

Confectionery Sunflower As an Emerging Crop

Dr. Chao-Chien Jan

USDA-ARS Fargo, ND USA (retired)

Sanrui Agritec Co. Ltd, Wu Yuan

Inner Mongolia, China (2017-2020)



Milestones in Development of Confection and Oilseed Sunflower

3000 BC	Domestication by North American Indians
1510	Spanish explorers introduced sunflower into Europe
1830-1840	Sunflower oil was recognized as a good cooking oil that was not prohibited by the Russian Orthodox Church during the season of Lent
1880	Sunflower reached 150,000 ha
1911-1916	Russian production reached 0.9 million ha Sunflower crop split into oilseed and confection
Mid-1900s	Reintroduction of sunflower from Europe to North America
1940-1965	Period of oil percentage explosion (30% to 55%)
1969-1970	Beginning of hybrid sunflower era

Milestones in Development of Confection and Oilseed Sunflower

1976	Success in production of high oleic Pervenets sunflower
1980s	Introduction of embryo rescue technique for difficult interspecific crosses
2000-2010	Mutation studies led to high palmitic, stearic, and oleic sunflower lines Change in composition of tocopherol content Herbicide resistance and molecular marker development (RFLP, SSR, SNPs)

Global Sunflower Production

Country	Total ha	Confection ha	% Confection	Yield kg/ha
Russia	8,500,000	1,020,000	12%	1828
China	850,000	810,000	95%	2847
Ukraine	5,960,000	240,000	4%	2559
Turkey	750,000	90,000	12%	2793
USA	560,000	60,000	11%	1750
Argentina	1,880,000	30,000	2%	2039
Total Next 10 Countries	690,000	34,000	5%	2046

U.S. Sunflower Production 1975-2016

	Hectares			Yield (kg/ha)		
	Oil	Confection	Total	Oil	Confection	
1975-1976	241,000	87,000	328,000	1227	1180	26.1
1977-1984	1,428,000	98,000	1,526,000	1310	1304	6.1
1985-1992	754,000	137,000	890,000	1354	1391	16.0
1993-2000	1,035,000	239,000	1,309,000	1502	1337	18.6
2001-2008	782,000	162,000	945,000	1484	1402	16.6
2009-2016	583,000	127,000	710,000	1688	1739	17.2

Chinese Sunflower Production

1930	Beginning of sunflower production in Heilongjiang Province
1960-1970	Main sunflower production was in Northeastern provinces
1980	Production shifted westward to Inner Mongolia, Xinjiang, and Gansu provinces due to Sclerotinia
1950-1990	Farmers selected adapted land races
1990-2000	Open-pollinated varieties
2000-2010	Some open-pollinated Introduction of foreign hybrids Rapid increase in confection sunflower production
2010-2020	Sharp increase in domestic proprietary hybrids

Chinese Sunflower Production 1978-2018

		Hectares		
	Oil	Confection	Total	Yield (kg/ha)
1978-1990	180,000	730,000	910,000	1392
1991-2000	170,000	690,000	860,000	1701
2001-2010	190,000	780,000	980,000	1836
2011-2018	200,000	820,000	1,020,000	2564





Normal seeds



Seed scarring
(Thrip damage)

Ideal Seed Quality Characteristics

China vs Rest of World

Trait	China	Rest of World
Seed length	2.3 cm	
Seed width	1.0 cm	
1000 seed weight	200 g	>100
Kernel ratio	>50%	>60
Protein content	>25%	>25
Oil content	<35%	<35
Plant height	190 cm	175

Performance of 14 Chinese Open-pollinated Sunflower Varieties and 27 Hybrids from Early 1960s through 2016

	1000 Wt Seed (g)	Seed Length (cm)	Seed Width (cm)	Seed Protein (%)	Maturity (days)	Yield kg/ha	Kernel Ratio %
OPV (1961-2012)	150	2.4	0.91	26.4	114	2610	54.4
	(120-230)	(1.7-3.0)	(0.83-1.00)	(12.2-35.8)	(97-120)	(1729-3525)	(48.9-60.0)
Hybrid (1995-2016)	156	2.1	0.83	22.0	101	3145	54.3
	(110-220)	(1.6-2.8)	(0.61-1.10)	(15.1-34.2)	(87-110)	(1936-3937)	(49.0-62.0)
Changes (Hybrid/OPV)	+4%	-14%	-10%	-12%	-12%	+20%	0

Challenges and Future Prospects

- Widen genetic variability of confection sunflower utilizing wild *Helianthus* species, interspecific amphiploids, and backcross populations of interspecific hybrids
- Use marker-assisted selection, embryo rescue, and greenhouses, all combined to accelerate the speed of breeding
- Enhance breeding effort on abiotic stresses, including drought, salinity, and variation of unfavorable temperature and soil conditions
- Develop herbicide resistant hybrids using existing IMISUN series or patented Clearfield sources, controlling both weeds and broomrape

Challenges and Future Prospects (cont)

- Improve oil quality through incorporation of high-oleic, and high-beta- or gamma-tocopherol traits
- Improve Broomrape resistance. Abundant Broomrape resistance is present in wild *Helianthus* species, and mostly simply inherited.
- Improve Sclerotinia resistance. All perennial *Helianthus* species are immune to Sclerotinia stalk rot.
- Doubled haploid techniques need to be developed
- International cooperation

ACKNOWLEDGEMENTS

International Sunflower Conference

Sanrui Agritec Co. Ltd

Jiuhuan Feng

Gerald Seiler

Brady Vick

Many others who have helped.....