

GROWING SOYBEANS IN NORTH DAKOTA

By T. E. STOA¹

Climatic conditions that favor corn production usually will be favorable for soybeans. Thus the production of this crop in the United States centers mainly in those states generally regarded as the corn belt. But, as in the case with corn, the development and introduction of earlier ripening varieties, has made possible the expansion of the soybean acreage into more northern states.

In North Dakota soybean production is confined largely to the southeastern section of the state. It is the area in the state with most favorable temperatures, the longest growing season, and generally satisfactory rainfall. In some years early soybeans may also ripen satisfactorily in other areas but in the drier sections the crop will usually be short, difficult to harvest, and the yield small. Experimental evidence and farm experience thus suggest that interest in soybean production in North Dakota should be confined largely to the southeastern section, and perhaps other local communities where growing corn for mature grain is a dependable practice. In other areas, except for the production of some high protein roughage or feed, soybeans probably will not be satisfactory.

Soybeans are purchased on the market and processed for the oil which the seed contains. Yield of oil ranges from about 17 to 21 per cent, depending upon the area where grown, variety and plumpness of the seed. In this northern region the oil content will usually range between 18 and 20 per cent, as shown in Table 1.

Table 1. HOW VARIETIES GROWN AT FARGO HAVE COMPARED IN YIELD OF OIL AND CRUDE PROTEIN.

Variety	Average yield of oil (%)			Average crude protein (%)		
	1946	1943	1940	1946	1943	1940
	to 1949	to 1949	to 1949	to 1949	to 1949	to 1949
Minsoy.....	19.8	17.8	17.6	39.3	38.3	36.9
Early Mandarin (Ottawa)...	20.5	18.7	18.2	40.6	39.1	37.8
Norsoy.....	19.5	17.7	....	41.6	40.0	....
Goldsoy.....	20.4	18.6	....	39.9	39.2	....
Early Manchu.....	20.6	18.6	18.2	38.7	38.2	37.2
Kabott ¹	20.7	19.2	18.3	40.0	38.6	38.2
Flambeau.....	20.9	....	....	39.8	....	....

¹Not grown in 1949, yield estimated, basis of relative difference in previous years.
Analysis 1940 to 1945 by Department of Agricultural Chemistry. Since 1946 by U. S. Regional Soybean Laboratory, Urbana, Illinois.

The oil has a number of industrial uses, but its use in the food industries is by far the most important. These food uses include oleomargarine, salad oils, vegetable shortenings and so-called lard substitutes. In non-food uses the oil is used in some paints, varnishes and linoleum, but these at present are relatively minor compared with its use as an edible oil. Soybean oil has an iodine number ranging from 125

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to 145 and is regarded as only a semi-drying oil. A high iodine number, indicating good drying quality, is preferred in oil to be used in paints and varnishes, where a hard film is desired. In an edible oil a low iodine number is acceptable and may be preferred.

Soybean meal, the bean residue after the oil is extracted, is high in protein and as such is of high value as a livestock feed.

Soil Preferences

In general the soil requirements for soybeans are about the same as those for corn. Mellow, fertile, silty loam soils usually are best. Heavier soils should have good drainage. Sandy loam soils warm up more readily, hasten development of the crop, and if located in areas of satisfactory summer rainfall will offer an advantage in short growing seasons. A soil where weed competition is not serious will assure the best opportunity for the crop.

Varieties

In 1937 when soybeans were first grown and harvested on a commercial basis in North Dakota, Minsoy was the only early ripening variety available. Minsoy could be depended on to mature in most of the years in the better adapted sections of Richland county but usually left no margin in case of a slow ripening season or an early frost. Minsoy, although yielding quite satisfactorily, lacked some in plant height, lodged easily, bore pods near to the ground and thus could not always be harvested easily.

Table 2. HOW THE LEADING EARLY RIPENING VARIETIES OF SOYBEANS HAVE COMPARED IN YIELD IN TRIALS AT FARGO, 1943 TO 1949, WITH AVERAGES SINCE 1940.

