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3-1-1921

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Recommended Citation

Evans, A.T. and Fowlds, M., "Soybeans in South Dakota" (1921). *Bulletins*. Paper 193.
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SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND
MECHANIC ARTS
**AGRICULTURAL
EXPERIMENT STATION**

BULLETIN 193 BROOKINGS, SOUTH DAKOTA MARCH, 1921

Soybeans In South Dakota

ARTHUR T. EVANS AND MATTHEW FOWLDS

The soybean is a summer annual legume, a native of eastern Asia. It has been grown in China and Japan for many hundreds of years, mainly for human consumption. It was introduced into the United States early in the 19th century but did not become popular until a few decades ago. At that time importations were made into Kansas. Since that time its culture has rapidly spread over the United States. Its popularity is now generally recognized throughout the agricultural states. In localities where it has become increasingly difficult to secure stands of red clover the soybean is becoming more and more depended on for the restoration of nitrogen and as a source of green manure. The uses to which it is adapted are many. It is equally good for hogging-off, grain, soiling, silage, and is sometimes used as pasture and hay. Few other plants are so diversified in their usage. The ability of the plant to maintain itself and produce a crop during the hottest part of the summer is a point in its favor.

The soybean, however, has its limitations and it should not be overlooked that the plant is a native of the warmer countries of the earth. In this region it is not well adapted to withstand heavy frosts. It will, however, endure light frost. For this reason it is quite necessary that it be utilized in South Dakota as early in the season as possible. It is at its best in our southern states, reaching its northern limits roughly at the northern limits of corn. This does not mean, however, that it will do well everywhere that corn is grown.

Within recent years the soybean has become increasingly popular in South Dakota. This is probably in part due to a demand for a plant high in protein to be used as a hogging-off crop in corn. Rape may supply this but it lacks one feature which the soybean supplies, namely, that of fixing nitrogen. The plant is now used to some extent in the southeastern por-

tion of South Dakota and many farmers in other quarters of the state are beginning to give it a trial in a small way at least.

The Plant

The soybean (*Glycine hispida*) often called "soja bean" is an erect plant growing from one to three feet in height. The stem is hairy, being covered with pubescence varying in color from gray to tawny. Some plants are more or less procumbent; others have a tendency to climb. The leaves are trifoliate and the leaflets more or less heart-shaped, quite similar to that of the garden bean. The flowers are abundant, borne in clusters from the axils of the leaves. The plant is strictly determinate in growth, all further growth stopping at the appearance of the flowers. The pods vary from yellowish to brown or black in color and are densely hairy. They usually contain two or three seeds, the color varying with different varieties. Yellow, green, brown, and black are the most common colors. The yellow or light colors are to be recommended for hogging-off since they can be more readily seen by the hogs when shattered. For silage tall growing varieties are to be recommended.

Adaptations

The soybean is a relatively new crop in South Dakota. Its success here will depend largely upon its proper utilization. It is not something new which will revolutionize farming conditions. Since it is a legume it will take free nitrogen from the air and store it in usable form in the soil. It is, therefore, a much more valuable crop to substitute on land where some crop has failed than millet, sorghum or sudan grass which are non-leguminous, provided it can be planted early enough to be utilized. The soybean is higher in protein than clover hay and when properly cured makes a valuable substitute, but it is better farm practice to grow red clover, alfalfa, and sweet clover than to depend on such a substitute in South Dakota.

TABLE 1
Digestible Nutrients in Forage Crops*

	Total dry matter in 100 pounds	DIGESTIBLE Crude protein	NUTRIENTS Carbo- hydrates	IN 100 Fat	POUNDS Total
Corn fodder, sweet -----	87.7	5.9	47.6	1.3	56.4
Timothy hay, all analyses ---	88.4	3.0	42.8	1.2	48.5
Alfalfa, all analyses -----	91.4	10.6	39.0	0.9	51.6
Red clover, all analyses ----	87.1	7.6	39.3	1.8	50.9
Sweet clover, white -----	91.4	10.9	38.2	0.7	50.7
Soybean hay -----	91.4	11.7	39.2	1.2	53.6

* From "Feeds and Feeding," Henry and Morrison.

