was subsequently evaluated for disease resistance and it was discovered that the prickly lettuce sample collected at Kena, which was given the number PI 251245, possessed resistance to lettuce mosaic virus. The resistance was located on a recessive allele named *mo.* Consequently, crosses with lettuce cvs. were made and the desirable gene was transferred to four lettuce cvs. grown in the western U.S., viz., Vanguard 75, Winterset, Autumn Gold, and Salinas 88 (Ryder, 1979) resulting in huge financial savings to the farmers. This valuable sample (PI 251245) and others

have been multiplied and are now conserved in the USDA *Lactuca* Germplasm Collection (LGCS), Salinas, California, which is the largest and most diverse collection of defined and characterized accessions of this genus in the world with over 10,000 samples. The accessions were also duplicated for safety at the Western Regional Plant Introduction Station (Table 1), Pullman, Washington (McGuire et al., 1993). It is assumed that the samples Knowles collected in 1958 are no longer cultivated and possibly extinct. Hence his collection is very valuable for future breeding efforts.

Table 1. Number of *Lactuca* accessions at the USDA Regional Plant Introduction Station, Pullman, Washington (1995)

Species	Number	Species	Number
L. altaica	1	*L. serriola*	159
L. dregeana	1	*L. serriola* f.	
L. indica	1	*L. integrifolia*	1
L. livida	1	*L. undulata*	1
L. perennis	5	*L. viminea*	1
L. quercina	1	*L. virosa*	17
L. saligna	16	*Lactuca* spp. (unidentified)	7
L. sativa	1,037		
L. sativa var. *capitata*	5		
		Total	1,254

High-temperature dormancy in lettuce seeds

The optimum soil temperature for germination of lettuce seeds ranges between 25 to 29°C (Damania, 1975). Genes from such wild and obsolete type of lettuce germplasm such as the *L. virosa* is known to have been used to overcome high temperature seed dormancy problems which, in the past, led to scarcity of this leafy vegetable during the hot summer months since salad lettuce seed rarely germinate when soil temperature is above 29°C (Damania, 1986). The cv. Vanguard is the only known derivative of the difficult cross between *L. sativa* and *L. virosa*. Crosses with *L. saligna* will provide resistance to the cabbage looper. Dried latex from *L. virosa* provided the drug lactucarium (Purseglove, 1968).

Lettuce germplasm collections

In USA, in addition to the collections at Salinas, California, and Pullman, Washington, UC Davis also maintains a sizable *Lactuca* collection. This collection was established in 1948 and includes mostly research and breeding material. Other major collections of this vegetable crop are located at: Center for Genetic Resources (CGN), Wageningen, the Netherlands; Horticultural Research

International (HRI), Wellesbourne, England; N.I. Vavilov Institute of Plant Industry (VIR), St. Petersburg, Russia; Research and Plant Breeding Institute for Vegetables, Olomouc, Czech Republic; and the Horticultural Sciences Department, Cornell University, New York, USA. It must be noted that, although *Lactuca* originated in the eastern Mediterranean, all the major genetic resources collections are located in the western hemisphere's major consumer countries.

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