PEANUT[1]

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Most of the world's peanut crop is crushed for extraction of edible oil and protein meal. But it is also an important shelled and in-the-shell nut crop and an ingredient of processed foods like peanut butter. Peanut originated in Bolivia and was introduced to Europe, Asia, and Africa in the sixteenth century. Now Asia and Africa grow over 40 million acres of groundnut (peanut) while less than 5 million acres are grown in the Western Hemisphere.

PEANUT IN THE UNITED STATES

Peanut, like soybean, was a slow starter in the United States, and it did not become a field crop until the last half of the nineteenth century. It's first use as a field crop was for hog pasture, and this use remained important until about 1930. Peanut butter and peanut candies appeared on the commercial market about 1900, and peanut vending machines were also introduced at that time.

World War II stimulated demand for peanut, and the crop was designated in 1941 as a basic commodity which categorized it politically as a major crop in the United States. The shaker-windrower and combine came into use about 1950 and reduced labor hours per acre. Production increased faster than consumption, and the surplus problem was managed with price supports, acreage allotments, and/or poundage quotas. Acreage allotments were eliminated in 1981 so anyone can grow peanut, but only those with quotas tied directly to allotments are eligible for price support.

Peanut is a major crop of the southern states from New Mexico to the Atlantic Coast. Georgia, Texas, Alabama, and North Carolina are the major producing states.

PEANUT IN MINNESOTA

Temperature is the major limiting factor since 3,000 growing degree-days (base 50)[2] have been suggested as necessary for peanut. The sandy soil trials to be discussed in this lecture had less than 2,200 growing degree-days, and the silt loam trials had less than 2,300 growing degree-days. Innovative gardeners grew peanut in Minnesota for many years, but unadapted varieties and poor production practices usually resulted in a crop failure or a low yield of poor quality nuts.

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[1]Peanut: A Food Crop for Minnesota. 1984. Minnesota Agricultural Experiment Station Bulletin AD-SB 2478 is a comprehensive publication on peanut and is available for $1.50 from Communication Resources, 433 Coffey Hall, University of Minnesota, St. Paul, MN 55108.

[2]Base 56 is sometimes used for peanut.

Why Research Peanut in Minnesota? Several diverse factors led me to include peanut research on my new crops project in 1975: Fieldbean production started on irrigated sandy soils in Minnesota about 15 years ago as a result of farmers on those soils needing an alternative cash crop to corn, potato, or soybean. Kidney fieldbean producers bought combines from the Lilliston Corporation, a Georgia manufacturer of peanut machinery. And over 30 years ago, an innovative farmer grew a field of Michelite navy fieldbean. Harvest-time was near and he had no practical way of harvesting the prostrate, long vines[3]. His implement dealer advised him to buy a used peanut digger that the dealer had located in Kansas. The farmer drove to Kansas, returned with the digger, and successfully harvested the Michelite fieldbean. Potato growers in 1975 had diggers that I believed could be modified for peanut harvesting. Some of the herbicides used in field crops in Minnesota were also approved for peanut. And finally, the political emergence of peanut-processor Jimmy Carter made good publicity for the peanut crop.

GROWTH OF THE PEANUT PLANT

Peanut grown as a cash crop would be an alternative to soybean or fieldbean, so comparisons are of interest. Peanut emergence is intermediate between the hypocotyl elongation (soybean, fieldbean) type and the internode elongation (fieldpea) type. The peanut hypocotyl elongates but usually stops before the cotyledons emerge, and only the four-foliolate leaves are visible above ground.

Peanut leaves include the cotyledons at the first node and a pinnately compound leaf with two pairs (four-foliolate) of leaflets at each of the succeeding nodes. Soybean and fieldbean have cotyledons at the first node, a pair of unifoliolate leaves at the second node, and a trifoliolate leaf at each of the other nodes. In contrast to the single main stem in soybean and fieldbean, peanut has three major stems i.e. branches from the axillary buds of the cotyledons are equal to the main stem in early growth.