The greatest value of soybeans in South Dakota undoubtedly lies in their value as a mixed crop for hogging-off or for silage. Planted with corn they supply a valuable concentrate for hogs which cannot be surpassed, at the same time restoring nitrogen to the soil. Used alone they do not make good silage. Although it keeps well it imparts an unpalatable taste to milk and butter. Mixed with corn in the ratio of two parts corn and one of soybeans such results do not obtain. (Bulletin 237, Ohio Exp. Station.)

Varieties

Hundreds of varieties of soybeans have been introduced into the United States and tested by the United States Department of Agriculture and by the state experiment stations. Many of these are handled by growers and seedsmen. The bulk of the soybean seed on the general market is grown in central and southern states. The varieties which are well adapted to those states are not generally suitable to grow in South Dakota. This state will perhaps not be able to compete with southern states in the production of soybeans for grain, but sufficient seed of the best varieties should be grown here to supply the local demand for seeding purposes. Only by doing this can a source of good seed, well acclimated to this state, be established.

If the crop is to be grown for seed, it is necessary to choose a variety which will ripen. In an average season, only the early varieties will mature seed. The medium early varieties which do not ripen but which produce well filled pods before the first frost can be grown for hay or silage. The large late maturing varieties are not desirable for any purpose. About 30 varieties have been tested at the station at Brookings for one or more years. Those which failed to mature were discarded after the first year.

The seed yields of the varieties tested more than one year are given in Table 2. The yield of hay for the same varieties is given in Table 3. A variety of cowpeas and of field peas is also included in the tables for comparison. During the season of 1919 a number of important commercial varieties were tested. The hay yields for these are given in Table No. 4. All of these varieties failed to ripen seed, although several contained well filled pods. The Mammoth Yellow failed to set pods at all. From results of this test it will be seen that Manchuria S. D. 508 gave the highest yields of both the hay and grain. The Manchu gave nearly as good results. The Mandarin and Chestnut, two varieties which were included for the first time in

1919, are also very promising. The Chestnut is the most desirable for hay on account of the finer quality stems which it produces. Ito San, the variety of which seed can be readily obtained in the market, has given less satisfactory yields. There are perhaps other varieties and strains which if introduced and tested would give as good or better yields than the ones already tested.

TABLE 2
Soybeans for Seed

	S.P.I. No.	S.D. No.	Yield in bushels per acre						7-year average	
			1914	1915	1916	1917	1918	1919		1920
Manchuria -----	28050	508	14.5	5.0	25.0	17	24.0	43	29	22.5
Manchu -----	30593	507	22.7	4.0	19.0	14	22.0	42	27	21.5
White Eyebrow --	30745	501	16.0	2.0	20.5	9	16.0	31	25	17.1
Ito San -----	33280	498	14.2	2.0	15.5	11	11.4	34	24	16.0
										5-year average
Black Eyebrow --	30744	502	18.7	4.0	20.5	14	18.0			15.0
Bopp -----	18227	730	17.3	13.0	16.5	16	19.0			16.4
Saskatoon -----		888	17.3	1.4	17.0	14	19.0			13.7
Ogemaw-----			4.0	4.0	11.2	8	15.0			8.4
										2-year average
Mandarin -----	36653	1192						34	22	28.0
Chestnut -----		1156						35	22	27.5
Early Brown ----		1201						32	18	25.0
Early Buff Cowpea	29282	487			22.0	16	14.0			
Canada Field Pea		14			8.0	4				

TABLE 3
Soybeans for Hay

	S.P.I. No.	S.D. No.	Yield in ton per acre						6-year average
			1915	1916	1917	1918	1919	1920	
Manchuria -----	28050	508	.84	1.44	1.80	1.05	3.00	2.88	1.83
Manchu -----	30593	507	1.08	1.08	1.62	1.02	2.64	3.12	1.76
White Eyebrow ----	30745	501	.90	1.14	1.08	.69	2.79	3.36	1.66
Ito San -----	33280	498	.72	1.14	1.38	.72	2.67	2.70	1.55
									4-year average
Black Eyebrow ----	30744	502	.75	1.14	1.50	1.05			1.11
Bopp -----	18227	730	1.11	1.38	1.62	.99			1.27
Saskatoon -----		888	.75	1.02	1.44	.84			1.01
									2-year average
Mandarin -----	36653	1192					3.06	2.82	2.94
Chestnut -----		1156					3.00	3.06	3.03
Early Brown ----		1201					2.89	1.98	2.43
Early Buff Cowpea --	29282	487			1.50	1.20			
Canada Field Pea ---		14		1.08		1.14			

Variety Description

Manchuria, S. D. 508. This is an early maturing variety which was introduced from northern Manchuria. The plant is short, erect, with gray pubescence and black seed pods. The

seeds are olive yellow and have a light brown seed scar. This variety has given the highest average yield of both seed and hay in the tests at the South Dakota Experiment Station at Brookings. It is to be recommended for hogging-off.