Variety	Yield in bushels per acre							Average		
	1943	1944	1945	1946	1947	1948	1949	1946 to 1949	1943 to 1949	1940 to 1949
Minsoy.....	9.9	22.3	19.0	14.6	18.7	10.6	18.0	15.5	16.2	17.6
Early Mandarin (Ottawa).....	11.8	21.9	20.8	16.3	19.2	20.6	21.6	19.4	18.9	18.8
Norsoy.....	14.2	24.9	20.3	17.2	18.8	19.1	22.4	19.4	19.6	....
Goldsoy.....	17.9	18.0	22.8	14.3	18.2	21.3	15.7	17.4	18.3	....
Early Manchu...	9.7	24.0	23.5	17.0	21.9	22.6	23.3	21.2	20.3	20.7
Kabott.....	16.5	13.9	18.0	12.8	13.2	13.3	16.0*	13.8	14.8	15.6
Early White Eye- brow.....	17.0	19.7	21.2	14.0	....	....	....	....	....	....
Flambeau.....	....	....	....	13.8	13.2	17.5	18.8	15.8	....	....

*Est. yield for 1949.

Since then a number of earlier ripening varieties have become available, affording a larger choice in varieties to grow. Of those ripening earliest, Manitoba Brown and Pagoda lack in yield, plant height or other characteristics, so have never come into much use. Others with more promise are described below. How these have compared in yield, as grown in the trials at Fargo and Edgeley, is shown in Tables 2 and 3.

Early Mandarin (Ottawa) is a selection from the Mandarin variety by the Dominion Experimental Farm, Ottawa. This variety has purple flowers, medium small yellow seed with pale hilum, grows to a height of 22 to 24 inches in this area and matures several days earlier than Minsoy. Early Mandarin stands up well for combine harvesting and yields quite satisfactorily.

It is one of the varieties best suited to this area and now grown quite extensively. Norsoy and Pridesoy are other names for a variety very similar, if not identical, to Early Mandarin.

Goldsoy is from a selection made at the Ontario Agricultural College, Guelph, Ontario. Goldsoy has purple flowers, medium large yellow seed with pale hilum. Matures about the same time as Early Mandarin and yields about as well or slightly less. This variety does not grow quite as tall and has a slightly weaker stalk than Early Mandarin. However, it stands up much better than Minsoy, and is one of the better varieties for use in this region.

Flambeau is a selection from the Manchu variety made by the Wisconsin Agricultural Experiment Station. Flambeau has purple flowers, medium small yellow seed with black hilum, does not grow quite as tall as Early Mandarin, yet is of sufficient height and strength of stalk to stand up well for convenient harvesting. Flambeau may not yield quite as well as Early Mandarin or Goldsoy in years and areas favorable for good soybean yields, but its greater earliness should increase the chances for successful maturity and yield in more marginal areas.

Early Manchu is from a lot of seed received by the North Dakota Agricultural Experiment Station from the U. S. Department of Agriculture in 1939 under the name Manchu (Montreal) and traces to a selection made from Manchu at Montreal. Grown for several years in comparison with common Manchu, obtained through commercial seed channels, this introduction was somewhat earlier, but still too late to assure satisfactory maturity, except in very favorable seasons. In more recent years it has matured more dependably, ranging in maturity about with Minsoy.

This early Manchu selection grows taller than varieties described above, stands up well and has medium small yellow seed with black hilum. It has been an excellent yielding strain and was increased in 1948 for release and use in those sections of Richland county where a variety slightly later than Early Mandarin or Goldsoy can be grown.

Habaro is a selection made by the Minnesota Agricultural Experiment Station from the foreign plant introduction No. 20405. Habaro has medium small seed with pale hilum, grows sufficiently tall and when it can mature, yields satisfactorily but is generally of later maturity than desired in this region and so is not recommended.

Kabott is a selection by the Dominion Experimental Farm, Ottawa, from soybeans introduced from Manchuria. Kabott has purple flowers, yellow medium large seed with pale hilum. This variety is earlier than

other varieties described here, but lacks some in plant height and capacity to yield. Not recommended except where earliness is most essential.

Wisconsin Black was originally released as a pedigreed strain from the Wisconsin Experiment Station, and for many years was one of the most common varieties grown in this northern region, but mostly for a high protein roughage or feed. Wisconsin Black has purple flowers, black medium small seed with black hilum. Matures earlier than Minsoy and only slightly later than Early Mandarin. Because of its color the variety does not have the preference on the market common to varieties with yellow seed. Wisconsin Black was discontinued in these tests in 1943. Previous to then, and for all the years tested, it averaged 13.1 bushels compared with 15.6 bushels for Minsoy. In oil content, for the years 1936 to 1943 period for which data are available, Wisconsin Black averaged 15.7 per cent compared with 16.4 per cent for Minsoy and in crude protein 37.4 per cent compared with 35.2 per cent for Minsoy.