The yellow flowers are produced from axillary buds and contain both male and female parts. Peanut is self-fertilized except for less than 3% cross-fertilization by insects. Peanut flowers are sessile; the style elongates but the ovary remains sessile at the stem until after pollination. Then the style and corolla wither, and the ovary elongates outward and downward into the soil about 2 inches deep. The elongating ovary is called a peg and ends with the pod at its tip. The peanut pod has no pedicel in contrast to the fruits of most other crops; the entire peg is ovarian tissue. As you can see in the slide, peanut is a crop that plants its progeny, and the branched taproot system is entirely separate from the pods.

VARIETIES

Some market types of peanut are Runner, Virginia, Spanish, and Valencia. Runner and Spanish are used for peanut butter. Virginia and Runner supply the large food nuts sold in-and out-of shell. Spanish supplies small shelled nuts, and Valencia is used for medium size in-the-shell nuts. Runner

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[3]Bush, navy bean varieties were not yet available.

varieties comprise about 75% of United States production, and Valencia accounts for less than 1%.

Previous attempts to raise peanut in Minnesota usually involved Spanish and occasionally Runner and Virginia varieties, but the relatively obscure Valencia type grown in New Mexico was overlooked. All four types have many varieties, but a few Valencia and Spanish varieties were best (Table 1). Valencia produces much cleaner pods than Spanish which usually requires washing after harvesting, especially when grown in nonsandy soil.

Table 1. Yields of peanut varieties on dryland silt loam, dryland sandy, and irrigated sandy soils, 1981-83.

Varieties	Market types	Pod yields/acre (pounds) silt loam	dryland sand	irrigated sand
Minnesota X52	Val-Spanish	1580	1320	1820
McRan	Valencia	1540	1210	1700
Valencia C	Valencia	1480	1250	1590
Pronto	Spanish	1450	1210	1420
Valencia A	Valencia	1490	1180	1370
Early Spanish	Spanish	1260	1260	1000
Delhi	Spanish	1200	1130	1100
NC 7	Virginia	540	390	410
Florunner	Runner	480	330	390
LSD 5%		450	450	450

PLANTING DATE

Because of peanut's warm temperature requirement, June planting was expected to be optimum, but planting in early May gave higher yields, larger seeds, and a higher shelling percentage (Table 2).

Table 2. Yields of early-, medium-, and late-planted peanut on dryland silt loam, dryland sandy, and irrigated sandy soils, 1981-82.

Planting dates	Pod yields/acre (pounds) silt loam	dryland sand	irrigated sand	averages 3 soils
April 29 to May 6	1290	1000	1840	1380
May 14 to May 21	1260	860	1540	1220
June 1 to June 2	1060	590	1170	940
LSD 5%	230	130	210	110

PLANTING DEPTH

Planting depth, planting date, and time of emergence are related. Deep planting and/or early planting delay emergence. Peanut was much slower emerging than soybean or fieldbean in April and May research plantings, but it emerged about the same time as soybean in June plantings.

Elongation of the hypocotyl and first internode varied with depth of planting. Hypocotyl lengths were 0.5 to 1 inch from 1-inch planting depths and 2 to 4 inches from 4-inch depths. First internode lengths were 0.5 to 1 inch from 1-inch planting depths and 1 to 2.5 inches from 4-inch depths. Planting depths of 1 to 2 inches are suggested. The pinnate compound leaf from the second node is usually the first part of the plant to emerge. Although peanut emerges slowly, it is not "wasting time" underground. The two main branches from the cotyledonary axillary buds start growth before emergence and are sometimes nearly 1 inch long when the peanut leaf emerges. The slow but extensive preemergence growth of peanut allows much more time for application of "soil cracking" stage herbicides in peanut than in soybean and accounts for the great usage and effectiveness of these herbicides in peanut production.

ROW SPACING AND PLANTING RATE

Peanut is a short plant; Spanish varieties do not fill 30-inch rows, but other varieties may fill them by midsummer. Both Spanish and Valencia varieties yielded more in 18-inch than in 30-inch row spacing except on dryland sand (Table 3). Highest yields were obtained from rows 18 inches apart planted

Table 3. Yields of peanut from 18-inch and 30-inch row spacings on dryland silt loam, dryland sandy, and irrigated sandy soils, 1981-82.