Mandarin, S. D. 1192. This is a very early variety which resembles Manchuria in size of plant and habit of growth. The seeds are straw yellow and have a pale seed scar.

Manchu, S. D. 507. This variety matures nearly one week later than Manchuria. The plant is tall, erect, and the pubescence is tawny. The seeds are straw yellow and have a black seed scar. The yield of hay and grain is nearly equal to Manchuria and its greater height makes it more adaptable to harvesting with machinery. It is quite promising as a silage plant. Its later maturity avoids the danger of shattering when harvested for silage.

Ito San, S. D. 498. This variety matures about the same time as the Manchu which it resembles in most of its characters except the seed. The seeds are straw yellow and have a pale seed scar near one end of which is a brown speck.

Chestnut, S. D. 1156. This variety matures about 10 days later than the Manchuria. The plant is somewhat procumbent. The stems are rather slender which characteristic makes for a good quality of forage. The seeds are brown, slightly flattened, and have a light brown seed scar.

Culture

Seed Bed. The seed bed may be prepared in a manner similar to that for corn.

TABLE 4
Soybeans for Hay*

In Tons Per Acre	
Mammoth Yellow	2.03
Swan	2.54
Haberlandt	2.75
Hollybrook	2.44
Mongol	2.54
Mikado	1.17
Morse	3.25
Medium Green	2.64
Sable	2.54
Ebony	2.68

* Computed on basis of yield of Manchuria for 1919. (See Table 1.) Commercial varieties from O. M. Scott & Sons, Marysville, Ohio. All of these varieties failed to mature seed. The Mammoth Yellow even failed to set seed.

Time of Seeding. The time of seeding coincides with that of corn. Since they are sensitive to frost it is necessary that all danger of frost be past and the temperature of the ground such as to stimulate good germination. In South Dakota these conditions are likely to be met during the latter part of May.

Method of Seeding. Soybeans may be planted in the hills with corn by the use of a special attachment on the planter. It is not advisable to mix with the corn as the seed settles to the bottom of the planter boxes unless it is frequently stirred. A common grain drill may be used if drilling is desired, the right distance between rows being secured by plugging the holes not needed. The beans should not be planted too deeply. Two inches is sufficient when there is enough moisture in the ground. Even shallower planting may suffice. The main point is to plant them no deeper than is necessary for sufficient moisture to germinate.

Inoculation. For the best results it is necessary to inoculate all seed before it is planted. This will insure the formation of root nodules. Inoculating material sufficient to treat a bushel may be obtained from Soil Survey Laboratory of the Agronomy Department of this Station for 50 cents. Application for this should be made as long as possible before it will be needed. In no case should that be less than two weeks before planting time.

Rate of Seeding. The rate of seeding varies with the method of planting. If hilled with corn the rate is from 15 to 30 pounds per acre. The Ohio Experiment Station has found that an increased rate of seeding decreases the yield of corn. If drilled the rate varies anywhere from one to four pecks per acre according to the distance between drill rows and the size of the soybean seeds. Under average conditions three pecks gives the best results. Broadcasting has not proven successful at this station.

Cultivation. Where the beans are drilled it is important to keep down the weeds until the young plants get a good start. This may be done by harrowing with a spike-toothed harrow just before the beans appear. The same results may be accomplished by the use of a weeder. If a weeder is available it can be utilized to great advantage after the beans are two or three inches high. At that time it is well to drive cross-wise of the drill rows for best results.

Harvesting. When drilled with corn the soybeans may be cut in with the fodder. It is important to cut before the

Pods are too ripe, otherwise much loss is experienced from shattering. Then, too, it must be remembered that the leaves drop as soon as the pods ripen. Since the leaves contain much of the protein it is not advisable to allow the plants to become over-ripe. If the plants are drilled and are to be harvested for seed it will be necessary to allow them to ripen. Cutting can best be done with a mower, bunching the beans as they are cut. If this is done on a cloudy day or while the plants are still damp with dew, the least shattering will occur.