Capital is a selection from a cross made at the Dominion Experimental Farm, Ottawa. It has been in our nursery trials for four years and has shown a satisfactory capacity for yield, comparing favorably with Early Mandarin. It has been later in ripening than Early Mandarin or Goldsoy, also slightly later than Early Manchu. Capital grows to good height, has white flowers, small yellow seed with pale hilum.

Others. Varieties grown extensively in areas of longer growing seasons, or new varieties of promise in those areas, are sometimes offered for sale in this area. Before buying such seed to plant on any large scale it is well to learn, if possible, how these compare in maturity with such varieties as are grown here.

Results at Edgeley¹

Conditions at the Edgeley Substation have been less favorable than at Fargo and the results there frequently have been disappointing. Best results were obtained in 1944 with yields approximating 20 bushels, for those varieties that matured before frost. In 1945 and again in 1949 results were very disappointing, yields ranging from 3 to 5 bushels per acre, drouth largely accounting for the poor yields. The comparative average yields for several varieties grown at Edgeley since 1944 are shown in Table 3.

Table 3. HOW VARIETIES HAVE COMPARED AT EDGELEY.

Variety	Average yields, bushels per acre		
	1947 to 1949	1946 to 1949	1944 to 1949
Minsoy.....	6.6	7.2	8.8
Early Mandarin.....	7.8	8.2	9.4
Norsoy.....	7.3	7.7	9.0*
Goldsoy.....	7.1	7.6	8.2
Early Manchu.....	7.2	8.3	7.7
Kabott.....	7.4	7.7	8.3
Flambeau.....	8.1	...	...

*Not grown one year, yield of Early Mandarin substituted.

¹Trials under supervision of Supt. Joe Tiernan.

Cultural Practices

In addition to choosing a suitable early variety, farmers not experienced in growing the crop may find these further suggestions helpful.

1. Soybeans are sensitive to low temperatures. Thus the crop should not be planted until the soil and air temperature are favorable, usually corn planting time or slightly later.

2. Plant in rows and cultivate to hold weeds in check. Soybeans start slowly, therefore do not compete well with early weeds. The regular grain drill, corn planters with proper plates, or a sugar beet drill may be used for planting. Rows should be spaced to suit the cultivator that is to be used. The closer the rows, yet permitting effective cultivation for weed control, the better the yield per acre is likely to be.

3. Rate to plant depends some upon the spacing between the rows, and size of seed. Drop seeds from $1\frac{1}{2}$ to 2 inches apart in the row. This will require from 20 to 35 pounds of seed per acre, depending on how far apart the rows are, the variety and size of seed used. Plant about $1\frac{1}{2}$ inches deep. Planting too deep, or in a soil which crusts, may result in poor emergence and unsatisfactory stand.

4. Inoculation for the purpose of introducing the "soybean bacteria" into the soil is recommended for soils where soybeans have not been grown before. Only with these organisms present in the soil can soybeans obtain nitrogen from the air and function as a nitrogen storing crop. Without these the plant would have to draw exclusively on the nitrogen in the soil. The soybean plant is not regarded as efficient a "nitrogen storer" as sweet clover or alfalfa. Having smaller root development in proportion to its top growth, a smaller portion of the nitrogen obtained from the air is left in the soil when the top growth is removed.

5. Cultivation to destroy weeds should begin early and continue as necessary. In this way plant competition will be reduced and moisture and fertility conserved for use of the soybean crop. Delayed seeding may be advisable in some instances to make possible destruction of early starting weeds. When cultivating the soybeans leave surface as level as possible, i.e. without much furrowing or ridging, so as to make it easier to harvest the crop.

6. For production of beans for market, the crop is ready to cut when the seed is hard, and the plant has lost most of its leaves. In this stage or slightly earlier, the crop may be harvested with a binder and allowed to cure in the shock. However, if the crop is to be harvested by direct combining, which is the most satisfactory method, the crop must be allowed to stand until dry so the harvested seed can be stored safely.

When beans are dry they will thresh easily and concaves should be adjusted accordingly. To prevent splitting or cracking the beans it is necessary to make the appropriate pulley adjustments which will slow the cylinder speed to about one-half that required for wheat, but allowing the remaining parts of the machine to run at normal speed. Machines

which have the beater or rub-bar types of cylinder are widely used where soybeans are grown extensively. Beans not sufficiently dry for safe storage should be spread out in an airy place and stirred occasionally to facilitate drying and avoid damage in storage.