	Pod yields/acre (pounds)		
Soils	18-inch rows	30-inch rows	LSD 5%
Silt loam	1580	1370	190
Dryland sand	1210	1250	190
Irrigated sand	1870	1680	190

with 105,000 seeds per acre, whereas highest yields from rows 30 inches apart resulted from only 70,000 seeds per acre. On dryland sand where row spacing had no effect, 70,000 seeds per acre produced highest yields. I suggest a planting rate of 90,000 seeds per acre with adjustments for germination below 90%, soil texture, and seed price.

INOCULANT AND FERTILIZER

Peanut, like soybean, responds well to residual soil fertility from other crops in the rotation, but its response to fertilizer is often low in soils of medium to high fertility levels. Minnesota farm soils generally have satisfactory fertility for peanut, and many are close to optimum pH (6.0-6.4) for peanut. The severe calcium and micronutrient deficiencies that sometimes occur in the major peanut states are not likely here.

Nitrogen fertilizer or rhizobial inoculant is needed for peanut on irrigated sandy soil (Table 4). It required 150 pounds per acre of nitrogen to equal the yield obtained from inoculant alone without fertilizer.

Table 4. Response of Valencia and Spanish peanut to rhizobial inoculation or nitrogen fertilizer on sandy soil.

Treatments	Pod yields/acre (pounds)	
	dryland	irrigated
Untreated	570	930
Inoculation	490	1380
N, 50 pounds/acre, June 2	610	1050
N, 150 pounds/acre (50 on June 2, July 1, July 28)	480	1390
LSD 5%	140	250

IRRIGATION

Seventeen trials over a 6-year period showed that irrigation of sandy soil increased average yield of peanut from 1000 pounds to 1450 pounds/acre. Irrigation is a yield stabilizing factor in Minnesota because rainfall distribution varies greatly. In some years irrigation did not increase yields appreciably.

HARVESTING, AFLATOXIN, AND SEED VIABILITY

Optimum harvest time is when most pods have a veined surface, seed coats are colored, and 75% of the pods show darkening on the inner surface of the hull. Peanut does not reach this stage in Minnesota, so immature pods are removed in the threshing, cleaning, and drying operations. Loss of pods from peg rot prior to harvest is a problem in the southern states, but it is not a concern in Minnesota because of the short growing season and the failure of peanut plants to reach full maturity. Harvesting should start after the first killing frost if the soil is dry enough for cultivation. Wet soil sticks to the pods. In hard, dry soils, digger blades may not maintain an even depth.

Aflatoxin is a concern in peanut producing states. Cool September and October weather in Minnesota should minimize this nutritional hazard if good drying practices are followed.

Seed for planting of some crops is produced outside of Minnesota for various reasons. For example, much of the fieldbean seed planted in Minnesota is produced in other states. Peanut seed harvested from our research plots has usually tested over 90% germination. In a storage trial, shelled seed maintained satisfactory viability for 3 years frozen and for 1 year in a heated office. Unshelled seed maintained viability for about 22 months in a heated office. All seed stored over 12 months molded severely on germinator blotters even when germination was satisfactory. Satisfactory seed for planting can be produced in Minnesota.

CROP COMPARISON

Peanut if grown commercially in Minnesota would be an alternative to soybean or fieldbean. Comparison trials on silt loam soil and on irrigated sand showed that soybean greatly outyielded peanut but that the crops did not differ in yield on dryland sand (Table 5). Yield and market prices are based on peanut pods and soybean seed, so business and scientific analyses of crop comparison data may differ because the plant parts differ.

Table 5. Comparative yields of peanut and soybean planted in the same trials.

	yields/acre (pounds)	
Soils	peanut	soybean
Dryland silt loam, 5-trial averages	1260	2640
Dryland sand, 5-trial averages	1040	960
Irrigated sand, 5-trial averages	1660	2800

Peanut foliage in June has shown unusually high tolerance to hail. Hail that decimated corn and soybean in June did not injure peanut.

CONCLUSIONS

Minnesotans who want a lifestyle of self-sufficient food production will find that peanut is a valuable addition to their crop choices. Other groups who are concerned about the precarious dependence of most Americans on distant food supplies should encourage locally grown peanut. However, production of peanut in Minnesota is economically inefficient considering the present cost and reliability of the food distribution system in the United States.

Research to develop varieties that require fewer heat units is needed if the area of commercial peanut production is to be extended northward.