Threshing can be done with an ordinary grain separator, with the cylinder run at one-half the ordinary speed and with one-half the concaves out. If this precaution is not taken many of the beans will be cracked and unsalable as those which are broken are unfit for seed. Small areas may be readily threshed with a flail.

ANNUAL RAINFALL BY MONTHS AT THE SEVERAL STATIONS

BROOKINGS

	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Jan.	0.22	0.17	1.06	0.26	1.20	1.07	0.61	0.28	0.02	0.22	0.18	1.47	1.54	0.19	0.07	0.34
Feb.	1.00	0.02	0.28	1.80	1.57	0.40	0.53	0.24	0.09	0.40	1.12	0.32	0.47	0.14	0.63	0.24
March	0.68	0.58	0.55	1.16	0.37	0.35	0.53	0.26	0.45	0.42	0.18	0.50	1.09	0.44	0.73	1.85
Apr.	1.01	1.40	1.67	2.10	1.16	2.34	1.62	3.36	2.24	1.64	2.03	2.95	3.09	1.28	1.90	2.95
May	6.14	3.51	2.36	6.46	4.85	0.87	1.90	6.98	3.60	4.16	2.12	3.72	3.08	3.40	3.87	3.84
June	6.09	4.89	5.65	6.35	2.29	1.85	3.78	2.09	1.96	6.67	3.28	4.27	3.49	1.85	9.30	7.27
July	0.98	1.86	3.77	4.69	2.44	1.68	3.32	2.52	2.99	1.62	3.04	0.40	2.03	3.95	5.60	5.45
Aug.	4.54	4.28	1.41	2.37	3.38	2.46	3.81	4.68	1.33	3.16	3.52	2.03	1.20	4.19	1.48	2.15
Sept.	2.16	5.13	1.28	3.89	1.67	0.96	3.08	1.61	1.55	3.32	2.68	0.84	2.89	0.72	1.69	1.99
Oct.	1.50	3.01	0.96	1.43	1.71	0.38	5.12	0.96	1.18	2.21	1.37	0.45	0.12	1.56	1.14	0.66
Nov.	2.45	0.89	0.10	1.30	0.65	0.17	0.23	0.00	0.81	T	0.28	0.03	0.04	1.61	1.35	1.30
Dec.	T	0.52	1.12	0.42	1.14	0.10	0.42	0.20	0.09	0.33	0.62	0.36	0.31	1.09	0.10	0.30
Total	22.77	26.26	20.21	32.17	22.44	12.63	24.95	23.18	16.31	24.15	20.42	17.34	19.35	20.42	27.86	28.34

COTTONWOOD

	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Jan.	0.66	T	0.17	0.16	0.03	0.39	0.04	0.45	0.32	0.04	0.27
Feb.	0.97	0.15	0.05	0.10	1.18	1.57	0.02	1.50	1.50	0.29	0.54
March	0.76	T	3.00	0.43	0.35	0.46	0.04	0.31	0.34	0.71	0.58
April	1.06	0.85	3.32	1.15	2.26	2.80	0.81	0.80	2.27	3.57	2.80
May	2.54	1.10	1.18	2.95	2.35	6.61	3.87	3.30	2.78	1.29	5.83
June	1.30	0.64	0.95	0.59	1.64	4.79	1.83	0.62	1.37	4.97	4.02
July	1.11	0.59	2.42	0.81	1.04	4.58	1.80	0.90	2.29	2.05	0.67
Aug.	0.48	2.41	3.42	1.84	1.88	2.51	2.22	2.00	3.43	0.20	1.87
Sept.	0.82	3.59	1.30	1.15	1.19	2.42	1.18	1.17	1.43	0.25	1.63
Oct.	0.32	1.15	0.11	0.76	2.23	0.90	0.57	0.14	0.28	2.03	0.93
Nov.	0.53	0.20	T	0.14	0.02	T	0.15	0.39	0.11	0.71	0.36
Dec.	3.00	0.42	0.12	0.38	0.84	0.10	0.14	0.50	0.25	0.20	0.18
Total	12.65	11.10	16.04	10.46	15.28	27.31	11.67	12.08	16.37	16.31	19.68