7. A light frost in the fall will destroy the leaves yet may not completely kill the plant. Beans that had reached full size may not have been seriously injured by this frost and will "ripen" and take on normal color. Beans less advanced when the leaves were destroyed likewise may "ripen" but the beans will be smaller and the yield correspondingly lower.

8. If grown for hay and planted in soil where weed competition is not too serious, plantings may also be in close drills. The crop is ready to cut for hay any time after blossoming, until the lower leaves begin to yellow. The yield and quality of the hay will be highest when the plant is well podded and beans one-half or more developed. Where seasons are short the crop may have to be cut earlier or soon after pods are formed, sacrificing some in yield in order to escape damage from frost, and to permit the crop to cure while there is favorable curing weather. In handling use care to avoid loss of leaves. The hay should be valued for its high protein content and quality rather than for its yield per acre.

9. Jackrabbits have a liking for the young soybean plant, and if they are numerous in a community could be very destructive in a small field. Grasshoppers can be very destructive at blossoming time, destroying the blossoms and preventing a good seed set.

10. A soybean crop tends to leave the surface soil loose and somewhat dry, factors to be kept in mind if the crop is grown in soils which may blow easily. However, cultivation which destroyed the weeds and helped to conserve moisture has better prepared the seedbed for the succeeding crop. Any of the small grains should do well following soybeans.

Outlook

A rapidly expanding industrial outlet for the oil and meal from soybeans has resulted in a growing and attractive market for this crop during the years since 1930. The crop acreage and production of soybeans in the United States increased rapidly to meet this demand as can be seen in Table 4. In more recent years, since war export quotas were removed, an increasing portion of our crop has been exported to Europe. To what extent we may continue to hold these foreign markets, thus absorbing that production in excess of our domestic requirements, will depend upon a number of factors. These will include the supply of soybeans in other countries, availability and competition from other oil producing crops, trade policies which may be in effect, dollar exchange and, in general, European recovery.

Table 4. SHOWING EXPANSION OF SOYBEAN ACREAGE AND PRODUCTION IN THE UNITED STATES, BASED ON THE ANNUAL AVERAGE ACREAGE AND PRODUCTION BY 5-YEAR PERIODS SINCE 1930.

Years	Average acreage harvested	Average production (bushels)
1930-34.....	1,163,000	16,602,000
1935-39.....	3,042,000	56,166,000
1940-44.....	8,243,000	150,971,000
1945-49.....	10,404,000	204,944,000

Compiled from records, Bureau of Agr. Economics U.S. Dept. of Agr.

Two recent books are of unusual interest. "Water in the Physiology of Plants" by Crafts, Currier and Stocking, is one of the *Chronica Botanica* series. Some chapters are: structure of water, properties of solutions, osmosis and osmotic pressure, up-take and movement, water loss and retention. "The Plant Alkaloids", by Henry, is a new edition of a book first published in 1913. One is impressed by the bulk (800 pages) of this book. The different types are taken up in turn with discussion on composition, occurrence and properties. There are many references at the end of each chapter. A final list is presented of "Minor Alkaloids" arranged by plant source.

—NDAC BOTANY NEWS LETTER.

D. F. Eveleth, Veterinarian, and Alice I. Goldsby, Assistant in Veterinary Science, are the authors of a paper on "Nicotine Arsenate—Copper Sulfate As A Sheep Anthelmintic" which appeared in the March 1950 issue of *VETERINARY MEDICINE*, pp. 115-118 and p. 128 (Vol. 45, No. 3).

STATION VARIETIES TOPS

The Pillsbury awards for both durum and hard red spring wheat exhibited at the North Dakota Winter Show in Valley City March 9 both were won by one man, William R. Woods of Tioga, in Williams county. The pioneer wheat grower, who homesteaded on his present farm 48 years ago, won the trophies with a 63 pounds sample of Mida hard red spring wheat, and a 65 pound sample of Stewart durum, both varieties produced and released by the North Dakota Agricultural Experiment station. A fortnight after winning the North Dakota wheat awards, Mr. Woods—with his 63 pound sample of Mida—won the national contest at Minneapolis, in the hard red spring wheat division.

WANTED: Copies of the following Press Bulletins issued by H. L. Bolley, Botanist of the North Dakota Agricultural Experiment Station, beginning with Press Bulletin No. 1, issued in October, 1893. The following numbers are especially desired: Nos. 5, 6, 7, 8, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 24, 32, 36, 38, 43 and 45.

H. L. Walster, Director