EUREKA

	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Jan. -----	0.10	0.60	0.50	0.25	0.10	0.22	0.90	0.79	0.40	0.14	0.07	0.16
Feb. -----	0.45	1.70	0.73	0.40	0.03	0.05	1.08	0.13	0.20	0.50	1.04	0.08
March -----	0.14	1.23	0.62	1.05	0.09	0.13	0.23	1.78	1.46	0.58	0.52	0.27
April -----	0.50	0.82	2.24	1.29	0.68	2.07	1.83	0.88	2.18	1.98	1.28	1.63
May -----	2.65	0.42	0.97	3.37	1.97	2.20	2.58	3.57	1.30	1.97	3.68	1.82
June -----	3.35	3.80	1.29	1.50	2.91	4.28	4.66	4.16	1.61	0.93	2.29	4.26
July -----	2.21	0.53	0.43	2.19	2.16	1.25	3.38	—	1.04	1.03	4.08	2.49
Aug. -----	1.39	2.60	3.27	3.27	1.53	2.11	2.47	4.62	0.93	1.77	0.77	2.05
Sept. -----	1.25	3.65	1.15	1.43	0.54	0.70	3.74	1.05	0.67	0.36	0.04	3.90
Oct. -----	0.17	0.18	0.61	0.07	1.52	0.87	3.10	0.29	0.06	0.55	1.13	0.36
Nov. -----	0.60	T	0.88	T	0.06	T	0.56	0.14	2.00	0.53	0.12	0.54
Dec. -----	2.40	0.25	0.80	0.11	0.52	0.53	0.36	0.06	0.75	0.20	0.32	0.09
Total -----	15.21	15.78	13.79	14.93	12.11	14.41	24.89	17.47	12.60	10.54	12.62	16.42

HIGHMORE

	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Jan. -----	T	0.26	0.82	0.11	0.13	0.05	0.13	0.43	1.40	1.12	0.60	0.10	0.27
Feb. -----	0.53	0.34	0.19	0.39	0.11	0.30	0.62	1.28	0.27	0.52	0.25	1.35	0.33
March -----	0.00	0.13	0.58	2.54	0.27	0.87	0.45	0.37	0.74	1.27	0.45	1.24	1.20
April -----	1.35	0.30	1.40	0.32	1.05	1.27	3.65	2.50	0.89	2.79	2.57	1.96	2.56
May -----	2.68	4.72	0.94	2.31	2.20	4.56	2.23	3.48	4.15	2.04	3.57	6.63	6.04
June -----	5.78	1.69	3.74	0.09	1.31	0.97	4.09	4.87	4.54	2.04	1.59	1.95	7.35
July -----	2.49	1.81	0.85	2.69	1.44	1.79	2.01	5.55	2.10	1.91	5.26	2.65	3.56
August -----	3.53	3.74	0.66	2.52	3.39	1.20	1.16	0.78	4.10	0.68	1.88	0.82	2.47
Sept. -----	0.62	1.70	0.89	3.06	0.71	0.53	1.01	2.36	2.75	2.03	0.62	0.54	1.51
Oct. -----	2.19	1.04	0.24	1.05	0.20	0.61	1.92	1.15	0.58	0.06	0.49	2.16	0.75
Nov. -----	1.39	0.71	0.40	0.35	0.00	0.03	—	0.32	0.13	0.07	1.10	1.80	0.84
Dec. -----	0.31	1.41	0.44	0.44	0.35	0.28	0.25	0.20	0.47	0.27	0.86	0.15	0.20
Total -----	28.87	17.85	9.05	15.87	12.00	12.46	17.52	23.29	22.12	14.80	19.24	21.35	27.08

VIVIAN

	1915	1916	1917	1918	1919	1920
Jan. -----	0.50	1.00	1.35	1.10	—	—
Feb. -----	1.77	0.04	0.18	0.50	0.32	0.58
March -----	1.19	0.29	1.00	0.50	0.66	1.52
April -----	2.62	1.08	2.38	3.92	4.14	4.55
May -----	3.02	3.46	5.20	3.33	3.23	7.51
June -----	4.31	4.49	1.18	1.70	5.01	5.54
July -----	6.76	3.53	1.02	2.07	4.00	3.42
Aug. -----	1.12	3.52	2.01	3.32	0.94	1.86
Sept. -----	3.16	0.90	2.64	0.75	1.70	0.80
Oct. -----	1.12	0.57	0.00	0.82	1.95	2.09
Nov. -----	0.38	0.12	—	0.22	1.91	1.32
Dec. -----	0.03	0.04	0.32	0.90	0.13	0.28
Total -----	25.98	19.04	17.28	19.13	23.99	29.47